

Town of Lunenburg



Wastewater Treatment Plant Upgrades & Expansion

Issued for Tender

December 2024

Contract No. 240800.00

Wastewater Treatment
Plant Upgrades & Expansion

0	Issued for Tender	SHE	Dec. 2/24	SHE
Rev.	Issue	Reviewed By:	Date	Issued By:
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END OF SECTION

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1. A complete Tender is comprised of the following:
 - a) The Tender Form in its entirety, with all pages and spaces for entry of information by Tenderers filled in as instructed.
 - b) Acknowledgment of addenda received by the Tenderer during the tendering period.
 - c) Tender Security (refer to clause 12 herein).
2. **Tenders shall be submitted exclusively by email to purchasing@townoflunenburg.ca up until 3:00 p.m., local time, on Thursday February 27th, 2025, hereinafter** referred to as the Tender Closing. Subject heading of email to read "CONTRACT NO. 240800.00 - TENDER SUBMISSION." The time stamp of the email received by purchasing@townoflunenburg.ca will be used to determine if the submission was received in time - not the time it was emailed sent by the sender. Last minute submissions are not recommended.
3. Before tendering, Tenderers shall have examined the *Site* of the Work and shall have satisfied themselves as to the working conditions, including labour conditions and labour rules, the nature and kind of work to be done, any special risks associated therewith and all other matters which may be necessary in order to form a proper conception under which the work will be required to be performed. Tenderers shall not be entitled to claim at any time after closing of tenders that there was any misunderstanding in regard to all such conditions.
5. When forming their estimates and preparing their tenders, Tenderers shall take full cognizance of the content of all the Contract Documents listed in Section 00 41 42 - Tender Form - Stipulated Price.
6. Any ambiguities, inconsistencies, or uncertainties in the Contract Documents which may become apparent to Tenderers when tendering shall be advised via email to the *Consultant* at sensslin@cbcl.ca not less than three (3) working days before Tender Closing. Tenderers will be advised simultaneously of any decisions on such matters as necessary by means of addenda (which will be serially numbered) and all addenda issued shall be incorporated into the Contract Documents.
7. Tenderer shall fill in the Completion Time and is notified that the completion date based on this may be taken into account in considering the tenders.
8. All tenders shall be valid for acceptance for sixty (60) calendar days from the Closing Date.
9. The Agreement is included in the Contract Documents at the time of tendering and is provided for information only and shall not be completed at the time of tendering.
10. The appending of any qualifying clauses to the tender or failure to comply with these instructions and with all other relevant provisions contained in the documents in the completing of any tender may render such tender liable to

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disqualification as determined by the *Owner*.

11. Contract Price to exclude HST. Harmonized sales tax shall be indicated as a separate amount and included in the *Total Amount Payable*.
12. Each tender shall be accompanied by Tender Security in the amount of ten percent (10%) of the *Total Amount Payable* (inclusive of *Value Added Taxes*) in evidence of the bona fide nature of the tender. Tender security must satisfy the same requirements of Contract Security as set forth in clause 13 herein.
13. Tender and Contract Security shall be in favour of the Owner and shall be in the form of a Certified Cheque, irrevocable Letter of Credit or a Bond which shall guarantee to the Owner that in the event of the successful Tenderer declining to enter into a formal agreement with the Owner as called for in the Contract Documents, or declining or neglecting to provide the Insurance or Contract Security required by the Contract Documents, then the Owner will be reimbursed the additional cost of accepting another tender or Tender Security amount, whichever is the lesser.
 - .1 A scan of a hard copy bond, certified cheque, or irrevocable letter of credit is permitted provided the original is provided in the subsequent hard copy submission
 - .2 The bonds shall be issued by a company whose guarantee bonds are acceptable to the Government of Canada. Use the latest edition of CCDC Form 220 for a Bid Bond, a CCDC Form 221 for a Performance Bond, and a Form 222 for a Labour and Material Bond.
 - .3 Bonds may be submitted in an electronic or digital format provided it meets the following criteria:
 - .1 The version submitted by the Tenderer must be verifiable by the Owner with respect to the totality and wholeness of the bond form, including: the content; all digital signatures; all digital seals; with the Surety Company, or an approved verification service provider of the Surety Company.
 - .2 The version submitted must be viewable, printable, and storable in standard electronic file formats acceptable to the Owner, and in a single file. Allowable formats include pdf.
 - .3 The verification may be conducted by the Owner immediately or at any time during the life of the bond and at the discretion of the Owner with no requirement for passwords or fees.
 - .4 The results of the verification must provide a clear, immediate and printable indication of pass or fail regarding subsection 12.3.1 above.
 - .5 Bonds failing the verification process will NOT be considered to be valid.
 - .6 Bonds passing the verification process will be treated as original and authentic.
14. The Tender Security of the unsuccessful Tenderers will be returned to them after the *Owner* enters into a formal agreement with the successful Tenderer or the expiration of validity of their tenders, whichever occurs first.
15. On the written acceptance by the *Owner* of a tender, that tender becomes the Contract and the Tenderer who has submitted it becomes the Contractor. The Contractor will be required to enter into a formal agreement with the *Owner*

following receipt of a written notice of acceptance from the *Owner*. The written notice of acceptance forms a Contract Agreement until the formal "Agreement" included herein is executed.

16. Within seven (7) days of written acceptance of a tender, the Contractor shall provide Contract Security in the amount and form as specified in Section 00 73 00 - Supplementary General Conditions, and Insurance as specified in CCDC 2-2020, GC 11.1.
17. Complete the Tender Form and have corrections initialled by the individual signing the tender.
18. Where manufactured articles are described or specified in the Contract Documents by name, catalogue number of a manufacturer or supplier, Tenderers shall tender on the basis of using only such articles. Procedure concerning substitution of a specified article with another shall be in accordance with equivalents and alternates in Section 01 25 00 - Substitution Procedures.
19. The *Owner* will not defray any expenses whatsoever incurred by Tenderers in the preparation and submission of their tenders. The *Owner* reserves the right to waive any formality or technicality in any tender.
20. The *Owner* reserves the right to accept or to reject any or all tenders received, or to select a tender which is deemed by the *Owner* to be in its best interests. The *Owner* reserves the right to negotiate with the lowest compliant tenderer in the event that all tendered prices are higher than anticipated.
21. Tenders, which in the opinion of the *Owner* are considered to be informal or unbalanced, may be rejected.
22. Tenders may be amended or withdrawn without penalty, by email to purchasing@townoflunenburg.ca prior to Tender Closing. Amendments shall not disclose either original or revised total price.
 - .1 Subject line of amendment or withdrawal to read as follows:
"[Amendment]/[Withdrawal] of Tender for Contract No. 240800.00". Provide an electronic signature and submit at email address provided above. All Submissions must be received prior to Tender Closing.
 - .2 The *Owner* will not be responsible for any failure attributable to the transmission or reception of the email. The time stamp of the email received by purchasing@townoflunenburg.ca will be used to determine if the submission was received in time - not the time it was emailed sent by the sender. Last minute submissions are not recommended.
23. Tenderers are encouraged to attend a non-mandatory *site* meeting, held at **the Site at 10:30am on Thursday February 13th, 2025**. Questions may be asked and description of the Work may be discussed during this meeting, however no minutes of the meeting will be distributed. Modifications made by way of addenda, to tendering requirements or the Contract Documents, shall be binding.
24. Tenderers shall take note that the *Owner* has *pre-selected* certain items of equipment for incorporation into the work by the Contractor. Procedures for taking over *pre-selected* equipment are specified in Section 01 11 00 - Summary

of Work. Copies of the *pre-Selected* equipment shop drawings or other information available upon request to the Consultant. Tenderers are also to take note that the *Pre-Selected Equipment Supplier* has provided additional Terms and Conditions as set forth in Appendix C herein. Where a potential conflict between the General Conditions of Contract and the *Pre-Selected Equipment Supplier* Terms and Conditions bring such conflicts to the Consultant and the Owner who will provide a resolution.

25. A Geotechnical Investigation Report and a Limited Environmental Site Assessment have been carried out at the *Site*. The Geotechnical Investigation Report, dated April 12, 2022, prepared by Conquest Engineering, is attached as Appendix A. The Limited Environmental Site Assessment, dated June 7, 2024, prepared by CBCL Limited, is attached as Appendix B. Any extrapolation or interpretations of the content of either of these reports is at the sole discretion of the Bidder/Contractor and the Owner or the Consultant accepts no liability for such extrapolations or interpretations.

END OF SECTION

TO: Town of Lunenburg

FROM: _____

The undersigned Tenderer, having carefully read and examined the undermentioned Contract Documents prepared by CBCL Limited for the completion of the Town of Lunenburg, Wastewater Treatment Plant Upgrades and Expansion, Contract No. 240800.00, which comprise all the tender documents in accordance with the following documents:

Tender Form - Stipulated Price
CCDC 2-2020:

Agreement Between Owner and Contractor

Definitions

General Conditions of the Stipulated Price Contract - CCDC 2-2020

Supplementary General Conditions

Specifications

Drawings

Addendum/Addenda

hereby accepts the same as part and parcel of the Contract herein referred to, and having carefully examined the locality and site of *Work* and having full knowledge of the *Work* required and of the materials to be furnished and used, does hereby Tender and offer to enter into a contract to perform and complete, the whole of the said *Work* and provide all necessary labour, plant, tools, materials and equipment and pay all applicable taxes, as set forth and in strict accordance with the Specifications, Drawings and other Contract Documents and to do all therein called for on the terms and conditions and under the provisions therein set forth as follows.

CONTRACT PRICE	\$	(A)
<i>Pre-Selected</i> Equipment Allowance	\$ 1,583,373.00	(B)
Electrical Maintenance Allowance	\$ 20,000.00	(C)
Rotary Sludge Press Maintenance Allowance	\$ 70,000.00	(D)
Key Pipe Data Hydrovac/Survey Allowance	\$ 15,000.00	(E)
SUBTOTAL	\$	(A+B+C+D+E)
ADD HST (15% OF SUBTOTAL)	\$	
TOTAL AMOUNT PAYABLE	\$	

Tenderer's HST Registration No. _____

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SEPARATE PRICES

Separate Prices requested shall not be included in the Contract Price. Consistent with their acceptance or rejection by the Owner they will be carried as a Change Order to the Contract Price, or in a separate agreement after the determination of award.

The Separate Prices required are as the follows:

1. Provide a price to supply and transport to Site between one and two hundred and fifty cubic metres of material from the Contractor's own off-Site sources meeting the definition of Select Backfill as described in Section 31 23 10. Such material will be measured by way of topographical survey taken both before its placement and after it is placed and compacted. No change order will be created for this item until all of the usable on Site material has been exhausted.

\$ _____/m³

COMPLETION TIME

1. Tenderer agrees to achieve Ready-for-Takeover of the Work within _____ weeks from written notification of Award.

The Undersigned Tenderer:

- .1 Declares that this tender is valid for acceptance until _____, 202____ (being sixty (60) calendar days from the Tender Closing).
- .2 Declares that the Contract Price set forth in the Tender Form has been correctly computed for the purposes of this tender and that it includes and covers all duties, and handling charges; transportation; and all other charges. Harmonized sales tax is not to be included in the Contract Price.
- .3 Hands you herewith by way of Tender Security a Bid Bond or Certified Cheque or irrevocable Letter of Credit in the amount of ten percent (10%) of the *Total Amount Payable* on the understanding that in the event of this tender not being accepted by you, then this Tender Security will be returned to the undersigned Tenderer either at the time that the Contract is entered into with some other Tenderer, or at the expiration of validity of this tender, whichever is the sooner.
- .4 Undertakes in the event of your acceptance of this tender, to execute a formal agreement in the form hereto attached, within seven (7) calendar days of written acceptance and further agrees to provide the Contract Security as specified in Part 14 of Section 00 73 00 - Supplementary General Conditions, and Insurance as specified in GC 11.1.
- .5 Undertakes, in the event of your acceptance of the Tender, to achieve *Ready for Takeover* within the number of weeks of written notification of Award indicated above.
- .6 Upon request, provide evidence of ability and experience within seven (7) calendar days of request, including experience in similar *Work*, *Work* currently in progress, senior supervisory staff available for the *Work*,

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equipment available for the *Work*, and financial resources.

- .7 Agrees that in the event of failing or neglecting either to provide the Contract Security and Insurance and/or to execute the Agreement in the manner herein before undertaken, then the Tender Security shall be forfeited.
- .8 Agrees that unless and until a formal agreement is prepared and executed, this tender together with your written acceptance thereof shall constitute a binding Contract between us.
- .9 Understands and agrees that the *Owner* is not bound to accept the lowest or any tender which they may receive.
- .10 Agrees to provide, maintain and pay for the insurance coverages specified in the Contract Documents. One copy of all insurance policies of the Contractor and two copies of certificates of insurance, certifying to the issuance of all insurance policies, shall be furnished to the *Owner*. Each and every insurance policy shall name the Contractor, *Owner* and *Consultant* as being insured in the full amount of the insurance.
- .11 Declares to have personal knowledge of the location of the proposed *Work* and is informed as to the actual conditions and requirements, including labour conditions and labour rules and shall not claim at any time after execution of the Agreement that there was any misunderstanding in regard to such conditions and requirements.
- .12 Declares to have carefully examined the documents and Addenda No. _____ to _____ referred to in the first paragraph of this Tender Form, and the Tenderer hereby accepts and agrees to the same as forming a part of the Contract.
- .13 Understands that in the event that the tendered Contract Price is not within the project budget, the *Owner* has the right to negotiate the Contract with the low bidder or reject all tenders received.
- .14 Agrees that the Warranty Period defined in the Contract Documents shall be for a period of one (1) year from the date of Ready-for-Takeover of the *Work*.
- .15 Understands Contract Security, as specified herein, will be retained until the expiration of the Warranty Period.
- .16 Understands that Substantial Performance of the *Work* will be established in accordance with General Conditions of the Contract and applicable lien legislation at the Place of *Work*.
- .17 Understands that after the issuance of the certificate of Substantial Performance of the *Work* by the Consultant, provided that the Contractor has relieved the *Owner* from any and all claims, demands and lien claims for and in respect of the Contract, and has completed all outstanding items and corrected all deficiencies, the Contractor shall submit an application for Final Payment and the Consultant will thereafter prepare the Final Certificate for payment in accordance with the General Conditions of the

Contract and applicable lien legislation at the Place of Work.

- .18 Understands that *Ready for Takeover* will only be given when the Contractor has completed all outstanding items and corrected all deficiencies. The Contractor can then submit an application for Final Payment and the *Consultant* will thereafter prepare the Final Certificate for payment in accordance with the General Conditions of the Contract.
- .19 Understands that the payment of holdback will be in accordance with the General Conditions of the Contract and subject to the provisions of the lien legislation applicable to the Place of *Work*.
- .20 Understands the occupational Health and Safety Legislation and any Workers or Workplace compensation legislation applicable to the Place of the *Work* and declares that they are in good standing and have all necessary certification as required by such legislation.
- .21 Agrees that time shall be construed as being of the essence of the Contract.

Town of Lunenburg
Wastewater Treatment Plant
Upgrades and Expansion
Contract No. 240800.00

TENDER FORM -
STIPULATED PRICE

Section 00 41 42
Page 5

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DATED THIS _____ DAY OF _____, 202____.

[Seal]

Name of Firm Tendering

Signature of Signing Officer

Witness

Name and Title (Printed)

Witness

Signature of Signing Officer

Name and Title (Printed)

Company Address

Telephone No.

Fax No.

Email

*NOTE: Tenders submitted by or on behalf of any Corporation must be signed and sealed in the name of such Corporation by a duly authorized officer or agent.

END OF SECTION

CCDC 2

Stipulated Price Contract

2 0 2 0

[Name of Project]

Apply a CCDC 2 copyright seal here. The application of the seal demonstrates the intention of the party proposing the use of this document that it be an accurate and unamended form of CCDC 2 – 2020 except to the extent that any alterations, additions or modifications are set forth in supplementary conditions.

CANADIAN CONSTRUCTION DOCUMENTS COMMITTEE
CANADIAN CONSTRUCTION DOCUMENTS COMMITTEE
CANADIAN CONSTRUCTION DOCUMENTS COMMITTEE

CCDC 2 STIPULATED PRICE CONTRACT

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- GC 12.3 Warranty

PART 13 INDEMNIFICATION AND WAIVER

- GC 13.1 Indemnification
- GC 13.2 Waiver of Claims

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Town of Lunenburg
Wastewater Treatment Plant
Upgrades and Expansion
Contract No. 240800.00

Section 00 53 42

December 2024

AGREEMENT BETWEEN
OWNER AND CONTRACTOR
CCDC 2 - 2020

AGREEMENT BETWEEN OWNER AND CONTRACTOR

For use when a stipulated price is the basis of payment.

This Agreement made on _____ day of _____ in the year _____.
by and between the parties

hereinafter called the "Owner"

and

hereinafter called the "Contractor"

The Owner and the Contractor agree as follows:

ARTICLE A-1 THE WORK

The Contractor shall:

1.1 perform the *Work* required by the *Contract Documents* for (insert below the description or title of the Work)

located at (insert below the Place of the Work)

for which the Agreement has been signed by the parties, and for which (insert below the name of the Consultant)

is acting as and is hereinafter called the "Consultant" and

1.2 do and fulfill everything indicated by the *Contract Documents*, and

1.3 commence the *Work* by the _____ day of _____ in the year _____ and, subject to adjustment in *Contract Time* as provided for in the *Contract Documents*, attain *Ready-for-Takeover*, by the _____ day of _____ in the year _____.

ARTICLE A-2 AGREEMENTS AND AMENDMENTS

2.1 The *Contract* supersedes all prior negotiations, representations or agreements, either written or oral, relating in any manner to the *Work*, including the bid documents that are not expressly listed in Article A-3 of the Agreement – CONTRACT DOCUMENTS.

2.2 The *Contract* may be amended only as provided in the *Contract Documents*.

ARTICLE A-3 CONTRACT DOCUMENTS

3.1 The following are the *Contract Documents* referred to in Article A-1 of the Agreement – THE WORK:

- Agreement between *Owner* and *Contractor*
- Definitions
- General Conditions

*

** (Insert here, attaching additional pages if required, a list identifying all other Contract Documents e.g. supplementary conditions; Division 01 of the Specifications – GENERAL REQUIREMENTS; Project information that the Contractor may rely upon; technical Specifications, giving a list of contents with section numbers and titles, number of pages and date; material finishing schedules; Drawings, giving drawing number, title, date, revision date or mark; addenda, giving title, number, date; time schedule)*

ARTICLE A-4 CONTRACT PRICE

4.1 The *Contract Price*, which excludes *Value Added Taxes*, is:

/100 dollars \$

4.2 *Value Added Taxes* (of _____ %) payable by the *Owner* to the *Contractor* are:

/100 dollars \$

4.3 Total amount payable by the *Owner* to the *Contractor* for the *Work* is:

/100 dollars \$

4.4 These amounts shall be subject to adjustments as provided in the *Contract Documents*.

4.5 All amounts are in Canadian funds.

ARTICLE A-5 PAYMENT

5.1 Subject to the provisions of the *Contract Documents* and *Payment Legislation*, and in accordance with legislation and statutory regulations respecting holdback percentages, the *Owner* shall:

- .1 make progress payments to the *Contractor* on account of the *Contract Price* when due in the amount certified by the *Consultant* unless otherwise prescribed by *Payment Legislation* together with such *Value Added Taxes* as may be applicable to such payments,
- .2 upon *Substantial Performance of the Work*, pay to the *Contractor* the unpaid balance of the holdback amount when due together with such *Value Added Taxes* as may be applicable to such payment, and
- .3 upon the issuance of the final certificate for payment, pay to the *Contractor* the unpaid balance of the *Contract Price* when due together with such *Value Added Taxes* as may be applicable to such payment.

5.2 Interest

- .1 Should either party fail to make payments as they become due under the terms of the *Contract* or in an award by adjudication, arbitration or court, interest at the following rates on such unpaid amounts shall also become due and payable until payment:
 - (1) 2% per annum above the prime rate for the first 60 days.
 - (2) 4% per annum above the prime rate after the first 60 days.Such interest shall be compounded on a monthly basis. The prime rate shall be the rate of interest quoted by
(Insert name of chartered lending institution whose prime rate is to be used)

for prime business loans as it may change from time to time.

- .2 Interest shall apply at the rate and in the manner prescribed by paragraph 5.2.1 of this Article on the settlement amount of any claim in dispute that is resolved either pursuant to Part 8 of the General Conditions – DISPUTE RESOLUTION or otherwise, from the date the amount would have been due and payable under the *Contract*, had it not been in dispute, until the date it is paid.

ARTICLE A-6 RECEIPT OF AND ADDRESSES FOR NOTICES IN WRITING

6.1 *Notices in Writing* will be addressed to the recipient at the address set out below.

6.2 The delivery of a *Notice in Writing* will be by hand, by courier, by prepaid first class mail, or by other form of electronic communication during the transmission of which no indication of failure of receipt is communicated to the sender.

6.3 A *Notice in Writing* delivered by one party in accordance with this *Contract* will be deemed to have been received by the other party on the date of delivery if delivered by hand or courier, or if sent by mail it will be deemed to have been received five calendar days after the date on which it was mailed, provided that if either such day is not a *Working Day*, then the *Notice in Writing* will be deemed to have been received on the *Working Day* next following such day.

6.4 A *Notice in Writing* sent by any form of electronic communication will be deemed to have been received on the date of its transmission provided that if such day is not a *Working Day* or if it is received after the end of normal business hours on the date of its transmission at the place of receipt, then it will be deemed to have been received at the opening of business at the place of receipt on the first *Working Day* next following the transmission thereof.

6.5 An address for a party may be changed by *Notice in Writing* to the other party setting out the new address in accordance with this Article.

Owner

*name of Owner**

address

email address

Contractor

*name of Contractor**

address

email address

Consultant

*name of Consultant**

address

email address

** If it is intended that a specific individual must receive the notice, that individual's name shall be indicated.*

ARTICLE A-7 LANGUAGE OF THE CONTRACT

- 7.1 When the *Contract Documents* are prepared in both the English and French languages, it is agreed that in the event of any apparent discrepancy between the English and French versions, the English / French # language shall prevail.
Complete this statement by striking out inapplicable term.
- 7.2 This Agreement is drawn in English at the request of the parties hereto. La présente convention est rédigée en anglais à la demande des parties.

ARTICLE A-8 SUCCESSION

- 8.1 The *Contract* shall enure to the benefit of and be binding upon the parties hereto, their respective heirs, legal representatives, successors, and assigns.

In witness whereof the parties hereto have executed this Agreement by the hands of their duly authorized representatives.

SIGNED AND DELIVERED
in the presence of:

WITNESS

OWNER

name of Owner

signature

signature

name of person signing

name and title of person signing

WITNESS

CONTRACTOR

name of Contractor

signature

signature

name of person signing

name and title of person signing

- N.B. Where legal jurisdiction, local practice or Owner or Contractor requirement calls for:*
- (a) proof of authority to execute this document, attach such proof of authority in the form of a certified copy of a resolution naming the representative(s) authorized to sign the Agreement for and on behalf of the corporation or partnership; or*
 - (b) the affixing of a corporate seal, this Agreement should be properly sealed.*

Town of Lunenburg
Wastewater Treatment Plant
Upgrades and Expansion
Contract No. 240800.00

Section 00 71 00

December 2024

DEFINITIONS CCDC 2 - 2020

DEFINITIONS

The following Definitions shall apply to all *Contract Documents*.

Change Directive

A *Change Directive* is a written instruction prepared by the *Consultant* and signed by the *Owner* directing the *Contractor* to proceed with a change in the *Work* within the general scope of the *Contract Documents* prior to the *Owner* and the *Contractor* agreeing upon adjustments in the *Contract Price* and the *Contract Time*.

Change Order

A *Change Order* is a written amendment to the *Contract* prepared by the *Consultant* and signed by the *Owner* and the *Contractor* stating their agreement upon:

- a change in the *Work*;
- the method of adjustment or the amount of the adjustment in the *Contract Price*, if any; and
- the extent of the adjustment in the *Contract Time*, if any.

Construction Equipment

Construction Equipment means all machinery and equipment, either operated or not operated, that is required for preparing, fabricating, conveying, erecting, or otherwise performing the *Work* but is not incorporated into the *Work*.

Consultant

The *Consultant* is the person or entity engaged by the *Owner* and identified as such in the Agreement. The *Consultant* is the Architect, the Engineer or entity licensed to practise in the province or territory of the *Place of the Work*.

Contract

The *Contract* is the undertaking by the parties to perform their respective duties, responsibilities and obligations as prescribed in the *Contract Documents* and represents the entire agreement between the parties.

Contract Documents

The *Contract Documents* consist of those documents listed in Article A-3 of the Agreement – CONTRACT DOCUMENTS and amendments agreed upon between the parties.

Contract Price

The *Contract Price* is the amount stipulated in Article A-4 of the Agreement – CONTRACT PRICE.

Contract Time

The *Contract Time* is the time from commencement of the *Work* to the date of *Ready-for-Takeover* as stipulated in paragraph 1.3 of Article A-1 of the Agreement – THE WORK.

Contractor

The *Contractor* is the person or entity identified as such in the Agreement.

Drawings

The *Drawings* are the graphic and pictorial portions of the *Contract Documents*, wherever located and whenever issued, showing the design, location and dimensions of the *Work*, generally including plans, elevations, sections, details, and diagrams.

Notice in Writing

A *Notice in Writing*, where identified in the *Contract Documents*, is a written communication between the parties or between them and the *Consultant* that is transmitted in accordance with the provisions of Article A-6 of the Agreement – RECEIPT OF AND ADDRESSES FOR NOTICES IN WRITING.

Owner

The *Owner* is the person or entity identified as such in the Agreement.

Other Contractor

Other Contractor means a contractor, other than the *Contractor* or a *Subcontractor*, engaged by the *Owner* for the *Project*.

Payment Legislation

Payment Legislation means such legislation in effect at the *Place of the Work* which governs payment under construction contracts.

Place of the Work

The *Place of the Work* is the designated site or location of the *Work* identified in the *Contract Documents*.

Product

Product or Products means material, machinery, equipment, and fixtures forming part of the *Work*, but does not include *Construction Equipment*.

Project

The *Project* means the total construction contemplated of which the *Work* may be the whole or a part.

Ready-for-Takeover

Ready-for-Takeover shall have been attained when the conditions set out in paragraph 12.1.1 of GC 12.1 – READY-FOR-TAKEOVER have been met, as verified by the *Consultant* pursuant to paragraph 12.1.4.2 of GC 12.1 – READY-FOR-TAKEOVER.

Shop Drawings

Shop Drawings are drawings, diagrams, illustrations, schedules, performance charts, brochures, *Product* data, and other data which the *Contractor* provides to illustrate details of portions of the *Work*.

Specifications

The *Specifications* are that portion of the *Contract Documents*, wherever located and whenever issued, consisting of the written requirements and standards for *Products*, systems, workmanship, quality, and the services necessary for the performance of the *Work*.

Subcontractor

A *Subcontractor* is a person or entity having a direct contract with the *Contractor* to perform a part or parts of the *Work* at the *Place of the Work*.

Substantial Performance of the Work

Substantial Performance of the Work is as defined in the lien legislation applicable to the *Place of the Work*.

Supplemental Instruction

A *Supplemental Instruction* is an instruction, not involving adjustment in the *Contract Price* or *Contract Time*, in the form of *Specifications*, *Drawings*, schedules, samples, models, or written instructions, consistent with the intent of the *Contract Documents*. It is to be issued by the *Consultant* to supplement the *Contract Documents* as required for the performance of the *Work*.

Supplier

A *Supplier* is a person or entity having a direct contract with the *Contractor* to supply *Products*.

Temporary Work

Temporary Work means temporary supports, structures, facilities, services, and other temporary items, excluding *Construction Equipment*, required for the execution of the *Work* but not incorporated into the *Work*.

Value Added Taxes

Value Added Taxes means such sum as shall be levied upon the *Contract Price* by the Federal or any Provincial or Territorial Government and is computed as a percentage of the *Contract Price* and includes the Goods and Services Tax, the Quebec Sales Tax, the Harmonized Sales Tax, and any similar tax, the collection and payment of which have been imposed on the *Contractor* by tax legislation.

Work

The *Work* means the total construction and related services required by the *Contract Documents*.

Working Day

Working Day means a day other than a Saturday, Sunday, statutory holiday, or statutory vacation day that is observed by the construction industry in the area of the *Place of the Work*.

Town of Lunenburg
Wastewater Treatment Plant
Upgrades and Expansion
Contract No. 240800.00

Section 00 72 45

December 2024

GENERAL CONDITIONS OF THE
STIPULATED PRICE CONTRACT
CCDC 2 - 2020

GENERAL CONDITIONS

PART 1 GENERAL PROVISIONS

GC 1.1 CONTRACT DOCUMENTS

- 1.1.1 The intent of the *Contract Documents* is to include the labour, *Products* and services necessary for the performance of the *Work* by the *Contractor* in accordance with these documents. It is not intended, however, that the *Contractor* shall supply products or perform work not consistent with, not covered by, or not properly inferable from the *Contract Documents*.
- 1.1.2 The *Contract Documents* are complementary, and what is required by one shall be as binding as if required by all. Performance by the *Contractor* shall be required only to the extent consistent with the *Contract Documents*.
- 1.1.3 The *Contractor* shall review the *Contract Documents* for the purpose of facilitating co-ordination and execution of the *Work* by the *Contractor*.
- 1.1.4 The *Contractor* is not responsible for errors, omissions or inconsistencies in the *Contract Documents*. If there are perceived errors, omissions or inconsistencies discovered by or made known to the *Contractor*, the *Contractor* shall promptly report to the *Consultant* and shall not proceed with the work affected until the *Contractor* has received corrected or additional information from the *Consultant*.
- 1.1.5 If there is a conflict within the *Contract Documents*:
- .1 the order of priority of documents, from highest to lowest, shall be
 - the Agreement between *Owner* and *Contractor*,
 - the Definitions,
 - Supplementary Conditions,
 - the General Conditions,
 - Division 01 of the *Specifications*,
 - technical *Specifications*,
 - material and finishing schedules,
 - the *Drawings*.
 - .2 *Drawings* of larger scale shall govern over those of smaller scale of the same date.
 - .3 dimensions shown on *Drawings* shall govern over dimensions scaled from *Drawings*.
 - .4 amended or later dated documents shall govern over earlier documents of the same type.
 - .5 noted materials and annotations shall govern over graphic indications.
- 1.1.6 Nothing contained in the *Contract Documents* shall create any contractual relationship between:
- .1 the *Owner* and a *Subcontractor*, a *Supplier*, or their agent, employee, or other person performing any portion of the *Work*.
 - .2 the *Consultant* and the *Contractor*, a *Subcontractor*, a *Supplier*, or their agent, employee, or other person performing any portion of the *Work*.
- 1.1.7 Words and abbreviations which have well known technical or trade meanings are used in the *Contract Documents* in accordance with such recognized meanings.
- 1.1.8 References in the *Contract Documents* to the singular shall be considered to include the plural as the context requires.
- 1.1.9 Neither the organization of the *Specifications* nor the arrangement of *Drawings* shall control the *Contractor* in dividing the work among *Subcontractors* and *Suppliers*.
- 1.1.10 *Specifications*, *Drawings*, models, and copies thereof furnished by the *Consultant* are and shall remain the *Consultant's* property, with the exception of the signed *Contract* sets, which shall belong to each party to the *Contract*. All *Specifications*, *Drawings* and models furnished by the *Consultant* are to be used only with respect to the *Work* and are not to be used on other work. These *Specifications*, *Drawings* and models are not to be copied or altered in any manner without the written authorization of the *Consultant*.
- 1.1.11 Physical models furnished by the *Contractor* at the *Owner's* expense are the property of the *Owner*.

GC 1.2 LAW OF THE CONTRACT

- 1.2.1 The law of the *Place of the Work* shall govern the interpretation of the *Contract*.

GC 1.3 RIGHTS AND REMEDIES

- 1.3.1 Except as expressly provided in the *Contract Documents*, the duties and obligations imposed by the *Contract Documents* and the rights and remedies available thereunder shall be in addition to and not a limitation of any duties, obligations, rights, and remedies otherwise imposed or available by law.

- 1.3.2 No action or failure to act by the *Owner*, the *Consultant* or the *Contractor* shall constitute a waiver of any right or duty afforded any of them under the *Contract*, nor shall any such action or failure to act constitute an approval of or acquiescence in any breach thereunder, except as may be specifically agreed in writing.

GC 1.4 ASSIGNMENT

- 1.4.1 Neither party to the *Contract* shall assign the *Contract* or a portion thereof without the written consent of the other, which consent shall not be unreasonably withheld.

PART 2 ADMINISTRATION OF THE CONTRACT

GC 2.1 AUTHORITY OF THE CONSULTANT

- 2.1.1 The *Consultant* will have authority to act on behalf of the *Owner* only to the extent provided in the *Contract Documents*, unless otherwise modified by written agreement as provided in paragraph 2.1.2.
- 2.1.2 The duties, responsibilities and limitations of authority of the *Consultant* as set forth in the *Contract Documents* shall be modified or extended only with the written consent of the *Owner*, the *Consultant* and the *Contractor*.

GC 2.2 ROLE OF THE CONSULTANT

- 2.2.1 The *Consultant* will provide administration of the *Contract* as described in the *Contract Documents*.
- 2.2.2 The *Consultant* will visit the *Place of the Work* at intervals appropriate to the progress of construction to become familiar with the progress and quality of the work and to determine if the *Work* is proceeding in general conformity with the *Contract Documents*.
- 2.2.3 If the *Owner* and the *Consultant* agree, the *Consultant* will provide at the *Place of the Work*, one or more project representatives to assist in carrying out the *Consultant's* responsibilities. The duties, responsibilities and limitations of authority of such project representatives shall be as set forth in writing to the *Contractor*.
- 2.2.4 Based on the *Consultant's* observations and evaluation of the *Contractor's* applications for payment, the *Consultant* will determine the amounts owing to the *Contractor* under the *Contract* and will issue certificates for payment as provided in Article A-5 of the Agreement – PAYMENT, GC 5.3 – PAYMENT and GC 5.5 – FINAL PAYMENT.
- 2.2.5 The *Consultant* will not be responsible for and will not have control, charge or supervision of construction means, methods, techniques, sequences, or procedures, or for safety precautions and programs required in connection with the *Work* in accordance with the applicable construction safety legislation, other regulations or general construction practice. The *Consultant* will not be responsible for the *Contractor's* failure to perform the *Work* in accordance with the *Contract Documents*.
- 2.2.6 Except with respect to GC 5.1 – FINANCING INFORMATION REQUIRED OF THE OWNER, the *Consultant* will be, in the first instance, the interpreter of the requirements of the *Contract Documents*.
- 2.2.7 Matters in question relating to the performance of the *Work* or the interpretation of the *Contract Documents* shall be initially referred in writing to the *Consultant* by the party raising the question for interpretations and findings and copied to the other party.
- 2.2.8 Interpretations and findings of the *Consultant* shall be consistent with the intent of the *Contract Documents*. In making such interpretations and findings the *Consultant* will not show partiality to either the *Owner* or the *Contractor*.
- 2.2.9 The *Consultant's* interpretations and findings will be given in writing to the parties within a reasonable time.
- 2.2.10 With respect to claims for a change in *Contract Price*, the *Consultant* will make findings as set out in GC 6.6 – CLAIMS FOR A CHANGE IN CONTRACT PRICE.
- 2.2.11 The *Consultant* will have authority to reject work which in the *Consultant's* opinion does not conform to the requirements of the *Contract Documents*. Whenever the *Consultant* considers it necessary or advisable, the *Consultant* will have authority to require inspection or testing of work, whether or not such work is fabricated, installed or completed. However, neither the authority of the *Consultant* to act nor any decision either to exercise or not to exercise such authority shall give rise to any duty or responsibility of the *Consultant* to the *Contractor*, *Subcontractors*, *Suppliers*, or their agents, employees, or other persons performing any of the *Work*.
- 2.2.12 During the progress of the *Work* the *Consultant* will furnish *Supplemental Instructions* to the *Contractor* with reasonable promptness or in accordance with a schedule for such instructions agreed to by the *Consultant* and the *Contractor*.
- 2.2.13 The *Consultant* will review and take appropriate action upon *Shop Drawings*, samples and other submittals by the *Contractor*, in accordance with the *Contract Documents*.

- 2.2.14 The *Consultant* will prepare *Change Orders* and *Change Directives* as provided in GC 6.2 – CHANGE ORDER and GC 6.3 – CHANGE DIRECTIVE.
- 2.2.15 The *Consultant* will conduct reviews of the *Work* to determine the date of *Substantial Performance of the Work* and verify that *Ready-for-Takeover* has been attained.
- 2.2.16 All certificates issued by the *Consultant* will be to the best of the *Consultant's* knowledge, information and belief. By issuing any certificate, the *Consultant* does not guarantee the *Work* is correct or complete.
- 2.2.17 The *Consultant* will receive and review written warranties and related documents required by the *Contract* and provided by the *Contractor* and will forward such warranties and documents to the *Owner* for the *Owner's* acceptance.
- 2.2.18 If the *Consultant's* engagement is terminated, the *Owner* shall immediately engage a *Consultant* against whom the *Contractor* makes no reasonable objection and whose duties and responsibilities under the *Contract Documents* will be that of the former *Consultant*.

GC 2.3 REVIEW AND INSPECTION OF THE WORK

- 2.3.1 The *Owner* and the *Consultant* shall have access to the *Work* at all times. The *Contractor* shall provide sufficient, safe and proper facilities at all times for the review of the *Work* by the *Consultant* and the inspection of the *Work* by authorized agencies. If parts of the *Work* are in preparation at locations other than the *Place of the Work*, the *Owner* and the *Consultant* shall be given access to such work whenever it is in progress.
- 2.3.2 If work is designated for tests, inspections or approvals in the *Contract Documents*, by the *Consultant's* instructions, or by the laws or ordinances of the *Place of the Work*, the *Contractor* shall give the *Consultant* reasonable notification of when the work will be ready for review and inspection. The *Contractor* shall arrange for and shall give the *Consultant* reasonable notification of the date and time of inspections by other authorities.
- 2.3.3 The *Contractor* shall furnish promptly to the *Consultant* two copies of certificates and inspection reports relating to the *Work*.
- 2.3.4 If the *Contractor* covers, or permits to be covered, work that has been designated for special tests, inspections or approvals before such special tests, inspections or approvals are made, given or completed, the *Contractor* shall, if so directed, uncover such work, have the inspections or tests satisfactorily completed, and make good covering work at the *Contractor's* expense.
- 2.3.5 The *Consultant* may order any portion or portions of the *Work* to be examined to confirm that such work is in accordance with the requirements of the *Contract Documents*. If the work is not in accordance with the requirements of the *Contract Documents*, the *Contractor* shall correct the work and pay the cost of examination and correction. If the work is in accordance with the requirements of the *Contract Documents*, the *Owner* shall pay the cost of examination and restoration.
- 2.3.6 The *Contractor* shall pay the cost of making any test or inspection, including the cost of samples required for such test or inspection, if such test or inspection is designated in the *Contract Documents* to be performed by the *Contractor* or is required by the laws or ordinances applicable to the *Place of the Work*.
- 2.3.7 The *Contractor* shall pay the cost of samples required for any test or inspection to be performed by others if such test or inspection is designated in the *Contract Documents*.

GC 2.4 DEFECTIVE WORK

- 2.4.1 The *Contractor* shall promptly correct defective work that has been rejected by the *Consultant* as failing to conform to the *Contract Documents* whether or not the defective work was incorporated in the *Work* or the defect is the result of poor workmanship, use of defective products or damage through carelessness or other act or omission of the *Contractor*.
- 2.4.2 The *Contractor* shall make good promptly *Other Contractors' work* destroyed or damaged by such corrections at the *Contractor's* expense.
- 2.4.3 If in the opinion of the *Consultant* it is not expedient to correct defective work or work not performed as provided in the *Contract Documents*, the *Owner* may deduct from the amount otherwise due to the *Contractor* the difference in value between the work as performed and that called for by the *Contract Documents*. If the *Owner* and the *Contractor* do not agree on the difference in value, they shall refer the matter to the *Consultant* for a finding.

PART 3 EXECUTION OF THE WORK

GC 3.1 CONTROL OF THE WORK

- 3.1.1 The *Contractor* shall have total control of the *Work* and shall effectively direct and supervise the *Work* so as to ensure conformity with the *Contract Documents*.

- 3.1.2 The *Contractor* shall be solely responsible for construction means, methods, techniques, sequences, and procedures and for co-ordinating the various parts of the *Work* under the *Contract*.

GC 3.2 CONSTRUCTION BY THE OWNER OR OTHER CONTRACTORS

- 3.2.1 The *Owner* reserves the right to award separate contracts in connection with other parts of the *Project* to *Other Contractors* and to perform work with own forces.
- 3.2.2 When separate contracts are awarded for other parts of the *Project*, or when work is performed by the *Owner's* own forces, the *Owner* shall:
- .1 provide for the co-ordination of the activities and work of *Other Contractors* and the *Owner's* own forces with the *Work* of the *Contract*;
 - .2 enter into separate contracts with *Other Contractors* under conditions of contract which are compatible with the conditions of the *Contract*;
 - .3 ensure that insurance coverage is provided to the same requirements as are called for in GC 11.1 – INSURANCE and co-ordinate such insurance with the insurance coverage of the *Contractor* as it affects the *Work*; and
 - .4 take all reasonable precautions to avoid labour disputes or other disputes on the *Project* arising from the work of *Other Contractors* or the *Owner's* own forces.
- 3.2.3 When separate contracts are awarded for other parts of the *Project*, or when work is performed by the *Owner's* own forces, the *Contractor* shall:
- .1 afford the *Owner* and *Other Contractors* reasonable opportunity to store their products and execute their work;
 - .2 co-ordinate and schedule the *Work* with the work of *Other Contractors* or the *Owner's* own forces that are identified in the *Contract Documents*;
 - .3 participate with *Other Contractors* and the *Owner* in reviewing their construction schedules when directed to do so; and
 - .4 report promptly to the *Consultant* in writing any apparent deficiencies in the work of *Other Contractors* or of the *Owner's* own forces, where such work affects the proper execution of any portion of the *Work*, prior to proceeding with that portion of the *Work*.
- 3.2.4 Where a change in the *Work* is required as a result of the co-ordination and integration of the work of *Other Contractors* or *Owner's* own forces with the *Work*, the changes shall be authorized and valued as provided in GC 6.1 – OWNER'S RIGHT TO MAKE CHANGES, GC 6.2 – CHANGE ORDER and GC 6.3 – CHANGE DIRECTIVE.
- 3.2.5 Disputes and other matters in question between the *Contractor* and *Other Contractors* shall be dealt with as provided in Part 8 of the General Conditions – DISPUTE RESOLUTION provided the *Other Contractors* have reciprocal obligations. The *Contractor* shall be deemed to have consented to arbitration of any dispute with any *Other Contractor* whose contract with the *Owner* contains a similar agreement to arbitrate. In the absence of *Other Contractors* having reciprocal obligations, disputes and other matters in question initiated by the *Contractor* against *Other Contractors* will be considered disputes and other matters in question between the *Contractor* and the *Owner*.
- 3.2.6 Should the *Owner*, the *Consultant*, *Other Contractors*, or anyone employed by them directly or indirectly be responsible for ill-timed work necessitating cutting or remedial work to be performed, the cost of such cutting or remedial work shall be valued as provided in GC 6.1 – OWNER'S RIGHT TO MAKE CHANGES, GC 6.2 – CHANGE ORDER and GC 6.3 – CHANGE DIRECTIVE.

GC 3.3 TEMPORARY WORK

- 3.3.1 The *Contractor* shall have the sole responsibility for the design, erection, operation, maintenance, and removal of *Temporary Work* unless otherwise specified in the *Contract Documents*.
- 3.3.2 The *Contractor* shall engage and pay for registered professional engineering personnel skilled in the appropriate disciplines to perform those functions referred to in paragraph 3.3.1 where required by law or by the *Contract Documents* and in all cases where such *Temporary Work* is of such a nature that professional engineering skill is required to produce safe and satisfactory results.
- 3.3.3 Notwithstanding the provisions of GC 3.1 – CONTROL OF THE WORK, paragraphs 3.3.1 and 3.3.2 or provisions to the contrary elsewhere in the *Contract Documents* where such *Contract Documents* include designs for *Temporary Work* or specify a method of construction in whole or in part, such designs or methods of construction shall be considered to be part of the design of the *Work* and the *Contractor* shall not be held responsible for that part of the design or the specified method of construction. The *Contractor* shall, however, be responsible for the execution of such design or specified method of construction in the same manner as for the execution of the *Work*.

GC 3.4 CONSTRUCTION SCHEDULE

3.4.1 The *Contractor* shall:

- .1 prepare and submit to the *Owner* and the *Consultant* prior to the first application for payment, a construction schedule that indicates the timing of the major activities of the *Work* and provides sufficient detail of the critical events and their inter-relationship to demonstrate the *Work* will be performed in conformity with the *Contract Time*;
- .2 monitor the progress of the *Work* relative to the construction schedule and update the schedule on a monthly basis or as stipulated by the *Contract Documents*; and
- .3 advise the *Consultant* of any revisions required to the schedule as the result of extensions of the *Contract Time* as provided in Part 6 of the General Conditions – CHANGES IN THE WORK.

GC 3.5 SUPERVISION

3.5.1 The *Contractor* shall provide all necessary supervision and appoint a competent representative who shall be in attendance at the *Place of the Work* while the *Work* is being performed. The appointed representative shall not be changed except for valid reason.

3.5.2 The appointed representative shall represent the *Contractor* at the *Place of the Work*. Information and instructions provided by the *Consultant* to the *Contractor's* appointed representative shall be deemed to have been received by the *Contractor*, except with respect to Article A-6 of the Agreement – RECEIPT OF AND ADDRESSES FOR NOTICES IN WRITING.

GC 3.6 SUBCONTRACTORS AND SUPPLIERS

3.6.1 The *Contractor* shall preserve and protect the rights of the parties under the *Contract* with respect to work to be performed under subcontract, and shall:

- .1 enter into contracts or written agreements with *Subcontractors* and *Suppliers* to require them to perform their work as provided in the *Contract Documents*;
- .2 incorporate the applicable terms and conditions of the *Contract Documents* into all contracts or written agreements with *Subcontractors* and *Suppliers*; and
- .3 be as fully responsible to the *Owner* for acts and omissions of *Subcontractors*, *Suppliers* and any persons directly or indirectly employed by them as for acts and omissions of persons directly employed by the *Contractor*.

3.6.2 The *Contractor* shall indicate in writing, if requested by the *Owner*, those *Subcontractors* or *Suppliers* whose bids have been received by the *Contractor* which the *Contractor* would be prepared to accept for the performance of a portion of the *Work*. Should the *Owner* not object before signing the *Contract*, the *Contractor* shall employ those *Subcontractors* or *Suppliers* so identified by the *Contractor* in writing for the performance of that portion of the *Work* to which their bid applies.

3.6.3 The *Owner* may, for reasonable cause, at any time before the *Owner* has signed the *Contract*, object to the use of a proposed *Subcontractor* or *Supplier* and require the *Contractor* to employ one of the other subcontract bidders.

3.6.4 If the *Owner* requires the *Contractor* to change a proposed *Subcontractor* or *Supplier*, the *Contract Price* and *Contract Time* shall be adjusted by the difference occasioned by such required change.

3.6.5 The *Contractor* shall not be required to employ as a *Subcontractor* or *Supplier*, a person or firm to which the *Contractor* may reasonably object.

3.6.6 The *Owner*, through the *Consultant*, may provide to a *Subcontractor* or *Supplier* information as to the percentage of the *Subcontractor's* or *Supplier's* work which has been certified for payment.

GC 3.7 LABOUR AND PRODUCTS

3.7.1 The *Contractor* shall maintain good order and discipline among the *Contractor's* employees engaged on the *Work* and employ only workers that are skilled in the tasks assigned.

3.7.2 The *Contractor* shall provide and pay for labour, *Products*, tools, *Construction Equipment*, water, heat, light, power, transportation, and other facilities and services necessary for the performance of the *Work* in accordance with the *Contract*.

3.7.3 Unless otherwise specified in the *Contract Documents*, *Products* provided shall be new. *Products* which are not specified shall be of a quality consistent with those specified and their use acceptable to the *Consultant*.

GC 3.8 SHOP DRAWINGS

3.8.1 The *Contractor* shall provide *Shop Drawings* as required in the *Contract Documents*.

3.8.2 The *Contractor* shall provide *Shop Drawings* to the *Consultant* to review in accordance with an agreed schedule, or in the absence of an agreed schedule, in orderly sequence and sufficiently in advance so as to cause no delay in the *Work* or in the work of *Other Contractors* or the *Owner's* own forces.

- 3.8.3 The *Contractor* shall review all *Shop Drawings* before providing them to the *Consultant*. The *Contractor* represents by this review that:
- .1 the *Contractor* has determined and verified all applicable field measurements, field construction conditions, *Product* requirements, catalogue numbers and similar data, or will do so, and
 - .2 the *Contractor* has checked and co-ordinated each *Shop Drawing* with the requirements of the *Work* and of the *Contract Documents*.
- 3.8.4 The *Consultant's* review is for conformity to the design concept and for general arrangement only.
- 3.8.5 At the time of providing *Shop Drawings*, the *Contractor* shall expressly advise the *Consultant* in writing of any deviations in a *Shop Drawing* from the requirements of the *Contract Documents*. The *Consultant* shall indicate the acceptance or rejection of such deviation expressly in writing.
- 3.8.6 The *Consultant's* review shall not relieve the *Contractor* of responsibility for errors or omissions in the *Shop Drawings* or for meeting all requirements of the *Contract Documents*.
- 3.8.7 The *Consultant* will review and return *Shop Drawings* in accordance with the schedule agreed upon, or, in the absence of such schedule, with reasonable promptness so as to cause no delay in the performance of the *Work*.

PART 4 ALLOWANCES

GC 4.1 CASH ALLOWANCES

- 4.1.1 The *Contract Price* includes the cash allowances, if any, stated in the *Contract Documents*. The scope of the *Work* or costs included in such cash allowances shall be as described in the *Contract Documents*.
- 4.1.2 The *Contract Price*, and not the cash allowances, includes the *Contractor's* overhead and profit in connection with such cash allowances.
- 4.1.3 Expenditures under cash allowances shall be authorized by the *Owner* through the *Consultant*.
- 4.1.4 Where the actual cost of the *Work* under any cash allowance exceeds the amount of the allowance, any unexpended amounts from other cash allowances shall be reallocated, at the *Consultant's* direction, to cover the shortfall, and, in that case, there shall be no additional amount added to the *Contract Price* for overhead and profit. Only where the actual cost of the *Work* under all cash allowances exceeds the total amount of all cash allowances shall the *Contractor* be compensated for the excess incurred and substantiated, plus an amount for overhead and profit on the excess only, as set out in the *Contract Documents*.
- 4.1.5 The net amount of any unexpended cash allowances, after providing for any reallocations as contemplated in paragraph 4.1.4, shall be deducted from the *Contract Price* by *Change Order* without any adjustment for the *Contractor's* overhead and profit on such amount.
- 4.1.6 The value of the *Work* performed under a cash allowance is eligible to be included in progress payments.
- 4.1.7 The *Contractor* and the *Consultant* shall jointly prepare a schedule that shows when the items called for under cash allowances must be ordered to avoid delaying the progress of the *Work*.

GC 4.2 CONTINGENCY ALLOWANCE

- 4.2.1 The *Contract Price* includes the contingency allowance, if any, stated in the *Contract Documents*.
- 4.2.2 The contingency allowance includes the *Contractor's* overhead and profit in connection with such contingency allowance.
- 4.2.3 Expenditures under the contingency allowance shall be authorized and valued as provided in GC 6.1 – OWNER'S RIGHT TO MAKE CHANGES, GC 6.2 – CHANGE ORDER and GC 6.3 – CHANGE DIRECTIVE.
- 4.2.4 The *Contract Price* shall be adjusted by *Change Order* to provide for any difference between the expenditures authorized under paragraph 4.2.3 and the contingency allowance.

PART 5 PAYMENT

GC 5.1 FINANCING INFORMATION REQUIRED OF THE OWNER

- 5.1.1 The *Owner* shall, at the request of the *Contractor*, before signing the *Contract*, and promptly from time to time thereafter, furnish to the *Contractor* reasonable evidence that financial arrangements have been made to fulfill the *Owner's* obligations under the *Contract*.
- 5.1.2 The *Owner* shall give the *Contractor Notice in Writing* of any material change in the *Owner's* financial arrangements to fulfil the *Owner's* obligations under the *Contract* during the performance of the *Contract*.

GC 5.2 APPLICATIONS FOR PAYMENT

- 5.2.1 Applications for payment on account as provided in Article A-5 of the Agreement – PAYMENT shall be submitted monthly to the *Owner* and the *Consultant* simultaneously as the *Work* progresses.
- 5.2.2 Applications for payment shall be dated the last day of each payment period, which is the last day of the month or an alternative day of the month agreed in writing by the parties.
- 5.2.3 The amount claimed shall be for the value, proportionate to the amount of the *Contract*, of *Work* performed and *Products* delivered to the *Place of the Work* as of the last day of the payment period.
- 5.2.4 The *Contractor* shall submit to the *Consultant*, at least 15 calendar days before the first application for payment, a schedule of values for the parts of the *Work*, aggregating the total amount of the *Contract Price*, so as to facilitate evaluation of applications for payment.
- 5.2.5 The schedule of values shall be made out in such form as specified in the *Contract* and supported by such evidence as the *Consultant* may reasonably require.
- 5.2.6 Applications for payment shall be based on the schedule of values accepted by the *Consultant* and shall comply with the provisions of *Payment Legislation*.
- 5.2.7 Each application for payment shall include evidence of compliance with workers' compensation legislation at the *Place of the Work* and after the first payment, a declaration by the *Contractor* as to the distribution made of the amounts previously received using document CCDC 9A 'Statutory Declaration'.
- 5.2.8 Applications for payment for *Products* delivered to the *Place of the Work* but not yet incorporated into the *Work* shall be supported by such evidence as the *Consultant* may reasonably require to establish the value and delivery of the *Products*.

GC 5.3 PAYMENT

- 5.3.1 After receipt by the *Consultant* and the *Owner* of an application for payment submitted by the *Contractor* in accordance with GC 5.2 – APPLICATIONS FOR PAYMENT:
 - .1 The *Consultant* will issue to the *Owner* and copy to the *Contractor*, no later than 10 calendar days after the receipt of the application for payment, a certificate for payment in the amount applied for, or in such other amount as the *Consultant* determines to be properly due. If the *Consultant* certifies a different amount, or rejects the application or part thereof, the *Owner* shall promptly issue a written notice to the *Contractor* giving reasons for the revision or rejection, such written notice to be in compliance with *Payment Legislation*.
 - .2 The *Owner* shall make payment to the *Contractor* on account as provided in Article A-5 of the Agreement – PAYMENT on or before 28 calendar days after the receipt by the *Owner* and the *Consultant* of the application for payment, and in any event, in compliance with *Payment Legislation*.

GC 5.4 SUBSTANTIAL PERFORMANCE OF THE WORK AND PAYMENT OF HOLDBACK

- 5.4.1 The *Consultant* will review the *Work* to certify or verify the validity of the application for *Substantial Performance of the Work* and will promptly, and in any event, no later than 20 calendar days after receipt of the *Contractors* application:
 - .1 advise the *Contractor* in writing that the *Work* or the designated portion of the *Work* is not substantially performed and give reasons why, or
 - .2 state the date of *Substantial Performance of the Work* or a designated portion of the *Work* in a certificate and issue a copy of that certificate to each of the *Owner* and the *Contractor*.
- 5.4.2 Where the holdback amount required by the applicable lien legislation has not been placed in a separate lien holdback account, the *Owner* shall, no later than 10 calendar days prior to the expiry of the holdback period stipulated in the lien legislation applicable to the *Place of the Work*, place the holdback amount in a bank account in the joint names of the *Owner* and the *Contractor*.
- 5.4.3 Subject to the requirements of any *Payment Legislation*, all holdback amount prescribed by the applicable lien legislation for the *Work* shall become due and payable to the *Contractor* no later than 10 *Working Days* following the expiration of the holdback period stipulated in the lien legislation applicable to the *Place of the Work*.
- 5.4.4 The *Contractor* shall submit an application for payment of the lien holdback amount in accordance with GC 5.3 – PAYMENT.
- 5.4.5 Where legislation permits progressive release of the holdback for a portion of the *Work* and the *Consultant* has certified or verified that the part of the *Work* has been performed prior to *Substantial Performance of the Work*, the *Owner* hereby agrees to release, and shall release, such portion to the *Contractor* in accordance with such legislation.

- 5.4.6 Notwithstanding any progressive release of the holdback, the *Contractor* shall ensure that such parts of the *Work* are protected pending the issuance of a final certificate for payment and be responsible for the correction of defects or work not performed regardless of whether or not such was apparent when the holdback was released.

GC 5.5 FINAL PAYMENT

- 5.5.1 When the *Contractor* considers that the *Work* is completed, the *Contractor* shall submit an application for final payment.
- 5.5.2 The *Consultant* will, no later than 10 calendar days after the receipt of an application from the *Contractor* for final payment, review the *Work* to verify the validity of the application and when the *Consultant* finds the *Contractor's* application for final payment valid, the *Consultant* will promptly issue a final certificate for payment to the *Owner*, with a copy to the *Contractor*.
- 5.5.3 If the *Consultant* rejects the application or part thereof, the *Owner* will promptly issue a written notice to the *Contractor* giving reasons for the revision or rejection, such written notice to be in compliance with *Payment Legislation*.
- 5.5.4 Subject to the provision of paragraph 10.4.1 of GC 10.4 – WORKERS' COMPENSATION, and any legislation applicable to the *Place of the Work*, the *Owner* shall, no later than 5 calendar days after the issuance of a final certificate for payment, pay the *Contractor* as provided in Article A-5 of the Agreement – PAYMENT and in any event, in compliance with *Payment Legislation*.

GC 5.6 DEFERRED WORK

- 5.6.1 If because of climatic or other conditions reasonably beyond the control of the *Contractor*, or if the *Owner* and the *Contractor* agree that, there are items of work that must be deferred, payment in full for that portion of the *Work* which has been performed as certified by the *Consultant* shall not be withheld or delayed by the *Owner* on account thereof, but the *Owner* may withhold, until the remaining portion of the *Work* is finished, only such an amount that the *Consultant* determines is sufficient and reasonable to cover the cost of performing such deferred *Work*.

GC 5.7 NON-CONFORMING WORK

- 5.7.1 No payment by the *Owner* under the *Contract* nor partial or entire use or occupancy of the *Work* by the *Owner* shall constitute an acceptance of any portion of the *Work* or *Products* which are not in accordance with the requirements of the *Contract Documents*.

PART 6 CHANGES IN THE WORK

GC 6.1 OWNER'S RIGHT TO MAKE CHANGES

- 6.1.1 The *Owner*, through the *Consultant*, without invalidating the *Contract*, may make:
- .1 changes in the *Work* consisting of additions, deletions or other revisions to the *Work* by *Change Order* or *Change Directive*, and
 - .2 changes to the *Contract Time* for the *Work*, or any part thereof, by *Change Order*.
- 6.1.2 The *Contractor* shall not perform a change in the *Work* without a *Change Order* or a *Change Directive*.

GC 6.2 CHANGE ORDER

- 6.2.1 When a change in the *Work* is proposed or required, the *Consultant* will provide the *Contractor* with a written description of the proposed change in the *Work*. The *Contractor* shall promptly present to the *Consultant*, in a form that can be reasonably evaluated, a method of adjustment or an amount of adjustment for the *Contract Price*, if any, and the adjustment in the *Contract Time*, if any, for the proposed change in the *Work*.
- 6.2.2 When the *Owner* and the *Contractor* agree to the adjustments in the *Contract Price* and *Contract Time* or to the method to be used to determine the adjustments, such agreement shall be effective immediately and shall be recorded in a *Change Order*. The value of the work performed as the result of a *Change Order* shall be included in the applications for progress payment.

GC 6.3 CHANGE DIRECTIVE

- 6.3.1 If the *Owner* requires the *Contractor* to proceed with a change in the *Work* prior to the *Owner* and the *Contractor* agreeing upon the corresponding adjustment in *Contract Price* and *Contract Time*, the *Owner*, through the *Consultant*, shall issue a *Change Directive*.
- 6.3.2 A *Change Directive* shall only be used to direct a change in the *Work* which is within the general scope of the *Contract Documents*.
- 6.3.3 A *Change Directive* shall not be used to direct a change in the *Contract Time* only.

- 6.3.4 Upon receipt of a *Change Directive*, the *Contractor* shall proceed promptly with the change in the *Work*.
- 6.3.5 For the purpose of valuing *Change Directives*, changes in the *Work* that are not substitutions or otherwise related to each other shall not be grouped together in the same *Change Directive*.
- 6.3.6 The adjustment in the *Contract Price* for a change carried out by way of a *Change Directive* shall be determined on the basis of the cost of the *Contractor*'s actual expenditures and savings attributable to the *Change Directive*, valued in accordance with paragraph 6.3.7 and as follows:
- 1 If the change results in a net increase in the *Contractor*'s cost, the *Contract Price* shall be increased by the amount of the net increase in the *Contractor*'s cost, plus the *Contractor*'s percentage fee on such net increase.
 - 2 If the change results in a net decrease in the *Contractor*'s cost, the *Contract Price* shall be decreased by the amount of the net decrease in the *Contractor*'s cost, without adjustment for the *Contractor*'s percentage fee.
 - 3 The *Contractor*'s fee shall be as specified in the *Contract Documents* or as otherwise agreed by the parties.
- 6.3.7 The cost of performing the work attributable to the *Change Directive* shall be limited to the actual cost of the following in as much as it contributes directly to the implementation of the *Change Directive*:

Labour

- 1 rates that are listed in the schedule or as agreed by the *Owner* and the *Contractor* including wages, benefits, compensation, contributions, assessments, or taxes incurred for such items as employment insurance, provincial or territorial health insurance, workers' compensation, and Canada or Quebec Pension Plan for:
 - (1) trade labour in the direct employ of the *Contractor*;
 - (2) the *Contractor*'s personnel when stationed at the field office;
 - (3) the *Contractor*'s personnel engaged at shops or on the road, in expediting the production or transportation of materials or equipment; and
 - (4) the *Contractor*'s office personnel engaged in a technical capacity, or other personnel identified in Article A-3 of the Agreement – CONTRACT DOCUMENTS for the time spent in the performance of the *Work*;

Products, Construction Equipment and Temporary Work

- 2 cost of all *Products* including cost of transportation thereof;
- 3 in the absence of agreed rates, cost less salvage value of *Construction Equipment*, *Temporary Work* and tools, exclusive of hand tools under \$1,000 owned by the *Contractor*;
- 4 rental cost of *Construction Equipment*, *Temporary Work* and tools, exclusive of hand tools under \$1,000;
- 5 cost of all equipment and services required for the *Contractor*'s field office;

Subcontract

- 6 subcontract amounts of Subcontractor with pricing mechanism approved by the *Owner*;

Others

- 7 travel and subsistence expenses of the *Contractor*'s personnel described in paragraph 6.3.7.1;
- 8 deposits lost provided that they are not caused by negligent acts or omissions of the *Contractor*;
- 9 cost of quality assurance such as independent inspection and testing services;
- 10 charges levied by authorities having jurisdiction at the *Place of the Work*;
- 11 royalties, patent license fees, and damages for infringement of patents and cost of defending suits therefor subject always to the *Contractor*'s obligations to indemnify the *Owner* as provided in paragraph 10.3.1 of GC 10.3 – PATENT FEES;
- 12 premium for all contract securities and insurance for which the *Contractor* is required, by the *Contract Documents*, to provide, maintain and pay in relation to the performance of the *Work*;
- 13 losses and expenses sustained by the *Contractor* for matters which are the subject of insurance under the policies prescribed in GC 11.1 – INSURANCE when such losses and expenses are not recoverable because the amounts are in excess of collectible amounts or within the deductible amounts;
- 14 taxes and duties, other than *Value Added Taxes*, income, capital, or property taxes, relating to the *Work* for which the *Contractor* is liable;
- 15 charges for voice and data communications, courier services, expressage, transmittal and reproduction of documents, and petty cash items;
- 16 cost for removal and disposal of waste products and debris;
- 17 legal costs, incurred by the *Contractor*, in relation to the performance of the *Work* provided that they are not:
 - (1) relating to a dispute between the *Owner* and the *Contractor* unless such costs are part of a settlement or awarded by arbitration or court,
 - (2) the result of the negligent acts or omissions of the *Contractor*, or
 - (3) the result of a breach of this *Contract* by the *Contractor*;
- 18 cost of auditing when requested by the *Owner*; and
- 19 cost of *Project* specific information technology in accordance with the method determined by the parties.

- 6.3.8 Notwithstanding any other provisions contained in the General Conditions of the *Contract*, it is the intention of the parties that the cost of any item under any cost element referred to in paragraph 6.3.7 shall cover and include any and all costs or liabilities attributable to the *Change Directive* other than those which are the result of or occasioned by any failure on the part of the *Contractor* to exercise reasonable care and diligence in the *Contractor's* attention to the *Work*. Any cost due to failure on the part of the *Contractor* to exercise reasonable care and diligence in the *Contractor's* performance of the *Work* attributable to the *Change Directive* shall be borne by the *Contractor*.
- 6.3.9 The *Contractor* shall keep full and detailed accounts and records necessary for the documentation of the cost of performing the *Work* attributable to the *Change Directive* and shall provide the *Consultant* with copies thereof.
- 6.3.10 For the purpose of valuing *Change Directives*, the *Owner* shall be afforded reasonable access to all of the *Contractor's* pertinent documents related to the cost of performing the *Work* attributable to the *Change Directive*.
- 6.3.11 Pending determination of the final amount of a *Change Directive*, the undisputed value of the *Work* performed as the result of a *Change Directive* is eligible to be included in progress payments.
- 6.3.12 If the *Owner* and the *Contractor* do not agree on the proposed adjustment in the *Contract Time* attributable to the change in the *Work*, or the method of determining it, the adjustment shall be referred to the *Consultant* for a finding.
- 6.3.13 When the *Owner* and the *Contractor* reach agreement on the adjustment to the *Contract Price* and to the *Contract Time*, this agreement shall be recorded in a *Change Order*.

GC 6.4 CONCEALED OR UNKNOWN CONDITIONS

- 6.4.1 If the *Owner* or the *Contractor* discover conditions at the *Place of the Work* which are:
- .1 subsurface or otherwise concealed physical conditions which existed before the commencement of the *Work* and differ materially from those indicated in the *Contract Documents*; or
 - .2 physical conditions, other than conditions due to weather, that are of a nature which differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the *Contract Documents*,
- then the observing party shall give *Notice in Writing* to the other party of such conditions before they are disturbed and in no event later than 5 *Working Days* after first observance of the conditions.
- 6.4.2 The *Consultant* will promptly investigate such conditions and make a finding. If the finding is that the conditions differ materially and this would cause an increase or decrease in the *Contractor's* cost or time to perform the *Work*, the *Owner*, through the *Consultant*, shall issue appropriate instructions for a change in the *Work* as provided in GC 6.2 – CHANGE ORDER or GC 6.3 – CHANGE DIRECTIVE.
- 6.4.3 If the *Consultant* finds that the conditions at the *Place of the Work* are not materially different or that no change in the *Contract Price* or the *Contract Time* is justified, the *Consultant* will promptly inform the *Owner* and the *Contractor* in writing.
- 6.4.4 If such concealed or unknown conditions relate to toxic and hazardous substances and materials, artifacts and fossils, or mould, the parties will be governed by the provisions of GC 9.2 – TOXIC AND HAZARDOUS SUBSTANCES, GC 9.3 – ARTIFACTS AND FOSSILS and GC 9.5 – MOULD.

GC 6.5 DELAYS

- 6.5.1 If the *Contractor* is delayed in the performance of the *Work* by the *Owner*, the *Consultant*, or anyone employed or engaged by them directly or indirectly, contrary to the provisions of the *Contract Documents*, then the *Contract Time* shall be extended for such reasonable time as the *Consultant* may recommend in consultation with the *Contractor*. The *Contractor* shall be reimbursed by the *Owner* for reasonable costs incurred by the *Contractor* as the result of such delay.
- 6.5.2 If the *Contractor* is delayed in the performance of the *Work* by a stop work order issued by a court or other public authority and providing that such order was not issued as the result of an act or fault of the *Contractor* or any person employed or engaged by the *Contractor* directly or indirectly, resulting in the failure of the *Contractor* to attain *Ready-for-Takeover* by the date stipulated in Article A-1 of the Agreement – THE WORK, then the *Contract Time* shall be extended for such reasonable time as the *Consultant* may recommend in consultation with the *Contractor*. The *Contractor* shall be reimbursed by the *Owner* for reasonable costs incurred by the *Contractor* as the result of such delay.
- 6.5.3 If the *Contractor* is delayed in the performance of the *Work* by:
- .1 labour disputes, strikes, lock-outs (including lock-outs decreed or recommended for its members by a recognized contractors' association, of which the *Contractor* is a member or to which the *Contractor* is otherwise bound),
 - .2 fire, unusual delay by common carriers or unavoidable casualties,
 - .3 abnormally adverse weather conditions, or

- .4 any cause beyond the *Contractor's* control other than one resulting from a default or breach of *Contract* by the *Contractor*, then the *Contract Time* shall be extended for such reasonable time as the *Consultant* may recommend in consultation with the *Contractor*. The extension of time shall not be less than the time lost as the result of the event causing the delay, unless the *Contractor* agrees to a shorter extension. The *Contractor* shall not be entitled to payment for costs incurred by such delays unless such delays result from actions by the *Owner*, the *Consultant* or anyone employed or engaged by them directly or indirectly.

6.5.4 No extension shall be made for delay unless *Notice in Writing* of the cause of delay is given to the *Consultant* not later than 10 *Working Days* after the commencement of the delay. In the case of a continuing cause of delay only one *Notice in Writing* shall be necessary.

6.5.5 If no schedule is made under paragraph 2.2.12 of GC 2.2 – ROLE OF THE CONSULTANT, then no request for extension shall be made because of failure of the *Consultant* to furnish instructions until 10 *Working Days* after demand for such instructions has been made.

GC 6.6 CLAIMS FOR A CHANGE IN CONTRACT PRICE

6.6.1 If the *Contractor* intends to make a claim for an increase to the *Contract Price*, or if the *Owner* intends to make a claim against the *Contractor* for a credit to the *Contract Price*, the party that intends to make the claim shall give timely *Notice in Writing* of intent to claim to the other party and to the *Consultant*.

6.6.2 Upon commencement of the event or series of events giving rise to a claim, the party intending to make the claim shall:

- .1 take all reasonable measures to mitigate any loss or expense which may be incurred as a result of such event or series of events, and
- .2 keep such records as may be necessary to support the claim.

6.6.3 The party making the claim shall submit within a reasonable time to the *Consultant* a detailed account of the amount claimed and the grounds upon which the claim is based and the *Consultant* will make a finding upon such claim.

6.6.4 Where the event or series of events giving rise to the claim has a continuing effect, the detailed account submitted under paragraph 6.6.3 shall be considered to be an interim account and the party making the claim shall, at such intervals as the *Consultant* may reasonably require, submit further interim accounts giving the accumulated amount of the claim and any further grounds upon which it is based. The party making the claim shall submit a final account after the end of the effects resulting from the event or series of events.

6.6.5 The *Consultant's* findings, with respect to a claim made by either party, will be given by *Notice in Writing* to both parties within 30 *Working Days* after receipt of the claim by the *Consultant*, or within such other time period as may be agreed by the parties.

6.6.6 If such finding is not acceptable to either party, the claim shall be settled in accordance with Part 8 of the General Conditions – DISPUTE RESOLUTION.

PART 7 DEFAULT NOTICE

GC 7.1 OWNER'S RIGHT TO PERFORM THE WORK, TERMINATE THE CONTRACTOR'S RIGHT TO CONTINUE WITH THE WORK OR TERMINATE THE CONTRACT

7.1.1 If the *Contractor* is adjudged bankrupt, or makes a general assignment for the benefit of creditors because of the *Contractor's* insolvency, or if a receiver is appointed because of the *Contractor's* insolvency, the *Owner* may, without prejudice to any other right or remedy the *Owner* may have, terminate the *Contractor's* right to continue with the *Work*, by giving the *Contractor* or receiver or trustee in bankruptcy *Notice in Writing* to that effect.

7.1.2 If the *Contractor* neglects to perform the *Work* properly or otherwise fails to comply with the requirements of the *Contract* to a substantial degree and if the *Consultant* has given a written statement to the *Owner* and *Contractor* which provides the detail of such neglect to perform the *Work* properly or such failure to comply with the requirements of the *Contract* to a substantial degree, the *Owner* may, without prejudice to any other right or remedy the *Owner* may have, give the *Contractor Notice in Writing*, containing particulars of the default including references to applicable provisions of the *Contract*, that the *Contractor* is in default of the *Contractor's* contractual obligations and instruct the *Contractor* to correct the default in the 5 *Working Days* immediately following the receipt of such *Notice in Writing*.

7.1.3 If the default cannot be corrected in the 5 *Working Days* specified or in such other time period as may be subsequently agreed in writing by the parties, the *Contractor* shall be in compliance with the *Owner's* instructions if the *Contractor*:

- .1 commences the correction of the default within the specified time,
- .2 provides the *Owner* with an acceptable schedule for such correction, and
- .3 corrects the default in accordance with the *Contract* terms and with such schedule.

- 7.1.4 If the *Contractor* fails to correct the default in the time specified or in such other time period as may be subsequently agreed in writing by the parties, without prejudice to any other right or remedy the *Owner* may have, the *Owner* may by giving *Notice in Writing*:
- .1 correct such default and deduct the cost thereof from any payment then or thereafter due the *Contractor* for the *Work* provided the *Consultant* has certified such cost to the *Owner* and the *Contractor*, or
 - .2 terminate the *Contractor*'s right to continue with the *Work* in whole or in part or terminate the *Contract*.
- 7.1.5 If the *Owner* terminates the *Contractor*'s right to continue with the *Work* as provided in paragraphs 7.1.1 and 7.1.4, the *Owner* shall be entitled to:
- .1 take possession of the *Work* and *Products* at the *Place of the Work*; subject to the rights of third parties, utilize the *Construction Equipment* at the *Place of the Work*; finish the *Work* by whatever method the *Owner* may consider expedient, but without undue delay or expense,
 - .2 withhold further payment to the *Contractor* until a final certificate for payment is issued,
 - .3 charge the *Contractor* the amount by which the full cost of finishing the *Work* as certified by the *Consultant*, including compensation to the *Consultant* for the *Consultant*'s additional services and a reasonable allowance as determined by the *Consultant* to cover the cost of corrections to work performed by the *Contractor* that may be required under GC 12.3 – WARRANTY, exceeds the unpaid balance of the *Contract Price*; however, if such cost of finishing the *Work* is less than the unpaid balance of the *Contract Price*, the *Owner* shall pay the *Contractor* the difference, and
 - .4 on expiry of the warranty period, charge the *Contractor* the amount by which the cost of corrections to the *Contractor*'s work under GC 12.3 – WARRANTY exceeds the allowance provided for such corrections, or if the cost of such corrections is less than the allowance, pay the *Contractor* the difference.
- 7.1.6 The *Contractor*'s obligation under the *Contract* as to quality, correction and warranty of the work performed by the *Contractor* up to the time of termination shall continue in force after such termination of the *Contract*.

GC 7.2 CONTRACTOR'S RIGHT TO SUSPEND THE WORK OR TERMINATE THE CONTRACT

- 7.2.1 If the *Owner* is adjudged bankrupt, or makes a general assignment for the benefit of creditors because of the *Owner*'s insolvency, or if a receiver is appointed because of the *Owner*'s insolvency, the *Contractor* may, without prejudice to any other right or remedy the *Contractor* may have, terminate the *Contract* by giving the *Owner* or receiver or trustee in bankruptcy *Notice in Writing* to that effect.
- 7.2.2 If the *Work* is suspended or otherwise delayed for a period of 20 *Working Days* or more under an order of a court or other public authority and providing that such order was not issued as the result of an act or fault of the *Contractor* or of anyone directly or indirectly employed or engaged by the *Contractor*, the *Contractor* may, without prejudice to any other right or remedy the *Contractor* may have, terminate the *Contract* by giving the *Owner* *Notice in Writing* to that effect.
- 7.2.3 The *Contractor* may give *Notice in Writing* to the *Owner*, with a copy to the *Consultant*, that the *Owner* is in default of the *Owner*'s contractual obligations if:
- .1 the *Owner* fails to furnish, when so requested by the *Contractor*, reasonable evidence that financial arrangements have been made to fulfill the *Owner*'s obligations under the *Contract*,
 - .2 the *Consultant* fails to issue a certificate as provided in Part 5 of the General Conditions – PAYMENT,
 - .3 the *Owner* fails to pay the *Contractor* when due the amounts certified by the *Consultant* or awarded by adjudication, arbitration or court, or
 - .4 the *Owner* fails to comply with the requirements of the *Contract* to a substantial degree and the *Consultant*, except for GC 5.1 – FINANCING INFORMATION REQUIRED OF THE OWNER, gives a written statement to the *Owner* and the *Contractor* that provides detail of such failure to comply with the requirements of the *Contract* to a substantial degree.
- 7.2.4 The *Contractor*'s *Notice in Writing* to the *Owner* provided under paragraph 7.2.3 shall advise that if the default is not corrected within 5 *Working Days* following the receipt of the *Notice in Writing*, the *Contractor* may, without prejudice to any other right or remedy the *Contractor* may have, suspend the *Work* or terminate the *Contract*.
- 7.2.5 If the *Contractor* terminates the *Contract* by giving a *Notice in Writing* to the *Owner* under the conditions set out above, the *Contractor* shall be entitled to be paid for all work performed including reasonable profit, for loss sustained upon *Products* and *Construction Equipment*, and such other damages as the *Contractor* may have sustained as a result of the termination of the *Contract*.

PART 8 DISPUTE RESOLUTION

GC 8.1 AUTHORITY OF THE CONSULTANT

- 8.1.1 Differences between the parties to the *Contract* as to the interpretation, application or administration of the *Contract* or any failure to agree where agreement between the parties is called for, herein collectively called disputes, which are not resolved

in the first instance by findings of the *Consultant* as provided in GC 2.2 – ROLE OF THE CONSULTANT, shall be settled in accordance with the requirements of Part 8 of the General Conditions – DISPUTE RESOLUTION.

- 8.1.2 If a dispute arises under the *Contract* in respect of a matter in which the *Consultant* has no authority under the *Contract* to make a finding, the procedures set out in paragraph 8.1.3 and paragraphs 8.3.3 to 8.3.8 of GC 8.3 – NEGOTIATION, MEDIATION AND ARBITRATION, and in GC 8.4 – RETENTION OF RIGHTS apply to that dispute with the necessary changes to detail as may be required.
- 8.1.3 If a dispute is not resolved promptly, the *Consultant* will give such instructions as in the *Consultant's* opinion are necessary for the proper performance of the *Work* and to prevent delays pending settlement of the dispute. The parties shall act immediately according to such instructions, it being understood that by so doing neither party will jeopardize any claim the party may have. If it is subsequently determined that such instructions were in error or at variance with the *Contract Documents*, the *Owner* shall pay the *Contractor* costs incurred by the *Contractor* in carrying out such instructions which the *Contractor* was required to do beyond what the *Contract Documents* correctly understood and interpreted would have required, including costs resulting from interruption of the *Work*.

GC 8.2 ADJUDICATION

- 8.2.1 Nothing in this *Contract* shall be deemed to affect the rights of the parties to resolve any dispute by adjudication as may be prescribed by applicable legislation.

GC 8.3 NEGOTIATION, MEDIATION AND ARBITRATION

- 8.3.1 In accordance with the rules for mediation as provided in CCDC 40 ‘Rules for Mediation and Arbitration of Construction Industry Disputes’ in effect at the time of bid closing, the parties shall appoint a Project Mediator
- .1 within 20 *Working Days* after the *Contract* was awarded, or
 - .2 if the parties neglected to make an appointment within the 20 *Working Days*, within 10 *Working Days* after either party by *Notice in Writing* requests that the Project Mediator be appointed.
- 8.3.2 A party shall be conclusively deemed to have accepted a finding of the *Consultant* under GC 2.2 – ROLE OF THE CONSULTANT and to have expressly waived and released the other party from any claims in respect of the particular matter dealt with in that finding unless, within 15 *Working Days* after receipt of that finding, the party sends a *Notice in Writing* of dispute to the other party and to the *Consultant*, which contains the particulars of the matter in dispute and the relevant provisions of the *Contract Documents*. The responding party shall send a *Notice in Writing* of reply to the dispute within 10 *Working Days* after receipt of such *Notice in Writing* setting out particulars of this response and any relevant provisions of the *Contract Documents*.
- 8.3.3 The parties shall make all reasonable efforts to resolve their dispute by amicable negotiations and agree to provide, without prejudice, frank, candid, and timely disclosure of relevant facts, information and documents to facilitate these negotiations.
- 8.3.4 After a period of 10 *Working Days* following receipt of a responding party’s *Notice in Writing* of reply under paragraph 8.3.2, the parties shall request the Project Mediator to assist the parties to reach agreement on any unresolved dispute. The mediated negotiations shall be conducted in accordance with the rules for mediation as provided in CCDC 40 in effect at the time of bid closing.
- 8.3.5 If the dispute has not been resolved at the mediation or within such further period as is agreed by the parties, the Project Mediator will terminate the mediated negotiations by giving *Notice in Writing* to the *Owner*, the *Contractor* and the *Consultant*.
- 8.3.6 By giving a *Notice in Writing* to the other party and the *Consultant*, not later than 10 *Working Days* after the date of termination of the mediated negotiations under paragraph 8.3.5, either party may refer the dispute to be finally resolved by arbitration under the rules of arbitration as provided in CCDC 40 in effect at the time of bid closing. The arbitration shall be conducted in the jurisdiction of the *Place of the Work*.
- 8.3.7 On expiration of the 10 *Working Days*, the arbitration agreement under paragraph 8.3.6 is not binding on the parties and, if a *Notice in Writing* is not given under paragraph 8.3.6 within the required time, the parties may refer the unresolved dispute to the courts or to any other form of dispute resolution, including arbitration, which they have agreed to use.
- 8.3.8 If neither party, by *Notice in Writing*, given within 10 *Working Days* of the date of *Notice in Writing* requesting arbitration in paragraph 8.3.6, requires that a dispute be arbitrated immediately, all disputes referred to arbitration as provided in paragraph 8.3.6 shall be:
- .1 held in abeyance until:
 - (1) *Ready-for-Takeover*,
 - (2) the *Contract* has been terminated, or
 - (3) the *Contractor* has abandoned the *Work*,whichever is earlier; and

- .2 consolidated into a single arbitration under the rules governing the arbitration under paragraph 8.3.6.

GC 8.4 RETENTION OF RIGHTS

- 8.4.1 It is agreed that no act by either party shall be construed as a renunciation or waiver of any rights or recourses, provided the party has given the *Notice in Writing* required under Part 8 of the General Conditions – DISPUTE RESOLUTION and has carried out the instructions as provided in paragraph 8.1.3 of GC 8.1 – AUTHORITY OF THE CONSULTANT.
- 8.4.2 Nothing in Part 8 of the General Conditions – DISPUTE RESOLUTION shall be construed in any way to limit a party from asserting any statutory right to a lien under applicable lien legislation of the jurisdiction of the *Place of the Work* and the assertion of such right by initiating judicial proceedings is not to be construed as a waiver of any right that party may have under paragraph 8.3.6 of GC 8.3 – NEGOTIATION, MEDIATION AND ARBITRATION to proceed by way of arbitration to adjudicate the merits of the claim upon which such a lien is based.

PART 9 PROTECTION OF PERSONS AND PROPERTY

GC 9.1 PROTECTION OF WORK AND PROPERTY

- 9.1.1 The *Contractor* shall protect the *Work*, the *Owner's* property and property adjacent to the *Place of the Work* from damage which may arise as the result of the *Contractor's* operations under the *Contract*, and shall be responsible for such damage, except damage which occurs as the result of:
- .1 errors or omissions in the *Contract Documents*; or
 - .2 acts or omissions by the *Owner*, the *Consultant*, *Other Contractors*, or their agents and employees.
- 9.1.2 Before commencing any work, the *Contractor* shall determine the location of all underground utilities and structures indicated in the *Contract Documents* or that are reasonably apparent in an inspection of the *Place of the Work*.
- 9.1.3 Should the *Contractor* in the performance of the *Contract* damage the *Work*, the *Owner's* property or property adjacent to the *Place of the Work*, the *Contractor* shall be responsible for making good such damage at the *Contractor's* expense.
- 9.1.4 Should damage occur to the *Work* or the *Owner's* property for which the *Contractor* is not responsible, as provided in paragraph 9.1.1, the *Contractor* shall make good such damage to the *Work* and, if the *Owner* so directs, to the *Owner's* property. The *Contract Price* and *Contract Time* shall be adjusted as provided in GC 6.1 – OWNER'S RIGHT TO MAKE CHANGES, GC 6.2 – CHANGE ORDER and GC 6.3 – CHANGE DIRECTIVE.

GC 9.2 TOXIC AND HAZARDOUS SUBSTANCES

- 9.2.1 For the purposes of applicable legislation related to toxic and hazardous substances, the *Owner* shall be deemed to have control and management of the *Place of the Work* with respect to existing conditions.
- 9.2.2 Prior to the *Contractor* commencing the *Work*, the *Owner* shall,
- .1 take all reasonable steps to determine whether any toxic or hazardous substances are present at the *Place of the Work*, and
 - .2 provide the *Consultant* and the *Contractor* with a written list of any such substances that are known to exist and their locations.
- 9.2.3 The *Owner* shall take all reasonable steps to ensure that no person's exposure to any toxic or hazardous substance exceeds the time weighted levels prescribed by applicable legislation at the *Place of the Work* and that no property is damaged or destroyed as a result of exposure to, or the presence of, toxic or hazardous substances which were at the *Place of the Work* prior to the *Contractor* commencing the *Work*.
- 9.2.4 Unless the *Contract* expressly provides otherwise, the *Owner* shall be responsible for taking all necessary steps, in accordance with applicable legislation in force at the *Place of the Work*, to dispose of, store or otherwise render harmless any toxic or hazardous substance which was present at the *Place of the Work* prior to the *Contractor* commencing the *Work*.
- 9.2.5 If the *Contractor*
- .1 encounters toxic or hazardous substances at the *Place of the Work*, or
 - .2 has reasonable grounds to believe that toxic or hazardous substances are present at the *Place of the Work*, which were not brought to the *Place of the Work* by the *Contractor* or anyone for whom the *Contractor* is responsible and which were not disclosed by the *Owner* or which were disclosed but have not been dealt with as required under paragraph 9.2.4, the *Contractor* shall
 - .3 take all reasonable steps, including stopping the *Work*, to ensure that no person's exposure to any toxic or hazardous substance exceeds any applicable time weighted levels prescribed by applicable legislation at the *Place of the Work*, and
 - .4 immediately report the circumstances to the *Consultant* and the *Owner* in writing.

- 9.2.6 If the *Owner* and the *Contractor* do not agree on the existence, significance of, or whether the toxic or hazardous substances were brought onto the *Place of the Work* by the *Contractor* or anyone for whom the *Contractor* is responsible, the *Owner* shall retain and pay for an independent qualified expert to investigate and determine such matters. The expert's report shall be delivered to the *Owner* and the *Contractor*.
- 9.2.7 If the *Owner* and the *Contractor* agree or if the expert referred to in paragraph 9.2.6 determines that the toxic or hazardous substances were not brought onto the place of the *Work* by the *Contractor* or anyone for whom the *Contractor* is responsible, the *Owner* shall promptly at the *Owner's* own expense:
- .1 take all steps as required under paragraph 9.2.4;
 - .2 reimburse the *Contractor* for the costs of all steps taken pursuant to paragraph 9.2.5;
 - .3 extend the *Contract Time* for such reasonable time as the *Consultant* may recommend in consultation with the *Contractor* and the expert referred to in 9.2.6 and reimburse the *Contractor* for reasonable costs incurred as a result of the delay; and
 - .4 indemnify the *Contractor* as required by GC 13.1 – INDEMNIFICATION.
- 9.2.8 If the *Owner* and the *Contractor* agree or if the expert referred to in paragraph 9.2.6 determines that the toxic or hazardous substances were brought onto the place of the *Work* by the *Contractor* or anyone for whom the *Contractor* is responsible, the *Contractor* shall promptly at the *Contractor's* own expense:
- .1 take all necessary steps, in accordance with applicable legislation in force at the *Place of the Work*, to safely remove and dispose the toxic or hazardous substances;
 - .2 make good any damage to the *Work*, the *Owner's* property or property adjacent to the place of the *Work* as provided in paragraph 9.1.3 of GC 9.1 – PROTECTION OF WORK AND PROPERTY;
 - .3 reimburse the *Owner* for reasonable costs incurred under paragraph 9.2.6; and
 - .4 indemnify the *Owner* as required by GC 13.1 – INDEMNIFICATION.
- 9.2.9 If either party does not accept the expert's findings under paragraph 9.2.6, the disagreement shall be settled in accordance with Part 8 of the General Conditions – DISPUTE RESOLUTION. If such disagreement is not resolved promptly, the parties shall act immediately in accordance with the expert's determination and take the steps required by paragraph 9.2.7 or 9.2.8 it being understood that by so doing, neither party will jeopardize any claim that party may have to be reimbursed as provided by GC 9.2 – TOXIC AND HAZARDOUS SUBSTANCES.

GC 9.3 ARTIFACTS AND FOSSILS

- 9.3.1 Fossils, coins, articles of value or antiquity, structures and other remains or things of scientific or historic interest discovered at the *Place or Work* shall, as between the *Owner* and the *Contractor*, be deemed to be the absolute property of the *Owner*.
- 9.3.2 The *Contractor* shall take all reasonable precautions to prevent removal or damage to discoveries as identified in paragraph 9.3.1, and shall advise the *Consultant* upon discovery of such items.
- 9.3.3 The *Consultant* will investigate the impact on the *Work* of the discoveries identified in paragraph 9.3.1. If conditions are found that would cause an increase or decrease in the *Contractor's* cost or time to perform the *Work*, the *Owner*, through the *Consultant*, shall issue appropriate instructions for a change in the *Work* as provided in GC 6.2 – CHANGE ORDER or GC 6.3 – CHANGE DIRECTIVE.

GC 9.4 CONSTRUCTION SAFETY

- 9.4.1 The *Contractor* shall be responsible for establishing, initiating, maintaining, and supervising all health and safety precautions and programs in connection with the performance of the *Work* in accordance with the applicable health and safety legislation.
- 9.4.2 The *Owner* and the *Contractor* shall comply with all health and safety precautions and programs established at the *Place of the Work*.
- 9.4.3 The *Owner* and the *Contractor* shall comply with the rules, regulations and practices required by the applicable health and safety legislation.
- 9.4.4 The *Owner* shall cause the *Consultant*, *Other Contractors* and the *Owner's* own forces to comply with all health and safety precautions and programs established by the *Contractor* at the *Place of the Work*.
- 9.4.5 Nothing in this *Contract* shall affect the determination of liability under the applicable health and safety legislation.

GC 9.5 MOULD

- 9.5.1 If the *Contractor* or the *Owner* observes or reasonably suspects the presence of mould at the *Place of the Work*, the remediation of which is not expressly part of the *Work*,
- .1 the observing party shall promptly report the circumstances to the other party in writing,
 - .2 the *Contractor* shall promptly take all reasonable steps, including stopping the *Work* if necessary, to ensure that no person suffers injury, sickness or death and that no property is damaged as a result of exposure to or the presence of the mould, and

- .3 if the *Owner* and the *Contractor* do not agree on the existence, significance or cause of the mould or as to what steps need be taken to deal with it, the *Owner* shall retain and pay for an independent qualified expert to investigate and determine such matters. The expert's report shall be delivered to the *Owner* and the *Contractor*.
- 9.5.2 If the *Owner* and the *Contractor* agree, or if the expert referred to in paragraph 9.5.1.3 determines that the presence of mould was caused by the *Contractor*'s operations under the *Contract*, the *Contractor* shall promptly, at the *Contractor*'s own expense:
- .1 take all reasonable and necessary steps to safely remediate or dispose of the mould,
 - .2 make good any damage to the *Work*, the *Owner*'s property or property adjacent to the *Place of the Work* as provided in paragraph 9.1.3 of GC 9.1 – PROTECTION OF WORK AND PROPERTY,
 - .3 reimburse the *Owner* for reasonable costs incurred under paragraph 9.5.1.3, and
 - .4 indemnify the *Owner* as required by GC 13.1 – INDEMNIFICATION.
- 9.5.3 If the *Owner* and the *Contractor* agree, or if the expert referred to in paragraph 9.5.1.3 determines that the presence of mould was not caused by the *Contractor*'s operations under the *Contract*, the *Owner* shall promptly, at the *Owner*'s own expense:
- .1 take all reasonable and necessary steps to safely remediate or dispose of the mould,
 - .2 reimburse the *Contractor* for the cost of taking the steps under paragraph 9.5.1.2 and making good any damage to the *Work* as provided in paragraph 9.1.4 of GC 9.1 – PROTECTION OF WORK AND PROPERTY,
 - .3 extend the *Contract Time* for such reasonable time as the *Consultant* may recommend in consultation with the *Contractor* and the expert referred to in paragraph 9.5.1.3 and reimburse the *Contractor* for reasonable costs incurred as a result of the delay, and
 - .4 indemnify the *Contractor* as required by GC 13.1 – INDEMNIFICATION.
- 9.5.4 If either party does not accept the expert's finding under paragraph 9.5.1.3, the disagreement shall be settled in accordance with Part 8 of the General Conditions – DISPUTE RESOLUTION. If such disagreement is not resolved promptly, the parties shall act immediately in accordance with the expert's determination and take the steps required by paragraphs 9.5.2 or 9.5.3, it being understood that by so doing neither party will jeopardize any claim the party may have to be reimbursed as provided by GC 9.5 – MOULD.

PART 10 GOVERNING REGULATIONS

GC 10.1 TAXES AND DUTIES

- 10.1.1 The *Contract Price* shall include all taxes and customs duties in effect at the time of the bid closing except for *Value Added Taxes* payable by the *Owner* to the *Contractor* as stipulated in Article A-4 of the Agreement – CONTRACT PRICE.
- 10.1.2 Any increase or decrease in costs to the *Contractor* due to changes in taxes and duties after the time of the bid closing shall increase or decrease the *Contract Price* accordingly.

GC 10.2 LAWS, NOTICES, PERMITS, AND FEES

- 10.2.1 The laws of the *Place of the Work* shall govern the *Work*.
- 10.2.2 The *Owner* shall obtain and pay for development approvals, building permit, permanent easements, rights of servitude, and all other necessary approvals and permits, except for the permits and fees referred to in paragraph 10.2.3 or for which the *Contract Documents* specify as the responsibility of the *Contractor*.
- 10.2.3 The *Contractor* shall be responsible for the procurement of permits, licences, inspections, and certificates, which are necessary for the performance of the *Work* and customarily obtained by contractors in the jurisdiction of the *Place of the Work* after the issuance of the building permit. The *Contract Price* includes the cost of these permits, licences, inspections, and certificates, and their procurement.
- 10.2.4 The *Contractor* shall give the required notices and comply with the laws, ordinances, rules, regulations, or codes which are or become in force during the performance of the *Work* and which relate to the *Work*, to the preservation of the public health, and to construction safety.
- 10.2.5 The *Contractor* shall not be responsible for verifying that the *Contract Documents* are in compliance with the applicable laws, ordinances, rules, regulations, or codes relating to the *Work*. If the *Contract Documents* are at variance therewith, or if, subsequent to the time of bid closing, changes are made to the applicable laws, ordinances, rules, regulations, or codes which require modification to the *Contract Documents*, the *Contractor* shall advise the *Consultant* in writing requesting direction immediately upon such variance or change becoming known. The *Consultant* will issue the changes required to the *Contract Documents* as provided in GC 6.1 – OWNER'S RIGHT TO MAKE CHANGES, GC 6.2 – CHANGE ORDER and GC 6.3 – CHANGE DIRECTIVE.

- 10.2.6 If the *Contractor* fails to advise the *Consultant* in writing; fails to obtain direction as required in paragraph 10.2.5; and performs work knowing it to be contrary to any laws, ordinances, rules, regulations, or codes; the *Contractor* shall be responsible for and shall correct the violations thereof; and shall bear the costs, expenses and damages attributable to the failure to comply with the provisions of such laws, ordinances, rules, regulations, or codes.
- 10.2.7 If, subsequent to the time of bid closing, changes are made to applicable laws, ordinances, rules, regulations, or codes of authorities having jurisdiction which affect the cost of the *Work*, either party may submit a claim in accordance with the requirements of GC 6.6 – CLAIMS FOR A CHANGE IN CONTRACT PRICE.

GC 10.3 PATENT FEES

- 10.3.1 The *Contractor* shall pay the royalties and patent licence fees required for the performance of the *Contract*. The *Contractor* shall hold the *Owner* harmless from and against claims, demands, losses, costs, damages, actions, suits, or proceedings arising out of the *Contractor*'s performance of the *Contract* which are attributable to an infringement or an alleged infringement of a patent of invention by the *Contractor* or anyone for whose acts the *Contractor* may be liable.
- 10.3.2 The *Owner* shall hold the *Contractor* harmless against claims, demands, losses, costs, damages, actions, suits, or proceedings arising out of the *Contractor*'s performance of the *Contract* which are attributable to an infringement or an alleged infringement of a patent of invention in executing anything for the purpose of the *Contract*, the physical model, plan or design of which was supplied to the *Contractor* as part of the *Contract*.

GC 10.4 WORKERS' COMPENSATION

- 10.4.1 Prior to commencing the *Work*, and again with the *Contractor*'s applications for payment, the *Contractor* shall provide evidence of compliance with workers' compensation legislation at the *Place of the Work*.

PART 11 INSURANCE

GC 11.1 INSURANCE

- 11.1.1 Without restricting the generality of GC 13.1 – INDEMNIFICATION, the *Contractor* shall provide, maintain and pay for the following insurance coverages, the requirements of which are specified in CCDC 41 'CCDC Insurance Requirements' in effect at the time of bid closing except as hereinafter provided:
- .1 General liability insurance in the name of the *Contractor* and include, or in the case of a single, blanket policy, be endorsed to name, the *Owner* and the *Consultant* as insureds but only with respect to liability, other than legal liability arising out of their sole negligence, arising out of the operations of the *Contractor* with regard to the *Work*. General liability insurance shall be maintained from the date of commencement of the *Work* until one year from the date of *Ready-for-Takeover*. Liability coverage shall be provided for completed operations hazards from the date of *Ready-for-Takeover* on an ongoing basis for a period of 6 years following *Ready-for-Takeover*.
 - .2 Automobile Liability Insurance from the date of commencement of the *Work* until one year after the date of *Ready-for-Takeover*.
 - .3 Unmanned aerial vehicle aircraft, manned aircraft or watercraft Liability Insurance when owned or non-owned manned or unmanned aircraft or watercraft are used directly or indirectly in the performance of the *Work*.
 - .4 "Broad form" property insurance in the joint names of the *Contractor*, the *Owner* and the *Consultant*. The policy shall include as insureds all *Subcontractors*. The "Broad form" property insurance shall be provided from the date of commencement of the *Work* until the earliest of:
 - (1) 10 calendar days after the date of *Ready-for-Takeover*;
 - (2) on the commencement of use or occupancy of any part or section of the *Work* unless such use or occupancy is for construction purposes, habitational, office, banking, convenience store under 465 square metres in area, or parking purposes, or for the installation, testing and commissioning of equipment forming part of the *Work*; and
 - (3) when left unattended for more than 30 consecutive calendar days or when construction activity has ceased for more than 30 consecutive calendar days.
 - .5 Boiler and machinery insurance in the joint names of the *Contractor*, the *Owner* and the *Consultant*. The policy shall include as insureds all *Subcontractors*. The coverage shall be maintained continuously from commencement of use or operation of the boiler and machinery objects insured by the policy and until 10 calendar days after the date of *Ready-for-Takeover*.
 - .6 The "Broad form" property and boiler and machinery policies shall provide that, in the case of a loss or damage, payment shall be made to the *Owner* and the *Contractor* as their respective interests may appear. In the event of loss or damage:
 - (1) the *Contractor* shall act on behalf of the *Owner* for the purpose of adjusting the amount of such loss or damage payment with the insurers. When the extent of the loss or damage is determined, the *Contractor* shall proceed to restore the *Work*. Loss or damage shall not affect the rights and obligations of either party under the *Contract* except

that the *Contractor* shall be entitled to such reasonable extension of *Contract Time* relative to the extent of the loss or damage as the *Consultant* may recommend in consultation with the *Contractor*;

- (2) the *Contractor* shall be entitled to receive from the *Owner*, in addition to the amount due under the *Contract*, the amount which the *Owner's* interest in restoration of the *Work* has been appraised, such amount to be paid as the restoration of the *Work* proceeds in accordance with the progress payment provisions. In addition the *Contractor* shall be entitled to receive from the payments made by the insurer the amount of the *Contractor's* interest in the restoration of the *Work*; and
- (3) to the *Work* arising from the work of the *Owner*, the *Owner's* own forces or *Other Contractors*, the *Owner* shall, in accordance with the *Owner's* obligations under the provisions relating to construction by the *Owner* or *Other Contractors*, pay the *Contractor* the cost of restoring the *Work* as the restoration of the *Work* proceeds and as in accordance with the progress payment provisions.

- .7 *Contractors' Equipment Insurance* from the date of commencement of the *Work* until one year after the date of *Ready-for-Takeover*.
- .8 *Contractors' Pollution Liability Insurance* from the date of commencement of the *Work* until one year after the date of *Ready-for-Takeover*.

11.1.2 Prior to commencement of the *Work* and upon the placement, renewal, amendment, or extension of all or any part of the insurance, the *Contractor* shall promptly provide the *Owner* with confirmation of coverage and, if required, a certified true copy of the policies certified by an authorized representative of the insurer together with copies of any amending endorsements applicable to the *Work*.

11.1.3 The parties shall pay their share of the deductible amounts in direct proportion to their responsibility in regards to any loss for which the above policies are required to pay, except where such amounts may be excluded by the terms of the *Contract*.

11.1.4 If the *Contractor* fails to provide or maintain insurance as required by the *Contract Documents*, then the *Owner* shall have the right to provide and maintain such insurance and give evidence to the *Contractor* and the *Consultant*. The *Contractor* shall pay the cost thereof to the *Owner* on demand or the *Owner* may deduct the cost from the amount which is due or may become due to the *Contractor*.

11.1.5 All required insurance policies shall be with insurers licensed to underwrite insurance in the jurisdiction of the *Place of the Work*.

11.1.6 If a revised version of CCDC 41 is published, which specifies reduced insurance requirements, the parties shall address such reduction, prior to the *Contractor's* insurance policy becoming due for renewal, and record any agreement in a *Change Order*.

11.1.7 If a revised version of CCDC 41 is published, which specifies increased insurance requirements, the *Owner* may request the increased coverage from the *Contractor* by way of a *Change Order*.

11.1.8 A *Change Directive* shall not be used to direct a change in the insurance requirements in response to the revision of CCDC 41.

PART 12 OWNER TAKEOVER

GC 12.1 READY-FOR-TAKEOVER

12.1.1 The prerequisites to attaining *Ready-for-Takeover* of the *Work* are limited to the following:

- .1 The *Consultant* has certified or verified the *Substantial Performance of the Work*.
- .2 Evidence of compliance with the requirements for occupancy or occupancy permit as prescribed by the authorities having jurisdiction.
- .3 Final cleaning and waste removal at the time of applying for *Ready-for-Takeover*, as required by the *Contract Documents*.
- .4 The delivery to the *Owner* of such operations and maintenance documents reasonably necessary for immediate operation and maintenance, as required by the *Contract Documents*.
- .5 Make available a copy of the as-built drawings completed to date on site.
- .6 Startup, testing required for immediate occupancy, as required by the *Contract Documents*.
- .7 Ability to secure access to the *Work* has been provided to the *Owner*, if required by the *Contract Documents*.
- .8 Demonstration and training, as required by the *Contract Documents*, is scheduled by the *Contractor* acting reasonably.

12.1.2 If any prerequisites set forth in paragraphs 12.1.1.3 to 12.1.1.6 must be deferred because of conditions reasonably beyond the control of the *Contractor*, or by agreement between the *Owner* and the *Contractor* to do so, *Ready-for-Takeover* shall not be delayed.

12.1.3 When the *Contractor* considers that the *Work* is *Ready-for-Takeover*, the *Contractor* shall deliver to the *Consultant* and to the *Owner* a comprehensive list of items to be completed or corrected, together with a written application for *Ready-for-Takeover* for review. Failure to include an item on the list does not alter the responsibility of the *Contractor* to complete the *Contract*.

12.1.4 The *Consultant* will review the *Work* to verify the validity of the application and will promptly, and in any event, no later than 10 calendar days after receipt of the *Contractor's* list and application:

- .1 advise the *Contractor* in writing that the *Work* is not *Ready-for-Takeover* and give reasons why, or
- .2 confirm the date of *Ready-for-Takeover* in writing to each of the *Owner* and the *Contractor*.

12.1.5 Immediately following the confirmation of the date of *Ready-for-Takeover*, the *Contractor*, in consultation with the *Consultant*, shall establish a reasonable date for finishing the *Work*.

12.1.6 The provision of GC 12.1 – READY-FOR-TAKEOVER shall be subject to GC 12.2 – EARLY OCCUPANCY BY THE OWNER.

GC 12.2 EARLY OCCUPANCY BY THE OWNER

12.2.1 The *Owner* may take occupancy of a part or the entirety of the *Work* before *Ready-for-Takeover* has been attained only as agreed by the *Contractor* which agreement shall not be unreasonably withheld.

12.2.2 The *Owner* shall not occupy a part or the entirety of the *Work* without prior approval by authorities having jurisdiction.

12.2.3 If the *Owner* takes occupancy of a part of the *Work* before *Ready-for-Takeover* has been attained:

- .1 The part of the *Work* which is occupied shall be deemed to have been taken over by the *Owner* as from the date on which it is occupied.
- .2 The *Contractor* shall cease to be liable for the care of such part as from this date, when responsibility shall pass to the *Owner*.
- .3 The warranty period specified in paragraph 12.3.1 of GC 12.3 – WARRANTY for that part of the *Work* shall start from the date on which it is occupied.

12.2.4 If the *Owner* takes occupancy of the entirety of the *Work* before all the prerequisites are met as described in paragraph 12.1.1 of GC 12.1 – READY-FOR-TAKEOVER, the *Work* shall, subject to the requirements of the applicable lien legislation, be deemed to achieve *Ready-for-Takeover*. This shall not relieve the *Contractor*'s responsibility to complete the *Work* in a timely manner.

GC 12.3 WARRANTY

12.3.1 Except for extended warranties as described in paragraph 12.3.6, the warranty period under the *Contract* is one year from the date when *Ready-for-Takeover* has been attained.

12.3.2 The *Contractor* shall be responsible for the proper performance of the *Work* to the extent that the design and *Contract Documents* permit such performance.

12.3.3 The *Owner*, through the *Consultant*, shall promptly give the *Contractor Notice in Writing* of observed defects and deficiencies which occur during the one year warranty period.

12.3.4 Subject to paragraph 12.3.2, the *Contractor* shall correct promptly, at the *Contractor*'s expense, defects or deficiencies in the *Work* which appear prior to and during the one year warranty period.

12.3.5 The *Contractor* shall correct or pay for damage resulting from corrections made under the requirements of paragraph 12.3.4.

12.3.6 Any extended warranties required beyond the one year warranty period as described in paragraph 12.3.1, shall be as specified in the *Contract Documents*. Extended warranties shall be issued by the warrantor to the benefit of the *Owner*. The *Contractor*'s responsibility with respect to extended warranties shall be limited to obtaining any such extended warranties from the warrantor. The obligations under such extended warranties are solely the responsibilities of the warrantor.

PART 13 INDEMNIFICATION AND WAIVER

GC 13.1 INDEMNIFICATION

13.1.1 Without restricting the parties' obligation to indemnify respecting toxic and hazardous substances, patent fees and defect in title claims all as described in paragraphs 13.1.4 and 13.1.5, the *Owner* and the *Contractor* shall each indemnify and hold harmless the other from and against all claims, demands, losses, costs, damages, actions, suits, or proceedings whether in respect to losses suffered by them or in respect to claims by third parties that arise out of, or are attributable in any respect to their involvement as parties to this *Contract*, provided such claims are:

- .1 caused by:
 - (1) the negligent acts or omissions of the party from whom indemnification is sought or anyone for whose negligent acts or omissions that party is liable, or
 - (2) a failure of the party to the *Contract* from whom indemnification is sought to fulfill its terms or conditions; and
- .2 made by *Notice in Writing* within a period of 6 years from the *Ready-for-Takeover* date or within such shorter period as may be prescribed by any limitation statute of the Province or Territory of the *Place of the Work*.

The parties expressly waive the right to indemnity for claims other than those provided for in this *Contract*.

- 13.1.2 The obligation of either party to indemnify as set forth in paragraph 13.1.1 shall be limited as follows:
- .1 In respect to losses suffered by the *Owner* and the *Contractor* for which insurance is to be provided by either party pursuant to GC 11.1 – INSURANCE, the minimum liability insurance limit for one occurrence, of the applicable insurance policy, as referred to in CCDC 41 in effect at the time of bid closing.
 - .2 In respect to losses suffered by the *Owner* and the *Contractor* for which insurance is not required to be provided by either party in accordance with GC 11.1 – INSURANCE, the greater of the *Contract Price* as recorded in Article A-4 – CONTRACT PRICE or \$2,000,000, but in no event shall the sum be greater than \$20,000,000.
 - .3 In respect to indemnification by a party against the other with respect to losses suffered by them, such obligation shall be restricted to direct loss and damage, and neither party shall have any liability to the other for indirect, consequential, punitive or exemplary damages.
 - .4 In respect to indemnification respecting claims by third parties, the obligation to indemnify is without limit.
- 13.1.3 The obligation of either party to indemnify the other as set forth in paragraphs 13.1.1 and 13.1.2 shall be inclusive of interest and all legal costs.
- 13.1.4 The *Owner* and the *Contractor* shall indemnify and hold harmless the other from and against all claims, demands, losses, costs, damages, actions, suits, or proceedings arising out of their obligations described in GC 9.2 – TOXIC AND HAZARDOUS SUBSTANCES.
- 13.1.5 The *Owner* shall indemnify and hold harmless the *Contractor* from and against all claims, demands, losses, costs, damages, actions, suits, or proceedings:
- .1 as described in paragraph 10.3.2 of GC 10.3 – PATENT FEES, and
 - .2 arising out of the *Contractor*'s performance of the *Contract* which are attributable to a lack of or defect in title or an alleged lack of or defect in title to the *Place of the Work*.
- 13.1.6 In respect to any claim for indemnity or to be held harmless by the *Owner* or the *Contractor*:
- .1 *Notice in Writing* of such claim shall be given within a reasonable time after the facts upon which such claim is based become known; and
 - .2 should any party be required as a result of its obligation to indemnify another to pay or satisfy a final order, judgment or award made against the party entitled by this contract to be indemnified, then the indemnifying party upon assuming all liability for any costs that might result shall have the right to appeal in the name of the party against whom such final order or judgment has been made until such rights of appeal have been exhausted.

GC 13.2 WAIVER OF CLAIMS

- 13.2.1 Subject to any lien legislation applicable to the *Place of the Work*, the *Contractor* waives and releases the *Owner* from all claims which the *Contractor* has or reasonably ought to have knowledge of that could be advanced by the *Contractor* against the *Owner* under the *Contract*, including, without limitation, those arising from negligence or breach of contract in respect to which the cause of action is based upon acts or omissions which occurred prior to or on the *Ready-for-Takeover* date, except as follows:
- .1 claims arising prior to or on the *Ready-for-Takeover* date for which *Notice in Writing* of claim has been received by the *Owner* from the *Contractor* no later than 5 calendar days before the expiry of the lien period provided by the lien legislation applicable at the *Place of the Work* or 20 calendar days following the *Ready-for-Takeover* date, whichever is later;
 - .2 indemnification for claims advanced against the *Contractor* by third parties for which a right of indemnification may be asserted by the *Contractor* against the *Owner* pursuant to the provisions of this *Contract*;
 - .3 claims respecting toxic and hazardous substances, patent fees and defect in title matters for which a right of indemnity could be asserted by the *Contractor* pursuant to the provisions of paragraphs 13.1.4 or 13.1.5 of GC 13.1 – INDEMNIFICATION; and
 - .4 claims resulting from acts or omissions which occur after the *Ready-for-Takeover* date.
- 13.2.2 The *Contractor* waives and releases the *Owner* from all claims resulting from acts or omissions which occurred after the *Ready-for-Takeover* date except for:
- .1 indemnification respecting third party claims, and claims respecting toxic and hazardous substances, patent fees and defect in title matters, all as referred in paragraphs 13.2.1.2 and 13.2.1.3; and
 - .2 claims for which *Notice in Writing* of claim has been received by the *Owner* from the *Contractor* within 395 calendar days following the *Ready-for-Takeover* date.
- 13.2.3 Subject to any lien legislation applicable to the *Place of the Work*, the *Owner* waives and releases the *Contractor* from all claims which the *Owner* has or reasonably ought to have knowledge of that could be advanced by the *Owner* against the *Contractor* under the *Contract*, including, without limitation, those arising from negligence or breach of contract in respect to which the cause of action is based upon acts or omissions which occurred prior to or on the *Ready-for-Takeover* date, except as follows:
- .1 claims arising prior to or on the *Ready-for-Takeover* date for which *Notice in Writing* of claim has been received by the *Contractor* from the *Owner* no later than 20 calendar days following the *Ready-for-Takeover* date;

- .2 indemnification for claims advanced against the *Owner* by third parties for which a right of indemnification may be asserted by the *Owner* against the *Contractor* pursuant to the provisions of this *Contract*;
 - .3 claims respecting toxic and hazardous substances for which a right of indemnity could be asserted by the *Owner* against the *Contractor* pursuant to the provisions of paragraph 13.1.4 of GC 13.1 – INDEMNIFICATION;
 - .4 damages arising from the *Contractor*'s actions which result in substantial defects or deficiencies in the *Work*. "Substantial defects or deficiencies" mean those defects or deficiencies in the *Work* which affect the *Work* to such an extent or in such a manner that a significant part or the whole of the *Work* is unfit for the purpose intended by the *Contract Documents*;
 - .5 claims arising pursuant to GC 12.3 – WARRANTY; and
 - .6 claims arising from acts or omissions which occur after the *Ready-for-Takeover* date.
- 13.2.4 Respecting claims arising upon substantial defects and deficiencies in the *Work*, as referenced in paragraph 13.2.3.4, and notwithstanding paragraph 13.2.3.5, the *Owner* waives and releases the *Contractor* from all claims except claims for which *Notice in Writing* of claim has been received by the *Contractor* from the *Owner* within a period of six years from the *Ready-for-Takeover* date, provided that any limitation statute of the Province or Territory of the *Place of the Work* permit such agreement. If the applicable limitation statute does not permit such agreement, the time within which any such claim may be brought shall be such shorter period as may be prescribed by any limitation statute of the Province or Territory of the *Place of the Work*.
- 13.2.5 The *Owner* waives and releases the *Contractor* from all claims arising from acts or omissions which occur after the *Ready-for-Takeover* date, except for:
- .1 indemnification for claims advanced against the *Owner* by third parties, as referenced in paragraph 13.2.3.2;
 - .2 claims respecting toxic and hazardous substances for which a right of indemnity could be asserted by the *Owner* against the *Contractor*, as referenced in paragraph 13.2.3.3;
 - .3 claims arising under GC 12.3 – WARRANTY; and
 - .4 claims for which *Notice in Writing* has been received by the *Contractor* from the *Owner* within 395 calendar days following the *Ready-for-Takeover* date.
- 13.2.6 "Notice in Writing of claim" as provided for in GC 13.2 – WAIVER OF CLAIMS to preserve a claim or right of action which would otherwise, by the provisions of GC 13.2 – WAIVER OF CLAIMS, be deemed to be waived, must include the following:
- .1 a clear and unequivocal statement of an intention to claim;
 - .2 a statement as to the nature of the claim and the grounds upon which the claim is based; and
 - .3 a statement of the estimated quantum of the claim.
- 13.2.7 A claim for lien asserted under the lien legislation prevailing at the *Place of the Work* shall qualify as notice of claim for the purposes of this *Contract*.
- 13.2.8 The party giving the *Notice in Writing* of claim as provided for in GC 13.2 – WAIVER OF CLAIMS shall submit within a reasonable time a detailed account of the amount claimed.
- 13.2.9 Where the event or series of events giving rise to a claim made under paragraphs 13.2.1 or 13.2.3 has a continuing effect, the detailed account submitted under paragraph 13.2.8 shall be considered to be an interim account and the party making the claim shall submit further interim accounts, at reasonable intervals, giving the accumulated amount of the claim and any further grounds upon which such claim is based. The party making the claim shall submit a final account after the end of the effects resulting from the event or series of events.
- 13.2.10 Nothing in GC 13.2 – WAIVER OF CLAIMS shall be deemed to affect the rights of the parties under any lien legislation or limitations legislation prevailing at the *Place of the Work*.

CCDC 41
CCDC INSURANCE REQUIREMENTS

PUBLICATION DATE: December 14, 2020

1. General liability insurance shall be with limits of not less than \$10,000,000 per occurrence, an aggregate limit of not less than \$10,000,000 within any policy year with respect to completed operations, and a deductible not exceeding \$10,000. The insurance coverage shall not be less than the insurance provided by IBC Form 2100 (including an extension for a standard provincial and territorial form of non-owned automobile liability policy) and IBC Form 2320. To achieve the desired limit, umbrella or excess liability insurance may be used. Subject to satisfactory proof of financial capability by the *Contractor*, the *Owner* may agree to increase the deductible amounts.
2. Automobile liability insurance in respect of vehicles that are required by law to be insured under a contract by a Motor Vehicle Liability Policy, shall have limits of not less than \$10,000,000 inclusive per occurrence for bodily injury, death and damage to property, covering all vehicles owned or leased by the *Contractor*. Where the policy has been issued pursuant to a government-operated automobile insurance system, the *Contractor* shall provide the *Owner* with confirmation of automobile insurance coverage for all automobiles registered in the name of the *Contractor*.
3. Manned Aircraft and watercraft liability insurance with respect to owned or non-owned aircraft and watercraft (if used directly or indirectly in the performance of the *Work*), including use of additional premises, shall have limits of not less than \$10,000,000 inclusive per occurrence for bodily injury, death and damage to property including loss of use thereof and limits of not less than \$10,000,000 for aircraft passenger hazard. Such insurance shall be in a form acceptable to the *Owner*.
4. Unmanned aerial vehicle liability insurance with respect to owned or non-owned aircraft (if used directly or indirectly in the performance of the *Work*), shall have limits of not less than \$5,000,000 per occurrence or accident for bodily injury, death and damage to property or such amounts as required by any applicable law or regulation.
5. "Broad form" property insurance shall have limits of not less than the sum of 1.1 times *Contract Price* and the full value, as stated in the *Contract*, of *Products* and design services that are specified to be provided by the *Owner* for incorporation into the *Work*, with a deductible not exceeding \$10,000. The insurance coverage shall not be less than the insurance provided by IBC Forms 4042 and 4047 or their equivalent replacement. Subject to satisfactory proof of financial capability by the *Contractor*, the *Owner* may agree to increase the deductible amounts.
6. Boiler and machinery insurance shall have limits of not less than the replacement value of the permanent or temporary boilers and pressure vessels, and other insurable objects forming part of the *Work*. The insurance coverage shall not be less than the insurance provided by a comprehensive boiler and machinery policy including hot testing and commissioning.
7. Contractors' equipment insurance coverage written on an "all risks" basis covering *Construction Equipment* used by the *Contractor* for the performance of the *Work*, shall be in a form acceptable to the *Owner* and shall not allow subrogation claims by the insurer against the *Owner*. Subject to satisfactory proof of financial capability by the *Contractor* for self-insurance, the *Owner* may agree to waive the equipment insurance requirement.
8. Contractors' Pollution liability insurance shall have limits of not less than \$5,000,000 per occurrence for bodily injury, death and damage to property.

Association of
Canadian
Engineering
Companies

Canadian
Construction
Association

Construction
Specifications Canada

The Royal Architectural
Institute of Canada

December 2024

These Supplementary Conditions amend the Stipulated Price Contract - CCDC 2 - 2020. Where a portion of the Contract is modified or deleted by these Supplementary General Conditions, the unaltered portions of the Contract shall remain in effect.

AGREEMENT BETWEEN OWNER AND CONTRACTOR

Page 4, after Article A-8 insert the following new Articles A-9 and A-10:

"ARTICLE A-9 SEVERABILITY

9.1 Each and every paragraph, section, clause, sub-clause, or other component of the *Contract* is severable one from the other. Should it be found by a court of competent jurisdiction that any one or more paragraphs or parts thereof are null and void, the validity of the remaining paragraphs or parts thereof shall not be affected.

ARTICLE A-10 TIME OF THE ESSENCE

10.1 Time shall be deemed to be of the essence of the *Contract*."

DEFINITIONS

Page 6, Add the following new Definitions:

Approved or Approval

Approved or Approval means acceptance by the *Consultant* in accordance with the *Consultant's* responsibilities described in Clause GC 2.2 ROLE OF THE CONSULTANT.

Period of Delay

The period of time from *Ready-for-Takeover* date specified in Article A-1, subclause 1.3, and the actual *Ready-for-Takeover* date; if any.

Pre-Selected Equipment Supplier

A *Pre-Selected Equipment Supplier* means a firm or corporation with whom the Contractor shall enter into a contract with and place a purchase order to supply the equipment as *Pre-Selected* by the *Owner*, for incorporation into the *Work*.

Site

The *Site* means the geographical location of the *Work* identified in the *Contract Documents*

Total Amount Payable

Total Amount Payable means the sum of the Contract Price as stipulated in Article A-4, subclause 4.3 subject to adjustments made in accordance with the provisions of the Contract Documents plus the amount of *Value Added Taxes*.

GENERAL CONDITIONS OF THE STIPULATED PRICE CONTRACT

PART 2 – ADMINISTRATION OF THE CONTRACT

GC 2.3 REVIEW AND INSPECTION OF THE WORK

Page 10, delete clause 2.3.3 and replace with the following:

- 2.3.3 The *Contractor* shall furnish promptly to the *Consultant* one (1) electronic file, in pdf file format, of certificates and inspection reports related to the *Work*. The *Contractor* will provide hard copies, in the quantity required, only upon request of the *Consultant* or *Owner*.

Page 10, within clause 2.3.5, add the following sentence at the end of the clause:

- 2.3.5 "If the *Consultant's* determination is not accepted by either party, then the matter shall be settled in accordance with the requirements of Part 8 of the General Conditions – DISPUTE RESOLUTION."

PART 3 – EXECUTION OF THE WORK

GC 3.4 CONSTRUCTION SCHEDULE

Page 12, in Clause 3.4.1.1, delete "prior to the first application for payment" and replace with "not later than two (2) weeks after receipt of the notice of award".

Page 12, add new clause 3.4.2 as follows:

- "3.4.2 If, at any time, it should appear to the *Owner* or the *Consultant* that the actual progress of the *Work* is behind schedule or is likely to become behind schedule, or if the *Contractor* has given notice of such to the *Owner* or the *Consultant* pursuant to clause 3.4.1.3, the *Contractor* shall take appropriate steps to cause the actual progress of the *Work* to conform to the schedule or minimize the resulting delay and shall produce and present to the *Owner* and the *Consultant* a recovery plan demonstrating how the *Contractor* will achieve the recovery of the schedule. If the *Contractor* intends to apply for a change in the *Contract Price* in relation to a schedule recovery plan, then the *Contractor* shall proceed in accordance with General Condition 6.6 – CLAIMS FOR A CHANGE IN CONTRACT PRICE."

GC 3.5 SUPERVISION

Page 12, add new clause 3.5.3 as follows:

- "3.5.3 The *Owner* may, at any time during the course of the *Work*, request the replacement of the appointed representative(s), where the grounds for the request involve conduct which jeopardizes the safety and security of the Site or the *Owner's* operations. Immediately upon receipt of the request, the *Contractor* shall make arrangements to appoint a replacement acceptable to the *Owner* and *Consultant*."

GC 3.7 LABOUR AND PRODUCTS

Page 12, delete clause 3.7.2 and replace with the following:

"3.7.2 The *Contractor* shall provide and pay for labour, *Products*, tools, *Construction Equipment*, transportation, and other facilities and services necessary for the performance of the *Work* in accordance with the *Contract*. Water, heat, light, and power will be provided by the party identified in Division 01 of these *Specifications*.

GC 3.8 SHOP DRAWINGS

Page 12, delete Clause 3.8.2 and replace with the following:

"3.8.2 Prepare and submit to the *Consultant* for review, a schedule of the dates for provision, review and return of *Shop Drawings*. Provide this submission a minimum of two (2) working days prior to the project start-up meeting."

PART 4 - ALLOWANCES

GC 4.1 CASH ALLOWANCES

Page 13, delete Clause 4.1.7 and replace with the following:

"4.1.7 The *Contractor* shall prepare a schedule, acceptable to the *Consultant* that shows when the *Consultant* and *Owner* must authorize ordering of items called for under cash allowances to avoid delaying the progress of the *Work*."

Page 13, add the following new Clause:

"4.1.8 The *Owner* reserves the right to call, or to have the *Contractor* call, for competitive bids for portions of the *Work*, to be paid for from cash allowances."

PART 5 - PAYMENT

GC 5.4 SUBSTANTIAL PERFORMANCE OF THE WORK AND PAYMENT OF HOLDBACK

Page 14, after Clause 5.4.1.2, add the following:

- "5.4.1.3 Submit a certificate by lien search to the *Owner* by a solicitor licensed to practice law in the Province of the *Place of the Work*, certifying that no lien associated with the *Work* exists against the *Owner's* property or *Work*;
- 5.4.1.4 Submit a clearance letter from the Workers' Compensation Board or provincially equivalent regulatory body; and
- 5.4.1.5 All such documents shall be dated not earlier than the expiry of the lien period as stipulated by the lien legislation in the *Place of the Work*."
- "5.4.1.6 The *Consultant* will provide an electronic copy of the Certificate of *Substantial Performance* and instruct the *Contractor* to post the certificate at the Site and to website indicated by the lien legislation of the *Place of the Work*. "

Page 14, delete Clause 5.4.3 in its entirety.

Page 14, after Clause 5.4.4, add the following:

"5.4.4.1 If, within sixty (60) calendar days after the issue of the certificate of *Substantial Performance of the Work*, the Contractor has not corrected all the documented deficiencies, the Owner shall retain sufficient monies, as determined by the Consultant, to cover the cost of completing said deficiencies. These monies shall be held in addition to holdback monies retained in accordance with the provisions of the Contract and subject to the terms of the lien legislation in the Place of Work."

GC 5.5 FINAL PAYMENT

Page 15, Clause 5.5.4, in line 2, change "5 calendar days" to "20 calendar days".

PART 6 - CHANGES IN THE WORK

Page 15, add new clause 6.1.1.3 as follows:

6.1.1.3 Changes that do not affect the *Contract Price* and time by *Supplemental Instruction*.

GC 6.2 CHANGE ORDER

Page 15, after Clause 6.2.2, add the following:

- "6.2.3 The mark-up on agreed upon changes are as follows:
- .1 *Work* performed by the Contractor's own forces will be the cost of the Work plus ten (10%) percent overhead and profit.
 - .2 *Work* performed by the Subcontractor's force will be the cost of Work plus 15% overhead and profit. Where the *Work* can be done by the Contractor's forces, as solely determined by the Consultant, but is done by the Subcontractor's forces, the mark-up for overhead and profit will be limited to ten (10%) percent.
- 6.2.4 Before the approval of any change order over \$1,000 in value the Consultant is entitled to receive, upon request, at a minimum, the following breakdown of cost associated with such change order:
- .1 Labour rates, excluding operators.
 - .2 Equipment rates including operators.
 - .3 Supervisory staff rates.
 - .4 Subcontractor and material or equipment invoices where applicable.
 - .5 Overhead costs including worker's compensation, site trailer cost as applicable, insurance, bonding, small tool expenses, CPP, and EI contributions.
- 6.2.5 No compensation for extra *Work* or material shall be allowed unless the Consultant issues a *Notice in Writing* authorizing such *Work* or material to be ordered in the form of a *Change Order*, *Change Directive*, or *Supplemental Instruction*.

December 2024

- 6.2.6 No compensation will be allowed for the cost of repairs to *Construction Equipment* of any kind on the *Site* except as directed by the *Consultant* in writing.
- 6.2.7 The price applicable to any *Work* deleted from the *Contract*, shall be deducted from the *Contract Price* and shall be mutually agreed upon by the *Contractor* and the *Consultant*. The price shall be comparable to prices quoted on *Work* of similar nature.

GC 6.4 - CONCEALED OR UNKNOWN CONDITIONS

Page 17, add a new clause 6.4.5 as follows:

- "6.4.5 If the *Contractor* was given access to the *Place of the Work* and/or professional reports relating thereto (including, without limitation, environmental, geotechnical, and structural reports) prior to the submission of the bid on which the *Contract* was awarded, then the *Contractor* confirms that they have investigated the *Place of the Work* and, in doing so, applied to that investigation the degree of care and skill required. In those circumstances, notwithstanding the provisions of clause 6.4.1, the *Contractor* is not entitled to an adjustment to the *Contract Price* or to an extension of the *Contract Time* for conditions which could reasonably have been ascertained by the *Contractor* by such investigation, or which could have been reasonably inferred from the material provided with the *Contract Documents*. In those circumstances, should a claim arise, the *Contractor* will have the burden of establishing that it could not have discovered the materially different conditions from an investigation because of restrictions placed on its access or inferred the existence of the conditions from the material provided with the *Contract Documents*."

GC 6.5 DELAYS

Page 18, after Clause 6.5.5, add the following new Clauses:

- "6.5.6 Should the *Contractor* fail to attain *Ready-for-Takeover* for the *Work* by the date indicated in Article A-1, Clause 1.3 in the AGREEMENT BETWEEN OWNER AND CONTRACTOR, the period of time from this agreed date to the actual date when the *Consultant* confirms the *Work* is *Ready-for-Takeover*, shall be termed the *Period of Delay*.
- 6.5.7 In the event there is a *Period of Delay*, the *Contractor* shall be liable for and shall pay to the *Owner* the cost of continuance of supervision during the *Period of Delay*, and all additional fees, disbursements and costs incurred by the *Owner* as a result of the *Period of Delay*, such charges hereby termed as *Delay Charges*. The *Owner* may deduct the amount of such *Delay Charges* from further progress payments."

GC 6.6 CLAIMS FOR A CHANGE IN CONTRACT PRICE

Page 18, add the following new Clause as 6.6.6 and renumber the last and subsequent clause:

- "6.6.6 The *Owner* may make claims arising out of the costs incurred for additional services provided by the *Consultant* resulting from the *Contractor's* failure to reasonably perform the *Work* in accordance with the terms and conditions of the *Contract*, including the *Contractor's*

issuance of unnecessary Requests for Information (RFI's). The *Consultant* will notify the *Owner* and *Contractor* where it has been determined that additional services will be required or have been provided in order not to cause a delay. The *Owner* shall make claims based on the *Consultant's* invoices."

PART 9 - PROTECTION OF PERSONS AND PROPERTY

GC 9.4 - CONSTRUCTION SAFETY

Page 22, after GC 9.4.5, add the following:

"9.4.6 The *Contractor* shall indemnify and save harmless the *Owner*, its agents, officers, directors, employees, *Consultants*, successors, appointees and assigns from and against the consequences of any and all safety infractions committed by the *Contractor* under the applicable occupational health and safety legislation in the *Place of the Work*, including the payment of legal fees and disbursements on a solicitor and client basis. Such indemnity shall apply to the extent to which the *Owner* is not covered by insurance, provided that the indemnity contained in this clause shall be limited to costs and damages resulting directly from such infractions and shall not extend to any consequential, indirect, or special damages."

PART 10 - GOVERNING REGULATIONS

GC 10.1 TAXES AND DUTIES

Page 23, after Clause 10.1.2, add new Clause 10.1.3 as follows:

"10.1.3 Indicate on each application for payment as a separate amount, the appropriate *Value Added Tax* the *Owner* is legally obliged to pay. This amount will be paid to the *Contractor* in addition to the amount certified for payment under the *Contract*."

PART 12 - OWNER TAKEOVER

Page 25, add new clause 12.1.1.9 and 12.1.1.10 as follows:

.9 Commissioning reports as in Section 01 91 13.

.10 Any other documentation identified as a closeout or Ready-for-Takeover document as specified in Section 01 78 00.

GC 12.3 WARRANTY

Page 26, add new clause 12.3.5 as follows and renumber subsequent clauses:

"All *Work* of repair or replacement carried out during the warranty period shall be maintained for a period of one (1) year from the date of the *Consultant's* acceptance of the *Work* of repair or replacement notwithstanding that the warranty period expires before the expiration of the said year. This clause shall not apply to normal operation maintenance, which shall be carried out by the *Owner*."

PART 13 - INDEMNIFICATION AND WAIVER

GC 13.1 INDEMNIFICATION

Page 26, Clause 13.1.1, in line 2, after "hold harmless the other" replace with "hold harmless the other and the *Consultant*."

PART 14 - CONTRACT SECURITY

GC 14.1 CONTRACT SECURITY

Page 28, add new clause 14.1 and 14.2 as follows:

"14.1 The Contractor shall, prior to commencement of the *Work*, provide to the Owner a Performance Bond and a Labour and Materials Bond, each in the amount of 50% of the Total Amount Payable or an Irrevocable Letter of Credit in the amount of 20% of the Total Amount Payable. The Irrevocable Letter of Credit shall be issued by a certified financial institution for a period of no less than twelve (12) months after the issue of Substantial Performance Certificate. Include the cost of providing the Irrevocable Letter of Credit in Contract Price. Should it become apparent that the final cost of the project will exceed the Total Amount Payable by more than 10%, the Contractor shall arrange to have his bonds or Irrevocable Letter of Credit reissued, based on the projected final cost."

14.2 The contract security will be retained until the expiration of the warranty period."

END OF SECTION

PART 1 - GENERAL

1.1 WORK OF THE PROJECT

- .1 The project is located at the Lunenburg Wastewater Treatment Plant at 125 Starr St, Lunenburg, NS B0J 2C0.
- .2 The project involves modification of an existing wastewater treatment plant. The Work includes but is not limited to the construction of new concrete tanks for an SBR complete with Process Mechanical installations, electrical, instrumentation & controls, commissioning & operator training; modifications to existing process tanks; replacement and modification of existing process equipment complete with Process Mechanical installations, electrical, instrumentation & controls, commissioning & operator training ; decommissioning and demolition of existing process equipment; side grading, drainage and site improvements; asphalt access road; construction of a new building; modifications to existing buildings, including interior and exterior walls, doors, roof complete with coatings and paint where applicable; mechanical systems as specified; extension of existing water service; interior and exterior electrical systems and lighting; process control and instrumentation system; and all work as specified in the Project Drawings.
- .3 The existing facility must remain in service and operational for the duration of the Work.

1.2 DIVISION OF WORK

- .1 Division of the Work among Subcontractors and Suppliers is solely Contractor's responsibility. Consultant and Owner assume no responsibility to act as an arbiter to establish subcontract limits between Sections or Divisions of the Work.

1.3 SPECIFICATIONS LANGUAGE AND STYLE

- .1 These specifications are written in the imperative mood and in streamlined form. The imperative language is directed to Contractor, unless stated otherwise.
- .2 Fulfill and perform all indicated requirements whether stated imperatively or otherwise.
- .3 When used in the context of a Product, read the word "provide" to mean "supply and install to result in a complete installation ready for its intended use".

1.4 CONTRACT DOCUMENTS FOR CONSTRUCTION PURPOSES

- .1 Owner will supply Contractor with a complete set of Contract Documents in electronic form before commencement of the Work. Contractor may print hard copies for construction purposes as required.

1.5 DOCUMENTS AT THE SITE

- .1 Keep the following documents at Place of the Work, stored securely and in good order and available to Owner and Consultant:
 - .1 Current Contract Documents, including Drawings, Specifications and addenda.
 - .2 Change Orders, Change Directives, and Supplementary Instructions.
 - .3 Reviewed Shop Drawings, Product data and samples.
 - .4 Field test reports and records.
 - .5 Construction progress schedule.
 - .6 Meeting minutes.
 - .7 Manufacturer's certifications.
 - .8 Permits, inspection certificates, and other documents required by authorities having jurisdiction.
 - .9 Current as-built drawings.
 - .10 Safety Data Sheets (SDS) for all controlled Products.
 - .11 Any other documents as stipulated as site documents at the construction start-up meeting.

1.6 CONTRACTOR'S USE OF PREMISES

- .1 Except as otherwise specified, Contractor has unrestricted use of the Site from time of Contract award until Ready-for-Takeover.
- .2 Confine Construction Equipment, Temporary Work, storage of Products, waste products and debris, and all other construction operations to limits required by laws, ordinances, permits, and Contract Documents, whichever is most restrictive. Do not unreasonably encumber Place of the Work.

1.7 OWNER PRE-SELECTED EQUIPMENT

- .1 The Following item(s) have been pre-selected by the Owner:
 - .1 Ultraviolet Disinfection System
 - .2 Sequencing Batch Reactor
 - .3 Fine Screen System
- .2 The Contractor is responsible for issuing a PO and purchasing the equipment upon the award of the Contract. The results of equipment pre-selection will not be subject to re-negotiation in this construction contract unless approved in writing by the Consultant. Placing a purchase order does not relinquish the responsibility of the Contractor or Supplier from any conditions of their respective contracts. An allowance has been provided in the tender form for this purchase. The Contractor will also be responsible for the coordination of and delivery to the site, unloading, insuring, protecting, installing, erecting, coordinating start-up and commissioning of the equipment supplied by the Owner.

- .3 Copies of the equipment specifications, as well as any additional pertinent information will be available for review upon request to the Consultant during the tendering period.
- .4 Adhere to the special payment schedule applicable to the pre-selected equipment package. Payment terms will be made available to the successful bidder.
- .5 Coordinate the delivery of the pre-selected equipment with the Supplier as required. Confirm the equipment can be installed prior to arranging shipping. Pay for shipping from manufacturer to site at no additional cost to the Contract. Site storage and transportation to/from site is the responsibility of the Contractor.
- .6 The Contractor must become thoroughly familiar with all the requirements of the pre-selected equipment by careful study of the equipment specifications, review drawings, other pertinent information, and by direct communication with the named suppliers. No extra payment will be made to the Contractor for any additional Work in connection with the proper installation, testing and operation of pre-selected equipment, necessitate by the Contractor's failure to ascertain the requirements (both direct and ancillary) for this equipment prior to submission of the tender.
- .7 Ascertain from the Pre-Selected Equipment Supplier the full extent of field work in accordance with the manufacturer's instructions and obtain all details, dimensions and other information necessary for the complete installation.

1.8 REFERENCES AND CODES

- .1 Perform Work in accordance with the latest edition of the National Building Code (NBC), National Fire Code (NFC), National Plumbing Code (NPC), Canadian Electrical Code, and/or any other code of provincial or local regulations provided that in any case of conflict or discrepancy the more stringent requirement governs.
- .2 Reference has been made to certain Domestic, National and International Standards throughout the various sections of the Specification contained herein. These Standards will be considered an integral part thereof and shall be read in conjunction with the Drawings and Specifications as if they were reproduced herein. Be completely familiar with their contents and requirements.

1.9 ASSISTANCE TO THE CONSULTANT AND THE CONSULTANT'S REPRESENTATIVE

- .1 During the continuance of the Contract, provide necessary labour and tools to assist the Consultant's authorized representative in measuring, checking, testing and examining the Work and for the setting out and measurement of the Works, the cost of all such being deemed to be covered by and included in the Contract Price.

1.10 LIST OF DRAWINGS

000 COVER SHEET

CIVIL

- C01 EXISTING CONDITIONS AND REMOVALS
- C02 PROPOSED SITE GRADING
- C03 MISCELLANEOUS DETAILS

ARCHITECTURAL

- A01 FLOOR PLANS
- A02 SECTIONS & DETAILS
- A03 EXTERIOR ELEVATIONS
- A04 REFLECTED CEILING PLAN, ROOF PLAN, AND DETAILS
- A05 SBR TANK ELECTRICAL BUILDING PLANS & BLDG SECTIONS
- A06 SBR TANK ELECTRICAL BUILDING ELEVATIONS
- A07 SBR TANK ELECTRICAL BUILDING DETAILS
- A08 SCHEDULES

STRUCTURAL

- S01 GENERAL NOTES
- S02 SBR TANK - BASE SLAB PLAN
- S03 SBR TANK - TOP OF WALL PLAN
- S04 SBR TANK - CROSS SECTIONS
- S05 SBR TANK - CROSS SECTIONS
- S06 SBR TANK - SECTIONS AND DETAILS
- S07 SBR TANK - SECTIONS AND DETAILS
- S08 SBR TANK - BASE SLAB REINFORCING PLAN
- S09 SBR TANK - WALL REINFORCING ELEVATIONS
- S10 SBR TANK - WALL REINFORCING ELEVATIONS
- S11 SBR TANK - STAIRS PLANS, SECTIONS AND DETAILS
- S12 NEW ELECTRICAL ROOM - EXISTING AND NEW CONDITION
- S13 NEW ELECTRICAL ROOM - PLANS AND CROSS SECTIONS
- S14 NEW ELECTRICAL ROOM - SECTIONS AND TYPICAL DETAILS
- S15 SBR TANK ELECTRICAL BUILDING - SLAB ON GRADE AND ROOF FRAMING PLANS
- S16 SBR TANK ELECTRICAL BUILDING - SECTIONS AND DETAILS
- S17 SBR TANK ELECTRICAL BUILDING - SECTIONS AND DETAILS
- S18 TYPICAL DETAILS - CONCRETE
- S19 TYPICAL DETAILS - MISCELLANEOUS
- S20 TYPICAL DETAILS - MASONRY, GENERATOR PAD

PROCESS

- P01 LEGEND
- P02 HYDRAULIC PROFILE AND FLOW DIAGRAM
- P03 P&ID SHEET 1 OF 3
- P04 P&ID SHEET 2 OF 3
- P05 P&ID SHEET 3 OF 3

P11 SITE YARD PIPING PLAN EXISTING CONDITIONS
P12 SITE YARD PIPING PLAN PROPOSED CONDITIONS
P13 PROCESS BUILDING DEMOLITION PLAN
P14 PROCESS BUILDING PLAN
P15 HEADWORKS PLAN, DETAIL AND SECTIONS
P16 PROCESS AREA PLAN AND SECTIONS
P17 SBR No.1 AND No.2 PLAN AT EL. 6.250
P18 SBR NO.1 AND NO.2 PLAN AT EL. 0.200
P19 SBR No.1 AND No.2 SECTIONS
P20 SBR No.1 AND No.2 SECTIONS
P21 SLUDGE HOLDING TANK MODIFICATIONS PLAN AND SECTION
P22 SECTION AND SCHEDULES
P23 MISCELLANEOUS DETAILS

MECHANICAL

M01 MECHANICAL PLUMBING - DEMOLITION
M02 MECHANICAL PLUMBING - NEW
M03 MECHANICAL HVAC - DEMOLITION
M04 MECHANICAL HVAC - NEW
M05 MECHANICAL SCHEDULES & DETAILS

ELECTRICAL

E01 LEGEND
E02 ELECTRICAL SITE PLAN
E03 SINGLE LINE DIAGRAM PROPOSED MODICATIONS SHEET 1 OF 3
E04 SINGLE LINE DIAGRAM PROPOSED MODICATIONS SHEET 2 OF 3
E05 SINGLE LINE DIAGRAM PROPOSED MODICATIONS SHEET 3 OF 3
E06 HAZARDOUS AREA CLASSIFICATION PLAN
E07 HEADWORKS AREA AND ELECTRICAL ROOMS
E08 PROCESS AREA
E09 SBR NO 1 AND SBR NO. 2
E10 SCHEMATICS 1 OF 2
E11 SCHEMATICS 2 OF 2, LIGHTING SCHEDULE AND TABLES
E12 ELECTRICAL DETAILS SHEET OF 1 OF 4
E13 ELECTRICAL DETAILS SHEET OF 2 OF 4
E14 ELECTRICAL DETAILS SHEET OF 3 OF 4
E15 ELECTRICAL DETAILS SHEET OF 4 OF 4

INSTRUMENTATION AND CONTROLS

J01 CONTROL AND BUILDING NETWORK BLOCK DIAGRAM AND IO LIST
J02 CABLING DIAGRAM SHEET 1 OF 3
J03 CABLING DIAGRAM SHEET 2 OF 3
J04 CABLING DIAGRAM SHEET 3 OF 3

Town of Lunenburg
Wastewater Treatment Plant
Upgrades & Expansion
Project No. 240800.00

SUMMARY OF WORK

Section 01 11 00

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PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Applicable.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Applicable.

END OF SECTION

PART 1 - GENERAL

1.1 RESTRICTIONS ON USE OF PREMISES

- .1 This subsection identifies restrictions that may impact the scheduling or execution of the Work. This does not purport to identify all potential disruptions, but rather it is meant to assist the Contractor to understand the project.
- .2 Be fully aware that the Owner will be present on the premises during the entire construction period for execution of normal operations. Cooperate with Owner in scheduling work to minimize conflict and to facilitate Owner's operation and maintenance activities.
- .3 Work of this Contract is located in an area where normal working hours are:
 - .1 7:30am to 7:30pm, Monday to Friday inclusive.
 - .2 Work performed outside these hours require approval by the Owner. Request approval in writing at least 48 hours in advance.
- .4 Make all reasonable efforts to provide access by the Owner's personnel to areas of the existing building. Temporary gravels, walkways, handrails, markers, and other means will be taken to provide safe, clean access to all areas requiring routine access.
- .5 The existing plant is a fully functional Wastewater Treatment facility. Working areas must remain reasonably clean and attention to dust control and prevention of excessive debris must be paid.
- .6 In general, the plant must remain functional throughout all stages of Work. From time to time, pre-planned disruptions to process operations for periods of two (2) hours will be permitted to accommodate tie-ins and other Work. A shut down of eight hours or more or one which could reduce effluent quality to the point where it does not meet the Approval to Operate or require overflows from the collection system, will require significant coordination with the Owner.

1.2 WORK SEQUENCE

- .1 Schedule and construct Work in stages to accommodate Owner's intermittent use of premises during construction. Do not close off Owner access of the facility that is operational until new construction becomes operational.

1.3 OWNER OCCUPANCY

- .1 Owner will occupy portions of the premises during entire construction period.
- .2 Cooperate with Owner in scheduling operations to minimize disruptions and to facilitate Owner usage.

1.4 NOISY WORK RESTRICTIONS IN OCCUPIED FACILITIES

- .1 Schedule excessively noisy work to avoid disturbance to building occupants. Perform excessive noise generating work outside of these hours.
 - .1 Use powder actuated devices only with Consultant's written permission.
 - .2 Operate construction equipment such that there is a minimum amount of noise and vibration. Should excessive noise and vibration be caused, at own expense, rectify the same to the approval of the Consultant.

1.5 MAINTAINING LIFE IN OCCUPIED FACILITIES

- .1 Maintain operational life safety systems and safety systems in public access to exits in occupied areas during all stages of the Work.
- .2 Determine nature and exact locations of existing fire and smoke sensors prior to the commencement of the Work. Avoid direct or indirect jarring while working in adjacent areas and exercise caution to avoid triggering these devices.
- .3 Be responsible for costs incurred by Owner on account of false fire alarms activated as a result of the execution of the Work without adequate precautions.

1.6 WEATHER CONDITIONS

- .1 Do not perform work when the weather is unsuitable. Do not place concrete, paving, or paint during freezing weather or upon frozen material unless approved in writing by the Consultant. When work is performed during freezing weather, provide necessary means for heating and all materials required in the work. Do not use frozen materials for backfilling and embankment. If there is delay or interruption in the work due to weather conditions, take necessary precautions to bond new work to old.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not applicable.

Town of Lunenburg
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WORK RESTRICTIONS

Section 01 14 00

Page 3

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PART 3 - EXECUTION

3.1 NOT USED

.1 Not applicable.

END OF SECTION

PART 1 - GENERAL

1.1 DEFINITION

- .1 In this Section "Substitution" means a Product, a manufacturer, or both, not originally specified in Contract Documents by proprietary name but proposed for use by Contractor in place of a Product, a manufacturer, or both, specified by proprietary name.

1.2 EQUIVALENTS AND ALTERNATES

- .1 Where any particular brand of manufactured article is described or specified, it is to be regarded as a standard of acceptance but another brand of equivalent quality and function may be accepted at the discretion of the Consultant.
- .2 When the Owner is prepared to permit the use of a non-equivalent brand of manufactured article as an alternative to any specified brand of manufactured article, it may be used at the discretion of the Consultant but only after price adjustments have been negotiated and approved by the Consultant. No extra fees will be charged for approved equivalents.
- .3 If the suggested alternative requires modifications, adjustments, or additions to the specified Works, submit to the Consultant, drawings and specifications for these modifications, adjustments or additions in the same detail as presented in the Contract. Approval in principle by the Consultant of these modifications, adjustments or additions in no way relieves the Contractor of obligations or liabilities under the Contract to provide for finished piece of Work complete and operational in all essentials.
- .4 No change or substitution can be made without the written consent of the Consultant.
- .5 The Consultant will record the time required to evaluate equivalents and alternates proposed by the Contractor including making changes to the Contract Documents occasioned thereby. Whether or not the Consultant accepts a proposed substitute, reimburse the Owner for the charges of the Consultant for evaluating any proposed substitute.

1.3 SUBSTITUTION PROCEDURES - TENDER PHASE

- .1 No change in the specification will be made prior to the acceptance of the tenders.

1.4 SUBSTITUTION PROCEDURES - CONSTRUCTION PHASE

- .1 Contractor may propose a Substitution wherever a Product or manufacturer is specified by proprietary name(s), unless there is accompanying language indicating that Substitutions will not be considered.
- .2 Contractor may propose a Substitution wherever a Product or manufacturer is specified by proprietary name(s) and accompanied by

language such as "or equal", "or approved equal", or other similar words. Do not construe such language as an invitation to unilaterally provide a Substitution without Consultant's prior acceptance in writing. Do not order or install any Substitution without a Supplemental Instruction, Change Order, or an approved shop drawing that clearly indicates the product shown is a substitution from one that was specified in the Project Documents.

- .3 Provided a proposed Substitution submission includes all of the information specified in this Section under Submission Requirements For Proposed Substitutions, Consultant will promptly review and accept or reject the proposed Substitution.
- .4 Consultant may accept a Substitution if satisfied that:
 - .1 the proposed substitute Product is the same type as, is capable of performing the same functions as, interfaces with adjacent Work the same as, and meets or exceeds the standard of quality, performance and, if applicable, appearance and maintenance considerations, of the specified Product, the proposed substitute manufacturer has capabilities comparable to the specified manufacturer, and the Substitution provides a benefit to Owner.
- .5 If Contractor fails to order a specified Product or order a Product by a specified manufacturer in adequate time to meet Contractor's construction schedule, Consultant will not consider that a valid reason to accept a Substitution.
- .6 If Consultant accepts a Substitution and subject to Owner's agreement, the change in the Work will be documented in the form of either a Supplemental Instruction or Change Order as specified in Section 01 26 00 - Contract Modification Procedures.
- .7 If a Substitution is accepted in the form of a Supplemental Instruction or Change Order, Contractor shall not revert to an originally specified Product or manufacturer without Consultant's prior written acceptance.

1.5 SUBMISSION REQUIREMENTS FOR PROPOSED SUBSTITUTIONS

- .1 Include with each proposed Substitution the following information:
 - .1 Identification of the Substitution, including product name and manufacturer's name, address, telephone numbers, and website.
 - .2 Reason(s) for proposing the Substitution.
 - .3 A statement verifying that the Substitution will not affect the Contract Price and Contract Time or, if applicable, the amount and extent of a proposed increase or decrease in Contract Price and Contract Time on account of the Substitution.
 - .4 A statement verifying that the Substitution will not affect the performance [or warranty] of other parts of the Work.
 - .5 Manufacturer's Product literature for the Substitution, including material descriptions, compliance with applicable codes and

- reference standards, performance and test data, compatibility with contiguous materials and systems, and environmental considerations. Product samples as applicable.
- .6 A summarized comparison of the physical properties and performance characteristics of the specified Product and the Substitution, with any significant variations clearly highlighted.
 - .7 Availability of maintenance services and sources of replacement materials and parts for the Substitution, as applicable, including associated costs and time frames.
 - .8 If applicable, estimated life cycle cost savings resulting from the Substitution.
 - .9 Details of other projects and applications where the Substitution has been used.
 - .10 Identification of any consequential changes in the Work to accommodate the Substitution and any consequential effects on the performance of the Work as a whole. A later claim for an increase to the Contract Price or Contract Time for other changes in the Work attributable to the Substitution will not be considered.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not applicable.

PART 3 - EXECUTION

3.1 NOT USED

- .1 Not applicable.

END OF SECTION

PART 1 -GENERAL

1.1 SCHEDULE OF LABOUR RATES

- .1 Prior to the first application for payment, submit for the Consultant's review a schedule of labour rates for all trades and classifications of trades, such as journeymen, apprentices, and foremen that will be employed in the Work. Provide a breakdown of payroll burden component of labour rates.
- .2 Labour rates to reflect the salaries, wages, and benefits paid to personnel in the direct employ of the Contractor, Subcontractors, and sub-Subcontractors, stated as hourly rates, that will be used when:
 - .1 preparing price quotations for Change Orders, and
 - .2 determining the cost of Work attributable to Change Directives.
- .3 Labour rates stated in the schedule of labour rates must be consistent with rates that will actually be paid, and payroll burden costs that will actually be incurred, in the normal performance of the Work, during regular working hours. Labour rates shall not include any additional overhead and profit component.
 - .1 Where collective agreements apply, the labour rates shall not exceed those established by collective agreement.
 - .2 Obtain the Owner's written acceptance of the schedule of labour rates before submitting the first Change Order quotation.
 - .3 Accepted schedule of labour rates will be used solely for evaluating Change Order quotations and cost of performing Work attributable to Change Directives.
- .4 The Contractor may request amendments to the accepted schedule of labour rates if changes in the labour rates that will actually be paid, or payroll burden cost that will actually be incurred, in the normal performance of the Work can be demonstrated. Obtain the Owner's written acceptance of such changes.

1.2 SCHEDULE OF EQUIPMENT RATES

- .1 Equipment rates to reflect the rates that will be used when:
 - .1 preparing price quotations for Change Orders, and
 - .2 determining the cost of Work attributable to Change Directives.
- .2 Equipment rates stated in the schedule shall be consistent with local equipment rental market rates and shall not include any additional overhead and profit component.
- .3 Obtain the Owner's written acceptance of the schedule of equipment rates before submitting the first Change Order quotation.
- .4 Accepted schedule of equipment rates will be used solely for evaluating Change Order quotations and cost of performing Work attributable to Change Directives.

- .5 The Contractor may request amendments to the accepted schedule of equipment rates if changes in local equipment rental market rates can be demonstrated. Obtain the Owner's written acceptance of such changes.

1.3 METHOD OF CONTRACT PRICE ADJUSTMENT - CHANGE ORDERS

- .1 Unless otherwise agreed, the adjustment of the Contract Price on account of a proposed change in the Work shall be based on a quotation for a fixed price increase or decrease to the Contract Price regardless of the Contractor's actual expenditures and savings.

1.4 CHANGE ORDER PROCEDURES

- .1 Upon issuance by the Consultant to the Contractor of a proposed change in the Work, and unless otherwise requested in the proposed change or unless otherwise agreed:
 - .1 Submit to the Consultant a fixed price quotation for the proposed change in the Work within five (5) Working days after receipt of the proposed change in the Work.
 - .2 If requested in the proposed change, provide a detailed breakdown of the price quotation including the following to the extent applicable, with appropriate supporting documentation:
 - .1 Estimated labour costs, including hours and applicable hourly rates based on the accepted schedule of labour rates.
 - .2 Estimated Product costs, including Supplier quotations, estimated quantities and unit prices.
 - .3 Estimated Construction Equipment costs.
 - .4 Enumeration of all other estimated costs included in the price quotation.
 - .5 Estimated credit amounts for labour and Products not required on account of the proposed change.
 - .6 Fees, not exceeding the applicable percentages for overhead and profit as specified in Section 00 73 00 - Supplementary General Conditions.
 - .7 Where applicable, Subcontractor quotations, also including a detailed breakdown of all of the above.
- .2 Include in the quotation the increase or decrease to the Contract Time, if any, for the proposed change, stated in number of days.
- .3 Include in the quotation the number of days for which the quotation is valid.
- .4 The quotation will be evaluated by the Consultant and the Owner and, if accepted by the Owner, be documented in the form of a signed Change Order.

1.5 FEES FOR OVERHEAD AND PROFIT – CHANGE ORDERS AND CHANGE DIRECTIVES

- .1 Where the Contractor's price quotation for a Change Order results in a net increase to the Contract Price, the Contractor's entitlement to a fee for overhead and profit in the quotation shall be as set forth in Section 00 73 00 – Supplementary General Conditions.
- .2 Where a Subcontractor's price quotation for a Change Order results in a net increase to the Subcontractor's contract price, the Subcontractor's entitlement to a fee for overhead and profit in the quotation shall be as set forth in Section 00 73 00 – Supplementary General Conditions.
- .3 Where the Contractor's or a Subcontractor's price quotation for a Change Order results in a net decrease in price before adjustment for fees for overhead and profit, such a price quotation shall be for the net decrease without any adjustment for fees for overhead and profit.
- .4 Where a Change Directive results in net savings on account of Work not required to be performed and a net decrease in the Contractor's or Subcontractor's cost, the net savings to the Contractor or Subcontractor shall be calculated without any adjustment for fees for overhead and profit.
- .5 When a Change Directive is ultimately recorded as a Change Order, there shall be no additional entitlement to fees for overhead and profit beyond those specified in this article.

1.6 CHANGE DIRECTIVE PROCEDURES

- .1 If a Change Directive is issued for a change in the Work for which a proposed change was previously issued, but no Change Order has yet been signed, the Change Directive shall cancel the proposed change and any Contractor quotations related to that change in the Work.
- .2 When proceeding with a change in the Work under a Change Directive, keep accurate records of daily time sheets for labour and Construction Equipment, and invoices for Product and Construction Equipment costs. Submit such records to the Consultant daily, until the Change Order superseding the Change Directive is issued.

1.7 SUPPLEMENTAL INSTRUCTIONS

- .1 The Consultant may issue Supplemental Instructions to provide clarifications to the Contract Documents, provide additional information, or make minor variations in the Work not involving adjustment in the Contract Price or Contract Time.
- .2 If the Contractor considers a Supplemental Instruction to require an adjustment in Contract Price or Contract Time, the Contractor shall promptly notify the Consultant and the Owner in writing and shall not proceed with any Work related to the Supplemental Instruction pending receipt of a Change Order, a Change Directive, or, in accordance with the dispute resolution provisions of the General Conditions of Contract, a Notice in Writing of a dispute and instructions to

proceed.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not applicable.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not applicable.

END OF SECTION

PART 1 -GENERAL

1.1 SCHEDULE OF VALUES

- .1 Prior to the first application for payment, submit for Consultant's review an initial schedule of values. Modify the initial schedule of values if and as requested by the Consultant. Obtain the Consultant's written acceptance of the initial schedule of values prior to the first application for payment.
- .2 Together with the first and all subsequent applications for payment, submit updated versions of the schedule of values to indicate the values, to the date of application for payment, of Work performed and Products delivered to Place of the Work.
- .3 Provide the schedule of values in an electronic spreadsheet format that provides for inclusion of the following information:
 - .1 Identifying information including title and location of the Work, name of Contractor, number and date of application for payment, and period covered by the application for payment.
- .4 A Work breakdown structure that is sufficiently detailed and comprehensive to facilitate Consultant's evaluation of applications for payment at an appropriate level of detail.
- .5 Provisions for approved Change Orders so that the breakdown amounts indicated in the schedule of values aggregate to the current total Contract Price. Also provide for indicating the estimated value of Change Directives within the schedule of values, separately from the current total Contract Price.
- .6 For each item in the Work breakdown structure, provide as a minimum the following information, under headings as indicated:
 - .1 Breakdown Amount: A dollar amount, including an appropriate pro rata portion of Contractor's overhead and profit.
 - .2 Performed to Date: The value of Work performed and Products delivered to Place of the Work up to the date of the application for payment, stated as a percentage of the Contract Price and in dollars.
 - .3 Previously Performed: The value of Work performed and Products delivered to the Place of the Work for which payment has been previously certified, stated in dollars.
 - .4 Current Period: The value of Work performed and Products delivered to Place of the Work for which Contractor is currently applying for payment, stated in dollars.
 - .5 Balance to Complete: The value of Work not yet performed and Products not yet delivered to Place of the Work, stated in dollars.

1.2 WORKERS' COMPENSATION CLEARANCE

- .1 Submit proof of workers' compensation clearance with each application for payment.

1.3 STATUTORY DECLARATIONS

- .1 Submit a statutory declaration in the form of CCDC 9A - Statutory Declaration of Progress Payment Distribution by Contractor with each application for payment except the first.

1.4 PAYMENT FOR PRODUCTS STORED OFF SITE

- .1 Owner may, due to extraordinary circumstances and at Owner's sole discretion, make payments for Products delivered to and stored at a location other than Place of the Work, subject to:
 - .1 a request submitted by Contractor in writing, with appropriate justification, and
 - .2 whatever conditions Owner or Consultant may establish for such payments, as required to protect Owner's interests.

PART - 2 PRODUCTS

2.1 NOT USED

- .1 Not applicable.

PART - 3 EXECUTION

3.1 NOT USED

- .1 Not applicable.

END OF SECTION

PART 1 - GENERAL

1.1 CONSTRUCTION START-UP MEETING

- .1 Within the notice of intent to award the Consultant will establish the time and location of a construction start-up meeting to review and discuss administrative procedures and responsibilities. Where possible, the Consultant will notify Contractor at least five (5) Working Days before the meeting.
 - .1 Senior representatives of Owner, Consultant, and Contractor, including Contractor's project manager and site superintendent, and major Subcontractors shall be in attendance.
- .2 Confirm attendance of the parties associated with the Contractor's forces listed above. The Consultant will chair the preconstruction meeting. The Contractor will be responsible for all subsequent construction progress meeting as stipulated in subsection 1.2 herein and record and distribute the minutes.
- .3 Agenda to include the following as applicable:
 - .1 Appointment of official representatives of Owner, Contractor, Subcontractors, Consultant, and subconsultants.
 - .2 Project communications.
 - .3 Contract Documents for construction purposes.
 - .4 Documents at the site.
 - .5 Contractor's use of premises.
 - .6 Owner-supplied Products.
 - .7 Work restrictions.
 - .8 Allowances.
 - .9 Substitution procedures.
 - .10 Contract modification procedures.
 - .11 Payment procedures.
 - .12 Construction progress meetings.
 - .13 Construction progress schedule, including long lead time items.
 - .14 Submittals schedule and procedures.
 - .15 Quality requirements, including testing and inspection procedures.
 - .16 Contractor's mobilization.
 - .17 Temporary utilities.
 - .18 Existing utility services.
 - .19 Construction facilities.
 - .20 Temporary barriers and enclosures.
 - .21 Temporary controls.
 - .22 Permitting.
 - .23 Field engineering and layout of Work.
 - .24 Site safety.
 - .25 Cleaning and waste management.

- .26 Closeout procedures and submittals.
- .27 Commissioning.
- .28 Other items.

1.2 CONSTRUCTION PROGRESS MEETINGS

- .1 Schedule regular bi-weekly construction progress meetings for the duration of the Work. Prepare meeting agendas, chair the meetings, and record and distribute the minutes.
- .2 Arrange for and provide physical space for meetings.
- .3 Record in the meeting minutes significant decisions and identify action items and action dates by attendees or the parties they represent.
- .4 Distribute copies of minutes within three Working Days after each meeting to all meeting attendees and any affected parties who may not be in attendance.
- .5 Arrange for the attendance of Subcontractors as and when appropriate to the progress of the Work.
- .6 Agenda for each meeting to include the following, as a minimum:
 - .1 Approval of minutes of previous meeting.
 - .2 Work progress since previous meeting.
 - .3 Field observations, including any problems, difficulties, or concerns.
 - .4 Construction progress schedule.
 - .5 Submittals schedule.
 - .6 Proposed changes in the Work.
 - .7 Requests for information.
 - .8 Site safety issues.
 - .9 Other business.

PART - 2 PRODUCTS

2.1 NOT USED

- .1 Not applicable.

PART 3 - EXECUTION

3.1 NOT USED

- .1 Not applicable.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 This Section specifies Contractor's responsibilities for preparation and submission of schedules and other documentation related to tracking construction progress.
- .2 The purpose of submitting progress schedules is to:
 - .1 Inform Owner and Consultant of actual progress versus planned progress, and
 - .2 Provide assurance that scheduling issues are being proactively identified and addressed in a timely manner, and that planned progress is being maintained as closely as possible.

1.2 CONSTRUCTION PROGRESS SCHEDULE

- .1 Format and Content:
 - .1 Prepare schedule in the form of a Gantt chart using appropriate scheduling software.
 - .2 Consultant will review format and content of initial schedule and request necessary changes, if any, within five (5) Working Days after receipt.
 - .3 Provide a Work breakdown structure identifying key activities, Work packages, and major milestones, including long delivery Products, inspection and testing activities, shutdown or closure activities, demonstration and training activities, and similar items, at a sufficient level of detail to effectively manage construction progress.
 - .4 Provide an updated schedule with each progress claim. Claims will not be certified until an updated progress schedule showing current progress in the form of percent complete is submitted and accepted by the Consultant.
 - .5 Indicate milestone date[s] for Ready-for-Takeover and Substantial Performance of the Work.
- .2 If changes are required, resubmit finalized initial schedule within five (5) Working Days after return of review copy.
- .3 Submit updated progress schedule indicating actual and projected start and finish dates with report date line and progress, activity relationships, critical path, float, and baseline comparison to current progress.
- .4 Include a written report with each updated progress schedule. Indicate Work status to date comparing baseline to actual progress, current forecasts, identifying problem areas, anticipated delays and impact on schedule, and planned corrective actions.

1.3 SUBMITTALS SCHEDULE

- .1 Format and Content:
 - .1 Prepare schedule identifying all required Shop Drawing, Product data, and sample submissions, including samples required for testing and including those for pre-purchased or pre-selected Products as applicable.
 - .2 Prepare schedule in electronic format.
 - .3 Provide a separate line for each required submittal, organized by Specifications section names and numbers, and further broken down by individual Products and systems as required.
 - .4 For each required submittal, show planned earliest date for return of reviewed submittal by Consultant and the latest date for return of reviewed submittal without causing delay.
- .2 Submission:
 - .1 Submit initial schedule to the Consultant within ten (10) Working Days after Contract award.
 - .2 Submit schedule via e-mail as .pdf files.
 - .3 Consultant will review format and content of initial schedule and request necessary changes, if any, within five (5) Working Days after receipt.
 - .4 If changes are required, resubmit finalized schedule within five (5) Working Days after return of review copy. Allow time in schedule for resubmission of submittals, should resubmission be necessary.
 - .5 Submit updated submittals schedule monthly to Owner and Consultant.

1.4 SCHEDULE MANAGEMENT

- .1 A schedule submitted as specified and accepted by the Consultant becomes the baseline schedule and shall be used as the baseline for updates.
- .2 At each regular progress meeting, review and discuss current construction progress and submittals schedules with Consultant and Owner, including activities that are behind schedule and planned measures to regain schedule slippage in key areas on or near the critical path.
- .3 Activities considered behind schedule are those with start or completion dates later than the dates shown on the baseline schedule.

1.5 RECORDING ACTUAL SITE CONDITIONS ON AS-BUILT DRAWINGS

- .1 Obtain from Consultant an electronic copy of the construction Drawings for the purpose of creating as-built drawings. Record information in electronic form, clearly identifying as-built deviations from the

originally obtained construction Drawings.

- .2 Clearly label each drawing as "AS-BUILT DRAWING". Record information concurrently with construction progress. Do not conceal Work until required information is recorded.
- .3 Record actual construction including:
 - .1 Measured depths of elements of foundation in relation to finish first floor datum.
 - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - .3 Measured locations of pipes, ducts, conduits, outlets, fixtures, access panels, and appurtenances, referenced to visible and accessible features of construction.
 - .4 Field changes of dimension and detail.
 - .5 Changes made by Change Orders and Supplemental Instructions
 - .6 References to Shop Drawings, where Shop Drawings show more detail.
- .4 Do not use as-built drawings for construction purposes.

1.6 PROGRESS PHOTOGRAPHS

- .1 Arrange for periodic digital photography to document and provide a photographic record of the progress of the Work.
- .2 Provide photographs of any aspect of the Work upon request of the Consultant, made either during the progress of the Work or requested in advance of a part of the Work. Provide as many photographs as deemed necessary by the Consultant to ascertain the status or condition of the Work.
- .3 Identify each photograph by project name and date taken.
- .4 Submission: Submit .jpg format files in standard resolution via e-mail at intervals indicated at the start up meeting or as requested by the Consultant.
- .5 Do not use progress or any other Project photographs for promotional purposes without Owner's written consent.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not applicable.

Town of Lunenburg
Wastewater Treatment Plant
Upgrades & Expansion
Project No. 240800.00

CONSTRUCTION PROGRESS
DOCUMENTATION

Section 01 32 00

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PART 3 - EXECUTION

3.1 NOT USED

.1 Not applicable.

END OF SECTION

PART 1 - GENERAL

1.1 ADMINISTRATIVE

- .1 Submit specified submittals to Consultant for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in the Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time or for Product substitutions or other deviations from the Drawings and Specifications.
- .2 Where required by authorities having jurisdiction, provide submittals to such authorities for review and approval.
- .3 Do not proceed with Work affected by a submittal until review is complete.
- .4 Present Shop Drawings, Product data, and samples in SI metric units. Where items or information is not produced in SI Metric units, converted values are acceptable.
- .5 Review submittals, provide verified field measurements where applicable, and affix Contractor's review stamp prior to submission to the Consultant. Contractor's review stamp represents that necessary requirements have been determined and verified, and that the submittal has been checked and coordinated with requirements of the Work and Contract Documents.
- .6 Verify field measurements and that affected adjacent Work is coordinated.
- .7 Submittals not meeting specified requirements will be returned with comments.
- .8 Reproduction of construction Drawings to serve as background for Shop Drawings is permitted.
- .9 Do not propose Substitutions or deviations from Contract Documents via Shop Drawing, Product data and sample submittals.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop detail or working drawings and manufacturer's data for all items requiring fabrication, on or off the site, and for all proprietary equipment to the Consultant for review before any such items or equipment are incorporated into the Works. This review of Shop Drawings by the Consultant is for the sole purpose of ascertaining conformance with the general design concept. This review shall not mean that the Consultant approves the detailed design inherent in the Shop Drawings, the responsibility for which remains with the Contractor submitting them, and such review shall not relieve the Contractor of responsibility for errors or omissions in Shop Drawings or of responsibility for meeting all requirements of the Construction and Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the jobsite, for information that pertains solely to fabrication processes or to

techniques of construction and installation, and for coordination of the Work of all sub-trades.

- .2 Indicate Products, methods of construction, and attachment or anchorage, erection diagrams, connections, explanatory notes, and other information necessary for completion of the Work.
 - .1 Where Products attach or connect to other Products, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross-references to Drawings, Specifications and other already reviewed Shop Drawings.
 - .2 Accompany submittals with a transmittal information including:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification of each submittal item and quantity.
 - .5 Other pertinent data.
 - .3 Shop Drawing submittals to include the following as a minimum:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .4 Contractor's stamp, date, and signature of Contractor's authorized representative responsible for Shop Drawing review, indicating that each Shop Drawing has been reviewed for compliance with Contract Documents and, where applicable, that field measurements have been verified.
 - .5 Details of appropriate portions of the Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationships to other parts of the Work.
 - .6 Product data submittals shall include safety data sheets (SDS) for all controlled Products.
- .3 Submit one (1) electronic file in pdf file format of all relevant shop drawings to the Consultant. Limit file sizes to 10Mb. Scans must be legible. Illegible pdf files will be returned unreviewed and must be

resubmitted so they are legible. For larger projects with multiple shop drawing submissions an FTP site can be set up used upon request to the Consultant for shop drawing submittals if required.

- .4 Submit electronic copy of Product data sheets or brochures where specified in the technical Specifications and in accordance with the format restrictions set forth in 1.2.6 above.
- .5 Where a submittal includes information not applicable to the Work, clearly identify applicable information and strike out non-applicable information.
- .6 The Consultant will not review shop drawings and other material involving a large amount of Work in those instances where it is evident that the Contractor has not used all the information contained in, or where such details are obviously not consistent with the Contract Documents.
- .7 Supplement standard information to include details applicable to Project.
- .8 Allow five (5) Working Days for Consultant's review of each submittal and incorporate in submittals schedule specified in Section 01 32 00 - Construction Progress Documentation. Allow additional five (5) Working Days where sub-Consultant or commissioning agent review is required.
- .9 If upon Consultant's review no errors or omissions are discovered, or if only minor corrections are required as indicated, submittal will be returned and fabrication or installation of Work may proceed.
- .10 If upon Consultant's review significant errors or omissions are discovered, a so noted copy will be returned for correction and resubmission. Do not commence fabrication or installation.
- .11 Consultant's notations on submittals are intended to ensure compliance with Contract Documents and are not intended to constitute a change in the Work requiring change to the Contract Price or Contract Time. If Contractor considers any Consultant's notation to be a change in the Work, promptly notify Consultant in writing before proceeding with the Work.
- .12 Resubmit corrected submittals through same procedure indicated above before any fabrication or installation of the Work proceeds. When resubmitting, notify Consultant in writing of any revisions other than those requested by Consultant.
- .13 The Consultant will provide a shop drawing list with ID's. Shop drawings are to have an ID written on them.

1.3 SAMPLES

- .1 Submit samples for Consultant's review in the number specified in the technical Specifications. Label samples as to origin, Project name, and intended use.
- .2 Deliver samples prepaid to Consultant's business address.

- .3 Notify Consultant in writing of any deviations in samples from requirements of Contract Documents.
- .4 Where a required colour, pattern or texture has not been specified, submit full range of available Products meeting other specified requirements.
- .5 Consultant selection from samples is not intended to change the Contract Price or Contract Time. If a selection would affect the Contract Price or Contract Time, notify Consultant in writing prior to proceeding with the Work.
- .6 Resubmit samples as required by the Consultant to comply with Contract Documents.
- .7 Reviewed and accepted samples will establish the standard against which installed Work will be reviewed.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not applicable.

PART 3 - EXECUTION

3.1 NOT USED

- .1 Not applicable.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations.
- .2 Province of Nova Scotia
 - .1 Occupational Health and Safety Act, S.N.S. - Updated 2013.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit one (1) copy of Contractor's authorized representative's work site health and safety inspection reports Consultant and/or authority having jurisdiction, weekly.
- .3 Submit copies of reports or directions issued by Federal and/or Provincial health and safety inspectors.
- .4 Submit copies of incident and accident reports.
- .5 Submit WHMIS Safety Data Sheets (SDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .6 Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to the Consultant.
- .7 On-site Contingency and Emergency Response Plan to address standard operating procedures to be implemented during emergency situations.

1.3 FILING OF NOTICE

- .1 File notice of project with Provincial authorities prior to beginning of work.
- .2 Install proper site separation and identification in order to maintain time and space at all times throughout life of project.

1.4 SAFETY ASSESSMENT

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

1.5 MEETINGS

- .1 Schedule and administer health and safety meeting with the Consultant prior to commencement of work.

1.6 REGULATORY REQUIREMENTS

- .1 Do work in accordance with Section 01 41 00 - Regulatory Requirements.

1.7 RESPONSIBILITY

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

1.8 COMPLIANCE REQUIREMENTS

- .1 Comply with Occupational Health and Safety Act, Occupational Safety General Regulations, N.S. Reg. 53/2013
- .2 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

1.9 UNFORESEEN HAZARDS

- .1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of work, follow procedures in place for employee's right to refuse work in accordance with acts and regulations of Province having jurisdiction and advise Consultant verbally and in writing.
- .2 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, advise Health and Safety co-ordinator and follow procedures in accordance with Acts and Regulations of Province having jurisdiction and advise Consultant verbally and in writing.

1.10 HEALTH AND SAFETY CO-ORDINATOR

- .1 Employ and assign to work, competent, and authorized representative as health and safety co-ordinator. Health and safety co-ordinator must:
 - .1 Have site-related working experience specific to activities associated with the Work being done in this contract.
 - .2 Have working knowledge of occupational safety and health regulations.
 - .3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.
 - .4 Be on site during execution of Work and report directly to and be under direction of site supervisor.

1.11 POSTING OF DOCUMENTS

- .1 Post applicable items, articles, notices and orders in conspicuous location on site in accordance with acts and regulations of Province having jurisdiction, and in consultation with Consultant.

1.12 CORRECTION OF NON-COMPLIANCE

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

1.13 BLASTING

- .1 Blasting or other use of explosives is not permitted without prior receipt of written instruction by Consultant.

1.14 POWDER ACTUATED DEVICES

- .1 Use powder actuated devices only after receipt of written permission from the Consultant.

1.15 WORK STOPPAGE

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

1.16 HAZARDOUS MATERIAL

- .1 Should material resembling hazardous materials other than those identified within the Contract Documents, including, but not limited to, spray or trowel applied asbestos, be encountered in course of work; stop work immediately. Do not proceed until written instructions have been received from the Consultant.
- .2 Where work entails use, storage, or disposal of toxic or hazardous materials, chemicals and or explosives, or otherwise creates a hazard to life, safety, health, or the environment; work shall be in accordance with the Jurisdictional Authority.

1.17 CONFINED SPACES

- .1 Carry out Work in confined spaces in compliance with the Provincial occupational Health and Safety Regulations (OH&S), - Occupational Safety General Regulations, Confined Space Entry provisions.
- .2 Provide approved air monitoring equipment where workers are working in confined spaces and ensure any test equipment to be used is calibrated, in good working order and used by trained persons.
- .3 Develop a confined space entry program specific to the nature of Work performed and in accordance with OH&S Act and Regulations and confirm supervisors and workers are trained in the confined space entry program.
- .4 Confirm personal protective equipment and emergency rescue equipment are appropriate to the nature of the work being performed is provided

and used.

- .5 Provide and maintain training of workers, as required by the Federal and Provincial Legislation.
- .6 Provide Consultant with a copy of an "Entry Permit" for each entry into the confined space to ensure compliance with Federal and Provincial Legislation.

1.18 FIRST AID

- .1 During the progress of the Works, provide and maintain at all times and in easily accessible positions on the Works adequate first aid kits equal to those required by the Worker's Compensation Act for the free use as necessary of all persons on the Site.

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 "Reference standards" means consensus standards, trade association standards, guides, and other publications expressly referenced in Contract Documents.
- .2 Where an edition or version date is not specified, referenced standards shall be deemed to be the latest edition or revision issued by the publisher at the time of bid closing. However, if a particular edition or revision date of a specified standard is referenced in an applicable code or other regulatory requirement, the regulatory referenced edition or version shall apply.
- .3 Reference standards establish minimum requirements. If Contract Documents call for requirements that differ from a referenced standard, the more stringent requirements shall govern.
- .4 If compliance with two or more reference standards is specified and the standards establish different or conflicting requirements, comply with the most stringent requirement. Refer uncertainties to Consultant for clarification.

1.2 TESTING

- .1 Pay for the services of testing laboratory including:
 - .1 Inspection and testing required by laws, ordinances, rules and regulations.
 - .2 Testing, adjustment and balancing of process, mechanical and electrical equipment systems.
 - .3 Tests specified to be performed by Contractor.
 - .4 Inspection and testing performed exclusively for convenience of Contractor.
 - .5 Testing to ensure a safe Work environment for employees or subcontractors employed by the Contractor
- .2 Testing to be completed by an accredited third party approved by the Owner. This party must be identified on a QA/QC Plan submitted prior to the commencement of construction. This plan must also include a list of all tests being conducted along with the specific intervals of such tests. These intervals are to be determined either as specified in these technical sections or as directed by the Consultant.
- .3 Provide such assistance, labour, and materials as are normally required for examining, measuring and testing the quality, weight or quantity, pay all costs of any material used, and supply samples of materials before incorporation in the Works for testing as may be selected and as specified herein.
- .4 Perform or arrange for the performance of all tests on all equipment in complete accordance with the relevant clauses of these Specifications and in the presence of the Consultant.

- .5 The cost of providing assistance, samples, etc., for testing and arranging tests shall be deemed to be covered by and included in the Contract Price unless noted otherwise, elsewhere in these Specifications.
- .6 The Contractor shall have no claim against the Owner or the Consultant in respect of any financial loss which may be suffered from the rejection of any materials or equipment due to their failure to meet specified test requirements, and the Contractor shall also bear the cost of remedying any defects such that the material or equipment will meet the specified tests, or failing this, of removing the material or equipment from the Site. The decision to repair or replace materials and equipment which have failed to meet test requirements will be made by the Consultant.
- .7 Employment of inspection and testing agencies by Contractor does not relieve Contractor from responsibility to perform the Work in accordance with Contract Documents.
- .8 Allow and arrange for inspection and testing agencies to have access to the Work, including access to off-site manufacturing and fabrication plants.
- .9 For inspection and testing required by Contract Documents or by authorities having jurisdiction, provide Consultant and inspection and testing agencies with timely notification in advance of required inspection and testing.
- .10 Submit test samples required for testing in accordance with submittals schedule specified in Section 01 32 00 - Construction Progress Documentation and in accordance with Section 01 33 00 - Submittal Procedures.
- .11 Provide labour, Construction Equipment, and temporary facilities to obtain and handle test samples on site.

1.3 MOCK-UPS

- .1 Prepare mock-ups of Work as specified in the technical Specifications. If a mock-up location is not indicated in the Drawings or Specifications, locate where directed by the Consultant.
- .2 Modify mock-up as required until Consultant approval is obtained.
- .3 Approved mock-ups establish an acceptable standard for the Work.
- .4 Protect mock-ups from damage until the Work they represent is complete.
- .5 Unless otherwise specified in the technical Specifications, approved mock-ups forming part of the Work may remain as part of the Work.
- .6 Remove mock-ups only when the Work they represent is complete or when otherwise directed by the Consultant.
- .7 Employment of inspection and testing agencies by Contractor or Owner does not relieve Contractor from responsibility to perform the Work in accordance with Contract Documents.

- .8 Allow and arrange for inspection and testing agencies to have access to the Work, including access to off-site manufacturing and fabrication plants.
- .9 For inspection and testing required by Contract Documents or by authorities having jurisdiction, provide Consultant and inspection and testing agencies with timely notification in advance of required inspection and testing.
- .10 Submit test samples required for testing in accordance with submittals schedule specified in Section 01 32 00 - Construction Progress Documentation.
- .11 Provide labour, construction equipment and temporary facilities to obtain handle test samples on site.

1.4 INSPECTION AND TESTING AGENCY REPORTS

- .1 For inspection and testing required by contract documents or by regulatory requirements, and performed by Contractor retained inspection and testing agencies, submit to Consultant and Owner copies of reports. Submit within five (5) days after completion of inspection and testing.
- .2 For inspection and testing performed by Owner retained inspection and testing agencies, copies of inspection and testing agency reports will be provided to Contractor.

PART 2 - PRODUCTS

2.1 NOT USE

- .1 Not applicable.

PART 3 - EXECUTION

3.1 NOT USED

- .1 Not applicable.

END OF SECTION

PART 1 - General

1.1 SUMMARY

- .1 This Section references to laws, by laws, ordinances, rules, regulations, codes, orders of Authority Having Jurisdiction, and other legally enforceable requirements applicable to Work and that are; or become, in force during performance of Work.

1.2 DESIGN CODES

- .1 Perform Work in accordance with the latest National and Provincial Building Codes in effect at the time of tender closing including all amendments. In the case of conflict or discrepancy between provincial or local codes, the more stringent requirements apply.
- .2 Specific design and performance requirements listed in specifications or indicated on Drawings may exceed minimum requirements established by referenced Building Code; these requirements will govern over the minimum requirements listed in Building Code
 - .1 Meet or exceed requirements of:
 - .1 Contract documents.
 - .2 Specified standards, codes and referenced documents.

1.3 HAZARDOUS MATERIAL DISCOVERY

- .1 Asbestos: demolition of spray or trowel-applied asbestos is hazardous to health. Stop work immediately when material resembling spray or trowel-applied asbestos is encountered during demolition work. Notify Consultant.
- .2 PCB: Polychlorinated Biphenyl: stop work immediately when material resembling Polychlorinated Biphenyl is encountered during demolition work. Notify Consultant.
- .3 Mould: stop work immediately when material resembling mould is encountered during demolition work. Notify Consultant.

1.4 BUILDING SMOKING ENVIRONMENT

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

1.5 QUALITY ASSURANCE

- .1 Regulatory requirements: Except as otherwise specified, apply for, obtain, and pay fees associated with, permits, licenses, certificates, and approvals required by regulatory requirements and Contract Documents, based on General Conditions of Contract and the following:
 - .1 Regulatory requirements and fees in force on date of Bid submission, and
 - .2 A change in regulatory requirements or fees scheduled to become effective after date of tender submission and of which public notice has been given before date of tender submission.

1.6 EASEMENTS AND NOTICES

- .1 Owner will obtain permanent easements and rights of servitude that may be required for performance of Work.
- .2 Give notices required by regulatory requirements.

1.7 PERMITS

- .1 Development Permit: the costs for applying for and obtaining a development permit is considered to be included in the stipulated price provided by the Contractor.
- .2 Building Permit:
 - .1 Apply for, obtain and pay for building permit on behalf of the Owner, and other permits required for Work and its various parts.
 - .2 It may be required that specific Subcontractors obtain and pay for permits required by authorities having jurisdiction, where their Work is affected by Work requiring permits including but not necessarily limited to a demolition permit.
 - .3 Display building permit and other permits in a conspicuous location at Place of Work.
- .3 Occupancy Permits:
 - .1 Apply for, obtain, and pay for occupancy permits, including partial occupancy permits where required by authority having jurisdiction.
 - .2 The Consultant will issue appropriate instructions to the Contractor for correction to Work where Contract Document deficiencies are required to be corrected in order to obtain occupancy permits, including partial occupancy permits.
 - .3 Correct deficiencies in accordance with Consultant's instructions. Where deficiency is not corrected, Owner reserves the right to make correction and charge the Contractor for costs incurred.
 - .4 Turn occupancy permits over to Owner before application for Ready for Takeover.
- .4 NSE Approval
 - .1 Owner has applied for an Approval to Construct from Nova Scotia Environment and Climate Change. Work cannot commence until the Approval has been received.

Town of Lunenburg
Wastewater Treatment Plant
Upgrades & Expansion
Project No. 240800.00

REGULATORY
REQUIREMENTS

Section 01 41 00

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PART 2 - PRODUCTS

2.1 NOT USED

.1 Not applicable.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not applicable.

END OF SECTION

PART 1 - GENERAL

1.1 TEMPORARY UTILITIES - GENERAL

- .1 Provide temporary utilities as specified and as otherwise necessary to perform the Work expeditiously.
- .2 Remove temporary utilities after use.

1.2 TEMPORARY WATER SUPPLY

- .1 Connect to and use Owner's existing water supply for temporary use during construction, subject to existing available volume and pressure. Reimburse Owner's utility costs based on metered usage. Install a sub-meter for this purpose at Contractor's cost. Provide a backflow preventor for any service being used.
- .2 Arrange and pay for necessary water supply connections and disconnections.

1.3 TEMPORARY HEATING AND VENTILATION

- .1 Arrange and pay for temporary heating and ventilation required during construction.
- .2 Vent construction heaters in enclosed spaces to the outside or use flameless type of construction heaters.
- .3 Provide temporary heat for the Work as required to:
 - .1 Facilitate progress of Work.
 - .2 Protect the Work against dampness and cold.
 - .3 Prevent moisture condensation on surfaces, freezing, or other damage to finishes or stored Products.
 - .4 Maintain specified minimum ambient temperatures and humidity levels for storage, installation and curing of Products.
 - .5 After building is enclosed, maintain interior temperature of minimum 10 degrees C.
- .4 Provide temporary ventilation for the Work as required to:
 - .1 Prevent accumulations of fumes, exhaust, vapours, gases and other hazardous, noxious, or volatile substances in enclosed spaces, as required to maintain a safe Work environment meeting applicable regulatory requirements.
 - .2 Do not allow hazardous, noxious, or volatile substances to migrate to Owner to occupied spaces.
 - .3 Ventilate temporary sanitary facilities.
- .5 New permanent building heating and ventilation systems may be used during construction, at Contractor's option. If used during construction:
 - .1 Pay utility costs resulting from the use of permanent systems.

- .2 Operate systems in a non-wasteful and energy efficient manner. Be responsible for any system damage.
- .3 Just prior to Ready-for-Takeover, replace filters, clean ductwork, and perform other required maintenance to ensure systems are in as near as new condition as possible.
- .4 Systems manufacturers' warranties do not commence until the date of Ready-for-Takeover or, if manufacturers' warranties do commence earlier when systems are put into use, arrange for necessary extension of manufacturers' warranties or provide equivalent coverage under Contractor's warranty.

1.4 TEMPORARY ELECTRICAL POWER AND LIGHTING

- .1 Connect to and use Owner's existing electrical supply for temporary use during construction. Reimburse Owner's utility costs based on metered usage. Install a sub-meter for this purpose at Contractor's cost
- .2 Existing maximum power supply of 230 V is available for temporary use during construction.
- .3 Arrange and pay for necessary connections and disconnections of temporary power and lighting in accordance with regulatory requirements.
- .4 New permanent building power and lighting systems may be used during construction, at Contractor's option. If used during construction:
 - .1 Pay utility costs resulting from the use of permanent systems.
 - .2 Operate systems in a non-wasteful and energy efficient manner. Be responsible for any system damage.
 - .3 Just prior to applying for Ready-for-Takeover, replace lamps which have been used for more than three (3) months.
 - .4 Ensure that systems manufacturers' warranties do not commence until the date of Ready-for-Takeover or, if manufacturers' warranties do commence earlier when systems are put into use, arrange for necessary extension of manufacturers' warranties or provide equivalent coverage under Contractor's warranty.
- .5 Protect persons from injury and avoid property damage by providing barricades, construction signs, torches, flashers, and guards as required during the progress of the construction Work. Enclosed material piles, equipment, plant or construction equipment which may serve as obstructions by fences or barricades and protect with proper lights when the visibility is poor.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not applicable.

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TEMPORARY UTILITIES

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PART 3 - EXECUTION

3.1 NOT USED

.1 Not applicable.

END OF SECTION

PART 1 - GENERAL

1.1 BARRIERS AND ENCLOSURES - GENERAL

- .1 Provide temporary barriers and enclosures necessary to protect the public and building occupants and to secure Place of the Work during performance of the Work.
- .2 Comply with applicable regulatory requirements.
- .3 Maintain temporary barriers and enclosures in good condition for the duration of the Work.
- .4 Remove temporary barriers and enclosures from Place of the Work when no longer required.

1.2 FENCING

- .1 Erect temporary security and safety site fencing of type and height determined by Contractor, subject to applicable regulatory requirements.
- .2 Provide lockable access gates as required to facilitate construction access.

1.3 EXTERIOR HOARDING

- .1 Erect temporary exterior site hoarding to comply with applicable regulatory requirements and as follows:
 - .1 Use lumber framing and, minimum 13 mm thick exterior grade plywood.
 - .2 Paint public side of hoarding with one coat primer and one coat exterior paint. Maintain public side of hoarding clean and in good repair until removed.
 - .3 Provide lockable access gates for Construction Equipment and lockable pedestrian doors as required to facilitate construction access.
 - .4 Erect and maintain pedestrian walkways including roof and side covers, complete with pedestrian signage and electrical lighting.

1.4 WEATHER ENCLOSURES

- .1 Provide weather tight enclosures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.
 - .1 Provide weather enclosures to protect floor areas where walls are not finished and to enclose Work areas that require temporary heating.
 - .2 Design weather enclosures to withstand wind pressure and snow loading requirements.

1.5 TEMPORARY ENCLOSURES AND DUST CONTROL

- .1 Provide full enclosures to localize silica dust generating activities, and for protection of workers, finished areas of Work and public.
 - .1 Erect, maintain, and relocate screens and/or partitions as required to facilitate construction operations and Owner's operational requirements.
 - .2 Cutting, breaking, or pulverizing of concrete products may result in exposure to airborne silica. Appropriate hygiene and personal protection of workers must be developed and employed as per the applicable Occupational Health and Safety Act with respect to airborne concentrations. Refer to the Ontario Ministry of Labour, Training and Skills Development Health and Safety Guidelines for Silica On Construction Projects for additional procedures.
 - .3 The size and locations of temporary enclosures shown on the plans are approximate. Adjust size and locations to accommodate repairs but maintain suitable drive aisles during the Work.
 - .4 Take special care to mitigate any dust from migrating to areas outside the enclosed Work areas. The Consultant reserves the right to stop Work if it is found that areas outside the enclosed Work areas are being subjected to unacceptable dust levels.
 - .5 Maintain and relocate protection as required until such Work is complete.
 - .6 At a minimum, provide temporary construction signage indicated on the drawings. Additional signage may be required by the Consultant and/or Owner.

1.6 FIRE ROUTES

- .1 Maintain fire access routes, including overhead clearances, for use by emergency response vehicles.

1.7 PROTECTION OF BUILDING FINISHES

- .1 Provide necessary temporary barriers and enclosures to protect completed or partially completed finished surfaces from damage during performance of the Work.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not applicable.

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TEMPORARY BARRIERS AND
ENCLOSURES

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PART 3 - EXECUTION

3.1 NOT USED

.1 Not applicable.

END OF SECTION

PART 1 GENERAL

1.1 TEMPORARY CONTROLS - GENERAL

- .1 Provide temporary controls as necessary for performance of the Work and in compliance with applicable regulatory requirements.
- .2 Maintain temporary controls in good condition for the duration of the Work.
- .3 Remove temporary controls and Construction Equipment used to provide temporary controls from Place of the Work when no longer required.

1.2 PLANT PROTECTION

- .1 Protect trees and other plant material designated to remain on site where indicated on Drawings.
- .2 Protect trees and shrubs susceptible to damage during construction by encasing with protective wood framework from grade to height of one metre.
- .3 For trees designated to remain, protect roots inside dripline from disturbance or damage during excavation and grading. Avoid traffic, dumping and storage of materials over root zones.
- .4 Minimize stripping of topsoil and vegetation.

1.3 DUST AND PARTICULATE CONTROL

- .1 Implement and maintain dust and particulate control measures in accordance with applicable regulatory requirements.
- .2 Execute Work by methods that minimize dust from construction operations and spreading of dust on site or to adjacent properties.
- .3 Provide temporary enclosures to prevent extraneous materials resulting from sandblasting or similar operations from contaminating air beyond immediate Work area.
- .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.
- .5 Use appropriate covers on trucks hauling fine, dusty, or loose materials.

1.4 DEWATERING

- .1 Provide temporary drainage and pumping as necessary to dewater excavations, trenches, foundations, and other parts of the Work. Maintain such areas free of water arising from groundwater or surface run-off, as required to keep them stable, dry, and protected from damage due to flooding.
- .2 Maintain standby equipment necessary to ensure continuous operation of dewatering system.

- .3 Do not pump water containing suspended materials or other harmful substances into waterways, sewers or surface drainage systems. Treat or dispose of such water in accordance with applicable regulatory requirements.

1.5 SITE DRAINAGE

- .1 Maintain grades to ensure proper site drainage.
- .2 Prevent surface water runoff from leaving the site
- .3 Prevent precipitation from infiltrating or from directly running off stockpiled waste materials. Cover stockpiled construction and waste materials with an impermeable liner during periods of Work stoppage including at end of each Working Day.
- .4 Control surface drainage from cuts and fills, from borrow and waste disposal areas, from stockpiles, staging areas, and other Work areas as required to prevent erosion and sedimentation.
- .5 Control surface drainage by ensuring that gutters are kept open and water is not directed across or over pavements or sidewalks, except through pipes or properly constructed troughs. Ensure that runoff from unfinished areas is intercepted and diverted to suitable outlets.

1.6 EROSION AND SEDIMENT CONTROL

- .1 Minimize amount of bare soil exposed at one time. Stabilize disturbed soils as quickly as practical to minimize erosion. Remove accumulated sediment resulting from construction activity from adjoining surfaces, drainage systems, and watercourses, and repair damage caused by soil erosion and sedimentation.
- .2 Provide and maintain appropriate temporary measures such as silt fences, straw bales, ditches, geotextiles, drains, berms, terracing, riprap, temporary drainage piping, sedimentation basins, vegetative cover, dikes, and other measures that may be required to prevent erosion and migration of silt, mud, sediment, and other debris.
- .3 Do not disturb existing embankments or embankment protection.
- .4 Periodically inspect erosion and sediment control measures to detect evidence of erosion and sedimentation. Promptly take corrective measures when necessary.
- .5 If soil and debris from site accumulate in ditches or other low areas, remove accumulation and restore area to original condition.

1.7 POLLUTION CONTROL

- .1 Take measures to prevent contamination of soil, water, and atmosphere through uncontrolled discharge of noxious or toxic substances and other pollutants, potentially causing environmental damage.
- .2 Be prepared, by maintaining appropriate materials, equipment, and trained personnel on site, to intercept, clean up, and dispose of spills or releases that may occur. Promptly report spills and releases

that may occur to:

- .1 authority having jurisdiction,
- .2 person causing or having control of pollution source, if known,
and
- .3 Owner and Consultant.
- .4 Contact manufacturer of pollutant, if known and applicable, to
obtain safety data sheets (SDS) and ascertain hazards involved
and precautions and measures required in cleanup or mitigating
actions.
- .5 Take immediate action to contain and mitigate harmful effects of
the spill or release.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not applicable.

PART 3 - EXECUTION

3.1 NOT USED

- .1 Not applicable.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL

- .1 Provide Products that are not damaged or defective, and suitable for purpose intended, subject to specified requirements. If requested by the Consultant, furnish evidence as to type, source and quality of Products provided.
- .2 Unless otherwise specified, maintain uniformity of manufacture for like items throughout.

1.2 MATERIALS AND WORKMANSHIP

- .1 All equipment, materials and workmanship shall be the best of the respective kinds described in the Contract and in accordance with the Consultant's instructions and may be subjected to standard tests as the Consultant may direct at the place of manufacture or fabrication or on the Site.
- .2 Where the Consultant has requested and before ordering materials for incorporation into the Works inform the Consultant of the source of the materials. No order for such materials will be given except with the authorization of the Consultant. Notwithstanding the fact that such authorization may have been given, the Consultant may forbid the use of any such materials, if upon delivery, they are found to be defective or unsuitable for incorporation in the Works. Keep the Consultant fully advised of the orders and delivery dates of materials.
- .3 All material and equipment required to be incorporated into the Work must be new and unused. Any material found during the progress of the Work to have cracks, flaws, or other defects will be rejected by the Consultant.
- .4 Replace materials and equipment found defective in manufacturer. This includes the furnishing of all materials and labour required for the replacement of installed material and equipment discovered defective prior to the final acceptance of the Works.

1.3 PRODUCT OPTIONS

- .1 Subject to the provisions of Section 01 25 00 -Substitution Procedures:
 - .1 Wherever a Product or manufacturer is specified by a single proprietary name, provide the named Product only.
 - .2 Wherever more than one Product or manufacturer is specified by proprietary name for a single application, provide any one of the named Products.
- .2 Wherever a Product is specified by reference to a standard only, provide any Product that meets or exceeds the specified standard. If requested by Consultant, submit information verifying that the

proposed Product meets or exceeds the specified standard.

- .3 Wherever a Product is specified by descriptive or performance requirements only, provide any Product that meets or exceeds the specified requirements. If requested by the Consultant, submit information verifying that the proposed Product meets or exceeds the specified requirements.

1.4 PRODUCT AVAILABILITY AND DELIVERY TIMES

- .1 Promptly upon Contract award and periodically during construction, review and confirm Product availability and delivery times. Order Products in sufficient time to meet the construction progress schedule and the Contract Time.
 - .1 If a specified Product is no longer available, promptly notify Consultant. Consultant will take action as required.
 - .2 If delivery delays are foreseeable, for any reason, promptly notify Consultant.
 - .3 If a delivery delay is beyond Contractor's control, Consultant will provide direction.
 - .4 If a delivery delay is caused by something that was or is within Contractor's control, Contractor shall propose actions to maintain the construction progress schedule for Consultant's review and acceptance.

1.5 STORAGE, HANDLING, AND PROTECTION

- .1 Store, handle, and protect Products during transportation to Place of the Work and before, during, and after installation in a manner to prevent damage, adulteration, deterioration and soiling.
 - .1 Comply with manufacturer's instructions for storage, handling and protection.
 - .2 Store packaged or bundled Products in original and undamaged condition with manufacturer's seals and labels intact. Do not remove from packaging or bundling until required in Work.
 - .3 Comply with the requirements of the workplace hazardous materials information system (WHMIS) regarding use, handling, storage, and disposal of hazardous materials, including requirements for labeling and the provision of safety data sheets (SDS).
 - .4 Store Products subject to damage from weather in weatherproof enclosures.
 - .5 Store sheet Products on flat, solid, supports and keep clear of ground. Slope to shed moisture.
 - .6 Remove and replace damaged Products.

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COMMON PRODUCT
REQUIREMENTS

Section 01 61 00

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PART 2 - PRODUCTS

2.1 NOT USED

.1 Not applicable.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not applicable.

END OF SECTION

PART 1 - GENERAL

1.1 SURVEYOR QUALIFICATIONS

- .1 Engage a registered land surveyor, licensed to practice in Place of the Work.

1.2 SUBMITTALS

- .1 Submit name and address of registered land surveyor performing survey Work.
- .2 Submit to Owner and Consultant the survey of the Work prepared and issued by a registered land surveyor on completion of the building footings and foundations and as required by authorities having jurisdiction and on completion of the Work.

1.3 REFERENCE POINTS

- .1 Before the Work of the Contract starts, the Consultant will only once provide the data for sufficient reference points to identify the Site on the ground. Have reference points established on-site by a licensed surveyor at no additional cost to the Contract. Maintain these, and/or re-establish points as required during the Contract period. Preserve and protect permanent reference points on site during construction.
- .2 Do not change or relocate reference points without prior written notice to the Consultant.
- .3 Report to Consultant when a reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations. Require registered land surveyor to replace reference points in accordance with original survey.

1.4 SURVEY REQUIREMENTS

- .1 Establish sufficient permanent benchmarks on site, referenced to established benchmarks by survey control points.
- .2 Confirm that existing survey reference points are in accordance with Owner's survey and property limits.
- .3 Establish initial lines and levels for building layout.
- .4 Maintain a complete, accurate log of control and survey Work as it progresses. Record locations with horizontal and vertical data in project record documents.

1.5 EXISTING UTILITIES AND STRUCTURES

- .1 Before commencing excavation, drilling or other earthwork, establish or confirm location and extent of all existing underground utilities and structures in Work area.
- .2 Promptly notify Consultant if underground utilities, structures, or their locations differ from those indicated in Contract Documents or in available project information. Consultant will provide appropriate

direction.

- .3 Record locations of maintained, re-routed and abandoned utility lines.

1.6 VERIFICATION OF EXISTING CONDITIONS

- .1 Where Work specified in any Section is dependent on the Work of another Section or Sections having been properly completed, verify that Work is complete and in a condition suitable to receive the subsequent Work. Commencement of Work of a Section that is dependent on the Work of another Section or Sections having been properly completed, means acceptance of the existing conditions.
- .2 Verify that ambient conditions are suitable before commencing the Work of any Section and will remain suitable for as long as required for proper setting, curing, or drying of Products used.
- .3 Ensure that substrate surfaces are clean, dimensionally stable, cured and free of contaminants.
- .4 Notify Consultant in writing of unacceptable conditions.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not applicable.

PART 3 - EXECUTION

3.1 NOT USED

- .1 Not applicable.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Except where otherwise specified in technical Specifications or otherwise indicated on Drawings, comply with requirements of this Section.

1.2 MANUFACTURER'S INSTRUCTIONS

- .1 Install, erect, or apply Products in strict accordance with manufacturer's instructions.
- .2 Notify Consultant, in writing, of conflicts between Contract Documents and manufacturer's instructions where, in Contractor's opinion, conformance with Contract Documents instead of the manufacturer's instructions may be detrimental to the Work or may jeopardize the manufacturer's warranty.
- .3 Do not rely on labels or enclosures provided with Products. Obtain written instructions directly from manufacturers.
- .4 Provide manufacturer's representatives with access to the Work at all times. Render assistance and facilities for such access so that manufacturer's representatives may properly perform their responsibilities.

1.3 CONCEALMENT

- .1 Conceal pipes, ducts, and wiring in floors, walls, and ceilings in finished areas:
 - .1 after review by Consultant and authority having jurisdiction, and
 - .2 where locations differ from those shown on Drawings, after recording actual locations on as-built drawings.
- .2 Provide incidental furring or other enclosures as required.
- .3 Notify Consultant in writing of interferences before installation.

1.4 FASTENINGS - GENERAL

- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials.
- .2 Prevent electrolytic action and corrosion between dissimilar metals and materials by using suitable non-metallic strips, washers, sleeves, or other permanent separators to avoid direct contact.
- .3 Use non-corrosive fasteners and anchors for securing exterior Work and in spaces where high humidity levels are anticipated.
- .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage.
- .5 Keep exposed fastenings to a minimum, space evenly and install neatly.

- .6 Do not use fastenings or fastening methods that may cause spalling or cracking of material to which anchorage is made.

1.5 FASTENINGS - EQUIPMENT

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .2 Bolts shall not project more than one diameter beyond nuts.

1.6 FIRE RATED ASSEMBLIES

- .1 When penetrating fire rated walls, ceiling, or floor assemblies, completely seal voids with fire-stopping materials, smoke seals, or both, in full thickness of the construction element as required to maintain the integrity of the fire rated assembly.

1.7 LOCATION OF FIXTURES, OUTLETS AND DEVICES

- .1 Consider location of fixtures, outlets, and devices indicated on Drawings as approximate.
- .2 Locate fixtures, outlets, and devices to provide minimum interference, maximum usable space, and as required to meet safety, access, maintenance, acoustic, and regulatory, including barrier free, requirements.
- .3 Promptly notify Consultant in writing of conflicting installation requirements for fixtures, outlets, and devices. If requested, indicate proposed locations and obtain approval for actual locations.

1.8 PROTECTION OF COMPLETED WORK AND WORK IN PROGRESS

- .1 Adequately protect parts of the Work completed and in progress from any kind of damage.
- .2 Promptly remove, replace, clean, or repair, as directed by Consultant, Work damaged as a result of inadequate protection.
- .3 Do not load or permit to be loaded any part of the Work with a weight or force that will endanger the safety or integrity of the Work.

1.9 REMEDIAL WORK

- .1 Notify Consultant of, and perform remedial Work required to, repair or replace defective or unacceptable Work. Ensure that properly qualified workers perform remedial Work. Coordinate adjacent affected Work as required.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not applicable.

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EXECUTION

Section 01 73 00

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PART 3 - EXECUTION

3.1 NOT USED

.1 Not applicable.

END OF SECTION

PART 1 - GENERAL

1.1 REQUEST FOR CUTTING, PATCHING AND REMEDIAL WORK

- .1 Submit written request in advance of cutting, coring, or alteration which affects or is likely to affect:
 - .1 Structural integrity of any element of the Work.
 - .2 Integrity of weather-exposed or moisture-resistant elements.
 - .3 Efficiency, maintenance, or safety of any operational element.
 - .4 Visual qualities of sight-exposed elements.
 - .5 Work of Owner or other contractors.
 - .6 Warranty of Products affected.
- .2 Include in request:
 - .1 Identification of Project.
 - .2 Location and description of affected Work, including drawings or sketches as required.
 - .3 Statement on necessity for cutting or alteration.
 - .4 Description of proposed Work, and Products to be used.
 - .5 Alternatives to cutting and patching.
 - .6 Effect on Work of Owner or other contractors.
 - .7 Written permission of affected other contractors.
 - .8 Date and time Work will be executed.

1.2 PRODUCTS

- .1 Unless otherwise specified, when replacing existing or previously installed Products in the course of cutting and patching Work, use replacement Products of the same character and quality as those being replaced.
- .2 If an existing or previously installed Product must be replaced with a different Product, submit request for substitution in accordance with Section 01 25 00 - Substitution Procedures.

1.3 PREPARATION

- .1 Inspect existing conditions in accordance with Section 01 71 00 - Examination and Preparation.
- .2 Provide supports to ensure structural integrity of surroundings; provide devices and methods to protect other portions of the Work from damage.
- .3 Provide protection from elements for areas that may be exposed by uncovering Work.

1.4 EXISTING UTILITIES

- .1 Known subsurface services and utilities may be indicated on the drawings or otherwise identified. Prior to carrying out any subsurface excavation, contact applicable utilities or Owner's personnel to

precisely locate buried structures or utilities on the ground. All costs to locate and identify such buried services shall be deemed to be included in the Contract Price. Test dig and carefully excavate to locate such services and utilities.

- .2 Where the Work involves breaking into or connecting to existing services, give Owner 48 hours of notice for necessary interruption of mechanical or electrical services.
- .3 Maintain excavations free of water.
- .4 Keep duration of interruptions to a minimum.
- .5 Carry out interruptions after regular working hours of occupants, preferably on weekends, unless Owner's prior written approval is obtained.
- .6 Protect and maintain existing active services. Record location of services, including depth, on as-built drawings.
- .7 Construct or erect barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures as required to protect pedestrian and vehicular traffic.

1.5 CUTTING, PATCHING, AND REMEDIAL WORK

- .1 Bear costs of repairing damage to the Site, property of others and injuries of persons resulting from the Contractor's operation under the Contract.
- .2 Immediately inform the Consultant of damage or injury to persons, property, services or materials.
- .3 Coordinate and perform the Work to ensure that cutting and patching Work is kept to a minimum.
- .4 Perform cutting, fitting, patching, and remedial Work to make the affected parts of the Work come together properly and complete the Work.
- .5 Provide openings in non-structural elements of the Work for penetrations of mechanical and electrical Work.
- .6 Perform cutting by methods to avoid damage to other Work.
- .7 Provide proper surfaces to receive patching, remedial Work, and finishing.
- .8 Perform cutting, patching, and remedial Work using competent and qualified specialists familiar with the Products affected, in a manner that neither damages nor endangers the Work.
- .9 Do not use pneumatic or impact tools without Consultant's prior approval.
- .10 Ensure that cutting, patching, and remedial Work does not jeopardize manufacturers' warranties.
- .11 Refinish surfaces to match adjacent finishes. For continuous surfaces refinish to nearest intersection. For an assembly, refinish entire

unit.

- .12 Fit Work to pipes, sleeves, ducts, conduit, and other penetrations through surfaces with suitable allowance for deflection, expansion, contraction, acoustic isolation, and firestopping.
- .13 Maintain fire ratings of fire rated assemblies where cutting, patching, or remedial Work is performed. Completely seal voids or penetrations of assembly with firestopping material to full depth or with suitably rated devices.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not applicable.

PART 3 - EXECUTION

3.1 NOT USED

- .1 Not applicable.

END OF SECTION

PART 1 - GENERAL

1.1 REGULATORY REQUIREMENTS

- .1 Comply with applicable regulatory requirements when disposing of waste materials.
- .2 Obtain permits from authorities having jurisdiction and pay disposal fees where required for disposal of waste materials and recyclables.

1.2 GENERAL CLEANING REQUIREMENTS

- .1 Provide adequate ventilation during use of volatile or noxious substances. Do not rely on building ventilation systems for this purpose.
- .2 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .3 Prevent cross-contamination during the cleaning process.
- .4 Notify the Consultant of the need for cleaning caused by Owner or other contractors.

1.3 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL - GENERAL

- .1 Keep Work, property, road surfaces, etc. in vicinity of the Works and in areas where Contractor's trucks will travel in a clean and orderly condition, free from excessive dirt, dust, snow, ice, rubbish, etc. at all times during the progress of the Work.
- .2 Maintain trucks so that no spillage will occur before leaving the Site. Trim loads and free wheels of accumulations of soil.
- .3 Keep Site free from accumulations of waste material and rubbish to prevent an unsightly or hazardous condition. On the completion of the Works clear away and remove from the Site all Construction Equipment, surplus materials, rubbish, and temporary Works of every kind and leave the whole of the Site and Works in a condition that meets the approval of the Consultant.
- .4 Do not dispose of volatile fluid wastes (such as mineral spirits, oil, or paint thinner) in storm or sanitary sewer systems or into streams or waterways.
- .5 Dispose of debris and waste materials in accordance with the latest regulations respecting Solid Waste Resource Management issued by Nova Scotia Environment, at no additional cost to the Contract.
- .6 Dispose of all construction and demolition waste at an approved C&D waste disposal site.
- .7 Where possible, divert construction and demolition waste to the appropriate recycling facilities. Minimize waste generated by the Work.
- .8 Do not burn or bury waste materials at Place of the Work.

- .9 Cover or wet down dry waste materials to prevent blowing dust and debris.

1.4 PROGRESSIVE CLEANING AND WASTE MANAGEMENT

- .1 Maintain the Work in a tidy and safe condition, free from accumulation of waste materials and construction debris.
- .2 Provide appropriate, clearly marked, containers for collection of waste materials and recyclables. Locate containers as directed by the Owner and/or Consultant.
- .3 Remove waste materials and recyclables from Work areas, separate, and deposit in designated containers at end of each Working Day. Collect packaging materials for recycling or reuse.
- .4 Remove waste materials and recyclables from Place of the Work at regular intervals in order to maintain a clean and orderly site.
- .5 Clean interior building areas prior to start of finish Work and maintain free of dust and other contaminants during finishing operations.
- .6 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly finished surfaces nor contaminate building systems.

1.5 FINAL CLEANING

- .1 Before final cleaning, arrange a meeting at Place of the Work to determine the acceptable standard of cleaning.
- .2 Remove from Place of the Work surplus Products, waste materials, recyclables, Temporary Work, and Construction Equipment not required to perform any remaining Work.
- .3 Provide professional cleaning by a qualified, established cleaning company.
- .4 Lock or otherwise restrict access to each room or area after completing final cleaning in that area.
- .5 Re-clean as necessary areas that have been accessed by Contractor's workers prior to Owner occupancy.
- .6 Remove stains, spots, marks, and dirt from finished surfaces, electrical and mechanical fixtures, furniture fitments, walls, and floors.
- .7 As applicable, clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and all other finished surfaces, including mechanical and electrical fixtures. Replace broken, scratched or otherwise damaged glass.
- .8 Remove dust from lighting reflectors, lenses, lamps, bulbs, and other lighting surfaces.

- .9 Vacuum clean and dust exposed wall, floor, and ceiling surfaces, behind grilles, louvres, and screens.
- .10 Clean mechanical, electrical, and other equipment. Replace filters for mechanical equipment if equipment is used during construction.
- .11 Remove waste material and debris from crawlspaces and other accessible concealed spaces.
- .12 Remove stains, spots, marks, and dirt from exterior facades.
- .13 Clean exterior and interior window glass and frames.
- .14 Clean and sweep roofs, clear roof drains, clean gutters and downspouts, sunken wells.
- .15 Remove snow and ice from exterior sidewalks, steps, driveways, roads, parking lots, and other paved surfaces.
- .16 Use leaf blowers to clean landscaped surfaces.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not applicable.

PART 3 - EXECUTION

3.1 NOT USED

- .1 Not applicable.

END OF SECTION

PART 1 GENERAL

1.1 SUBSTANTIAL PERFORMANCE OF THE WORK

- .1 Complete the prerequisites to, and the procedures for, attaining substantial performance of the Work, or similar such milestone as provided for in the lien legislation applicable to the Place of the Work.

1.2 READY-FOR-TAKEOVER

- .1 The prerequisites to attaining Ready-for-Takeover of the Work are described in the General Conditions of the Contract.

1.3 INSPECTION AND REVIEW BEFORE READY-FOR-TAKEOVER

- .1 Contractor's Inspection: Before applying for the Consultant's review to establish Ready-for-Takeover of the Work:
 - .1 Ensure that the specified prerequisites to Ready-for-Takeover of the Work are completed.
 - .2 Conduct an inspection of the Work to identify defective, deficient, or incomplete work.
 - .3 Prepare a comprehensive and detailed list of items to be completed or corrected.
 - .4 Provide an anticipated schedule and costs for items to be completed or corrected.
- .2 Consultant's Review: Upon receipt of the Contractor's application for review, together with the Contractor's list of items to be completed or corrected, the Consultant and the Contractor shall arrange a mutually satisfactory agreed date and time to jointly review the Work. The Consultant will advise the Contractor whether or not the Work is Ready-for-Takeover. Add additional items, if any, to the Contractor's list of items to be completed or corrected. Provide the Consultant with a copy of the revised list.
- .3 Maintain the list of items to be completed or corrected and promptly correct or complete defective, deficient and incomplete work. The Contractor's inspection and Consultant's review procedures specified above shall be repeated until the Work is Ready-for-Takeover and no items remain on the Contractor's list of items to be completed or corrected.
- .4 When the Consultant determines that the Work is Ready-for-Takeover, the Consultant will notify the Contractor and the Owner in writing to that effect.

1.4 PREREQUISITES TO FINAL PAYMENT

- .1 After Ready-for-Takeover of the Work and before submitting an application for final payment in accordance with the General Conditions of Contract:

- .1 Correct or complete all remaining defective, deficient, and incomplete work.
- .2 Remove from the Place of the Work all remaining surplus Products, Construction Equipment, and Temporary Work.
- .3 Perform final cleaning and waste removal necessitated by the Contractor's work performed after Ready-for-Takeover, as specified in Section 01 74 00 - Cleaning and Waste Management.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not applicable.

PART 3 - EXECUTION

3.1 NOT USED

- .1 Not applicable.

END OF SECTION

PART 1 - GENERAL

1.1 OPERATION AND MAINTENANCE MANUAL

- .1 Prepare a comprehensive operation and maintenance manual, in the language of the Contract, using personnel qualified and experienced for this task.
- .2 Fifteen working days before the anticipated Ready-for-takeover date submit an initial draft of the operation and maintenance manual for Consultant's review. If required by Consultant's review comments, revise manual contents, and resubmit for Consultant's review. If required, repeat this process until Consultant accepts the draft manual in writing.
- .3 Submit final version to Owner in hard copy and electronic format. Provide three (3) hard copies.

1.2 OPERATION AND MAINTENANCE MANUAL FORMAT

- .1 Organize data in the form of an instructional manual.
- .2 Binders: vinyl, hard covered, three D-rings, loose leaf, 216 x 279 mm, with spine and face pockets.
- .3 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.
- .4 Cover: Identify each binder with typed or printed title "Operation and Maintenance Manual", name of Project or facility, and subject matter of contents.
- .5 Arrange content by systems, under Section numbers and sequence of Table of Contents.
- .6 Provide tabbed fly leaf for each separate Product or system, with typed description of Product and major component parts of equipment.
- .7 Text: Manufacturer's printed data, or typewritten data.
- .8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- .9 In addition to the hard copy requirements given above, provide an electronic copy of manual in PDF format.
- .10 Provide electronic copy of Shop Drawings in manual as 1:1 scaled PDF files in .pdf file format on electronic media acceptable to Owner.

1.3 OPERATION AND MAINTENANCE MANUAL - GENERAL CONTENT

- .1 Table of contents for each volume.
- .2 Introductory information including:
 - .1 Date of manual submission.
 - .2 Complete contact information for Consultant, subconsultants, other consultants, and Contractor, with names of responsible

parties.

- .3 Schedule of Products and systems indexed to content of volume.
- .3 For each Product or system, include complete contact information for Subcontractors, Suppliers and manufacturers, including local sources for supplies and replacement parts.
- .4 Product Data: mark each sheet to clearly identify specific products, options, and component parts, and data applicable to installation. Delete or strike out inapplicable information. Supplement with additional information as required.
- .5 Reviewed Shop Drawings.
- .6 Permits, certificates, letters of assurance and other relevant documents issued by or required by authorities having jurisdiction.
- .7 Warranties.
- .8 Operating and maintenance procedures, incorporating manufacturer's operating and maintenance instructions, in a logical sequence.
- .9 Training materials as specified in Section 01 79 00 - Demonstration and Training.

1.4 OPERATION AND MAINTENANCE MANUAL - EQUIPMENT AND SYSTEMS CONTENT

- .1 Each item of equipment and each system: include description of unit or system and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- .2 Panel Board Circuit Directories: provide electrical service characteristics, controls, and communications.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide Contractor's coordination drawings, with installed colour coded piping diagrams.

- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include testing and balancing reports.
- .15 Include additional content as specified in technical Specifications sections.

1.5 OPERATION AND MAINTENANCE MANUAL - PRODUCTS AND FINISHES CONTENT

- .1 Include Product data, with catalogue number, options selected, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured Products.
- .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 Include an outline of requirements for routine and special inspections and for regular maintenance to ensure that on-going performance of the building envelope will meet the initial building envelope criteria.
- .4 Include additional content as specified in technical Specifications sections.

1.6 OPERATION AND MAINTENANCE MANUAL - WARRANTIES CONTENT

- .1 Separate each warranty with index tab sheets keyed to Table of Contents listing.
- .2 List each warrantor with complete contact information.
- .3 Verify that documents are in proper form and contain full information. Ensure that warranties are for the correct duration and are in Owner's name.

1.7 RECORD INFORMATION

- .1 Record Drawings:
 - .1 After award of Contract, Consultant will provide a set of drawings for purpose of maintaining record drawings. Accurately and neatly record deviations from Contract Documents caused by site conditions and changes ordered by Consultant.
 - .2 Identify drawings as "Project Record Copy". Maintain in new condition and make available for inspection on site by Consultant.
 - .3 On completion of Work and prior to final inspection, submit record documents to Consultant.
- .2 Maintain record drawings on site as the work progresses for all aspects of the work.

1.8 PROJECT RECORD DRAWINGS

- .1 Transfer all information marked up on the as-built drawings during the progress of the Work to a master set of record drawing files provided by Consultant, in electronic format.
- .2 Mark revised drawings as "RECORD DRAWINGS".
- .3 Submit completed record drawings in electronic form to Owner and Consultant.

1.9 SPARE PARTS, MAINTENANCE MATERIALS, AND SPECIAL TOOLS

- .1 Supply spare parts, maintenance materials, and special tools in quantities specified in technical Specifications sections.
- .2 Ensure spare parts and maintenance materials are new, not damaged nor defective, and of same quality, manufacturer, and batch or production run as installed Products.
- .3 Provide tags for special tools identifying their function and associated Product.
- .4 Deliver to and store items at location directed by Owner at Place of the Work. Store in original packaging with manufacturer's labels intact and in a manner to prevent damage or deterioration.
- .5 Catalogue all items and submit to Consultant an inventory listing organized by Specifications section. Include Consultant reviewed inventory listing in operation and maintenance manual.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not applicable.

PART 3 - EXECUTION

3.1 NOT USED

- .1 Not applicable.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 When specified in individual Sections, have the manufacturer provide an authorized representative to demonstrate operation of equipment and systems, instruct Owner's personnel, and provide written report that demonstration and instructions have been completed prior to scheduled date of Ready-for-Takeover of the Work.
- .2 Owner will provide list of personnel to receive training and will coordinate their attendance at agreed upon times.
- .3 Coordinate and schedule demonstration and training provided by Subcontractors and Suppliers.

1.2 SUBMITTALS

- .1 Submit proposed dates, times, durations, and locations for demonstration and training of each item of equipment and each system for which demonstration and training is required. Allow sufficient time for training and demonstration for each item of equipment or system, or time as may be specified in technical Specifications.
- .2 Consultant and Owner will review submittal and advise Contractor of any necessary revisions.
- .3 Submit report(s) within five (5) Working Days after completion of demonstration and training:
 - .1 Identifying time and date of each demonstration and training session,
 - .2 Summarizing the demonstration and training performed, and
 - .3 Include a list of attendees.
- .4 Provide copies of completed Operation and Maintenance Manuals for use in demonstrations and instructions.
- .5 Instruct personnel in all phases of operation and maintenance using Operation and Maintenance Manuals as the basis of instructions.
- .6 Review contents of manual in detail to explain all aspects of operation and maintenance. Prepare and insert additional data in Operations and Maintenance Manuals when the need for additional data becomes apparent during instructions.

1.3 PREREQUISITES TO DEMONSTRATION AND TRAINING

- .1 Testing, adjusting, and balancing has been performed in accordance with Contract Documents.
- .2 Equipment and systems are fully operational.
- .3 Copy of completed operation and maintenance manual is available for use in demonstration and training.

- .4 Conditions for demonstration and training comply with requirements specified in technical Specifications.

1.4 DEMONSTRATION AND TRAINING

- .1 Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, and maintenance of each item of equipment and system.
- .2 Review operation and maintenance manual in detail to explain all aspects of operation and maintenance.
- .3 Prepare and insert additional information in operation and maintenance manual if required.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not applicable.

PART 3 - EXECUTION

3.1 NOT USED

- .1 Not applicable.

END OF SECTION

PART 1 - GENERAL

1.1 COMMISSIONING

.1 General:

- .1 The Commissioning Objectives are:
 - .1 To bring the mechanical, electrical, and other systems and components from a state of "static completion" to a state of "dynamic operation".
 - .2 To verify conformance to Contract Requirements.
 - .3 To confirm the equipment meets the design intent of the Specifications and function in accordance with defined operational requirements.
 - .4 To confirm the completed facility meets user stated requirements.
- .2 Commissioning services will be as described herein and as specified in the individual Sections.
- .3 Commissioning will need to be completed before Ready-For-Takeover.

1.2 SUBMITTALS

- .1 Prior to start of Work, submit name of Equipment Supplier's personnel proposed to perform services. Submit documentation to confirm personnel compliance with quality assurance provision.
- .2 Commissioning services to be as described herein and as specified in the individual specification sections.

1.3 COMMISSIONING PLAN

- .1 Commissioning Plan, developed by the Contractor in collaboration with applicable equipment vendors, the Owner and the Consultant, consists of:
 - .1 Roles and responsibilities of the commissioning team during all phases of commissioning.
 - .2 Description of systems, intended operation and performance details.
 - .3 Static testing and verification procedures.
 - .4 Functional performance testing procedures.
 - .5 Documentation requirements for test results.
 - .6 Seasonal or deferred commissioning.
 - .7 Training plan for operators.
 - .8 Preparation of the Final Commissioning Reports.

1.4 ROLES AND RESPONSIBILITIES

- .1 Contractor's responsibilities:

- .1 Prepare Commissioning Plan, with input from equipment vendors, Owner and Consultant.
 - .1 Manage the commissioning process.
 - .2 Confirm subcontractors, including equipment suppliers, carry out applicable tests, procedures prior to Consultant's review.
 - .3 Arrange for walkthrough and commissioning reports, procedures and demonstration, after Work has been reviewed, tested and commissioned.
 - .4 Arrange and schedule training sessions, including preparation and distribution of materials.
 - .5 Perform and document all preliminary tests. Assemble manuals of completed test forms and verification forms.
 - .6 Provide assistance to equipment suppliers during start up to address installation concerns. Provide mechanical and/or electrical trades as required.
 - .7 Perform system start-up and testing.
 - .8 Fill out commissioning data sheets and test forms/manual.
 - .9 Provide training and instruction and prepare Operating and Maintenance Manual for presentation to the operating and maintenance personnel.
 - .10 Attend operation of system through tests with Consultant and Owner.
 - .11 Obtain all code-required inspections and certifications and approvals.
 - .12 Obtain and submit all warranties to Consultant.
- .2 Consultant's responsibilities:
 - .1 Inspect installation.
 - .2 Certify completion of Contractor's commissioning.
 - .3 Receive all test reports from the Contractor and verify results.
 - .4 Participate in the equipment start-up testing conducted by the Contractor and verify results.
 - .5 Communicate apparent deviations from the specifications.
 - .6 Participate in the performance testing process.
 - .7 Review the as-built drawings.
 - .8 Provide technical assistance on plant operations to assist Contractor planning of Commissioning.
 - .9 Communicate requirement and coordinate activities relating to system integration work.
- .3 Owner's responsibilities:
 - .1 Making staff available at appointed times for training by manufacturer's representatives and providing labour to conduct work within facilities that is not included in this Contract.

- .2 Where applicable, test and commission systems that are Owner-supplied and installed.
- .4 Equipment vendor's responsibilities :
 - .1 Perform and document all preliminary tests, assemble manuals of completed test forms and verification forms.
 - .2 Perform component start-up and testing with Contractors
 - .3 Manage installation of the systems.
 - .4 Perform system start-up and testing.
 - .5 Arrange for training sessions schedule, including preparation and distribution of materials.
 - .6 Provide training and instruction and prepares Operating and Maintenance Manual for presentation to the operating and maintenance personnel.
 - .7 Provide training and instruction and prepares Operating and Maintenance Manual for presentation to the operating and maintenance personnel.
 - .8 Be present for operation of system through tests with Consultant, Owner and Contractors.
 - .9 Assemble and deliver all spare parts and special tools to the Owner.

1.5 COMMISSIONING MEETINGS

- .1 Commissioning meetings: All parties to participate in routine on-site meetings, specific commissioning meetings throughout the period that commissioning is taking place or being planned. Commissioning meetings will be coordinated and chaired by the Contractor. The Contractor will take minutes and distribute minutes within three (3) working days of the subject meeting. Update and circulate the updated commissioning schedule one (1) working day prior to commissioning meetings.
- .2 The Contractor, Consultant and Owner will work together in a concerted effort to fully commission all systems in an organized manner and in a manner that will allow all to carry out their own obligations fully.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not applicable.

Town of Lunenburg
Wastewater Treatment Plant
Upgrades & Expansion
Project No. 240800.00

GENERAL COMMISSIONING
REQUIREMENTS

Section 01 91 13

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PART 3 - EXECUTION

3.1 NOT USED

.1 Not applicable.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies the requirements for furnishing all materials, labour, tools and equipment and performing all operations necessary to complete the demolition, removals, and modifications to existing buildings and structures. The work generally includes, but is not limited, to removal of all items as shown on the Project Drawings.
- .2 Existing WWTP must remain in operation throughout construction. Prepare and submit sequencing plan to ensure that all individual unit operations of the existing process remain in operation until the new process to replace them is commissioned and operating. Design and implement plan to prevent construction dust and debris from contaminating the treatment process. Coordinate with the Consultant/Owner as required.

1.2 RELATED WORK

- .1 Concrete: Division 03
- .2 Mechanical: Divisions 22 & 23
- .3 Electrical: Division 26
- .4 Site Civil: Divisions 31, 32 and 33
- .5 Process: Divisions 40 to 46

1.3 REFERENCES

- .1 Canadian Standards Association (CSA).
 - .1 CSA S350-M1980 (R2003), Code of Practice for Safety in Demolition of Structures.
- .2 National Building Code of Canada, Division B, Part 8.

1.4 EXISTING CONDITIONS

- .1 Items to be demolished or removed are to be based on their existing conditions.
- .2 A site assessment has been carried out for the Site. Report titled "Limited Environmental Site Assessment", dated June 7, 2024, prepared by CBCL Limited, is attached as Appendix B. Any interpretation or extrapolations of its content is at the Contractor's sole discretion and the Consultant will accept no liability for its findings.

1.5 PROTECTION

- .1 Prevent movement, settlement or damage of adjacent structures and services. Provide bracing and shoring as required. Repair damage caused by demolition as directed by Consultant.
- .2 Support affected structures and, if safety of structure being demolished or adjacent structures or services appears to be

endangered, cease operations and notify the Consultant.

- .3 Protect existing items designated to remain and items designated for salvage. In event of damage to such items, immediately replace or make repairs to approval of the Consultant and at no cost to Owner.
- .4 Keep noise, dust and inconvenience to occupants and neighbours to a minimum.
- .5 Provide temporary dust screens, covers and other protection as required. Refer to Section 01 56 00.
- .6 Prevent debris from blocking surface drainage, process, mechanical and electrical systems which must remain in operation.
- .7 Do not allow demolition work to adversely affect adjacent watercourses, groundwater and wildlife, or contribute to excess air and noise pollution. If demolition affects above areas in the opinion of the Consultant, remediate affected areas at no cost to the Contract.
- .8 Fires and burning of waste or materials is not permitted on site.
- .9 Do not bury waste or materials on site.
- .10 Prevent extraneous materials from contaminating air beyond application area, by providing temporary enclosures during demolition work.
- .11 Cover or wet down dry materials and waste to prevent blowing dust and debris.
- .12 Protect trees, plants and foliage on site and adjacent properties.

1.6 REGULATORY REQUIREMENTS

- .1 Perform demolition work in compliance with applicable Federal, Provincial and Municipal Regulations.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not applicable.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Inspect site with the Consultant and verify extent and location of items designated for removal, disposal, recycling, salvage, relocation and items to remain.
- .2 Locate and protect utilities. Preserve active utilities traversing site in operating condition.
- .3 Maintain wiring to existing equipment designated to remain.

- .4 Disconnect and remove all existing services which are designated to be removed. Disconnect and remove all redundant conduit and wiring back to source.
- .5 Where partitions or support structures are to be removed, disconnect equipment and electrical services to items on the partition and make wiring safe. Where pipe work, conduit or wiring passes through partitions to be removed, maintain the service to all devices to remain by extending piping and wiring or re-routing as necessary. Relocate equipment and electrical devices found where partitions or support structures are to be removed and the components are designated to remain.
- .6 Test existing equipment, electrical devices and wiring, which are to be reused for proper operation and advise Consultant of any device malfunction. Repair or replace any device which is damaged in the process of reinstallation at no additional cost to the Contract.
- .7 Shut off, disconnect and cap mechanical services.
 - .1 Sewer and water lines.
 - .2 Other underground services: remove and dispose of as directed by Consultant.
- .8 Notify and obtain approval of utility companies before starting removals.
- .9 Include any and all charges associated with coordinating the work by Nova Scotia Power or any utility affected by the Work in the Contract Price.
- .10 In locations of pipe removals at slabs and walls where not specifically indicated on drawings, cut pipe flush at both ends, infill with non-shrink grout, grind smooth where required, and finish such surfaces to match existing coating system of adjacent areas.
- .11 Where directed to remove existing pipework, fittings, valves and equipment supported at existing floors, remove associated pipe support structures, anchor bolts and related accessories. Following removal, grind smooth the affected area, and finish to match existing coating system of adjacent areas.

3.2 SAFETY CODE

- .1 Observe construction safety measures of Provincial Government, including but not limited to the Occupational Health and Safety Act, provided that in any case of conflict or discrepancy the more stringent requirement will apply.
- .2 Store volatile waste in closed containers and remove from premises daily.
- .3 WHMIS:
 - .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and

disposal of hazardous materials; and regarding labelling and provision of safety data sheets acceptable to Labour Canada and Health Canada.

- .4 Exercise pollution and environmental control measures as specified and as required during the Work.
- .5 At the end of each day's work, leave work in safe and stable condition.

3.3 REMOVAL FROM SITE

- .1 At end of each day's work, leave work in a safe and stable condition.
- .2 Stockpiling of demolition debris is permitted on a temporary basis as approved by the Consultant.
- .3 Removal of temporary stockpiled material will be required, if it is deemed by the Consultant, to interfere with operations of Owner.
- .4 Complete demolition in a manner to minimize dust. Keep materials wetted as directed by the Consultant.

3.4 PROCESS/ MECHANICAL ITEMS

- .1 Process/mechanical items demolition and removals refer to Divisions 22, 23 and 40 as well as the civil, process, and mechanical drawings.
- .2 Coordinate with the Owner for salvage of existing equipment. Owner will provide list of equipment for salvage to the Contractor and designate a location on-site for storage.
- .3 Transport equipment not designated for salvage off-Site for disposal.
- .4 Remove sludge, grit, and debris from existing tanks, basins and channels and clean them out when work is being done on them prior to putting them back into service.

3.5 ELECTRICAL ITEMS

- .1 For electrical and instrumentation items demolition and removals, refer to Division 26 and to the Electrical & Instrumentation Drawings.

3.6 SALVAGE AND DISPOSAL OF MATERIALS

- .1 Items not designated for reuse or relocation shall be disposed off site at authorized facilities. Confirm with the Owner prior to disposal, in case the Owner wishes to retain said items for spare parts.
- .2 Pay all costs and fees associated with the removal from site and disposal.

3.7 BACKFILL

- .1 Backfill in areas as indicated and in accordance with Division 31.

3.8 RESTORATION

- .1 Restore areas and existing works outside areas of demolition to match condition of adjacent, undisturbed areas.

3.9 CLEANUP

- .1 Upon completion of work, remove debris, trim surfaces and leave work site clean.

END OF SECTION

PART 1 -GENERAL

1.1 WORK INCLUDED

- .1 This section specifies the requirements for supplying, transporting and installing concrete formwork and falsework.

1.2 RELATED REQUIREMENTS

- .1 Section 03 20 00 - Concrete Reinforcing.
- .2 Section 03 30 00 - Cast-in-Place Concrete.

1.3 REFERENCE STANDARDS

- .1 CSA A23.1:24/A23.2:24, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- .2 CSA 086:24, Engineering Design in Wood.
- .3 CSA 0121:17(R2022), Douglas Fir Plywood.
- .4 CSA 0153:19(R2024), Poplar Plywood.
- .5 CSA S269.1-16(R2021), Falsework and Formwork.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Collect, separate, and recycle all site generated waste materials in accordance with Section 01 74 00 - Cleaning and Waste Management.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Seal and store emptied containers safely for disposal.
- .4 Use sealers, form release and stripping agents that are non-toxic, biodegradable and have zero or low VOC's.

1.5 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings for formwork and falsework as follows:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Nova Scotia, Canada.
 - .2 Prepare Shop Drawings in accordance with CSA S269.1 for formwork and falsework.
 - .3 Indicate formwork design data: permissible rate of concrete placement, and temperature of concrete, in forms.
 - .4 Indicate sequence of erection and removal of formwork/falsework as directed by Consultant.
 - .5 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and

- locations of temporary embedded parts.
- .6 Indicate sequence of erection and removal of formwork and falsework.
- .7 Include the following information on falsework Shop Drawings:
 - .1 Longitudinal, lateral, vertical, dead, live, and impact loads used in design.
 - .2 Safe bearing capacity of soil underneath mud sills.
 - .3 Maximum column, post and support loads.
 - .4 Deflection diagrams for beams with deflection of 10 mm or more.
 - .5 Deflection diagrams indicating initial and final elevation of deck surfaces, roofs and soffits.
 - .6 Grade of structural steel.
 - .7 Indicate steel posts, girders, beams, connections, bracing and welding, providing sufficient detail for safe performance of falsework.
 - .8 Fully detailed steel frame shoring.
 - .9 Species, grades and sizes of wood.
 - .10 Type and weight of equipment (moving or stationary) supported by falsework.
 - .11 Sequence, methods and rate of concrete placement.
 - .12 Proprietary equipment, adequately identified for checking purposes.
 - .13 Full details and locations of splices.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Formwork materials:
 - .1 For concrete without special architectural features, use wood and wood product formwork materials to CSA O121, CSA O86, and CSA O153.
 - .2 For concrete with special architectural features, use formwork materials to CSA A23.1/A23.2.
- .2 Form ties:
 - .1 Removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes minimum 25 mm diameter in concrete surface.
 - .2 Concrete designated to be watertight: snap-off metal ties, fixed length with break back points set back minimum 25mm, and to have an integral waterstop at centre of tie. Remove cone and fill void with Krytol Waterstop Grout as manufactured by Kryton

International Inc. or approved equivalent flush with finished surface.

- .3 Form release agent: chemically active release agents containing compounds that react with free lime present in concrete to provide water insoluble soaps, preventing concrete from sticking to forms; having no adverse affect on paint, adhesives, waterproofing, or other treatments which are specified for application to concrete and containing no non-drying ingredients such as mineral oil. Use biodegradable form release agent with low VOC content.
 - .1 Acceptable products: DuoGuard II by W.R. Meadows, Crete-Lease BIO-TRU-XTRA by Cresset, Enviro-Form by IPA Systems, Bio-Nox by Nox-Crete, or approved equivalent.
- .4 Falsework materials: to CSA S269.1.

PART 3 - EXECUTION

3.1 FABRICATION AND ERECTION

- .1 Verify lines, levels, and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.
- .2 Obtain Consultant's approval for use of earth forms.
- .3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
- .4 Fabricate and erect falsework in accordance with CSA S269.1.
- .5 Refer to architectural drawings for concrete members requiring architectural exposed finishes.
- .6 Do not place shores and mud sills on frozen ground.
- .7 Provide site drainage to prevent washout of soil supporting mud sills and shores.
- .8 Fabricate and erect formwork in accordance with CAN/CSA S269.1 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA A23.1/A23.2.
- .9 Align form joints and make watertight. Keep form joints to minimum.
- .10 Use 25 mm chamfer strips on external corners and 25 mm fillets at interior corners, joints, unless specified otherwise.
- .11 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated. Obtain the Engineer's permission before framing openings not indicated in concrete beams, walls, columns, or slabs.
- .12 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections. Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.

- .13 Clean formwork in accordance with CSA A23.1/A23.2, before placing concrete.
- .14 Step/lower all foundations as indicated on drawings. Coordinate with civil, process, and electrical subcontractors to step footings down as required to allow all underground plumbing and electrical services to be sleeved through foundation walls or run above footings/zone of influence. Do not locate any services under foundations or their associate zone of influence without written approval from the Consultant.
- .15 All stepped footings shown on the drawings are approximate and all required stepped footings may not be shown. Review all foundations and building services and submit to the Consultant the proposed footing locations and elevations to allow all services to be sleeved through the foundation wall and/or provide the required frost cover. Submit the proposed stepped footing locations and elevations prior to commencing any foundation work.
- .16 Construction Joints:
 - .1 Incorporate either horizontal or vertical construction joints in accordance with CSA A23.1 and to the Consultant's approval. Submit proposed joint locations for review prior to start of formwork erection.
 - .2 Maximum permitted length of concrete pour and the distance between construction joints can not exceed 18000 mm for liquid-containing structures (tanks).
 - .3 Provide construction joints in concrete where work is left off at day's end. Immediately before next pour, clean construction joint and brush with grout of neat cement.
 - .4 Run reinforcement continuously through construction joints and roughen concrete surface to an amplitude of 6 mm, unless indicated otherwise on drawings.
- .17 Coat formwork with form release agent before reinforcement, anchors or other accessories are placed, unless soaking with water during hot weather is acceptable. Do not coat plywood forms pre-coated with a chemical release agent.
- .18 Do not erect formwork that will prevent or encumber installation or inspection of reinforcing.
- .19 Prior to the concrete pour, identify any reinforcing that does not meet cover requirements. Review and correct as necessary formwork tolerances and alignment, particularly where suspended slabs are located.
- .20 Provide and maintain during the total duration on site, properly constructed guard rails and toe boards at all slab edges and around all slab openings. Build these in accordance with the Construction Safety Act. When the work of this trade is complete, all guard rails and toe boards are to be left in proper condition and will become

Owner's property. The dismantling of same becomes the responsibility of subsequent subcontractors.

- .21 Re-use formwork and falsework subject to requirements of CSA A23.1/A23.2.

3.2 REMOVAL AND RESHORING

- .1 Do not remove forms until concrete has cured sufficiently to support its own weight and imposed construction loads. Remove forms in such a manner to ensure the complete safety of the structure and to prevent spalling or chipping of concrete. When removing forms, conform to the following minimum periods of time after placing concrete:
 - .1 Non-weight supporting forms: remove formwork for columns, walls, footings, slabs on grade, grade beams, and other parts not supporting the weight of concrete as soon as concrete has cured sufficiently to resist damage from removal operations, but in no case sooner than 24 h.
 - .2 Weight supporting forms: leave formwork for suspended slabs, beams (with clear spans less than 6000 mm), and other parts supporting the weight of concrete in place for a minimum of 7 days or the time needed until the concrete element has achieved 70% of the specified 28-day compressive strength for that element, whichever is greater. Cast additional cylinders for the purpose of early testing to verify 70% of compressive strength has been achieved.
 - .3 Formwork for beams with clear spans greater than 6000 mm shall be left in place for a minimum of 14 days or the time needed until the concrete element has achieved 70% of the specified 28-day compressive strength for that element, whichever is greater.
 - .4 Formwork for liquid-containing structures (tanks): In addition to the above, do not remove formwork for any concrete element until the concrete has reached a minimum compressive strength of 25 MPa. Cast additional cylinders for the purpose of early testing to verify compressive strength has been achieved.
- .2 After removal of formwork of weight supporting forms, immediately install adequate reshores. Submit proposed stripping and reshoring schedule for review by the Consultant prior to first concrete pour. Keep reshores in place a minimum of 28 days after concrete pour.
- .3 Safely maintain structure, both before and after removal of the forms, until concrete has reached its specified 28-day strength.
- .4 Provide necessary reshoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.
- .5 Space reshoring in each principal direction at not more than 3000 mm apart.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning and Waste Management. 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 and recycling in accordance with Section 01 74 00 - Cleaning and Waste Management and Disposal. Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies the requirements for supplying, fabricating, shipping, and placing the reinforcing as detailed on the drawings and as noted in these specifications.

1.2 RELATED REQUIREMENTS

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

1.3 REFERENCE STANDARDS

- .1 ASTM A1064/A1064M-24, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- .2 CSA A23.1:24/A23.2:24, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .3 CSA A23.3:24, Design of Concrete Structures.
- .4 CSA G30.18:21, Carbon Steel Bars for Concrete Reinforcement.
- .5 CSA G40.20-13/G40.21-13 (R2023), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .6 CSA W186:21, Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .7 RSIC-20, Reinforcing Steel Manual of Standard Practice.

1.4 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice.
 - .2 Indicate placing of reinforcement and:
 - .1 Bar bending details.
 - .2 Lists.
 - .3 Quantities of reinforcement.
 - .4 Sizes, spacings, locations of reinforcement and mechanical splices if approved by Consultant, with identifying code marks to permit correct placement without reference to structural drawings.
 - .5 Indicate sizes, spacings and locations of chairs, spacers and hangers.
 - .3 Indicate position and size of openings in slabs and walls. Coordinate with trades requiring openings.

- .4 Reinforcement shop drawings must indicate the location of all concrete pour joints. Obtain the Consultant's approval for location of joints prior to cutting and bending of reinforcement.
- .5 Detail lap lengths and bar development lengths to CSA A23.3, unless otherwise indicated. Provide Class B tension lap or when bars of different sizes (35M or smaller) are lap spliced in tension, the splice length to be the larger of the development length of the larger bar or the splice length of the smaller bar, as per CSA A23.3.

1.5 SOURCE QUALITY CONTROL

- .1 Provide Consultant with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum four (4) weeks prior to beginning reinforcing work. Mill test reports to include certification that reinforcing steel recycled steel content rating meets or exceeds 90%. Certification to also include a breakdown of the pre-consumer, post-industrial and post-consumer content percentages of recycled content.
- .2 Supply test reports at no additional cost to the Contract.
- .3 Upon request inform Consultant of proposed source of supplied material.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle reinforcing in accordance with manufacturer's recommendation.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Collect, separate, and recycle all site generated waste materials in accordance with Section 01 74 00 - Cleaning and Waste Management.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Substitute different size bars only if permitted in writing by Consultant.
- .2 Reinforcing steel: billet steel, grade 400W, deformed bars to CSA G30.18, unless indicated otherwise.
- .3 Cold-drawn annealed steel wire ties: to ASTM A1064.
- .4 Deformed steel wire for concrete reinforcement: to ASTM A1064.
- .5 Welded steel wire fabric: Plain in accordance ASTM A1064, fabricated from as drawn steel wire into flat sheets; sizes as indicated on Drawings.
- .6 Chairs, bolsters, bar supports, spacers: to CSA A23.1/A23.2.

- .7 Mechanical splices: subject to approval of Consultant.
- .8 Plain round bars: to CSA G40.20/G40.21.

2.2 FABRICATION

- .1 Fabricate reinforcing steel in accordance with CSA A23.1/A23.2 and RSIC.
- .2 Obtain Consultant's written approval for locations of reinforcement splices other than those shown on placing drawings.
- .3 Upon approval of Consultant, weld reinforcement in accordance with CSA W186.
- .4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 All steel reinforcing bars to have the necessary net sectional area and will be cut to the exact lengths, bent cold to the exact forms and dimensions, shown on the approved plans, or otherwise required, before being placed in position. Bending must be accurately done, in a bending machine and no welding or heating of any bars will be allowed, except with written approval from the Consultant.

3.2 FIELD BENDING

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

3.3 PLACING REINFORCEMENT

- .1 Examine formwork to ensure that it has been completed and adequately braced in place before starting reinforcement placing.
- .2 Cutting or puncturing vapour retarder is not permitted; repair damage and reseal vapour retarder before placing concrete.
- .3 Place reinforcing steel as indicated on placing drawings and in accordance with CSA A23.1/A23.2.
 - .1 Clean all reinforcing of millscale, oil grease, or other deleterious material before and after erection.
 - .2 Secure reinforcing steel rigidly in position with annealed wire or use approved clips at intersections supported on reinforcing chairs.

- .3 Do not allow the position of the bars to alter during concreting and maintain the correct cover at all times.
- .4 Prior to placing concrete, obtain the Consultant's approval of reinforcing material and placement. Provide Consultant with a minimum of 48 hours notice when reinforcing material will be installed and ready for inspection.
- .5 Maintain cover to reinforcement during concrete pour to the dimensions shown on the drawings.
- .6 Place all reinforcing bars and hold rigidly in the exact positions in the forms as shown on the approved plans, or otherwise required, and there must be no displacement of the same by the placing and tamping of the concrete. Adjusting or moving the bars while the concrete is being placed will not be permitted unless specified on the plans. Protect concrete required for reinforcing steel in accordance with CSA A23.3. Tie all bars properly, brace to prevent displacement. Do not place concrete until the steel reinforcement, after being cleaned and placed in position, has been examined and approved by the Consultant.
- .7 Do not cut or trim hooks on hooked bars. If cover with standard hook can not be achieved, rotate/skew hook.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies the requirements for providing all labour, tools, materials and equipment to perform all cast-in-place concrete work.

1.2 RELATED REQUIREMENTS

- .1 Section 03 10 00 - Concrete Forming and Accessories.
- .2 Section 03 20 00 - Concrete Reinforcing.
- .3 Section 07 26 00 - Air/Vapour Barrier
- .4 Section 07 21 00 - Insulation

1.3 REFERENCE STANDARDS

- .1 ASTM C260/260M-10a(R2016), Standard Specification for Air-Entraining Admixtures for Concrete.
- .2 ASTM C309-19, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- .3 ASTM C494/C494M-24, Standard Specification for Chemical Admixtures for Concrete.
- .4 ASTM C827/C827M-23, Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures.
- .5 ASTM C1116/C1116M-23, Standard Specification for Fiber-Reinforced Concrete
- .6 ASTM D2240-15(2021), Standard Test Method for Rubber Property - Durometer Hardness.
- .7 ASTM D3575-20, Standard Test Methods for Flexible Cellular Materials Made from Olefin Polymers.
- .8 ASTM E1745-17 (2023), Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
- .9 CGSB-51.34-2022, Polyethylene Sheet for Use in Building Construction - Material Specification.
- .10 CSA A23.1:24/A23.2:24, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- .11 CSA A3000:23, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
- .12 CSA S900.2:21, Structural Design of Wastewater Treatment Plants.

1.4 SUBMITTALS

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

- .2 Minimum of four (4) weeks prior to commencing concrete work, submit shop drawings to Consultant for review containing the following for each concrete mix:
 - .1 Cement type.
 - .2 Minimum compressive strength at 28 days.
 - .3 Class of exposure.
 - .4 Nominal size of coarse aggregate.
 - .5 Air content.
 - .6 Slump at time and point of discharge.
 - .7 Admixtures.
- .3 Minimum of four (4) weeks prior to commencing slab on grade concrete work, submit shop drawings to Consultant for review containing the following:
 - .1 Construction joint placement.
 - .2 Isolation joint placement.
 - .3 Contraction joint placement.
 - .4 Joint filling/sealing details.
- .4 Submit two (2) copies of WHMIS SDS.
- .5 Site Quality Control Submittals:
 - .1 Concrete pours: submit accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described in PART 3 - FIELD QUALITY CONTROL.
 - .2 Concrete hauling time: submit for review by Consultant deviations exceeding maximum allowable time of 120 minutes for concrete delivered to site of Work and discharged after batching.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with applicable local, provincial and national regulations, and in accordance with Section 01 74 00.
- .2 Use trigger operated spray nozzles for water hoses.
- .3 Designate a cleaning area for tools to limit water use and runoff.
- .4 Carefully coordinate the specified concrete work with weather conditions.
- .5 Seal emptied containers and store safely for disposal.
- .6 Prevent plasticizers, water-reducing agents and air-entraining agents from entering drinking water supplies or streams. Using appropriate safety precautions, collect liquid or solidify liquid with an inert, noncombustible material and remove for disposal. Dispose of all waste in accordance with applicable local, provincial and national regulations.

- .7 Choose least harmful, appropriate cleaning method which will perform adequately.

1.6 QUALITY ASSURANCE

- .1 Minimum four (4) weeks prior to starting concrete work submit to the Consultant manufacturer's test data and certification by qualified independent inspection and testing laboratory that the following materials will meet specified requirements:
 - .1 Portland cement.
 - .2 Supplementary cementing materials.
 - .3 For fly ash, provide details of supplier's quality control program, test data for at least three (3) samples from the previous month's supply and details of proposed quality control tests to be made between shipment to concrete supplier and use in the concrete.
 - .4 Grout.
 - .5 Admixtures.
 - .6 Aggregates.
 - .7 Water.
 - .8 Waterstops.
 - .9 Waterstop joints.
 - .10 Joint filler.
- .2 Provide certification that mix proportions selected will produce concrete of specified quality and yield and that strength will comply with CSA A23.1 and that mix design is adjusted to prevent alkali aggregate reactivity problems.
- .3 Provide certification that plant, equipment and materials to be used in concrete comply with requirements of CSA A23.1. Submit a copy of the plants Atlantic Concrete Association Plant certification.
- .4 At least four (4) weeks prior to beginning Work, inform Consultant of source of fly ash. Changing source of fly ash without written approval of Consultant is prohibited. Provide written confirmation from concrete supplier the percent replacement of mass of Portland cement for fly ash/supplementary cementing materials for all concrete mix design.
- .5 Minimum four (4) weeks prior to starting concrete work, provide proposed quality control procedures for review by Consultant on following items:
 - .1 Falsework erection.
 - .2 Hot weather concrete.
 - .3 Cold weather concrete.
 - .4 Curing.
 - .5 Finishes.
 - .6 Formwork removal.
 - .7 Joints.

- .6 Quality Control Plan: provide written report to Consultant verifying compliance that concrete in place meets performance requirements of concrete as established in PART 2 - PRODUCTS.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.
 - .1 Modifying maximum time limit without receipt of prior written agreement from Consultant and concrete producer as described in CSA A23.1/A23.2 is prohibited.
 - .2 Submit deviations for review by Consultant.
 - .3 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.
- .2 Prepare to implement alternative concrete supply and placement contingency plans in the event of concrete material supply issues, batch plant malfunction and/or transport and placement equipment malfunction.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Portland cement: to CSA A3000.
- .2 Supplementary cementing materials: to CSA A3000.
- .3 Water: to CSA A23.1.
- .4 Aggregates: to CSA A23.1/A23.2. Coarse aggregates to be normal density.
- .5 Air entraining admixture: to ASTM C260.
- .6 Chemical admixtures: to ASTM C494. Consultant to approve accelerating or set retarding admixtures during cold and hot weather placing.
- .7 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents to CSA A23.1/A23.2.
 - .1 Compressive strength: 50 MPa at 28 days.
 - .2 Consistency:
 - .1 Fluid: to ASTM C827. Time of efflux through flow cone (ASTM C939), under 30 s.
 - .2 drops in 3 s, (ASTM C109, applicable portion) 125 to 145%.
 - .3 Plastic: to ASTM C827. Flow table, 5 drops in 3 s, (ASTM C109, applicable portions) 100 to 125%.
 - .4 Dry pack to manufacturer's requirements.
 - .3 Acceptable products: SikaGrout 212 as manufactured by Sika Canada Inc., SikaGrout 928 as manufactured by Sika Canada, V1 Premium

Grout and V3-10K Grout as manufactured by W.R. Meadows, or approved equivalent.

- .8 Repair mortar: Acceptable products: SikaEmaco-488 CI by Sika Canada Inc., or approved equivalent.
- .9 Bonding agent: Acceptable products: Sikadur ADH 1414 by Sika Canada Inc., or approved equivalent.
- .10 Synthetic Macro-fiber: Polypropylene/polyethylene synthetic macrofiber to ASTM C1116 Type 3, minimum 50 mm length, aspect ratio 50 to 90.
 - .1 Acceptable products: TUF-Strand SF by Euclid Chemical Company, or approved equivalent.
- .11 Vapour Retarder Membrane: to be a 10 mil (0.25 mm) thick, polyolefin resin sheet in accordance with ASTM E1745 such as Perminator 10mil by W.R. Meadows Inc., or approved equivalent. Seal seams with a 100 mm wide high density polyethylene tape with pressure sensitive adhesive to suit a 150 mm wide sheet overlap in accordance with the manufacturer's written recommendations.
- .12 Curing compound: to CSA A23.1/A23.2 and ASTM C309, Type I-D with fugitive dye. Confirm compatibility with finish floor adhesives.
- .13 Premoulded concrete expansion joint filler:
 - .1 Closed-cell, polyethylene joint filler with peel-off tape in accordance with ASTM D3575.
 - .1 Acceptable products: Foam Tech as manufactured by NMW Inc., Deck-O-Foam as manufactured by W.R. Meadows Inc., or approved equivalent.
 - .2 For concrete surfaces in contact with hot asphalt, use Foam Tech H as manufactured by NMW Inc. or approved equivalent.
- .14 Joint sealer/filler:
 - .1 A two (2) component, polysulphide sealant, Duoflex SL (self-levelling) for slabs and Duoflex NS (non-sag) for walls, complete with compatible foam back rod and primer.
 - .2 For slabs subject to vehicle traffic, use either a semirigid epoxy or polyurea filler with a minimum Shore A hardness of 80 in accordance with ASTM D2240.
 - .1 Acceptable products: Rezi-Weld Flex as manufactured by W.R. Meadows inc., Euco Qwikjoint UVR as manufactured by The Euclid Chemical Company, 3004 PenJoint as manufactured by ASTC Polymers, Loadflex-524 EZ as manufactured by Sika, or approved equivalent.
- .15 Rigid insulation: as specified in Section 07 21 00 - Insulation.
- .16 Waterstops:
 - .1 Ribbed waterstops: 10mm thick by 150mm high, extruded PVC.

- .1 Acceptable product: Greenstreak 705 Ribbed Center Bulb by Sika or approved equivalent.
- .2 Hydrophilic, non-bentonite modified chloroprene rubber based concrete joint waterstop.
 - .1 Acceptable product: Hydrotite CJ-0725 by Sika or approved equivalent.
- .3 Ribbed waterstop and hydrophilic waterstop must be compatible so they can be lapped where required to create a continuous watertight joint. This joint/lap must be covered under manufacturer's warranty.
- .17 Weep hole tubes: plastic.
- .18 Chemical Adhesive Anchoring System:
 - .1 Two-component tube inject system. All adhesive anchor and rebar installation, including drilling of holes, preparation, storage, usage, and curbing to be in accordance with the written instructions and training as provided by the manufacturer.
 - .2 For core drilled holes, use Hilti TE-YRT hole roughening tool in accordance with the written manufacturer's instructions.
 - .1 Acceptable products: Hilti HIT-HY 200 V3 by Hilti Canada Corp. or approved equivalent.

2.2 CONCRETE MIXES

- .1 General: Where practically possible, for all concrete mixes listed below, except for concrete flat slab work, concrete supplier to maximize the amount Portland cement replaced with fly ash or another approved cementitious recycled material while maintaining the characteristics listed for each concrete mix listed as well as the workability of each mix. Concrete supplier to provide written confirmation of the percent replacement of Portland cement for fly ash/supplementary cementing materials for all mix designs.
- .2 Slump requirements for each mix shall be identified and reviewed by the contractor and concrete supplier prior to construction. Slump to be specified based on placement and finishing requirements, as well as the requirements of CSA A23.1.
- .3 Proportion normal density concrete in accordance with CSA-A23.1, Alternative 1 to give following properties for concrete external pads, curbs and walkways:
 - .1 Minimum compressive strength at 28 days: 32 MPa.
 - .2 Class of exposure: C-2.
 - .3 Nominal size of coarse aggregate: 20 mm.
 - .4 Air content: to CSA A23.1, concrete exposed to cycles of freeze/thaw.
 - .5 Chemical admixtures: type as approved, and in accordance with ASTM C494.

- .4 Proportion normal density concrete in accordance with CSA-A23.1, Alternative 1 to give following properties for concrete in all building foundations and perimeter walls:
 - .1 Minimum compressive strength at 28 days: 25 MPa.
 - .2 Class of exposure: F-2.
 - .3 Nominal size of coarse aggregate: 20 mm.
 - .4 Air content: to CSA A23.1, concrete exposed to cycles of freeze/thaw.
 - .5 Chemical admixtures: type as approved, and in accordance with ASTM C494.
- .5 Proportion normal density concrete in accordance with CSA-A23.1, Alternative 1 to give following properties for concrete in mud slabs:
 - .1 Minimum compressive strength at 28 days: 20 MPa.
 - .2 Class of exposure: N.
 - .3 Nominal size of coarse aggregate: 20 mm.
 - .4 Air content: 3% maximum.
 - .5 Chemical admixtures: type as approved, and in accordance with ASTM C494.
- .6 Proportion normal density concrete in accordance with CSA-A23.1, Alternative 1 to give following properties for interior concrete slabs on grade and housekeeping pads:
 - .1 Minimum compressive strength at 28 days: 25 MPa.
 - .2 Class of exposure: N-CF.
 - .3 Nominal size of coarse aggregate: 20 mm.
 - .4 Air content: 3% maximum.
 - .5 Chemical admixtures: type as approved and in accordance with ASTM C494.
- .7 Proportion normal density concrete in accordance with CSA A23.1 Alternative 1 to give the following properties for all concrete in SBR tank:
 - .1 Minimum compressive strength at 28 days: 35 MPa.
 - .2 Class of exposure: A-1.
 - .3 Nominal size of coarse aggregate: 20 mm.
 - .4 Air content: to CSA A23.1, concrete exposed to cycles of freeze/thaw.
 - .5 Chemical admixtures: type as approved, and in accordance with ASTM C494.
- .8 Proportion normal density concrete in accordance with CSA A23.1 Alternative 1 to give the following properties for benching/grout in tanks and channels:
 - .1 Minimum compressive strength at 28 days: 25 MPa
 - .2 Class of exposure: A-4.

- .3 Nominal size of coarse aggregate: 10 mm
- .4 Air content: to CSA A23.1, concrete exposed to cycles of freeze/thaw.
- .5 Chemical admixtures: type as approved, and in accordance with ASTM C494.
- .6 Synthetic macro-fibre dosage: 1.8 kg/m³.
- .9 Provide concrete mix designs based on trial mixes that have been designed and tested by a qualified professional engineer registered or licensed to practice in the Province of Nova Scotia and submitted for review to Consultant.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Confirm founding material on which footings and other concrete work are to be placed are free from water. Place concrete only on frost-free ground. Remove previously frozen bearing surfaces.
- .2 Confirm foundations bear on bedrock, structural fill overlying glacial till or residual soil with a minimum factored bearing resistance at ultimate limited states (ULS) of 275 kPa and a minimum factored bearing resistance at serviceability limit states (SLS) of 175 kPa as per Conquest Engineering report, dated April 12, 2022, project number 210803.03 and in accordance with Section 31 23 10. Place structural fill as directed by the geotechnical engineer and in the presence of the geotechnical engineer or one of their qualified representatives.
- .3 Inspect all foundation surfaces and obtain approval from the Contractor's geotechnical engineer prior to placing forms, reinforcing or concrete. If bearing surfaces are deemed unacceptable because conditions do not meet those anticipated during design, make adjustments as directed.
- .4 Confirm fill has been placed to meet specified requirements, and that underslab services have been installed, inspected, tested and approved.
- .5 Do not place plumbing and electrical conduit under foundations or their associated zone of influence. Coordinate with the civil, process, mechanical and electrical subcontractors and notify the Consultant of any areas that require step/lowering the foundation so that all services either sleeve through foundation walls or run above footing/zone of influence prior to installing formwork/rebar fabrication. Do not place plumbing or conduit under foundations or their associated zone of influence without written consent from the Consultant.
- .6 If necessary, place a mud slab in the bottom of footing excavations to prevent softening of the in-situ foundation soils. Place a mud slab in the bottom of base slab excavations for liquid-containing structures (tanks).

3.2 WORKMANSHIP

- .1 Obtain the Consultant's approval before placing concrete. Provide 48 hours minimum notice prior to placing of concrete. Do not place concrete until authorized by the Consultant and following satisfactory site review and observations of the geotechnical base preparations, formwork, reinforcing steel, and other associated concrete batching and placing operations.
- .2 Pumping of concrete is permitted only after approval of equipment, methods, and mix design.
- .3 Do not disturb reinforcement and inserts during concrete placement. Provide continuous supervision during placement of concrete including concrete grout to maintain reinforcing steel and inserts in correct position.
- .4 Prior to placing of concrete obtain Consultant's approval of proposed method for protection of concrete during placing and curing.
- .5 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, workability, air content, temperature and test samples taken.
- .6 Do not place load upon new concrete until authorized by Consultant.
- .7 Place concrete reinforcing in accordance with Section 03 20 00 - Concrete Reinforcing. Concrete protective cover to reinforcement is as indicated on the drawings.
- .8 Support bars on plastic coated steel chairs to maintain exact cover requirements.
- .9 For concrete placed against hardened concrete, roughen the existing surface locally with a 6 mm amplitude prior to pouring adjacent concrete.
- .10 Placing concrete during rain or weather events that could damage concrete is prohibited.
- .11 Protect newly placed concrete from rain or weather events in accordance with CSA A23.1/A23.2.
- .12 In cold weather protect concrete work to CSA A23.1 and the following:
 - .1 If there is a probability of the air temperature falling below 5°C within 24 h of placing (as forecast by the nearest official meteorological office), keep all materials and equipment needed for adequate protection and curing on hand and ready for use before concrete placement is started.
 - .2 During cold weather provide adequate protection of the concrete that will maintain the concrete temperature at a minimum of 10°C for a minimum of 7 days and for the time necessary to attain 70% of the specified strength.
 - .3 Do not place concrete on or against any surface that will lower the temperature of the concrete in place below 10°C.

- .4 Provide protection by means of heated enclosures, coverings, insulation, or a suitable combination of these methods as per CSA A23.1.
- .5 Following the termination of wet curing, surfaces must be dry prior to freezing.
- .6 Do not expose concrete to a sudden temperature change after end of curing period. Do not completely remove protection until the surface of the concrete has cooled to within 10°C of ambient air temperature.
- .7 Cover all heating and heating related costs at no additional cost to the Contract.
- .13 In hot weather protect concrete work to CSA A23.1 and following:
 - .1 When air temperature is at or above 25°C, do not use curing compounds and keep concrete surface moist continually during protection stage using burlap maintained in a moist condition.
 - .2 Regulate generation of heat through hydration to control thermal gradients to prevent thermal cracking.
- .14 Monitor concrete temperature and moisture evaporation rates and provide appropriate hot weather protection as defined in clause 7 of CSA A23.1. Maintain records of all measurements during hot weather periods for review by the Consultant.
- .15 Protect previous Work from staining.
- .16 Clean and remove stains prior to application for concrete finishes.

3.3 CONSTRUCTION

- .1 Do cast-in-place concrete work in accordance with CSA A23.1.
- .2 Concrete to be dense, homogenous and free of cold joints, voids and honeycombing. Concrete to be fully bonded to reinforcing steel, anchors and embedded parts.
- .3 Do not permit vertical free fall of concrete mix to exceed 1.5 metres.
- .4 For exposed concrete, take special precautions when placing to prevent segregation of concrete, and to avoid cold joints, honeycombing or voids. Do not allow vibrator to touch formwork.
- .5 Consolidate concrete using a mechanical form vibrator method complete with mechanical hand held vibrators, if required, and subject to the approval of Consultant.
- .6 Use form vibrators only when sections are too narrow for internal type. Employ a sufficient number of vibrators to achieve complete consolidation of concrete throughout entire volume of each layer. Have available at least one (1) extra vibrator on hand for emergency.
- .7 Do not use vibrators for the use of moving concrete for concrete slabs.

- .8 Use only tools and handling equipment that are clear of rust or other harmful and foreign material to avoid effervescence and staining of slabs or hardened concrete.
- .9 Place concrete in consolidated lifts and keep approximately horizontal and evenly distributed throughout the formed assembly. The rate of placement to be such that each successive lift is vibrated into the preceding lift to achieve proper bonding.
- .10 Place concrete monolithically without any cold joints. Construction joints to be as indicated on drawing and proposed joint locations as per Section 03 10 00. For liquid-containing structures (tanks), do not place concrete until the previously placed concrete, adjacent to the next pour, has cured for a minimum of 72 hours.
- .11 Concrete placement and vibrating activities to be in accordance with the formwork design data, limitations and parameters provided by the Contractor.
- .12 Foundations, sleeves, and inserts:
 - .1 Set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere. Sleeves and openings greater than 100 mm x 100 mm not indicated, must be approved by the Consultant.
 - .2 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of modifications from Consultant before placing of concrete.
 - .3 Check locations and sizes of foundations, sleeves and openings shown on drawings. Provide confirmation by qualified surveyor.
 - .4 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.
- .13 Finishing:
 - .1 Finish concrete in accordance with CSA A23.1, and Part 3.11 Finishing of this section.
 - .2 Use procedures acceptable to Consultant or those noted in CSA A23.1 to remove excess bleed water. Confirm surface is not damaged.
 - .3 Cut back form ties and plug openings in a manner acceptable to Consultant.
 - .4 Repair holes and surface defects to the satisfaction of Consultant.
 - .5 Remove honeycombed or otherwise defective concrete and repair in a manner approved and to the satisfaction of Consultant.
 - .6 Confirm that all exposed concrete has neatly formed, 45 degree beveled, 25 mm chamfered edges where designated in accordance with Section 03 10 00 - Concrete Forms and Accessories.

- .14 Anchor bolts:
 - .1 Place anchor bolts to templates under supervision of trade supplying anchors prior to placing concrete.
 - .2 Protect anchor bolt holes from water accumulations.
- .15 Core-drilling/cutting of holes in any concrete element is not permitted without written consent from the Consultant. All proposed core-drilling/cutting must be submitted to the Consultant for review prior to execution of work. Request for core-drilling/cutting must have 72 hours notice to allow Consultant adequate time to review proposed locations.
- .16 Backfilling of non-retaining walls or grade beams may commence once the concrete has cured for the required curing period. Backfill to proceed in approximately equal lifts on both sides of the wall or grade beam.
- .17 Backfilling of retaining walls may commence 28 days after placement and the specified 28-day strength of concrete has been achieved.
- .18 All liquid-containing structures (tanks) to be constructed liquid tight. Refer to Part 3.16 - Leakage Testing and Crack Repair.

3.4 MASS CONCRETE

- .1 Concrete placements having a minimum dimension greater or equal to 1000 mm are defined as mass concrete. Do mass concrete in accordance with CSA A23.1.
- .2 Design concrete mix and employ construction procedures in accordance with CSA A23.1 such that the maximum temperature in the concrete and the maximum temperature difference from interior of mass to outside face do not exceed those specified in CSA A23.1.
- .3 Determine maximum temperature of the concrete at the time of placing by estimating the temperature rise during concrete batching, placing, hydration and curing.
- .4 Thermal control plan: in accordance with CSA A23.1.
 - .1 Submit a thermal control plan for mass concrete placements.
 - .2 Thermal control plan shall include procedures in place to be implemented if the temperature exceeds specified limits.
- .5 Monitor concrete and ambient temperatures during the thermal control period.

3.5 INSERTS

- .1 Do not pass sleeves, ducts, pipes or other openings through concrete elements, except where indicated on the structural drawings or approved by the Consultant.
- .2 Where approved by Consultant, set sleeves, ties, pipe hangers, miscellaneous metals and other inserts and openings as indicated or specified elsewhere. Sleeves and openings greater than 100 mm x 100 mm

not indicated on the structural drawings must be approved by Consultant.

- .3 Maximum diameter of core-drilled holes is 200 mm. Proposed core-drilled penetrations must be approved by the Consultant prior to the placement of concrete. All core-drilled holes to be approved by the Consultant prior to execution of the work.
- .4 Do not eliminate or displace reinforcement to accommodate hardware larger than 400 mm. For inserts/ hardware less than 400 mm, displace bars to accommodate. If inserts cannot be located as specified, obtain approval of modifications from Consultant before placing concrete.
- .5 Coordinate locations and sizes of sleeves and openings shown on structural, civil, mechanical, electrical and process drawings.
- .6 Larger size openings in walls and slabs have been shown on the structural drawings. Refer to process, electrical and mechanical drawings for all remaining cast-in-place concrete penetrations. All pipe sleeves containing wall flanges are to be cast-in-place at the time of concrete pour.

3.6 PLACING GROUT

- .1 Grout where indicated using procedures in accordance with manufacturer's recommendations which result in 100% contact over grouted area.

3.7 WATERSTOPS

- .1 Install waterstops to provide continuous water seal. Do not distort or pierce waterstop in such a way as to hamper performance. Do not displace reinforcement when installing waterstops. Use equipment to manufacturer's requirements to field splice waterstops.
- .2 PVC Waterstops:
 - .1 Tie waterstop rigidly in place with factory applied grommets or pre-punched holes, or field applied hog rings placed at 300 mm centers between the two outermost ribs of the waterstop.
 - .2 Use only straight heat sealed butt joints in field. Use factory or field welded corners and intersections unless otherwise approved by the Consultant. For field welds, use welding iron as approved by and in accordance with the waterstop manufacturer.
 - .3 Use only ribbed PVC waterstops for liquid-containing structures (tanks), unless noted otherwise on drawings.
- .3 Provide waterstops as required to provide continuous seal and as indicated on the drawings and at all construction joints. Not all waterstops are indicated on the Drawings.
- .4 Install waterstops in accordance with manufacturer's written instructions.
- .5 Install hydrophilic waterstop with a minimum 50 mm clear cover to edge of concrete.

3.8 SLAB-ON-GRADE JOINTS

- .1 Provide construction joint between adjacent concrete pours.
- .2 Provide an isolation joint where the slab-on-grade abuts a vertical element.
- .3 For unreinforced slabs on grade or slabs on grade reinforced with welded wire fabric, provide saw cut contraction joints as indicated on the drawings and in accordance with CSA A23.1 except at those locations where construction joints or isolation joints are provided. Commence sawing as soon as the concrete has hardened sufficiently to permit cutting without chipping, spalling or tearing and before all controlled shrinkage cracking occurs. Locate and complete all saw cuts in accordance with the Project Drawings and terminate all saw cuts at the face of columns, foundation walls and other control joints as shown on the Project Drawings.
- .4 Do not provide saw cut contraction joints in slabs with continuous reinforcing unless otherwise indicated or at locations not indicated on the Project Drawings. If the Contractor wishes to revise contraction joint placement, submit deviations to the Consultant for review.

3.9 JOINT FILLERS

- .1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by the Consultant. When more than one piece is required for a joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.
- .2 Locate and form isolation, construction and contraction joints as indicated. Install joint filler and sealants.
- .3 Finish with sealants cold joints around perimeters of equipment pads curbing and other similar locations, before painting work.
- .4 Use 12 mm thick joint filler to separate slabs-on-grade from vertical surfaces and extend joint filler from bottom of slab to within 19mm of finished slab surface unless indicated otherwise. Top joint filler with backer rod and 12 mm sealant.

3.10 VAPOUR RETARDER MEMBRANE

- .1 Install underslab vapour retarder membrane (Perminator, 10 mil) under all concrete slabs-on-grade inside building and under all concrete building basement slabs.
- .2 Install membrane in strict accordance with membrane manufacturer's written instructions.
- .3 Lap underslab vapour retarder membrane minimum 150 mm at joints and seals using high density polyethylene tape with pressure sensitive adhesive to create vapour and gas tight joints.
- .4 Seal all pipe and conduit penetrations through the membrane using 'The Boot' and high-density polyethylene tape to create vapour and gas

tight seals.

- .5 Seal to inside of concrete foundation walls and concrete pits to create a vapour and gas tight connection.
- .6 Seal punctures in dampproof membrane before placing concrete. Use patching material at least 150mm larger than puncture and seal.

3.11 FINISHING

- .1 Finish concrete in accordance with CSA A23.1, the drawings and process equipment shop drawings (where applicable). Report any discrepancy between the code/drawings/shop drawings to the Consultant in writing.
- .2 Use smooth form finish for all concrete surfaces. Use form facing material that will produce a smooth, hard, uniform texture on the concrete. Do not use material with raised grain, torn surfaces, worn edges, patches, dents or other defects that will impair the texture of the concrete surface. Patch the holes and defects. Patch bug holes exceeding 5 mm in any dimension smooth.
- .3 Use rubbed finish for all interior concrete exposed to view. Remove fins exceeding 3 mm in height.
- .4 Horizontal surfaces:
 - .1 Exterior slabs on grade, exterior equipment pads, and exterior walkways: After concrete has received float finish, give concrete surface a light broom finish by evenly drawing a concrete broom across surface with even, continuous strokes applied in the transverse or short direction. Do not use power trowel or steel trowel.
 - .2 Interior slabs on grade and interior suspended slabs: After concrete has received float finish, finish the surface with multiple passes of a hand or machine trowel to achieve a flat trowel finish. Addition of water to surface to facilitate finishing is prohibited.
 - .3 Base slabs for liquid-containing structures (tanks): hand or machine float finish.
 - .4 Do not apply steel troweled finish to concrete with total air content greater than 3%.
- .5 Tolerance:
 - .1 Finish all slabs and pads in accordance with CSA A23.1. All slabs and pads to have concrete surfaces finished to within 12 mm in 3000 mm as measured with a 3000 mm straight edge paced on surface unless noted otherwise.
 - .2 Slab finish classifications:
 - .1 Interior slabs on grade: Classification B.
- .6 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radius edges unless otherwise indicated.

- .7 Elevation survey: if requested by Owner, carry out an elevation survey on finished slabs in accordance with the measurement procedures outlined in CSA A23.1 to confirm all concrete slabs meet the specified finishes/tolerances.

3.12 CONCRETE CURING

- .1 Cure concrete in accordance with CSA A23.1 and as follows:
 - .1 Duration: Cure all concrete for at least three (3) consecutive days. Concrete with the following class of exposure must be cured for at least seven (7) consecutive days and the time necessary to obtain 70% of the specified strength: C-XL, C-1, C-2, A-XL, A-1, A-2, F-1, S-1, S-2, and N-CF concrete used for exposed interior slabs on grade. The use of high-volume supplementary cementitious materials (HVSCM) may affect curing time, refer to CSA A23.1 for requirements of concrete containing HVSCM.
 - .2 Methods of curing:
 - .1 General: Method of curing concrete may be altered for another method provided the initial curing method is maintained for at least 24 h. If curing method is altered, do not allow surface to dry during transition.
 - .2 Curing formed surfaces: The period during which concrete is in contact with forms may be considered as curing time. During curing period, keep forms wet to minimize loss of moisture. If forms are removed prior to the specified curing period, continue curing by one of the methods specified for "curing unformed surfaces" below.
 - .3 Curing unformed surfaces: curing compounds, ponding or continuous sprinkling with water, applying water and covering with polyethylene sheets (lapped and lying flat on the floor), or applying water and covering with absorptive mat or burlap fabric curing methods may be used.
 - .4 Do not use curing compounds or polyethylene sheets for C-XL or A-XL concrete exposure or liquid-containing structures (tanks).
 - .5 Do not use curing compounds where bond is required for subsequent topping, coating, or applied finishes.
 - .6 Use approved curing compounds in accordance with the manufacturer's written instructions.

3.13 REPAIRS

- .1 In the event that the post-finishing survey shows that the slab surface does not meet the specified tolerances, take corrective action within five (5) working days, or as directed by the Consultant.
- .2 Submit proposed corrective action in writing, with complete details of methods, tools, and materials for the Consultant's approval. Upon

acceptance of the proposed method, a test area is to be prepared, and upon acceptance, is to be the standard for the remainder of the repairs.

- .3 Grind down high points to a smooth surface conforming to the specifications and with a surface finish equal to the remainder of the slab. If cutting or chipping by hammer is required at high areas, then cut the area low with square saw cut edges and patched as noted below.
- .4 Fill low areas by patching with a bonded topping. Chip edges of patch areas and saw cut square a minimum of 25 mm deep. Alternatively, the Consultant may approve feather edging if epoxy type topping is used and a properly bonded smooth finish can be removed before placing patch material. Patches are to be finished to a smooth surface equal to the finish on the remainder of the slab, and cured adequately. Do all patching procedures in strict accordance with the manufacturer's directions and to the approval of the Consultant.

3.14 FIELD QUALITY CONTROL

- .1 Testing of concrete and materials will be carried out and paid for by the Contractor. Use a Testing Laboratory designated or acceptable by the Consultant in accordance with CSA A23.1/A23.2.
- .2 Test concrete in accordance with CSA A23.1/A23.2. Conduct a complete set of tests consisting of a slump, air test, and compressive strength test (a minimum of five (5) test cylinders are required) for the conditions below.
 - .1 Each day's pour.
 - .2 Each type or grade of concrete.
 - .3 Each change of concrete supplier.
 - .4 Each 50 cubic metres or fraction thereof.
- .3 Test one (1) cylinder at seven (7) days, two (2) cylinders at 28-days and hold two (2) cylinders in reserve. The cylinders held in reserve may be used for additional compressive strength testing should previous test results fail to be conclusive or meet the specified compressive strength.
- .4 For liquid-containing structures (tanks), if the Contractor wants to strip formwork prior to seven (7) days, pay for additional cylinders to be cast and tested at no additional cost to the Contract. Refer to Section 03 10 00 for minimum compressive strength requirements prior to stripping formwork.
- .5 If the Contractor wants to strip formwork early, pay for additional cylinders to be cast and tested at no additional cost to the Contract.
- .6 Take additional test cylinders during cold weather concreting.
- .7 Non-destructive Methods for Testing Concrete shall be in accordance with CSA A23.2.
- .8 Site observations or testing by the Consultant will not augment or replace Contractor quality control nor relieve them or their contractual responsibility.

3.15 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning and Waste Management.
- .2 Waste Management: separate waste materials in accordance with Section 01 74 00 - Cleaning and Waste Management.

3.16 LIQUID-CONTAINING STRUCTURE LEAKAGE TESTING AND CRACK REPAIR

- .1 Leak test the SBR Tank in accordance with CSA S900.2. Complete the Qualitative Test (Part 1) and Quantitative Test (Part 2) in accordance with ACI 350.1. Acceptance criteria for the Quantitative Test is a maximum volume loss of 0.05% of volume per day. The initial filling rate shall not exceed 1.2 metres per hour. Backfilling around the structure is not permitted until leak test has been completed.
- .2 Do not perform leak test until 28 days has passed since the last section placement and that the specified 28-day strength has been achieved for all concrete elements that are part of the structure. Prior to conducting tests, obtain approval from the Consultant.
- .3 Repair leaking cracks or joints using one (1) of the following systems:
 - .1 System 1 - Chemical Inject Resin: An approved high-pressure injected polyurethane resin. Have crack repair performed by companies that regularly engage in chemical injection work for concrete structures with a minimum of three (3) years experience installing this type of material. Perform work as per the manufacturer's written specifications and as follows:
 - .1 Clean and seal identified crack surface.
 - .2 Drill injection holes as per manufacturer's directions.
 - .3 Install injection ports or packers at 150 mm centres.
 - .4 Prepare injection equipment. Two (2) pumps are required, one (1) for water and one (1) for chemical.
 - .5 Flush crack.
 - .6 Begin injection at lowest packer on vertical crack or at the first packer flushed for a horizontal crack. Continue injection until injection resin appears at the adjacent packer. Proceed with the injecting adjacent packers as per manufacturer's recommendations.
 - .7 Re-inject water to cure resin.
 - .8 Following crack repair procedure, remove excess resin from concrete surface. Cut ports flush with wall and apply grout to create a smooth texture on remediated surface.
 - .2 System 2 - Leak Repair System:
 - .1 Acceptable product: Krytol Leak Repair System by Kryton International Inc. or approved equivalent.

- .2 Chase the length of joints and cracks to a minimum depth of 40 mm. Provide rectangular shaped chase that is deeper than wide.
- .3 Use leak repair system recommended water stop plug to stop water leakage.
- .4 Use leak repair system recommended repair grout to completely fill the chase flush with adjacent surfaces. Make repairs and repeat leakage test at no additional cost of contract.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 This Section specifies requirements for supplying, transporting, and installing concrete unit masonry including masonry accessories, connectors, mortar, and grout where indicated.

1.2 RELATED SECTIONS

- .1 Section 07 21 00 - Insulation.
- .2 Section 07 26 00 - Air/Vapour Barrier.
- .3 Section 07 92 00 - Sealants.

1.3 REFERENCE STANDARDS

- .1 ASTM C979/C979M-24, Standard Specification for Pigments for Integrally Colored Concrete.
- .2 ASTM D1056-20, Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.
- .3 ASTM F1554-20, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
- .4 ASTM F593-24, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
- .5 CSA A165 Series-14(R2024), CSA Standards on Concrete Masonry Units.
- .6 CSA A179-14(R2024), Mortar and Grout for Unit Masonry.
- .7 CSA A23.1:24/A23.2:24, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .8 CSA A370-14(R2023), Connectors for Masonry.
- .9 CSA A371-14(R2024), Masonry Construction for Buildings.
- .10 CSA G30.18:21, Carbon Steel Bars for Concrete Reinforcement.
- .11 CSA G40.20-13/G40.21-13(R2023), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .12 CSA S304:24, Design of Masonry Structures.
- .13 CSA W186:21, Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .14 RSIC-20, Reinforcing Steel Manual of Standard Practice.

1.4 REQUIREMENTS OF REGULATORY AGENCIES

- .1 Construct masonry work as required by Jurisdictional authorities.
- .2 Before commencing masonry Work, verify site conditions will allow construction of masonry within required limitations of wall heights wall thicknesses openings, bond, anchorage, lateral support, and compressive strength of masonry units and mortars.

1.5 SHOP DRAWINGS

- .1 Submit shop drawings for masonry and connectors in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit manufacturer's instructions, printed product literature and data sheets for concrete masonry units, mortar, grout, anchorage materials, reinforcing materials, and masonry accessories and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Submit reinforcing and anchorage shop drawings consisting of bar bending details, lists and placing drawings. Provide shop drawings detailing bar bending details, anchorage details, lists and placing drawings.
- .4 On placing drawings, bar bending details, lists, quantities of reinforcement, sizes, spacings and locations of reinforcement with identifying code marks to permit correct placement without reference to structural drawings. Prepare reinforcement drawings in accordance with RSIC.

1.6 PRODUCT 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 materials from nicks, scratches, and blemishes.
 - .3 Keep materials dry until use.
 - .4 Store under waterproof cover on pallets or plank platforms held off ground by means of plank or timber skids.
 - .5 Cover masonry units with non-staining waterproof membrane covering.
 - .6 Allow air circulation around concrete masonry units.
 - .7 Installation of wet or stained masonry units is prohibited.
 - .8 Replace defective or damaged materials with new.

1.7 SITE CONDITIONS

- .1 Masonry units, cementitious materials, and sand stored on Site to be protected from contaminants, rain, snow, and groundwater.
- .2 When Work is not in progress, cover the exposed top surfaces of masonry, and cavity if present to prevent intrusion of moisture.
- .3 Ambient conditions: assemble and erect components when temperatures are above 4°C.
- .4 Weather requirements: to CSA A371.

.5 Cold weather requirements:

.1 To CSA A371 and as follows:

- .1 Temperature of units when laid not to be less than 4°C.
- .2 Maintain temperature of mortar between 4°C and 50°C until batch is used or becomes stable.
- .3 Place grout in masonry at a minimum temperature of 20°C and a maximum temperature of 50°C.
- .4 Maximum mixing water and sand temperature shall not exceed 70°C to avoid flash set.
- .5 When air temperature is between -7°C to -4°C, provide source heat on both sides of the walls under construction and employ windbreaks when the wind speed exceeds 25 km/h.
- .6 When air temperature is below -7°C, provide enclosures and supplementary heat to maintain an air temperature above 0°C.

.6 Protect completed masonry and section not in progress as follows:

- .1 When the mean daily air temperature is between 0°C to 4°C, protect masonry from rain or snow for 48 hours.
- .2 When mean daily air temperature is between -4°C to 0°C, cover masonry for 48 hours.
- .3 When the mean daily air temperature is between -7°C to -4°C, cover masonry with insulating blankets for 48 hours.
- .4 When mean daily air temperature is below -7°C, maintain masonry temperature above 0°C for 48 hours by enclosure and provide supplementary heat.

.7 Hot weather requirements:

.1 To CSA A371 and as follows:

- .1 Protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.
- .2 Keep masonry dry using waterproof, non-staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until masonry work is completed and protected by flashing or other permanent construction.
- .3 The spreading of mortar beds shall be limited to 1.2 m and the masonry units shall be set within 1 min of spreading the mortar when the mean daily air temperature is above 38°C or above 32°C with a wind velocity greater than 13 km/h.

PART 2 - PRODUCTS

2.1 UNIT MASONRY

- .1 Standard concrete block units to CSA A165.1:
 - .1 Classification H/20/A/O.
 - .2 Dimensions nominal: 200 mm wide x 200 mm high x 400 mm long.
 - .3 Special shapes: provide provide purpose-made shapes for lintels and bond beams, and door jambs. Provide additional special shapes as indicated.
 - .4 Acceptable manufacturers: Shaw Group, V.M. Rice, Casey Concrete or approved equivalent.
- .2 Architectural concrete unit masonry to CSA A165.1:
 - .1 Classification: SF/25/A/M.
 - .2 Size: 90 mm wide x 190 mm high x 390 mm long (typical sized unit).
 - .3 Special shapes: as indicated, including "L" corners, under windows and mechanical louvres, etc.
 - .4 Colour: to match existing.
 - .5 Acceptable manufacturers: Split Ashlar by Shaw Group, V.M. Rice, Casey Concrete or approved equivalent.

2.2 REINFORCEMENT

- .1 Bar reinforcement: to CSA A371 and CSA G30.18, Grade 400W.
- .2 Joint reinforcement ties: CSA A371 with corrosion protection to CSA S304 and CSA A370:
 - .1 Single wythe joint reinforcement:
 - .1 Type and size: extra heavy duty ladder type with 4.76 mm diameter side rods with 4.76 mm diameter cross rods.
 - .2 Material: stainless steel, type 304.
 - .3 Acceptable products: BL-10 by Blok-Lok Limited or approved equivalent.
 - .2 Multiple wythe joint reinforcement:
 - .1 Type and size: extra heavy duty ladder type with 4.76 mm diameter side rods with 4.76 mm diameter cross rods.
 - .2 Material: stainless steel, type 304.
 - .3 Acceptable products: BL-11, BL-21, or BL-42 by Blok-Lok Limited or approved equivalent.
 - .3 Cold drawn steel wire.
 - .4 Use prefabricated corners and tees to match joint reinforcing.

2.3 CONNECTORS

- .1 Connectors: to CSA A370 and S304.
- .2 Anchors: to CSA A370.
 - .1 Anchor rods:
 - .1 Carbon steel: to ASTM F1554, grade 36 or as indicated on drawings, galvanized, unless noted otherwise.
 - .2 Stainless steel: to ASTM F593, type 316L, condition CW1 (6 mm to 16 mm) and CW2 (19 mm to 38 mm).
 - .2 Wedge anchors: expansion type, stainless steel 316, size as noted on drawings.
 - .1 Acceptable products: Kwik Bolt TZ2 by Hilti Canada Corp. or approved equivalent.
 - .3 Chemical adhesive anchoring system:
 - .1 Two-component tube inject system. All adhesive anchor and rebar installations, including drilling of holes, preparation, storage, usage, and curbing to be in accordance with the written instructions and training as provided by the manufacturer.
 - .2 Fastening into solid concrete block or grouted concrete block installation: Hilti HIT-HY 270 adhesive by Hilti Canada Corp. or approved equivalent.
 - .3 Fastening into hollow concrete block installation: Hilti HIT-HY 270 adhesive with HIT-SC screen tubes by Hilti Canada Corp. or approved equivalent.

2.4 MORTAR AND GROUT

- .1 Use same brands of materials and source of aggregate for entire project.
- .2 Cement: to CSA A179.
- .3 Fine and coarse aggregate: to CSA A179.
- .4 Water: clean and potable.
- .5 Mortar: to CSA A179 based on proportion specification:
 - .1 Loadbearing: Type S.
 - .2 Non-loadbearing and partitions: Type N.
 - .3 Parapet walls: Type S.
- .6 Parging mortar: Type N based on proportion specification.
- .7 Use colouring pigment in accordance with ASTM C979:
 - .1 Add mortar color in accordance with manufacturer's instructions.
 - .2 Colour: to be selected by the Consultant.
 - .3 Acceptable product: Interstar or approved equivalent.

- .8 Mortar to be manufactured at the job site based on the proportion limits of Table 3 or 4 of CSA A179.
- .9 Mortar manufactured off-site at a batching plant is not permitted unless authorized by Consultant.
- .10 Grout for all masonry walls, bond beams and lintels: to CSA A179 based on proportion specification.
 - .1 Coarse grout: unless noted otherwise.
 - .2 Fine grout: for spaces whose least dimension is less than 50 mm.
 - .3 Slump: 200 mm to 275 mm.
- .11 Grout to be manufactured at the job site based on the proportion limits of Table 5 of CSA A179.
- .12 Grout manufactured off-site at a batching plant is not permitted unless authorized by Consultant.

2.5 MASONRY ACCESSORIES

- .1 Embedded plates, angles and channels: to CSA G40.20/G40.21, grade 300W.
- .2 Movement joint filler: purpose-made closed cell neoprene to ASTM D1056 of size and shape indicated, and backer rod and caulking as per Section 07 92 00.
 - .1 Acceptable product: NS Neoprene Sponge by Blok-Lok Limited or approved equivalent.
- .3 Flashings: non-vapour permeable, self-adhered, through-wall flashing consisting of rubberized asphalt integrally laminated to polyethylene liner.
 - .1 Nominal thickness: 1 mm (40 mils).
 - .2 Acceptable products: Blueskin TWF by Henry Company or Perm-A-Barrier Wall Flashing by W.R. Grace.
- .4 Lap adhesive: recommended by masonry flashing manufacturer.
- .5 Weep hole vents: purpose-made polypropylene copolymer.
 - .1 Size: 9.5 mm thick x 86 mm wide x 89 mm tall.
 - .2 Colour: to suit mortar.
 - .3 Acceptable Products: CELLVENT by Blok-Lok or approved equivalent.
- .6 Mortar diverters: shape and sized to suit cavity spaces.
 - .1 Acceptable products: Mor-Control by Block-Lok Ltd., Mortar Net by Mortar Net USA Ltd., or approved equivalent.
- .7 Grout screens: 6 mm square monofilament screen fabricated from high-strength, non-corrosive polypropylene polymers to isolate flow of grout in designated areas.
 - .1 Acceptable products: mortar grout screen by Blok-Lok or approved equivalent.

- .8 Insulation wedges: impact resistant plastic clip.
- .1 Acceptable product: Wedge-Lok by Blok-Lok or approved equivalent.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verify the following:
 - .1 Substrate conditions which have been previously installed under other sections or contracts, are acceptable for product installation in accordance with manufacturer's instructions before installation of concrete block.
 - .2 Site conditions are acceptable and are ready to receive work.
 - .3 Built-in items are in proper location, and ready for roughing into masonry work.
 - .4 Commencing installation means acceptance of existing substrates.

3.2 CONSTRUCTION

- .1 Do masonry work in accordance with CSA A371.
- .2 Build masonry plumb, level, and true to line, with vertical joints in alignment, respecting construction tolerances permitted by CSA A371.
- .3 Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimum of cutting.
- .4 Mixing and blending: mix units within each pallet and with other pallets to maintain uniform blend of colour and texture.
- .5 Cut blocks as required to ensure coursing height aligns with intersecting and adjacent walls.
- .6 Concrete block units:
 - .1 Bond: running.
 - .2 Coursing height: 200 mm for one block and one joint.
 - .3 Jointing: concave where exposed or where paint or other finish coating is specified.
- .7 Architectural concrete unit masonry:
 - .1 Bond: running.
 - .2 Coursing height: 200 mm for one block and one joint.
 - .3 Jointing: concave where exposed or where paint or other finish coating is specified.
- .8 Special shapes:
 - .1 Install special units to form corners, returns, offsets, reveals and indents without cut ends being exposed and without losing bond or module.

- .2 End bearing: as indicated on drawings.
- .3 Install special shaped units.
- .9 Exposed masonry:
 - .1 Remove chipped, cracked, and otherwise damaged units, In accordance with CSA A165, in exposed masonry and replace with undamaged units.
- .10 Jointing:
 - .1 Allow joints to set just enough to remove excess water, then tool with round jointer to provide smooth, joints true to line, compressed, uniformly concave joints where concave joints are indicated.
- .11 Cutting:
 - .1 Cut out for electrical switches, outlet boxes, and other recessed or built-in objects.
 - .2 Make cuts straight, clean, and free from uneven edges.
- .12 Building-In:
 - .1 Build in items required built into masonry.
 - .2 Verify accessories, frame anchors, guards, and such items specified in other Sections are available for building in before Work commences. Cooperate in the setting and aligning of built-in Work and provide for later installation of items which are included in the Work of other Sections, to avoid cutting, fitting, and patching.
 - .3 Prevent displacement of built-in items during construction. Check plumb, location and alignment frequently, as work progresses.
- .13 Support of load:
 - .1 Install grout in accordance with CSA A371 in all core fills and lintels.
 - .2 Install expanded metal mesh below voids to be filled with grout. Keep mesh 25 mm back from faces of units.
 - .3 Install reinforced concrete block lintels over openings in masonry where steel not indicated.
 - .4 Install loose lintels to support architectural veneer at all openings. See structural for lintel details.
- .14 Provisions for movement:
 - .1 Caulk corner joints of all block work where walls butt into continuous walls, at dissimilar material intersections (concrete walls and columns) and at masonry wall intersection with floor slabs, caulking to be done before painting. Slightly rake the vertical mortar joint during installation so as to provide slight slot for caulking joint. Tie wall butting to intersecting wall

with Flex-o-Lok anchor system with masonry screw anchors and ties at every second block course.

- .2 Install movement joints at locations indicated on Drawings.
- .15 Insulation wedges: installed at 400 mm o.c. vertical and 800 mm o.c. horizontal.

3.3 MORTAR AND GROUT

- .1 Do masonry mortar and grout work in accordance with CSA A179.
- .2 Mix all cementitious materials and aggregates completely to a homogeneous mass with the amount of water required to produce desired workability. Mix mortar in a mechanical batch mixer for 3 to 5 mins. mix grout in a mechanical batch mixer for 5 to 10 mins.
- .3 Use job site prepared mortar and place in final position within 1.5 hours after mixing when air temperature is 25°C or higher, and within 2.5 hours after mixing when the air temperature is less than 25°C.
- .4 Use job site prepared grout and place in final position within 1.5 hours after mixing.
- .5 Discard off site, prepared mortar and grout not used within the times permitted above.
- .6 Retemper job site prepared mortar that has stiffened because of moisture evaporation within the periods specified above by adding water in quantities and at intervals sufficient to restore proper workability.
- .7 Mix in mortar colour pigments.
- .8 Remove excess mortar from grout spaces.
- .9 Work grout into masonry cores and cavities to eliminate voids.
- .10 Displacing reinforcement while placing grout is prohibited.
- .11 Prior to placement of grout, obtain the Consultant's approval of placement of reinforcement and connectors.

3.4 ANCHORAGE, CONNECTORS AND REINFORCEMENT

- .1 Supply and install masonry connectors and reinforcement in accordance with CSA A370, CSA A371, CSA A23.1/A23.2 and CSA S304.1 unless indicated otherwise.
- .2 Fabricate reinforcement in accordance with CSA A23.1 and RSIC.
- .3 Install bars vertically and continuously in cores of hollow masonry units where indicated.
- .4 Obtain the Consultant's approval for locations of reinforcement splices other than shown on placing drawings.
- .5 Upon approval of the Consultant, weld reinforcement in accordance with CSA W186.
- .6 Ship reinforcement and connectors, clearly identified in accordance with drawings.

- .7 Tie masonry veneer to backing and as indicated on Drawings.
- .8 Horizontal joint reinforcement:
 - .1 Install horizontal joint reinforcement as indicated on Drawings.
 - .2 Place masonry joint reinforcement in first horizontal joints above and below openings. Extend minimum 400 mm each side of opening.
 - .3 Lap joint reinforcement ends minimum 300 mm.
 - .4 Use prefabricated corner and tee sections.
 - .5 Joint reinforcement to be discontinuous across movement joints, unless otherwise indicated.
- .9 Reinforced lintels and bond beams:
 - .1 Reinforce masonry beams, masonry lintels and bond beams as indicated on Drawings.
 - .2 Supply and install additional reinforcement to masonry as indicated around openings.
 - .3 Bond beam reinforcement to be continuous across movement joints, unless noted otherwise.
- .10 Field bending:
 - .1 Do not field bend reinforcement and connectors except where indicated or authorized by Consultant.
 - .2 When field bending authorized, bend without heat, applying slow and steady pressure.
 - .3 Replace bars and connectors with cracks or splits.

3.5 MASONRY ACCESSORIES

- .1 Install movement joints as indicated on Drawings.
- .2 Lap adhesive: apply adhesive to flashing lap joints.
- .3 Brick vents: install brick vents at locations indicated on Drawings.
- .4 Install weep hole vents in vertical joints immediately over flashings, in exterior wythes of cavity wall and masonry veneer wall construction, at maximum horizontal spacing of 600 mm on centre.
- .5 Mortar diverters: install purpose made diverters in cavities where indicated and as directed, size and shape to suit purpose and function.
- .6 Grout screens: install purpose made screens in cavities where indicated and as directed, size and shape to suit purpose and function.
- .7 Install masonry anchors using SAFESET installation system to manufacturer's instructions. For masonry anchors into hollow cells, use HIT-SC screen tubes.

3.6 TOLERANCE

- .1 Tolerances to CSA A371 apply.

3.7 FIELD QUALITY CONTROL

- .1 Testing of mortar and grout will be carried out by an independent testing company appointed by the Contractor in accordance with CSA A179. Arrange and pay for these tests at no additional cost to the Contract.
- .2 Prior to construction, a test set for mortar, grout, grout slump shall be completed to establish strength control values. Complete a test set of mortar cubes, grout cylinders, and grout slump tests for every 250 m² or portion thereof of concrete block or architectural concrete block.
- .3 Mortar test set:
 - .1 Each test set to consist of six (6) mortar cubes.
 - .2 Test three (3) cubes at 7 days and three (3) cubes at 28 days.
- .4 Grout test set:
 - .1 Each test set to consist of three (3) grout cylinders.
 - .2 Test one (1) cylinder at 7 days and two (2) cylinders at 28 days.
 - .3 Test slump in accordance with CSA A179.

3.8 CLEANING

- .1 Leave Work area clean at end of each day.
- .2 Clean concrete block and brick masonry as work progresses.
- .3 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block and finally by brushing.
- .4 Clean 10 m² area of wall as designated by the Consultant as directed below and leave for one (1) week. If no harmful effects appear after mortar has set and cured, protect windows, sills, doors, trim, and other work, and clean concrete masonry as follows:
 - .1 Remove large particles with wood paddles without damaging surface. Saturate masonry with clean water and flush off loose mortar and dirt.
 - .2 Scrub with solution of 25 ml trisodium phosphate and 25 ml household detergent dissolved in 1 L of clean water using stiff fibre brushes, then clean off immediately with clean water using hose. Alternatively, use proprietary compound recommended by concrete masonry manufacturer in accordance with manufacturer's directions.
 - .3 Repeat cleaning process as often as necessary to remove mortar and other stains.

- .4 Use acid solution treatment only for difficult to clean concrete masonry as recommended by the manufacturer.

3.9 PROTECTION

- .1 Temporary Bracing:
 - .1 Provide temporary bracing of masonry work during and after erection until permanent lateral support is in place.
 - .2 Brace masonry walls as necessary to resist wind pressure and lateral forces during construction.
- .2 Moisture Protection:
 - .1 Keep masonry dry using waterproof, non staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until completed and protected by flashing or other permanent construction.
 - .2 Cover completed and partially completed work not enclosed or sheltered with waterproof covering at end of each work day. Anchor securely in position.
 - .3 Air Temperature Protection: protect completed masonry as recommended in Section 1.7 - SITE CONDITIONS.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This Section specifies requirements for furnishing all materials, labour, tools and equipment, and performing all operations necessary to complete all miscellaneous metal and fabricated items, as shown on the Drawings and specified in this Section.
- .2 The Work generally includes the following categories and all related items of miscellaneous metal shown on the Drawings except where noted otherwise:
 - .1 Anchors, chemical anchors, bolts and inserts
 - .2 Miscellaneous steel
 - .3 Pipe and valve supports
 - .4 Pipe bollards
 - .5 Electrical and mechanical equipment supports
 - .6 Bar grating
 - .7 Checker plate
 - .8 Guardrails
 - .9 Ladders
 - .10 Access hatches
 - .11 Aluminum tread plate
 - .12 Hose racks
 - .13 Weir plates
 - .14 Baffles
 - .15 Safety gates
- .3 Where not indicated in this Section, refer to drawings for number of items to be provided for each category.

1.2 RELATED WORK

- .1 Section 03 30 00 - Cast-In-Place Concrete.
- .2 Section 04 20 00 - Masonry.
- .3 Section 09 91 23 - Painting.

1.3 REFERENCES

- .1 ASTM A29/A29M-23, Standard Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought.
- .2 ASTM A53/A53M-24, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-coated Welded and Seamless.
- .3 ASTM A276/A276M-24a, Standard Specification for Stainless Steel Bars and Shapes.
- .4 ASTM A312/A312M-24b, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.

- .5 ASTM A480/A480M-24, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
- .6 ASTM A484/A484M-24b, Standard Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings.
- .7 ASTM A500/A500M-23, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- .8 ASTM A572/A572M-21e1, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
- .9 ASTM A780/A780M-20, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- .10 ASTM B209/B209M-21a, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .11 ASTM B221-21, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- .12 ASTM F436/F436M-19, Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.
- .13 ASTM A563/A563M-23, Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric).
- .14 ASTM F593-24, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
- .15 ASTM F1554-20, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
- .16 ASTM F3125/F3125M-23, Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength.
- .17 CSA G40.20/G40.21-13(R2023), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .18 CSA G164-18(R2023), Hot Dip Galvanizing of Irregularly Shaped Articles.
- .19 CSA S16:24, Design of Steel Structures.
- .20 CSA S157-17/S157.1-17 (R2022), Strength Design in Aluminum / Commentary on CSA S157-17, Strength Design in Aluminum.
- .21 CSA W48:23, Filler metals and allied materials for metal arc welding.
- .22 CSA W59:24, Welded Steel Construction.
- .23 CISC/CPMA Standard 1-73A, A Quick-drying One-coat Paint for Use on Structural Steel.
- .24 CISC/CPMA Standard 2-75, A Quick-drying Primer for Use on Structural Steel.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Clearly indicate materials, core thicknesses, finishes, connections, joints, method of attachment, number of anchors, supports, reinforcement, details, and accessories.
- .3 Provide stamp and signature by a qualified professional engineer registered or licensed to practice in the Province of Nova Scotia for connection designs.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- .1 Label, tag or otherwise mark items supplied for installation by other sections to indicate its function, location, and shop drawing designation.

1.6 JOB CONDITIONS

- .1 Protection:
 - .1 Maintain protection of Work of this Section from time of installation until final finishes are applied.
 - .2 Protect galvanized surfaces from damage.
 - .3 Protect exposed surfaces of prefinished metal work which does not receive site finishing with protective coatings or wrappings. Use materials recommended by finishers or manufacturers of metals to ensure that method is sufficiently protective, easily removed, and harmless to the finish.

1.7 DESIGN OF DETAILS AND CONNECTIONS

- .1 Design details and connections in accordance with requirements of CSA S16 to resist axial forces, shear, moment, and torsion indicated.
- .2 Unless noted otherwise, connections are to be designed and detailed to resist 50% of the total uniformly distributed factored load capacity of the members and 75% of the tensile capacity of bracing members.
- .3 For non-standard connections, submit sketches and design calculations sealed with the stamp and signature of a qualified Professional engineer registered or licensed to practice in the Province of Nova Scotia.
- .4 For standard connections, select details from CISC Handbook of Steel Construction to ensure structural adequacy. Submit all standard connections for each structural steel member size. Connection designs must be sealed with the stamp and signature of a qualified Professional engineer registered or licensed to practice in the Province of Nova Scotia.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Use new materials that are free from corrosion, rust, and mill scale.
- .2 W-Shapes: to CSA G40.21 grade 350W or ASTM A572 grade 50 (345 MPa).
- .3 Hollow Structural Sections (HSS): to CSA G40.21 grade 350W class C or ASTM A500 grade C.
- .4 Steel angles, plates and bars: to CSA G40.21, 300W.
- .5 Steel channels: to CSA G40.21, 350W.
- .6 Steel pipe: to ASTM A53, grade B, schedule 80, galvanized, unless noted otherwise.
- .7 Stainless steel plate: to ASTM A480, type 316L.
- .8 Stainless steel angles, bars, channels, and W-Shapes: to ASTM A276, type 316L.
- .9 Stainless steel tubing: to ASTM A312, type 316L.
- .10 Aluminum plate: to ASTM B209.
- .11 Aluminum sections: to ASTM B221.
- .12 Welding materials: to CSA W48 and W59 and certified by Canadian Welding Bureau.
- .13 Stud anchors:
 - .1 Mild steel to ASTM A29, grade 1010 to 1020 and CSA W59, type B.
 - .2 Stainless steel to ASTM A276, type 316L.
 - .3 Acceptable Product: Nelson type H4L or S3L by Stanley Engineered Fastening or approved equivalent.
- .14 Anchor rods: to ASTM F1554, grade 36, unless otherwise noted.
- .15 Stainless steel anchor rods: to ASTM F593, type 316L, condition CW1 (6mm to 16mm) and CW2 (19mm to 38mm).
- .16 Bolts: to ASTM F3125 grade A325 unless otherwise noted.
- .17 Nuts and washers: to ASTM A563 and ASTM F436 respectively.
- .18 Galvanizing: Galvanizing: hot-dip method with minimum zinc coating of 100 μm (705 g/m²) for structural sections and plates, and 65 μm (455 g/m²) for bolts/nuts/washers and conforming to CSA G164.
- .19 Galvanized touch-up coating: to ASTM A780.
 - .1 Acceptable product: Brite Zinc by CRC Industries, Cold Galv by Dynaflux Inc. or approved equivalent.
- .20 Shop coat primer: to CISC/CPMA 2-75.
- .21 Chemical Adhesive Anchoring System:

- .1 Two-component tube inject system. All adhesive anchor and rebar installation, including drilling of holes, preparation, storage, usage, and curbing to be in accordance with the written instructions and training as provided by the manufacturer.
- .2 For core drilled holes, use Hilti TE-YRT hole roughening tool in accordance with the written manufacturer's instructions.
- .3 Acceptable products: Hilti HIT-HY 200 V3 adhesive by Hilti Canada Corp. or approved equivalent.

2.2 FABRICATION

- .1 Workmanship and finish must be equal to the best practice of modern shops for each item of work.
- .2 Build work square, true, straight, and accurate to required size, with joints closely fitted and properly secured.
- .3 Provide exposed surfaces with a smooth finish and sharp, well defined lines and arises. Form sections to shape and size shown with sharp lines and angles.
- .4 Confirm castings have sharp corners and edges, and are clean, smooth, and true to pattern.
- .5 Make exposed welds continuous for length of each joint. File or grind exposed welds smooth and flush.
- .6 Where possible, fit and shop assemble work, ready for installation.
- .7 Fabricate miscellaneous steel in accordance with CSA S16, CSA S157 (aluminum) and in accordance with reviewed shop drawings.
- .8 When welding on site, check with plant staff before grounding to ensure that this activity will not have adverse effects on the plant equipment.
- .9 Provide holes for attachment of other work only when and where approved by the Consultant or as shown on the Drawings.
- .10 Verify dimensions and conditions of existing work before commencing fabrication and report discrepancies or problems to the Consultant. Do not proceed until notified by the Consultant.
- .11 Remove mill marks, identification, and surface imperfections of exposed steel by grinding smooth and galvanized touch up primer.

2.3 SHOP PAINTING

- .1 Apply one (1) coat of primer to metal items, with exception of galvanized, aluminum, stainless steel, or concrete encased items. For locations where steel is to be top-coated with architectural paint, prime steel in accordance with CISC/CPMA 2. Prime all other steel in accordance with CISC/CPMA 1. For locations where architectural topcoat is required, refer to architectural drawings.
- .2 Prime after fabrication and before damage to surface occurs from weather or other exposure.

- .3 Spray prime contact surfaces of field assembled, bolted, friction type joints with primer only. Do not brush primer after spraying.
- .4 Do not prime metal within 50 mm of edge to be welded. Give unprotected steel one coat of approved protective coating after shop fabrication is completed.
- .5 Copy previous erection marks and weight marks on areas that have been shop primed.

2.4 MISCELLANEOUS METALWORK ITEMS

- .1 Anchors, chemical adhesive anchors, bolts and inserts:
 - .1 Provide as required to fasten miscellaneous metal items to concrete or masonry.
 - .2 Where sizes, kinds and spacing of anchors are not indicated or specified, provide as necessary for the purpose as approved by the Consultant.
 - .3 Hot-dip galvanize all anchors, bolts and inserts except stainless steel or aluminum anchors, bolts and inserts.
- .2 Miscellaneous steel:
 - .1 Provide miscellaneous steel as required for equipment supports, angles, and steel framing to shape, size and details required.
 - .2 Galvanize or paint miscellaneous steel items after fabrication, where indicated on drawings.
- .3 Pipe and valve supports: fabricated from steel plate, thickness indicated, galvanize after fabrication. Anchor into concrete floor slab as shown.
- .4 Pipe bollards:
 - .1 Fabricate bollards of 150 mm diameter steel pipe, to ASTM A53, grade B, schedule 80, galvanized. Fabricate bollards to lengths indicated, fill with concrete and set in concrete foundation.
 - .2 Exposed steel for pipe bollard assemblies to receive one (1) of the following exterior finishes:
 - .1 Shop painted with one (1) coat of inorganic zinc primer of 3 mils dry film thickness (DFT), such as Carbonzinc II by Carboline Company or approved equivalent. Finish with two (2) top coats (4 mils DFT each) of Carboguard 890 (colour: Safety Yellow) or approved equivalent.
 - .2 Covered with a high density polyethylene (HDPE) post sleeve with two (2) upper bands of 3M reflective tape. Bollard cover sleeve colour: Safety Yellow.
 - .1 Acceptable product: 7" BollardGard Bumper Post Sleeve by Innoplast, Inc., or approved equivalent.

- .5 Electrical and mechanical equipment supports: fabricate from structural steel channel and plate to details indicated, galvanize after fabrication.
- .6 Gratings:
 - .1 5 mm bars, depth as shown, type 30W102 galvanized steel or type 30-102 aluminum bar grating, as noted on drawings.
 - .2 Gratings to have ends banded and all bars permanently locked at intersections.
 - .3 Support gratings on angle frames of sizes indicated.
 - .4 Provide grating hold down clips as required, galvanized steel or aluminum to match grating material.
 - .5 Reinforce all penetrations in grating to full satisfaction of the Consultant at no additional cost.
 - .6 All stair treads to be 32x5 type 30W102 bar grating with checker plate nosings, galvanized.
 - .7 All exterior grating and treads to be serrated.
 - .8 Acceptable products: as manufactured by Nucor Vulcraft Canada or approved equivalent.
- .7 Checkerplate: thickness as indicated, minimum 6 mm, raised pattern galvanized steel or aluminum, as indicated, floor plate.
- .8 Steel handrails and guardrails:
 - .1 Fabricate handrails, guardrails, and posts using hollow structural sections (HSS), outside diameter and wall thickness as shown on the Drawings.
 - .2 Make changes in direction with smooth radius curves. Mitre joints and weld flush.
 - .3 Fabricate posts from same material as rail. Space and attach posts as shown.
 - .4 Fabricate kick plates using 6 mm thick plate to CSA G40.21.
 - .5 Hot-dip galvanize handrails, guardrails, and post assemblies after fabrication unless otherwise noted.
 - .6 Safety swing gate: self-closing, spring loaded, single door, galvanized, width to suit guardrail opening. Acceptable product: Kee Gate as manufactured by Kee Safety Limited or approved equivalent.
- .9 Ladders:
 - .1 Fabricate from shapes and sizes indicated on the Drawings.
 - .2 Material: Carbon steel or stainless steel, as noted on drawings.
 - .3 Finish: hot dip galvanized for carbon steel.
 - .4 Fasten to concrete with Kwik Bolt TZ2 SS316L wedge anchors.
- .10 Floor Hatches:

- .1 Manufactured Type: hatches denoted on drawings as Pre-manufactured Hatch to be based on Bilco Type J-AL, and as follows and as shown on the drawings:
 - .1 Size: as indicated on drawings.
 - .2 Door leaf: single leaf aluminum.
 - .3 Channel frame: aluminum with anchor flange around perimeter; and continuous gas tight neoprene gasket.
 - .4 Hardware: heavy duty stainless steel hinges, stainless steel pins, compression spring operators, and automatic hold-open arm with release handle. Provide a recessed cylinder lock with keyway protected by a threaded cover plug. Other hardware stainless steel.
 - .5 Finish: mill finish aluminum with bituminous coating applied to exterior of frame.
 - .6 Provide fall protection safety grating.
 - .7 Acceptable product: as manufactured by Bilco or approved equivalent.
- .11 Lifting Hooks: fabricate from steel bolt to ASTM F1554 and plate to CSA G40.21, size shown. Grout into roof slabs and underside of floor slabs as shown.
- .12 Hose rack: fabricated from stainless steel plate of size and shape shown. Provide 13 mm diameter stainless steel expansion shield bolts for attachment to masonry walls. Acceptable alternate: aluminum.
- .13 Weir plate: fabricated from stainless steel plate to size and shape indicated. Provide slotted hole in weir plate to allow for height adjustment.
- .14 Bar Screen: bars, plate, angles, structural sections, and fasteners to be stainless steel.
- .15 Baffles: fabricated from stainless steel plate to size and shape indicated. Provide slotted hole in baffles to allow for height adjustment.
- .16 Miscellaneous steel platforms: fabricate to dimensions indicated on drawings. Platforms to be constructed of elements as indicated on drawings. (Final steel platform dimensions to be coordinated with site dimensions.)
- .17 Where aluminum surfaces come into contact with dissimilar materials such as metals (steel) or concrete, exposed aluminum surfaces shall be painted with one (1) coat of bituminous paint or use of other approved insulating material.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verify all dimensions and take necessary field measurements required prior to fabrication to assure that all items function properly when installed.
- .2 Notify the Consultant of all discrepancies prior to fabrication for approval.

3.2 INSTALLATION

- .1 Install miscellaneous metal items in the locations shown on the Drawings.
- .2 Install metalwork square, plumb and true using welded connections wherever possible to provide rigid structures. Provide anchor bolts, bolts and plates as necessary for connecting to structure of types acceptable to the Consultant.
- .3 Hand over items for casting into concrete to appropriate trades together with setting templates.
- .4 Exposed fastening devices to match finish, and to be compatible with material thorough which they pass.
- .5 Do welding work in accordance with CSA W59 unless specified otherwise.
- .6 Touch-up field welds, bolts, and burnt or scratched surfaces with primer after installation.
- .7 Touch-up galvanized surfaces with zinc-rich coating in accordance with ASTM A780.
- .8 Paint installed metal work.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This Section specifies requirements for supplying, transporting and installing all items of rough carpentry.

1.2 RELATED WORK

- .1 Section 07 21 00 - Insulation.
- .2 Section 07 92 00 - Sealants.
- .3 Section 09 91 23 - Painting.

1.3 REFERENCES

- .1 ASTM A307-21, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
- .2 ASTM F1554-20, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
- .3 CSA O80 Series:21, Wood Preservation.
- .4 CSA O121:17(R2022), Douglas Fir Plywood.
- .5 CSA O141:23, Softwood Lumber.
- .6 CSA O151:17(R2022), Canadian Softwood Plywood.
- .7 CSA O325:21, Construction Sheathing.
- .8 NLGA, Standard Grading Rules for Canadian Lumber, 2022.
- .9 National Building Code (NBC), 2015.

1.4 QUALITY ASSURANCE

- .1 Lumber identification: by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.
- .2 Plywood identification: by grade mark in accordance with applicable CSA standards.

PART 2 - PRODUCTS

2.1 PERFORMANCE CRITERIA

- .1 Lumber: provide lumber products that are all sides finished (S4S) in nominal dimensions required for the project; grade marked by accredited agencies of the Canadian Lumber Standards Accreditation Board and conform to National Grading Rules published by the National Lumber Grades Authority, and as follows:
 - .1 Grading: machine grading, visual grading, or both.
 - .2 Moisture content: kiln dry, 19% or less.

- .3 Structural design properties: Strength and related properties in accordance with CSA O86 and NLGA SPS 2.
- .4 Sizes: Nominal dressed dimensions described in CSA O141 for surfaced dry conditions and wood species.
- .2 Plywood Grades: Provide plywood products in nominal dimensions required for the project; grade-marked by accredited agencies of the APA and that conform to the Canadian Plywood Grading Guide, and tolerances described for specific plywood Products below, and identified as follows:
 - .1 Standard: CSA O121 or CSA O151.
 - .2 Manufacturer's mill identification.
 - .3 Bond quality (exterior or interior).
 - .4 Commercial species grouping (DFP, CSP, ASP or HEM-FIR).
 - .5 Product grade (SHG, SEL, SEL TF, G1S or G2S).
 - .6 Nominal thickness.
 - .7 Additional grade or product designations (if applicable).
- .3 Machine stress-rated lumber is acceptable for all purposes.
- .4 Glued end-jointed (finger-jointed) lumber is not acceptable.
- .5 Pressure treat all lumber in contact with ground, masonry, or concrete.

2.2 MATERIALS

- .1 Lumber materials:
 - .1 Structural light framing:
 - .1 Grade: No. 2 or better.
 - .2 Sizes: 38mm to 89mm width by 38mm to 89mm depth, as indicated on drawings.
 - .3 Species: Spruce-Pine-Fir (SPF).
 - .2 Structural joists and planks:
 - .1 Grade: No. 2 or better.
 - .2 Sizes: 38mm to 89mm width by 114mm or greater depth, as indicated on drawings.
 - .3 Species: Spruce-Pine-Fir (SPF).
 - .3 Beam and stringer:
 - .1 Grade: No.2 or better.
 - .2 Sizes: 114mm or greater in width, depth exceeds width by more than 51mm, as indicated on drawings.
 - .3 Species: Spruce-Pine-Fir (SPF).
 - .4 Post and timber:
 - .1 Grade: No.2 or better.
 - .2 Sizes: 114mm or greater in width, depth exceeds width by 51mm or less, as indicated on drawings.
 - .3 Species: Spruce-Pine-Fir (SPF).

- .5 Miscellaneous Framing: Provide furring, blocking, nailing strips, grounds, rough bucks, cants, curbs, fascia backing and sleepers, and other materials matching lumber used within framed construction; or use light framing, No. 2 grade or better materials where lumber grade is not indicated.
- .2 Panel materials:
 - .1 Douglas fir plywood (DFP): to CSA 0121, standard construction, thickness indicated.
 - .2 Canadian softwood plywood (CSP): to CSA 0151, standard construction, thickness indicated. Exterior grade.
 - .3 Bond quality, grade and thickness in accordance with Part 3.4 SCHEDULES of this section.

2.3 ACCESSORIES

- .1 Sealants: as specified in Section 07 92 00 - Sealants.
- .2 Nails, spikes and staples: galvanized for exterior work, plain finish for interior work.
- .3 Bolts: to ASTM A307, unless noted otherwise. 13 mm diameter minimum, complete with nuts and washers.
- .4 Anchor rods: to ASTM F1554, grade 36, unless noted otherwise.
- .5 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, recommended for purpose by manufacturer.
- .6 General purpose adhesive: exterior grade 3.
- .7 Sill gasket: purpose made compressible sill gasket by "TrueFoam", or approved equivalent.
- .8 Prefabricated anchoring systems, connectors and hangers:
 - .1 Prefabricated hot-dipped zinc coated steel products tested or designed in accordance with CSA 086.
 - .2 Types and configurations as indicated on drawings.
 - .3 Acceptable manufacturers: Simpson Strong-Tie or approved equivalent

2.4 FINISHES

- .1 Galvanizing: use galvanized fasteners for exterior work, interior highly humid areas and pressure-preservative treated lumber as indicated.

2.5 WOOD PRESERVATIVE

- .1 Surface-applied wood preservative: clear copper naphthenate or 5% pentachlorophenol solution, water repellent preservative.
- .2 Use pressure preservative treated wood to CSA 080, water borne for stained finish, where indicated and as follows:

- .1 Treat plywood to CSA O80.9 using CCA or ACA preservative to obtain minimum net retention of 4.0 kg/m³ of wood.
- .2 Treat lumber to CSA O80.2 using CCA or ACA preservative to obtain minimum net retention of 4.0 kg/m³ of wood.
- .3 Following water-borne preservative treatment, kiln dry material.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Treat cut surfaces of pressure preservative treated material with surface applied wood preservative, before installation, and as follows:
 - .1 Apply preservative by dipping, or by brush to completely saturate and maintain wet film on surface for minimum three (3) minute soak on lumber and one (1) minute soak on plywood.
 - .2 Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of preservative before installation.
 - .3 Treat all material as indicated and as follows:
 - .1 Wood cants, backing, curbs, nailers on roof deck, and wall blocking.

3.2 INSTALLATION

- .1 Comply with requirements of NBC, Division B, Part 9 supplemented by following paragraphs.
- .2 Install members true to line, levels and elevations, square and plumb.
- .3 Construct continuous members from pieces of longest practical length.
- .4 Install spanning members with "crown-edge" up.
- .5 Install furring and blocking as required to space-out and support casework, cabinets, electrical equipment mounting boards, and other work as required.
- .6 Install furring to support siding applied vertically where there is no blocking.
 - .1 Align and plumb faces of furring and blocking to tolerance of 1:600.
- .7 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.
- .8 Install wood cants, nailers, curbs and other wood supports as required and secure using galvanized or stainless steel fasteners.
- .9 Sheathing to be installed as and where indicated on the Drawings.
- .10 Cutting of holes by trades or splices in members not indicated are not permitted.

3.3 ERECTION

- .1 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.
- .2 Countersink bolts where necessary to provide clearance for other work.
- .3 Use nailing disks for soft sheathing as recommended by sheathing manufacturer.

3.4 SCHEDULES

- .1 Sheathing:
 - .1 Roof sheathing: DFP or CSP, exterior rated, tongue and groove, sheathing grade, thickness as indicated on drawings.
 - .2 Ceiling sheathing: DFP or CSP, exterior rated, tongue and groove, G1S grade, thickness as indicated on drawings
- .2 Electrical equipment backboards: DFP or CSP, interior rated (interior application) or exterior rated (exterior application), square edged, G1S grade, 19 mm thick. Overall dimensions to suit equipment layout and arrangement. Painting of panel in Section 09 91 23.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This Section specifies requirements for supply, fabrication, transporting and erecting prefabricated, pre-engineered structural wood products including Parallel Strand Lumber (PSL), Laminated Strand Lumber (LSL), Laminated Veneer Lumber (LVL), Composite Wood Joists (I-Joists) and Open Web Joists.

1.2 RELATED WORK

- .1 Section 06 10 00 - Rough Carpentry.

1.3 REFERENCES

- .1 APA PRI-405-21, Performance Standards for Commercial I-Joists, 2021.
- .2 ASTM D5055-19e1, Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists.
- .3 CSA 0141:23, Canadian Standard Lumber.
- .4 CSA 0325:21. Construction Sheathing.
- .5 CSA 086:24, Engineering Design in Wood.
- .6 NLGA, Standard Grading Rules for Canadian Lumber, 2022.
- .7 National Building Code of Canada (NBC), 2015.

1.4 DESIGN CRITERIA

- .1 Design prefabricated wood I-joists and open web joists, bracing and bridging in accordance with CSA 086 and NBC, Part 4 requirements, post-disaster building designation. Internal and external wind pressures shall be determined in accordance with NBC, Part 4 requirements, Category 3 building designation.
- .2 Dead load and snow loads are indicated on the design drawings. Design trusses for point loads from suspended mechanical/electrical equipment as noted on plans.
- .3 Limit combined live load and dead load deflections to 1/240 of span unless otherwise specified or indicated. Limit live load deflection to 1/300 of span unless otherwise specified or indicated.

1.5 SHOP DRAWINGS

- .1 Submit shop drawings and erection drawings in accordance with Section 01 33 00.
- .2 Submit manufacturer's installation instructions and special handling criteria, installation sequence, printed product literature, catalogue pages and data sheets clearly identifying products used for the Project.
- .3 Shop Drawings:

- .1 Indicate applicable dimensions, fasteners, erection details and connection materials and finishes.
- .2 Indicate applicable grades, shop-applied finishes, camber, cuts, ledgers, holes and connection details.
- .3 Coordinate critical installation conditions and related work required by other subcontractors.
- .4 Indicate temporary bracing required for installation.
- .4 Prefabricated wood I-joists and Open Web Joists:
 - .1 Each shop drawing submission must bear signature and stamp of a professional engineer registered or licensed to Practice in the province of Nova Scotia.
 - .2 Indicate species, sizes, and stress grades of all lumber used as structural members. Show span, camber, configuration and spacing of members. Indicate connector types, thicknesses, sizes, locations, and design value. Show bearing details. Indicate design load for each member.
 - .3 Submit stress diagram or print-out of computer design indicating design load for each member. Indicate factored loads, resistance, and utilizations.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Delivery:
 - .1 Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
 - .2 Carefully unload materials using forklifts or cranes, to avoid damage.
 - .3 Keep lumber stored in wrapped and strapped bundles stacked not to exceed the manufacturer's height restrictions.
 - .4 Support bundles to prevent excessive bowing.
 - .5 Keep wrapping in place until right before installation of materials. Slit wrapping on underside to prevent moisture build up.
- .2 Storage and handling:
 - .1 Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.
 - .2 Keep materials dry.
 - .3 Handle individual pieces to prevent physical damage during measuring, cutting and erection; use padded or non-marring slings when lifting.
 - .4 Store components on a hard, dry, level surface.
 - .5 Do not store components in contact with the ground.
 - .6 Do not allow components to have prolonged exposure to weather.

- .7 Protect corners using wood blocking.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Laminated Veneer Lumber (LVL): structural composite lumber comprised of laminated veneers glued together using manufacturer's proprietary waterproof adhesives and bonded under pressure and heat to provide design stresses based on 100% load duration and with the following properties:
 - .1 Water Resistant Coating: not required.
 - .2 Grade: as indicated on Drawings, unless noted otherwise on Drawings.
 - .3 Dimensions: as indicated on Drawings.
- .2 Laminated Strand Lumber (LSL): structural composite lumber comprised of laminated strands oriented along length of members glued together using manufacturer's proprietary waterproof adhesives and bonded under pressure and heat to provide design stresses based on 100% load duration, and with the following properties:
 - .1 Water Resistant Coating: not required.
 - .2 Grade: 1.3E, unless noted otherwise on Drawings.
 - .3 Dimensions: as indicated on Drawings.
- .3 Parallel Strand Lumber (PSL): large section structural composite lumber comprised of laminated strands oriented along length of members glued together using manufacturer's proprietary waterproof adhesives and bonded under pressure and heat to provide design stresses based on 100% load duration, and with the following properties:
 - .1 Water Resistant Coating: not required.
 - .2 Grade: as indicated on Drawings, unless noted otherwise on Drawings.
 - .3 Dimensions: as indicated on Drawings.
- .4 Prefabricated I-Joists: structural member fabricated to ASTM D5055, comprised of sawn or structural composite lumber flanges and structural panel webs bonded using manufacturer's proprietary waterproof adhesives to form an I-cross sectional shape with the following properties:
 - .1 Type: Commercial, meeting requirements of APA PRI-405.
 - .2 Flange Stock: sawn-lumber or structural composite lumber.
 - .3 Web Material: oriented strand board (OSB) to CSA O325.
 - .4 Dimensions: depth as indicated on Drawings.
 - .5 Adhesive: to ASTM D5055.
 - .6 Acceptable products: TJI I-Joists as manufactured by Trus Joist or approved equivalent.

- .5 Prefabricated Open Web Joists: structural member fabricated to CSA O86, individually tested for load performance, comprised of machine stress rated (MSR) lumber flanges and web members and an OSB web panel at one end for on-site adjustment:
 - .1 Grade: as required to meet Design Criteria, unless noted otherwise.
 - .2 Dimensions: depth as indicated on Drawings.
 - .3 Trimmable length: adjustable length up to 600 mm.
 - .4 Acceptable products: TRIFORCE open joist as manufactured by Barrette Structural Distribution or approved equivalent.
- .6 Lumber grades: provide lumber products that are all sides finished (S4S) in nominal dimensions required for the project; grade marked by accredited agencies of the Canadian Lumber Standards Accreditation Board and conform to National Grading Rules published by the National Lumber Grades Authority (NLGA), and as follows:
 - .1 Grading: Machine grading, visual grading, or both based on material type.
 - .2 Moisture Content: Kiln dry, 19% or less.
 - .3 Structural Design Properties: Strength and related properties in accordance with CSA O86 and NLGA SPS 2.
 - .4 Other acceptable Products: Lumber products meeting requirements of the American Lumber Standards Committee designated ALS Program Lumber and that are accepted by the Canadian Lumber Standards Accreditation Board may be acceptable for the Project when proof of compliance with strength and related properties meeting CSA O86 are submitted before purchasing any structural wood Products.
- .7 Finger-jointed lumber:
 - .1 Provide machine-graded lumber (MSR) products meeting requirements of NLGA SPS 1 and SPS 4 acceptable to AHJ
 - .2 Provide MSR products meeting stress design requirements indicated in the NBC that are grade marked by accredited agencies of the Canadian Lumber Standards Accreditation Board and conform to National Grading Rules published by the NLGA.

2.2 FABRICATION

- .1 Fabricate structural composite lumber, I-Joists and Open Web Joists in accordance with the Drawings, Specifications and the reviewed shop drawings.
- .2 Mark all members for identification; mark top surface of straight beams clearly.
- .3 Do not splice or join members in locations other than those shown on the Drawings.

- .4 Apply specified sealer to exposed areas of structural composite lumber after fabrication; double treat exposed ends of laminates.
- .5 Fasten plies of engineered lumber by nailing, screwing or through bolting as recommended by manufacturer; additional fasteners may be required to correct cupping and crowing of plies in built-up members.

2.3 ACCESSORIES

- .1 Sheathing: as specified in Section 06 10 00.
- .2 Wood framing and blocking: I-Joist and as specified in Section 06 10 00.
- .3 Rim Boards: Laminated Strand Lumber (LSL).
- .4 Ancillary wood components: provide permanent bridging and bracing; headers and support framing at openings, and sheathing supports; blocking panels and other framing accessories required for complete and functional installation in accordance with manufacturer's written installation requirements.
- .5 Fasteners: as specified in Section 06 10 00.
- .6 Prefabricated anchoring systems, connectors and hangers: as specified in Section 06 10 00.

PART 3 - EXECUTION

3.1 ERECTION

- .1 Verify site conditions are acceptable for installation of shop-fabricated structural wood components in accordance with manufacturer's written instructions. Report any discrepancies to the Consultant immediately upon discovery. Proceed with installation of shop-fabricated structural wood components after unacceptable conditions are corrected.
- .2 Install shop-fabricated structural wood components in accordance with reviewed shop drawings and manufacturer's written instructions.
- .3 Erection aids:
 - .1 Securely brace shop-fabricated structural wood components during construction; anchored to the ground, foundation, a braced wall or other completed, stable section of the structure.
 - .2 Remove temporary bracing as sheathing is attached, use caution to ensure that installed components remain stable.
 - .3 Support members laterally at end bearings and cantilevers.
- .4 Site modifications: shop-fabricated structural wood components that require notching, cutting or drilling arising from site conditions and that do not meet manufacturer's standard details must be performed in accordance with manufacturer's written recommendations, as directed by the Consultant. The following modifications will not be permitted:

- .1 Holes spaced closer to supports than recommended by manufacturer.
- .2 Cut holes that are larger than recommended by manufacturer.
- .3 Hole locations spaced differently than recommended by manufacturer.
- .4 Going through bolts, or using nails or screws not recommended by the manufacturer to fasten composite or built-up members.
- .5 Damaged components: do not use structural composite lumber components that exhibit visible damage; damaged components will require replacement with material of same quality and performance as specified Products.
- .5 Adjusting: repair damage to adjacent materials caused by installation of materials specified in this Section.

3.2 CLEANING

- .1 Progress cleaning: clean in accordance with Section 01 74 00. 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.

3.3 PROTECTION

- .1 Protect installed work from damage arising from subsequent construction activity on the site.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This Section specifies requirements for design, supply, transporting and erecting pre-fabricated wood roof trusses where shown on the Drawings and as specified herein.

1.2 RELATED WORK

- .1 Section 06 10 00 - Rough Carpentry.

1.3 REFERENCES

- .1 CSA O86:24, Engineering Design in Wood.
- .2 CSA O141:23, Canadian Standard Lumber.
- .3 CSA W47.1:19(R2024), Certification of Companies for Fusion Welding of Steel.
- .4 NLGA, Standard Grading Rules for Canadian Lumber, 2022.
- .5 National Building Code of Canada (NBC), 2015.

1.4 DESIGN CRITERIA

- .1 Design trusses, bracing and bridging in accordance with CSA O86 and NBC, Part 4 requirements, post-disaster building designation. Internal and external wind pressures shall be determined in accordance with NBC, Part 4 requirements, Category 3 building designation.
- .2 Dead load and snow loads are indicated on the design drawings. Design trusses for point loads from suspended mechanical/electrical equipment as noted on plans.
- .3 Limit combined live load and dead load deflections to 1/240 of span unless otherwise specified or indicated. Limit live load deflection to 1/300 of span unless otherwise specified or indicated.
- .4 Design and supply all truss uplift anchors (truss tie downs), including girder truss tie downs, in accordance with CSA O86, to withstand the wind uplift loads shown on Drawings and the horizontal and uplift reactions on reviewed shop drawings.
- .5 At truss bearing points, where the compression resistance perpendicular to the grain is exceeded, the truss manufacturer must provide bearing plates.

1.5 SOURCE QUALITY CONTROL

- .1 Identify lumber by grade stamp of an agency certified by Canadian Lumber Standards Administration Board.

1.6 QUALIFICATION OF MANUFACTURERS

- .1 Fabricator for welded steel connections to be certified in accordance with CSA W47.1.

1.7 SHOP DRAWINGS

- .1 Submit shop drawings and erection drawings in accordance with Section 01 33 00.
- .2 Each shop drawing submission showing connection details must bear signature and stamp of professional engineer registered or licensed to Practice in the province of Nova Scotia.
- .3 Indicate species, sizes, and stress grades of all lumber used as structural members. Show pitch, span, camber, design heel height, configuration and spacing of members. Indicate connector types, thicknesses, sizes, locations, and design value. Show bearing details. Indicate design load for each member.
- .4 Submit stress diagram or print-out of computer design indicating design load for each member. Indicate factored loads, resistance, and utilizations.
- .5 Indicate arrangement of webs or other members to accommodate ducts and other specialties.
- .6 Show lifting points for storage, handling, and erection.
- .7 Show location of lateral bracing for compression members.

1.8 DELIVERY AND STORAGE

- .1 Store members on job site in accordance with manufacturer's instructions. Provide bearing supports and bracings. Prevent bending, warping, and overturning of members.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Lumber: SPF species, No. 2 grade or better, softwood, S4S, with maximum moisture content of 19% at time of fabrication and to following standards:
 - .1 CSA O141.
 - .2 NLGA.
- .2 Fastenings: to CSA O86.
- .3 Tie-down anchors: prefabricated wood truss to top plate uplift anchors, galvanized, to resist uplift force calculated as per the NBC.
 - .1 Acceptable manufacturers: Simpson Strong-Tie or approved equivalent.

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.

PART 3 - EXECUTION

3.1 ERECTION

- .1 Erect wood trusses in accordance with reviewed erection drawings.
- .2 Indicated lifting points to be used to hoist trusses into position.
- .3 Make adequate provisions for handling and erection stresses.
- .4 Exercise care to prevent out-of-plane bending of trusses.
- .5 Install temporary horizontal and cross bracing to hold trusses plumb and in safe condition until permanent bracing and decking are installed.
- .6 Install permanent bracing in accordance with reviewed shop drawings, prior to application of loads to trusses.
- .7 Do not cut or remove any truss material without approval of the Consultant.
- .8 Provide galvanized uplift anchor(s), at each truss bearing point, to resist uplift and horizontal reactions, calculated as per the NBC.
- .9 All truss tie downs (uplift anchors), including girder truss tie downs, to be designed, supplied, and installed by truss supplier.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies requirements for dampproofing under slabs as specified and where indicated on the Drawings.

1.2 RELATED WORK

- .1 Insulation: Section 07 21 00
- .2 Sealants: Section 07 92 00
- .3 Cast-In-Place Concrete: Section 03 30 00

1.3 STORAGE AND HANDLING

- .1 Provide and maintain dry, off-ground weatherproof storage, at temperatures above freezing, free from contact with cold or frozen surfaces.
- .2 Store materials on supports to prevent deformation.
- .3 Remove only in quantities required for same day use.
- .4 Store materials in accordance with manufacturers written instructions.

1.4 ENVIRONMENTAL REQUIREMENTS

- .1 Maintain air temperature and substrate temperature at dampproofing installation area above 5°C for 24 hours before, during and 24 hours after installation.
- .2 Do not apply dampproofing in wet weather.
- .3 Provide forced air circulation during installation and curing periods for enclosed applications.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Under slab dampproofing vapour barrier: "Moiststop" sheet membrane, reinforced polyethylene, 10 mil thick, complete with lapped/sealed joints.

PART 3 - EXECUTION

3.1 APPLICATION

- .1 Under slabs:

- .1 Install sheet poly dampproofing/vapour barrier below concrete floor slab and extend 100mm up vertical face of concrete walls.
- .2 Lap joints of sheet dampproofing/vapour barrier 150mm minimum and apply a continuous heavy bead of acoustic sealant or Building Wrap Tape, to seal joints.
- .3 After concrete slab has been poured, install continuous perimeter caulked joint between foundation wall and slab.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This Section specifies requirements for furnishing all materials, labour, tools, and equipment necessary to complete mineral wool batt insulation and rigid insulation as indicated and as specified herein.

1.2 RELATED WORK

- .1 Rough Carpentry: Section 06 10 00
- .2 Dampproofing: Section 07 11 13
- .3 Hollow Metal Doors, Frames and Hardware: Section 08 11 14

1.3 REFERENCES

- .1 ULC-S701.1-2022, Thermal Insulation, Polystyrene, Boards.
- .2 ULC-S702.1/ULC-S702.2-2023, Thermal Insulation, Mineral Fibre, for Buildings, Part 1: Material Specification.
- .3 CGSB 71-GP-24M-83, Adhesive, Flexible for Bonding Cellular Polystyrene Insulation.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- .1 Package insulation materials and label them to designate manufacturer, type, density and insulation value, and reference standard specification number if applicable.
- .2 Store insulation materials in dry areas, protected from wetting and traffic.
- .3 Store insulation board flat, on a flat surface, to prevent edge damage and placing of materials on top of stored boards.
- .4 Store insulation board and adhesives at a minimum temperature of 4°C for 12 hours before installation, and store freezable adhesives only at temperatures above 0°C at all times.

1.5 JOB CONDITIONS

- .1 Install insulation materials subject to damage by water, freezing, sunlight or similar adverse environmental conditions with adequate protection against damage.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Confirm the compatibility of materials of an insulation system and the construction with which they are in contact.

- .2 Inform others whose Work is affected of the thickness and installation methods of insulation to be installed.

2.2 MATERIALS

- .1 Mineral wool batt insulation: to CAN/ULC-S702, Type 1.
- .2 Rigid board insulation:
 - .1 Below grade insulation: extruded, closed cell, cellular foamed polystyrene to ULC 701, Type 3, thickness indicated, shiplapped edges. Cover exposed perimeter wall insulation to a minimum of 200mm below grade with 12.5mm thick cementitious board cladding.
 - .1 Acceptable product: Styrofoam SM by Dow Chemical Canada Inc., Celfort 300 as manufactured by Owens Corning, or approved equivalent.
 - .2 Rigid insulation: to CAN/ULC S701, type 4, expanded polystyrene, minimum compressive strength of 415 kPa, thickness as indicated on drawings.
 - .1 Acceptable products: Styrofoam Highload 60 as manufactured by Dow Chemical, Foamular 600 as manufactured by Owens Corning, or approved equivalent.
 - .3 Above grade: closed cell, cellular foamed polystyrene to CAN/ULC S701.1, Type 2, thickness indicated, (based on 50mm equal to RSI 1.761) shiplapped edges.
 - .1 Acceptable product: Styrofoam Cavitymate SC by Dow Chemical Canada Inc., Celfort 200 as manufactured by Owens Corning, TrueBoard type 2 by TrueFoam or approved equivalent.
- .3 Vapour barrier type adhesive: to CGSB 71-GP-24, Type 2, Class as recommended by manufacturer and compatible with polystyrene insulation.

2.3 COMPATIBILITY

- .1 Confirm all materials that come in contact with insulation board adhesive are compatible. Provide proof of compatibility if requested.

2.4 PERFORMANCE REQUIREMENTS

- .1 Fit insulation within construction elements and dimensions indicated on Drawings, without compression.

PART 3 - EXECUTION

3.1 WORKMANSHIP

- .1 Install insulation after building substrate materials are dry.
- .2 Verify all surfaces to which board insulation is applied are clean, reasonably smooth with no abrupt changes in plane, free of grease and

with protruding fins of mortar or concrete removed, and that the surfaces are otherwise acceptable for board insulation application as specified.

- .3 Install insulation to maintain continuity of thermal protection to building elements and spaces.
- .4 Fit insulation tightly around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and other protrusions.
- .5 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.
- .6 Do not enclose insulation until it has been inspected and approved by the Consultant.

3.2 EXAMINATION

- .1 Examine substrates and immediately inform Consultant in writing of defects.
- .2 Prior to commencement of work ensure:
 - .1 Substrates are firm, straight, smooth, dry, free of snow, ice or frost, and clean of dust and debris.
 - .2 Surfaces have not been coated with releasing agents, and other contaminants which would affect positive bonding of polyurethane insulation.
- .3 Report, in writing, to the Consultant defects or conditions which would affect work. Do not proceed with work until conditions have been rectified.

3.3 PERIMETER FOUNDATION INSULATION

- .1 Install insulation boards vertically at 600 mm o.c. from top of foundation footings to underside of concrete floor slab, and for overhead door locations extend boards 600mm horizontally in from the foundation wall and 600mm past overhead door openings at each side (Lay boards on level, compacted fill).
- .2 Exterior application: extend boards as indicated on exterior face of the perimeter foundation wall with adhesive.
- .3 Cover exposed perimeter rigid foundation insulation with cementitious board to a minimum of 300mm below grade.

3.4 MINERAL WOOL BATT INSULATION INSTALLATION

- .1 Pack insulation in door frames as indicated.

3.5 ADJUSTMENT AND CLEANING

- .1 Remove adhesive and clean surfaces without marring or damaging surface.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 07 92 00 - Sealants.

1.2 REFERENCE STANDARDS

- .1 ACI 302.1R-15, Guide for Concrete Floor and Slab Construction.
- .2 ASTM D882-18, Standard Test Method for Tensile Properties of Thin Plastic Sheetings.
- .3 ASTM D1117-01, Standard Guide for Evaluating Non-woven Fabrics.
- .4 ASTM D1709-24, Standard Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method.
- .5 ASTM D374/D374M-23, Standard Test Method for Thickness of Solid Electrical Insulation.
- .6 ASTM E84-24, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .7 ASTM E96/E96M-24a, Standard Test Methods for Gravimetric Determination for Water Vapor Transmission Rate of Materials.
- .8 ASTM E154/E154M-08a(R2019), Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
- .9 ASTM E1677-23, Standard Specification for Air Barrier (AB) Material or Assemblies for Low-Rise Building Walls.
- .10 ASTM E1709-16(R2022), Standard Test Method for Measurement of Retroreflective Signs Using a Portable Retroreflectometer at a 0.2 Degree Observation Angle.
- .11 ASTM E1745-17(2023), Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
- .12 ASTM E2178-21a, Standard Test Method for Determining Air Leakage Rate and Calculation of Permeance of Building Materials.
- .13 ASTM E2357-24, Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for vapour barrier and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Certificates:

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

1.4 DELIVERY STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance Section 01 61 00 and 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, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect from nicks, scratches, and blemishes
 - .3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 SHEET VAPOUR BARRIER

- .1 Vapour barrier (6 mils) in accordance the following:
 - .1 Air Penetration: 0.001 cfm/ft² at 75 Pa, when tested in accordance with ASTM E2178. Type I per ASTM E1677 0.04 cfm/ft² at 75 Pa, when tested in accordance with ASTM E2357.
- .2 Water Vapor Transmission: 28 perms, in accordance with ASTM E96, Method B.
- .3 Water Penetration Resistance: Minimum 280 cm in accordance with ASTM E96.
- .4 Basis Weight: Minimum 2.7 oz/yd², in accordance with TAPPI Test Method T-410.
- .5 Air Resistance: Air infiltration at >1500 seconds, in accordance with TAPPI Test Method T-460.
- .6 Tensile Strength: Minimum 38/35 lbs/in., in accordance with ASTM D882, Method T-460.
- .7 Tear Resistance: 12/10 lbs., in accordance with ASTM D1117.
- .8 Surface Burning Characteristics: Class A, when tested in accordance with ASTM E84. Flame Spread: 10, Smoke Developed: 10.
- .9 Acceptable manufacturer: Tyvek or approved equivalent.

2.2 BELOW GRADE VAPOUR BARRIER

- .1 Vapor barrier membrane (10 mils) must meet or exceed all requirements of ASTM E 1745, Classes A, B, & C.
 - .1 Maximum Permeance ASTM E96: 0.0043 Perms.
 - .2 Water Vapor Transmission Rate ASTM F1249 calibrated to ASTM E96 (water method): 0.0016 grains/ft.2/hr.
 - .3 Tensile Strength: to ASTM E154, Section 9: 52 Lb. Force/Inch.
 - .4 Puncture Resistance ASTM D1709, Method B: 2,655 Grams.
 - .5 Water Vapor Retarder ASTM E1745: Meets or exceeds Class A, B & C.
 - .6 Thickness of Retarder (plastic): to ACI 302.1R: Not less than 10 mils.

2.3 ACCESSORIES

- .1 Joint sealing tape: air resistant pressure sensitive adhesive tape: as recommended by vapour barrier manufacturer.
- .2 Sealant:
 - .1 Compatible with vapour retarder materials, recommended by vapour retarder manufacturer.
 - .2 In accordance with Section 07 92 00 - Sealants.
- .3 Staples: minimum 6 mm leg.
- .4 Moulded box vapour barrier: factory-moulded polyethylene box for use with recessed electric switch and outlet device boxes.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

- .1 Install and inspect services prior to installation of retarder.
- .2 Install sheet vapour retarder as indicated on the Project Drawings and to form continuous retarder.
- .3 Use sheets of largest practical size to minimize joints.

- .4 Inspect for continuity. Repair punctures and tears with sealing tape before work is concealed.

3.3 EXTERIOR SURFACE OPENINGS

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

3.4 PERIMETER SEALS

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

3.5 LAP JOINT SEALS

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

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
 - .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.
 - .1 Remove insulation material spilled during installation and leave work area ready for application of wall board.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies requirements for providing all labour, tools, materials, and equipment for the installation of an air/vapour barrier within the wall cavity.

1.2 RELATED WORK

- .1 Sealants: Section 07 92 00
- .2 Masonry: Section 04 20 00

1.3 QUALITY ASSURANCE

- .1 Membrane: applied by applicator trained and approved by manufacturer for application of its products.
- .2 Applicators: minimum five (5) years proven experience.
- .3 Notify the manufacturer's representative when work is started by the applicator.
- .4 Manufacturer's representative:
 - .1 Inspect substrate prior to commencement of work, during application of membrane and upon completion of work.
 - .2 Provide technical assistance to applicator and assist where required in correct installation of membrane.

1.4 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00.
- .2 Submit duplicate 300 x 300 mm samples of membrane waterproofing.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials to the job site in undamaged and original packaging indicating the name of the manufacturer and product.
- .2 Store roll materials in original packaging.
- .3 Store adhesives and primers at temperatures of 5°C and above to facilitate handling.
- .4 Keep solvent away from open flame or excessive heat.
- .5 Protect rolls from direct sunlight until ready for use.

1.6 COORDINATION

- .1 Maintain continuity of the waterproofing membrane throughout the scope of this section.

1.7 ENVIRONMENTAL PROTECTION

- .1 Provide forced air circulation during installation and curing periods for enclosed applications.

1.8 WARRANTY

- .1 Provide a product warranty from the waterproofing membrane manufacturer that expressly states the waterproofing membrane will remain in a watertight condition and will not leak as a result of faulty materials for a period of five (5) years. Scope of warranty to include material required to return the membrane to a watertight condition.

PART 2 - PRODUCTS

2.1 SHEET MATERIALS

- .1 Rubberized asphalt bonded to sheet polyethylene, nominal total thickness of 40 mil (1mm).
 - .1 Acceptable material:
 - .1 Perm-A-Barrier by WR Grace, System 4000.
 - .2 SopraSeal Stick 1100 by Soprema.
 - .3 Carlisle QSC - 705 Adhered Membrane Vapour/Barrier by Carlisle Syntec.
 - .4 Blueskin SA by Bakor.
 - .5 Aqua Barrier ABV by IKO Industries.
 - .6 ExoAir 110 by Tremco.
 - .2 Primer: solvent based, as recommended by the sheet membrane manufacturer for application to glass-mat faced exterior sheathing board, cast-in-place concrete and plywood.
 - .3 Mastics: at terminations and projections as recommended and supplied by membrane manufacturer.
 - .4 Attachments: galvanized steel termination bars and anchors.
 - .5 Substrate cleaner: non-corrosive type recommended by sealant manufacturer compatible with adjacent materials.

2.2 COMPATIBILITY

- .1 Confirm all materials used are compatible.
- .2 Provide proof of compatibility.

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.
- .2 Perform Work in accordance with National Air Barrier Association - Professional Contractor Quality Assurance Program.

3.2 ENVIRONMENTAL REQUIREMENTS

- .1 Install membrane at surface and ambient temperature of 5°C or above, in dry weather conditions.
- .2 For applications below 5°C consult membrane manufacturer's technical representative for instructions and, obtain Consultant's approval before proceeding with Work.

3.3 EXAMINATION

- .1 Verify surfaces and conditions are ready to accept the Work of this section.
- .2 Confirm all surfaces are clean, dry, sound, smooth, continuous and comply with air barrier manufacturer's requirements.
- .3 Report any unsatisfactory conditions to the Consultant in writing.
- .4 Do not start work until deficiencies have been corrected. Commencement of Work implies acceptance of conditions.

3.4 PREPARATION

- .1 Remove loose or foreign matter which might impair adhesion of materials.
- .2 Confirm all substrates are clean of oil or excess dust, all masonry joints struck flush and open joints filled; and all concrete surfaces free of large voids, spalled areas or sharp protrusions.
- .3 Confirm all substrates are free of surface moisture prior to application of self-adhesive membrane and primer.
- .4 Confirm metal closures are free of sharp edges and burrs.
- .5 Prime substrate surfaces to receive adhesive and sealants in accordance with manufacturer's instructions.

3.5 INSTALLATION: SHEET MATERIALS

- .1 Align and position self-adhering membrane over primed substrate, remove protective film and press firmly into place. Provide a minimum 150 mm overlap at all end and side laps, position lap seal over firm bearing.

- .2 Corner details: double cover outside and inside corners, use 300 mm wide initial strip of membrane centred on axis of corner. Follow with full width of sheet membrane to cover initial strip completely.
- .3 Construction and control joints: install membrane in double thickness over properly sealed joints, use 300 mm wide initial strip of membrane centred over joint. Follow with full width of sheet membrane. Assure that joints are properly sealed; joint filler and a compatible sealant are installed.
- .4 Tie-in to window frames, aluminum screens, hollow metal door frames, spandrel panels, roofing system and at the interface of dissimilar materials as indicated in drawings.
- .5 Roll membrane with a metal roller to ensure complete adhesion to substrate material. Roll in two (2) separate passes at 90 degrees to each other.
- .6 Small protrusions (pipes, etc.) through the membrane, should be pre-stripped with membrane and sealed with mastic.
- .7 Caulk joints with mastic. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- .8 Inspect membrane installation meticulously and immediately. Holes and tears in the membrane must be repaired with air/vapour barrier membrane material. The repair must exceed the affected surface area by a minimum of 150 mm. The membrane piece applied for the repair must be sealed around its edges with mastic.
- .9 Perform pull tests on outer surface of applied sheet membrane air/vapour barrier material to ensure adequate adhesion of the membrane to the substrate and cohesion of the membrane itself using equipment specifically design for this purpose. Adhesion/cohesion must be 15 psi, minimum. It is this trade's responsibility to ensure adhesion/cohesion meets this criteria before Work by other trades. Re-do work as required to ensure adequate adhesion/cohesion.

3.6 CLEANING

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

3.7 PROTECTION OF WORK

- .1 Protect finished work.
- .2 Do not permit adjacent work to damage work of this section.
- .3 Protect finished work from climatic conditions.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies roofing accessories including flashing, fascia, soffit, eavestroughs/downspouts, scuppers and rubber booting.

1.2 RELATED WORK

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

1.3 REFERENCES

- .1 CAN/CGSB-93.2-M91, Pre-finished Aluminum Siding, Soffits and Fascia, Prefinished for Residential Use.

1.4 STORAGE AND HANDLING

- .1 Provide and maintain dry, off-ground weatherproof storage.
- .2 Remove only in quantities required for same day use.

PART 2 - PRODUCTS

2.1 MATERIALS - GENERAL

- .1 Prefinished aluminum fascia and continuous soffit vent system with factory applied coating to CAN/CGSB-93.2 supplemented and amended as follows:
 - .1 Type SF, base metal thickness 26 gauge.
 - .2 Class 1.
 - .3 Colour: white.
 - .4 Fasteners, hangers, clips, starter strips and other devices: of same material as sheet metal, of length and thickness suitable for application.
- .2 Eave protection: self-adhering, waterproof, glass fibre reinforced rubberized asphalt membrane.
 - .1 Acceptable product: Eaveshield as manufactured by Northern Globe, Ice and Water Shield by W.R. Grace, Eaveguard by Bakor, or approved equivalent.

2.2 SOFFIT AND FASCIA FABRICATION

- .1 Fabricate aluminum soffit, fascias, flashings and other sheet aluminum work in accordance with Aluminum Association Aluminum Sheet Metal Work in Building Construction.
- .2 Form pieces in 2.44 m maximum lengths. Make allowance for expansion at joints.

- .3 Hem exposed edges on underside 12 mm. Lap and seal corners with sealant.
- .4 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .5 Form copings and fascias to profiles indicated of prefinished aluminum.

2.3 SCUPPERS

- .1 Galvanized steel to CSA G164, manufactured with closure flange trim to exterior, 100mm wide wall flanges interior and base extending to as shown on the Project Drawings.

PART 3 - EXECUTION

3.1 APPLICATION

- .1 Install drip edge along eaves and rake ends, overhanging 12 mm, with minimum 75 mm flange extending onto roof decking and 38 mm down fascia. Nail to deck at 200 mm oc. Keep bottom edge of drip flange (at 45° angle bend) 5 mm to 9.5 mm away from fascia.
- .2 Eave protection:
 - .1 Apply eave protection along roof eaves (2 wythes), along rake edges (1 wythe), and at ridge vents (1 wythe total) or at other penetrations penetrating roof surface, all in accordance with manufacturer's recommendations.
 - .2 Extend eave protection from fascia to point on roof minimum 600 mm beyond inside face of exterior wall.
 - .3 Overlap end joints minimum 150 mm. Lap second course minimum 100 mm over top selvedge from course to course.
 - .4 Confirm ambient and surface temperatures are above 5°C during installation.

3.2 INSTALLATION OF ACCESSORIES

- .1 Install soffits and fascias as detailed.
- .2 Use concealed fastenings except where approved before installation.
- .3 Lock end joints and caulk with sealant.

3.3 CLEAN-UP

- .1 Upon completion of the work, clean area of all unused material, packages, and containers.

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- .2 Remove deposits, stains, and protection and clean metals left unpainted and exposed to view with cleaners recommended by the manufacturer.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This sections specifies requirements for furnishing all materials, labour, tools and equipment, and performing all operations necessary to complete all steel siding and fabricated items, as shown on the Drawings and specified herein.

1.2 RELATED WORK

- .1 Masonry: Section 04 20 00
- .2 Sealants: Section 07 92 00

1.3 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00.
- .2 Submit duplicate 300 mm long samples of siding material, of colour and profile specified.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Indicate dimensions, profiles, attachment methods, schedule of wall elevations, trim, corner and closure pieces, and related work.

PART 2 - PRODUCTS

2.1 METAL FLASHING/TRIM

- .1 Prefinished sheet metal flashings/trims, foam and metal closures, and trim: factory precoated sheet steel of same material, thickness, and finish as exterior siding and to Section 07 62 00.

2.2 STEEL SIDING AND COMPONENTS

- .1 Exterior Wall Siding Accent band:
 - .1 Finish coating: 8000 series prefinished Steel.
 - .2 Vertical, 4 gauge, profile of CL938
 - .3 Colour: as selected by the Consultant.
 - .4 Thickness: 0.46 mm base metal nominal thickness.
 - .5 Profile: 190 mm on centre, 38 mm deep preformed interlocking joints.
 - .6 Acceptable material: ChannelWall by VicWest Steel, Agway Metals AR-38 or approved equivalent.

2.3 ACCESSORIES

- .1 Exposed trim: outside corners, cap strip, drip cap, starter strip and trim of same material, colour and gloss as cladding, with fastener holes pre-punched.

2.4 SIDING FASTENER

- .1 Fasteners: exposed screw fasteners with colour matched heads to match siding.

2.5 CAULKING

- .1 Sealants: as specified in Section 07 92 00.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Protect metal surfaces in contact with concrete, mortar, or other cementitious surface with isolation coating.
- .2 Confirm waterproofing membrane/flashings are in place prior to installing curved/sloped metal roofing.
- .3 Touch up roofing and flashings with matching paint at abrasions of screw fasteners.

3.2 INSTALLATION

- .1 Install siding in accordance with manufacturer's written instructions
- .2 Install continuous starter strips, outside corners, edgings, drip cap, door/window opening flashings, etc. as required.
- .3 Install outside corners, fillers and closure strips with carefully formed and profiled work.
- .4 Install fascia siding as indicated in Section 07 31 13.
- .5 Maintain joints in exterior siding, true to line, tight fitting, hairline joints.
- .6 Attach components in manner not restricting thermal movement.
- .7 Caulk junctions with adjoining work with sealant. Do work in accordance with Section 07 92 00.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 07 62 00 - Sheet Metal Flashing and Trim

1.2 REFERENCES

- .1 American Society of Testing and Materials (ASTM)
 - .1 ASTM C208-22, Standard Specification for Cellulosic Fiber Insulating Board.
 - .2 ASTM C1177/C1177M-24, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
 - .3 ASTM D3273-21, Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
 - .4 ASTM D5147/5147M-18(R2024), Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material.
- .2 Canadian Standard Association (CSA)
 - .1 CSA O80-Series:21, Wood Preservation.
 - .2 CSA A231.1:19/A231.2:19, Precast Concrete Paving Slabs/Precast Concrete Pavers.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 37-GP-56M-80, Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing.
 - .2 CGSB 37-GP-9MA-83, Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing.
 - .3 CGSB 51.34-86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .4 Underwriters Laboratories Canada (ULC)
 - .1 ULC S102-2018, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 ULC S114-2018, Standard Method of Test for Determination of Non-Combustibility in Building Materials.
 - .3 ULC S126-2014, Standard Method of Test for Fire Spread Under Roof-Deck Assemblies.
 - .4 ULC S770-2015, Standard Test Method for Determination of Long-term Thermal Resistance of Closed-Cell Thermal Insulating Foams

1.3 DESIGN/ PERFORMANCE REQUIREMENTS

- .1 Perform work in accordance with all federal, provincial, and local codes.
- .2 System must be cold applied.

- .3 System must be FM Global Approved.

1.4 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data: Manufacturer's data sheets on each product to be used, including:
 - .1 Preparation instructions and recommendations.
 - .2 Storage and handling requirements and recommendations.
 - .3 Installation instructions.
- .3 Shop Drawings: Submit shop drawings including installation details of roofing, flashing, pitch pockets fastening, insulation and vapour barrier, including notation of roof slopes and fastening patterns of insulation and base modified bitumen membrane, prior to job start.
- .4 Manufacturer's Certificates: Provide to certify products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- .1 Perform Work in accordance with CRCA Roofing and Waterproofing Manual.
- .2 Manufacturer Qualifications: Company specializing in manufacturing products specified with documented {RS#1685} certification.
- .3 Installer Qualifications: Company specializing in performing Work of this section with minimum five years documented experience.
- .4 Installer's Field Supervision: Maintain a full-time Supervisor/Foreman on job site during all phases of roofing work while roofing work is in progress.
- .5 Product Certification: Provide manufacturer's certification that conform to requirements specified herein, are chemically and physically compatible with each other, and are suitable for inclusion within the total roof system specified herein.
- .6 Source Limitations: Obtain all components of roof system from a single manufacturer. Secondary products that are required shall be recommended and approved in writing by the roofing system Manufacturer. Upon request of the Consultant or Owner, submit Manufacturer's written approval of secondary components in list form, signed by an authorized agent of the Manufacturer.

1.6 PRE- INSTALLATION MEETINGS

- .1 Convene minimum two (2) weeks prior to commencing Work of this section.
- .2 Review installation procedures and coordination required with related Work.
- .3 Inspect and make notes of job conditions prior to installation:

- .1 Record minutes of the conference and provide copies to all parties present.
- .2 Identify all outstanding issues in writing designating the responsible party for follow-up action and the timetable for completion.
- .3 Installation of roofing system shall not begin until all outstanding issues are resolved to the satisfaction of the Consultant.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver and store product in manufacturer's unopened packaging with labels intact until ready for installation.
- .2 Store all roofing materials in a dry place, on pallets or raised platforms, out of direct exposure to the elements until time of application. Store materials at least 100mm above ground level and covered with "breathable" tarpaulins.
- .3 Store in accordance with the instructions of the manufacturer prior to their application or installation. Store roll goods on end on a clean flat surface. No wet or damaged materials will be used in the application.
- .4 Store at room temperature wherever possible, until immediately prior to installing the roll. During winter, store materials in a heated location with a 50-degree F (10 degree C) minimum temperature, removed only as needed for immediate use. Keep materials away from open flame or welding sparks.
- .5 Avoid stockpiling of materials on roofs without first obtaining acceptance from the Consultant.
- .6 Store adhesive in a range of temperature quoted in the manufacturer's literature. Area of storage shall be constructed for flammable storage.

1.8 COORDINATION

- .1 Coordinate Work with installing associated metal flashings as Work of this section proceeds.

1.9 PROJECT CONDITIONS

- .1 Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- .2 Do not use torches on roof at any time. Propane lines are present and represent a significant explosive hazard.
- .3 No smoking is permitted on Site.

1.10 WARRANTY

- .1 Upon completion of the work, provide the Owner the manufacturer's written and signed no dollar limit Warranty, warranting that, if a leak develops in the roof during the term of this warranty, due either to defective material or defective workmanship by the Contractor, the manufacturer shall provide the Owner, at the Manufacturer's expense, with the labour and material necessary to return the defective area to a watertight condition.
- .1 Warranty Period: 20 years from date of acceptance.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 System must be cold applied.
- .2 System must be FM Global Approved.
- .3 Material Compatibility: Ensure components of roof system are compatible with adjoining materials under application and service as demonstrated by roofing manufacturer and based on testing and field experience.
 - .1 Sheathing: Gypsum glass mat reinforced silicone treated board conforming to {RS#624}, non-combustible according to CAN/ULC-S114 thermal barrier as tested to CAN/ULC-S126, flame spread 0, smoke developed 0 To CAN/ULC-S102 and {RS#944} with a rating of 10, no mould growth after 4 weeks exposure, minimum 6 mm or for fire rating requirement 12 mm thick gypsum board 1200 mm wide, maximum practical length, tapered edge as required.
 - .2 Vapour Retarder: self-adhering membrane composed of modified SBS asphalt with a top surface of high density cross laminated polyethylene film in compliance with CAN/CGSB-51.34-M, type 1, fully adhered.
- .4 Polyisocyanurate Insulation: Closed cell rigid foamed plastic boards conforming to CAN/ULC-S704, Type 2, Class 3, faced with glass reinforced organic felt paper, perforated, maximum board size 1220 mm x 2440 mm minimum 150 mm thick to furnish a minimum R-Value in accordance with CAN/ULC-S770, LTTR of 20.4.
- .5 Polyisocyanurate Insulation: Closed cell rigid foamed plastic boards conforming to CAN/ULC-S704, Type 2, Class 3, faced with glass reinforced organic felt paper, perforated, maximum board size 1220 mm x 2440 mm. Thickness as shown on the Project Drawings.
- .6 Insulation Coverboard: Type II, Grade 2, asphalt coated fibreboard, minimum compressive strength of 310 kPa (45 psi), high density, 13 mm thick. Single layer insulating system as a substitute to a multi-layer insulating system is acceptable.

- .7 Coverboard: Asphaltic core board comprised of mineral fortified asphalt sandwiched between a non-woven glass reinforced mat, board size 1220 mm x 1524 mm x 3 mm.
- .8 Adhesive: highly elastomeric, solvent free, foamable adhesive for bonding many approved board stock products.
- .9 Insulation and Membrane Adhesive:
 - .1 Horizontal Application: Solvent-free, single component, moisture cured urethane membrane adhesive. Non- flammable during application and moisture resistant, moisture cures to a flexible and strong film. Cure time dependent on moisture availability.
 - .2 Vertical and Sloped Application: Solvent free, single component urethane adhesive compatible with SBS Modified Bitumen sanded surface membranes.
- .10 SBS Modified Bitumen Base Sheet: SBS modified asphalt base sheet meeting CGSB 37-GP-56M Type 2, grade 2 Class P, 180g/m² polyester reinforced, SBS modified bitumen coated and sanded top and bottom surface. The use of a pre-adhered, integral base sheet/coverboard product is acceptable.
- .11 SBS Modified Bitumen Base Flashing: SBS modified asphalt base sheet meeting CGSB 37-GP-56M Type 2, grade 2 Class P, 140g/m² polyester reinforced, SBS modified bitumen coated and sanded top and bottom surface.
- .12 SBS Modified Bitumen Cap Sheet: SBS modified asphalt cap sheet meeting CGSB 37-GP-56M, Type 2, Grade 2, Class G, 180 g/m² (0.6 oz/sq ft) polyester reinforced, sanded bottom surface and granulated top surface. Granular colour to be selected by Consultant from manufacturer
- .13 Fire Rated SBS Modified Bitumen Cap: SBS modified asphalt cap sheet with additives to achieve Class A fire rating when used with a 1-1/2:12 to 2-1/2:12 roof slope. (Addendum No. 2)
- .14 SBS Modified Bitumen Cap Flashing: SBS modified asphalt cap sheet meeting CGSB 37-GP-56M, Type 2, Grade 2, Class G, 180 g/m² (0.6 oz/sq ft) polyester reinforced, sanded bottom surface and granulated top surface. Granular colour to be selected by Consultant from manufacturer's samples.
- .15 Fire Rated SBS Modified Bitumen Cap Flashing: SBS modified asphalt cap sheet with additives to achieve Class A fire rating when used with a 1-1/2:12 to 2-1/2:12 roof slope.
- .16 Mastics: Asphalt mastic conforming to CGSB 37-GP-9Ma requirements.
- .17 Bituminous Materials:
 - .1 Asphalt Primer: Unfilled asphalt conforming to CGSB 37-GP-9Ma.
 - .2 Cutback Asphalt Plastic Cement: Fibrated cut back type plastic asphalt compound.
 - .3 Rubberized Asphalt Sealing Compound.

- .4 Bituminous Paint: As recommended by the roofing manufacturer.
- .18 Lumber, Nailers and Blocking:
 - .1 #2 grade or better plank. Pressure treated lumber to CSA O80.1-M with CCA to AWPA P-5. Asphalt treated creosote impregnated lumber will not be accepted. Piping of lumber not permitted.
 - .2 Seal cut ends of lumber with Coppers Napthenate preservative to CSA O80.1.
- .19 Fasteners:
 - .1 Confirm fasteners compatibility with roof membranes and flashings. Fasteners to be of type and size shown on Drawings and acceptable by roofing membrane manufacturer.
 - .2 Use self-drilling, self-tapping, organic fluoropolymer coated screws for securing of wood nailers and blocking. Screws to pass FM V Class 1 criteria, minimum of 30 cycles in a Kesternich Cabinet. Ensure thread diameter is a minimum of 6 mm (0.245") such as "#14 HD" by Tru-Fast.
 - .3 Use nails to secure metal to wood that are galvanized and long enough to penetrate wood by a minimum of 25 mm.
 - .4 Use self-drilling, self-tapping, organic fluoropolymer coated screws to secure rigid insulation to decking. Screws to pass FM Class 1 criteria, minimum of 30 cycles in a Kesternich Cabinet. Ensure thread diameter is minimum 5.58 mm (0.220") such as "#12 DP" by Tru-Fast and penetrate decking by a minimum of 25mm.
 - .5 Stressplates for Insulation Sheathing Attachment: 75 mm (3") diameter, galvanized steel or Galvalume, "MP-3" by Tru-Fast or equal.
 - .6 Confirm fasteners are acceptable to membrane manufacturer and be in compliance with fastener standard {RS#2616}, 1-28 and 1-29.
- .20 Metal Flashing: to Section 07 62 00 - Metal Flashing and Trim.

2.2 ACCESSORIES

- .1 Concrete Roof Pavers: Precast concrete conforming to CSA A231.2 having minimum strength of 35 MPa (5000 psi), steam cured, 4% and 6% entrained air, with edges chamfered and non-slip finish, 610 mm 610 mm x 64 mm thick.
- .2 Paver Pedestals: Black plastic mouldings, UV resistant, adjustable, complete with spacers. Provide mid-span pad under each paver to avoid breakage.
- .3 Walkways: SBS modified asphalt cap sheet membrane of a different colour from field membrane cap sheet.
- .4 Walkways: SBS modified asphalt cap sheet membrane of a different colour from field membrane cap sheet around all roof mounted equipment mechanical equipment.

- .5 Stack-Jack Flashings: 1.6 mm thick x 300 mm high x diameter to suit, seamless, spun aluminium sleeve flashings with premoulded urethane insulation on inner side of sleeve and 100 mm wide bituminous paint primed flange with removable 1.2 mm thick aluminum cap with neoprene grommet cap seal and 1.6 mm thick aluminium type bitumen protection cup.
- .6 Flashings for Flexible Conduit: 1.3 mm thick x 300 mm high x diameter to suit, seamless, spun copper sleeve flashings with premoulded urethane insulation on inner side of sleeve, 150 mm wide bituminous paint primed sleeve flange with 0.69 mm thick flexible copper liner with premoulded urethane insulation on inner side of liner.
- .7 Flashings for "B" Vents: 2.1 mm thick x 300 mm high x diameter to suit, seamless spun aluminum sleeve flashing with sloping sides having 50 mm wide perforated aluminum vent holes at top of sleeve, 100 mm wide bituminous paint primed sleeve flange with 2.1 mm thick split aluminum collar, aluminum rivets, and 4.8 mm diameter stainless steel nuts and bolts and 1.6 mm thick aluminum type bitumen protection cup.
- .8 Flashings for Gas Lines: 1.6 mm thick x 300 mm high x diameter to suit, seamless spun aluminum sleeve flashing with 50 mm wide perforated aluminum vent holes at top of sleeve, 100 mm wide bituminous paint primed sleeve flange with removable 1.3 mm thick formed aluminum collar and 2.1 mm thick aluminum type bitumen protection cup.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Do not begin installation until substrates have been properly prepared.
- .2 Inspect and approve the deck condition, slopes and fastener backing if applicable, parapet walls, expansion joints, roof drains, stack vents, vent outlets, nailers and surfaces and elements.
- .3 Verify Work penetrating the roof deck, or which may otherwise affect the roofing, has been properly completed.
- .4 If substrate preparation and other conditions are the responsibility of another installer, notify the Consultant of unsatisfactory preparation before proceeding.

3.2 PREPARATION

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

- .2 Fill substrate surface voids that are greater than 6.35mm wide with an acceptable fill material.
- .3 Roof surface to receive roofing system shall be smooth, clean, free from loose gravel, dirt and debris, dry and structurally sound.
- .4 Wherever necessary, all surfaces to receive roofing materials shall be power broomed and vacuumed to remove debris and loose matter prior to starting work.
- .5 Do not apply roofing during inclement weather. Do not apply roofing membrane to damp, frozen, dirty, or dusty surfaces.
- .6 Fasteners and plates for fastening components mechanically to the substrate must provide a minimum pull out capacity of 300 lbs. (136 k) per fastener.
- .7 Prime decks where required, in accordance with requirements and recommendations of the primer and deck manufacturer.

3.3 INSTALLATION - GENERAL

- .1 Install modified bitumen membranes and flashings in accordance with manufacturer's instructions and with the recommendations provided by the National Roofing Contractors Association's Roofing & Waterproofing Manual, the Asphalt Roofing Manufacturers Association, and applicable codes.
- .2 General: avoid installation of modified bitumen membranes at temperatures lower than 40-45 degrees F. When work at such temperatures is unavoidable use the following precautions:
 - .1 Take extra care during cold weather installation and when ambient temperatures are affected by wind or humidity, to ensure adequate bonding is achieved between the surfaces to be joined. Use extra care at material seam welds and where adhesion of the applied product to the appropriately prepared substrate as the substrate can be affected by such temperature constraints as well.
 - .2 Unrolling of cold materials, under low ambient conditions must be avoided to prevent the likelihood of unnecessary stress cracking. Rolls must be at least 40 degrees F at the time of application. If the membrane roll becomes stiff or difficult to install, it must be replaced with roll from a heated storage area.
 - .3 Commence installation of the roofing system at the lowest point of the roof (or roof area), working up the slope toward the highest point. Lap sheets shingle fashion so as to constantly shed water.
 - .4 All slopes greater than 2:12 require back-nailing to prevent slippage of the ply sheets. Use ring or spiral-shank 25.4mm cap nails, or screws and plates at a rate of 1 fastener per ply (including the membrane) at each insulation stop. Place insulation stops at 16 ft o.c. for slopes less than 3:12 and 4

feet o.c. for slopes greater than 3:12. On non-insulated systems, nail each ply directly into the deck at the rate specified above. When slope exceeds 2:12, install all plies parallel to the slope (strapping) to facilitate back nailing. Install 4 additional fasteners at the upper edge of the membrane when strapping the plies.

3.4 INSTALLATION OF ROOF SYSTEM

- .1 Base sheet installation over substrate: tape roof joints, install vapour barrier to deck in accordance with wind uplift calculation report.
 - .1 Beginning at the low point of the roof, fasten one ply of approved base sheet to the substrate with interply adhesive.
 - .2 Start with an appropriate roll width (1/3 or 1/2 roll width) to accommodate off-setting of side laps of subsequent layers of base sheet. Install so that no side laps are against the flow of water.
 - .3 Fasten base sheet with a minimum fastening pattern of every 225mm o.c. on side laps and every 450mm o.c. in two staggered rows in the field of the sheet. (check specification for exact fastening pattern).
 - .4 Overlap base sheet side laps 100mm and end laps 200mm. Offset end laps a minimum of 900mm.
 - .5 Additional plies of base sheet are to be installed as specified in the section below. Note: Do not leave fastened base exposed; cover in the same day with the base sheet and/or cap sheet.
- .2 Base sheet installation over substrate: tape roof joints, install vapour barrier to deck in accordance with FM standard.
 - .1 Beginning at the low point of the roof, fasten one ply of approved base sheet to the substrate with interply adhesive.
 - .2 Start with an appropriate roll width (1/3 or 1/2 roll width) to accommodate off-setting of side laps of subsequent layers of base sheet. Install so that no side laps are against the flow of water.
 - .3 Overlap base sheet side laps 100mm and end laps 200mm. Offset end laps a minimum of 900mm.
 - .4 Additional plies of base sheet are to be installed as specified in the section below. Note: Do not leave fastened base exposed; cover in the same day with the base sheet and/or cap sheet.
(Addendum No. 2)
- .3 Insulation Installation:
 - .1 To vapour barrier: Adhere minimum R-20 polyisocyanurate with adhesive in accordance with wind uplift calculation report.

Adhere recovery board in insulation adhesive in accordance with wind uplift calculation report.

.4 Insulation installation:

.1 To vapour barrier: adhere polyisocyanurate with adhesive in accordance with FM standard. Adhere recovery board in insulation adhesive in accordance with FM standard.

.5 Modified Base Ply(s): Cut base ply sheets into 5400mm lengths and allow plies to relax before installing. Install in interplay adhesive applied at the rate required by the manufacturer. Shingle sheets uniformly over the prepared substrate to achieve the number of plies specified. Shingle in proper direction to shed water on each large area of roofing.

.1 Sweep or blow away any dust, dirt or sand particles that could interfere with adhesion.

.2 Tape all insulation joints prior to applying adhesive to keep material from seeping in between the boards. (duct tape can be used for taping insulation joints)

.3 Relax base sheet prior to application (until sheet lies flat) and work with no more than 5400mm lengths. This will allow the sheet to sit down into the adhesive.

.4 Snap chalk lines for area of application to prevent material from skinning over in areas that material will not be applied immediately.

.5 Pour a liberal amount of adhesive onto the roof at a rate 7.57 to 9.46 litres per square for the base layer of adhesive to the top insulation board. Work outwards to eliminate voids. Coverage based on a smooth surface, uneven surfaces or more porous roof board will increase the coverage rate.

.6 Start base sheet application at the low point of the roof with appropriate roll width to offset side laps 5400mm from side laps of base sheet. Install flush to roof edge if over base sheet, otherwise turn the base sheet over the fascia minimum 50mm and nail 225mm o.c. For perimeter flashing details, you must extend the base sheet up to a minimum of 200mm. Design layout so that no side laps are against the flow of water. For smaller roof sections, cut rolls into manageable lengths.

.6 Modified Cap Ply(s): Cut cap ply sheets into 5400mm lengths and allow plies to relax before installing. Install in interplay adhesive applied at the rate required by the manufacturer. Shingle sheets uniformly over the prepared substrate to achieve the number of plies specified. Shingle in proper direction to shed water on each large area of roofing.

.1 Lap ply sheet ends 200mm. Stagger end laps 300mm minimum.

- .2 Solidly bond to the base layers with adhesive at the rate of 7.57 to 9.46 litres per 9.3 square meters.
- .3 Roll must push a puddle of adhesive in front of it. Adhesive must extend no further than 50mm from the edge of the membrane on all side and end laps. All side and end laps must be heat welded with Leister Bitumat Hot Air Welder or equivalent. Take care to eliminate air entrapment under the membrane.
- .4 Install subsequent rolls of modified across the roof as above with a minimum of 102mm side laps and 200mm staggered end laps. Lay modified membrane in the same direction as the underlayers but the laps shall not coincide with the laps of the base layers.
- .5 Allow cold adhesive to set for 5 to 10 minutes before installing the top layer of modified membrane.
- .6 Extend membrane 50mm beyond top edge of all cants in full application of the cold adhesive as shown on the Drawings.
- .7 Wood Blocking and Nailers: Provide wood blocking, nailers and cant strips as specified in Section 06 10 00. Provide nailers at all roof perimeters and penetrations for fastening membrane flashings and sheet metal components.
 - .1 Wood nailers should match the height of any insulation, providing a smooth and even transition between flashing and insulation areas.
 - .2 Space nailer lengths with a minimum 4mm gap for expansion and contraction between each length or change of direction.
 - .3 Fasten nailers and flashings in accordance with Factory Mutual "Loss Prevention Data Sheet 1- 49, Perimeter Flashing" and be designed to be capable of resisting a minimum force of 200 lbs/lineal foot in any direction.
- .8 Metal Work: Provide metal flashings, counter flashings, parapet coping caps and thru-wall flashings as specified in Section 07 62 00. Install in accordance with the SMACNA "Architectural Sheet Metal Manual" or the NRCA Roofing Waterproofing manual.
- .9 Flashing Base Ply: Install flashing sheets by the same application method used for the base ply.
 - .1 Seal curb, wall and parapet flashings with an application of mastic and mesh on a daily basis. Do not permit conditions to exist that will allow moisture to enter behind, around or under the roof or flashing membrane.
 - .2 Prepare all walls, penetrations, expansion joints and where shown on the Drawings to be flashed with required primer at the rate of 9.3 square meters per litre. Allow primer to dry tack free.
 - .3 Adhere to the underlying base ply with specified flashing ply adhesive unless otherwise specified. Nail off at a minimum of 203mm o.c. from the finished roof at all vertical surfaces.

- .4 Solidly adhere the entire flashing ply to the substrate. Secure the tops of all flashings that are not run up and over curb through termination bar fastened at 153mm O.C. and sealed at top.
 - .5 Seal all vertical laps of flashing ply with a three-course application of trowel-grade mastic and fibreglass mesh.
 - .6 Coordinate counter flashing, cap flashings, expansion joints and similar work with modified bitumen roofing work as specified.
 - .7 Coordinate roof accessories, miscellaneous sheet metal accessory items, including piping vents and other devices with the roofing system work.
- .10 Flashing Cap Ply: Install flashing cap sheets by the same application method used for the base ply.
- .1 Seal curb, wall and parapet flashings with an application of mastic and mesh on a daily basis. Do not permit conditions to exist that will allow moisture to enter behind, around or under the roof or flashing membrane.
 - .2 Prepare all walls, penetrations, expansion joints and where shown on the Drawings to be flashed with required primer at the rate of 9.3 square meter per litre. Allow primer to dry tack free.
 - .3 Adhere to the underlying base flashing ply with specified flashing ply adhesive unless otherwise specified. Nail off at a minimum of 200mm o.c. from the finished roof at all vertical surfaces.
 - .4 Coordinate counter flashing, cap flashings, expansion joints and similar work with modified bitumen roofing work as specified.
 - .5 Coordinate roof accessories, miscellaneous sheet metal accessory items with the roofing system work.
 - .6 All stripping shall be installed prior to flashing cap sheet installation.
 - .7 Heat and scrape granules when welding or adhering at cut areas and seams to granular surfaces at all flashings.
 - .8 Secure the top edge of the flashing sheet using a termination bar only when the wall surface above is waterproofed, or nailed 102mm on center and covered with an acceptable counter flashing.
- .11 Roof Walkways: Provide walkways in areas with mechanical equipment.

3.5 PROTECTION

- .1 Provide traffic ways, erect barriers, fences, guards, rails, enclosures, chutes and the like to protect personnel, roofs and structures, vehicles and utilities.
- .2 Protect exposed surfaces of finished walls with tarps to prevent damage.
- .3 Plywood for traffic ways required for material movement over existing roofs shall be not less than 16mm thick.

- .4 In addition to the plywood listed above, an underlayment of minimum 13mm recover board is required on new roofing.
- .5 Obtain special permission from the Manufacturer before any traffic over new roofing.

3.6 FIELD QUALITY CONTROL

- .1 Inspection: Provide manufacturer's field observations at start-up and daily until completion. Provide a final inspection upon completion of the Work.
 - .1 Issue warranty upon manufacturer's acceptance of the installation.
 - .2 Have field observations performed by a Manufacturer's Representative employed full-time by the manufacturer and whose primary job description is to assist, inspect and approve membrane installations for the manufacturer.
 - .3 Provide observation reports from the Manufacturer's Representative indicating procedures followed, weather conditions and any discrepancies found during inspection.
 - .4 Provide a final report from the Technical Representative, certifying that the roofing system has been satisfactorily installed according to the project specifications, approved details and good general roofing practice.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section includes requirements for providing metal roofing on Wastewater Treatment Buildings as indicated on the Drawings and as specified herein.

1.2 RELATED WORK

- .1 Sealants: Section 07 92 00

1.3 REFERENCES

- .1 ASTM A653/653M-23, Standard Application for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process.
- .2 Canadian Sheet Steel Building Institute (CSSBI).

1.4 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00.
- .2 Submit duplicate 300 x 300 mm samples of roofing material, of colour and profile specified.

1.5 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Indicate dimensions, profiles, attachment methods, schedule of wall elevations, trim and closure pieces, metal furring, and related work.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Prefinished steel standing seam roof: factory-formed, lappable, concealed fastener steel roofing system, nominal core thickness of 26 ga, Z275 galvanized sheet steel conforming to ASTM A653M, prefinished to CSSBI 40.7, Series 8000 finish, profile and color as selected by the Consultant.
 - .1 Acceptable product: VICWEST, or approved equivalent.
- .2 Roof Underlayment:
 - .1 40 mil thick SBS modified bitumen self-adhesive membrane.
 - .1 Acceptable Products: SOPREMA Lastobond Shield, Blueskin PE 200HT or approved equivalent.
 - .2 Primer: composed of SBS synthetic rubbers and adhesive enhancing resins.

- .1 Acceptable product: SOPREMA Elastocol Stick, Blueskin adhesive or approved equivalent.
- .3 Joint Sealing: solvent-based mastic containing SBS modified bitumen, fibres and mineral fillers.
 - .1 Acceptable product: SOPREMA Sopramastic, Bakor 570-05 Polybitume Sealant or approved equivalent.
- .3 Prefinished sheet metal flashings, ridge vents, foam and metal closures, and trim: factory precoated sheet steel of same material, thickness and finish as exterior roofing.
- .4 Sealants: in accordance with Section 07 92 00, colour selected by the Consultant.
- .5 Snow guard: 6061-T6 aluminum extrusions, mechanically attached with clamps, colour to match steel roofing.
 - .1 Acceptable product: S-5 ColorGard by Metal Roof Innovations Ltd., or approved equivalent.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Protect metal surfaces in contact with concrete, mortar, or other cementitious surface with isolation coating.
- .2 Have waterproofing membrane/flashings in place prior to installing curved/sloped metal roofing.
- .3 Touch up roofing and flashings with matching paint at abrasions of screw fasteners.

3.2 INSTALLATION - ROOFING

- .1 Install roofing over support system in accordance with manufacturer's instructions.
- .2 Install exterior corners, fillers and closures with individually formed and profiled work.
- .3 Maintain joints true to line, tight fitting.
- .4 Seal in accordance with Section 07 92 00.

3.3 INSTALLATION - FLASHINGS

- .1 Install prefinished flashings in accordance with applicable CRCA FL Series specifications and Section 07 62 00.
- .2 Install flashing to form weathertight junction. Caulk flashings in accordance with Section 07 92 00.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED WORK

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

1.2 REFERENCES

- .1 ASTM D523-14(R2018) Test Method for Specular Gloss.
- .2 CAN/CGSB-51.32-M77 Sheathing, Membrane, Breather Type.
- .3 CAN/CGSB-93.1-M85 Sheet, Aluminum Alloy, Prefinished, Residential.
- .4 Aluminum Association Aluminum Sheet Metal Work in Building Construction.
- .5 Canadian Roofing Contractors Association (CRCA) Manual.

1.3 SUBMITTALS

- .1 Submit duplicate 50 mm x 50 mm samples of each type of sheet metal material, colour and finish.
- .2 Submit shop drawings in accordance with Section 01 33 00.

PART 2 - PRODUCTS

2.1 PREFINISHED STEEL SHEET FLASHING

- .1 Prefinished steel, with factory applied silicone modified polyester.
 - .1 Class F1S.
 - .2 Colour: to match roof colour specified in Section 07 61 00.
 - .3 Specular gloss: 30 units +/- 5 in accordance with ASTM D523.
 - .4 Thickness - 0.76 mm (22 gauge).

2.2 ALUMINUM SHEET

- .1 Base sheet: proprietary utility sheet, plain, 0.60 mm (24 gauge) minimum thickness.
- .2 Finish: factory applied coating to CAN/CGSB-93.1 supplemented and amended as follows:
 - .1 Type 1 - post-forming sheet.
 - .2 Class F1S - finish coated one side.
 - .3 Colour of coating: to be commercially uniform and match the colour of doors and frames.

2.3 ACCESSORIES

- .1 Isolation coating: alkali resistant bituminous paint.

- .2 Underlay for metal flashing: dry sheathing to CAN/CGSB-51.32.
- .3 Sealants: as per Section 07 92 00.
- .4 Cleats: of same material as flashing specified, and temper as sheet metal, minimum 50 mm wide. Thickness 0.76 mm (22 gauge).
- .5 Fasteners: of same material as sheet metal, ring thread flat head roofing nails of length and thickness suitable for metal flashing application.
- .6 Washers: of same material as sheet metal, with rubber packings.

2.4 FABRICATION

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

2.5 METAL CAP FLASHINGS

- .1 Form flashings, copings and fascias to profiles of prefinished steel.
- .2 Form flashings in accordance with CRCA FL series details. Provide slotted fixing holes and steel/plastic washer fasteners. Cover face and ends with plastic tape.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install sheet metal work in accordance with CRCA FL series details, Aluminum Sheet Metal Work in Building Construction.
- .2 Use concealed fastenings except where approved before installation.
- .3 Provide underlay under sheet metal. Secure in place and lap joints 100 mm.
- .4 Counter flash bituminous flashings at intersections of roof with vertical surfaces and curbs. Flash joints using S-lock forming tight fit over hook strips.

- .5 Lock end joints and caulk with sealant.
- .6 Install surface mounted reglets true and level, and caulk top of reglet with sealant.
- .7 Insert metal flashing into reglets under cap flashing to form weathertight junction.
- .8 Caulk flashing at reglet cap flashing with sealant.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies requirements for supplying and applying firestopping and smoke seal material as required for wall/floor/ceilings in areas/rooms which are fire-rated, as noted in the Room Finish Schedule.

1.2 RELATED WORK

- .1 Firestopping and smoke seals within electrical assemblies (i.e., inside conduits) are specified in Division 26.

1.3 REFERENCES

- .1 ASTM E605/E605M-19(R2023), Standard Test Methods for Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members.
- .2 ASTM E736/E736M-19(R2023), Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members.
- .3 ASTM E759/E759M-92(R2023), Standard Test Method for Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members.
- .4 ASTM E761/E761M-92(R2023), Standard Test Method for Compressive Strength of Sprayed Fire-Resistive Material Applied to Structural Members.
- .5 ASTM E937/E937M-93(R2023), Standard Test Method for Corrosion of Steel by Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members.
- .6 ASTM E2174-20a, Standard Practice for On-site Inspection of Installed Fire Stops.
- .7 ULC S115-2018, Method of Fire Tests of Firestop Systems.
- .8 International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments.
- .9 National Building Code, 20.

1.4 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00.
- .2 Submit duplicate 300 x 300 mm samples showing actual firestop material proposed for project.

1.5 SUBMITTALS

- .1 Submit shop drawings and product and safety data in accordance with Section 01 33 00.

- .2 Submit shop drawings to show proposed material, including composition and limitations, reinforcement, anchorage, fastenings and method of installation. Construction details should accurately reflect actual job conditions.
- .3 Provide manufacturer's engineering judgments identification number and drawing details when no ULC or UL system are available for an application. Engineered judgments must include both project name and contractor's name who will install firestop system as described in drawing.
- .4 Submit material safety data sheets provided with product delivered to job site.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Firestopping and smoke seal systems: in accordance with ULC-S115.
 - .1 Asbestos-free materials and systems capable of maintaining an effective barrier in compliance with requirements of ULC-S115 and not to exceed opening sizes for which they are intended.
 - .2 Firestop system rating: F.
- .2 Service penetration assemblies: certified by ULC in accordance with ULC-S115 and listed in ULC Guide No. 40 U19.
- .3 Service penetration firestop components: certified by ULC in accordance with ULC-S115 and listed in ULC Guide No. 40 U19.13 and ULC Guide No. 40 U19.15 under the Label Service of ULC.
- .4 Fire-resistance rating of installed firestopping assembly in accordance with NBC.
- .5 Sprayed-Fire Resistive Materials:
 - .1 Intermediate \Durability SFRM: Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-resistance design, and mixed with water at Site to form a slurry or mortar before conveyance and application.
 - .2 Bond Strength: Minimum 20.6-kPa cohesive and adhesive strength based on field testing according to ASTM E736.
 - .3 Density: Not less than 240 kg/cu. m) and as specified in the approved fire-resistance design, according to ASTM E605.
 - .4 Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design or ASTM E605, whichever is thicker, but not less than 0.375 inch (9 mm).
 - .5 Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate

- markings of applicable testing agency.
- .6 Flame-Spread Index: 0.
- .7 Smoke-Developed Index: 0.
- .8 Compressive Strength: Minimum 206 kPa according to ASTM E761.
- .9 Corrosion Resistance: No evidence of corrosion according to ASTM E937.
- .10 Deflection: No cracking, spalling, or delamination according to ASTM E759.
- .6 Firestopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.
- .7 Firestopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal.
- .8 Primers: to manufacturer's recommendation for specific material, substrate, and end use.
- .9 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.
- .10 Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.
- .11 Sealants for vertical joints: non-sagging.
- .12 Acceptable manufacturers:
 - .1 Hilti Canada Corporation
 - .2 3M
 - .3 A/D Fire Protection Systems

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 COORDINATION

- .1 Coordinate location and proper selection of cast-in-place firestop devices with trade responsible for the work. Install device before

placement of concrete.

- .2 Provide adequate spacing of field run pipes to allow for installation of cast-in-place firestop devices without interference.

3.3 INSTALLATION

- .1 Install firestopping material and components in accordance with ULC certification and manufacturer's instructions.
- .2 Install firestopping and smoke seal material and components at all walls, floors and ceilings in fire rated rooms as noted on Room Finish Schedule, and on Drawings.
- .3 Install firestopping and smoke seal on both sides of wall or slab where penetration or opening exists in fire rated rooms.
- .4 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.
- .5 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.
- .6 Tool or trowel exposed surfaces to a neat finish.
- .7 Remove excess compound promptly as work progresses and upon completion.

3.4 INSPECTION

- .1 Notify the Consultant when ready for inspection and prior to concealing or enclosing firestopping materials and service penetration assemblies.

3.5 SCHEDULE

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

fire separation.

3.6 FIELD QUALITY CONTROL

- .1 Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
- .2 Keep areas of work accessible until inspection by applicable code authorities.
- .3 Perform inspection of through-penetration firestopping in accordance with ASTM E2174.
- .4 Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.
- .5 Install a warning card that is clearly visible adjacent to all large and medium openings that may be re-penetrated. This card should contain the following information:
 - .1 Warning that the opening has been firestop protected.
 - .2 Indicate the firestop system used (ULC).
 - .3 F rating or FT rating.
 - .4 Firestop product(s) used.
 - .5 Person to contact and phone number in case of modification or new penetration of firestop system.

3.7 CLEAN UP

- .1 Remove excess materials and debris and clean adjacent surfaces immediately after application.
- .2 Remove temporary dams after initial set of firestopping and smoke seal materials.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This Section specifies requirements for supplying, and applying sealants as indicated.

1.2 RELATED WORK

- .1 Cast-in-place Concrete: Section 03 30 00
- .2 Dampproofing: Section 07 11 13
- .3 Hollow Metal Doors, Frames and Hardware: Section 08 11 14

1.3 REFERENCES

- .1 ASTM C920-18, Specification for Elastomeric Joint Sealants.
- .2 CAN/CGSB-19.13-M87 Sealing Compound, One Component, Elastomeric, Chemical Curing.
- .3 CAN/CGSB-19.24-M90 Multi-component, Chemical Curing Sealing Compound.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver and store materials in original wrappings and containers with manufacturer's seals and labels intact. Protect from freezing, moisture and water.

1.5 ENVIRONMENTAL AND SAFETY REQUIREMENTS

- .1 Sealant and substrate materials to be minimum 5°C.
- .2 Should it become necessary to apply sealants below 5°C, consult sealant manufacturer and follow their recommendations.
- .3 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of material safety data sheets acceptable to Labour Canada.
- .4 Conform to manufacturer's recommended temperatures, relative humidity and substrate moisture content for application and curing of sealants including special conditions governing use.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Primers: type recommended by sealant manufacturer.
- .2 Joint fillers:
 - .1 General: compatible with primers and sealants, outsized 30 to 50%.

- .2 Polyethylene, urethane, neoprene or vinyl: extruded closed cell foam, Shore A hardness 20.
- .3 Bond breaker: pressure sensitive plastic tape, which will not bond to sealants.
- .4 Sealants:
 - .1 Interior and exterior caulking around perimeter of pressed steel frames and to base of frames to flooring: to CAN/CGSB-19.13, one-component, moisture curing, modified polyurethane, paintable, normal temperature range dry conditions, movement range to 10%.
 - .1 Acceptable product: DyMonic by Tremco Limited, or approved equivalent.
 - .2 Interior control and expansion joints: to CAN/CGSB-19.24 multi-component sealant, self levelling, for joint movement up to 25%.
 - .1 Acceptable product: Duoflex SL by Sternson Division of Sika Canada Inc., THC-900 for horizontal joints and THC-901 for vertical joints by Tremco Limited, or approved equivalent.
 - .3 Interior locations including: at corner joints where masonry walls butt into continuous walls, at masonry walls and concrete floor slabs, and at equipment pads to floor slabs, except where another sealant is specified: to CGSB 19.13.
 - .1 Acceptable product: DyMonic by Tremco Limited, or approved equivalent.
 - .4 Mildew resistant silicone sealant for use around sinks and washroom fixtures:
 - .1 Acceptable product: Tremsil 200 with mildew resistant properties by Tremco or approved equivalent.
 - .5 Joint cleaner: xylol, methylethyleketon or non-corrosive type recommended by sealant manufacturer and compatible with joint forming materials.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.
- .2 Remove by brushing, scrubbing, scraping or grinding loose mortar, dust, oil, grease, oxidation, mill scale, coatings and all other materials affecting bond of compounds from surfaces to which sealant compounds must adhere, except for painted surfaces.
- .3 Clean down caulked metal surfaces with clean cellulose sponges or rags soaked in solvent recommended by sealant manufacturer, and wipe dry with clean cloths. Confirm solvent is not injurious to painted surfaces.

- .4 Confirm releasing agents, coatings or other treatments have either not been applied to joint surfaces, or that they are entirely removed.
- .5 Confirm joint surfaces are dry and frost free.

3.2 APPLICATION

- .1 Apply sealant products where indicated on the drawings and as outlined in Clause 2.1 of this Section.
- .2 Where necessary to prevent staining, mask adjacent surfaces before priming and caulking.
- .3 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.
- .4 Apply sealants, primers, joint fillers, and bond breaker if required, to manufacturer's instructions. Apply sealant using gun with proper size nozzle. Use sufficient pressure to fill voids and joints solid. Superficial pointing with skin bead is not acceptable.
- .5 Form surfaces of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities. Neatly tool surface to a slight concave joint.

3.3 CURING

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

3.4 CLEANING

- .1 Clean adjacent surfaces immediately and leave work neat and clean.
- .2 Remove excess and droppings, using recommended cleaners as work progresses.
- .3 Remove masking tape after initial set of sealant.
- .4 Do not use chemicals, scrapers, or other tools which would damage surfaces of caulked materials when excess compounds or droppings are removed. Repair Work damaged by cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This Section specifies requirements for supplying and installing interior and exterior hollow metal doors, and frames as indicated.

1.2 RELATED WORK

- .1 Sealants: Section 07 92 00
- .2 Painting: Section 09 91 23

1.3 REFERENCES

- .1 Canadian Steel Door and Frame Manufacturers' Association, (CSDFMA).
 - .1 CSDFMA, Specifications for Commercial Steel Doors and Frames.
 - .2 CSDFMA, Recommended Selection and Usage Guide for Commercial Steel Doors.
 - .3 CSDFMA, Recommended Locations for Hardware for Steel Doors and Frames.
- .2 National Fire Protection Association (NFPA):
 - .1 NFPA 80-2022, Fire Doors and Windows.
 - .2 NFPA 252-2022, Methods of Fire Test of Door Assemblies.
- .3 ASTM A653/A653M-23, Specification for Steel Sheet, Zinc-coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-dip Process.
- .4 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .5 CSA G40.21-13(R2023), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .6 ULC S104-15, Fire Test of Door Assemblies.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings and hardware schedule in accordance with Section 01 33 00 using D.H.I. (Door and Hardware Institute) formats.
- .2 Indicate type of door and frame, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, finishes and fire ratings.
- .3 Indicate proposed hardware including make, model, material, function, finish and all other pertinent information.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- .1 Brace frame units to prevent distortion in shipment and protect finished surfaces by sturdy protective wrapping.
- .2 Store doors and finishing hardware in a secure, dry location. Remove wrappings when finally stored in location, secure from damage. Store

doors vertically with blocking between to allow air to circulate.

- .3 Repair damage to finishes immediately after it occurs to prevent rusting. Use primer for painted surfaces and zinc primer for galvanized surfaces.
- .4 Maintain inventory list with hardware schedule.

1.6 REQUIREMENTS OF REGULATORY AGENCIES

- .1 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with ULC S104M and NFPA 252 for ratings specified or indicated.

PART 2 - PRODUCTS

2.1 DOOR MATERIAL

- .1 Sheet steel: 1.2 mm base thickness, commercial grade steel to ASTM A653, hot dipped galvanized, coating designation Z275 for exterior doors.
- .2 Door Core:
 - .1 Exterior hollow steel: vertically stiffened with steel ribs and all voids filled with semi-rigid fibrous insulation minimum density 1.5 pcf.
 - .2 Interior honeycomb: structural core consisting of Kraft paper having 24.5mm cell size to thickness indicated.
- .3 Exterior doors to have caps at top of door.

2.2 FRAME MATERIAL

- .1 Sheet steel: commercial grade steel to ASTM A653, hot dipped galvanized, coating designation Z275 for exterior frames.
 - .1 Frames: 1.6 mm base steel thickness.
 - .2 Floor anchors, channel spreaders and wall anchors: minimum 1.6 mm base steel thickness.
 - .3 Guard boxes: minimum 0.8 mm base steel thickness.
 - .4 Hinge reinforcements: minimum 2.6 mm base steel thickness.
- .2 Top and bottom reinforcing channels: to CSA G40.21-M, type 300W.
- .3 Door bumpers: black neoprene single stud, three for each single door, and two for each double door.
- .4 Frames for exterior doors to be thermally broken and must accommodate expansion and contraction with surface temperature range of -34 deg.C to 76 deg.C. Deflection must not exceed 1/175th of span under wind loads for building locality in accordance with the National Building Code. Pack frames with fibreglass insulation and/or polyurethane insulation.

2.3 ADHESIVES

- .1 Honeycomb cores and steel components: heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.
- .2 Polystyrene and polyurethane cores: heat resistant, epoxy resin based, low viscosity, contact cement.

2.4 PRIMER

- .1 Touch up primer for doors and frames to CAN/CGSB-1.181.

2.5 DOOR AND FRAME FABRICATION

- .1 The following fabricators are approved to perform work of this section: S.W. Fleming & Co. Ltd., Daybar, Apex Doors and Frames.
- .2 Steel doors to be 45 mm thick unless otherwise indicated.
- .3 Interior frames in accordance with frame schedule on the Project Drawings; exterior frames in accordance with frame schedule on the Project Drawings.
- .4 Fabricate steel doors and frames as detailed, in accordance with Steel Door and Frame Manufacturers' Association, "Canadian Manufacturing Specifications for Steel Doors and Frames".
- .5 Mortise, reinforce, drill and tap doors and reinforcements to receive hardware using templates provided by finish hardware supplier.
- .6 Shop prime cold rolled steel sheet.
- .7 Touch up doors and frames at factory with primer where galvanized finish damaged during fabrication.
- .8 Cut mitres and joints of frames accurately and weld continuously on inside of frame profile.
- .9 Grind welded corners and joints of frames to flat plane, fill with metallic paste filler and sand to uniform smooth finish.
- .10 Prepare doors and frames for installation of hardware. Provide all steel reinforcements. Drill and tap to template information.
- .11 Reinforce all doors and frames for door closers whether closers are scheduled or not.
- .12 Install three (3) door bumpers on strike jamb for each single door and two (2) door bumpers at head for double doors.
- .13 Reinforce heads of frames wider than 1200 mm.
- .14 Provide floor anchors, adjustable tee anchors, and steel anchors in accordance with Canadian Steel Door and Frame Manufacturers Association. Weld floor anchors to frame.
- .15 Close tops and bottoms of doors with recessed spot welded channel and closures. Mechanically interlock longitudinal edges.

- .16 Install galvanized steel top caps for all exterior doors.
- .17 Construct thermally broken frames using steel core, separating exterior portion of frame from interior portion with polyvinyl chloride thermal break.
- .18 Insulate exterior frame components with polyurethane insulation.

2.6 THERMALLY BROKEN DOORS AND FRAMES

- .1 Fabricate thermally broken doors by using insulated core and separating exterior parts from interior parts with continuous interlocking thermal break.
- .2 Thermal break: rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19Ma.
- .3 Fabricate thermally broken frames separating exterior parts from interior parts with continuous interlocking thermal break.
- .4 Apply insulation.

2.7 HARDWARE MATERIAL

- .1 Locks and lock set trim to be the product of one (1) manufacturer. Provide two (2) keys for each lock. Construction master key doors as directed by the Consultant. Provide two (2) construction keys and two (2) removal tools. Exterior doors keyed alike.
- .2 Lock fronts and strikes shall be bevelled, rounded or rabbeted as required. The hardware supplier will determine and be responsible for the hand and bevel of all doors.
- .3 Butt hinges to be product of one (1) manufacturer. Construct loose pin hinges for exterior doors opening outward with non-removable pins, when doors are closed. Furnish half mortise and full surface hinges for exterior doors opening out with one-way or twin-head screws or bolts.

PART 3 - EXECUTION

3.1 DOOR INSTALLATION

- .1 Install doors in accordance with manufacturer's instructions.
- .2 Fit doors with 6 mm clearance at jambs and head of frame, and 10 mm clearance over threshold.

3.2 HARDWARE INSTALLATION

- .1 Have the hardware supplier furnish and deliver in sufficient time so as not to impede the progress of the work, all necessary templates and schedules required to fabricate doors and frames.
- .2 Furnish manufacturers' instructions for proper installation of each hardware component.

- .3 Install hardware to standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular construction) prepared by Canadian Steel Door and Frame Manufacturers Association.
- .4 The mounting height may be varied conforming to the manufacturer's specific instructions and as approved by the Consultant.
- .5 Install hardware and trim square and plumb to doors.
- .6 Use all the installation aids available for a proper installation of the hardware items.
- .7 Protect exposed surfaces from scratches and abrasions with suitable covering until building is ready for final inspection.
- .8 Clean hardware before turn over to the Owner.
- .9 Adjust all hardware as required to provide smooth operation. Lubricate hardware if required by supplier's instructions.
- .10 Deliver keys to the Owner at building completion.

3.3 ADJUSTMENT

- .1 Adjust hinged doors to swing freely and easily, to remain stationary at any point of swing, to close evenly and tightly against stops without binding, and to latch positively when doors are closed with moderate force.

3.4 DOOR & HARDWARE SCHEDULE

- .1 Door: sizes and materials as shown on Drawings.
- .2 Hardware: as shown on Drawings.

3.5 FINISH REPAIRS

- .1 Touch up finishes damaged during installation.
- .2 Fill exposed frame anchors, and surfaces with imperfections, marks/scratches/dents, etc., with metallic paste filler and sand to a uniform smooth finish. Prime areas affected.
- .3 Finish paint doors and frames as specified in Section 09 91 23.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 This section specifies the requirements for the supply of insulated sectional overhead doors, complete with electric operators and controls, operating hardware, tracks and support with a manual chain back up.

1.2 RELATED SECTIONS

- .1 Section 05 50 00 - Metal Fabrications.
- .2 Section 07 92 00 - Sealants.

1.3 REFERENCES

- .1 UL 325-23, Door, Drapery, Gate, Louvre, and Window Operations and Systems.
- .2 ASTM A123/A123M-24, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

1.4 DESIGN/ PERFORMANCE REQUIREMENTS

- .1 Design exterior door assembly to withstand wind load of 2.2 kPa with a maximum horizontal deflection of 1/240 of opening width.
- .2 Wiring Connections: Requirements for electrical characteristics:
 - .1 208 volts, single phase, 60Hz
- .3 Single-source responsibility: provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from one source acceptable to manufacturer of primary components.

1.5 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data: manufacturer's data sheets on each product to be used, including:
 - .1 Preparation instructions and recommendations.
 - .2 Storage and handling requirements and recommendations.
 - .3 Installation methods.
- .3 Shop Drawings: indicate plans and elevations including opening dimensions and required tolerances, connection details, anchorage spacing, hardware locations, and installation details.
- .4 Manufacturer Certificates: certify products meet or exceed specified requirements.
- .5 Operation and maintenance data.
- .6 Provide colour selection samples.

1.6 QUALITY ASSURANCE

- .1 Manufacturer qualifications: company specializing in manufacturing products specified in this section with minimum five (5) years documented experience.
- .2 Installer qualifications: authorized representative of the manufacturer with minimum five (5) years documented experience.
- .3 Products requiring electrical connection: listed and classified by Underwriters Laboratories, Inc. acceptable to authority having jurisdiction as suitable for purpose specified.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Store products in manufacturer's unopened labelled packaging until ready for installation.
- .2 Protect materials from exposure to moisture until ready for installation.
- .3 Store materials in a dry, ventilated weathertight location.

1.8 WARRANTY

- .1 Warranty: manufacturer's limited door and operators system warranty for ten (10) years against delamination of polyurethane foam from steel face and all other components for three (3) years or 20,000 cycles, whichever comes first.

PART 2 - PRODUCTS

2.1 INSULATED SECTIONAL OVERHEAD DOORS

- .1 Door assembly: metal/foam/metal sandwich panel construction, with PVC thermal break and weather-tight ship-lap design meeting joints.
 - .1 Panel thickness: 51mm
 - .2 Exterior surface: ribbed, textured
 - .3 Exterior steel: 38mm, hot-dipped galvanized to ASTM A123.
 - .4 End stiles: 16 gauge with thermal break.
 - .5 Spring counterbalance: sized to weight of the door, with a helically wound, oil tempered torsion spring mounted on a steel shaft; cable drum of die-cast aluminum high strength galvanized aircraft cable. Sized with a minimum 7 to 1 safety factor.
 - .1 High cycle spring: 25,000 cycles
 - .6 Insulation: CFC-free and HCFC-free polyurethane, fully encapsulated.
 - .7 Thermal values: R-value of 17.50; U-value of 0.057.
 - .8 Air infiltration: 0.08 cfm at 15mph; 0.08 cfm at 25mph.
 - .9 Partial glazing of steel panels:

- .1 6mm tempered glass.
- .2 Hardware: galvanized steel hinges and fixtures. Ball bearing rollers with hardened steel races.
- .3 Lock:
 - .1 Keyed lock with interlock switch for automatic operator.
- .4 Weatherstripping:
 - .1 EPDM bulb-type strip at bottom section.
 - .2 Flexible jamb seals.
 - .3 Flexible header seal.
- .5 Track: provide track as recommended by manufacturer to suit loading required and clearances available.
 - .1 Size:
 - .1 51mm.
 - .2 Type:
 - .1 Standard lift.

2.2 OPERATOR

- .1 Electric Motor Operation: provide CSA (or other certification agency approved by the electrical authority having jurisdiction) listed electric operator, size and type as recommended by manufacturer to move door in either direction at not less than 2/3 foot nor more than 1 foot per second. Operator must meet UL325 requirements for continuous monitoring of safety devices.
 - .1 Entrapment protection: required for momentary contact, includes radio control operation.
 - .1 Photoelectric sensors monitored to meet UL325.
 - .2 Operator controls:
 - .1 Push-button operated control stations with open, close, and stop buttons.
 - .2 Backup manual chain hoist.
 - .3 Surface mounting.
 - .4 Interior location.
- .2 Electric operator, controls and wiring to be suitable for installation in a Zone 1 hazardous area. Refer to Division 26 and electrical drawings for requirements.
- .3 Electric operator, controls and wiring to be suitable for installation in a Zone 2 hazardous area. Refer to Division 26 and electrical drawings for requirements.
- .4 Provide a manual chain back up.

2.3 ACCEPTABLE PRODUCT

- .1 592 Series Thermacore insulated steel door by the Overhead Door Corporation or approved equivalent.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Do not begin installation until openings have been properly prepared.
- .2 Verify wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.
- .3 Verify electric power is available and of correct characteristics.
- .4 Notify the Consultant of unsatisfactory preparation work before proceeding.

3.2 PREPARATION

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

3.3 INSTALLATION

- .1 Install overhead doors and track in accordance with approved shop drawings and the manufacturer's printed instructions.
- .2 Coordinate installation with adjacent work to ensure proper clearances and allow for maintenance.
- .3 Anchor assembly to wall construction and building framing without distortion or stress.
- .4 Securely brace door tracks suspended from structure. Secure tracks to structural members only.
- .5 Fit and align door assembly including hardware.
- .6 Coordinate installation of electrical service. Complete power and control wiring from disconnect to unit components in accordance with Division 26 specifications and indicated hazardous area classification.

3.4 CLEANING AND ADJUSTING

- .1 Adjust door assembly to smooth operation and in full contact with weatherstripping.
- .2 Clean doors, frames and glass.
- .3 Remove temporary labels and visible markings.

3.5 PROTECTION

- .1 Do not permit construction traffic through overhead door openings after adjustment and cleaning.
- .2 Protect installed products until completion of project.

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- .3 Touch-up, damaged coatings and finishes and repair minor damage before applying for Ready for Takeover.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 This section specifies the requirements for the supply and installation of door hardware including locks, latches, butt hinges, exit devices, kickplates, closers, operators, thresholds, fastening and keys.

1.2 RELATED SECTIONS

- .1 Section 08 11 14 - Hollow Metal Doors, Frames and Hardware.

1.3 REFERENCE

- .1 American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA)
 - .1 ANSI/BHMA A156.1-2021, American National Standard for Butts and Hinges.
 - .2 ANSI/BHMA A156.2-2022, Bored and Preassembled Locks and Latches.
 - .3 ANSI/BHMA A156.3-2020, Exit Devices.
 - .4 ANSI/BHMA A156.4-2024, Door Controls - Closers.
 - .5 ANSI/BHMA A156.10-2024, Power Operated Pedestrian Doors.
 - .6 ANSI/BHMA A156.15-2021, Release Devices - Closer Holder, Electromagnetic and Electromechanical.
 - .7 ANSI/BHMA A156.16-2023, Auxiliary Hardware.
 - .8 ANSI/BHMA A156.17-2019, Self-closing Hinges and Pivots.
 - .9 ANSI/BHMA A156.18-2020, Materials and Finishes.
 - .10 ANSI/BHMA A156.19-2019, Power Assist and Low Energy Power - Operated Doors.
 - .11 ANSI/BHMA A156.20-2021, Strap and Tee Hinges and Hasps.
- .2 Canadian Steel Door and Frame Manufacturers' Association (CSDMA)
 - .1 CSDMA Recommended Dimensional Standards for Commercial Steel Doors and Frames - 2009.
- .3 UL Standards:
 - .1 UL 325-17, Door, Drapery, Gate, Louvre, and Window Operators and Systems.
 - .2 UL 10 B-08, Fire Tests of Door Assemblies.
 - .3 UL 10 C-16, Positive Pressure Fire Tests of Door Assemblies.
 - .4 ULC 104-15, Standard Method for Fire Tests of Door Assemblies.
- .4 CSA Standards:
 - .1 CAN/CSA C22.2 No. 247-14(R2019), Operators and Systems of Doors, Gates, Draperies and Louvres.

1.4 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 and as supplemented herein.
- .2 Product Data: Submit manufacturer's instructions, printed product literature and data sheets for door hardware and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop drawing:
 - .1 Submit shop drawings for hardware specified herein.
 - .2 Indicate specified hardware, including make, model, material, function, size, finish, and other pertinent information.
- .4 Manufacturer's Instructions: submit manufacturer's installation instructions.

1.5 CLOSEOUT SUBMITTALS

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

1.6 QUALITY ASSURANCE

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

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 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 Package items of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.
- .4 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect door hardware from nicks, scratches, and blemishes.
 - .3 Protect prefinished surfaces with wrapping.

- .4 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 HARDWARE ITEMS

- .1 Use a single manufacturer's products for similar items throughout the Work.

2.2 DOOR HARDWARE

- .1 Locks and latches:
 - .1 To ANSI/BHMA A156.2, as stated in Hardware Schedule.
 - .2 Normal strikes: mortise style, box type, lip projection not beyond jamb.
 - .3 Cylinders: key into keying system as directed.
- .2 Butts and hinges:
 - .1 Butts and hinges: to ANSI/BHMA A156.1, designated by letter A and numeral identifiers, followed by size and finish, listed in Hardware Schedule.
 - .2 Self-closing hinges and pivots: to ANSI/BHMA A156.17, designated by letter K and numeral identifiers listed in Hardware Schedule, with suffix letter F indicating listed for used on fire doors.
 - .3 Strap and tee hinges and hasps: to ANSI/BHMA A156.20, designated by letter A and numeral identifiers listed in Hardware Schedule, size listed in accordance with ANSI/BHMA A156.20, table I.
- .3 Exit devices: to ANSI/BHMA A156.3.
- .4 Kickplates: to ANSI/BHMA A156.16.
- .5 Door Closers and Accessories:
 - .1 Door controls (closers): to ANSI/BHMA A156.4.
 - .2 Door controls - overhead holders: to ANSI/BHMA A156.8.
 - .3 Closer/holder release devices: to ANSI/BHMA A156.15.
- .6 Personnel Door Operators:
 - .1 Power assist and low energy power operated doors: to ANSI/BHMA A156.19.
 - .2 Electro-mechanical system installed in a header to resist dust, dirt and corrosion. Bearings to be fully lubricated and sealed to minimize wear and friction. Removable operator from the header as a unit. Equipment to operate between temperature extremes of -4 degrees F and +120 degrees F.
 - .3 Operator to open with a 1/8 HP motor through reduction gears splined spindle, door are and linkage assembly. Drive train to have positive constant engagement. Operator to stop the door in

the open position by electrically reducing the motor voltage and stalling against stop.

- .4 Operator to close door by spring energy. employing the motor as a dynamic brake to control closing speed. Closing spring to be pre-loaded for positive closing action. Low energy operator door closing time to will not be less than 4.5 seconds.
- .5 Operator to function as a manual door closer in the direction of swing with or without electric power. To facilitate easy manual operation of door and to prolong gear and motor life the operator will have a one-way clutch in the gear train.
- .7 Thresholds: full width of door opening, stainless steel mill finish, STC rating 46 where indicated.

2.3 FASTENINGS

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

2.4 KEYING

- .1 Doors, padlocks and cabinet locks to be keyed as directed.
- .2 Supply keys in duplicate for every lock in this Contract.
- .3 Supply three (3) master keys for each master key or grand master key group.
- .4 Stamp keying code numbers on keys and cylinders.
- .5 Supply construction cores.
- .6 Hand over permanent cores and keys to the Consultant.

PART 3 - EXECUTION

3.1 INSTALLATION

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

- .3 Supply manufacturers' instructions for proper installation of each hardware component.
- .4 Install hardware to standard hardware location dimensions in accordance with CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction).
- .5 Where door stop contacts door pulls, mount stop to strike bottom of pull.
- .6 Install key control cabinet.
- .7 Use only manufacturer's supplied fasteners.
 - .1 Use of "quick" type fasteners, unless specifically supplied by manufacturer, is unacceptable.

3.2 ADJUSTING

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

3.3 CLEANING

- .1 Progress cleaning: clean in accordance with the Section 01 74 00 and as supplemented herein.
 - .1 Leave Work area clean at end of each day.
 - .2 Clean hardware with damp rag and approved non-abrasive cleaner, and polish hardware in accordance with manufacturer's instructions.
 - .3 Remove protective material from hardware items where present.
 - .4 Final cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
- .2 Waste management: separate waste materials for reuse and recycling.
 - .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 door hardware installation.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies all exterior and interior glazing requirements as per the Door and Frame Schedules.

1.2 RELATED WORK

- .1 Sealants: Section 07 92 00
- .2 Hollow Metal Doors, Frames and Hardware: Section 08 11 14

1.3 REFERENCES

- .1 ASTM C1048-18, Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.

PART 2 - PRODUCTS

2.1 GLAZING

- .1 Glazing:
 - .1 6 mm tempered glass to ASTM C1048, single glazed as per drawing detail.

2.2 GLAZING AND SEALING COMPOUND MATERIALS

- .1 Glazing compound and sealant compound as recommended by manufacturer.

2.3 ACCESSORIES

- .1 Glazing tape: preformed butyl tape, 10-15 durometer hardness, paper release, black or grey colour, 3 mm thick x 10 mm wide.
- .2 Setting blocks: neoprene, Shore "A" durometer hardness 80, 100 mm long x 6 mm high x width to suit glass thickness.
- .3 Spacer shims: neoprene, Shore "A" durometer hardness 80, 75 mm long x 3 mm thick x 10 mm high.
- .4 Glazing splines: neoprene manufacturer's standard dry glazing splines to suit aluminum extrusions, manufacturer's standard colour.
- .5 Primer-sealers and cleaners: to glass manufacturer's standard.

PART 3 - EXECUTION

3.1 WORKMANSHIP

- .1 Remove protective coatings and clean contact surfaces with solvent and wipe dry.

- .2 Apply primer-sealer to contact surfaces.
- .3 Place setting blocks as per manufacturer's instructions.
- .4 Install glass, rest on setting blocks, ensure full contact and adhesion at perimeter.
- .5 Install removable stops, without displacing tape or sealant.
- .6 Provide edge clearance of 3 mm minimum.
- .7 Insert spacer shims to center glass in space. Place shims at 600 mm o.c. and keep 6 mm below sight line.
- .8 Apply cap bead of sealant at perimeter void, each face of glazed units (trim back shim tape where required first).
- .9 Apply sealant to uniform and level line, flush with sightline and tooled or wiped with solvent to smooth appearance.
- .10 Do not cut or abrade tempered, heat treated, or coated glass.

3.2 INSTALLATION

- .1 Dry method - tape/tape:
 - .1 Cut glazing tape to length and install against permanent stop, project 1.5 mm above sightline.
 - .2 Place glazing tape on free perimeter of glass in same manner described above.
 - .3 Install with 10 mm shim at base on borrowed lights.

3.3 FINISHING

- .1 Immediately remove sealant and compound droppings from finished surfaces. Remove labels after work is completed.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This Section specifies requirements for supplying and installing gypsum board on ceiling and walls where shown on the Drawings.

1.2 RELATED WORK

- .1 Rough Carpentry: Section 06 10 00
- .2 Sealants: Section 07 92 00
- .3 Painting: Section 09 91 23

1.3 REFERENCES

- .1 ASTM A653/A653M-23, Specification for Steel Sheet Zinc-Coated (Galvanized) or Zinc-Iron (Galvannealed) by the Hot-Dip Process.
- .2 ASTM C475/C475M-22, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- .3 ASTM C840-24, Standard Specification for Application and Finishing of Gypsum Board.
- .4 ASTM C1002-22, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
- .5 ASTM C1047-19, Accessories for Gypsum Wallboard and Gypsum Veneer Base.
- .6 ASTM C1396/C1396M-24, Standard Specification for Gypsum Board.
- .7 CAN/ULC-S102-18, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials in original packages, containers or bundles bearing manufacturers brand name and identification.
- .2 Store materials inside, level, under cover. Keep dry. Protect from weather, other elements and damage from construction operations and other causes.
- .3 Handle gypsum boards to prevent damage to edges, ends or surfaces. Protect metal accessories and trim from being bent or damaged.

1.5 ENVIRONMENTAL REQUIREMENTS

- .1 Maintain temperature minimum 10°C, maximum 21°C, for 48 hours prior to and during application of gypsum boards and joint treatment, and for at least 48 hours after completion of joint treatment.
- .2 Apply board and joint treatment to dry, frost free surfaces.

- .3 Ventilation: Ventilate building spaces as required to remove excess moisture that would prevent drying of joint treatment material immediately after its application.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Fire-rated gypsum board: 1-hour fire-rated, to ASTM C1396, 15.9 mm thick, 1200 mm wide x maximum practical length, dense gypsum core.
 - .1 Standard of Acceptance: CGC Sheetrock Fire Code Core gypsum board panels.
- .2 Drywall furring channels: 0.5 mm core thickness galvanized steel channels for screw attachment of gypsum board.
- .3 Steel drill screws: to ASTM C1002.
- .4 Laminating compound: as recommended by manufacturer, asbestos-free.
- .5 Casing beads, corner beads, control joints and edge trim: to ASTM C1047, 0.5 mm base thickness commercial grade sheet steel with Z275 zinc finish to ASTM A653, perforated flanges; one piece length per location.
- .6 Joint compound: to ASTM C475, asbestos-free.

PART 3 - EXECUTION

3.1 ERECTION

- .1 Do application and finishing of gypsum board in accordance with ASTM C840 except where specified otherwise.
- .2 Install work level to tolerance of 1:1200.
- .3 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers and grilles.

3.2 APPLICATION

- .1 Do not apply gypsum board until bucks, anchors, blocking, electrical and mechanical work are approved.
- .2 Apply gypsum board to metal furring using screw fasteners. Maximum spacing of screws 300 mm o.c.

3.3 INSTALLATION

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

- .2 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.
- .3 Splice corners and intersections together and secure to each member with three (3) screws.
- .4 Install access doors to electrical and mechanical fixtures specified in respective Sections.
 - .1 Rigidly secure frames to furring or framing systems.
- .5 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.
- .6 Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.
- .7 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.
- .8 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.
- .9 Completed installation to be smooth, level and plumb, free from waves and other defects and ready for surface finish.
- .10 Mix joint compound slightly thinner than for joint taping.
- .11 Apply thin coat to entire surface using trowel or drywall broadknife to fill surface texture differences, variations or tool marks.
- .12 Allow skim coat to dry completely.
- .13 Remove ridges by light sanding or wiping with damp cloth.
- .14 Provide protection that ensures gypsum drywall work will remain without damage or deterioration at time of Ready for Takeover.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 09 21 16 - Gypsum Board Assemblies.

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM C645-18, Specification for Nonstructural Steel Framing Members.
 - .2 ASTM C754-20, Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
- .2 Environmental Choice Program (ECP).
 - .1 CCD-047a-98, Paints - Surface Coatings.
 - .2 CCD-048-98, Surface Coatings - Recycled Water-borne.
- .3 Hollow Metal Manufacturers Association (HMMA).
 - .1 HMMA 840-16, Guide Specification for Installation and Storage of Hollow Metal Doors and Frames.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two (2) copies of Workplace Hazardous Safety Data Sheets (SDS) in accordance with Section 01 35 29.06.

1.4 QUALITY ASSURANCE

- .1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Non-load bearing channel stud framing: to ASTM C645, for screw attachment of gypsum board. Knock-out service holes at 460 mm centres.
- .2 Floor and ceiling tracks: to ASTM C645, 0.912 mm thick, in widths to suit stud sizes, 32 mm flange height at floor, 50 mm flange height at top.
- .3 Metal channel stiffener: 18 x 38 mm size, 1.4 mm thick cold rolled steel, coated with rust inhibitive coating.
- .4 Sealants: as per Section 07 92 00.
- .5 Insulating strip: rubberized, moisture resistant 3 mm thick foam strip, 12 mm wide, with self-sticking adhesive on one face, lengths as required.

PART 3 - EXECUTION

3.1 ERECTION

- .1 Align partition tracks at floor and ceiling and secure at 400 mm on centre maximum.
- .2 Install damp proof course under stud shoe tracks of partitions on slabs on grade.
- .3 Stud placement:
 - .1 Place studs vertically at 400 mm on centre, and not more than 50 mm from abutting walls, and at each side of openings and corners. Position studs in tracks at floor and ceiling. Cross brace steel studs as required to provide rigid installation to manufacturer's instructions.
 - .2 Secure partitions: Place studs vertically at 305 mm on centre, and not more than 50 mm from abutting walls, and at each side of openings and corners. Position studs in tracks at floor and ceiling. Cross brace steel studs as required to provide rigid installation to manufacturer's instructions.
 - .1 Construct wall corners with double studs.
 - .2 Install anti-spread bracing approximately 1220 mm above bottom of wall between double studs at door jambs and adjacent studs.
 - .3 Install double studs at door jambs.
 - .4 Frame door as per HMMA 840, Part 3, A, B, C, D, and E, except that screws shall be replaced with steel rivets.

- .4 Attach studs to bottom track using screws.
 - .1 Secure partitions: Attach studs to top and bottom track using high-strength steel rivets.
- .5 Erect metal studding to tolerance of 1:1000.
- .6 Co-ordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.
- .7 Co-ordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other Sections.
- .8 Provide two studs extending from floor to ceiling at each side of openings wider than stud centres specified. Secure studs together, with legs facing, using column clips or other approved means of fastening placed alongside frame anchor clips.
- .9 Install heavy gauge single jamb studs at openings.
- .10 Erect track at head of door/window openings and sills of sidelight/window openings to accommodate intermediate studs. Secure track to studs at each end, in accordance with manufacturer's instructions. Install intermediate studs above and below openings in same manner and spacing as wall studs.
- .11 Frame openings and around built-in equipment, cabinets, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.
- .12 Provide wood blocking as required and as indicated, secured between studs for attachment of fixtures behind lavatory basins, toilet and bathroom accessories, and other fixtures including grab bars and towel rails, attached to steel stud partitions.
- .13 Install steel studs or furring channel between studs for attaching electrical and other boxes.
- .14 Extend partitions to ceiling height except where noted otherwise on drawings.
- .15 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs. Use 50 mm leg slotted ceiling tracks. Studs to be cut 25 mm short.
- .16 Install continuous insulating strips to isolate studs from uninsulated surfaces.
- .17 Install two (2) continuous beads of acoustical sealant under studs and tracks around perimeter of all partitions as specified in Section 07 92 00 - Sealants.

3.2 CLEANING

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

END OF SECTION

PART 1 - General

1.1 RELATED REQUIREMENTS

- .1 Section 09 21 16 - Gypsum Board Assemblies.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/Ceramic Tile Institute (CTI)
 - .1 ANSI A108/A118/A136.1:2024, American National Specifications For The Installation of Ceramic Tile.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C144-18, Standard Specification for Aggregate for Masonry Mortar.
 - .2 ASTM C150/C150M-24, Standard Specification for Portland Cement.
 - .3 ASTM C207-24, Standard Specification for Hydrated Lime for Masonry Purposes.
 - .4 ASTM C627-18(R2024), Standard Test Method for Evaluating Ceramic Floor Tile Installation Systems Using the Robinson-Type Floor Tester.
 - .5 ASTM C847-18, Standard Specification for Metal Lath.
 - .6 ASTM C979/C979M-24, Standard Specification for Pigments for Integrally Coloured Concrete.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 71-GP-22M-78 AMEND., Adhesive, Organic, for Installation of Ceramic Wall Tile.
- .4 Canadian Standards Association (CSA International)
 - .1 CSA A123.3-05 (R2015), Asphalt Saturated Organic Roofing Felt.
 - .2 CSA A3000:23, Cementitious materials compendium.
- .5 International Organization for Standardization (ISO)
 - .1 ISO 13007-1:2014, Ceramic tiles - Grouts and adhesives - Part 1: Terms, definitions, and specifications for adhesives
 - .2 ISO 13007:2013, Ceramic tiles - Grouts and adhesives - Part 2: Test methods for adhesives.
 - .3 ISO 13007-3:2010, Ceramic tiles - Grouts and adhesives - Part 3: Terms, definitions, and specifications for grouts.
 - .4 ISO 13007-4:2013, Ceramic tiles - Grouts and adhesives - Part 4: Test methods for grouts.
- .6 Terrazzo Tile and Marble Association of Canada (TTMAC)

- .1 2019-2021 Specifications Guide 09 30 00, Tile Installation Manual.
- .2 Hard Surface Maintenance Guide.

1.3 DESIGN AND PERFORMANCE CRITERIA

- .1 Factory blend tile that exhibits colour variations within the ranges selected and package so tile units taken from one package show the same range in colours as those taken from other packages.
- .2 Provide tile products manufactured in accordance with ANSI A108.1 as appropriate to the colour and texture specifications established by the general design concept for the project.
- .3 Performance Requirements:
 - .1 Static Coefficient of Friction: Tile installed on walkway surfaces having following values as determined by testing identical products per ASTM C1028:
 - .1 Level Surfaces: Minimum 0.6 dry.
 - .2 Ramp Surfaces: Minimum 0.8 dry.
 - .2 Load-Bearing Performance: Provide installations rated for the following load-bearing performance in accordance with ASTM C627 for ceramic tile installed on walkway surfaces:
 - .1 Extra Heavy: Passes cycles 1 through 14.
 - .2 Heavy: Passes cycles 1 through 12.
 - .3 Floor Level Tolerances: Provide materials to attain floor levelness tolerances required by this Section; calculate quantity of materials based on the difference between the specified tolerance and the initial tolerance specified in Section 03 35 00; measurements will be made in the same manner as used in Section 03 35 00.
 - .1 Use frost resistant tiles for exterior work in accordance with CAN/CGSB 75.1 having a moisture absorption rating of 3.5% or less.
 - .2 Provide Products used in exits having a flame spread rating of 25 or less when tested in accordance with ASTM E84 or ULC S102.2.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures:
 - .1 Include manufacturer's information on:
 - .1 Ceramic tile, marked to show each type, size, and shape required.
 - .2 Cementitious backer unit.
 - .3 Dry-set cement mortar and grout.

- .4 Divider strip.
 - .5 Elastomeric membrane and bond coat.
 - .6 Reinforcing tape.
 - .7 Levelling compound.
 - .8 Latex cement mortar and grout.
 - .9 Commercial cement grout.
 - .10 Organic adhesive.
 - .11 Slip resistant tile.
 - .12 Waterproofing isolation membrane.
 - .13 Fasteners.
- .2 Create shop drawing in CAD file format - Consultant will provide CAD floor plans. Indicate tile layout, control joint locations, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, thresholds, and setting details.
- .1 Locate and detail movement joints.

1.5 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Provide minimum 2% of each type and colour of tile required for project for maintenance use. Store where directed.
- .3 Maintenance material same production run as installed material.

1.6 QUALITY ASSURANCE

- .1 Conform to requirements of Terrazzo, Tile and Marble Association of Canada (TTMAC).
- .2 Obtain each type of tile material required from single source. For colour consistency, ensure the supplier has capacity to provide products from the same production run, dye lot, caliber, and batch number.
- .3 Obtain setting and grouting materials from one manufacturer to ensure compatibility.
- .4 Installer Qualifications: Specializing in tile work having minimum of 5 years successful documented experience with work comparable to that required for this project. Installer must be registered as a member in good standing with the Terrazzo, Tile and Marble Association of Canada.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials in containers with labels legible and intact and grade-seals unbroken.
- .2 Store materials so as to prevent damage or contamination.
- .3 Store materials in a dry area, protected from freezing, staining and damage.

- .4 Store cementitious materials on a dry surface.

1.8 SITE CONDITIONS

- .1 Surfaces for tile installation must be clean, dimensionally stable, cured, level, plumb and free of contaminants such as oil, sealers and curing compounds.
- .2 Maintain air temperature and structural base temperature at ceramic tile installation area above 12 degrees C for 48 hours before, during, and 48 hours after, installation. Tile and setting material stored at same conditions 48 hours before and 7 days after application.
- .3 Do not install tiles at temperatures less than 12 degrees C or above 38 degrees C.
- .4 Do not apply epoxy mortar and grouts at temperatures below 15 degrees C or above 25 degrees C.

PART 2 - Products

2.1 FLOOR & WALL TILE MATERIALS

- .1 Materials: as scheduled, or as otherwise selected by Consultant; Refer to Legends and Schedules on Drawings for tile requirements.
- .2 CT1 Porcelain tile; unglazed (small grain pattern): Tika Series by Richmond Tile + Stone (formally Casaroma).
 - .1 Colour: Allow for 2 colours chosen by the Consultant.
 - .2 Size: 300 mm x 600 mm.

2.2 MORTAR, GROUT, AND ADHESIVE MANUFACTURERS

- .1 Acceptable Manufacturers: Subject to compliance with requirements herein, provide products from one of the following manufacturers:
 - .1 Custom Building Products.
 - .2 Kiesel.
 - .3 Laticrete International Inc.
 - .4 Mapei Corporation Inc.
 - .5 Flextile Ltd.

2.3 MORTAR AND ADHESIVE MATERIALS

- .1 Thick Set Beds: Portland Cement With Latex Additive (for application over waterproofing and crack isolation membranes):
 - .1 Portland Cement: to ASTM C150, Type I, from one source only, non-staining and non-air entraining.
 - .2 Mortar Sand: ASTM C114, free of deleterious materials, well graded.
 - .3 Setting Bed Sand: ASTM C136, 100 percent passing No. 4 sieve.

- .4 Latex Additive:
 - .1 Description: latex additive serving as replacement for gauging water, for use with site mixed Portland cement mortar.
 - .2 Quantity: as recommended by latex additive manufacturer to produce workable consistency.
- .5 Acceptable Products:
 - .1 Description: latex additive serving as replacement for gauging water, for use with site mixed Portland cement mortar.
 - .2 Quantity: as recommended by latex additive manufacturer to produce workable consistency.
- .2 Thin Set Mortar: professional-grade, single-component, high-performance, polymer-modified thin-set mortar for interior and exterior installations of ceramic, porcelain, and dimensional natural-stone tile, to ISO 13007 classification C2EP1.
 - .1 Acceptable Materials:
 - .1 Ultraflex 2, by Mapei, or similar with same or better material properties and performance characteristics and approved for application at showers and wet areas.
 - .2 Kiesel Servoflex Trio Thin & Medium Mortar for floors
 - .3 Kiesel Servolight Thin Set Mortar for walls.

2.4 GROUT

- .1 Colouring Pigments:
 - .1 Pure mineral pigments, limeproof and nonfading, complying with ASTM C979.
 - .2 Colouring pigments to be added to grout by manufacturer.
 - .3 Job coloured grout not acceptable.
- .2 Unsanded Latex Portland Cement Grout for Wall Joints less than 3 mm and Glass Tile: latex-modified, factory blended, mildew resistant, non-sanded grout consisting of Portland cement and additives; comply with ANSI A118.6.
 - .1 Latex Additive: Type as recommended by latex mortar manufacturer.
- .3 Sanded Latex Portland Cement Grout for Wall and Floor Joints greater than 3 mm: latex-modified, factory blended, mildew resistant, sanded grout consisting of Portland cements, graded quartz, and additives; comply with ANSI A118.7.
 - .1 Latex Additive: Type as recommended by latex mortar manufacturer.
- .4 Grout for Wet Areas:
 - .1 Epoxy Grout: Multi-component, factory prepared, 100 percent epoxy resin and hardener with sand or mineral filler material; comply with ANSI A118.3.

- .2 Colour: colours to match materials, confirm colour with Consultant prior to ordering.
- .3 Acceptable Products:
 - .1 100% Solids Epoxy Grout by Custom Building Products.
 - .2 Latapoxy SP-100 Stainless Epoxy Grout by Laticrete.
 - .3 Latapoxy SP-100 Vertical Grade Epoxy Grout by Laticrete.
 - .4 Kerapoxy Chemical Resistant Grout by Mapei.
 - .5 Okapox Royal Epoxy Grout by Keisel.

2.5 ACCESSORIES

- .1 Trim shapes:
 - .1 Conform to applicable requirements of adjoining floor and wall tile.
 - .2 Use slip resistant trim shapes for horizontal surfaces of showers, overflow ledges, recessed steps, shower curbs, drying area curbs, and stools.
 - .3 Use trim shapes sizes conforming to size of adjoining field wall tile, including existing spaces, unless specified otherwise.
 - .4 At all unfinished outside corners and exposed edges of wall tile provide Schluter RO 60 AGGB (brushed chrome) finish.
 - .5 At wall tiles with unfinished, exposed edges, provide Schluter RO 80 AGGB (brushed chrome anodized finish).
 - .6 For dissimilar transition from ceramic tile to other floor finishes (painted floor, vinyl tile,). Aluminum, satin anodized finish, anchoring leg and adjustable sloped surface to suit adjacent floor material; Schluter RENO-AEVT, height to suit finished tile thickness. Install flush with finished tile surface and in strict accordance with the manufacturer's specifications.
- .2 Control Joints:
 - .1 Rigid PVC anchoring legs and side sections, with soft CPE top and bottom movement zones which is also the only visible surface, 5 mm wide overall; Schluter DILEX-BWS. Thickness to suit tile, colour to later selection. Install every 4500 mm maximum in each direction, at control joint locations in substrate, at change of tile material under doors, changes in substrate, and in accordance with the manufacturer's specifications.
- .3 Floor sealer and protective coating: to CAN/CGSB-25.20, Type 1 to tile and grout manufacturer's recommendations.
- .4 Sealants: to Section 07 92 00 - Joint Sealants.
- .5 Uncoupling Membrane: Rigid polyethylene membrane with a grid structure of square cavities 3 mm high each cut back in a dovetail configuration having anchoring fleece laminated to underside or non-directional, non-deteriorating woven mat 10 mm complete with manufacturers

recommended floor adhesives and setting materials:

- .1 Standard of Acceptance:
 - .1 Schlüter Ditra.
 - .2 Mapelastic Aquadefense by Mapei.
 - .3 LevelQuik Waterproofing & Anti-Fracture Membrane by Custom Building Products.
- .2 Accessories:
 - .1 Manufacturer's recommended accessories as required for a complete installation.

2.6 PATCHING AND LEVELLING COMPOUND

- .1 Cement base, acrylic polymer compound, manufactured specifically for resurfacing and leveling concrete floors. Products containing gypsum are not acceptable.
- .2 Have not less than the following physical properties:
 - .1 Compressive strength - 25 MPa.
 - .2 Tensile strength - 7 MPa.
 - .3 Flexural strength - 7 MPa.
- .3 Capable of being applied in layers up to 50 mm thick, being brought to feather edge, and being trowelled to smooth finish.
- .4 Ready for use in 48 hours after application.
- .5 Acceptable materials:
 - .1 Ultraplan Easy by Mapei, or similar with same or better material properties and performance characteristics.
 - .2 Servocret RS by Keisel.

2.7 CLEANING COMPOUNDS

- .1 Specifically designed for cleaning masonry and concrete and which will not prevent bond of subsequent tile setting materials including patching and leveling compounds and elastomeric waterproofing membrane and coat.
- .2 Materials containing acid or caustic material are not acceptable.

2.8 FLOOR PROTECTION

- .1 Protection Mat: breathable mat to allow for heavy traffic on flooring.
 - .1 Acceptable Materials: EZcover, by McTech Group.

PART 3 - Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's printed installation requirements, technical datasheets, specifications, and installation details.

3.2 EXAMINATION

- .1 Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the work.
- .2 Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- .3 Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

- .1 Prepare substrates according to manufacturer's printed instructions as required to meet warranty requirements.
- .2 Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
- .3 Remove substrate paint, coatings and other substances that are incompatible with adhesives or contain soap, wax, oil, solvents, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- .4 Mechanically remove contamination on the substrate that may cause damage to the flooring material. Permanent and non-permanent markers, pens, crayons, paint, etc., shall not be used to write on the back of the flooring material or used to mark the substrate as they could bleed through and stain the flooring material.
- .5 Prepare Substrates as follows:
 - .1 Moisture Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
 - .2 Perform anhydrous calcium chloride test, ASTM F1869. Results shall not exceed 5 lbs. Moisture Vapor Emission Rate per 1,000 sq. ft. in 24-hours.
- .6 - or -
 - .1 Perform relative humidity test using in situ probes, ASTM F2170. Shall not exceed 80%.

- .2 A pH test for alkalinity shall be conducted. Results shall range between 7 and 9. If the test results are not within the acceptable range of 7 to 9, the installation shall not proceed until the problem has been corrected.
- .3 Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.
- .7 Fill cracks, holes, depressions, and irregularities in the substrate with good quality Portland cement-based underlayment leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- .8 Floor covering shall not be installed over expansion joints.
- .9 Do not install flooring products until they are same temperature as the space where they are to be installed.
- .10 Move flooring products and installation materials into spaces where they will be installed at least 48-hours in advance of installation.
- .11 Sweep and vacuum clean substrates to be covered by flooring products immediately before installation.

3.4 MEMBRANE INSTALLATION

- .1 Install crack suppression membrane in accordance with manufacturer's written instructions to produce membrane of uniform thickness bonded securely to substrate.
- .2 Install tiling after liquid applied membranes are cured.

3.5 INSTALLATION - GENERAL

- .1 Installation shall meet or exceed the requirements of TTMAC 09 30 00 - Tile Installation Manual.
- .2 Apply tile to clean and sound surfaces.
- .3 Fit tile around corners, fitments, fixtures, drains and other built-in objects. Maintain uniform joint appearance. Cut edges smooth and even. Do not split tiles.
- .4 Maximum surface tolerance 1:800.
- .5 Make joints between tile uniform and approximately 1.5 mm wide, plumb, straight, true, even and flush with adjacent tile. Ensure sheet layout not visible after installation. Align patterns.
- .6 Lay out tiles so perimeter tiles are minimum 1/2 size.
- .7 Sound tiles after setting and replace hollow-sounding units to obtain full bond.
- .8 Make internal angles square, external angles bull nosed.
- .9 Use bullnose edged tiles at termination of wall tile panels, except where panel abuts projecting surface or differing plane.
- .10 Install divider strips at junction of tile flooring and dissimilar materials.

- .11 Allow minimum 24 h after installation of tiles, before grouting.
- .12 Clean installed tile surfaces after installation and grouting cured.
- .13 Make control joints at 4500 mm in each direction. Make joint width same as tile joints. Use product specified in Part 2.
- .14 Caulk joints at intersections of floor and wall and inside corners of wall tile, colour to match grout.
- .15 Protect installed areas from traffic until setting materials have cured for periods specified in TTMAC 09 30 00 - Tile Installation Manual.

3.6 UNCOUPLING MEMBRANES

- .1 Prepare surfaces as recommended by manufacturer.
- .2 Install waterproofing and uncoupling membranes in accordance with manufacturer's printed instructions as required to produce membrane installations of uniform thickness bonded securely to substrate.
- .3 Install tiling after liquid applied membranes are cured.

3.7 INSTALLATION WALL TILE

- .1 Install tile on gypsum board or backer board as indicated, to TTMAC details 305W and/or 306W as applicable to conditions.
- .2 100% back butter all tile at time of installation.
- .3 Grout tile as specified.

3.8 INSTALLATION FLOOR TILE

- .1 Install tile on concrete floor substrates, to TTMAC detail 309F, 310F and/or 311F as applicable to conditions.
- .2 100% back butter all tile at time of installation.
- .3 Grout tile as specified.

3.9 SPECIAL ACCESSORIES

- .1 Install transitions, edge protection, control joints, and other accessories in the tile work in accordance with manufacturer's specifications. Use longest lengths practical.

3.10 PROTECTIVE COATING

- .1 Apply in accordance with manufacturer's instructions.

3.11 FIELD QUALITY CONTROL

- .1 After 2-day cure-period, Consultant will sound tiles, and any hollow-sounding tiles shall be replaced at Contractor's expense.
- .2 After 2-day cure-period, Consultant will measure flatness of applications for adherence to specified tolerances using standard straight edge method; non-compliant work shall be re-done as required

by Contractor at Contractor's expense.

3.12 CLEANING

- .1 Progress Cleaning: clean in accordance with Division 01: General Requirements - Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools, and equipment in accordance with Division 01: General Requirements - Cleaning. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Manage and dispose of demolition and construction waste materials in accordance with Division 01: General Requirements - Waste Management and Disposal.

3.13 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by Work of this Section.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies requirements to supply and install acoustic tile ceiling and suspension system where indicated on the Drawings and as specified herein.

1.2 RELATED WORK

- .1 Mechanical fixtures: Divisions 22 & 23
- .2 Electrical fixtures: Division 26

1.3 REFERENCES

- .1 ASTM C635-22, Standard Specification for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.
- .2 ASTM C636-19, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.

1.4 DESIGN CRITERIA

- .1 Maximum deflection: 1/360th of span to ASTM C635 deflection test.

1.5 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00.
- .2 Submit one (1) representative model of each type ceiling suspension system and each type of acoustical tile.
- .3 Ceiling system to show basic construction and assembly, treatment at walls, recessed fixtures, splicing, interlocking, finishes, acoustical unit installation.

1.6 ENVIRONMENTAL CONDITIONS

- .1 Permit wet work to dry before commencement of installation. Do not start work if further installation of damp materials is contemplated.
- .2 Maintain uniform minimum temperature of 15°C and humidity of 20 - 40% before and during installation.
- .3 Store materials in work area 48 hours prior to installation.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Intermediate duty system to ASTM C635/C635.
- .2 Acoustic units for suspended ceiling system: to CAN/CGSB-92.1.

- .1 Type: mineral fibreboard, non-fire rated.
- .2 Flame spread rating: 25 or less.
- .3 Ceiling Attenuation Class (CAC) range: 35 to 39.
- .4 Noise reduction coefficient (NRC) designation: 0.5 to 0.6.
- .5 Edge type: Square.
- .6 Colour: white.
- .7 Size: 610 x 610 x 19 mm thick.
- .8 Shape: flat.
- .9 Accessories: corrosion resistant retention clips, 2/panel in entry areas only.
- .10 Acceptable products: Radar Climaplus by CGC, or Cortega 769 by Armstrong or approved equivalent.
- .3 Basic materials for suspension system: commercial quality cold rolled steel.
- .4 Suspension system: two directional exposed tee bar grid, non-fire rated.
 - .1 Acceptable product: Prelude as manufactured by Armstrong, DX as manufactured by CGC, or approved equivalent.
- .5 Exposed tee bar grid components: shop painted satin sheen white baked vinyl enamel. Components die cut. Main tee with double web, rectangular bulb and 25 mm rolled cap on exposed face. Cross tee with rectangular bulb; web extended to form positive interlock with main tee webs; lower flange extended and offset to provide flush intersection.
- .6 Hanger wire: 2.6 mm diameter galvanized soft annealed steel wire.
- .7 Hanger inserts: purpose made.
- .8 Accessories: splices, clips, wire ties, retainers and wall moulding flush and reveal, to complement suspension system components, as recommended by system manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install suspension system in accordance with ASTM C636 except where specified otherwise.
- .2 Do not erect ceiling suspension system or install tiles until work above ceiling has been inspected by the Consultant.
- .3 Coordinate ceiling work to accommodate components of other sections, such as light fixtures, radiant heating panels, and diffusers, to be built into acoustical ceiling components.

- .4 Secure hangers to overhead structure using attachment methods acceptable to Consultant.
- .5 Install hangers to adequately support suspension system.
- .6 Coordinate suspension system with location of related components.
- .7 Install wall mould to provide correct ceiling height.
- .8 Completed suspension system to support super- imposed loads, such as lighting fixtures diffusers, and grilles.
- .9 Support at light fixtures, radiant heating panels and diffusers with additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.
- .10 Interlock cross member to main runner to provide rigid assembly.
- .11 Finished ceiling system to be square with adjoining walls and level within 1:1000.
- .12 Install clips in entrance/exit areas for wind uplift.

3.2 ACOUSTICAL UNITS

- .1 Install acoustical tiles in ceiling suspension system.

3.3 CLEANING

- .1 Touch up scratches, abrasions, voids and other defects in painted surfaces, in acoustical tiles where minor repair is acceptable, and similarly on tee-bar grid.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies requirements to supply and install sheet flooring, rubber base and vinyl stair nosing where indicated on the Drawings.

1.2 REFERENCES

- .1 ASTM F1303-04 (R2021), Standard Specification for Sheet Vinyl Floor Covering and Base.
- .2 ASTM D2047-17, Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine.
- .3 CAN/CGSB-25.20-95, Surface Sealer Floors.
- .4 CAN/CGSB-25.21-95, Detergent Resistant Floor Polish.

1.3 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00.
- .2 Submit duplicate tile in size specified, and 300 mm long base.

1.4 ENVIRONMENTAL REQUIREMENTS

- .1 Maintain air temperature and structural base temperature at flooring installation area above 20°C for 48 hours before, during and for 48 hours after installation.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Resilient base: rubber, top set, continuous complete with premoulded end stops and external corners.
- .2 Sheet vinyl with backing to ASTM F1303, commercial duty, to match existing colour and texture.
- .3 Primers and adhesives: waterproof, recommended by flooring manufacturer for specific material on applicable substrate, above, at or below grade.
- .4 Sub-floor filler and leveller: Portland cement based latex type filler as recommended by flooring manufacturer for use with their product.
- .5 Metal edge strips: aluminum extruded, smooth, mill finish with lip to extend under floor finish, shoulder flush with top of adjacent floor finish.
- .6 Sealer and wax: type recommended by flooring manufacturer.
- .7 Stair nosing: slip resistance in accordance with ASTM D2047, profile and colour to match existing nosings

PART 3 - EXECUTION

3.1 INSPECTION

- .1 Confirm concrete floors are dry, by using test methods recommended by tile manufacturer.

3.2 SUB-FLOOR TREATMENT

- .1 Remove sub-floor ridges and bumps. Fill low spots, joints, holes and other defects with sub-floor filler.
- .2 Clean floor and apply filler; trowel and float to leave smooth, flat hard surface. Prohibit traffic until filler cured and dry.
- .3 Prime concrete to flooring manufacturer's printed instructions.

3.3 FLOORING APPLICATION

- .1 Provide high ventilation rate, with maximum outside air, during installation, and for 48 to 72 hours after installation. If possible, vent directly to outside. Do not let contaminated air recirculate through district or whole building air distribution system. Maintain extra ventilation for at least one (1) month following building occupation.
- .2 Apply adhesive uniformly using recommended trowel. Do not spread more adhesive than can be covered by flooring before initial set takes place.
- .3 Lay flooring with seams parallel to building to produce a minimum number of seams. Border widths minimum 1/3 width of full material.
- .4 Run sheets in direction of traffic. Double cut sheet joints and continuously seal heat weld according to manufacturer's printed instructions.
- .5 Heat weld seams of linoleum sheet flooring in accordance with manufacturer's printed instructions.
- .6 As installation progresses, and after installation roll flooring with 45 kg minimum roller to ensure full adhesion.
- .7 Cut flooring around fixed objects.
- .8 Install feature strips and floor markings where indicated. Fit joints tightly.
- .9 Install flooring in pan type floor access covers. Maintain floor pattern.
- .10 Continue flooring over areas to receive movable type partitions without interrupting floor pattern.
- .11 Continue flooring through areas to receive movable type partitions without interrupting floor pattern.

- .12 Terminate flooring at centreline of door in openings where adjacent floor finish or colour is dissimilar.
- .13 Install metal edge strips at unprotected or exposed edges where flooring terminates.

3.4 BASE APPLICATION

- .1 Lay out base to keep number of joints at minimum.
- .2 Clean substrate and prime with one coat of adhesive.
- .3 Apply adhesive to back of base.
- .4 Set base against wall and floor surfaces tightly by using 3 kg hand roller.
- .5 Install straight and level to variation of 1:1000.
- .6 Scribe and fit to door frames and other obstructions. Use premoulded end pieces at flush door frames.
- .7 Cope internal corners. Use premoulded corner units for right angle external corners. Use formed straight base material for external corners of other angles.
- .8 Use toeless type base where floor finish will be carpet, coved type elsewhere.
- .9 Install toeless type base before installation of carpet on floors.
- .10 Heat weld base in accordance with manufacturer's printed instructions.

3.5 INITIAL CLEANING AND WAXING

- .1 Remove excess adhesive from floor, base and wall surfaces without damage.
- .2 Clean, seal and wax floor and base surface with three (3) coats of wax and polishing on all sheet flooring.

3.6 PROTECTION OF FINISHED WORK

- .1 Protect new floors from time of final set of adhesive until final inspection.
- .2 Prohibit traffic on floor for 48 hours after installation.

3.7 RE-FINISHING OF EXISTING SHEET FLOORING

- .1 Strip finish from existing sheet flooring where indicated on the Project Drawings.
- .2 Re-finish flooring in accordance with the flooring manufacturer's written instructions.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This Section specifies requirements for providing all labour, tools, equipment and materials to complete all painting including preparation, painting and touch-up.
- .2 Coordinate painting work for piping and equipment as specified under Division 40 through 46.

1.2 RELATED WORK

- .1 Rough Carpentry: Section 06 10 00
- .2 Hollow Metal Doors, Frames and Hardware: Section 08 11 14
- .3 Manufacturer's coatings of mechanical equipment: Divisions 23 and 40 through 46.

1.3 REFERENCES

- .1 Canadian Painting Contractors' Architectural (CPCA).
 - .1 Painting Specifications Manual 1998.
- .2 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-1.146-99, Cold Curing, Glass Epoxy Coating.
 - .2 CAN/CGSB-1.38-2000, Interior Enamel Undercoat.
 - .3 CAN/CGSB-1.57-03, Interior Alkyd Semigloss Enamel.
 - .4 CAN/CGSB-1.59-97, Alkyd Exterior Gloss Enamel.
 - .5 CAN/CGSB-1.81-M90 CORR, Air Drying and Baking Alkyd Primer for Vehicles and Equipment.
 - .6 CAN/CGSB-1.188-04, Emulsion Type Filler Masonry Block.
 - .7 CAN/CGSB-1.195-99, Interior Latex Semigloss Paint.
 - .8 CAN/CGSB-1.213-04, Etch Primer (Pretreatment Coating or Tie Coat) for Steel and Aluminium.
 - .9 CAN/CGSB-85.100-93, Painting.
 - .10 CAN/CGSB-85.10-99, Protective Coatings for Metals.
 - .11 CAN/CSA 1.119-2000, Interior Latex Primer-Sealer.

1.4 QUALITY ASSURANCE

- .1 Provide affidavits stating only "first-line" products have been used on this Contract.
- .2 Paint manufacturer must be represented by a qualified technical representative, trained as a paint inspector, with a minimum five (5) years experience.
- .3 The manufacturer's technical representative will make a minimum of one (1) inspection prior to and during application to ensure proper application.

- .4 After inspection the manufacturer's representative will provide a written report to the Consultant within five (5) working days.

1.5 START-UP MEETING

- .1 After award of Contract and prior to the painting and coating work, hold a start-up meeting with the following people present:
 - .1 The Owner.
 - .2 The Consultant.
 - .3 The applicator and their designated inspectors and crew supervisors who will be working on site on this project.
 - .4 The paint manufacturer's trained paint inspector.
- .2 The purpose of the meeting will be to discuss the specifications, job conditions, and painting and coating Work to be done with reference to the most recent product data sheets and application instructions.

1.6 SURFACE AND ENVIRONMENTAL CONDITIONS

- .1 Apply paint finish only in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
- .2 Do not apply exterior paint finishes in unsuitable weather conditions.
- .3 Do not apply paint finishes when relative humidity exceeds 85%, when condensation has formed or is likely to form, or immediately following rain, frost, or formation of dew.
- .4 Provide adequate ventilation or isolation measures to protect against toxic fumes.
- .5 Apply paint only to adequately prepared surfaces.
- .6 Apply paint only when previous coat of paint is dry or adequately cured.
- .7 Additional Interior Application Requirements:
 - .1 Apply paint finishes only when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.

1.7 DELIVERY, HANDLING AND STORAGE

- .1 Deliver, store and handle materials in accordance with Section 01 61 00.
- .2 Labels to clearly indicate:
 - .1 Manufacturer's name and address.
 - .2 Type of paint or coating.
 - .3 Compliance with applicable standard.
 - .4 Colour number in accordance with established colour schedule.

- .3 Remove damaged, opened and rejected materials from site.
- .4 Provide and maintain dry, temperature controlled, secure storage.
- .5 Observe manufacturer's recommendations for storage and handling.
- .6 Store materials and supplies away from heat generating devices.
- .7 Store materials and equipment in a well ventilated area with temperature range 7°C to 30°C.
- .8 Store temperature sensitive products above minimum temperature as recommended by manufacturer.
- .9 Keep areas used for storage, cleaning and preparation, clean and orderly to approval of Consultant. After completion of operations, return areas to clean condition to approval of Consultant.
- .10 Remove paint materials from storage only in quantities required for same day use.
- .11 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling storage, and disposal of hazardous materials.
- .12 Fire Safety Requirements:
 - .1 Provide fire extinguisher adjacent to storage area.
 - .2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
 - .3 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada.

1.8 SUBMITTALS

- .1 Submit product data and manufacturer's installation/application instructions for each paint and coating product to be used in accordance with Section 01 33 00.
- .2 Submit the names of paint manufacturers and local supplier. Confirm painting requirements and submit colour schedule for approval as per Section 01 33 00 prior to ordering of products
- .3 Upon completion, submit records of products used. List products in relation to finish system and include the following:
 - .1 Product name, type and use.
 - .2 Manufacturer's product number.
 - .3 Colour numbers.
 - .4 Manufacturer's Safety Data Sheets (SDS).

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Paint products as manufactured by Glidden/Devroe Coating, and Pittsburgh Paint Ltd (PPG) or approved equivalent.
- .2 Use only "first line" products produced by the manufacturer. Use only products of manufacturer whose best quality lines meet or exceed CGSB specifications for finishing materials as specified in the Paint Formulae, except where otherwise specified.
- .3 Paint materials for each coating formula to be products of a single manufacturer.

PART 3 - EXECUTION

3.1 WORKMANSHIP

- .1 All painting application and methods to be done in strict accordance with the recommendation of the applicable CGSB Standards, manufacturer's instructions and subject to the approval of the Consultant.
- .2 Do not paint when temperature is below 10°C.
- .3 Before painting equipment mask manufacturer's name plates and any other name plates carrying informational data pertaining to equipment. Do not paint nameplates.
- .4 Paint to be well mixed and kept stirred while being applied. Do not thin paint unless approved by the Consultant, and only with such materials and to such extent as not to damage paint.
- .5 Spread paint to coverage not greater than that recommended by paint manufacturer.
- .6 Force paint into pores, angles and crevices of well cleaned surfaces and in such manner as will assure a continuous even coat making contact with all parts of the surface and producing a film free of air bubbles, skips and thin spots.
- .7 Paint thickness for each coat to be minimum as recommended by the applicable CGSB specifications or as recommended by the manufacturer of the material subject to approval of the Consultant.
- .8 Defective painting and finishing Work resulting from application to unsatisfactory surfaces shall be considered the responsibility of those performing the Work of this Section.

3.2 PREPARATION OF SURFACES

- .1 In general:

- .1 Vacuum clean interior areas immediately before finishing Work commences.
- .2 Remove from surfaces grease, oil, dirt, dust, ridges, and other soil and materials that would adversely affect the adhesion or appearance of finish coatings.
- .3 Remove rust on surfaces primed under Work of other Sections and the areas reprimed under the Work of those Sections.
- .4 Finish, patch and smooth surfaces to remove cracks, holes, ridges, and similar blemishes.
- .5 Touch up damaged prime coats on shop primed metals with same priming material.
- .6 Neutralize high alkaline surfaces to receive latex paints. Remove residue before painting.
- .7 Scrub mildewed surfaces with a bleach solution and rinse with clean water.
- .8 In the case of existing coatings, hand tool clean to remove all loose flaking paint and rust and feather sand edges.

3.3 DEGLOSS EXISTING PAINT COATINGS BY SCUFF SANDING.

- .1 Touch up shop paint primer on steel with same type primer as originally used.
- .2 Prepare wood surfaces to CAN/CGSB-85-100.
 - .1 Sand surfaces smooth; clean soiled surfaces and remove dust and dirt.
 - .2 Use vinyl sealer over knots and resinous areas.
 - .3 Apply wood paste filler to nail holes and cracks.
 - .4 Prepare galvanized steel and zinc coated surfaces to CAN/CGSB-85-10.
 - .5 Equipment pads, concrete floor surfaces preparation: clean and etch with muriatic acids.
 - .6 PVC piping surfaces preparation: scuff sand, clean soiled surfaces, and remove dust and dirt.
 - .7 Interior steel, ductwork, piping:
 - .1 Vacuum clean to remove all dust, dirt and other contaminants from all surfaces.
 - .2 Remove from surfaces grease, oil, dirt, dust, ridges and other soil and materials that would adversely affect the adhesion or appearance of finish coating.
 - .3 Hand tool clean SSPC-SP2 to remove any, dirt, rust, loose paint, etc.
 - .4 Use a rust inhibitor covering in all areas where rust is encountered prior to applying finish coat.
 - .5 Prepare and prime black iron piping (i.e. Sprinkler lines, mains, etc.) prior to finish coat of paint.

3.4 APPLICATION

- .1 Sand and dust between each coat to remove defects visible from distance up to 1500 mm.
- .2 Finish bottoms, edges, tops and cutouts of doors after fitting as specified for door surfaces.
- .3 Finish all surfaces exposed to view, requiring finish for preservation of material, or to facilitate maintenance.
- .4 Apply number of coats of specified paints to designated surfaces as indicated in Painting Formulae and manufacturer's recommendations.
- .5 Protect and cover machinery and equipment and adjacent surfaces during painting operations.
- .6 Take special care during paint application to ensure disconnects and unions remain properly operable once painting operations completed.

3.5 MECHANICAL, ELECTRICAL AND PROCESS EQUIPMENT

- .1 Paint inside of ductwork where visible with primer and one (1) coat of matte black paint.
- .2 Leave factory-finished electrical and process equipment in original finish except for touch-up as required, unless otherwise indicated under Division 40.
- .3 Paint exposed conduits, pipes, fittings, fasteners and hangers. Colour to match adjacent surfaces, except as noted otherwise. Paint pipe hangers to match piping.
- .4 Paint valves and miscellaneous devices to match adjacent piping. Where adjacent piping is not painted, paint valves to match adjacent machinery, as directed by the Consultant.
- .5 Paint both sides and edges of plywood backboards for electrical equipment before installation.
- .6 Do not paint over nameplates.

3.6 PAINTING FORMULAE

- .1 Formula 1: for exterior galvanized and zinc coated ferrous metals, including metal doors apply: 1 coat galvanized steel primer CAN/CGSB-1.213 (Speedhide Int/Ext Rust Inhibitive Steel Primer 6-212) 2 coats semi-gloss enamel CAN/CGSB-1.59 (PPG HPC Industrial Alkyd Gloss Enamel 4308H Series)
- .2 Formula 2: for interior galvanized and zinc coated metal apply:
1 coat galvanized steel primer to CAN/CGSB-1.213 (Speedhide Int/Ext Rust Inhibitive Steel Primer 6-212)

2 coats semi-gloss enamel to CAN/CGSB-1.57 (PPG HPC Industrial Alkyd Semi-Gloss 4336H Series)

- .3 Formula 3: for interior galvanized and zinc coated metal doors electrostatically apply:
 - 2 coats single component epoxy to CAN/CGSB-1.146,
 - 1 coat Amerlock 600 Epoxy primer, 2 to 4 mils DFT.
 - 1 coat PPG HPC High Build Epoxy 95-501 Series at 3 to 4 mils DFT.

- .4 Formula 4: for interior machinery and equipment (not coated by equipment manufacturer) apply:
 - 1 coat alkyd primer CAN/CGSB-1.81
 - (Multiprime Universal Alkyd Metal Primer 4360 Series)
 - 2 coats semi-gloss latex CAN/CGSB-1.195
 - (Pitt-Tech Plus EP DTM Acrylic Semi-Gloss 90-1610 Series)

- .5 Formula 5: for interior primed ferrous metals, apply:
 - 1 coat spot priming same type as originally used.
 - 2 coats semi-gloss enamel CAN/CGSB-1.57
 - (PPG HPC Industrial Alkyd Semi-Gloss 4336H Series)

- .6 Formula 6: for interior plywood (equipment backboards, ceiling etc.) apply:
 - 1 coat enamel undercoat CGSB-1.38
 - (Dulux Jammer Alkyd Primer Sealer 20000 or Seal Grip Alkyd Universal Primer Sealer 17-941NFC)
 - 2 coats semi-gloss enamel CAN/CGSB-1.57
 - (PPG HPC Industrial Alkyd Semi-Gloss 4336H Series)

- .7 Formula 7: for epoxy coating for interior floors:
 - two (2) coats of Aquapon water based epoxy at 2 to 3 mils DFT per coat (PPG 98-1 Series, Devoe Tru-Glaxe WB 4406).

- .8 Formula 8: for interior gypsum board apply:
 - 1 coat primer - sealer to CAN/CGSB 1.119

(Dulux Ultra Primer Sealer 976000 or Speedhide Sealer 6-2C)
 - 2 coats semi-gloss latex to CAN/CGSB 1.195m (Dulux Ultra Latex Semi-Gloss 948000 Series or Speedhide Latex Semi-Gloss 6-500C Series)

- .9 Formula 9: for interior concrete block walls, dry areas, apply:
 - 1 coat block filler CAN/CGSB-1.188

(Dulux X-Pert Blockfiller 36250 or Speedhide Block Filler 6-151XIC)
 - 2 coats semi-gloss enamel CAN/CGSB-1.57

(PPG HPC Industrial Alkyd Semi-Gloss 4336H Series)

3.7 COLOUR SCHEDULE

- .1 Colours are based on PPG Canada Inc. paint system. Other manufacturers must provide paint to match their colours as closely as possible.
- .2 System/equipment:
 - .1 Interior doors and trim: colour to be selected by the Consultant.
 - .2 Interior block walls: colour to be selected by the Consultant.
 - .3 Plywood backboards: colour to be selected by the Consultant.
 - .4 Exterior doors and trim: colour to be selected by the Consultant.
 - .5 Exterior exhaust/intake weatherhoods: paint colour to be selected by Consultant from the manufacturer's standard colour range to match exterior trim.
 - .6 Exterior exhaust/intake louvres: pre-finished, paint colour to be selected by Consultant from the manufacturer's standard colour range to match exterior trim.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Thermal Insulation for Piping: Section 23 07 19.

1.2 REFERENCES

- .1 ANSI/ASME B16.15-2024, Cast Copper Alloy Threaded Fittings, Classes 125 and 250.
- .2 ANSI/ASME B16.18-2021, Cast Copper Alloy Solder Joint Pressure Fittings.
- .3 ANSI/ASME B16.22-2021, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
- .4 ANSI/ASME B16.24-2021, Cast Copper Alloy Pipe Flanges, Flanged Fittings and Valves: Classes 150, 300, 600, 1500 and 2500.
- .5 AWWA C111/A21.11-2023, Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
- .6 ASTM A307-21, Specification Specification for Carbon Steel Bolts and Studs, and Threaded Rod 60000 PSI Tensile Strength.
- .7 ASTM B32-20, Standard Specification for Solder Metal.
- .8 ASTM66S B75/B75M-20, Standard Specification for Seamless Copper Tube.
- .9 ASTM B88M-22, Standard Specification for Seamless Copper Water Tube (Metric).
- .10 ASTM F492-95, Standard Specification for Propylene and Polypropylene (PP) Plastic-Lined Ferrous Metal Pipe and Fittings.
- .11 MSS SP-80-19, Bronze Gate, Globe, Angle and Check Valves.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Submit data for following: valves, trap primers.

1.4 MAINTENANCE DATA

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

PART 2 - PRODUCTS

2.1 PIPING

- .1 Domestic hot and cold systems within building:
 - .1 Above ground: copper tube, hard drawn, type L: to ASTM B88M.

- .2 Buried and embedded: copper tube, soft annealed, type L: to ASTM B88M, in long lengths and with no buried joints. "PEX", CSA approved potable water piping may be used under slab.

2.2 FITTINGS

- .1 Bronze pipe flanges and flanged fittings, Class 150 and 300: to ANSI B16.24.
- .2 Cast bronze threaded fittings, Class 125 and 250: to ANSI/ASME B16.15.
- .3 Cast copper, solder type: to ANSI B16.18. (Lead-free).
- .4 Wrought copper and copper alloy, solder type: to ANSI B16.22.
- .5 Piping NPS 2-1/2 and over: roll groove copper fittings to ASTM B75, alloy C12200. Victaulic "No-Sweat".

2.3 JOINTS

- .1 Rubber gaskets, 3 mm thick: to ANSI/AWWA C111/A21.11.
- .2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.
- .3 Solder/brazing: tin-antimony 95-5: to ASTM B32, or tin-silver 94-6. (Lead free.)
- .4 Teflon tape: for threaded joints.
- .5 Piping NPS 2-1/2 and over: roll groove couplings with ductile or malleable iron housings, grade E EPDM flush seal gaskets and heat treated carbon steel bolts/nuts to ASTM A183. Victaulic "No-Sweat".
- .6 Dielectric unions between dissimilar metals to ASTM F492, complete with thermoplastic liner.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with the 2015 Canadian Plumbing Code and the local authority having jurisdiction.
- .2 Cut square, ream and clean tubing and tube ends, clean recesses of fittings and assemble without binding.
- .3 Assemble all piping using fittings manufactured to ANSI standards.
- .4 Install tubing close to building structure to minimize furring, conserve headroom and space. Group exposed piping and run parallel to walls.
- .5 Connect to fixtures and equipment in accordance with manufacturers instructions unless otherwise indicated.
- .6 Buried tubing:

- .1 Lay in well compacted washed sand in accordance with AWWA Class B bedding.
- .2 Bend tubing without crimping or constriction. Minimize use of fittings.
- .7 Provide union nuts at all faucets. Do not directly solder faucets to supplies.
- .8 Test piping systems in accordance with Section 22 05 00.

3.2 DISINFECTION

- .1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction. After testing, provide acceptable water quality test report to the Consultant for approval.

3.3 PRE-START-UP INSPECTIONS

- .1 Systems to be complete, prior to flushing, testing and start-up.
- .2 Verify system can be completely drained.
- .3 Confirm air chambers, expansion compensators are installed properly.

3.4 START-UP

- .1 Timing: 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 procedures:
 - .1 Establish circulation and ensure that air is eliminated.
 - .2 Check pressurization to confirm proper operation and to prevent water hammer, flashing and/or cavitation.
 - .3 Bring HWS storage tank up to design temperature slowly.
 - .4 Monitor piping DHWS 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.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
- .2 Canadian Standards Association (CSA)
 - .1 CSA-B64 Series-21, Backflow Preventers and Vacuum Breakers.
- .3 Health Canada/Workplace Hazardous Materials Information Systems (WHMIS).
 - .1 Safety Data Sheets (SDS).

1.2 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet for fixtures and equipment.
 - .2 Indicate dimensions, construction details and materials for specified items.
 - .3 Submit WHMIS SDS in accordance with Section 01 33 00. Indicate VOC's for adhesive and solvents during application and curing.
- .3 Shop Drawings:
 - .1 Submit shop drawings to indicate materials, finishes, method of anchorage, number of anchors, dimensions, construction and assembly details and accessories.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .3 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00. Include:
 - .1 Description of plumbing specialties and accessories, giving manufacturer's name, type, model, year and capacity.
 - .2 Details of operation, servicing and maintenance.
 - .3 Recommended spare parts list.

1.3 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 00.

- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard packaging materials in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by the Consultant.
- .5 Fold up metal and plastic banding flatten and place in designated area for recycling.

PART 2 - PRODUCTS

2.1 BACK FLOW PREVENTERS

- .1 To CSA-B64 Series.
- .2 Application: domestic service entrance and fire protection system service entrance.
 - .1 Domestic water:
 - .1 Reduced pressure principle type consisting of a pressure differential relief valve located between two independently operated spring-loaded centre guided check valves.
 - .2 Ductile iron construction with FDA approved fusion epoxy coat inside and out.
 - .3 Compound check.
 - .4 Single access cover.
 - .5 Maximum temperature range: 0.5°C to 60°C.
 - .6 Maximum pressure: 1205 kPa.
 - .7 CSA certified.
 - .8 Acceptable Product: Watts 009LF, Wilkins, Zurn.

2.2 HOSE BIBBS AND SEDIMENT FAUCETS

- .1 Bronze construction complete with integral back flow preventer, hose thread spout, replaceable composition disc, chrome plated in finished areas, and caps on chains.

2.3 PIPE WALL AND FLOOR PENETRATION SEAL

- .1 Application:
 - .1 Pipes penetrating exterior concrete walls below grade and concrete floors on grade.
- .2 Seal material to be EPDM.
- .3 Pressure plates to be glass- reinforced plastic.
- .4 Bolts and nuts to be stainless steel 18-8.
- .5 Suitable temperature range to be -40°C to 121°C.

- .6 Wall sleeves to be Schedule 40 black iron pipe. Sleeves in exterior walls to be galvanized.
- .7 Floor sleeves to be Schedule 40 black iron pipe.
- .8 Wall and floor sleeves to be sufficiently long to mount flush with interior and exterior walls and flush with finished floor of slab-on-grade floors.
- .9 Acceptable Product: Metraseal MS Series, Link Seal.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Bring cleanouts to wall or finished floor unless serviceable from below floor.
- .2 Building drain cleanout and stack base cleanouts: line size to maximum NPS4.

3.2 BACK FLOW PREVENTORS

- .1 Install in accordance with CSA-B64 Series, where indicated and elsewhere as required by code.
- .2 Reduced pressure type where backflow would constitute a health hazard.
- .3 Pipe discharge to terminate over nearest drain and or service sink.

3.3 HOSE BIBBS AND SEDIMENT FAUCETS

- .1 Install at bottom of risers, at low points to drain systems, and as indicated.

3.4 TESTING AND ADJUSTING

- .1 Backflow preventers:
 - .1 Test tightness, accessibility for O&M of cover and of valve.
 - .2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.
 - .3 Verify visibility of discharge from open ports.
- .2 Hose bibbs, sediment faucets:
 - .1 Verify operation and at all low points.
- .3 Training:
 - .1 Demonstrate full compliance with Design Criteria.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 This section is to be read in conjunction with and covers items common to all sections of Division 23. It is intended to supplement the requirements of Division 01.
- .2 Specification sections referred to within this section are as follows:
 - .1 Metal Fabrications: Section 05 50 00
 - .2 Firestopping and Smoke Seals: Section 07 80 00
 - .3 Plumbing Specialties and Accessories: Section 22 42 01
 - .4 Duct Accessories: Section 23 33 00

1.2 GENERAL

- .1 Perform the Work included in these specifications and any accompanying drawings, by providing all supervision, labour, materials, supplies, construction tools, equipment and services, hoisting, transportation, receiving, handling, storage, and all other services and expenditures; unless otherwise specified in the scope. Including those not specifically mentioned but which are necessary for a complete installation.

1.3 REFERENCES

- .1 NEMA MG1-98(R2002), Motors and Generators.
- .2 CSA C390:22, Test Methods, Marking Requirements, and Energy Efficiency Levels for Three-Phase Induction Motors.
- .3 CAN/CGSB 1.181-99, Ready-Mix Organic Zinc-Rich Coatings.

1.4 EQUIPMENT

- .1 Equipment assemblies comprised of electro-mechanical components must be CSA approved and bear the appropriate label. If the equipment in question is not CSA approved as an assembly, have the manufacturer arrange and pay for Spot approval and labelling of the equipment prior to installation.

1.5 EQUIPMENT INSTALLATION

- .1 Provide unions and flanges to permit equipment maintenance and disassembly and to minimize disturbance to piping and duct systems without interfering with other equipment.
- .2 Provide means of access for servicing equipment including permanently lubricated lifetime bearings.
- .3 Pipe equipment drains to floor drains.
- .4 Install equipment, rectangular cleanouts and similar items parallel to or perpendicular to building lines.

1.6 ANCHOR BOLTS AND TEMPLATES

- .1 Supply anchor bolts and templates for installation by others.

1.7 TRIAL USAGE

- .1 The Owner may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

1.8 PROTECTION OF OPENINGS

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

1.9 ELECTRICAL

- .1 Electrical work and electrical equipment:
 - .1 Refer to mechanical drawings to determine mechanical/electrical wiring responsibilities.
 - .2 A number of rooms/areas as noted on the drawings are hazardous locations. Install all electrical devices in these areas in accordance with Section 18 of the Canadian Electrical Code for the specified classification. These areas contain hydrogen sulphide (North American Gas Group C, IEC Gas Group IIB) and methane (North American Gas Group D, IEC Gas Group IIA) gases. These areas are also a Category 2 location in accordance with Section 22 of the Canadian Electrical Code and complete with electrical installation as per the requirements of a Category 2 location.

1.10 EQUIPMENT SUPPORTS

- .1 Equipment supports supplied by equipment manufacturer: specified elsewhere in Division 23.
- .2 Equipment supports not supplied by equipment manufacturer: fabricate from structural grade steel meeting requirements of Section 05 50 00.
- .3 Mount base mounted equipment on "Type B1" chamfered edge housekeeping pads, minimum of 100mm high and minimum 100mm larger than equipment dimensions all around.

1.11 SLEEVES

- .1 Pipe sleeves:
 - .1 Through masonry, concrete or fire rated assemblies: nominal 0.912mm (20 ga.) galvanized steel.
 - .2 Through foundation walls: Schedule 40 steel pipe with annular in continuously welded at midpoint of wall.

- .3 Provide 25mm clearance all around service piping or ducting for building settlement/ movement.
- .2 Duct sleeves:
 - .1 Through masonry, concrete, or fire rated assemblies: in accordance with SMACNA Fire Damper Guide, Table 2-2, and as below.
- .3 Terminate pipe sleeves flush with surface of concrete and masonry walls, concrete floors on grade and 25mm above other floors.
- .4 Fill voids around pipes:
 - .1 Caulk between sleeve and pipe in foundation walls and below grade floors with waterproof, fire retardant, non-hardening mastic.
 - .2 Where sleeves pass through walls or floors, provide space for firestopping to maintain fire rating integrity.
 - .3 Where sleeves pass through interior walls not fire-rated, provide acoustic caulking.
 - .4 Allow for no contact between copper tube or pipe and ferrous sleeve.
 - .5 Fill future-use sleeves with lime plaster or other easily removable filler.
 - .6 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint to CAN/CGSB-1.181.

1.12 PREPARATION FOR FIRESTOPPING

- .1 Firestopping material and installation within annular space between pipes, ducts, insulation and adjacent fire separation: specified in Section 07 80 00.
- .2 Uninsulated unheated pipes not subject to movement: no special preparation.
- .3 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe to move without damaging firestopping material.
- .4 Insulated pipes and ducts: cut back insulation at fire separation to allow proper firestopping.
- .5 Firestopping material for piping and duct penetrations in Section 07 80 00.

1.13 ESCUTCHEONS

- .1 On pipes passing through walls, partitions, floors and ceilings in finished areas.
- .2 Chrome or nickel plated brass or Type 302 stainless steel, one piece type with set screws.
- .3 Outside diameter to cover opening or sleeve.

- .4 Inside diameter to fit around finished pipe.

1.14 TESTS

- .1 Give the Consultant 24 hour written notice of date for tests.
- .2 Insulate or conceal work only after testing and approval by the Consultant.
- .3 Conduct tests in presence of the Consultant.
- .4 Bear costs including retesting and making good.
- .5 Piping:
 - .1 General: maintain test pressure without loss for 2 hours unless otherwise specified.
 - .2 Hydraulically test hydronic piping systems at 1-1/2 times system operating pressure or minimum 862 kPa, whichever is greater.
- .6 Equipment: test as specified in relevant sections.
- .7 Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures or test medium.

1.15 PAINTING

- .1 Finish painting as specified in Section 09 91 23 except where specified elsewhere in the Mechanical Specifications.
- .2 Apply at least one (1) coat of corrosion resistant primer paint to ferrous supports and site fabricated work.
- .3 Prime and touch up marred finished paintwork to match original.
- .4 Restore to new condition, finishes which have been damaged too extensively to be merely primed and touched up.

1.16 DIELECTRIC COUPLINGS

- .1 General:
 - .1 Compatible with and to suit pressure and temperature rating of piping system.
 - .2 Where pipes of dissimilar metals are joined.
- .2 Pipes NPS 2 and under: isolating unions.
- .3 Pipes NPS 2-1/2 and over: isolating flanges.
- .4 Acceptable Material: EBCO, Walter Valiet Co.

1.17 DRAIN VALVES

- .1 Locate at low points and at section isolating valves unless otherwise specified.
- .2 Minimum NPS 3/4 unless otherwise specified: bronze, ball valve with hose end male thread, complete with cap and chain.

- .3 No water from any drain or relief valve to discharge on the floor.
Pipe drains to hub drains or funnel floor drains.

1.18 OPERATING AND MAINTENANCE INSTRUCTIONS

- .1 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .2 Provide demonstrations and instructions in conjunction with the appropriate equipment manufacturers representatives.
- .3 Use operation and maintenance manual, record drawings, audio visual aids, etc. as part of instruction materials.
- .4 Have instructions in maintenance and operating of the following equipment given by factory trained personnel and for the time period specified. The time specified does not include the time for start-up of systems and equipment:
 - .1 Give instruction on the operation and maintenance of all mechanical components including but not limited to: pumps, fans, air handling units, boilers and domestic hot water system. Instruction period to be for a period of not less than one (1) working day. Review with the instructors for an additional 1/2 working day, 90 days after the acceptance of the building by the Owner.
 - .2 Where more detailed instructions for some equipment or systems are called for in other sections of the specifications, those sections of the specifications shall take precedence over this section.

1.19 OPERATION AND MAINTENANCE MANUAL

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00.
- .2 Operation and maintenance manual to be approved by the Consultant and final copies deposited with the Consultant before final inspection.
- .3 Operation data to include:
 - .1 Control schematics for each system including environmental controls.
 - .2 Description of each system and its controls.
 - .3 Description of operation of each system 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.
- .4 Maintenance data to include:

- .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
- .2 Data to include schedules of tasks, frequency, tools required and task time.
- .5 Performance data to include:
 - .1 Equipment manufacturer's performance data sheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified elsewhere.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93.
- .6 Approvals:
 - .1 Submit one (1) draft pdf copy of Operation and Maintenance Manual to the Consultant for approval. Submission of individual data will not be accepted unless so directed by the Consultant.
 - .2 Make changes as required and re-submit as directed by the Consultant.
- .7 Additional data: Prepare and insert into operation and maintenance manual when need for same becomes apparent during demonstrations and instructions specified above.

1.20 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00.
- .2 Shop drawings and product data shall show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances. (e.g., access door swing spaces).
- .3 Shop drawings and product data shall be 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 as to current model production.
 - .5 Certification of compliance to applicable codes.

1.21 CLEANING

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork, fans and air handling systems.
- .2 In preparation for final acceptance, clean and refurbish all equipment and leave in operating condition.

1.22 DRAWINGS

- .1 The Consultant's mechanical drawings:
 - .1 Are not intended to show structural details or architectural features.
 - .2 Are not to be scaled.
 - .3 Except where dimensioned, indicate general mechanical layouts only. Because of the small scale of the Mechanical Drawings, it is not possible to show all offsets, fittings and accessories which may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves and accessories which are required to meet site conditions.
- .2 Provide field drawings to indicate relative position of various services when required by the Consultant.

1.23 RECORD DRAWINGS

- .1 Refer to Section 01 78 00.

1.24 WARRANTIES

- .1 Make good all defects other than normal wear and tear during the life of the warranty period. Warrant all work and installed equipment to work quietly and satisfactorily and to accomplish the work for which it was installed during the life of the warranty. At any time during this period, make any necessary changes and adjustments, or replacements, to accomplish this at no additional cost to the project.

1.25 PERMITS AND REGULATIONS

- .1 Comply with all regulations and authorities having jurisdiction where applicable, including but not limited to the following:
 - .1 Department of Labour.
 - .2 Fire Marshall.
 - .3 Plumbing Inspector.
 - .4 Provincial Board of Insurance Under-writers.
 - .5 National Building Code.
 - .6 Occupational Health & Safety Act.
 - .7 NFPA
- .2 Obtain and pay for any permits required by local codes and regulations and arrange for inspections applicable to the Contractor responsibilities.
- .3 Any additional materials or labour required to conform to any of these rules and regulations will be furnished under the Contract with no additional cost to the Owner.

1.26 RELATED WORK

.1 Caulking:

- .1** Perform caulking in compliance with the requirements of Section 07 92 00.

.2 Welding:

- .1** Have welding performed as specified in Division 23 for all mechanical piping and structural supports and hangers.
- .2** Have welding performed by certified welders in accordance with the Nova Scotia Provincial Labour Requirements and By-Laws.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Firestopping: Section 07 80 00

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with authorities having jurisdiction.
- .2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
- .3 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not applicable

PART 3 - EXECUTION

3.1 CONNECTIONS TO EQUIPMENT

- .1 In accordance with manufacturer's instructions unless otherwise indicated.
- .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 as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, components.

3.3 DRAINS

- .1 Install piping with grade in direction of flow except as indicated or specified otherwise.
- .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 to be visible.
- .4 Drain valves: NPS 3/4 bronze gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.4 AIR VENTS

- .1 Install air vents at high points in piping systems and where indicated.
- .2 Install isolating valve at each automatic air valve.
- .3 Install drain piping to approved location and terminate where discharge is visible.

3.5 DIELECTRIC COUPLINGS

- .1 General: Compatible with system, to suit pressure rating of system.
- .2 Locations: Where dissimilar metals are joined.
- .3 NPS 2 and under: isolating unions or bronze valves.
- .4 Over NPS 2: Isolating flanges.

3.6 PIPEWORK INSTALLATION

- .1 Screwed fittings to be jointed with Teflon tape.
- .2 Protect openings against entry of foreign material.
- .3 Install so that equipment can be isolated and removed without interruption to operation of any 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 the size of the main. Hole saw (or drill) and ream main so as 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 so as to minimize furring space, maximize headroom, conserve space.
- .8 Except where indicated otherwise, slope piping in direction of flow for positive drainage and venting.
- .9 Except where indicated, install so as 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.
- .12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .13 Provide for thermal expansion as indicated and specified.
- .14 Valves:
 - .1 Install in accessible locations.
 - .2 Remove interior parts before soldering.
 - .3 Install with stems above the horizontal position unless otherwise indicated.
 - .4 Valves to be accessible for maintenance without removing adjacent piping.
 - .5 Install globe valves in bypass around control valves.
 - .6 Use gate, ball or butterfly valves at branch take-offs for isolating purposes except where otherwise specified.
 - .7 Install butterfly valves between weld neck flanges to ensure full compression of liner.
 - .8 Install plug cocks or ball valves for glycol service.
 - .9 Use chain operators on valves NPS 2-1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.
- .15 Check Valves:
 - .1 Install silent check valves on discharge of pumps and in vertical pipes with downward flow and elsewhere as indicated.
 - .2 Install swing check valves in horizontal lines on discharge of pumps and elsewhere as indicated.

3.7 ESCUTCHEONS

- .1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.
- .2 Construction: One (1) 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.

3.8 PREPARATION FOR FIRESTOPPING

- .1 Material and installation within annular space between pipes, ducts, insulation, and adjacent fire separation to Section 07 80 00.
- .2 Uninsulated unheated pipes not subject to movement: No special preparation.
- .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 vapour barriers.

3.9 FLUSHING OUT OF PIPING SYSTEMS

- .1 Before start-up, clean interior of piping systems in accordance with relevant sections of Divisions 22 and 23.
- .2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

- .1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
- .2 CAN/CGSB-24.3-92, Identification of Piping Systems.

1.2 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00.
- .2 Submit samples and lists of proposed wording for approval before engraving.

PART 2 - PRODUCTS

2.1 MANUFACTURERS NAMEPLATES

- .1 Provide metal nameplate on each piece of equipment, mechanically fastened complete with raised or recessed letters and numbers.
- .2 Provide ULC and CSA registration plates as required by respective agency and inspection authority.
- .3 Indicate size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and HP of motors, year manufactured, RPM, SF, efficiency, etc.

2.2 SYSTEM NAMEPLATES

- .1 Colour:
 - .1 Hazardous: red letters, white background.
 - .2 Elsewhere: black letters, white background except where required otherwise by applicable codes.
- .2 Construction: 3mm thick, laminated plastic or white anodized aluminum, matte finish, square corners, letters accurately aligned and machine engraved into core. Etched in data on aluminum sheet is unacceptable.
- .3 Sizes:
 - .1 Conform to following table:

Size	Dimensions (mm. x mm.)	No. of Lines	Height (mm)
1	10 x 50	1	3
2	12 x 75	1	5
3	12 x 75	2	3
4	19 x 100	1	8
5	19 x 200	1	8
6	19 x 100	2	5

7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	19

- .1 Use average of 25 letters/numbers per nameplate.
- .2 Use size #6 for terminal cabinets and control panels.
- .3 Use size #9 for equipment in mechanical rooms.
- .4 Use size #2 for control components and sensors.

2.3 PIPING

- .1 General:
 - .1 To CAN/CGSB-24.3.
 - .2 Identify medium by lettered legend, classification by primary and secondary colours, direction of flow by arrows.
- .2 Sizes:
 - .1 Legend: block capitals to following table:

Outside Dia. of Pipe or Insulation	Size of Letters
up to NPS 1-1/4	12mm
NPS 1-1/2 to 2	19mm
 - .2 Primary colour bands:
 - .1 At valves and fittings: 200mm long.
 - .2 Elsewhere: 100mm long.
 - .3 Secondary colour bands: 50mm wide, 75mm in from one end of primary colour band.
 - .4 Arrows:
 - .1 Outside diameter of pipe/insulation 38mm and greater: 150mm long x 38mm high.
 - .2 Outside diameter of pipe/insulation less than 38mm: 100mm long x 50mm high.
 - .3 Use double headed arrows where flow is reversible.
- .3 Material:
 - .1 Paint: to CAN/CGSB-1.60.
 - .2 Legend markers, arrow colour bands: plastic coated cloth material with protective overcoating and waterproof contact adhesive undercoating, suitable for 100% RH and continuous operating temperature of 148.8°C and intermittent temperature of 204.4°C. Apply to clean, prepared surfaces. Wrap tape around pipe or pipe covering with ends overlapping one (1) pipe diameter.
 - .3 Waterproof and heat resistant plastic marker tags: for pipes and tubing NPS and smaller.
 - .4 Acceptable Material: W.H. Brady Inc., Seton Name Plate Corp., Setmark Pipe Markers, S.M.S. Construction Specialties.

- .4 Colours: Where not covered by table below, submit legend, primary and secondary classification colours to Consultant for approval.
- .5 Table: Pipe and valve identification. Use existing facility identification system and provide new as required.

Pipe Marker Legend	Valve Tag Legend	Primary Colour	Secondary Colour
Domestic cold water	D.C.W.	Green	None
Domestic hot water	D.H.W.	Green	None
Storm sewer	S.S.	Green	None
Sanitary sewer	SAN.S.	Green	None
Vent (Plumbing)	V.P.	Green	None
Refrigerant Gas	R.G.		

- .1 Legend and arrows: Black or white to contrast with primary colour.

2.4 DUCTWORK

- .1 50mm high black stencilled letters indicating fan/system I.D. and directional flow arrows 150mm long x 50mm high. Mark "Odour" on odour collection duct work.

2.5 VALVES AND CONTROLLERS

- .1 Circular white plastic tags with 12mm high engraved black lettering.

2.6 CONTROLS IDENTIFICATION

- .1 Identify all control systems, equipment, components, and sensors.
- .2 Inscription to identify function and, where applicable, fail-safe position.

PART 3 - EXECUTION

3.1 GENERAL

- .1 Do identification work in accordance with CAN/CGSB-24.3.
- .2 Provide ULC and CSA registration plates, as required by respective agency.
- .3 Provide identification only after all painting has been completed.

3.2 LOCATION OF NAMEPLATES

- .1 In conspicuous location to facilitate easy reading from operating floor and to properly identify equipment and/or system.

- .2 Provide stand-offs for nameplates on hot surfaces and insulated surfaces.
- .3 Do not insulate or paint over plates.

3.3 PIPING

- .1 Locations:
 - .1 On long straight runs in open areas, in mechanical and ventilation equipment rooms, and in areas with no ceilings so that at least one is clearly visible from any one viewpoint in operating areas or walking aisles and not at more than 9m intervals.
 - .2 Adjacent to all changes in direction.
 - .3 At least once in each small room through which piping passes.
 - .4 On both sides of visual obstruction or where run is difficult to follow.
 - .5 On both sides of any separation such as walls, floors and partitions.
 - .6 Where piping is concealed in pipe chase, ceiling space, or other confined space, at entry and leaving points and adjacent to each access opening. In ceiling space, piping systems shall be identified every 9m (maximum) and as specified herein.
 - .7 At beginning and end points of each run and at each piece of equipment in run.
 - .8 At point immediately upstream of major manually operated or automatically controlled valves. Where this is not possible, place identification as close to valve as possible, preferably on upstream side.
 - .9 Legend to be easily and accurately readable from usual operating areas and all readily accessible points.
 - .10 Plane of legend to be approximately at right angles to most convenient line of sight with consideration of operating positions, lighting conditions, reduced visibility of colour or legends caused by dust and dirt and risk of physical damage.

3.4 DUCTWORK

- .1 Stencil over final finish only.
- .2 Locations of ductwork identification:
 - .1 On long straight runs in open areas in mechanical and ventilation equipment rooms and in areas with no ceilings so that at least one is clearly visible from any one viewpoint in operating areas or walking aisles and not at more than 9m intervals.
 - .2 Adjacent to all changes in direction.
 - .3 At least once in each small room through which ductwork passes.

- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of any separation such as walls, floors and partitions.
- .6 Where ductwork is concealed in duct chase, ceiling space or other confined space, at entry and leaving points and adjacent to each access opening, maximum 9m apart.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled dampers. Where this is not possible, place identification as close to damper as possible, preferably on upstream side.
- .9 Legend to be easily and accurately readable from usual operating areas and all readily accessible points.
- .10 Plane of legend to be approximately at right angles to most convenient line of sight with consideration of operating positions, lighting conditions, reduced visibility of colour or legends caused by dust and dirt and risk of physical damage.
- .11 Beside each access door.

3.5 VALVES AND CONTROLLERS

- .1 Secure tags with non-ferrous chains or closed "S" hooks for valves and operating controllers except at plumbing fixtures and radiation.
- .2 Provide circular 12mm dia. colour coded self-adhesive valve identification tabs on the underside of suspended ceiling systems, attached to the suspension grid, located at all heating, domestic water, and bearing the same colours as scheduled in 2.3.5. Where two (2) colours are shown use a second inner 6mm dia. tab centred on the primary 12mm tab.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL

- .1 Procure the services of a balancing and certifying agent, hereinafter referred to as "the Agency", to balance and certify all air handling systems including exhaust systems at no additional cost to the Contract.
 - .1 Acceptable Recognized Agents: Associated Air Balance Council (AABC) agents, National Environmental Balancing Bureau (NEBB) member agents.
 - .2 Relevant, demonstrated, minimum 5-year experience with similar projects may be substituted for the above standard of acceptance, provided that the proposed Agency makes such a request, enclosing appropriate references, during the Tender Period.
 - .3 Acceptable Firms: Scotia Air Balancing; Source Management Limited; Scan Air Balance; Controlled Air Management.
- .2 The Agency will be responsible to the Contractor but report jointly to the Construction Manager and the Contractor. Report in writing to the Construction Manager discrepancies or items not installed in accordance with the Contract Documents.
- .3 Balance and test all systems in accordance with the latest and most stringent measures stipulated in either Associated Air Balance Council (AABC), "National Standards for Total System Balance"; National Environment Balancing Bureau (NEBB) "Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems"; and ANSI/ASHRAE 111 "Standard Practices for Measurement, Testing, Ventilation, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems". Final balancing and certifying reports to include details of actual test procedures used and subsequent results.
- .4 Submit three (3) copies of the Balancing and Certifying report upon completion of the work.

1.2 CONTRACTOR'S RESPONSIBILITY

- .1 Provide the Agency within three (3) weeks of tender close, with one (1) set of Contract Documents, and as issued change orders.
 - .1 Provide shop drawings within 30 days of their approval in accordance with Section 01 33 00.
- .2 Cooperate with the Agency in the following manner:
 - .1 Provide immediate labour and tools to make corrections when required without undue delay. Install balancing flow and temperature sensing and regulating devices and equipment as well as balancing dampers as required by the Agency and approved by the Consultant.

- .2 Operate air systems and equipment as and when required by the Agency or the Consultant.
- .3 Before balancing commences, the following Work must be complete:
 - .1 All equipment operable in safe and normal operation.
 - .2 Environmental control systems complete and operable.
 - .3 Proper thermal overload protection in place for electrical equipment.
 - .4 Air systems:
 - .1 Filters clean and in place.
 - .2 Duct systems clean of debris.
 - .3 Correct fan rotation verified.
 - .4 Fire and volume dampers in place and open.
 - .5 Coil fins cleaned and combed.
 - .6 Access doors closed and duct end caps in place.
 - .7 All outlets installed and connected.
 - .8 Duct system leakage test complete.

1.3 AGENCY'S RESPONSIBILITY

- .1 Within five (5) weeks of tender award the Agency will perform a pre-construction Contract Drawing and specification review and provide:
 - .1 A written report on deficiencies in the Contract Documents.
 - .2 Recommend where additional balancing devices should be installed.
 - .3 Detail those balance and inspection procedures stipulated in the AABC National Balancing Standards, the NEBB Procedural Standards for Balancing, or ANSI/ASHRAE Standard Practices for Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems which cannot be followed and applied to this project.
- .2 The Agency will perform a complete review and inspection of the mechanical work during construction. These inspections will occur at regular intervals to provide for a minimum of three (3) inspections. After each inspection the Agency will meet the Consultant and provide a written report to recommend corrective action.
- .3 Leave all system components in proper working order and with correct settings.
 - .1 Replace belt guards.
 - .2 Close access doors.
 - .3 Close doors to electrical switch boxes.
- .4 All recorded data must represent a true, actually measured, or observed condition. Report any observed abnormal conditions in the mechanical systems or conditions, which prevent Total System Balance, immediately to the Consultant.

- .5 Permanently mark settings of all valves, dampers and other adjustment devices to allow the setting to be restored. Set and lock all memory stop balancing devices.
- .6 Prior to starting testing and balancing submit to the Consultant the following:
 - .1 A list of instruments to be used for testing and balancing.
 - .2 Calibration date for instrument and the serial number for calibration.
 - .3 Report in writing the sequence in which areas and equipment will be tested and balanced.

1.4 AIR SYSTEMS

- .1 The Agency to include the following for air systems:
 - .1 Installation data, manufacturer and model, size, arrangement discharge and class of fans, motor type, horsepower, voltage, phase, cycles, and full load amps. Location and local identification data.
 - .2 Design data, total volume, flow rate, static pressure, motor horsepower, r/min and amps, outside air flow rate, air fan r/min, fan power.
 - .3 Recorded data, air flow rates, static pressure, fan r/min, motor operating amps, motor power.
 - .4 System schematics:
 - .1 Complete systems schematic with required and actual flow rates at each outlet or inlet. Show room numbers and floors.
 - .2 Duct air quantities: for mains, branches and maximum and minimum for outside air and exhaust; duct size, pressure reading, sum of velocity measurements, average velocity, duct recorded flow rates, duct design flow rates.
 - .3 Air inlets and outlets, supply or exhaust outlet identification. Location number designation.
 - .5 Manufacturer's catalogue identification and type, application factors, designated area, design and recorded velocities, design and recorded air flow rates, deflector vane or diffusion cone settings.
 - .6 Permissible deviation from design air quantities will be as follows:
 - .1 Fans: +5% to +10%.
 - .2 Diffusers and supply grilles: 0% to +10%.
 - .3 Return and exhaust grilles: 0% to - 10%.
 - .7 After submission of report, perform random check of 30% of air inlets and outlets in the presence of and as directed by the

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TESTING, ADJUSTING AND
BALANCING (TAB) OF
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Consultant.

PART 2 - PRODUCTS

2.1 NOT APPLICABLE.

PART 3 - EXECUTION

3.1 NOT APPLICABLE.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

- .1 ASTM C411-19, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
- .2 ULC/CAN S102-18(R2019), Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .3 ULC S110-2013, Standard Method of Test for Air Ducts.
- .4 ANSI/NFPA 90A-24, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .5 ANSI/NFPA 90B-24, Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
- .6 ASTM C553-24, Standard Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.
- .7 CAN/CGSB 51-GP-52MA-89, Vapour Barrier Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Submit for approval manufacturer's catalogue literature related to installation.

1.3 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services and equipment in hung ceilings and non-accessible chases and furred spaces.
 - .2 "EXPOSED" - will mean "not concealed" as defined herein.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 All components of insulation system to have maximum flame spread rating of 25 and maximum smoke developed rating of 50 in accordance with CAN/ULC-S102.
- .2 Materials to be tested in accordance with ASTM C411.

2.2 MINERAL FIBRE BLANKET WITH VAPOUR BARRIER

- .1 Application: on either cold or variable temperature, round, rectangular (width less than 750 mm) or oval ducting.
 - .1 Minimum 3 m from roof or exterior walls connected to exhaust fans.

- .2 Outside air intakes, 50 mm entire length including outside air intake plenums.
- .2 Material:
 - .1 To ASTM C553, rigid mineral fiber blanket, min. density of 0.86 watt/meter.^{°k}; CGSB 51-GP-52M for vapour barrier, flexible foil faced (in concealed areas).
 - .2 Acceptable material: Knauf Duct Wrap FSK; Owens Corning FRK faced flexible duct insulation; Manville Microlite; Manson Alley Wrap FSK.

2.3 MINERAL FIBRE RIGID WITH VAPOUR BARRIER

- .1 Application: on either cold or variable temperature rectangular duct greater than 750 mm in width.
 - .1 Minimum 3 m from roof or exterior walls connected to exhaust fans.
 - .2 Outside air intakes, 50 mm entire length including outside air intake plenums. Thickness; 50 mm.
- .2 Material: CAN/ULC-S110M, rigid mineral fiberboard; vapour barrier, jacket and facing material.
- .3 Fresh air intakes and exhaust plenums to have 50 mm thick insulation.

2.4 FASTENINGS

- .1 Tape: self-adhesive, 100 mm wide, aluminum, ULC labelled for less than 25 flame spread and less than 50 smoke developed.
 - .1 Acceptable material: S. Fattal Insultape; Tuck; Compac.
- .2 Contact adhesive: quick setting.
 - .1 Acceptable material: Armstrong 520; Childers CP.82; Foster 85-20; Bakor 230-39, asbestos free.
- .3 Lap seal adhesive: quick setting for joints and lap sealing of vapour barriers.
 - .1 Acceptable material: Childers CP.80; Foster 85-75; Bakor 230-06, asbestos free.
- .4 Pins:
 - .1 Weld pins 4 mm diameter, with 32 mm diameter head for installation through the insulation. Length to suit thickness of insulation.
 - .2 Acceptable material: Duro Dyne, Clip-Pin.
 - .3 Weld pins 2 mm diameter, for installation prior to applying insulation. Length to suit thickness of insulation. Nylon retain clips 32 mm square.

- .4 Acceptable material: Duro Dyne spotter pins with spotter clips or stop clips as required.

2.5 JACKETS

- .1 Apply canvas jackets complete with lagging adhesive on all exposed ductwork, ULC listed plain weave, cotton fabric, 227 grams, as follows:
 - .1 Ducting that has air moving at less than 16°C to be complete with vapour barrier.
 - .2 Factory applied foil-scrim-kraft facing consisting of aluminum foil reinforced with fibreglass yarn mesh and laminated to chemically treated fire resistant kraft is acceptable for duct insulation in concealed spaces.
 - .3 Acceptable materials: Alpha-Maritex 3451-RW, Clairmont Diplag 60, S. Fattal Thermocanvas.
- .2 Acceptable material: Bakor Foilskin or approved equivalent.

PART 3 - EXECUTION

3.1 APPLICATION

- .1 Apply insulation after required tests have been completed and approved. Insulation and surfaces must be clean and dry when installed and during application of any finish. Apply insulation materials, accessories and finishes to manufacturer's recommendations and as specified.
- .2 Vapour barriers and insulation to be unbroken over full length of duct or surface, without penetration for standing duct seams and without interruption at sleeves and supports.
- .3 Use stand-offs for all duct mounted control accessories.
- .4 Apply 50 mm wide x 0.912mm (20 ga.) thick galvanized sheet metal corner reinforcement to all rectangular ductwork which is to have a canvas jacket.

3.2 INSTALLATION

- .1 General:
 - .1 Install in accordance with ANSI/NFPA 90A and ANSI/NFPA 90B.
 - .2 Adhere and seal vapour barrier using vapour seal adhesives.
 - .3 Stagger longitudinal and horizontal joints, on multi-layered insulation.
 - .4 Fill voids or openings between insulation and duct sleeve voids.
- .2 Mechanical fastenings:

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- .1 On rectangular ducts, use 50% coverage of insulating cement and weld pins at not more than 200 mm centres, but not less than two (2) rows per side and bottom.
 - .3 Insulation types and thicknesses: conform to the following table:
 - .1 Rectangular duct shall be complete with type C1 insulation (rigid board).
- | | TIAC Code | Vapour Retarder | Thickness (mm) |
|-----------------------|-----------|-----------------|----------------|
| Round air ducts | C2 | Yes | 38 |
| Rectangular air ducts | C1 | Yes | 38 |
| Exterior ductwork | C1 | Yes | 75 |
- .4 Supports, hangers in accordance with Sections 23 05 29 and 23 31 14.
 - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Plumbing General Requirements: Section 22 05 00

1.2 REFERENCES

- .1 ASTM C411-19, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
- .2 ULC/CAN S102.2-2019, Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies.
- .3 ASTM C547-22a, Standard Specification for Mineral Fibre Pipe Insulation.
- .4 CGSB 51-GP-52MA-89, Vapour Barrier Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .5 ASTM C335/C335M-23, Standard Test Method for Steady-State Heat Transfer Properties of Pipe Insulation.
- .6 ASTM C449-07(R2019), Standard Specification for Mineral Fibre Hydraulic Setting Thermal Insulating and Finishing Cement.
- .7 NFPA 90A-2021, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .8 NFPA 90B-2021, Standard for the Installation of Warm Air Heating and Air Conditioning Systems.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for pipe, fittings, valves and jointing recommendations.

1.4 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services and equipment in hung ceilings and non-accessible chases and furred spaces.
 - .2 "EXPOSED" - will mean "not concealed" as defined herein.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 All components of insulation system to have maximum flame spread rating of 25 and maximum smoke developed rating of 50 in accordance with CAN/ULC-S102.2.

- .2 Test materials in accordance with ASTM C411.

2.2 P-1 FORMED MINERAL FIBER TO 204°C

- .1 Application: for the following piping, valves and fittings:
- .1 Non-potable hot water, temperature 60°C.
- .2 Materials:
- .1 To ASTM C547, jacketed rigid mineral fiber sleeving for piping.
- .2 Acceptable Materials: Owens Corning SSL-II; Knauf ASJ; Manson Alley-K-APT; Manville Micro-Lok-AP-T; Fattal Fat-lock ASJ.
- .3 Thermal Conductivity "k" must not exceed 0.035 watt/meter °k at 24°C mean temperature when tested in accordance with ASTM C335. Thickness:

	Nominal Pipe Sizes (NPS)			
	Thickness			
System	25mm & under	32mm to 50mm	62mm to 100mm	125mm & over
D.H.W.	25mm	38mm	38mm	N/A

2.3 P-2 FLEXIBLE UNICELLULAR TUBULAR ELASTOMER

- .1 Application: for piping, valves and fittings on refrigerant piping.
- .2 Acceptable product: Armaflex.

	Nominal Pipe Sizes (NPS)	
	Thickness	
System	25mm & under	32mm to 50mm
Refrigerant Piping	38mm	38mm

2.4 P-3 FORMED MINERAL FIBER C/W VAPOUR BARRIER TO 85°C

- .1 Application: for piping, valves and fittings on:
- .1 Non-potable water (NPW).
- .2 Rainwater/storm piping above slab.
- .3 Condensate drain piping.
- .4 Domestic Cold Water (DCW).
- .2 Material:
- .1 To ASTM C547, rigid mineral fiber sleeving for piping and CGSB 51-GP-52Ma, vapour barrier jacket and facing material.
- .2 Acceptable products: Owens Corning SSL-II; Knauf ASJ; Manson Alley-K-APT; Manville Micro Lok-AP-T; Fattal Fat-lock ASJ.
- .3 Thermal Conductivity "k" must not exceed 0.035 watt/meter °k at 24°C mean temperature when tested in accordance with ASTM C335. Thickness:

	Nominal Pipe Sizes (NPS)			
	Thickness			
System	25mm & under	32mm to 50mm	62mm to 100mm	125mm & over

D.C.W	25mm	38mm	38mm	50mm
D.P.W.	25mm	38mm	38mm	50mm
Rainwater/storm piping	25mm	38mm	38mm	50mm
Condensate drain	25mm	38mm	38mm	50mm
H.P.S.W.	25mm	38mm	38mm	50mm

2.5 P-4 FLEXIBLE MINERAL FIBER C/W VAPOUR BARRIER TO -16°C

- .1 Application on:
 - .1 Underside of roof drain bodies.
- .2 Materials:
 - .1 To ASTM C553, mineral fiber blanket for
 - .1 Acceptable products: Knauf Duct Wrap FSK; Owens Corning faced flexible duct insulation; Manville Microlite; Manson Alley Wrap FSK.
- .3 Thickness: all sizes, 38mm.

2.6 FASTENINGS

- .1 For insulation systems P-1, P-2, P-3, P-4:
 - .1 Tape: self-adhesive, 100mm wide, ULC labelled for less than 25 flame spread and less than 50 smoke developed.
 - .2 Acceptable products: Compact; S. Fattal Insultape; TUCK.
- .2 Lap seal adhesive: quick-setting for joints and lap sealing of vapour barriers.
 - .1 Acceptable products: Childers CP.82; Foster 85-75; Bakor 230-06, asbestos-free.
- .3 Lagging adhesive: fire retardant coating.
 - .1 Acceptable products: Childers CP.50A-HV2; Foster 30-36; Bakor 120-09, asbestos-free.
- .4 For underside of roof drain bodies.
 - .1 Contact adhesive: quick-setting for seams and joints.
 - .1 Acceptable products: Armstrong 520 adhesive; Childers CP.82; Foster 85-20; Bakor 230-39, asbestos-free.

2.7 INSULATION CEMENT

- .1 To ASTM C449.
- .2 For installation at piping elbows and at ends of insulation (eg. around 2-way or 3-way control valves).

2.8 JACKETS

- .1 Interior piping:
 - .1 Stainless steel:

- .1 Type: 304 or type 316 where additional corrosion protection is required (Process areas).
 - .2 Thickness: 0.25mm.
 - .3 Finish: Smooth corrugated.
 - .4 Joining: longitudinal and circumferential slip joints with 50mm laps.
 - .5 Fittings: 0.5mm thick die shaped fitting covers with factory attached protective liner.
 - .6 Metal jacket banding and mechanical seals: stainless steel, 19mm wide, 0.5mm thick at 300mm spacing.
 - .7 Application: Jackets for insulated piping in process areas.
- .2 PVC Jacketing:
- .1 Commercial PVC jacketing, pre-curved, 0.5mm thickness complete with self-sealing lap tape on the longitudinal seam.
 - .2 Flame spread of 25 or less, smoke spread of 50 or less.
 - .3 Install as per the manufacturer's written instructions.
 - .4 Application: Jacket for insulated piping in all areas except process areas.

PART 3 - EXECUTION

3.1 APPLICATION

- .1 Apply insulation after required tests have been completed and approved. Clean and dry insulation and surfaces before installation and during application of any finish. Apply insulation materials, accessories and finishes in accordance with manufacturer's recommendations and as specified herein.
- .2 Insulation on roof drain bodies held in place with 100% coverage of adhesive.
- .3 On piping with insulation and vapour barrier or jacket, install high density insulation under hanger shield. Maintain integrity of vapour barrier or jacket over full length of pipe without interruption at fittings and supports.
- .4 Use piping saddles and shields. Clevis hangers must not penetrate the insulation. Use oversized clevis hangers.

3.2 INSTALLATION

- .1 Install in accordance with ANSI/NFPA 90A and ANSI/NFPA 90B.
- .2 Multi-layered: staggered butt joint construction.
- .3 Vertical pipe over NPS 3: insulation supports welded or bolted to pipe directly above lowest pipe fitting. Thereafter, locate on 4.5m centres.

- .4 Seal and finish exposed ends and other terminations with insulating cement.
- .5 Expansion joints in piping: provide for adequate movement of expansion joint without damage to insulation or finishes.
- .6 Flanges and unions at equipment, expansion joints, valves, other components requiring regular maintenance: install insulation and finish to permit easy disassembly and replacement without damage to adjacent insulation and finishes.
- .7 Insulation is not required for:
 - .1 Chrome plated piping, valves and fittings.

3.3 FASTENINGS

- .1 Secure pipe insulation by tape at each end and centre of each section, but not greater than 1m on centres.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.22-2021, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
 - .2 ASME B16.24-2021, Cast Copper Alloy Pipe Flanges and Flanged Fittings, and Valves Classes 150, 300, 600, 900, 1500 and 2500.
 - .3 ASME B16.26-2018, Cast Copper Alloy Fittings for Flared Copper Tubes.
 - .4 ASME B31.5-2022, Refrigeration Piping and Heat Transfer Components.
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM A307-21, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
 - .2 ASTM B280-23, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- .3 Canadian Standards Association (CSA)
 - .1 CSA B52-23, Mechanical Refrigeration Code.

PART 2 - PRODUCTS

2.1 TUBING

- .1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.
 - .1 Hard copper: to ASTM B280, type ACR B.
 - .2 Annealed copper: to ASTM B280, with minimum wall thickness as per CSA B52 and ASME B31.5.

2.2 FITTINGS

- .1 Service: design pressure 2068 kPa and temperature 121°C.
- .2 Brazed:
 - .1 Fittings: wrought copper to ASME B16.22.
 - .2 Joints: silver solder, 45% Ag-15% Cu 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 A 307, heavy series.

.4 Flared:

- .1 Bronze or brass, for refrigeration, to ASME B16.26.

2.3 PIPE SLEEVES

- .1 Hard copper or steel, sized to provide 6 mm clearance around between sleeve and uninsulated pipe or between sleeve and insulation.

2.4 VALVES

- .1 22mm and under: Class 500, 3495 kPa, 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 22mm: Class 375, 2502 kPa, 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.

PART 3 - EXECUTION

3.1 GENERAL

- .1 Work to be performed by licensed (certified) refrigeration personnel.
- .2 Install in accordance with CSA B52, and ASME B31.5.

3.2 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.

3.3 PIPING INSTALLATION

- .1 General:
 - .1 Soft annealed copper tubing: bend without crimping or constriction Hard drawn copper tubing: do not bend. Minimize use of fittings.
- .2 Suction lines:
 - .1 Pitch at least 12 mm per 3 m away from the evaporator.
 - .2 Provide trap at base of risers.
 - .3 Provide double risers for compressors having capacity modulation.
 - .1 Large riser: install traps as specified above.
 - .2 Small riser: size for 5m/s fpm at minimum load. Connect upstream of traps on large riser.

3.4 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 1999 kPa and 1000 kPa on high and low sides respectively.
- .3 Test Procedure: Build pressure up to 34 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.

3.5 DEHYDRATION AND CHARGING

- .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 5Pa 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 96 kPa vacuum and hold for 4 h.
 - .2 Break vacuum with refrigerant to 14 kPa.
 - .3 Final to absolute and hold for at least 12 h.
 - .4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
 - .5 Submit test results to the Consultant.
- .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 the Consultant.

3.6 INSTRUCTIONS

- .1 Post instructions in frame with glass cover in accordance with CSA B52.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Firestopping and Smoke Seals: Section 07 80 00

1.2 REFERENCES

- .1 SMACNA 1966-2020, HVAC Duct Construction Standards, Metal and Flexible, 1995.
- .2 SMACNA 1958-2021, HVAC Systems Duct Design, 1990.
- .3 ASHRAE Handbook.
- .4 ASTM A653/A653M-23, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00.
- .2 Indicate following:
 - .1 Sealants
 - .2 Tape
 - .3 Proprietary Joints

1.4 CERTIFICATION OF RATINGS

- .1 Catalogue or published ratings must be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

PART 2 - PRODUCTS

2.1 SEAL CLASSIFICATION

- .1 Classification as follows:

Maximum Pressure (Pa)	SMACNA Seal Class	Location of duct
250	B	Main risers and headers
125	C	Branch run-outs

- .2 Seal classification:
 - .1 Class B: longitudinal seams, transverse joints and connections made airtight with sealant, tape, or combination thereof.
 - .2 Class C: transverse joints and connections made air tight with sealant, tape, or combination thereof. Longitudinal seams unsealed.

2.2 SEALANT

- .1 Sealant: oil resistant, polymer type non-toxic flame resistant duct sealant. Temperature range of -30°C to 93°C.
- .1 Acceptable Material: Duro Dyne S-2; Foster 30-32; Bakor 530-09.

2.3 TAPE

- .1 Tape: polyvinyl treated, open weave fiberglass tape, 50mm.
- .1 Acceptable Material: Duro Dyne FT-2.

2.4 DUCT LEAKAGE

- .1 In accordance with SMACNA HVAC Duct Leakage Test Manual.

2.5 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows: R/D = 1.5 at fan discharge, R/D = 1.0 elsewhere.
- .3 Square mitred elbows: with single thickness vanes.
- .4 Main supply duct branches without splitter damper. Provide branch duct balancing dampers.
- .5 Sub branch duct with 45° boot connection and branch duct balancing damper.
- .6 Transitions:
 - .1 Diverging: 45° maximum included angle.
 - .2 Converging: 60° maximum included angle.
- .7 Offsets: short radiused elbows as indicated.
- .8 Obstruction deflectors: maintain full cross-sectional area. Maximum included angles as for transitions.

2.6 FIRESTOPPING

- .1 Retaining angles all around duct sleeve, on both sides of fire separation. Refer also to Section 07 80 00.
- .2 Firestopping material and installation must not distort duct.
- .3 Breakaway duct joints at fire damper locations.

2.7 GALVANIZED STEEL

- .1 Duct work to be galvanized steel.
- .2 Lock forming quality: to ASTM A653, Z90 zinc coating.
- .3 Thickness: to SMACNA HVAC duct construction standard.
- .4 Fabrication: to SMACNA HVAC duct construction standard.

- .5 Joints: to SMACNA or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint shall be considered to be a class A seal.
 - .1 Acceptable Manufacturers: Ductmate Canada Ltd.; Exanno Nexus, for proprietary joints.

2.8 HANGERS AND SUPPORTS

- .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hanger: 500mm wide.
- .2 Hanger configuration: to SMACNA, galvanized steel angle with black galvanized steel rods to SMACNA HVAC Duct Construction Standard, Section 4.
- .3 Upper hanger attachments:
 - .1 For steel joist: manufactured joist clamp or steel plate washer.
 - .1 Acceptable Material: Grinnell fig. 86 for joist clamps, Grinnell fig. 60 for plate washer.
 - .2 For steel beams: manufactured beam clamps:
 - .1 Acceptable Material: Grinnell fig. 93 and 89X clip.

2.9 SHEET METAL PLENUMS

- .1 Nominal 1.214 (18 ga.) galvanized steel sheet re-squared and formed into 600mm wide panels with 50mm deep standing seams in accordance with SMACNA HVAC equipment and casings standard.
- .2 Where indicated, plenum to be constructed of 1.214 (18 ga.) 316 stainless steel sheet required and formed into 600 mm wide panels with seams continuously welded.
- .3 Formed channel sections top and bottom of vertical sections and at all wall and floor intersections.
- .4 Galvanized 50mm x 50mm x 3mm thick angle frames around all duct and access door openings.

PART 3 - EXECUTION

3.1 GENERAL

- .1 Do work in accordance with SMACNA HVAC Duct Construction Standards.
- .2 Support risers in accordance with SMACNA.
- .3 Install breakaway joints in ductwork on each side of fire separation.
- .4 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

- .5 Provide access doors every 7.5m for future maintenance, inspection and cleaning. Not applicable to individual branch ducts serving grilles, registers and diffusers.

3.2 HANGERS

- .1 Strap hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Hanger spacing: in accordance with SMACNA HVAC duct construction standards.

3.3 WATERTIGHT DUCT

- .1 Provide watertight duct for:
 - .1 Fresh air intakes.
 - .2 Plenums.
- .2 Form bottom of horizontal duct without longitudinal seams. Seal joints of bottom and side sheets. Seal all with duct sealer.

3.4 SHEET METAL PLENUMS

- .1 Add sealant during closure of standing seams and channel sections and fasten with bolts or blind rivets at 30mm on centre.
- .2 Secure angle frames to wall or floor at 600mm on centre and caulk air-tight. Provide 6mm thick neoprene pads to avoid dissimilar metal contact.
- .3 Provide light metal channel at wall and floor into which insulation can be finished.

3.5 LEAKAGE TESTS

- .1 In accordance with SMACNA HVAC Duct Leakage Test Manual.
- .2 Make trial leakage tests as instructed to demonstrate workmanship.
- .3 Install no additional ductwork until trial test has been approved by the Consultant.
- .4 Test section minimum of 22.5m long with not less than three (3) branch takeoffs and two 90° elbows.
- .5 Complete test before insulation or concealment.

3.6 SEALING AND TAPING

- .1 Apply sealant to outside of joint to manufacturer's recommendations.
- .2 Bed tape in sealant and recoat with minimum of one (1) coat of sealant to manufacturer's recommendations.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Ductwork - Low Pressure Metallic to 500 Pa: Section 23 31 14

1.2 REFERENCES

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - .1 SMACNA 1966-2020 HVAC Duct Construction Standards - Metal and Flexible.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00.
- .2 Indicate the following:
 - .1 Flexible connections.
 - .2 Duct access doors.
 - .3 Turning vanes.
 - .4 Instrument test ports.
 - .5 Access doors.

1.4 CERTIFICATION OF RATINGS

- .1 Catalogue or published ratings must be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

PART 2 - PRODUCTS

2.1 FLEXIBLE CONNECTIONS

- .1 Frame: 75mm wide galvanized sheet metal, nominal 0.607mm (24 ga.), with fabric clenched by means of double locked seams.
- .2 Flexible material: fire resistant, woven fiberglass, extinguishing, neoprene coated glass fabric, temperature rated at minus 40°C to plus 90°C, self-extinguishing.
- .3 Acceptable Manufacturers: Duro Dyne; Metal-Fab; Durolon.

2.2 ACCESS DOORS IN DUCTS

- .1 Non-insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, nominal 0.607mm (24 ga.) complete with sheet metal angle frame, gasketed.
- .2 Insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.607mm (24 ga.) thick complete with sheet metal angle frame and 25mm thick rigid glass fibre

insulation, gasketed.

- .3 Size: 300mm x 350mm covering a 250mm x 300mm opening in duct.
- .4 See also Section 23 31 14.
- .5 Hardware:
 - .1 Forged bolts, stop nuts and non-corrosive star shaped handle.
 - .2 Neoprene or foam rubber gasket.
 - .3 Reinforce duct adjacent to access door as required to prevent distortion and smooth cut edges to prevent injury to service personnel.
 - .4 Acceptable Manufacturers: NR Murphy Ltd. Fabricated cleanout door; Nexus PDQ; Nailor.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Flexible connections:
 - .1 Install in following locations:
 - .1 Inlets and outlets to ERVs.
 - .2 Inlets and outlets of supply and exhaust fans.
 - .3 As indicated.
 - .2 Distance between metal parts when system in operation: 38mm to 62mm.
 - .3 Install in accordance with recommendations of SMACNA.
 - .4 When fan is running:
 - .1 Ducting on each side of flexible connection to be in alignment.
 - .2 Provide slack material in flexible connection.
- .2 Access doors:
 - .1 Location:
 - .2 At fire dampers, to allow link replacement.
 - .1 At devices requiring maintenance.
 - .2 At locations required by code.
 - .3 Ducting systems must be accessible every 7.5 m maximum (see also Section 23 31 14).
 - .4 Elsewhere as indicated.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

- .1 SMACNA 1966-2020 HVAC Duct Construction Standards, Metal and Flexible.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00.
- .2 Indicate construction, size, and location.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Manufacture to SMACNA standards.

2.2 SINGLE BLADE DAMPERS

- .1 Of same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
- .2 Size and configuration to recommendations of SMACNA.
- .3 Locking quadrant with shaft extension to accommodate insulation thickness.
- .4 Inside and outside nylon end bearings.
- .5 Channel frame of same material as adjacent duct, complete with angle stop.
- .6 Application: round ductwork in electrical, mechanical, entry corridor, and Polymer rooms.
- .7 Where indicated on drawings, install Rossi Everlock dampers with lockable handle.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3 For supply and exhaust systems, locate balancing dampers in each branch duct.
- .4 Locate balance damper as close as possible to main ducts for each grille, register and diffuser.
- .5 Install splitter damper blade, pivot and control rod in rigid manner to prevent vibration.

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DAMPERS - BALANCING

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- .6 Caulk air-tight between duct and damper frame.
- .7 Installation of dampers to be vibration free.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL

- .1 This section applies to operating dampers not specified in under the Controls scope of work.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00.
- .2 Indicate the following:
 - .1 Performance data.
 - .2 Construction, size and location.

1.3 MAINTENANCE DATA

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

1.4 CERTIFICATION OF RATINGS

- .1 Catalogue or published ratings must be those obtained from tests carried out by manufacturer or those ordered from an independent testing agency.

1.5 ACCEPTABLE PRODUCTS)

- .1 Acceptable Manufacturers: Tamco, Titus, Nailor, Ruskin, Alumavent.

PART 2 - PRODUCTS

2.1 MULTI-LEAF DAMPERS

- .1 Opposed blade or parallel blade to suit application, for throttling or open/closed action; parallel blade type for mixing application.
- .2 Extruded aluminum, interlocking blades, complete with internal polyurethane blade insulation, extruded EPDM elastomer seals, extruded TPE thermoplastic frame seals, extruded aluminum frame complete with polystyrene insulation. (Low leakage construction).
- .3 Bearings comprised of a celcon inner bearing fixed to a 11mm aluminum hexagon blade pin rotating within a polycarbonate outer bearing inserted in the frame; no metal-to-metal or metal-to-plastic contact.
- .4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod. Linkage hardware is installed in frame side and constructed of aluminum and corrosion resistant zinc and nickel-plated steel, complete with cup-point trunnion screws for a slip-proof grip.
- .5 Operator:

- .1 120/1/60 electric actuators as shown on the Project Drawings.
- .2 Two-position spring return motors:
 - .1 For normally closed position, complete with accessories for direct drive coupling to the control damper shift.
 - .2 Provide integral end switch where indicated.
 - .3 Acceptable Manufacturers: Belimo; Honeywell; Johnson.
- .3 Actuator complete with explosion proof actuator enclosure suitable, zone 2 hazardous rating, Gas Group C&D.
- .6 Performance: leakage in closed position to be less than 82 L/S/m² at 1 kPa differential across damper. Pressure drop at full open position for a 1200mm x 1200mm damper to be less than 7.5 Pa differential across damper at 5 m/s air flow.
- .7 Acceptable products: Tamco Series 9000 SW, or approved equivalent.

2.2 BACK DRAFT DAMPERS

- .1 Automatic gravity operated, multi leaf, aluminum construction with nylon bearings, centre pivoted or counterweighted, as required for positive closure.
- .2 Acceptable products: Tamco Series 7000, or approved equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.
- .3 Seal multiple damper modules with silicon sealant.
- .4 Upon system start-up, ensure that dampers operate through full angular range and seal tightly in their closed position. See also Controls related specification sections.
- .5 Caulk airtight between duct and damper frame for tight close-off.
- .6 Extend damper control rod or jack shaft through damper casing to the outside of the duct or equipment casing to allow proper connection of direct-coupled damper actuator.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 HVAC General Requirements: Section 23 05 00
- .2 Duct Accessories: Section 23 33 00

1.2 REFERENCES

- .1 AMCA 99-16, Standards Handbook.
- .2 ANSI/AMCA 210-16, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .3 AMCA 300-24, Reverberant Room Method for Sound Testing of Fans.
- .4 AMCA 301-22 Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .5 ANSI/ASHRAE 51-16, Laboratory Methods of Testing Fans for Rating.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00.
- .2 Product data to include fan curves and sound rating data, showing point of operation.
- .3 Indicate the following: motors, wheels, bearings, shafts, drives for all return and exhaust fans, dimensions, weight, sound power levels and service clearances.

1.4 OPERATION AND MAINTENANCE DATA

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

1.5 MAINTENANCE MATERIALS

- .1 Provide maintenance materials as follows:
 - .1 Spare parts to include:
 - .2 Matched sets of belts.

1.6 MANUFACTURED ITEMS

- .1 Catalogued or published ratings must be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards in force.

1.7 ACCEPTABLE MANUFACTURERS

- .1 Twin City, Greenheck, Cook.

PART 2 - PRODUCTS

2.1 FANS GENERAL

- .1 Capacity, static pressure, revolutions per minute, power, model and size as indicated in fan schedule on Drawings.
- .2 Sound ratings: comply with AMCA (Air Moving and Conditioning Association) 301, tested to AMCA 300. Unit must bear AMCA certified sound rating seal where appropriate.
- .3 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.
- .4 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210, and ANSI/ASHRAE 51. Unit must bear AMCA certified rating seal, except for propeller fans smaller than 300mm diameter.
- .5 Motors: high efficiency; sizes as indicated. Refer also to Section 23 05 00 for additional motor requirements.
- .6 Factory primed before assembly in colour standard to manufacturer.
- .7 Scroll casing drains: as indicated, complete with plug.
- .8 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

PART 3 - EXECUTION

3.1 FAN INSTALLATION

- .1 Install fans as indicated
- .2 Install fan restraining snubbers.
- .3 Provide replacement sheaves and belts if required for final air balance.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

- .1 ASTM E90-23, Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .2 ANSI/ASHRAE 51-16, Laboratory Method of Testing Fans for Rating.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Indicate fabrication and erection details, including anchorage, accessories, and finishes.

1.3 MAINTENANCE DATA

- .1 Provide operation and maintenance data for maintenance of manually operated louvres for incorporation into manual specified in Section 01 78 00.

1.4 CERTIFICATION OF RATINGS

- .1 Catalogued or published ratings must be those obtained from tests carried out by manufacturer or those ordered by them from independent testing agency signifying adherence to codes and standards.

1.5 TEST REPORTS

- .1 Submit certified data from index laboratory substantiating acoustic aerodynamic performance to ASTM E90.

PART 2 - PRODUCTS

2.1 GOOSENECK HOODS

- .1 Thickness, joints, and construction to SMACNA and ASHRAE.
- .2 Provide bird screening.
- .3 Prefabricated insulated roof curbs, minimum 450mm high.

2.2 STATIONARY LOUVRES

- .1 Construction: welded with exposed joints ground flush and smooth.
- .2 Material: extruded aluminum alloy 6063-T5.
- .3 Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1.5m between supports.
- .4 Frame, head, sill and jamb: 150mm deep one piece extruded aluminum, minimum 2.657mm (12 ga.) thick with approved caulking slot, integral to unit and sill extension as indicated. Sill drain piped to outside.
- .5 Mullions: at 1500mm maximum centres.

- .6 Fastenings: stainless steel SAW-194-8F with SAW-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.
- .7 Screen: 12mm x 12mm openings, 2mm dia. wire aluminum birdscreen on inside face of louvres in formed U-frame, removable.
- .8 Finish: factory applied AAMA 2605 finish with colour to be determined during shop drawing phase.
- .9 Acceptable Material: Ruskin; E.H. Price; Alumavent; Venlex.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install to the sizes and where indicated in accordance with manufacturer's recommendations and in accordance with recommendations of SMACNA.
- .2 Reinforce and brace air vents, intakes and gooseneck hoods for wind speed in accordance with NBC for location.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Copper Tubing and Fittings Refrigerant: Section 23 23 00

1.2 REFERENCES

- .1 Air-Conditioning and Refrigeration Institute (ARI)
 - .1 ARI 210/240-08, Standard for Unitary Air Conditioning and Air-Source Heat Pump Equipment.
- .2 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE Standard 15-24, Safety Standard for Refrigeration Systems.
- .3 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C13256-2-01(R2021), Performance of Ground and Water Source Heat Pumps.
 - .2 CAN/CSA C656-14(R2023), Performance Standard for Single Package Central Air Conditioners and Heat Pumps.
- .4 Environment Canada, (EC)/Environmental Protection Services (EPS)
 - .1 EPS 1/RA/2-1996, Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.
 - .2 Environment Canada-1994, Ozone-Depleting Substances Alternatives and Suppliers List.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with Sections 01 33 00.
- .2 Indicate:
 - .1 Capacities.
 - .2 ARI Ratings.
 - .3 Sound Power levels.
 - .4 Installation instructions.
 - .5 Start-up Instructions.
 - .6 O&M, Instructions.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 00.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins

for recycling in accordance with Waste Management Plan.

- .4 Divert unused metal and wiring materials from landfill to metal recycling facility approved by the Consultant.

1.5 WARRANTY

- .1 Provide a warranty that expressly states the heat pumps are comprehensively covered for a period of six (6) years.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Heat pumps/AC units: CSA approved and carry ARI or CSA certification seal.
- .2 Units to have integral sloped drain pans with pipe connection for contractor to run drain line.
- .3 Provide any additional accessories and controls required for a complete working system as indicated on drawings.
- .4 Heating operation down to -20°C (-5°F) ambient temperature.
- .5 Units to have auto restart upon power failure.

2.2 DUCTED UNITS

- .1 Minimum efficiencies: SEER = 19, COP = 14 Btu/h / kW.
- .2 Maximum fan static pressure: 200 Pa (0.8")

2.3 DUCTLESS UNITS

- .1 Minimum efficiencies: SEER = 19, COP = 11 Btu/h / kW.

2.4 REFRIGERANTS

- .1 Type of Refrigerant: R410A
- .2 Refrigerant pipe lengths up to 20m with 15m height difference allowed between units.

2.5 COOLING CAPACITIES

- .1 As per schedule

2.6 ZONE CONTROLLERS

- .1 Wired wall mount controller complete with 7-day schedule, heating/cooling/auto modes.
- .2 All units to come c/w auxiliary heater control device.

2.7 APPROVED MANUFACTURERS

- .1 Basis of design: Fujitsu.

- .2 Approved alternates: Mitsubishi, LG, Trane, Daikin

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install where indicated and in accordance with the manufacturer's instructions.
- .2 Install outdoor units in accordance with manufacturer's instructions.
- .3 Secure with hold-down bolts.
- .4 Make duct connections through flexible connections.
- .5 Level unit with fans running. Align ductwork. flexible connections. Misalignment with fan stopped not to strain or damage flexible connection.
- .6 Make piping connections.
- .7 Allow for nothing to obstruct ready access to components or to prevent removal of components for servicing.
- .8 Provide complete controls for this system.
- .9 Pipe condensate drain line to funnel floor drain near water entrance.

3.2 DRAIN PANS

- .1 Install so that no water can accumulate and arrange for easy access for cleaning.

3.3 CONTROLS

- .1 Provide wiring and programming as required for a complete working system.

3.4 START-UP AND COMMISSIONING

- .1 Manufacturer to certify installation and performance. Submit written report to the Consultant and Owner.
- .2 Demonstrate to the Consultant and Owner operation of system, including sequences of operation, startup, shutdown, schedules, etc.

3.5 MAINTENANCE SERVICE DURING WARRANTY PERIOD

- .1 Provide services, materials, and equipment to maintain HVAC controls system for warranty period of one (1) year after date of substantial completion. Provide detailed preventative maintenance schedule for system components as described in Submittal article.
- .2 Emergency Service Calls:
 - .1 Initiate service calls when controls system is not functioning correctly.

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- .2 Qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost.
- .3 Furnish the Owner with telephone number where service personnel may be reached at any time.
 - .1 Service personnel to be on site ready to service system after receiving request for service.
 - .2 Perform work continuously until system restored to reliable operating condition.
- .4 Operation: foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of system based on original design conditions and as recommended by manufacturer.
- .5 Work requests: record each service call request, when received separately on approved form and include:
 - .1 Serial number identifying component involved.
 - .2 Location, date and time call received.
 - .3 Nature of trouble.
 - .4 Names of personnel assigned.
 - .5 Instructions of work to be done.
 - .6 Amount and nature of materials used.
 - .7 Time and date work started.
 - .8 Time and date of completion.
- .6 Provide system modifications in writing.
 - .1 No system modification, including operating parameters and control settings, to be made without prior written approval of the Consultant.

END OF SECTION

PART 1 - GENERAL

1.1 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00.
- .2 Submit product data sheets for unit heaters. Include:
 - .1 Product characteristics.
 - .2 Performance criteria.
 - .3 Mounting methods.
 - .4 Physical size.
 - .5 kW rating, voltage, phase.
 - .6 Cabinet material thicknesses.
 - .7 Limitations.
 - .8 Colour and finish.
- .3 Submit product data sheets for unit heaters. Include product characteristics, performance criteria, physical size, limitations and finish.

1.2 REFERENCES

- .1 CSA C22.2 No. 46-13(R2022), Electric Air Heaters.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for unit heaters for incorporation into manual specified in Section 01 78 00.

PART 2 - PRODUCTS

2.1 UNIT HEATERS

- .1 Unit heater: to CSA C22.2 No. 46, horizontal discharge complete with adjustable louvres finished to match cabinet or vertical discharge cone type with cone diffusers.
- .2 Fan type unit heater with built-in high heat limit protection, fan-delay switches.
- .3 Fan motor: totally enclosed, permanently lubricated, ball bearing type with resilient mount.
 - .1 Built-in fan motor thermal overload p.
- .4 Hangers: as indicated.
- .5 Elements: mineral insulated steel sheath with aluminum, continuous helical brazed fins.
- .6 Cabinet: 1.6mm thick, fitted with brackets for rod or wall mounting.

2.2 HORIZONTAL UNIT HEATER - HUH

- .1 Electric unit heater: horizontal, forced fan type of kW rating, voltage and phase as specified on the drawings.
- .2 Heating elements: Element totally enclosed in a metal tubular sheath with spiral steel fins.
- .3 Fan motor: totally enclosed, permanently lubricated ball bearing type. Fan shall be factory wired and shall be complete with built in fan motor thermal overload protection. Motor to be explosion proof to Class 1 Division 2 where indicated.
- .4 Cabinet: die formed, steel, 18 gauge, complete with adjustable louvres.
- .5 Provide unit heater complete with heavy duty, mounting bracket suitable for wall or ceiling mounting as indicated on the drawings.
- .6 Finish: Polyester, epoxy powder coat paint finish, almond colour.
- .7 Provide unit heater complete with the following controls and accessories:
 - .1 Automatic reset over temperature protection.
 - .2 Terminal blocks for all field wiring.
 - .3 Control circuit.
 - .4 Contactors.
 - .5 Power disconnect switch.
- .8 Unit heater must be suitable for operation by integral thermostat as noted on the drawings.
- .9 Unit heaters in process areas to be explosion proof for Zone 2 hazardous rating, gas groups IIA & IIB.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install all electric heaters and controls as indicated and in accordance with manufacturer's instructions.
- .2 Power and control connections are specified in Division 26.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00.
- .2 Test cut-out protection when air movement is obstructed.
- .3 Test fan delay switch to assure dissipation of heat after element shut down.
- .4 Test unit cut-off when fan motor overload protection has operated.

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.5 Confirm heaters and controls operate correctly.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 IEEE C2 - National Electrical Safety Code; 2017.
- .2 NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.2 RELATED SECTIONS

- .1 Section 23 05 00 - Common Installation Requirements for HVAC
- .2 Section 23 07 19 - HVAC Piping Insulation
- .3 Section 25 05 01 - EMCS: General Requirements
- .4 Section 26 05 00 - Electrical General Requirements
- .5 Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets
- .6 Section 26 27 26 - Wiring Devices

1.3 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 IEEE C2-2023 National Electrical Safety Code.
 - .2 ANSI/NFPA 70-2023, National Electrical Code.
- .2 Canadian Standards Association (CSA)
 - .1 CSA C22.1-24, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.
 - .2 CSA C22.3 No.1-20, Overhead Systems.
 - .3 CSA C22.3 No. 7:20, Underground Systems.
 - .4 CSA C22.2 No. 45.1:22, Electrical Rigid Metal Conduit - Steel
 - .5 CSA C22.2 No.56-2017(R2022), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit
 - .6 CSA C22.2 No. 0.3-09(R2023), Test Methods for Electrical Wires and Cables.

1.4 SYSTEM DESCRIPTION

- .1 Electrical:
 - .1 Hard wiring between field control devices (wall controllers, thermostats, temperature sensors, etc.) and mechanical equipment (condensers, evaporators, dampers, etc.), or ENCS field panels, as applicable.
 - .2 All wiring to comply with the specifications provided in Division 26 - Electrical.
- .2 Mechanical:

- .1 Provide all control wiring and conduit to the requirements of Division 26.

1.5 PERSONNEL QUALIFICATIONS

- .1 Qualified factory trained supervisory personnel to:
 - .1 Continuously direct and monitor all work.
 - .2 Attend site meetings.

PART 2 - PRODUCTS

2.1 WIRING

- .1 As per requirements of Electrical Divisions.
- .2 For 50V and above copper conductor with chemically cross-linked thermosetting polyethylene insulation rated RW90 and 600V. Colour code in accordance with Section 26 05 00 -Electrical General Requirements.
- .3 Run controls wiring in conduit.
- .4 Sizes:
 - .1 120V Power supply: to match or exceed 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: #18AWG or 20AWG stranded twisted pair.
 - .4 Analog input and output: shielded #18 minimum solid copper or #20 minimum stranded twisted pair. Wiring must be continuous without joints.
 - .5 More than four (4) conductors: #22 minimum solid copper.
- .5 Terminations:
 - .1 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

2.2 CONDUIT

- .1 As per requirements of Division 26 - Electrical
- .2 Conduits: In accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .3 Electrical metallic tubing to CSA C22.2 No. 0.3. Flexible and liquid tight flexible metal conduit to CSA C22.2 No.56. Rigid steel threaded conduit to CSA C22.2 No. 45.1.
- .4 Junction, pull boxes and cabinets: In accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.
- .5 Outlet and conduit boxes: In accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

2.3 WIRING DEVICES, COVER PLATES

- .1 Conform to CSA and Section 26 27 26 - Wiring Devices.
- .2 Receptacles:
 - .1 Duplex: CSA type 5-20R.
 - .2 Single: CSA type 5-20R.
 - .3 Cover plates and blank plates: finish to match other plates in area.

2.4 STARTERS, CONTROL DEVICES

- .1 Have across-the-line starters provided by the Electrical subcontractor or have it supplied with the equipment.
- .2 Starter Diagrams:
 - .1 Provide copy of wiring and schematic diagrams - mount one (1) copy in each starter with additional copies for operation and maintenance manuals.

2.5 SUPPORTS FOR CONDUIT, FASTENINGS, EQUIPMENT

- .1 Support conduits in accordance with Section 26 05 29 - Hangers and Supports for Electrical Systems.
- .2 Solid masonry, tile and plastic surfaces: lead anchors or nylon shields.
- .3 Hollow masonry walls, suspended drywall ceilings: expansion anchors.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install equipment, components so that manufacturers and CSA labels are visible and legible after commissioning is complete.

3.2 PIPING

- .1 Insulation: refer to Section 23 07 19 - HVAC Piping Insulation.

3.3 SUPPORTS

- .1 Install special supports as required and as indicated.

3.4 ELECTRICAL GENERAL

- .1 Do complete installation in accordance with requirements of:
 - .1 Electrical Divisions, this specification.
 - .2 CSA 22.1 Canadian Electrical Code, latest edition.
 - .3 ANSI/NFPA 70.
 - .4 ANSI C2.

- .2 Fully enclose or properly guard electrical wiring, terminal blocks, high voltage (above 50 V) contacts and mark to prevent accidental injury.
- .3 Do underground installation to CAN/CSA C22.3 No.7, except where otherwise specified.
- .4 Conform to manufacturer's recommendations for storage, handling and installation.
- .5 Check factory connections and joints. Tighten where necessary to ensure continuity.
- .6 Install electrical equipment between 1000mm and 2000 mm above finished floor wherever possible and adjacent to related equipment.
- .7 Protect exposed live equipment such as panel, mains, outlet wiring during construction for personnel safety.
- .8 Shield and mark 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, 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.

3.5 CONDUIT SYSTEM

- .1 Install communication wiring in conduit. Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems. Maximum conduit fills not to exceed 40%. Design drawings do not show conduit layout.
- .2 Install conduits parallel or perpendicular to building lines, to conserve headroom and to minimize interference.
- .3 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Obtain approval from the Consultant before starting such work. Provide complete conduit system to link field panels and devices with main control centre. Conduit size to match conductors plus future expansion capabilities as specified.
- .4 Bend conduit so that diameter is reduced by less than 1/10th original diameter.
- .5 Conduit length between pull boxes to less than 30 meter.
- .6 Field thread on rigid conduit to be of sufficient length to draw conduits up tight.

- .7 Use conduit outlet boxes for conduit up to 35 mm diameter and pull boxes for larger sizes.
- .8 Fastenings and supports for conduits, cables, and equipment:
 - .1 Provide metal brackets, frames, hangers, clamps and related types of support structures 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 the Consultant.
- .9 Install polypropylene fish cord in empty conduits for future use.
- .10 Where conduits become blocked, remove and replace blocked sections.
- .11 Do not pass conduits through structural members.
- .12 Conduits may be run in flanged portion of structural steel.
- .13 Group conduits wherever possible on suspended or surface channels.
- .14 Pull boxes:
 - .1 Install in inconspicuous but accessible 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 record drawings.
 - .6 Identify AC power junction boxes, by panel and circuit breaker.
- .15 Install terminal blocks or strips indicated in cabinets to Electrical Division.
- .16 Provide bond wire in all conduits. Minimum size: #12 AWG.
- .17 Install bonding conductor for 120 volt and above in conduit.

3.6 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 shorts, unspecified grounds.
 - .2 Resistance to ground of all circuits is greater than 50 Megohms.
- .5 Provide Consultant with test results showing locations, circuits, results of tests.

- .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 physical contact with compression screw.
- .9 Install all strands of conductor in lugs of components. Strip insulation only to extent necessary for installation.

3.7 WIRING DEVICES, COVER PLATES

- .1 Refer to Division 26 & Division 27 for requirements.
- .2 Receptacles:
 - .1 Install vertically in gang type outlet box when more than one receptacle is required in one 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.

3.8 STARTERS, CONTROL DEVICES

- .1 Install and make control connections as indicated. Power connections above 50V by Electrical Division.
- .2 Install correct over-current devices.
- .3 Identify each control wire, terminal for external connections with permanent number marking identical to diagram.
- .4 Performance Verification:
 - .1 Operate switches and controls to verify functioning.
 - .2 Perform start and stop sequences of contactors and relays.
 - .3 Check that interlock sequences, with other separate related starters, equipment and auxiliary control devices, operate as specified.

3.9 GROUNDING

- .1 Install complete, permanent, continuous grounding system for equipment, including conductors, connectors and accessories.
- .2 Install separate bonding 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.

3.10 TESTS

.1 General:

- .1 Perform following tests in addition to tests specified Section 25 08 20 - EMCS: Warranty and Maintenance.
- .2 Give 14 days' written notice of intention to test.
- .3 Conduct in presence of the Consultant and authority having jurisdiction.
- .4 Conceal work only after tests satisfactorily completed.
- .5 Report results of tests to the Consultant in writing.
- .6 Preliminary tests:
 - .1 Conduct as directed to verify compliance with specified requirements.
 - .2 Make needed changes, adjustments, replacements.
 - .3 Insulation resistance tests:
 - .1 Megger all circuits, feeders, equipment for 120 - 600V with 1000V instrument. Resistance to ground to be more than required by Code before energizing.
 - .2 Test insulation between conductors and ground, efficiency of grounding system to satisfaction of the Consultant and authority having jurisdiction.

3.11 IDENTIFICATION

- .1 Refer to Section 25 05 54 - EMCS: Identification.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL

- .1 This Section covers items common to Sections of Divisions 26, 27, 28, 40 and portions of 33.

1.2 RELATED WORK

- .1 Firestopping and Smoke Seals: Section 07 80 00
- .2 Painting: Section 09 91 23
- .3 Process Control Systems Equipment and Cabling: Section 26 91 00
- .4 Primary Process Instrumentation Devices and Cabling: Section 26 90 00

1.3 REFERENCES

- .1 CSA C22.1-24, Canadian Electrical Code, Part 1.
- .2 CSA C22.2 No. 0.1:19(R2024), General Requirements for Double-Insulated Equipment.
- .3 CSA C22.3 No. 7:20(R2022), Underground Systems.
- .4 CSA C235:19, Preferred Voltage Levels for AC Systems, 0 to 50 000 V.
- .5 EEMAC Y1-2-1979, Standard for Performance Specification for Finishing Systems for Outdoor Electrical Equipment.
- .6 EEMAC 2Y-1-1958, Standard for CEMA Light Gray Colour for Indoor Switchgear.

1.4 SCOPE OF WORK

- .1 The Work to be done under this contract consists of furnishing all materials, tools, equipment and labour, and performing the electrical services as indicated and as specified herein and on the Electrical Drawings.
- .2 Arrange for the power utility to supply and install one (1) 600/347V, three phase, four wire underground power service to the new wastewater treatment plant building new electrical room.
- .3 Coordinate with the power utility to have a complete and fully functioning system and to include connections to the incoming mains of the power utility.
- .4 Supply and install one (1) 600/347VAC, three phase, four-wire power service to the new wastewater treatment plant electrical room including service entrance rated, main switchboard, and utility meter base as indicated on the drawings and specifications herein.
- .5 Supply and install two (2) 600/347V distribution switchboard, and one (1) new 600V, 3 phase automatic transfer switch as indicated on the Drawings and specified herein.

- .6 Supply and install two (2) new 600V Motor Control Centre as indicated on the drawings and specified herein.
- .7 Supply and install new power distribution equipment as indicated on the drawings including, but not necessarily limited to the following list: VFD's, motor starters, circuit breakers, receptacles, disconnect switches, panelboards, and transformers.
- .8 Supply and install new underground electrical duct banks as indicated on the drawings and specified in Sections 33 65 73 and 33 65 76.
- .9 Supply and install new instrumentation and controls equipment as indicated on the drawings and as specified in Sections 26 90 00 and 26 91 00.
- .10 Supply and install power distribution and general services wiring and cables as indicated on the drawings and specifications herein.
- .11 Supply and install control, instrumentation and communication wiring and cables as specified herein and in Sections 26 91 00 and 26 90 00.
- .12 Supply and install required cable glands, cable tray, conduit, conduit fittings and required mounting hardware.
- .13 Supply and install grounding necessary to meet the requirements of the CEC - Part 1 and the local provincial inspection authority.
- .14 Install and interwire electrical/instrumentation for process systems specified in other divisions and pre-selected by the Owner including provision and installation of all power, control cabling, conduit, supports, and mounting hardware, in accordance with these specifications and shop drawing/manufacturer requirements.
- .15 Document, test and calibrate to satisfaction of the Consultant, electrical, instrumentation and controls equipment as specified herein and on the drawings.
- .16 Safely store electrical, instrumentation and controls equipment awaiting installation.
- .17 Protect installed electrical, instrumentation and controls equipment.
- .18 Repair/replace equipment damaged during construction, or otherwise deemed defective or non-compliant with this specification at no expense to the Contract. These expenses include all material, labour and other fees.
- .19 Coordinate/schedule with other trades to ensure that the construction proceeds in a timely and efficient manner.
- .20 Firestop electrical penetrations through fire rated walls and floors.
- .21 Supply and install new heat trace systems as indicated and specified in Section 40 41 00.
- .22 A number of rooms/areas as noted on the Project Drawings are hazardous locations. Install all electrical equipment in these areas in accordance with Sections 18 and 22 of the Canadian Electrical Code for the specified classification. These areas contain hydrogen sulphide

(North American Gas Group C, IEC Gas Group IIB) and methane (North American Gas Group D, IEC Gas Group IIA) gases. Zone 1 and Zone 2 hazardous areas are also a Category 2 location in accordance with Section 22 of the Canadian Electrical Code. Complete the electrical installation in accordance with the requirements of a Category 2 location.

- .23 Supply and install one (1) new 600/347V, 3-phase, 4-wire standby diesel generator complete with sound attenuation, weatherproof, non walk-in enclosure and auxiliary equipment.
- .24 Supply and install one (1) 600V, 3-phase automatic transfer switch and standby diesel generator.
- .25 Supply and install outdoor, indoor and emergency lighting systems as indicated.

1.5 CODES AND STANDARDS

- .1 Do complete installation in accordance with the Canadian Electrical Code, CSA C22.1, and local regulations except where specified otherwise.
- .2 Comply with all CSA electrical bulletins in force at the time of tender submission. While not identified or specified by reference number in this division, the bulletins will be considered to form part of the related CSA part II standard.

1.6 CARE, OPERATION AND START-UP

- .1 Instruct operating personnel in the operation, care and maintenance of equipment.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components, including but not limited to switchboards, digital meters, motor control centres, VFD's, overload relays, motor circuit protectors, automatic transfer switches, adjustable circuit breakers, instruments and controls.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

1.7 VOLTAGE RATINGS

- .1 Operating voltages: to CSA C235.
- .2 Motors, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.8 PERMITS, FEES AND INSPECTION

- .1 Submit to the Electrical Inspection Department, Municipal Authority and Supply Authority the necessary number of drawings and

specifications for examination and approval prior to commencement of Work. Submit information within thirty (30) working days of the award of trade package and provide the Consultant with written notice at the time this has been submitted.

- .2 Provide the Consultant with a copy of the Electrical Inspection Department and Supply Authority Plans Review Report immediately upon receipt. No shop drawings will be reviewed prior to receipt of the Plans Review Report from the Contractor.
- .3 Obtain all necessary permits including an Electrical Wiring Permit for electrical work and Communications Cabling Permit for communications cabling work from the authority having jurisdiction prior to commencement of Work. Provide a copy of each permit to the Consultant upon receipt. Display permits on the work site.
- .4 Upon specific request, the Consultant will provide to the Contractor, up to a maximum of three (3) copies of the drawings and specifications required for submittal to the Electrical Inspection Department and Supply Authority. These drawings and specifications will be provided to the Contractor at no cost, unless specified otherwise.
- .5 Arrange for all required inspections to be conducted by the authority having jurisdiction. Provide a copy of all inspection reports to the Consultant immediately upon receipt. Notify the Consultant immediately of changes required by the authority having jurisdiction prior to making changes. All changes must be approved by the Consultant.
- .6 Furnish Certificates of Acceptance from authorities having jurisdiction upon completion of Work. Include a copy in the Operations and Maintenance Manual.
- .7 Pay all associated fees.

1.9 MATERIALS AND EQUIPMENT

- .1 Equipment and material to be CSA certified or certified by an agency approved by the Electrical Inspection Department having jurisdiction. Where there is no alternative to supplying equipment which is not certified, obtain special approval from Electrical Inspection Department and the Consultant.
- .2 Factory assemble control panels and component assemblies.

1.10 ELECTRIC MOTORS EQUIPMENT AND CONTROLS

- .1 Coordinate supplier and installer responsibility for mechanical and process equipment specified in other specification divisions with the Contractor to confirm complete and functioning systems.
- .2 Confirm location of mechanical and process equipment and associated control devices specified in other divisions. Device locations may not be necessarily shown on the electrical drawings.

1.11 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.
 - .1 Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1.
- .2 Clean and touch up surfaces of new shop-painted equipment scratched or marred during shipment or installation, to match original paint to the satisfaction of the Consultant. If not acceptable, replace equipment at no additional cost to the Contract.
- .3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

1.12 FASTENERS AND EQUIPMENT MOUNTING

- .1 Fastening devices for all equipment and components, including bolts, nuts, washers, and screws shall be galvanized steel throughout except as follows:
 - .1 Use electrogalvanized steel fastening devices in dry areas (electrical room, mechanical room and similar areas).
 - .2 Use 316 stainless steel hardware outside, in wet and/or corrosive areas, and in electrically hazardous areas.
- .2 Where there is no wall for mounting control panels, major junction boxes, instrumentation, transmitter/ analyzer, etc., supply and install an 6 mm thick stainless steel (316) plate for mounting this equipment. Secure mounting plate to back-to-back U-shaped strut as specified. Remove all sharp edges and round corners on mounting plate.
- .3 In electrical rooms and mechanical rooms, wall mount electrical equipment on 21mm thick fire retardant plywood backboards. Fasten plywood backboards directly to the wall. Paint plywood with two (2) coats of fire retardant paint to match wall colour.
- .4 Wall mount instrumentation transmitter/analyzer type equipment on 16mm thick, plastic high density polyethylene puck board (semi-transparent white). Mount puck board on 41mm square u-shaped stainless steel channel.

1.13 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as specified herein.
- .2 Identification:
 - .1 Provide panels, disconnect switches, MCC's, receptacles, transformers, control panels, magnetic starters, TOL's, etc. with lamicoid nameplates as further described herein. Affix all plates true and level, and plumb in all instances.

- .2 Affix nameplates to other types of surfaces with contact type cement.
- .3 Affix nameplates to building "exterior" surfaces with nylon inserts and self tapping screws unless specifically indicated otherwise.
- .4 Apply contact type cement to complete rear side of plate (buttered), as opposed to several locations or areas on same.
- .5 Lamicoid nameplates installed on distribution panelboards, motor control centres, transformers, and splitters to indicate the following:
 - .1 Designated name of equipment.
 - .2 Amorage of overcurrent protection device.
 - .3 Voltages, number of phases and wires.
 - .4 Designation of power source.

PANEL C
120/208V, 100A, 3PH, 4W
FED FROM PANEL B

- .6 Lamicoid nameplates installed on combination starters, magnetic starters, manual starter and all various systems controls, control panels, disconnect switches, etc., to contain the following information:
 - .1 Designated name of equipment or equipment being fed, whichever is applicable.
 - .2 Designated name of power source.
 - .3 Branch circuit breaker number(s) where possible.
 - .4 Voltage(s) and phase.

FAN NO. 1
PANEL H - CKT. 17
120V, 1 pH
FAN NO. 2
MCC NO. 1
600V, 3 PH

- .7 Lamicoid nameplates installed on fusible type disconnect switches to also indicate the maximum designated/designed fuse size and type.
- .8 Install lamicoid nameplates on all junction and pull boxes sized 150 mm x 150 mm and larger indicating name of system, designated panel name and electrical characteristics where applicable.
- .9 Install lamicoid nameplates adjacent to each overcurrent device located in switchboards, CDP panels, etc. They need only indicate designated name and/or number of equipment they feed. Identify unused O.C. devices as spare(s).

- .10 Install lamicoid nameplates above all types of receptacles and abutted directly to tops of their respective device plates. Identification to indicate respective panel source complete with associated circuit breaker number(s). Lamicoid plate to be 1.5 mm thick x 13 mm high complete with 6 mm black letters on white core, directly above all flush receptacles. Plate to be identical width as finish device plate and the top left and right corners are to be rounded off.
- .11 Identify lamicoid nameplates above 120V receptacles protected by GFCI circuit breakers, or GFCI type receptacles as per the following:
 - .1 1.5mm thick x 19mm wide complete with 6 mm black letters on white core above all receptacles. Identical width as finish device plate (EXAMPLE: GFCI Protected Panel H-26).
- .12 Install lamicoid nameplate(s) for voice/data/CATV/CCTV/multimedia outlets directly to face of finish plate where possible and as follows:
 - .1 1.5mm thick x 19mm wide complete with 6mm black letters on white core above all receptacles. Identical width as finish device plate.
- .13 Allow for an "average" of 40 letters for each lamicoid nameplate.
- .14 Lamicoid to be 3 mm thick plastic engraving sheet, white face, black core, for all electrical systems except fire alarm systems to have red face with white core.
- .15 Lettering on lamicoid nameplates must not "start", nor "end" nearer than 9 mm from either, or both ends of said plates.
- .16 Size of lettering, including overall lengths of various plates must be as indicated in the following chart:

NOMINAL NAMEPLATE SIZES			
Size 1	10mm x 50mm	1 line	5mm high letters
Size 2	13mm x 75mm	1 line	6mm high letters
Size 3	16mm x 75mm	2 lines	5mm high letters
Size 4	19mm x 90mm	1 line	10mm high letters
Size 5	50mm x 90mm	2 lines	13mm high letters
Size 6	25mm x 100mm	1 line	13mm high letters
Size 7	25mm x 100mm	2 lines	6mm high letters
Size 8	50mm x 150mm	2 lines	13mm high letters
Size 9	50mm x 100mm	2 lines	10mm high letters

- .3 Have wording on nameplates and labels approved by the Consultant prior to manufacture.
- .4 Identification to be English.
- .5 Supply and install lamicoid nameplates on, or adjacent to, all various systems' control panels and/or cabinets complete with information as

indicated. Nameplates to reflect individual system's assigned name, and where applicable, also indicate both designated panel name and associated branch circuit breaker number(s).

.6 Control Transformers:

- .1 Concealed control transformers located within ceiling spaces are to have lamicoid nameplates installed adjacent to same indicating their identified system, primary power source including designated panel name, complete with associated branch circuit breaker number(s).
 - .2 Install a second plate with identical information on underside of room grid system or access opening frame directly below control transformer, so as to identify its concealed location directly above same.
 - .3 Identify control transformers installed in either control cabinets or on walls adjacent to same with lamicoid nameplates containing information as previously indicated.
- .7 Co-ordinate names of equipment and systems with other trades to make equipment identification consistent.
- .8 In addition to required nameplates and colour coding, junction boxes to have the panel and circuit numbers of all wiring contained within listed on the coverplate. List to be written using black indelible marker neatly and legible.
- .9 Colour code electrical junction boxes and pull boxes as follows:
- .1 Apply colour coding prior to pulling conductors into boxes.
 - .2 Where primary colour only is indicated:
 - .1 Colour inside and outside of box.
 - .2 Colour all cover plates.
 - .3 Where primary and secondary colours are indicated:
 - .1 Paint inside and outside of box with the primary colour.
 - .2 Diagonally apply to each half of the cover plate the primary and secondary colours.
- .10 Provide clearly visible marking on electrical equipment to warn persons of potential electrical shock and arc flash hazards as specified in the Canadian Electrical Code.
- .11 Provide terminal boxes, panels and miscellaneous equipment fed from two or more sources with a warning nameplate prominently displayed: "CAUTION - MORE THAN ONE SOURCE VOLTAGE".
- .12 Provide terminal boxes, panels and miscellaneous wire ways containing intrinsically safe circuits with a warning nameplate prominently displayed: "INTRINSICALLY SAFE CIRCUIT".

1.14 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors

- of feeders and branch circuit wiring. Install labels in a "flagged" manner around individual conductors.
- .2 Maintain phase sequence and colour coding throughout.
 - .3 Colour code: to CSA C22.1
 - .4 Use colour coded wires in communication cables, matched throughout system.
 - .5 Indicate panel and circuit number on all phase conductors (i.e., Panel A, ckt 3) at the device and at any intermediate junction/pull boxes.
 - .6 Indicate MCC designation and section number or field mounted motor starter on all phase conductors at the device.
 - .7 Identify all neutral conductors to indicate the phase conductor with which they are associated and at any intermediate junction/pull boxes.

1.15 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and cables.
- .2 Install coloured 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 19 mm wide auxiliary colour.

System	Prime	Auxiliary
up to 250V	yellow	
up to 600V	yellow	green
Telephone	blue	grey
Fire alarm	red	
Other communication system	green	blue
Security	brown	
Building HVAC Controls (<50V)	orange	
PLC I/O Digital	white	grey
PLC I/O Analog	white	blue
Intrinsically safe	blue	

- .4 For power cables to electrical equipment, indicate designated name of equipment and designated name of power source (i.e., Fuel Pump #1 - fed from MCC #1).
- .5 Where more than one cable terminates at a device, add cable number (i.e., -1, -2) to end of cable identification.
- .6 Use Electrovert PVC K-marking sleeves (black on yellow), complete with PVC carrier strip and self-locking nylon cable ties (black) or approved equivalent.

1.16 WIRING TERMINATIONS

- .1 Use lugs and terminals for termination of conductors that are suitable for either copper or aluminum conductors.

1.17 MANUFACTURER'S AND CSA LABELS

- .1 Visible and legible after equipment is installed.

1.18 WARNING SIGNS

- .1 As specified and to meet requirements of Electrical Inspection Department.
- .2 Treated polyethylene plastic or coated rust free aluminum signs, minimum size 180mm x 250mm.

1.19 LOCATION OF EQUIPMENT

- .1 Locate outlets in accordance with the Drawings and these Specifications.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of equipment at no extra cost or credit, providing distance does not exceed 3 m and information is given before installation.
- .4 Locate light switches on latch side of doors.

1.20 MOUNTING HEIGHT

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
 - .1 Local switches: 1350mm AFF.
 - .2 Wall receptacles:
 - .1 General: 450mm AFF.
 - .2 Elevated mounting in process areas: 1200mm AFF.
 - .3 Above top of counters or counter splash backs: 150mm.
 - .4 Outdoors: 1200mm above finished grade.
 - .3 Thermostats: 1500mm AFF.
 - .4 Telecommunication outlets:
 - .1 General: 450mm AFF.
 - .2 Elevated mounting in process areas: 1200mm AFF.
 - .3 Above top of counters or counter splash backs: 150mm.
 - .4 Outdoors: 1200mm above finished grade.
 - .5 Panelboards: as required by Code or as indicated.

1.21 LOAD BALANCE

- .1 Measure phase current to panelboards with normal loads operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
- .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- .3 Submit, at completion of Work, report listing phase and neutral currents on panelboards and transformers operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

1.22 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete. 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.
- .3 Arrange and pay for holes through exterior walls; provide flashings and make weatherproof.
- .4 Install conduits to be embedded or plastered over, neatly and close to the building structure so furring can be kept to a minimum.

1.23 FIRESTOPPING

- .1 Provide complete firestopping and smoke sealing of all cable, cabletrough or conduit penetrations through fire-resistant separations in accordance with specification Section 07 80 00.

1.24 FIELD QUALITY CONTROL

- .1 Conduct and pay for following tests:
 - .1 Power distribution system including phase rotation, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .4 Emergency generator and automatic transfer switch.
 - .5 Telecommunications system.
- .2 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- .3 Insulation resistance testing:
 - .1 Megger circuits, feeders and distribution equipment up to 350 V with a 500 V instrument.

- .2 Megger 350-600 V circuits, feeders and distribution equipment with a 1000 V instrument.
- .3 Check resistance to ground before energizing.
- .4 Provide a type written tabular report indicating test results.
- .4 Provide a type written tabular report indicating the normal field measured load current for all motors, indicating the motor circuit protector trip setting or fuse type/rating, the overload heater element sizes and/or settings. Indicate the motor nameplate current.
- .5 Provide "as-commissioned" settings for VFD's.
- .6 Advise the Consultant of dates when testing will take place. Provide five (5) days notice of such tests.
- .7 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .8 Submit test results for the Consultant review and approval.

1.25 COORDINATION OF PROTECTIVE DEVICES

- .1 Confirm circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings as per Protection Coordination and Arc Flash study to be supplied by the Contractor. Submit the Protection Coordination and Arc Flash study to the Owner and Consultant for review and approval prior to application and testing of protective overcurrent devices. Protective devices and Arc flash studies to incorporate comments from the Owner and the Consultant and must be stamped by a professional engineer licenced to practice in the province where the Work is taking place.
- .2 Include recommended overcurrent settings for all adjustable circuit breaker trip units, motor circuit protector trip units, motor overloads and power distribution fuses in the study.
- .3 Include Arc flash labels for each piece of electrical distribution equipment and control panels.

1.26 QUALITY ASSURANCE

- .1 Instructions:
 - .1 Interferences: electrical drawings are generally of a diagrammatic nature. Plan and coordinate the Work to eliminate interferences with other trades. Provide all necessary raceway offsets, fittings, and boxes, adjust all fixture and equipment boxes, adjust all fixture and equipment locations and provide all supporting materials required for a planned, coordinated and neat installation. Where interferences occur, the Consultant's will decide which item must be relocated regardless of which was installed first.
 - .2 Electrical workmanship: provide workmanship of the highest quality. Sub-standard Work will not be accepted. Use only persons

- skilled in the trades involved.
- .3 Electrical materials: provide all materials used in this Work, unless particularly specified otherwise, that are new, free from flaws, or imperfections.
- .4 Sleeves and inserts: furnish and locate all sleeves and inserts required for this work in accordance with drawings.
- .2 Applicable standards:
 - .1 All electrical work must conform with the requirements and recommendations of the Canadian Electrical Code and all local codes and ordinances. In conflicts between codes, the more stringent requirements govern.
 - .2 In no instance will the standard established by this specification be reduced by any of the codes or standards referred to in this specification.
 - .3 Standards: the specifications and standards of the following organizations are by reference made as part of these specifications and all electrical Work, unless otherwise indicated, to comply with their requirements and recommendations wherever applicable.
 - .4 Canadian Standard Association (CSA).
 - .5 Institute of Electrical and Electronics Engineers (I.E.E.E.).
 - .6 Instrument Society of America (I.S.A.).
 - .7 American Society for Testing Materials (A.S.T.M.).
 - .8 Insulated Power Cable Engineers Association (I.P.C.E.A.).
 - .9 National Electrical Manufacturers' Association (N.E.M.A.).
 - .10 National Fire Protection Association (N.F.P.A.).
 - .11 Underwriter's Laboratories of Canada (U.L.C.).
 - .12

1.27 PROCESS/MECHANICAL EQUIPMENT PACKAGES

- .1 Coordinate electrical work with the process and mechanical system vendors.
- .2 Provide and coordinate connection details and requirements for interwiring mechanical and process equipment packages specified under all Divisions, including pre-selected equipment.
- .3 Refer to manufacturer's shop drawings for connection details and recommended installation details.
- .4 Provide all cable, conduit, cable channel/trough, supports and miscellaneous hardware as per the requirements of this specification.

1.28 RECORD DRAWINGS

- .1 Record drawings:

- .1 After award of Contract, Consultant will provide a set of full-sized drawings for purpose of maintaining record drawings. Accurately and neatly record deviations from Contract Documents caused by site conditions and changes ordered by the Consultant.
- .2 Identify drawings as "Project Record Copy". Maintain in new condition and make available for inspection on site by the Consultant.
- .3 On completion of Work and prior to final inspection, submit record documents to Consultant.

1.29 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from site and dispose of all debris and waste materials at appropriate disposal/recycling facilities.
- .2 Separate and recycle waste materials in accordance with applicable Construction/Demolition Waste Management And Disposal Regulations and Section 01 74 00.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not applicable.

PART 3 - EXECUTION

3.1 NOT USED

- .1 Not applicable.

END OF SECTION

Part 1 - GENERAL

1.1 REFERENCES

- .1 CSA C22.2, No. 65-18(R2022), Wire Connectors.
- .2 CSA C22.2, No. 197-M1983(R2023), PVC Insulating Tape.

Part 2 - PRODUCTS

2.1 WIRE AND BOX CONNECTORS

- .1 Pressure type wire connectors: with current carrying parts of copper sized to fit copper conductors as required.
- .2 Tin-plated copper, colour keyed, crimp type compression connectors, (long barrel, two hole) with a straight, 45° or 90° lug tongue configuration as required.
 - .1 Acceptable products: Thomas & Betts "Color-keyed" compression connectors or approved equivalent.
- .3 Clamps or connectors for armoured cable, liquid tight, flexible conduit, as required.
- .4 Wire connectors to be rated for operating voltage indicated.

2.2 ELECTRICAL TAPE

- .1 Vinyl Electrical Tape:
 - .1 Minimum 0.178mm thick, vinyl insulating tape per CSA standard C22.2 No. 197
 - .2 Temperature rating up to 105°C continuous.
 - .3 Tape to be conformable for cold weather application down to -18°C
 - .4 Pressure sensitive rubber based adhesive.
 - .5 Suitable for wet and dry locations.
 - .6 Rated for 600V circuits and below.
 - .7 Flame retardant and UV resistant.
 - .8 Colour: Black.
 - .9 Acceptable Materials: 3M Scotch 33+ or approved equivalent.
- .2 Rubber Insulating Tape:
 - .1 Highly conformable, ethylene propylene rubber (EPR), high voltage insulating and sealing tape (self bonding).
 - .2 Temperature rating up to 90°C continuous and 130°C short term overload service.
 - .3 Suitable for wet and dry locations.
 - .4 Rated for 600V circuits and below.
 - .5 Flame retardant.

- .6 Colour: Black.
- .7 Acceptable Manufacturers: 3M Scotch, or approved equivalent.

Part 3 - EXECUTION

3.1 WIRE AND BOX CONNECTORS INSTALLATION

- .1 Make connections and terminations electrically and mechanically secure. Sizes of connectors to be per manufacturer's recommendations for various sizes and combinations of wire sizes.
- .2 Make joints required in lighting and receptacle branch wiring #8 and smaller utilizing "twist-on" type connectors as manufactured by "Ideal" (colour coded wirenut) or "Marrettes" #31, #33 or #35, or approved equivalents.
- .3 Make lighting and receptacle branch wiring joints larger than #8 AWG utilizing colour keyed crimp type compression connectors (two hole, long barrel, tin-plated copper) complete with manufacturer approved compression tools. Bolt compression connectors together and torque in accordance with manufacturer's recommendation. Install first layers of rubber insulating tape followed by additional layers of vinyl electrical tape in accordance with the manufacturer's instructions. Heat shrink can also be used.
- .4 Plier tighten "twist-on" type connectors.
- .5 For connections to equipment not provided with lugs, install colour keyed, crimp type compression connectors (long barrel, two hole, tin-plated copper, straight lug tongue) complete with manufacturer approved compression tools. Alternate lug tongue configurations (45° and 90°) will be accepted where required by application.

END OF SECTION

Part 1 - GENERAL

1.1 SUBMITTALS

- .1 Submit shop drawings, and product data in accordance with Section 01 33 00.

1.2 RELATED SECTIONS

- .1 Conduits, Conduit Fastenings and Conduit Fittings: Section 26 05 34
- .2 Wire and Box Connectors (0 - 1000V): Section 26 05 20
- .3 Primary Process Instrumentation Devices and Cabling: Section 26 91 00

1.3 REFERENCES

- .1 CSA C22.1-24, Canadian Electrical Code.
- .2 CSA C22.2 No. 208:18(R2023), Fire Alarm and Signal Cable.

Part 2 - PRODUCTS

2.1 BUILDING WIRES

- .1 Conductors: soft drawn, stranded, copper (of 98% conductivity). Minimum size #12 AWG.
- .2 Copper conductors: size as indicated, with 600 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90-XLPE.
- .3 Copper conductors: size as indicated, with 1000V insulation of chemically cross-linked thermosetting polyethylene material rated RWU90-XLPE.
- .4 Colour code wiring in accordance with CSA C22.1.
- .5 SOW type flexible copper conductor may be utilized for drops from a junction box to a suspended luminaire in non-hazardous process areas.
- .6 AC90 may be used for drops from a junction box to a lighting fixture in areas with drop T-bar ceiling.

2.2 TECK 90 CABLE

- .1 Provide TECK cable in accordance with Section 26 05 00.
- .2 Conductors:
 - .1 Grounding conductor: stranded copper.
 - .2 Circuit conductors: stranded copper, size and quantity as indicated.
- .3 Insulation:

- .1 Chemically cross-linked thermosetting polyethylene rated type RW90, 1000V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking aluminum.
- .6 Overall covering: Polyvinyl chloride (PVC), heat, flame and moisture resistant material, FT4 rated, UV resistant, black colour.
- .7 Connectors:
 - .1 Non Hazardous Areas: Die cast aluminum connectors suitable for TECK 90 cables and complete with aluminum locknut.
 - .2 Zone 1 and Zone 2 Hazardous Areas: Die cast aluminum connectors suitable for TECK 90 cables and complete with sealing compound and aluminum locknut.
- .8 TECK 90 cables must be suitable for installation in the hazardous area classification indicated.

2.3 VFD CABLES

- .1 Use VFD cable where indicated on the Project Drawings for motors controlled by a variable frequency controller.
- .2 Conductors:
 - .1 Grounding conductors: three (3) stranded, bare copper ground wires, symmetrically located in continuous contact with copper tape shield.
 - .2 Circuit conductors: stranded, copper, size and quantity as indicated.
- .3 Insulation: flame retardant, chemically cross-linked thermosetting polyethylene (XLPE) rated 1000V.
- .4 Shielding: copper tape shield helically wound (100% coverage with 50% overlap) and tinned copper drain wire.
- .5 Continuously sheathed aluminium armour where installed in free air or in cable tray.
- .6 Overall covering: polyvinyl chloride (PVC); heat, flame, and moisture resistant material; FT4 rated; UV resistant (outdoor only); black in colour.
- .7 Connectors for armoured cables:
 - .1 Connectors:
 - .1 Non hazardous areas: die cast aluminum connectors suitable for armoured VFD cables and complete with aluminum locknut.
 - .2 Zone 1 and Zone 2 Hazardous areas: die cast aluminum connectors suitable for armoured VFD cables and complete with sealing compound and aluminum locknut.

- .3 Acceptable manufacturers: Thomas and Betts, Crouse-Hinds, Appleton, Nexans.
- .8 VFD cables must be suitable for installation in the hazardous area classification indicated.
- .9 Acceptable material Nexans DriveRX VFD cable, Beldan, or approved equivalent.

2.4 CONTROL CABLES

- .1 Type LVT: two (2) soft annealed solid copper conductors, #18AWG with PVC insulation, outer covering of thermoplastic jacket (brown colour), rated 300V.
- .2 24 Vdc control cable: stranded annealed tinned copper multi-conductors, minimum #16AWG size, quantity as indicated.
 - .1 Insulation: XLPE insulation.
 - .2 Shielding: foil tape shield over conductors.
 - .3 Armour: interlocking aluminum where required or as indicated.
 - .4 Overall covering: PVC jacket (moisture resistant and fire retardant), grey colour, FT4 rated, UV resistant.
 - .5 Voltage rating: 300V or 600V to suit application or as indicated.
 - .6 CSA type CIC (unarmoured) or ACIC (armoured).
- .3 120Vac control cables:
 - .1 Unarmoured conductors:
 - .1 Conductors: stranded copper, minimum size #14AWG, type RW90.
 - .2 Voltage rating: 600V.
 - .2 Armoured cables (TECK 90):
 - .1 Conductors:
 - .1 Grounding conductor: stranded copper.
 - .2 Circuit conductors: stranded copper, minimum size #14AWG.
 - .2 Insulation: RW90-XLPE, 600V.
 - .3 Inner jacket: polyvinyl chloride (PVC) material.
 - .4 Armour: interlocking aluminum.
 - .5 Overall jacket: polyvinyl chloride (PVC), heat, flame and moisture resistant material, FT4 rated, UV resistant, black colour.
- .4 Cables must be suitable for installation in the hazardous area classification indicated.

2.5 PROCESS CONTROL AND INSTRUMENTATION

- .1 Refer to Sections 26 90 00, 26 91 00, and electrical drawings.

2.6 PROCESS CONTROL COMMUNICATIONS CABLES

- .1 Refer to Sections 26 90 00, 26 91 00, and electrical drawings.

Part 3 - EXECUTION

3.1 INSTALLATION OF CABLES: GENERAL

- .1 Support cables independently of supports used for equipment of other trades; do not support from or secure cables to ductwork and piping.
- .2 Install cables in a neat and professional manner, so as to conserve headroom.
- .3 Install cables parallel and perpendicular to building lines.
- .4 In wet/damp areas and outdoors, cables to enter into the bottom of the equipment.
- .5 Twist together stranded conductors at each termination.
- .6 Ty-wrap branch circuit phase conductors and neutral (where applicable) at the closest point of entry within all panelboards, pullboxes, junction boxes, motor control centres and switchboards.
- .7 Conductor length for parallel feeders to be identical.
- .8 Wiring in walls: drop or loop vertically from the ceiling above. Avoid running wiring horizontally in walls.
- .9 Terminate conductors/cables.
- .10 Do not lay cables on top of suspended ceiling grids and tiles.

3.2 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows: in conduit systems in accordance with Section 26 05 34.

3.3 INSTALLATION OF CONTROL CABLE

- .1 Install unarmoured cables as follows: in conduit systems in accordance with Section 26 05 34.
- .2 Group cables wherever possible on surface mounted channels.
- .3 Terminate cables and provide connectors as required.
- .4 Install in accordance with clause 3.1 - Installation of Cables: General.
- .5 On walls, secure armoured cables to surface mounted u-shaped supports.

3.4 INSTALLATION OF TECK 90 AND ARMOURED VFD CABLE

- .1 Group cables wherever possible on surface mounted channels.
- .2 Terminate cables and provide connectors as required.

- .3 Install in accordance with clause 3.1 - Installation of Cables:
General.
- .4 On walls, secure armoured cables to surface mounted u-shaped supports.
- .5 Do not use TECK90 cables for general services such as lighting and
receptacles except where specifically indicated.

3.5 INSTALLATION OF UNARMoured VFD CABLE

- .1 Install cables as follows: in conduit systems in accordance with
Section 26 05 34.

END OF SECTION

Part 1 - GENERAL

1.1 RELATED WORK

- .1 Electrical General Requirements: Section 26 05 00

Part 2 - PRODUCTS

2.1 EQUIPMENT

- .1 Clamps for grounding of conductor, size as required to grounding electrodes.
- .2 Direct buried grounding conductors: bare stranded copper of minimum 98% conductivity, un-tinned, soft annealed, size as indicated.
- .3 Insulated grounding and bonding conductors: soft-drawn, stranded copper of minimum 98% conductivity, un-tinned, type RW90 (green coloured insulation). Conductors to be FT4 rated when installed in free-air.
- .4 Make ground connections on the ground bus as follows:
 - .1 For wire sizes 6 AWG and smaller: copper, one-hole, short barrel (single crimp) lugs.
 - .2 Wire larger than 6 AWG to be two-hole, long barrel (dual crimp) lugs.
- .5 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Thermit welded type conductor connectors.
 - .5 Bonding jumpers, straps.
 - .6 Pressure wire connectors.
- .6 Copper crimp type compression connectors, (long barrel, two hole).
- .7 Copper crimp type compression connectors (cable to cable, cable to ground rod, etc.)
- .8 Rod electrodes, copper clad steel, 21mm diameter, 3m long.

2.2 MANUFACTURERS

- .1 Acceptable manufacturers: FCI - Burndy Corporation, Erico Inc., Thomas & Betts, Ilsco.

Part 3 - EXECUTION

3.1 INSTALLATION GENERAL

- .1 Install complete permanent, continuous, system and circuit, equipment, grounding systems including, conductors, connectors, accessories, as indicated, to conform to requirements of the Consultant, and local authority having jurisdiction over installation.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Make buried connections and connections to electrodes using exothermic welding process or inspectable copper crimp type compression connectors.
- .5 Use mechanical connectors for grounding connections to equipment provided with grounding lugs.
- .6 Soldered joints not permitted.
- .7 Make grounding connections in radial configurations only, with connections terminating at single grounding point. Avoid loop connections.
- .8 Provide insulated copper bonding conductor in all conduit runs. Minimum size #14AWG or as indicated in Table 16 of the CEC, whichever is larger.
- .9 Use copper, crimp type compression connectors for grounding connections to equipment not provided with connectors.
- .10 Secure the 'feed' bonding conductor (wrapped around unbroken) to the grounding screw of each outlet/device box, before connecting to the other grounding conductors and/or providing a "pig-tail" lead for device terminations.
- .11 Twist all ground/bond wires together with a screw-on type wire connector, and then placed in the rear of the outlet box.

3.2 ELECTRODES

- .1 Bond separate, multiple electrodes together.
- .2 Use copper conductors, size as indicated, for connections to electrodes.
- .3 Install grounding triad near the electrical service entrance and connect to electrical grounding system with copper conductor, size as indicated on the Project Drawings.

3.3 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections to neutral of secondary systems.

3.4 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list: Service equipment, , transformers, frames of motors, control panels, outdoor lighting, process equipment, instrumentation, building steel work and air ducts.

3.5 COMMUNICATION SYSTEMS

- .1 Install grounding connectors for telephone and data systems as follows:
 - .1 Telephone: make grounding connections in accordance with the telephone company's requirements.
 - .2 Data: as indicated or as recommended by manufacturer.

3.6 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00.
- .2 Perform tests before energizing electrical system.

END OF SECTION

Part 1 - GENERAL

1.1 NOT USED

- .1 Not applicable.

Part 2 - PRODUCT

2.1 SUPPORT CHANNELS

- .1 U shape, size 41 mm x 41 mm, 2.7 mm thick, surface mounted, suspended or set in poured concrete walls and ceilings unless otherwise indicated.
- .2 Standard rolled structural steel shapes and plates or prefabricated structural systems.
- .3 Materials:
 - .1 Hot-dipped galvanized steel (after fabrication) unless otherwise noted.
 - .2 Electrogalvanized steel in dry non-process areas.
 - .3 316 Stainless steel outside, in wet and/or corrosive areas, and in electrically hazardous areas.

2.2 CABLE TIES

- .1 Nylon flame retardant, low smoke cable tie, size as required.
- .2 Nylon flame retardant, low smoke cable tie mounting bracket. Mechanical fastening type only; adhesive mounts not acceptable.

Part 3 - EXECUTION

3.1 INSTALLATION

- .1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors or nylon shields.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls with stainless steel toggle bolts.
- .4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .5 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole straps for conduits and cables larger than 50 mm.

- .3 Conduit straps to match conduits in material and finish. Cable straps to be galvanized steel or stainless steel to suit area.
- .4 Use heavy duty pipe clamps (with adjustable saddles) to secure conduits/cables to support channels.
- .6 Suspended support systems for horizontal runs:
 - .1 Support individual conduit runs with minimum 9 mm diameter continuously threaded rods and spring clips.
 - .2 Support two (2) or more conduits on channels supported by minimum 12 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
 - .3 Continuously threaded rods to be zinc plated steel or stainless steel to match supporting hardware.
- .7 For surface mounting of two (2) or more conduits and cable, use support channels spaced in accordance with the Canadian Electrical Code (maximum 1.5m spacing).
- .8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .9 Provide adequate support for conduits and cables dropped vertically to equipment where there is no wall support.
- .10 Do not use wire lashing or perforated strap to support or secure conduits or cables.
- .11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of the Consultant.
- .12 Provide fastenings and supports as required for each type of equipment, cables and conduits, and in accordance with manufacturer's installation recommendations.
- .13 Provide hot dipped galvanized or stainless steel beam clamps to secure conduits to exposed steel work. Use stainless steel clamps in hazardous areas and in wet/corrosive areas.
- .14 Support various suspended types of junction, pull and/or outlet boxes as well as conduits, with minimum size 9 mm threaded rod, nuts and flat washers. Secure threaded rods to boxes with one (1) flat washer and nut installed on both sides of box. Provide:
 - .1 One (1) rod required for all type boxes sized 150 mm x 150 mm and smaller.
 - .2 Two (2) rods required for boxes sized 200 mm x 200 mm and larger, up to and including those sized 300 mm x 300 mm.
 - .3 Minimum of four (4) rods required for all boxes sized larger than 300 mm x 300 mm.
 - .4 Cut off all excess rod within 12 mm of channel bottom.

- .15 In addition to C.E.C. minimum conduit spacing requirements, suspended conduit runs containing horizontal or vertical elbows are to have one additional support rod installed not greater than 300 mm and mid point of "all" 90° bends. Maximum spacings between conduit support channels shall be as dictated by smallest size conduit(s) being supported and/or secured to same.
- .16 Where galvanized steel supports are exposed to moisture, touch-up all field cut surfaces with galvanizing paint.
- .17 Install isolator pads between dis-similar metals as required.
- .18 Coordinate support system locations with other trades before installing.

END OF SECTION

Part 1 - GENERAL

1.1 SUBMITTALS

- .1 Submit shop drawings, and product data in accordance with Section 01 33 00.

Part 2 - PRODUCTS

2.1 CABINETS

- .1 In non-hazardous locations, provide cabinets constructed of code-gauge sheet steel, each with a hinged and gasketed door, for surface, floor, or flush mounting as indicated on the Drawings. Use NEMA Type 4X stainless steel enclosures in damp and wet process and non-process areas. Use NEMA 4X stainless steel enclosures outdoors. Use primed and grey baked-on enamel NEMA Type 1 steel enclosures in dry indoor non-process areas; and use primed and grey-baked on enamel NEMA Type 12 steel enclosures in dry indoor process areas. Provide cabinets with no knockouts; cut holes for conduit entrances after cabinet is mounted in final position.
- .2 In hazardous locations, cabinets must be suitable for installation in the specified hazardous classification. Cabinet materials must be copper-free aluminum or stainless steel (316).
- .3 Provide all cabinets with continuously hinged doors, padlocking attachment, door stop kit and door handle.

2.2 JUNCTION AND PULL BOXES

- .1 General: Provide outlet, tap, junction, pull and floor boxes with screw-fastened covers. Provide junction and pull boxes longer than 500mm in any dimension complete with continuously hinged cover.
- .2 Tap, Junction and Pull Boxes: Provide boxes constructed of welded and galvanized sheet steel, of sizes required by Canadian Electrical Code. Use 14 USS gauge metal on boxes with no dimension of 600 mm or more, except use 10-gauge boxes with any dimension of 900 mm or more.
- .3 Use NEMA Type 1 enclosures (steel) in dry indoor non-process areas.
- .4 Use NEMA Type 12 enclosures (steel, grey baked on enamel finish) in dry process areas and in mechanical rooms.
- .5 In damp, wet and outdoor locations, use NEMA Type 4X water-tight boxes with clamped, threaded or bolted covers. Boxes to be stainless steel (316SS) or copper free cast aluminum boxes. PVC boxes may be used in areas where rigid PVC conduit is installed.
- .6 Hazardous Rated Boxes:

- .1 Boxes must be suitable for the hazardous classification as noted on the drawings.
- .2 Boxes to be cast ferrous metal boxes with threaded connection for use with threaded galvanized steel conduit.
- .3 Boxes to be copper free cast aluminum boxes with threaded connections for use with threaded aluminum conduit.

2.3 SPLITTER BOX

- .1 14 gauge steel enclosure, welded corners and formed hinged cover suitable for locking in the closed position.
- .2 Phenolic insulated splitter blocks to match required number and size of incoming and outgoing conductors as indicated.
- .3 Provide minimum of three (3) spare terminals on each set of lugs.
- .4 Electrical ratings as indicated on Drawings.
- .5 Unless otherwise indicated on the Drawings, enclosure rating shall be NEMA Type 12.
- .6 Finish: baked grey enamel.
- .7 Acceptable Materials: Eurobex 1400T Series or approved equivalent.

Part 3 - EXECUTION

3.1 CABINETS, JUNCTION AND PULL BOXES

- .1 Only main junction and pull boxes are indicated on the drawings. Provide boxes to suit field conditions and where required by the Canadian Electrical Code.
- .2 Install junction and pull boxes in inconspicuous but accessible locations.
- .3 Mount cabinets with top not higher than 2m above finished floor.
- .4 Provide all required mounting hardware.
- .5 Junction or outlet boxes feeding a maximum of two fixture drops must not be sized smaller than 100mm square.
- .6 Concealed boxes located in the ceiling spaces above suspended type ceilings are not to be installed greater than 762mm above the finished ceiling elevation.
- .7 Junction boxes larger than 150mm x 150mm used in branch circuit wiring are to be complete with bonding terminal stripes.
- .8 Bond all pull boxes with bonding conductor.

3.2 SPLITTER BOX

- .1 Install splitters and mount plumb, true and square to building lines.

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3.3 IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00.

END OF SECTION

Part 1 - GENERAL

1.1 REFERENCES

- .1 CSA C22.1-24 Canadian Electrical Code, Part 1.

Part 2 - PRODUCTS

2.1 OUTLET AND CONDUIT BOXES

- .1 General:
 - .1 Size boxes in accordance with CSA C22.1.
 - .2 100 mm square or larger outlet boxes as required for special devices.
 - .3 Gang boxes where wiring devices are grouped.
 - .4 Blank cover plates for boxes without wiring devices.
 - .5 Combination boxes with barriers where outlets for more than one system are grouped.
 - .6 347V outlet boxes for 347V switching devices.
- .2 Sheet steel outlet boxes:
 - .1 Electro-galvanized steel single and multi-gang flush device boxes for flush installation, minimum size 75 x 50 x 38 mm or as indicated. Use 100 mm square outlet boxes when more than one conduit enters one side.
 - .2 100 mm square or octagonal outlet boxes for lighting fixture outlets.
 - .3 Electro-galvanized steel utility boxes for outlets connected to surface mounted EMT, minimum size 100mm x 54mm x 47mm.
- .3 Masonry boxes: electro-galvanized steel masonry single and multi-gang boxes for devices flush mounted in exposed block walls.
- .4 Concrete boxes: electro-galvanized steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.
- .5 Surface mounted outlet boxes:
 - .1 Cast FS or FD copper free aluminum or feralloy boxes (to match conduit material) with factory threaded hubs and mounting feet for surface wiring of switches, receptacles, thermostats, etc.
 - .2 NEMA 4X PVC outlet boxes in areas where PVC conduit is to be used.
- .6 Explosion proof outlet boxes:
 - .1 Surface mounted, single gang, cast copper free aluminum or iron alloy (galvanized) to match conduit material, outlet box with

factory threaded hubs, rated for installation in the hazardous area classification as noted on the drawings.

- .2 Confirm outlet box and devices are compatible and that the required hazardous rating is maintained.

2.2 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of foreign materials.
- .3 Conduit outlet bodies for conduit up to 35mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.
- .5 Watertight bushings and cable connectors for all cable/conduit terminations in NEMA 3R/4/4X pull/junction boxes, control panels and cabinets.
- .6 Sealing rings for conduit connections in wet and damp areas.

Part 3 - EXECUTION

3.1 OUTLET BOX, AND CONDUIT BOX INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similarly approved material to prevent entry of construction material. Remove upon completion of Work.
- .3 Provide correct size of openings in boxes for conduit and armoured cable connections. Reducing washers not allowed.
- .4 Install flush mounted boxes in all finished areas unless otherwise indicated.
- .5 Install surface mounted boxes in service rooms and above ceilings unless otherwise indicated.
- .6 Install flush mounted boxes outside in exterior walls unless otherwise indicated.
- .7 Use type FS and FD boxes for surface mounted devices (regardless of system type involved).
- .8 In metal drywall partitions, install a short piece of metal stud (same width as wall) on non-supported side of box and secure to box.
- .9 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .10 For flush installations, mount outlet box flush with finished wall using plaster rings to permit wall finish to come within 6mm of opening.

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.11 Install flush mounted floor boxes where indicated.

END OF SECTION

Part 1 - GENERAL

1.1 LOCATION OF CONDUIT

- .1 Drawings do not show all conduits. Those shown are in diagrammatic form only.

1.2 RELATED WORK

- .1 Fastenings and Supports: Section 26 05 29
- .2 Outlet Boxes, Conduit Boxes and Fittings: Section 26 05 32

1.3 REFERENCES

- .1 CSA C22.2 No.45.1-2022, Electrical Rigid Metal Conduit - Steel.
- .2 CSA C22.2 No.45.2-08(R2023), Electrical Rigid Metal Conduit - Aluminum, Red Brass and Stainless Steel.
- .3 CSA C22.2 No. 56-17(R2022), Flexible Metal Conduit and Liquid Tight Flexible Metal Conduit.
- .4 CSA C22.2 No. 83-M1985(R2022), Electrical Metallic Tubing.
- .5 CSA C22.2 No. 211.2-06(R2021), Rigid PVC (Unplasticized) Conduit.

Part 2 - PRODUCTS

2.1 CONDUITS

- .1 Rigid galvanized steel threaded conduit, fittings and connectors: to CSA C22.2 No. 45.1.
- .2 Rigid aluminum threaded conduit, fittings and connectors: to CSA C22.2 No. 45.2.
- .3 Electrical metallic tubing (EMT) with steel set screw couplings: to CSA C22.2 No. 83.
- .4 Rigid PVC conduit, fittings and connectors: to CSA C22.2 No. 211.2.
- .5 Flexible aluminum conduit and liquid-tight flexible metal conduit: to CSA C22.2 No. 56.
- .6 Minimum power and control/instrumentation conduit size for all areas: 21mm.
- .7 Rigid PVC conduit to be FT4 rated.

2.2 CONDUIT FASTENINGS

- .1 One (1) hole conduit straps to secure surface conduits 50 mm and smaller. Two (2) hole conduit straps for conduits larger than 50 mm.

- .2 Heavy duty pipe clamps (with adjustable saddle) to secure conduits to support channels.
- .3 Refer to specification Section 26 05 29 for suspended and surface support systems for conduits.
- .4 Finish and material to match conduit.
- .5 Provide isolators between dis-similar metals as required.

2.3 CONDUIT FITTINGS

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Factory "ells" where 90° bends are required for 27mm and larger conduits.
- .3 Connectors and couplings for EMT: steel set-screws in non-dusty areas and rain tight fittings in dusty areas.
- .4 Cast type EYS and EYD seal fittings with factory threaded hubs and rated for the hazardous classification. Acceptable manufacturers: Appleton, Crouse-Hinds, Killark or approved equivalent.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for linear expansion as required.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to building as required.
- .4 Provide expansion fittings at exit point (above-ground) of all underground services, and where indicated on the drawings.
- .5 Where rigid PVC conduit is installed above ground, provide expansion fittings spaced in accordance with manufacturer's instructions and the Canadian Electrical Code.

2.5 FISH CORD

- .1 Polypropylene.

Part 3 - EXECUTION

3.1 CONDUIT INSTALLATION

- .1 General:
 - .1 Use threaded rigid aluminum conduit unless otherwise indicated.
 - .2 Use rigid galvanized steel threaded conduit in dry, non-hazardous process areas.

- .3 Use rigid PVC conduit in wet, non-hazardous process areas.
- .4 Use electrical metallic tubing (EMT) in dry, non-process areas and where not subjected to damage. Do not use EMT in cast concrete. Convert EMT to rigid galvanized steel conduit below 2.4m where EMT is surface mounted and subjected to mechanical damage.
- .5 Use rigid PVC conduit for all direct buried underground services: minimum size 27mm diameter.
- .6 Use rigid PVC conduit in slab and under slab. Conduit stub ups to be rigid aluminum conduit, with heat shrink sleeve. Leave no portion of aluminum conduit exposed to concrete. Electrical non-metallic tubing (ENT) is not permitted.
- .7 Use liquid-tight flexible metal conduit for connection to vibrating equipment (motors, valves, transformers, motorized dampers, etc.) and instruments in non-hazardous areas.
- .8 Use flexible couplings (explosion-proof, watertight, Appleton Type EXGJH or EXLK or approved equivalent) for vibrating equipment (motors, valves, etc.) and instruments located in hazardous areas.
- .9 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .10 Conceal conduits except in mechanical rooms, electrical rooms and in process areas.
- .11 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .12 Mechanically bend steel conduit over 21 mm diameter.
- .13 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .14 Install polypropylene fish cord in all empty conduits. Cap and seal at each end.
- .15 Where conduits become blocked, remove and replace blocked section. Do not use liquids to clean out conduits.
- .16 Dry conduits out before installing wire.
- .17 Provide minimum 300 mm spacing between instrumentation/control conduits and 600V power conduits. Where possible, instrumentation/control conduits to cross at right angles to 600V power conduits.
- .18 Seal around all conduit penetrations into chemical rooms with non-shrink grout. Seal conduits penetrating into these rooms using duxseal.
- .19 Install conduit sealing fittings in hazardous areas in accordance with Canadian Electrical Code requirements. Fill with compound. Seal conduit leaving a hazardous area using an approved sealing fitting at exit point.

- .20 Drawings do not show all required unions. Unions to facilitate removal of equipment. Where seals are installed, install the unions between the equipment and the seal.
- .21 Install conduits to prevent low pockets where moisture can accumulate. Install a combination breather and drain fitting at the lowest point of each above-grade conduit system, which is unbroken by sealing fittings or other obstructions.
- .2 Surface conduits:
 - .1 Run parallel or perpendicular to building lines.
 - .2 Group conduits wherever possible on suspended or surface channels.
 - .3 Do not pass conduits through structural members except as indicated.
 - .4 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum 25 mm at crossovers.
 - .5 Fasten to flutes of metal roof deck when practical.
 - .6 Do not run conduits where they might obstruct lifting devices such as monorails.
 - .7 Install support channels on walls for vertical conduit drops.
- .3 Concealed conduits:
 - .1 Do not install horizontal runs in masonry walls.
 - .2 Do not install conduits in concrete toppings.
 - .3 Run parallel or perpendicular to building lines.
- .4 Conduits underground: slope conduits to provide drainage.
- .5 Install below slab conduits in trenches not less than 300mm from underside of concrete floor slab to top of trench. Provide a minimum 150mm of freshwater sand all around conduits.
- .6 Supply and install pull string in each spare conduit. Cap and seal conduit at each end.

END OF SECTION

Part 1 - GENERAL

1.1 RELATED WORK

- .1 Electrical General Requirements: Section 26 05 00
- .2 Excavating, Trenching and Backfilling: Section 31 23 10
- .3 Concrete Encased Duct Banks: Section 33 65 73
- .4 Direct Buried Underground Cable Ducts: Section 33 65 76

Part 2 - PRODUCTS

2.1 MARKERS

- .1 Warning marker tape, colour as noted.
- .2 Include tracer tape over fibre cables.

Part 3 - EXECUTION

3.1 CABLE INSTALLATION IN DUCTS

- .1 Install cables as indicated in ducts.
- .2 Do not pull spliced cables inside ducts.
- .3 Do not install splices underground.
- .4 Install multiple cables in duct simultaneously.
- .5 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .6 To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.
- .7 Before pulling cable into ducts and until cables are properly terminated; seal ends of non-leaded cables with moisture seal tape.
- .8 After installation of cables, seal duct ends with duct sealing compound.
- .9 After installation of cables in hazardous areas, seal duct ends with appropriate sealing devices and compound.

3.2 MARKERS

- .1 Install continuous marker tape over all buried conduits.

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3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00.

END OF SECTION

Part 1 - GENERAL

1.1 REFERENCES

- .1 NRCan 20019, Transformer Efficiencies.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00.

1.3 OPERATIONS & MAINTENANCE DATA

- .1 Provide operations and maintenance data for transformers for incorporation into manual.

Part 2 - PRODUCTS

2.1 TRANSFORMERS

- .1 Use transformers of one (1) manufacturer throughout project.
- .2 Transformers must meet or exceed energy efficiencies as outlined in NRCan 2019.
- .3 Design 1:
 - .1 Type: dry.
 - .2 3 phase, kVA as indicated, 600 V input, 120/208 V output, 60 Hz.
 - .3 Voltage taps: 2.5% - 2FCAN, 2 FCBN (95%, 97.5%, 100%, 102.5% and 105%).
 - .4 Insulation: Class H, 150°C temperature rise.
 - .5 Basic Impulse Level (BIL): standard.
 - .6 Hipot: standard.
 - .7 Average sound level: standard.
 - .8 Impedance at 170°C: standard.
 - .9 Enclosure: NEMA Type 2, ventilated removable metal front panel and hood, drip proof.
 - .10 Mounting: as indicated.
 - .11 Finish: in accordance with Section 26 05 00.
 - .12 Winding configuration: Delta primary, grounded Y secondary. All windings copper. T-connected transformers are not acceptable.
 - .13 Options:
 - .1 Vibration isolators.
 - .2 Dual rated spade type transformer lug for ground/bonding of transformers.
 - .14 Acceptable material:
 - .1 Hammond Power
 - .2 Schneider Electric

- .3 Delta Transformers
- .4 Rex Manufacturing

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00.
- .2 Label size: 9.

Part 3 - EXECUTION

3.1 INSTALLATION

- .1 Securely mount dry type transformer on concrete housekeeping pad or on wall as indicated. Refer to drawings for mounting details. Where transformers do not have internal vibration isolators, provide external vibration isolators on transformer support channels at each of the four corners and between the transformer enclosure legs and floor or support structure.
 - .1 Acceptable material: Vibro-Acoustics RM Series, size as required.
- .2 Transformer electrical terminations to be front accessible.
- .3 Install with adequate clearance around transformer for ventilation in accordance with the Canadian Electrical Code and Electrical Inspection department having jurisdiction.
- .4 Install transformers in level upright position.
- .5 Remove shipping supports only after transformer is installed and just before putting into service.
- .6 Loosen isolation pad bolts until no compression is visible.
- .7 Megger both primary and secondary windings with 1000 V and 500 V megger as recommended by the manufacturer and report immediately any reading below 100 megohms. Submit test results for the Consultant's review and approval and include in O&M Manual.
- .8 Confirm the transformer is on the correct tap. Record tap settings and include in O&M Manual.
- .9 Add lugs for copper conductors when double neutrals are used.
- .10 Provide all dry type transformers complete with a dual rated spade type transformer lug, sized as required to facilitate both grounding and bonding conductor requirements.
 - .1 Bolt lug directly to transformer enclosure (chassis) with a minimum of two (2) 12 mm bolts, flat and lock washers and accompanying nuts etc.
 - .2 To contain number of termination openings as necessary to ensure individual terminations of "each" ground and "each" bond conductor(s) is achieved.

- .11 Make primary and secondary connections in accordance with wiring diagram.
- .12 Energize transformers after installation and testing is complete.
- .13 For transformers mounted above the floor, construct a support structure from galvanized structural steel channel, painted to match wall colour.

END OF SECTION

Part 1 - GENERAL

1.1 RELATED WORK

- .1 Electrical General Requirements: Section 26 05 00
- .2 Moulded Case Circuit Breakers: Section 26 28 21

1.2 REFERENCES

- .1 CAN/CSA C22.2 No. 31-23, Switchgear Assemblies

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data for review and approval in accordance with Section 01 33 00.
- .2 Indicate on shop drawings.
 - .1 Floor anchoring method and foundation template.
 - .2 Dimensioned cable entry and exit locations.
 - .3 Dimensioned position and size of bus.
 - .4 Overall length, height and depth.
 - .5 Dimensioned layout of internal and front panel mounted components.
- .3 Include time-current characteristic curves for circuit breakers and fuses.

1.4 OPERATIONS AND MAINTENANCE DATA

- .1 Provide maintenance data for service entrance board for incorporation into manual as specified in Section 01 78 00.

1.5 SOURCE QUALITY CONTROL

- .1 Submit two (2) copies of certified factory test results in accordance with Section 01 33 00.

Part 2 - PRODUCTS

2.1 MATERIALS

- .1 Switchboards to CSA C22.2 No. 31.

2.2 SERVICE ENTRANCE BOARD

- .1 Furnish dead front type, completely metal enclosed, self-supporting switch boards consisting of the required number of vertical sections bolted together for form one (1) rigid unit.
- .2 Rating: 600 Vac, 3-phase, 4-wire, continuous ampere rating and short circuit rating (momentary RMS symmetrical) as noted on the drawings,

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minimum 42 kA bus bracing rating.

.3 Vertical sections:

- .1 Section 1: Side mounted, bussed wireway for main incoming cables (bottom entry).
- .2 Section 2: Main breaker, utility CT cabinet and outgoing lugs.
- .3 Section 3: Distribution section complete with feeder circuit breakers.
- .4 Barrier metering section from adjoining sections.
- .5 Provision for installation of power supply authority metering in barriered section.
- .6 Switchboard to be front accessible.
- .7 Hinged access panels with captive knurled thumb screws.
- .8 Bus bars and main connections: 99.3% copper, tin plated. Main horizontal busbars shall be mounted with all three phases arranged in the same vertical plane.
- .9 Bus from wireway to line side of main breaker.
- .10 Bus from load side of main breaker to the outgoing lugs section via utility metering section.
- .11 Identify phases with colour coding.
- .12 38 mm channel sill.
- .13 Provide switchboard complete with driphood.
- .14 Include ventilation openings where required.
- .15 Provide switchboard suitable for use as service entrance equipment, meet local utility requirements and be labelled in accordance with CSA requirements.
- .16 Provide the assembly with adequate lifting means and with the capability of being moved into installation position and bolted directly to the floor.

2.3 MAIN BREAKER

- .1 Provide low voltage moulded case circuit breaker, 600 Vac, frame and trip rating as indicated on the drawings. Circuit breaker to be CSA listed for application in its intended enclosure.
- .2 Provide circuit breaker complete with adjustable electronic overcurrent trip unit (LSI), true RMS sensing.
- .3 Refer to Section 26 28 21 - Moulded Case Circuit Breakers for additional circuit breaker specifications.

2.4 GROUNDING

- .1 Furnish copper ground bus firmly secured to each vertical section structure and extend to entire length of the switchboard.

- .2 Lugs at each end for grounding conductor, sized as indicated on the drawings.

2.5 POWER SUPPLY AUTHORITY METERING

- .1 Separate compartment and metal raceway for exclusive use of power supply authority metering.
- .2 Mounting accessories and wiring for metering supplied by utility:
 - .1 Three (3) current transformers.
 - .2 Two (2) potential transformers.

2.6 INCOMING/OUTGOING LUGS

- .1 Provide screw type mechanical lugs to terminate incoming service entrance cables and outgoing cables.
- .2 Refer to drawings for quantity and configuration of cables.

2.7 FINISHES

- .1 Apply finishes in accordance with Section 26 05 00.
 - .1 Service entrance board exterior: grey.

2.8 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00.
- .2 Nameplates:
 - .1 White plate, black letters.
 - .2 Complete board labelled: " Main 600V Switchboard DP-1."
 - .3 Main disconnect labelled: "Main Breaker".

2.9 ACCEPTABLE MANUFACTURERS

- .1 Schneider Electric (Square D).
- .2 Eaton Canada
- .3 Siemens.

Part 3 - EXECUTION

3.1 INSTALLATION

- .1 Locate service entrance board and install in accordance with manufacturer's instructions. Provide 100 mm thick concrete housekeeping pad (minimum 50 mm larger than the outside dimensions and complete with chamfered edges) under switchboard.
- .2 Connect main utility service to incoming cable lugs.
- .3 Connect loads to feeders.

- .4 Connect neutral conductors to common neutral bus with respective neutral identified.
- .5 Provide one (1) grounding conductor from ground bus to building ground as indicated.
- .6 Apply adjustable breaker trip unit settings in accordance with the CEC and Protection Coordination Study to confirm proper working and protection of components.
- .7 Install the equipment and check in accordance with the manufacturer's recommendations. This includes but is not limited to:
 - .1 Confirm the pad location is level to within 3 mm.
 - .2 Confirm bus bars are torqued to the manufacturer's recommendations.
 - .3 Assemble all shipping sections, remove all shipping braces and connect all shipping split mechanical and electrical connections.
 - .4 Secure assemblies to foundation or floor channels.
 - .5 Measure and record Megger readings phase to phase, phase to ground and neutral to ground.

END OF SECTION

Part 1 - GENERAL

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.2 OPERATIONS AND MAINTENANCE DATA

- .1 Provide operations and maintenance data for panelboards for incorporation in to manual.
- .2 Include panel schedules.

Part 2 - PRODUCTS

2.1 PANELBOARDS

- .1 Panelboard:
 - .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 Bus and breakers rated for the interrupting capacity (momentary rms symmetrical) as indicated on the drawings.
- .3 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.
- .4 Panelboard: mains, number of circuits, and number and size of branch circuit breakers as indicated on the drawings.
- .5 Provide two (2) keys for each panelboard and key panelboards alike.
- .6 Tin-plated, copper busbars with neutral of same ampere rating as mains.
- .7 Mains: suitable for bolt-on breakers.
- .8 Trim with concealed front bolts and hinges.
- .9 Trim and door finish: baked grey enamel.
- .10 Provide panelboard complete with driphood.
- .11 Surface mount panelboards unless noted otherwise.

2.2 BREAKERS

- .1 Breakers: as specified in Section 26 28 21.
- .2 Bolt-on breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

- .3 Lock-on devices for 10 % of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to the Consultant.

2.3 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00.
- .2 Nameplate for each panelboard size 9 engraved.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit.

2.4 ACCEPTABLE MANUFACTURERS

- .1 Eaton, Schneider Electric (Square D), Siemens.

Part 3 - EXECUTION

3.1 INSTALLATION

- .1 Locate panelboard as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Connect panelboard to source transformer or circuit breaker as indicated.
- .3 Connect loads to circuits.
- .4 Connect neutral conductors to common neutral bus with respective neutral identified.
- .5 Install type-written panel schedule in panelboards.

END OF SECTION

Part 1 - GENERAL

1.1 RELATED WORK

- .1 Electrical General Requirements: Section 26 05 00
- .2 Moulded Case Circuit Breakers: Section 26 28 21

1.2 REFERENCES

- .1 CAN/CSA C22.2 No. 31-23, Switchgear Assemblies

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data for review and approval in accordance with Section 01 33 00.
- .2 Drawings to include electrical details of panel, branch breaker type, quantity, ampacity, and enclosure dimensions.
- .3 Include time-current characteristic curves for circuit breakers and fuses.

1.4 OPERATIONS AND MAINTENANCE DATA

- .1 Provide maintenance data for panelboard for incorporation into manual as specified in Section 01 78 00.

Part 2 - PRODUCTS

2.1 DISTRIBUTION PANELBOARD

- .1 Panelboard arrangement to conform with arrangement shown on the Project Drawings.
- .2 Rating: 600 Vac, 3-phase, 4-wire, continuous ampere rating and short circuit rating (momentary RMS symmetrical) as noted on the drawings, minimum 42 kA bus bracing rating.
- .3 Panelboard to be surface mounted, front accessible.
- .4 Provide two (2) keys for each panelboard and key panelboards alike.
- .5 Bus bars and main connections: 99.3% copper, tin plated with neutral of the same rating as mains.
- .6 Copper ground bus bonded to enclosure.
- .7 Branch mounting space: to suit branch breakers with minimum space for four (4) 3-pole breakers.
- .8 Trim to be concealed front bolts and hinges.
- .9 Nominal enclosure dimensions: 90" (2286mm) high, 38" (965mm) wide, 12" (300mm) deep.

2.2 BRANCH BREAKERS

- .1 Moulded case circuit breakers as specified in Section 26 28 21.
- .2 Provide feeder circuit breakers in distribution section as noted on the drawings.
- .3 Electrical ratings of all circuit breakers as indicated on drawings.
- .4 Circuit breakers to be factory installed.

2.3 SURGE PROTECTIVE DEVICE

- .1 Include SPD device in panelboard as specified in Section 26 43 13..

2.4 CUSTOMER METERING

- .1 Include digital power meter in panelboard per Section 26 09 23.
- .2 Include mounting accessories, instrument transformers, and wiring for metering system for a complete and functioning system.

2.5 INCOMING LUGS

- .1 Provide screw type mechanical lugs to terminate incoming cables.
- .2 Refer to drawings for quantity and configuration of cables.

2.6 FINISHES

- .1 Apply finishes in accordance with Section 26 05 00.
 - .1 Trim and door finish: baked grey enamel.

2.7 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00.
- .2 Nameplates:
 - .1 White plate, black letters.
 - .2 Complete board labelled as per Project Drawings.
 - .3 Branch breakers labelled as per load.

2.8 ACCEPTABLE MANUFACTURERS

- .1 Schneider Electric.
- .2 Eaton Canada
- .3 Siemens.

Part 3 - EXECUTION

3.1 INSTALLATION

- .1 Locate panelboard as indicated and mount securely, plumb, true, square, to adjoining surfaces or mounting structure.
- .2 Connect incoming cables to incoming cable lugs.
- .3 Connect loads to feeders.
- .4 Connect neutral conductors to common neutral bus with respective neutral identified.
- .5 Apply adjustable breaker trip unit settings in accordance with the CEC and Protection Coordination Study to maintain proper working and protection of components.

END OF SECTION

Part 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies requirements for the supply and installation of the motor control centres.

1.2 RELATED WORK

- .1 Electrical General Requirements: Section 26 05 00
- .2 Moulded Circuit Breakers: Section 26 28 21
- .3 Motor Starters to 600V: Section 26 29 10

1.3 REFERENCES

- .1 CAN/CSA-C22.2, No. 5-16(R2020), Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-National standard, with UL 489 and NMX-J-266-ANCE).
- .2 CSA-C22.2, No. 14-22, Industrial Control Equipment.
- .3 CSA-C22.2 No. 66.2-2021, Low Voltage Transformers: Ground Purpose Transformers.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Indicate:
 - .1 Outline dimensions
 - .2 Configuration of equipment on elevation drawing complete with motor starter identification on the same elevation.
 - .3 Dimensioned foundation template.
 - .4 Cable duct entry and exit locations.
 - .5 Dimensioned position and size of busbars.
 - .6 Schematic and wiring diagrams for motor starters.
 - .7 Magnetic circuit breaker type.
 - .8 Overload relay type.
 - .9 Starter size and type.
 - .10 Enclosure type.

1.5 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for motor control centre for incorporation into manual specified in Section 01 78 00.
- .2 Include data for each type and style of starter.

Part 2 - PRODUCTS

2.1 MOTOR CONTROL CENTRE

- .1 Motor control centre manufactured to NEMA Standards.
- .2 Control equipment to CSA-C22.2, No. 14.
- .3 Control transformers to CSA-C22.2 No. 66.2.
- .4 Circuit breakers to CSA-C22.2 No. 5.
- .5 Rating 600 volts, 60 Hz, 3-phase, 3 or 4-wire as indicated on the Project Drawings, continuous ampere rating and short circuit interrupting rating (momentary RMS symmetrical) as indicated on the drawings.
- .6 Compartmentalized vertical sections with common power busbars, front only arrangement, minimum 300mm depth.
- .7 Floor mounting, free standing, enclosed dead front.
- .8 Indoor NEMA Type 2 enclosure with gasketed doors and driphood.
- .9 Front mounting.
- .10 Class 1 type B wiring.
- .11 Horizontal wireways, equipped with cable supports across top and bottom, extending full width of motor control centre insulated from busbars by steel barriers.
- .12 Vertical wireways for load and control conductors extending full height of vertical sections, and equipped with cable tie supports. Installation wiring to units accessible with doors open and units in place.
- .13 Openings, with removable coverplates, in side of vertical sections for horizontal wiring between sections.
- .14 Incoming cables to enter at top or bottom, as indicated on the drawings.
- .15 Provision for outgoing cables to exit via top or bottom.
- .16 Include bottom plate for termination of armoured cables entering from the bottom.
- .17 Removable lifting means.
- .18 Continuous 100 mm channel iron floor sills with 19 mm diameter holes for bolts.
- .19 Main horizontal and branch vertical, three phase, high conductivity, tin-plated copper busbars (aluminum not acceptable) in separate compartment extending entire width and height of motor control centre, supported on insulators and rated:
 - .1 Main horizontal busbars ampere rating as noted on the drawings.

- .2 Branch vertical busbars ampere rating as recommended by manufacturer for loads indicated.
- .20 Branch vertical busbars for distribution of power to units in vertical sections.
- .21 Automatic shutters to cover plug-in stab openings when units are removed.
- .22 No other cables, wires, equipment in main and branch busbar compartments.
- .23 Brace buswork to withstand effects of short-circuit current of minimum 42 KA (momentary rms symmetrical) at rated voltage.
- .24 Bus Supports: high dielectric strength, low moisture absorption, high impact material, with long creepage surface designed to discourage collection of dust.
- .25 Copper ground bus, minimum size 25 mm x 6 mm extending entire width of motor control centre, located at bottom.
- .26 Motor starter units NEMA size 4 and smaller, circuit breaker units 200A and smaller plug-in type shall connect to the vertical bus by means of self-aligning silver plated copper stab-on connectors provided with stainless steel back-up springs. Provision for units to be installed or removed, off load, while buses are energized.
- .27 Isolate units withdrawn from vertical bus but support by structure. Units must be capable of complete withdrawal.
- .28 Do not mount unit terminal blocks mounted in vertical wireway.
- .29 Overload relays must be manually reset from front with door closed.
- .30 Hinge doors on left side.
- .31 Provide MCC units (starter, breaker, etc.) complete with external operating handle of circuit switch (with defeater mechanism) to prevent door opening with switch in the 'on' position. Provide for three (3) padlocks to lock operating handle in 'off' position and lock door closed.
- .32 Provide devices and components by one (1) manufacturer except where noted otherwise to facilitate ease of maintenance.
- .33 Provide equipment in accordance with Section 26 05 00. Individual compartment name-plates engraved as indicated.
- .34 All painted parts must undergo a phosphetizing prepaint treatment for rust resistance. Final coat of paint to be ANSI 61 Light Grey.
- .35 General arrangement and individual unit features to be as indicated on the Drawings.
- .36 Provide all current and potential instrument transformers.
- .37 Provide spare parts as follows:
 - .1 One (1) spare set contactor contacts for each size used.
 - .2 One (1) spare contactor coil of each size used.

- .3 Six (6) control fuses of each size used.
- .4 One (1) control transformer of each size used.
- .5 One (1) spare electronic overload relay.
- .38 Control fuses to be HRC, fast acting high interrupting capacity.

2.2 MOTOR STARTERS

- .1 Provide motor starters and devices in accordance with Section 26 29 10.

2.3 CIRCUIT BREAKERS

- .1 Provide circuit breakers in accordance with Section 26 28 21.

2.4 VARIABLE FREQUENCY DRIVE

- .1 Provide variable frequency drive in accordance with 26 29 23.

2.5 FUSED DISCONNECT SWITCHES

- .1 Provide fused disconnect switches in accordance with Section 26 28 23.

2.6 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00.
- .2 Starter and breaker designation label, white plate, black letters, size 4, engraved as indicated.
- .3 Motor control centre designation label, white plate, black letters, size 9, engraved as indicated.

2.7 ACCEPTABLE MANUFACTURER'S

- .1 Eaton Canada.
- .2 Schneider Electric.
- .3 Siemens.
- .4 Allen Bradley.

Part 3 - EXECUTION

3.1 INSTALLATION

- .1 Provide concrete housekeeping pad (minimum 100mm thick, minimum 50mm larger than the outside dimensions of the MCC and complete with chamfered edges) under each MCC.
- .2 Fully wrap the motor control centre and protect from dust and moisture during construction.
- .3 Set and secure (bolt) motor control centre in place on channel bases, rigid, plumb and square to the building floor and wall. Confirm pad location is level to within 3mm.

- .4 Install starters, connect power and control as indicated.
- .5 Confirm correct breaker trip settings and overload device elements are installed and set to match the respective motor full load current and service factor and in accordance with Protection Coordination Study.

3.2 TESTS

- .1 Perform tests in accordance with Section 26 05 00 and the manufacturer's instructions.
- .2 Operate switches and contactors to verify correct functioning.
- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Confirm sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.
- .5 Confirm all monitoring equipment is connected and properly working upon completion of installation. Simulate I/O from each unit and verify status and alarms at the plant PLC control system.

END OF SECTION

Part 1 - GENERAL

1.1 SUBMITTALS

- .1 Submit shop drawings, and product data in accordance with Section 01 33 00.

Part 2 - PRODUCTS

2.1 SWITCHES

- .1 Design S1:
 - .1 Heavy duty, specification Grade, 20 A, 120 V, single pole, three-way, four-way switches as indicated, with the following features:
 - .1 Terminals approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine molding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 White nylon, heavy duty toggle.
 - .6 Integral ground terminal.
 - .7 Acceptable materials: Hubbell #HBL1221W (single pole); Hubbell #HBL1223W (3-way), or approved equivalent.
 - .2 Toggle operated fully rated for lamps, and up to 80% of rated capacity of motor loads.
 - .3 Provide the switches of one (1) manufacturer throughout project.
 - .4 Approved manufacturers: Eaton Wiring Devices, Leviton, Hubbell, Pass & Seymour.
- .2 Design S2:
 - .1 Heavy duty 20A, 120V, single pole, toggle switch with the following features:
 - .1 Rated for the hazardous classification as noted on the drawings.
 - .2 Factory sealed switching mechanism.
 - .3 Aluminum operator mechanism and nylon cam.
 - .4 Copper free, cast aluminum body with threaded hubs, 316 stainless steel hardware and aluminum alloy cover.
 - .5 Suitable for wet/damp/corrosive locations.
 - .6 Acceptable manufacturers:
 - .1 Crouse-Hinds
 - .2 Appleton
 - .3 Killark.
 - .2 Non-hazardous rated switches of one (1) manufacturer throughout project. Use the hazardous rated switches of a single

manufacturer throughout the Work.

2.2 RECEPTACLES

.1 Design R1:

- .1 Heavy duty, specification grade duplex receptacles, CSA type 5-15R, 125 V, 15 A, U ground, with following features:
 - .1 Urea molded housing, white colour.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight (8) back wired entrances, four (4) side wiring screws.
 - .5 Triple wipe contacts and rivetted grounding contacts.
 - .6 Nylon face.
 - .7 Acceptable materials: Hubbell #HBL5262W or approved equivalent.
 - .8 Acceptable Manufacturers: Hubbell, Pass & Seymour, Eaton Wiring Devices, Leviton.

.2 Design R2:

- .1 Heavy duty, specification grade duplex receptacles, CSA type 5-20R, 125 V, 15/20 A, U ground, with following features:
 - .1 Urea molded housing, white colour.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight (8) back wired entrances, four (4) side wiring screws.
 - .5 Triple wipe contacts and rivetted grounding contacts.
 - .6 Nylon face.
 - .7 Acceptable materials: Hubbell #HBL5362W or approved equivalent.
 - .8 Acceptable Manufacturers: Hubbell, Pass & Seymour, Eaton Wiring Devices, Leviton.

.3 Design R3:

- .1 GFI duplex receptacles. Specification grade, CSA type 5-15R, 125V, 15A, U-Ground with the following features:
 - .1 White urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Eight (8) back wired entrances, four (4) side wiring screws.
 - .4 Triple wipe contacts and riveted grounding contacts.
 - .5 Ivory nylon face.
 - .6 Trip rating: 4-6 mA.
 - .7 Tamper resistant.

- .8 Visual indication of power 'on' and ground fault condition via LED lights.
 - .9 Self testing with test and reset buttons.
 - .10 Acceptable materials: Hubbell #GFR5262SGW or approved equivalent.
 - .11 Approved Manufacturers:
 - .1 Hubbell
 - .2 Pass & Seymour
 - .3 Leviton
 - .4 Eaton Wiring Devices.
- .4 Design R4:
- .1 GFI duplex receptacles. Specification grade, CSA type 5-20R, 125V, 15/20A, U-Ground with the following features:
 - .1 White urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Eight (8) back wired entrances, four (4) side wiring screws.
 - .4 Triple wipe contacts and riveted grounding contacts.
 - .5 Ivory nylon face.
 - .6 Trip rating: 4-6 mA.
 - .7 Tamper resistant.
 - .8 Visual indication of power 'on' and ground fault condition via LED lights.
 - .9 Self testing with test and reset buttons.
 - .10 Acceptable materials: Hubbell #GFR5362SGW or approved equivalent.
 - .11 Approved Manufacturers:
 - .1 Hubbell
 - .2 Pass & Seymour
 - .3 Leviton
 - .4 Eaton Wiring Devices.
- .5 Design R5:
- .1 Single receptacle and cover assembly, 15A or 20A as indicated, 125 VAC with the following features:
 - .1 Rated for the hazardous classification as noted on the drawings.
 - .2 Twist to activate receptacle, with audible "click" to indicate make and break of built-in contacts. Twisting plug locks in place so that the plug cannot be removed without deactivating receptacle.
 - .3 Factory sealed receptacle.
 - .4 Copper free cast aluminum body with threaded hubs, 316 stainless steel hardware and spring loaded aluminum alloy

- cover.
- .5 Suitable for wet/damp/corrosive locations.
- .6 Acceptable manufacturers:
 - .1 Appleton
 - .2 Crouse-Hinds
 - .3 Killark
- .6 Other receptacles with ampacity and voltage as indicated.
- .7 Use the receptacles of a single manufacturer throughout the Work.

2.3 COVER PLATES

- .1 Cover plates for wiring devices.
- .2 Provide the cover plates from one (1) manufacturer throughout project.
- .3 Brushed stainless steel, 1 mm thick, cover plates, for wiring devices mounted in flush-mounted outlet boxes.
- .4 Electrogalvanized or cast aluminum cover plates with gaskets for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .5 Self-closing, weatherproof spring-loaded cast aluminum or PVC cover plates, complete with gaskets for duplex or single receptacles as indicated. Exterior cover plates must be suitable for wet locations whether or not a plug is inserted into a receptacle.

Part 3 - EXECUTION

3.1 SWITCH, RECEPTACLE, AND COVER PLATE 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 (1) switch is required in one location.
 - .3 Mount toggle switches at height specified in these Specifications or as indicated.
 - .4 Recess switches in finished areas.
 - .5 Install size 1 identification lamicoid for control switches for pumps, motors, and process equipment.
- .2 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one (1) receptacle is required in one location.
 - .2 Mount receptacles at the height specified in these Specifications or as indicated.
 - .3 Recess receptacles in finished areas.
- .3 Cover plates:

- .1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .2 Install suitable common cover plates where wiring devices are grouped.
- .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

3.2 FIELD QUALITY CONTROL

- .1 Test all switches for proper operation.
- .2 Test all receptacles for the following:
 - .1 Polarity and grounding.
 - .2 Voltage drop test (test at 12A for 15A devices and 16A for 20A devices). Voltage must be within 5% of the transformer secondary voltage.
- .3 Record results including any deficiencies corrected.

END OF SECTION

Part 1 - GENERAL

1.1 REFERENCES

- .1 CSA C22.2 No. 248.8-11(R2020), Low Voltage Fuses - Part 8: Class J Fuses.
- .2 CSA C22.2 No. 248.4:00(R019), Low Voltage Fuses - Part 4: Class CC Fuses.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00.

1.3 MAINTENANCE MATERIALS

- .1 Provide three (3) spare fuses of each type and size.

1.4 DELIVERY AND STORAGE

- .1 Ship fuses in original containers.
- .2 Do not ship fuses installed.
- .3 Store fuses in original containers in moisture free location.

Part 2 - PRODUCTS

2.1 FUSES GENERAL

- .1 Fuses: use the product of a single manufacturer throughout the Work.
- .2 Low voltage fuses, types as specified, to be CSA certified in accordance with applicable CSA Standard referred to in 1.1.

2.2 FUSE TYPES

- .1 All fuses to be high rupturing capacity (HRC) type, minimum 200kA interrupting rating (momentary RMS symmetrical).
- .2 Class J:
 - .1 Fuses rated 1 to 600 amperes, 600 Vac, to be CSA certified Class J in accordance with Standard C22.2 No. 248.8.
 - .2 Where a time delay characteristic is required, fuses shall carry 500% of their ampere rating for not less than 10 seconds and be clearly labelled "time delay".
- .3 Class CC:
 - .1 Fuses rated 1 to 30 amperes, 600 Vac, to be CSA certified Class CC in accordance with Standard C22.2 No. 248.4.
 - .2 Where a time delay characteristic is required, fuses shall carry 200% of their ampere rating for not less than 12 seconds.

- .4 Standard of acceptance:
 - .1 Class J: Mersen type A4J (non-time delay) and AJT (time delay).
 - .2 Class CC: Mersen type ATMR (non-time delay) and ATDR (time delay) and ATQR (time delay).
 - .3 Class J (high speed, semi-conductor protection): Mersen Type HSJ.
- .5 Acceptable manufacturers:
 - .1 Mersen.
 - .2 Bussmann.
 - .3 Littlefuse.

Part 3 - EXECUTION

3.1 INSTALLATION

- .1 Install fuses in mounting devices immediately before energizing circuit.
- .2 Confirm correct fuses are fitted to physically matched mounting devices.
- .3 Confirm correct fuses are fitted to assigned electrical circuit.
- .4 Confirm fuse size is correctly identified on equipment.
- .5 For feeder circuit fuses, use fast acting Class J fuses unless otherwise noted.
- .6 For full voltage non-reversing motor starters, full voltage reversing motor starters, full voltage multi-speed motor starters and transformers, use time delay Class J fuses.
- .7 For solid state, reduced voltage motor soft starters and VFD's, use high speed, semi-conductor protection Class J fuses.
- .8 For 600Vac control circuits, use Class CC type fuses. Use time delay Class CC fuses upstream of control transformers and solenoids.

END OF SECTION

Part 1 - GENERAL

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00.

Part 2 - PRODUCTS

2.1 BREAKERS GENERAL

- .1 Bolt-on moulded case circuit breaker, quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.
- .2 Common trip breakers: with single handle for multiple applications.
- .3 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from 5 to 10 x current rating.
- .4 Circuit breakers with interchangeable trips on units over 200A.
- .5 Circuit breakers to have interrupting rating (momentary RMS symmetrical) as indicated.

2.2 THERMAL MAGNETIC BREAKERS

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping.
- .2 Provide ground fault interrupter type (5mA maximum) for circuits so marked.

2.3 MAGNETIC BREAKERS

- .1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.

2.4 SOLID STATE TRIP BREAKERS

- .1 Moulded case circuit breaker to operate by means of a solid state trip with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload conditions, and long time, short time and instantaneous tripping for phase and ground fault (where indicated) short circuit protection. Trip unit to have independent adjustable long time and short time pick-up, ground fault pick-up, ground fault delay.

2.5 OPTIONS

- .1 Provide enclosures for individual circuit breakers as indicated on the drawings.

- .2 Where noted on the drawings, the circuit breaker must be 100% rated.

2.6 MANUFACTURERS

- .1 Acceptable manufacturers: Eaton, Schneider Electric, Siemens.

Part 3 - EXECUTION

3.1 INSTALLATION

- .1 Install circuit breakers as indicated.

END OF SECTION

Part 1 - GENERAL

1.1 RELATED WORK

- .1 Electrical General Requirements: Section 26 05 00

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00.

Part 2 - PRODUCTS

2.1 DISCONNECT SWITCHES

- .1 Non-hazardous:
 - .1 Heavy duty, fusible and non-fusible horsepower rated, disconnect switch in size and voltage as indicated.
 - .2 Provision for padlocking in the off switch position by three (3) pad locks.
 - .3 Mechanically interlocked door to prevent opening when handle in ON position.
 - .4 Fuses: size and type as indicated.
 - .5 Fuse holders: 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 Provide equipment identification in accordance with Section 26 05 00.
 - .9 Enclosure:
 - .1 NEMA Type 1 (painted steel) in electrical rooms and other dry non-process areas.
 - .2 NEMA Type 12 (painted steel) unless noted otherwise.
 - .3 NEMA Type 4X (stainless steel) in wet/damp and/or corrosive areas and outdoors.
 - .10 Provide switches complete with window to view open/close status of disconnect switch blades.
 - .11 Include auxiliary contacts (2 N.O.) rated 10A at 120 VAC. Auxiliary contacts must make after and break before the disconnect switch blades.
 - .12 Acceptable manufacturers: Schneider Electric, Eaton, Siemens.
- .2 Hazardous:
 - .1 Heavy duty, non-fusible, horsepower rated disconnect switch in size and voltage as indicated.

- .2 Provision for padlocking in the off switch position by three padlocks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Quick-make, quick-break action.
- .5 ON-OFF switch position indication on switch enclosure cover.
- .6 Enclosure and external handle to be cast copper free.
- .7 Switches suitable for installation in a Zone 1 or Zone 2 (Gas Groups C and D) hazardous area as indicated on the drawings.
- .8 Include auxiliary contacts (2 N.O.) rated minimum 10A @ 120 VAC. Auxiliary contacts must make after and break before disconnect switch contacts.
- .9 Disconnect switch to be suitable for outdoors and wet/damp indoor locations as applicable.
- .10 Standard of acceptance: Killark B7N Series or approved equivalent.
- .11 Acceptable manufacturers: Killark, Crouse-Hinds, Appleton.

2.2 MANUAL TOGGLE TYPE SWITCHES

- .1 Non-Hazardous rated:
 - .1 Manual "on-off" switch, horsepower rated, of size, type, rating as indicated, with components as follows:
 - .1 Toggle type switch with quick-make, quick-break switching mechanism.
 - .2 Terminals: screw type, suitable for #10AWG (or smaller) copper conductors.
 - .3 Enclosure:
 - .1 NEMA Type 1 (painted steel) in electrical rooms and other dry, non-process areas.
 - .2 NEMA Type 12 (painted steel) unless noted otherwise.
 - .3 NEMA Type 4X (stainless steel) outdoors and in wet/damp and/or corrosive areas.
 - .4 Unit complete with locking tab to permit padlocking in the off position.
 - .2 Acceptable materials: Schneider Electric type K (Class 2510) or approved equivalent.
 - .3 Acceptable manufacturers: Schneider Electric, Eaton, Siemens, Allen Bradley.
- .2 Hazardous:
 - .1 Manual "on-off" switch, heavy duty, horsepower rated, of size and rating as indicated.
 - .2 Provision for padlocking in the off switch position.
 - .3 Toggle type switch with quick-make, quick-break action.
 - .4 ON-OFF switch position indication on switch enclosure cover.

- .5 Terminals: screw type, suitable for copper conductors.
- .6 Enclosure and cover to be cast copper free.
- .7 Switches suitable for installation in a Zone 1 or Zone 2 hazardous area as indicated on the drawings.
- .8 Acceptable manufacturers:
 - .1 Killark
 - .2 Crouse-Hinds
 - .3 Appleton

Part 3 - EXECUTION

3.1 DISCONNECT SWITCH INSTALLATION

- .1 Install disconnect switches complete with fuses, type, rating as indicated on drawings.
- .2 Install true, plumb and square to building lines.
- .3 Confirm disconnect switch has proper clearance for operation of handle.

END OF SECTION

Part 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies requirements for the supply and installation of motor starters.

1.2 RELATED WORK

- .1 Electrical General Requirements: Section 26 05 00

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00.
- .2 Indicate:
 - .1 Mounting method and dimensions.
 - .2 Starter size and type.
 - .3 Layout of identified internal and front panel components.
 - .4 Enclosure types.
 - .5 Schematic and wiring diagrams for each type of starter.
 - .6 Circuit breaker type.
 - .7 Overload relay type.

1.4 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for motor control centre for incorporation into manual.
- .2 Include data for each type and style of starter.

Part 2 - PRODUCTS

2.1 MATERIALS

- .1 Starters: EEMAC E14-1.
 - .1 Half size starters not acceptable.
 - .2 IEC equipment not acceptable.
 - .3 Minimum starter size 1. Overloads shall be sized for actual motor horsepower ratings.

2.2 MANUAL MOTOR STARTERS

- .1 Single-phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
 - .1 Switching mechanism, toggle type quick make and break.
 - .2 Overload heater(s), manual reset, trip indicating handle.

- .3 Terminals: screw type, suitable for #10AWG (or smaller) copper conductors.
- .4 Enclosure:
 - .1 NEMA Type 1 (painted steel) in electrical rooms and dry, non-process areas.
 - .2 NEMA Type 12 (painted steel) unless noted otherwise.
 - .3 NEMA Type 4X (stainless steel) in wet/damp non-hazardous areas, in chemical rooms, and outdoors.
 - .4 Hazardous rated to match area classification.
- .2 Accessories:
 - .1 Toggle switch labelled as indicated.
 - .2 Indicating light: standard, heavy duty, oil tight LED type and colour as follows: Green = Run/On.
 - .3 Locking tab to permit padlocking in "ON" or "OFF" position.
- .3 Acceptable manufacturers:
 - .1 Non-hazardous: Schneider Electric, Eaton Canada, Siemens, Allen Bradley.
 - .2 Hazardous: Killark, Appleton, Crouse-Hinds.

2.3 FULL VOLTAGE MAGNETIC STARTERS

- .1 Single phase and 3 phase magnetic or combination magnetic starters of size, type (non-reversing, reversing or multi-speed type), rating as indicated on the Drawings with components as follows:
 - .1 Enclosure:
 - .1 NEMA Type 1 (painted steel) in electrical rooms and dry, non-process areas.
 - .2 NEMA Type 12 (painted steel) unless noted otherwise.
 - .3 NEMA Type 4X (stainless steel) in wet/damp process areas and outdoors.
 - .2 120 V operating coil with primary and secondary fused control transformer where indicated. Provide control fuses for 120 V power supply circuit from panelboards.
 - .3 For three-phase magnetic starters, provide adjustable solid state motor overload protective device in each phase, with single phasing and ground fault protection, manually reset from outside enclosure.
 - .4 For single-phase magnetic starters, provide adjustable solid state motor overload protective device, manually reset from outside enclosure.
 - .5 Power and control terminals.
 - .6 Wiring and schematic diagram inside starter enclosure in visible location.

- .7 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- .2 Combination type starters to include motor circuit interrupter or fused disconnect switch as noted on the Drawings and with operating lever on outside of enclosure to control disconnecting device 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 is open.
- .3 Accessories:
 - .1 Selector switches: industrial heavy duty, Nema style, 30mm, watertight, corrosion resistant (NEMA 4X enclosure only), oil and dust tight, labelled as indicated.
 - .2 Indicating lights: industrial, heavy duty, NEMA style, 30 mm, watertight, corrosion resistant (NEMA 4X enclosure only), oil and dust tight, LED type, colour as indicated.
 - .3 Auxiliary contacts as indicated.
 - .4 Provide motor current transducers for starter units indicated on the drawings.
 - .5 Provide door mounted devices, terminal blocks, and auxiliary contacts as detailed on the Drawings.

2.4 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00.
- .2 Magnetic starter designation label, white plate, black letters, size 9, engraved as indicated.
- .3 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.

2.5 ACCEPTABLE MANUFACTURERS

- .1 Allen Bradley.
- .2 Eaton (Cutler-Hammer).
- .3 Schneider Electric (Square D).
- .4 Siemens.

Part 3 - EXECUTION

3.1 INSTALLATION

- .1 Install starters, connect power and control as indicated.

- .2 Confirm correct breakers, fuses and overload devices elements are installed and set per manufacturer's recommendation for motor size and coordination study.

3.2 TESTS

- .1 Perform tests in accordance with Sections 01 79 00 and 26 05 00 and manufacturer's instructions.
- .2 Operate switches, contactors to verify correct functioning.
- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Confirm sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.
- .5 Confirm monitoring equipment is connected and properly working upon completion of installation. Simulate I/O from each unit and verify status and alarms.

END OF SECTION

Part 1 - GENERAL

1.1 GENERAL

- .1 This section pertains only to the electrical connection of motors.

Part 2 - PRODUCTS

2.1 MOTORS

- .1 Motors are supplied with associated mechanical, and process equipment.

Part 3 - EXECUTION

3.1 INSTALLATION

- .1 Install wiring, flexible connections and grounding.
- .2 Terminate wiring as per Section 26 05 20. Alternately, use a CSA-approved motor lead pigtail splice kit complete with crimp-type compression connectors as specified in Section 26 05 20.
- .3 Use liquid-tight flexible conduit for connections to motors.
- .4 Check rotation before coupling to driven equipment.
- .5 Confirm electrical installation does not interfere with rotation, operation or maintenance of equipment.

END OF SECTION

Part 1 - GENERAL

1.1 DESCRIPTION OF SYSTEM

- .1 This specification describes the requirements for design, supply and delivery of variable speed drives. Refer to related specification sections for mechanical and process motor specifications.

1.2 RELATED SECTIONS

- .1 Electrical General Requirements: Section 26 05 00

1.3 CODES AND STANDARDS

- .1 Starter must be designed to meet or exceed applicable CSA, UL, NEMA, and IEEE standards.
- .2 Complete installation according to CSA Standards unless specified otherwise.
- .3 Comply with CSA Electrical Bulletins in force at time of tender submission.

1.4 SHOP DRAWINGS

- .1 Provide shop drawings in accordance with specification Section 01 33 00.
- .2 Indicate:
 - .1 Outline dimensions of cabinet and mounting instructions.
 - .2 Drive, size, type and configuration.
 - .3 Layout of identified internal and front panel mounted components.
 - .4 Schematic and wiring diagrams.
 - .5 Component data sheets.
 - .6 Enclosure type.

1.5 WARRANTY

- .1 Provide a warranty for all material for a period of one (1) year minimum from the Ready for Takeover date and replace, at no cost to the Owner, faulty materials. The warranty must include the cost of all labour, travel and expenses for repairs within the warranty period.

1.6 OPERATION AND MAINTENANCE MANUAL

- .1 Provide operation and maintenance data including information on the drives and any required relays and other components that make up the complete package.

1.7 SPARE PARTS

- .1 Submit list of recommended spare parts to have on site to limit downtime.

- .2 Submit manufacturer's policy of providing spare parts for older equipment (e.g.: spare parts must be available for ten (10) years minimum after original equipment has been manufactured).

Part 2 - PRODUCTS

2.1 GENERAL

- .1 Provide a variable speed drive for motors indicated.
- .2 The blower motors M-410, M-420, M-430 and M-440 are positive displacement type motors (constant torque load).

2.2 POWER SUPPLY

- .1 The source voltage to each VFD is 600V, 3-phase via utility power and/or a 600V, 3-phase diesel engine generator. Refer to the single line diagram on the drawings.
- .2 The minimum required three phase momentary short circuit current (rms symmetrical) rating at rated voltage is 42kAIC unless noted otherwise.

2.3 DESIGN CRITERIA

- .1 Digital, pulse width modulated, modular construction, CSA approved.
- .2 Drive to convert incoming fixed frequency three phase AC power into variable voltage and variable frequency utilizing pulse width modulation.
- .3 Drive to include a full wave diode bridge rectifier to convert AC to DC. SCR and other switching power devices are not acceptable.
- .4 Drive to utilize DC capacitors to filter out bus ripple and provide smooth DC power to the transistor section.
- .5 Drive to utilize IGBT transistors to produce a pulse width modulated output. SCR's are not acceptable. The IGBT minimum Vce rating will be 1200V.
- .6 Drive main input power will be 600V, 3-phase, 60hz. Voltage tolerance shall be -15%/+10%. Frequency tolerance shall be 48hz to 63hz.
- .7 Drive to be rated to provide current to support motors at 1.15 service factor continuously.
- .8 The efficiency of the drive must be a minimum of 95% at full load and full speed.
- .9 Displacement power factor must be greater than 0.95 lagging over the entire speed range.
- .10 Provide minimum 3% input line reactors or equivalent. Input line reactors or equivalent can be integral to the VFD.
- .11 Provide output dv/dt filter downstream from each VFD. Locate dv/dt filter, within the MCC or drive enclosure.

- .12 Drive must be able to provide full rated output current continuously. For variable torque loads, VFD must be able to provide 110% overload for up to one (1) minute and 150% overload for up to three (3) seconds. For constant torque loads, VFD must be able to provide 150% overload for up to one (1) minute and 200% overload for up to three (3) seconds.
- .13 Provide drive complete with power line loss ride through feature for a minimum of 0.5 seconds.
- .14 Drive to be controlled by a field mounted hand/off/auto selector switch and the specified PLC control panel. In the "off" position, the drive shall stop the motor. In the "hand" position, the drive shall start the motor and the drive speed will be changed from a local speed potentiometer. In the auto position, the drive start/stop and speed control will be initiated via discrete PLC I/O as indicated. The drive will ramp up and down between a preset minimum base speed and the maximum motor speed (maximum 100%) over an adjustable time period.
- .15 Provide most recent version of programming software and appropriate interface hardware to enable drive configuration from a laptop computer.
- .16 Provide digital input points as indicated on the Drawings.
- .17 Provide 4-20mA output signal to indicate motor current.
- .18 Provide analog input to accept a 4-20mA analog signal (speed control in Auto).
- .19 Provide voltage input to accept potentiometer signal (speed control in hand).
- .20 Provide a minimum of two (2) programmable relay contacts (dry, rated 120V) as indicated for remote monitoring.
- .21 Protective functions:
 - .1 Drive to have built in CSA approved adjustable electronic motor overload (class 10, 20, 30) protection to protect the connected motor.
 - .2 Drive to have input metal oxide varistors (MOV's) for surge protection.
 - .3 Provide drive complete with the following protective functions:
 - .1 Over and under voltage.
 - .2 Overcurrent.
 - .3 Ground fault.
 - .4 Drive over temperature.
 - .5 Blown DC bus fuse.
 - .6 Overload.
 - .7 Input and output phase loss.
 - .8 Unbalance current fault
 - .9 Motor stall protection.

- .4 Provide for three (3) auto restart attempts for selected fault conditions.
- .5 Drive to permit the operator to lock out the reverse operation for applications where reverse would damage equipment.
- .22 Provide each drive complete with an operator keypad for local programming, monitoring, speed control and start/stop control. Each keypad must be visible and accessible from the front of the enclosure with the door closed. Provide keypad complete with the following minimum features:
 - .1 LCD high resolution display.
 - .2 Keypad to indicate the following minimum operating conditions: drive run, drive stopped, drive fault.
 - .3 As a minimum, output speed, power, frequency and current must be displayed continuously as selected by the user.
 - .4 Fault reset button.
 - .5 Start/stop buttons (for local control).
 - .6 Present fault condition shall be displayed.
 - .7 Keypad entries shall be password protected.
- .23 Programming features:
 - .1 Drive to have a minimum of three (3) independently adjustable acceleration and deceleration ramps. Times are to be adjustable from 0.1 to 3200 seconds (nominal).
 - .2 Drive to have an adjustable output frequency from 25-320hz (nominal).
 - .3 Control methods available to be selectable sensorless vector, selectable Volts/hz patterns, and direct torque control.
 - .4 Drive to have adjustable minimum and maximum speed settings.
 - .5 Drive to have an adjustable carrier frequency (nominal 1-15khz).
 - .6 Drive must have a minimum of three (3) adjustable frequency reject points to prevent system operation at resonant speed.
- .24 Drive to be sized for variable torque or constant torque load to match the application load characteristics.
- .25 Provide drive electronics complete with conformal coatings for protection against dust and chemicals.

2.4 COMMUNICATIONS

- .1 Provide drive complete with ethernet/IP Communications.

2.5 ACCESSORIES

- .1 Include necessary CT's and PT's for specified monitoring and protection.
- .2 Include a three pole disconnect switch in each drive enclosure to remove all power to the VFD. Disconnect switch must be operable from the front or side without opening the enclosure door. There must be

- provision for locking the switch in the "off" position and preventing switching to the "on" position while the enclosure door is open.
- .3 Provide DIN rail mounted terminal blocks, complete with labels for all field wiring. Blocks to be section type, medium duty, 600V, 15A rated. Provide spare terminals (15% of used terminals) in any strip. Terminate external wiring on terminal strips. Provide separate terminal strips for AC and DC circuit.
 - .4 Control fuses to be HRC type, complete with din rail mounted, finger safe fuse holders (Ferraz Shawmut Ultrasafe type or approved equivalent, complete with blown fuse indicator).
 - .5 Control transformer:
 - .1 Single-phase, dry-type, control transformer with 600 Volt primary and 120 Volt secondary complete with two (2) primary fuses and one (1) secondary fuse installed with starter as indicated.
 - .2 Size control transformer for control circuit load plus 20% spare capacity.
 - .6 VFD enclosure to include integrated fan thermostatically controlled to automatically operate in accordance with VFD manufacturer's cooling requirements.

2.6 ACCEPTABLE MATERIALS

- .1 Allen Bradley Powerflex 753 series.
- .2 ABB ACS880 series.
- .3 Eaton SVX 9000 series.
- .4 Schneider Electric Altivar 930 series.
- .5 Inclusion in this list does not exempt the requirement that any specified model must be compliant with the equipment specifications.

Part 3 - EXECUTION

3.1 INSTALLATION

- .1 Locate, install and connect VFD and input line reactor and dv/dt filter where indicated on the drawings and in accordance with the manufacturer's instructions.
- .2 Check starter and adjust in accordance with project requirements and manufacturers recommendations.
- .3 Connect power, control wiring (digital and analog inputs and outputs) and communications wiring as noted on the drawings.

3.2 COMMISSIONING

- .1 Arrange and pay for a factory certified representative to set up and commission each drive at site for proper operation to the satisfaction of the Consultant. Document all testing and set-up and submit to

Consultant.

- .2 Provide commissioning test reports and setup/configuration parameters (hard copy and files sent via email to the Owner and Consultant).

3.3 TRAINING

- .1 Provide a factory certified representative as required to train personnel at site.

END OF SECTION

Part 1 - GENERAL

1.1 WORK INCLUDED

- .1 The work to be done under this Section includes the design, fabrication, warranty, supply and installation for the Package Diesel Generator as specified and includes furnishing all materials, labour, tools, equipment and performing all operations necessary including supervision of installation, field testing and commissioning.

1.2 REFERENCES

- .1 ANSI/NEMA MG 1-2021, Motors and Generators.
- .2 ASTM D975-24, Standard Specification for Diesel Fuel.
- .3 ISO 3046-1-2002, Reciprocating Internal Combustion Engines: Performance - Part 1: Declarations of Power, Fuel and Lubricating Oil Consumptions, and Test Methods - Additional Requirements for Engines for General Use.
- .4 NFPA 70-2023, National Electrical Code.

1.3 RELATED WORK

- .1 Electrical General Requirements: Section 26 05 00
- .2 Automatic Load Transfer Equipment: Section 26 36 23
- .3 Primary Process Instrumentation Devices and Cabling: Section 26 90 00
- .4 Moulded Case Circuit Breakers: Section 26 28 21

1.4 DESCRIPTION OF SYSTEM

- .1 The set must be of proven standard design with a record of satisfactory performance; prototypes will not be accepted. Where any provision of this specification causes a deviation from the Manufacturer's normal practice such as to materially impair performance, price or delivery of the equipment, have the Manufacturer call attention to this in their quotation and offer the normal standard equipment as an alternative.
- .2 Generating system consists of:
 - .1 Diesel engine.
 - .2 Alternator.
 - .3 Alternator control panel.
 - .4 Battery charger and battery.
 - .5 Fuel supply system.
 - .6 Exhaust system.
 - .7 Steel mounting base.
 - .8 Ventilation system.
 - .9 Block heater.
 - .10 Non-walk in sound attenuated enclosure.

- .3 Provide a system designed to operate as emergency standby unattended.

1.5 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Include:
 - .1 Engine: make and model, with performance curves.
 - .2 Alternator: make and model.
 - .3 Voltage regulator: make, model and type.
 - .4 Battery: make, type and capacity.
 - .5 Battery charger: make, type and model.
 - .6 Alternator control panel: make and type of meters and controls.
 - .7 Governor type and model.
 - .8 Cooling air requirements in m³/s.
 - .9 British standard or DIN rating of engine.
 - .10 Flow diagrams for:
 - .1 Fuel.
 - .2 Cooling air.
 - .11 Dimensioned drawing showing complete generating set mounted on steel base, including vibration isolators, exhaust system, radiator, drip trays, and total weight.
 - .12 Continuous full load output of set at 0.8 PF lagging.
 - .13 Description of set operation including:
 - .1 Automatic starting and transfer to load and back to normal power, including time in seconds from start of cranking until unit reaches rated voltage and frequency.
 - .2 Manual starting.
 - .3 Automatic shut down and alarm on:
 - .1 Over cranking.
 - .2 Over speed.
 - .3 High engine temp.
 - .4 Low lube oil pressure.
 - .5 Short circuit.
 - .6 Alternator over voltage.
 - .7 Lube oil high temperature.
 - .4 Manual remote emergency stop.
 - .14 Sub-base mounted fuel tank system including all associated instrumentation.
 - .15 Sound attenuated weather proof enclosure.

1.6 OPERATION AND MAINTENANCE DATA

- .1 Provide copies of operation and maintenance data for diesel generator as described in Section 01 78 00.
- .2 Include in Operation and Maintenance Manual instructions for particular unit supplied and not general description of units

manufactured by supplier and:

- .1 Operation and maintenance instructions for engine, alternator, control panel, battery charger, battery, fuel system, engine room ventilation system, block heater, exhaust system and accessories, to permit effective operation, maintenance and repair.
- .2 Technical data:
 - .1 Illustrated parts lists with parts catalogue numbers.
 - .2 Schematic diagram of electrical controls.
 - .3 Flow diagrams for:
 - .1 Fuel system.
 - .2 Lubricating oil.
 - .3 Cooling system.
 - .4 Certified copy of factory test results.
 - .5 Maintenance and overhaul instructions and schedules.
 - .6 Precise details for adjustment and setting of time delay relays or sensing controls which require on site adjustment.

1.7 MAINTENANCE SPARES

- .1 Include:
 - .1 Two (2) fuel filter replacement elements.
 - .2 Two (2) lube oil filter replacement elements.
 - .3 Two (2) air cleaner filter elements.
 - .4 Two (2) sets of fuses for control panel.
 - .5 Special tools for unit servicing as recommended by the manufacturer.

1.8 SOURCE QUALITY CONTROL

- .1 Factory test generator set including engine, alternator, control panels, transfer switch and accessories.
- .2 Provide four (4) copies of factory test results to the Consultant for inclusion into the Operations and Maintenance Manual.
- .3 Test procedure:
 - .1 Prepare blank forms and check sheet with spaces to record data. At top of first sheet record:
 - .1 Date.
 - .2 Generator set serial no.
 - .3 Engine, make, model, serial no.
 - .4 Alternator, make, model, serial no.
 - .5 Voltage regulator, make and model.
 - .6 Rating of generator set, kW, kVA, V, A, r/min, Hz.
 - .2 Mark check sheet and record data on forms in duplicate as test proceeds.

- .3 Signature of manufacturer's Quality Control representative on completed forms to indicate concurrence in results of test.
- .4 Tests:
 - .1 Standard Factory Tests as recommended by manufacturer.
- .5 Demonstrate:
 - .1 Automatic shutdown of engine on resumption of normal power.
 - .2 That battery charger reverts to high rate charge after cranking.
 - .3 Automatic startup of genset upon signal from automatic transfer switch.
- .6 Demonstrate low oil pressure and high engine temperature shutdown devices operation without subjecting engine to these excesses.

1.9 EXTENDED WARRANTY

- .1 Diesel engine generator set must be warranty covered for 60 months or 1500 operating hours, whichever occurs first from the date of Ready-for-Takeover.
- .2 The warranty must be comprehensive. No deductibles will be allowed for travel time, expenses, part and labour.

1.10 SERVICE AND SUPPORT

- .1 The manufacturer of the generator set must maintain service parts inventory at a central location which is accessible to the service location 24 hours per day, 365 days per year.
- .2 The generator set must be serviced by a local service organization that is trained and factory certified in generator set service. The supplier must maintain an inventory of critical replacement parts at the local service organization and in service vehicles. The service organization must be on call 24 hours per day, 365 days per year.
- .3 Manufacturer to maintain model and serial number records of each generator set provided for at least 20 years.

Part 2 - PRODUCTS

2.1 GENERATOR SET

- .1 Ratings:
 - .1 Generator set to operate at 1800 rpm and at a voltage of 600 VAC, 3-phase, 4-wire, 60 Hertz.
 - .2 Generator set to be rated at the minimum kW/kVA rating at 0.8 PF as indicated on the drawings, based on site conditions of:
Altitude 64 meters, ambient temperatures up to 40 degrees C.
 - .3 The generator set rating will be based on emergency/standby service.

.2 Performance:

- .1 Voltage regulation must be plus or minus 0.5 percent for any constant load between no load and rated load. Random voltage variation with any steady load from no load to full load must not exceed plus or minus 0.5 percent.
- .2 Frequency regulation to be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load must not exceed plus or minus 0.25%.
- .3 Diesel engine-generator set to be capable of single step load pick up of 100% nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.
- .4 The generator set must be capable of sustaining a minimum of 90% of rated no load voltage with the specified kVA load at near zero power factor applied to the generator set.
- .5 Alternator to produce a clean AC voltage waveform, with not more than 5% total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3% in any single harmonic. Telephone influence factor must be less than 40.

.3 Construction:

- .1 Mount the engine-generator set on a heavy-duty steel base to maintain alignment between components. Base to incorporate a battery tray with hold-down clamps within the rails
- .2 All switches, lamps, and meters in the control system must be oil-tight and dust-tight, and the enclosure door shall be gasketed. There must be no exposed points in the control (with the door open) that operate in excess of 50V.

.4 Connections:

- .1 Generator set load connections to be composed of silver flashed or tin plated copper bus bars, drilled to accept mechanical or compression terminations of the number and type as shown on the drawings. Provide a sufficient lug space for use with cables of the number and size as shown on the drawings.
- .2 Make power connections to auxiliary devices at the devices.
- .3 Make generator set control interfaces to other system components on a common, permanently labelled terminal block assembly.

2.2 ENGINE AND ENGINE EQUIPMENT

.1 Diesel engine: to ISO 3046/1.

- .1 Engine: standard product of current manufacture, from company regularly engaged in production of such equipment.

- .2 Turbo charged, synchronous speed 1800 r/min, four cycle engine, radiator and fan cooled.
- .3 The horsepower rating of the engine at its minimum tolerance level must be sufficient to drive the alternator and all connected accessories.
- .4 Cooling System:
 - .1 Liquid cooled: heavy duty industrial radiator mounted on generating set base with engine driven pusher type fan to direct air through radiator from engine side with ethylene glycol anti-freeze non-sludging above minus 46°C.
 - .2 To maintain manufacturer's recommended engine temperature range at 10% continuous overload in ambient temperature of 50°C.
 - .3 Coolant heater: thermostatically controlled liquid coolant heating system, sized in accordance with manufacturer's recommendations and complete with thermostat and single point AC power connection heater (208VAC single-phase, powered from local distribution panel). Provide shut-off valve directly on engine block.
- .5 Fuel: Grade No. 2 diesel to ASTM D 975.
- .6 Fuel system: engine driven solid injection, mechanical positive displacement fuel pump, replaceable fuel filters, fuel rack solenoid energized when engine running, flexible supply and return fuel lines.
- .7 Governor:
 - .1 Steady state speed band of plus or minus 0.5%.
 - .2 Speed regulation no load to full load 5% maximum.
 - .3 Electronic type, electric actuator, speed droop externally adjustable from isochronous to 5%, temperature compensated with steady state speed maintenance capability of plus or minus 0.25%.
- .8 Lubrication system:
 - .1 Pressure lubricated by engine driven positive displacement mechanical oil lubrication pump.
 - .2 Lube oil filter: replaceable, full flow type, removable without disconnecting piping.
 - .3 Lube oil cooler.
 - .4 Engine sump drain valve.
 - .5 Oil level dip-stick.
- .9 Starting system:
 - .1 Positive shift, gear engaging starter 24VDC.
 - .2 Cranking limiter to provide three (3) cranking periods of 15 s duration, each separated by 15 s rest without overheating.

- .3 24VDC starting batteries with sufficient capacity to crank engine for 1 min at 0°C without using more than 25% of ampere hour capacity. Batteries to be mounted in battery tray with hold down clamps within the rails, off the concrete floor slab and complete with battery cables and connectors.
- .4 Battery charger: constant voltage, solid state, two stage from trickle charge at standby to boost charge after use. Regulation: plus or minus 2% output for plus or minus 10% input variation. Equipped with DC voltmeter, DC ammeter and on-off switch. Charger to be suitable for connection to 15A, 120 V, 1-phase, 60 Hz supply (powered from local distribution panel). Provide charger complete with "alarm" lights (loss of AC power, low battery voltage, high battery voltage), "power on" light and a dry form 'C' contact (rated 4A, 120V) for each alarm condition for remote monitoring.
- .10 Provide vibration isolators, spring/pad type, quantity as recommended by the generator set manufacturer.
- .11 Guards to protect personnel from hot and moving parts. Locate guards so that normal daily maintenance inspections can be undertaken without their removal.
- .12 Drip tray.
- .13 Replaceable dry element air cleaner with restriction indicator.

2.3 ALTERNATOR

- .1 Alternator: to NEMA MG1.
- .2 The alternator must be capable of delivering rated output (kVA/kW) at rated frequency and power factor, at any voltage not more than 5% above or below rated voltage.
- .3 Voltage rating and capacity as indicated on the drawings.
- .4 Output at 40°C ambient:
 - .1 100% full load continuously.
 - .2 110% full load for 1 h.
 - .3 150% full load for 1 min.
- .5 Four-pole, 2/3 pitch, revolving field, brushless, single pre-lubricated sealed bearing.
- .6 Drip proof construction.
- .7 Amortisseur windings.
- .8 Synchronous type.
- .9 Exciter: permanent magnet.
- .10 All insulation system components must meet NEMA MG-1 temperature limits for class H insulation.

- .11 Digital voltage regulator: microprocessor based, programmable operating characteristics, over excitation protection, fault detection logging, digital display, remote communication capability, adjustable over voltage and under voltage protection, load steady state to full load steady state.
 - .1 Regulation: $\pm 1\%$ no load steady state to full load steady state.
 - .2 Regulation temperature drift: less than 0.5% for any 33°C change over the operating temperature range.
 - .3 Programmable V/Hz characteristic: two (2) slope ranges adjustable from 1-10V/Hz.
 - .4 Regulator response time: maximum of 10ms.
 - .5 Regulating sensing: Trus RMS 3-phase with variable sense range from 90 to 600VAC.
 - .6 Regulator stability: stable for total harmonic distortion of the generator output voltage waveform up to 20%.
 - .7 Voltage adjust range: -10% to 10% of regulator sensing voltage.
 - .8 Regulator voltage gain: 0-10%.
 - .9 Reactive droop adjustment: 0-10%.
- .12 Capable of sustaining 300% rated current for period not less than 10s permitting selective tripping of down line protective devices when short circuit occurs.
- .13 The sub-transient reactance of the alternator must not exceed 12%, based on standby rating of the generator set.

2.4 GENERATOR SET CONTROL

- .1 Provide a generator set with a microprocessor-based control system that is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system must also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification. Mount the control on the generator set. Control to be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered. Generator set mounted control to include the following features and functions:
 - .1 Control switches:
 - .1 Mode Select Switch: mode select switch to initiate the following control modes. When in the RUN or Manual position the generator set will start, and accelerate to rated speed and voltage as directed by the operator. In the OFF position the generator set will immediately stop, bypassing all time delays. In the AUTO position the generator set will be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.

- .2 Emergency Stop switch: switch to be Red "mushroom-head" push-button. Depressing the emergency stop switch will cause the generator set to immediately shut down, and be locked out from automatic restarting.
- .3 RESET switch: this is used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
- .4 PANEL LAMP switch: depressing the panel lamp switch will cause the entire panel to be lighted with DC control power. The panel lamps will automatically be switched off within a preset time delay after the switch is depressed, or after the switch is depressed a second time.
- .2 Generator Set AC Output Metering:
 - .1 Provide a generator set with a metering set including the following features and functions as a minimum:
 - .1 Digital metering set, 0.5% accuracy, to indicate generator RMS voltage and current, frequency, output current, output KW, KW-hours, and power factor. Generator output voltage must be available in line-to-line and line-to-neutral voltages, and shall display all three phase voltages (line to neutral or line to line) simultaneously.
- .3 Generator set alarm and status display:
 - .1 Provide a generator set with alarm and status indicating lamps to indicate non-automatic generator status, and existing warning and shutdown conditions. Lamps to be high-intensity LED type. The lamp condition must be clearly apparent under bright room lighting conditions. Generator set control to indicate the existence of the following alarm and shutdown conditions on an alphanumeric digital display panel:
 - .1 Low oil pressure (alarm)
 - .2 Low oil pressure (shutdown)
 - .3 Oil pressure sender failure (alarm)
 - .4 Low coolant temperature (alarm)
 - .5 High coolant temperature (alarm)
 - .6 High coolant temperature (shutdown)
 - .7 Engine temperature sender failure (alarm)
 - .8 Low coolant level (alarm or shutdown--selectable)
 - .9 Fail to crank (shutdown)
 - .10 Fail to start/over crank (shutdown)
 - .11 Over speed (shutdown)
 - .12 Low DC voltage (alarm)
 - .13 High DC voltage (alarm)
 - .14 Weak battery (alarm)

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- .15 High AC voltage (shutdown)
 - .16 Low AC voltage (shutdown)
 - .17 Under frequency (shutdown)
 - .18 Over current (warning)
 - .19 Over current (shutdown)
 - .20 Short circuit (shutdown)
 - .21 Over load (alarm)
 - .22 Emergency stop (shutdown)
- .2 Include provisions for indication of four customer-specified alarm or shutdown conditions. Labelling of the customer-specified alarm or shutdown conditions to be of the same type and quality as the above specified conditions. Non-automatic indicating lamp to be red and flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.
- .4 Engine status monitoring:
 - .1 The following information must be available from a digital status panel on the generator set control:
 - .1 Engine oil pressure (psi or kPA)
 - .2 Engine coolant temperature (degrees F or C)
 - .3 Engine oil temperature (degrees F or C)
 - .4 Engine speed (rpm)
 - .5 Number of hours of operation (hours)
 - .6 Number of start attempts
 - .7 Battery voltage (DC volts)
 - .2 Control system to also incorporate a data logging and display provision to allow logging of warning or shutdown indications (minimum of last 10) on the generator set, as well as total time of operation at various loads, as a percent of the standby rating of the generator set.
- .5 Engine control functions:
 - .1 Include a cycle cranking system, which allows for user selected crank time, rest time, and number of cycles. Initial settings to be for old system to include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. Governor control to include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting. Governor control to be suitable for use in parallelling applications without component changes.
 - .2 The control system must include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.

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- .3 The control system must include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sender or wiring components, and an actual failure conditions.
- .6 Alternator control functions:
 - .1 Generator set to include an automatic digital voltage regulation system that is matched and prototype tested by the engine manufacturer with the governing system provided. It must be immune from mis-operation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. Equip the voltage regulation system with three-phase RMS sensing and must control buildup of AC generator voltage to provide a linear rise and limit overshoot. System to include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below a threshold of 58-59 HZ. Voltage regulator to include adjustments for gain, damping, and frequency roll-off. Adjustments to be broad range, and made via digital raise-lower switches, with an alphanumeric LED readout to indicate setting level. Rotary potentiometers for system adjustments are not acceptable.
 - .2 Provide controls to monitor the output current of the generator set and initiate an alarm (over current warning) when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls will shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (over current shutdown). Provide the protective functions in compliance to the requirements of NFPA 70 article 445.
 - .3 Provide controls to individually monitor all three phases of the output current for short circuit conditions. The control/protection system will monitor the current level and voltage. Controls to shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (short circuit shutdown). Provide the protective functions in compliance to the requirements of NFPA 70 article 445.
 - .4 Provide controls to monitor the KW load on the generator set, and initiate an alarm condition (over load) when total load on the generator set exceeds the generator set rating for in excess of 5 seconds. Controls to include a load shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is

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overloaded.

- .5 Provide an AC over/under voltage monitoring system that responds only to true RMS voltage conditions. The system will initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown to occur when the output voltage of the alternator is less than 85% for more than 10 seconds.
- .6 Provide a battery monitoring system which initiates alarms when the DC control and starting voltage is less than 25VDC or more than 32VDC. During engine cranking (starter engaged), the low voltage limit will be disabled, and if DC voltage drops to less than 14.4 volts for more than two seconds a "weak battery" alarm will be initiated.
- .7 Control interfaces for remote monitoring: bring all control and interconnection points from the generator set to remote components to a separate connection box. No field connections will be made in the control enclosure or in the AC power output enclosure. Provide the following features in the control system.
 - .1 Provide Form "C" dry contact set rated 15A @ 120V (minimum) to indicate each of the following: critical fault and non-critical fault.
 - .2 Provide four (4) N.O. generator run isolated contacts, rated 5A @ 120V (minimum) and wired to terminals for connection to ventilation systems and/or remote monitoring system.
- .2 Locate the generator control panel on the generator.

2.5 STEEL MOUNTING BASE

- .1 Complete generating set mounted on structural steel base of sufficient strength and rigidity to protect assembly from stress or strain during transportation, installation and under operating conditions on suitable level surface.
- .2 Assembly fitted with vibration isolators and control console resiliently mounted.
 - .1 Spring type isolators with adjustable side snubbers and adjustable for levelling.
 - .2 Pad type isolators are acceptable.
 - .3 Whether they are spring type or pad type there must be no gap between the genset frame and the subbase tank.
- .3 Sound insulation pads for installation between isolators and concrete base.

- .4 Provide a double wall, sub-base tank. The fuel tank base capacity must permit the unit to operate at 100% load for a period of 24 hours and be provided as an integral part of the enclosure. Install the fuel tank in a rupture basin with 110% capacity. The tank must be manufactured and certified to meet ULC 142.18 standards. Provide a locking fill cap, a mechanical reading fuel level gauge, low fuel level alarm contact and fuel tank rupture alarm contact. Connect the low fuel level and rupture basin contacts to the generator set control panel to give alarm on these two conditions. Control panel to have a dry contact rated 5A @ 120VAC for remote annunciation for these alarm conditions.
- .5 Provide fuel tank overfill protection and fuel fill box to prevent spillage.

2.6 EXHAUST SYSTEMS

- .1 Heavy duty critical type horizontally mounted exhaust silencer with condensate drain, plug and flanged couplings.
- .2 Heavy duty stainless steel exhaust piping, with flanged connections, size and material as per manufacturer's specifications.
- .3 Fittings and accessories as required.
- .4 Expansion joints: stainless steel, corrugated, of suitable length, to absorb both vertical and horizontal expansion.
- .5 Through wall stainless steel thimbal of suitable length to pass through wall and to absorb both vertical and horizontal expansion.
- .6 Insulate all exhaust components with high temperature (calcium silicate) insulation to 50 mm thickness.
- .7 Support exhaust system from roof structure using vibration isolating pipe hangers.

2.7 CIRCUIT BREAKER

- .1 Provide integral moulded case circuit breaker to Section 26 28 21, complete with electronic overcurrent trip unit (LSI). Circuit breaker to be factory wired to the generator complete with enclosure mounted on the generator skid.
- .2 Provide circuit breaker complete with provision to padlock in the off position.

2.8 SOUND ATTENUATED ENCLOSURE

- .1 Standard Non Walk-in Sound Attenuated Enclosure:
 - .1 Weather resistant, sound attenuated enclosure of aluminum with electrostatically applied powder coated baked polyester paint complete with integral fuel tank.
 - .2 Sound pressure level not to exceed 85 dBA at 1 meter, and 75 dBA at 7.0 meters from the enclosure at full load.

- .3 Enclosure to consist of a roof, side walls and end walls.
- .4 All fasteners must be either zinc plated or stainless steel.
- .5 Enclosure to have the number of doors required so that all normal maintenance operations may be accomplished without disassembly of any enclosure components.
- .6 Fabricate access doors of the same material as the enclosure walls and reinforce for rigidity. Handles to be key lockable, all doors keyed alike, and hinges to be zinc die cast or stainless steel.
- .7 Air intake silencer.
- .8 Exhaust air silencer.
- .9 Extend lube oil and coolant drains to the exterior of the enclosure and terminate with drain valves and capped with pipe nipples on flanged connectors.
- .10 Radiator access will be through a hinged, lockable cover on enclosure.
- .11 Fully guard the cooling fan and charging alternator to prevent injury.
- .12 Enclosure sound attenuation: provide acoustical foam between all supports and inside doors and sound baffles on air intake and air discharge.
- .13 A critical type silencer, companion flanges, and flexible stainless steel exhaust fitting properly sized shall be furnished. Enclosure manufacturer to internally mount the exhaust silencer(s) and maintain the weather resistant integrity and aesthetic appearance of the system. Externally mounted silencers will not be permitted.
- .14 Lifting points on base frame suitable for lifting combined weight on base fuel tank, generator set and enclosure. Provide a tested and certified single point lifting facility to aid in generator placement.
- .15 Provide a 15A, 120V GFCI duplex service receptacle (CSA 5-15R configuration) in the enclosure.
- .16 Wire the packaged generator for a single point 120/208VAC, single phase, 3 wire, 60 Hz power circuit (amperage as required by the manufacturer), minimum 10 kA interrupting rating. The generator package must provide all necessary wiring, receptacles fusing and circuit breakers to distribute power to the various auxiliary devices (i.e., battery charger, block heater, receptacle, etc.).

2.9 FINISHES

- .1 Provide factory applied, manufacturer's standard epoxy paint finish.
- .2 Alternator control cubicle: paint inside, exterior to match engine and alternator.

- .3 Other ducts and racks grey.
- .4 Supply 0.25 L of touch-up enamel.

2.10 EQUIPMENT IDENTIFICATION

- .1 Control panels: complete with Generator voltages, kW and kVA rating and breaker sizing.

2.11 FABRICATION

- .1 Shop assemble generating units including:
 - .1 Base.
 - .2 Engine and radiator.
 - .3 Alternator.
 - .4 Control panel.
 - .5 Battery and charger.

2.12 ACCEPTABLE MANUFACTURERS

- .1 Caterpillar, Kohler, Cummins, Detroit, MTU.

Part 3 - EXECUTION

3.1 INSTALLATION

- .1 Handle and install equipment in strict accordance with manufacturer's instructions. Confirm such instructions are issued at time of shop drawing issue and are available on site when required.
- .2 Provide cast-in-place concrete equipment attachments as required by the equipment and as shown on the Drawings.
- .3 Provide correct type and full number, size and length of anchor bolts and other connecting bolts as required by equipment manufacturer. Preset anchor bolts in concrete where convenient; otherwise leave suitable openings in concrete and set anchor bolts later using Red-Head Epoxy anchors or other approved fastening methods.
- .4 Coordinate location and provide items for embedding into cast-in-place concrete.

3.2 RESPONSIBILITY OF TEMPORARY TRIAL USAGE

- .1 Obtain written permission from the Consultant to use and test permanent equipment and systems prior to acceptance by the Owner.
- .2 The guarantee period shall not be affected by temporary trial use of the equipment.
- .3 Clean and renew equipment and systems used before acceptance. Restore to original or new working condition.

- .4 Protect equipment and systems openings from dirt, dust and other foreign materials during temporary usage.

3.3 INSPECTION, TESTING AND START-UP

- .1 Provide the services of competent servicemen, mechanics or other trained personnel of the equipment supplier's or manufacturer's to check the complete installation and be present for start-up of the equipment. Submit a written report signed by the equipment manufacturer's representative to the Consultant stating the following:
 - .1 That a satisfactory installation of equipment has been performed and outlining any modifications that have been made as a result of the commissioning or testing of the equipment at no additional cost to the Contract.
 - .2 That the equipment is now ready for permanent operation;
- .2 Have the equipment manufacturer's representative fully instruct the permanent operator of the equipment in the proper operation and maintenance of all equipment at no additional cost to the Contract.
- .3 Replace defective material and equipment with new. Bear costs including re-testing and repairing.

3.4 FIELD QUALITY CONTROL

- .1 Demonstrate:
 - .1 Unit start, transfer to load, re-transfer to normal power, unit shut down, on "Automatic" control.
 - .2 Unit start and shut down on "Manual" control
 - .3 Unit start and transfer on "Test" control.
 - .4 Unit start on "Engine start" control.
 - .5 Operation of automatic alarms and shut down devices.
- .2 Provide resistive load bank and temporary connecting cables sized for full rating of generator for testing.
- .3 Run unit on 100% load for minimum period of eight (8) hours to show load carrying ability, stability of voltage and frequency, and satisfactory performance of heat exchanger system to provide adequate engine cooling.
- .4 During full load test, also measure sound levels and demonstrate conformance to specifications.
- .5 At end of test run, check battery voltage to demonstrate battery charger has returned battery to fully charged state.
- .6 Submit start up report to Contractor within five (5) days of successful commissioning of system.
- .7 Provide fuel for testing and leave fuel tank full on acceptance.

END OF SECTION

Part 1 - GENERAL

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data for review and approval in accordance with Section 01 33 00.

1.2 OPERATION AND MAINTENANCE DATA

- .1 Provide maintenance data for UPS for incorporation into manual as specified in Section 01 78 00.

1.3 WARRANTY

- .1 Have the manufacturer provide a product warranty for a period of not less than two (2) years from the date of Ready-for-Takeover. Warranty to include full parts and labour.

1.4 SCOPE OF SUPPLY

- .1 One (1) UPS unit for PLC-01 at the new Electrical room at the WWTP.

1.5 SYSTEM DESCRIPTION

- .1 Uninterruptible Power Supply (UPS) System to be a solid state system providing single-phase uninterruptible AC power for sensitive electronic equipment loads. It must comply with the requirements of the Underwriters Laboratories standard 1778, FCC Part 15, Subpart B, Class A (RFI/EMI), IEEE 587 Categories A and B, and shall be listed under the Underwriters Laboratories of Canada.

Part 2 - PRODUCTS

2.1 MATERIALS

- .1 UPS to be designed to operate as a true on-line double conversion system in normal, emergency, recharge and bypass modes.
- .2 The UPS unit will be comprised of the following components housed in a NEMA type 1 enclosure:
 - .1 Input converter.
 - .2 Battery charger.
 - .3 Inverter.
 - .4 Battery (nominal 5 year life, hot swappable, consisting of the appropriate number of sealed battery cells).
 - .5 Cooling fan.
- .3 UPS system to include a front panel LCD screen or LED type status indicating the following:
 - .1 UPS on.
 - .2 Overload.

- .3 Load percentage.
 - .4 Battery charge level.
 - .5 UPS inverter is operating and supplying power.
 - .6 UPS is in bypass.
 - .7 UPS is operating from battery power.
 - .8 UPS fault condition.
- .4 Provide the UPS complete with an On/Off pushbutton and an audible alarm reset pushbutton.
 - .5 UPS to have built-in protection against under voltage, overcurrent and over voltage conditions, including low-energy lightning surges on primary AC sources.
 - .6 UPS to have an input power plug (to match UPS rating) and output distribution consisting of minimum three (3) NEMA 5-15R receptacles.
 - .7 UPS to have automatic transfer bypass protection to transfer output load from the inverter to the bypass source in the event of overload, over temperature, DC bus over voltage and inverter failure conditions.
 - .8 Design requirements:
 - .1 Input voltage: 120 Vac nominal, 60 Hz, single phase, 2 wire plus ground.
 - .2 Output voltage: 120 Vac $\pm$ 3%, 60 Hz, single phase, 2 wire plus ground.
 - .3 Output load capacity:
 - .1 Operator Interface PC's: minimum 1500VA/1050W at 0.7 lagging power factor.
 - .2 PLC Control Panels: minimum 1500VA.
 - .3 Telecommunications Racks: minimum 2000 VA.
 - .4 Battery runtime: minimum ten (10) minute run time at the output load capacity rating.
 - .5 If required, provide external battery or upsize the UPS VA rating to achieve minimum battery run times.
 - .9 Performance requirements:
 - .1 AC input to UPS:
 - .1 Voltage: 120 Vac nominal, 70-138 V range.
 - .2 Input frequency: 60 Hz, range 40-70 Hz.
 - .3 Input power factor: greater than 0.95 lagging at rated load.
 - .4 Input line transient immunity: conforming to IEEE 587, Category A and B tests.
 - .2 AC output, UPS inverter:
 - .1 Voltage: 120 Vac.
 - .2 Voltage regulation: $\pm$ 3% steady state.
 - .3 Frequency: 60 Hz, $\pm$ 5% synchronized to utility, $\pm$ 0.1 Hz free running or on battery operation.

- .4 Frequency slew rate: 1.0 Hz per second (maximum).
- .5 Load power factor range: 0.65 lagging to unity.
- .6 Overload capability:
 - .1 130% rated load for 10 seconds.
 - .2 150% rated load for 1.5 seconds.
 - .3 200% sub-cycle.
- .7 Voltage transient response:
 - .1 $\pm 7\%$ for 0-100% loading (normal).
 - .2 $\pm 9\%$ for 0-100% loading (battery mode).
- .8 Transient recovery time: to nominal voltage within 90 milliseconds.
- .9 Efficiency: minimum 83%.
- .10 UPS to have a relay interface card complete with dry contacts (minimum 24 VDC) for remote monitoring of the following conditions: input power failure, low battery, and UPS fault.
- .11 UPS to be rack mounted in telecommunications cabinets.
- .12 Acceptable materials:
 - .1 Ablerex ARES RT series.
 - .2 Liebert GXT4 series.
 - .3 Or approved equivalent.

Part 3 - EXECUTION

3.1 INSTALLATION

- .1 Locate UPS units as follows:
 - .1 Floor mount the UPS near the operator's interface PC.
 - .2 Mount the UPS in PLC cabinet JB-990.
 - .3 Rack mount the UPS telecommunications cabinets JB-991 and JB-993.
 - .4 Mount the UPS in the Lift station control panel JB-992.
 - .5 Mount the UPS in the Scada Network Panel JB-994.
- .2 Assemble and interconnect components to provide complete UPS as specified.
- .3 Connect AC mains to UPS.
- .4 Connect UPS output to load.
- .5 Start up UPS and make preliminary tests to ensure satisfactory performance.

END OF SECTION

Part 1 - GENERAL

1.1 REFERENCES

- .1 CSA C61869-1-14(R2019), Instrument Transformers, General Requirements.
- .2 CSA C22.2 No. 178.1-22, Automatic Transfer Switches.

1.2 SCOPE OF SUPPLY

- .1 Provide one (1) automatic transfer switch at the treatment plant.

1.3 SYSTEM DESCRIPTION

- .1 Automatic load transfer equipment to:
 - .1 Monitor voltage on all phases of normal and emergency power supply.
 - .2 Initiate cranking of standby generator unit on normal power failure or abnormal voltage on any one phase below preset adjustable limits for adjustable period of time.
 - .3 Transfer load from normal supply to standby unit when standby generator reaches rated frequency and voltage pre-set adjustable limits.
 - .4 Transfer load from standby generator to normal power supply when normal power restored, confirmed by sensing of voltage on all phases above adjustable pre-set limit for adjustable time period.
 - .5 Shut down standby unit after running unloaded to cool down using adjustable time delay relay.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Include:
 - .1 Make, model and type.
 - .2 Single line diagram showing controls and relays.
 - .3 Description of equipment operation including:
 - .1 Automatic starting and transfer to standby unit and back to normal power.
 - .2 Test control.
 - .3 Manual control.
 - .4 Automatic shutdown.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for automatic load transfer equipment for incorporation into manual specified in Section 01 78 00.
- .2 Detailed instructions to permit effective operation, maintenance and repair.

.3 Technical data:

- .1 Schematic diagram of components, controls and relays.
- .2 Illustrated parts lists with parts catalogue numbers.
- .3 Certified copy of factory test results.

Part 2 - PRODUCTS

2.1 MATERIALS

- .1 Instrument transformers: to CSA C61869-1.
- .2 Transfer switch must meet or exceed the requirements of CSA C22.2 No. 178.1.
- .3 Transfer switch to be mechanically interlocked to ensure only two possible positions, normal or emergency.
- .4 Provide all transfer switches and controllers from a single manufacturer.
- .5 Busbars and main connections: 99.3% copper, tin plated.
- .6 Main operators that include overcurrent disconnect devices, linear motors and gears shall not be accepted.
- .7 Designs utilizing components of moulded case circuit breakers or switches will not be accepted.

2.2 CONTACTOR TYPE TRANSFER EQUIPMENT

- .1 Two (2) 3-phase contactors mounted on common frame, in double throw arrangement, mechanically and electrically interlocked, solenoid operated. Include a microprocessor controller to provide automatic operation. The operating time must not exceed 8 cycles including the power failure sensing.
- .2 Install equipment in a NEMA type 2 enclosure, free standing, floor mounted.
- .3 Open transition type switch with a fully rated solid neutral.
- .4 Rated: continuous ampere rating as noted on the drawings, 600V, 60 Hz, 3 phase, 4 wire.
- .5 Main contacts: silver composition, switches rated 600A and above must have segmented, blowout construction and must be protected by separate arcing contacts.
- .6 Switch and relay contacts, coils, spring and control elements accessible for inspection and maintenance from front of panel without removal of switch panel or disconnection of drive linkages and power conductors.
- .7 Minimum 35kA momentary (rms symmetrical) fault withstand rating. Transfer switch to be suitable for connection to standby generator as indicated.

2.3 MICROPROCESSOR CONTROLLER

- .1 Controller's sensing and logic will be provided by a built-in microprocessor for maximum reliability.
- .2 Connect the controller to the transfer switch by an interconnecting wiring harness. Harness to include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance.
- .3 LCD display and keypad to be an integral part of the controller for viewing all available data and setting desired operational parameters.
- .4 Controller LCD display to include a "System Status" screen. Screen to display a clear description of the active operating sequence and switch position.
- .5 Controller to contain a diagnostic screen for the purpose of detecting system errors. Screen to provide information on the status input signals to the controller which may be preventing load transfer commands from being completed.
- .6 Controller to have the ability to log data and to maintain the last 50 events, even in the event of a total loss of power. The following events will be time and date stamped and maintained in a non volatile memory.
 - .1 Event Logging:
 - .1 Date, time, and reason for transfer normal to emergency.
 - .2 Date, time, and reason for transfer emergency to normal.
 - .3 Date, time, and reason for engine start.
 - .4 Date, time, engine stopped.
 - .5 Date, time, emergency source available.
 - .6 Date, time, emergency source not available.
 - .2 Statistical Logging:
 - .1 Total number of transfers.
 - .2 Total number of transfers due to source failure.
 - .3 Total number of days controller is energized.
 - .4 Total number of hours both normal and emergency are available.

2.4 VOLTAGE, FREQUENCY AND PHASE ROTATION SENSING

<u>Parameter</u>	<u>Sources</u>	<u>Dropout</u>	<u>Pickup</u>
Under voltage	N & E, 30Ø	70-98%	85-100%
Over voltage	N & E, 30Ø	102-115%	2% below trip
Under frequency	N & E	85-98%	90-100%
Over frequency	N & E	102-110%	2% below trip
Voltage unbalanced	N & E	5-20%	1% below DO

- .1 Voltage and frequency settings must be field adjustable in 1% increments locally with the display and keypad and remotely via ethernet communications port access.
- .2 The controller must be capable (when activated by the keypad or through the serial port) of sensing the phase rotation of both the normal and emergency sources. The source will be considered unacceptable if the phase rotation is not the preferred rotation selected.
- .3 Provide source status screens for both normal and emergency to provide digital readout of voltage on all 3 phases, frequency, and phase rotation.

Part 3 - EXECUTION

3.1 INSTALLATION

- .1 Locate, install and connect transfer switch as indicated on the drawings and in accordance with the manufacturer's written instructions.
- .2 Check controller and adjust as required.
- .3 Connect auxiliary contacts to PLC as indicated.
- .4 Mount control switches and annunciation lights in door of automatic transfer switch.
- .5 Connect transfer switch to generator control panel as per manufacturer's recommendations, with 2-#14 AWG RW90 in conduit.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00.
- .2 Energize transfer equipment from normal power supply.
- .3 Set selector switch in "Test" position to ensure proper standby start, running, transfer, re-transfer. Return selector switch to "Auto" position to ensure standby shuts down.
- .4 Set selector switch in "Manual" position and check to confirm proper performance.
- .5 Set selector switch in "Engine start" position and check to ensure proper performance. Return switch to "Auto" to stop engine.
- .6 Set selector switch in "Auto" position and open normal power supply disconnect. The existing standby genset should start, come up to rated voltage and frequency, and then load should transfer to standby. Allow to operate for 10 min, then close main power supply disconnect. Load should transfer back to normal power supply and standby should shutdown.
- .7 Repeat, at 15 minute intervals, four (4) times, complete test with selector switch in each position, for each test.

- .8 After completion of tests above, and a five minute cooling period, load test engine for a minimum of four (4) hours using the building load. Co-ordinate testing with consultant to ensure representative plant load is available for load test. Record the following at 5 minute intervals for the first 15 minutes and at 15 minute intervals thereafter: voltage, frequency, amperes, engine oil pressure and temperature. Tabulate results and submit to the Consultant for review and approval.
- .9 Arrange and pay for a factory certified representative to set up and commission transfer switch for proper operation to the satisfaction of the Consultant. Document all testing and set up and submit to the Consultant.
- .10 Have the factory certified representative fully instruct the plant operators in the proper operation and maintenance of the automatic transfer switch and controls.

END OF SECTION

Part 1 - GENERAL

1.1 DESCRIPTION OF WORK

- .1 This section specifies requirements for the supply and installation of Transient Voltage Surge Suppression (SPD) for the protection of the building's electrical system.

1.2 REFERENCES

- .1 IEEE C62.41.1-02(R2008), IEEE Guide on the Surge Environment in Low-Voltage AC Power Circuits.
- .2 ANSI/IEEE 1100-2005, Recommended Practice for Powering and Grounding Electronic Equipment.
- .3 OSHA, Occupational Safety and Health Association, Compliance Handbook.
- .4 UL 1283-2017, UL Standard for Safety Electromagnetic Interference Filters.
- .5 UL 1449-2022, UL Standard for Safety Surge Protective Devices.

1.3 SUBMITTALS

- .1 Provide shop drawings with wiring diagrams, installation information, testing and maintenance procedures, and operational information for the transient protection system.
- .2 Provide safety data as specified in Section 01 35 29.06.
- .3 Indicate:
 - .1 Dimensional Drawing indicating proposed mounting arrangements.
 - .2 Written functional description of the transient protection circuit in terms of components, configuration, design approach, and performance capability.
 - .3 The means of connection of the SPD to the electrical distribution system.
 - .4 Have the manufacturer provide UL 1449, data card showing the Suppressed Voltage Rating (SVR) for the specific catalogue number with data clearly demonstrating the maximum surge current rating has been tested on a complete SPD unit including all necessary fusing/overcurrent protection, thermal disconnects, integral disconnects and monitoring systems.
 - .5 Submit data demonstrating the complete SPD unit, including all overcurrent protection, is fully capable of a minimum repetitive surge current rating of 12,000 ANSI/IEEE C62.41.1, Category C3 (10kA) impulses without failure or a change in performance characteristics of more than 10%.

1.4 EXTENDED WARRANTY

- .1 Provide an extended product warranty for a period of not less than 10 years from the date of Ready-for-Takeover. Warranty to cover unlimited replacement of system protection modules during warranty period. The first five (5) years of this warranty must include any field labour required to perform repair or replacement work.

1.5 OPERATION AND MAINTENANCE DATA

- .1 Provide maintenance data for SPD for incorporation into manual specified in Section 01 78 00.

Part 2 - PRODUCTS

2.1 MANUFACTURERS

- .1 Acceptable manufacturers:
 - .1 Liebert.
 - .2 Total protection solution.
 - .3 Eaton Clipper Supervisor series.
 - .4 Schneider Electric.
 - .5 CITEL
- .2 Inclusion in this list does not exempt the requirements that any proposed manufacturer must be compliant with the specifications.

2.2 ENVIRONMENTAL

- .1 General requirements:
 - .1 No audible noise must be generated.
 - .2 Operating Conditions:
 - .1 0 - 50 Degrees C
 - .2 15 - 85 Percent Humidity Non-Condensing

2.3 SURGE PROTECTIVE DEVICE (SPD) - TYPE A

- .1 General requirements for service entrance:
 - .1 Rated for a 600Y/347 volt, 60 Hertz, 3-phase, 4-wire.
 - .2 Provide surge suppressors in accordance with the following requirements:
 - .1 Unit to be parallel in design and connect in parallel into the electrical system. Each surge suppression element (MOV) must be individually fused so that a failure of one element and/or fuse must not affect other surge suppression elements.
 - .2 Unit to be UL 1449, 4th Edition Listed as a type 1 SPD.

- .3 The maximum continuous operating voltage (MCOV) must be greater than 115% of the nominal system operating voltage.
- .4 Maximum Voltage Protection Rating (VPR) for 600Y/347 Volt systems as follows:
 - .1 L-L = 3000V
 - .2 L-N = 1800V
 - .3 L-G = 1800V
 - .4 N-G = 1800V
- .5 Unit to provide minimum surge current rating of 100,000 amperes per mode (L-N, L-G, N-G) and 200,000 amperes per phase based on ANSI/IEEE C62.41 standard 8 by 20 microsecond current waveform.
- .6 Unit to have a short circuit current rating of 200,000A at rated voltage or greater.
- .7 EMI/RFI filtering.
- .8 Response time no greater than 1 nanosecond for any of the individual protection modes.
- .9 Unit to include solid-state, long-life externally mounted LED visual status indicators that indicate the on- line status and operational integrity of each phase of the unit.
- .10 Unit to have a Form C summary alarm output contact rated for at least 1 amp at 120VAC for remote annunciation of SPD status.
- .11 Include feature that tests the integrity of all modules, MOVs and fuses in the system.
- .12 Unit to have an audible alarm with an alarm on/off switch to silence the alarm.
- .13 Provide a surge counter to totalize transient voltage surges in both the normal and common mode. Provide the counter with a 10-year battery back-up to maintain counts in the event of power loss.
- .14 Enclosure: NEMA 1 unless noted otherwise.

2.4 SURGE SUPPRESSORS - TYPE B

- .1 General requirements:
 - .1 Rated for a 600Y/347 volt, 60 Hertz, 3-phase, 4-wire.
 - .2 Provide surge suppressors in accordance with the following requirements:
 - .1 Unit to be parallel in design and connect in parallel into the electrical system. Each surge suppression element (MOV) must be individually fused so that a failure of one element and/or fuse must not affect other surge suppression elements.
 - .2 Unit to be UL 1449, 4th Edition Listed as a type 2 SPD.

- .3 The maximum continuous operating voltage (MCOV) must be greater than 115% of the nominal system operating voltage.
- .4 Maximum Voltage Protection Rating (VPR) for 600Y/347 Volt system as follows:
 - .1 L-L = 3000V
 - .2 L-N = 1800V
 - .3 L-G = 1800V
 - .4 N-G = 1800V
- .5 Unit to provide minimum surge current rating of 80,000 amperes per mode (L-N, L-G, N-G) and 160,000 amperes per phase based on ANSI/IEEE C62.41 standard 8 by 20 microsecond current waveform.
- .6 Unit to have a short circuit current rating of 100,000A at rated voltage or greater.
- .7 EMI/RFI filtering.
- .8 Response time no greater than 1 nanosecond for any of the individual protection modes.
- .9 Unit to include solid-state, long-life externally mounted LED visual status indicators that indicate the on-line status and operational integrity of each phase of the unit.
- .10 Unit to have a Form C summary alarm output contact rated for at least 1 amp at 120VAC for remote annunciation of SPD status.
- .11 Include feature that tests the integrity of all modules, MOV's and fuses in the system.
- .12 Unit to have an audible alarm with an alarm on/off switch to silence the alarm.
- .13 Provide a surge counter to totalize transient voltage surges in both the normal and common mode. Provide the counter with a 10-year battery back-up to maintain counts in the event of power loss.
- .14 Enclosure: NEMA 1.

2.5 SURGE SUPPRESSORS - TYPE C

- .1 General requirements:
 - .1 Rated for a 120 volt, 60 Hertz, 1-phase, 2-wire.
 - .2 Provide surge suppressors in accordance with the following requirements:
 - .1 Unit to be parallel in design and connect in parallel into the electrical system. Each surge suppression element (MOV) must be individually fused so that a failure of one element and/or fuse must not affect other surge suppression elements.

- .2 Unit to be UL 1449, 4th Edition Listed as a type 2 or 4 SPD.
- .3 The maximum continuous operating voltage (MCOV) must be greater than 115% of the nominal system operating voltage.
- .4 Maximum Voltage Protection Rating (VPR) for 120 Volt systems as follows:
 - .1 L-N = 600V
 - .2 L-G = 600V
 - .3 N-G = 600V
- .5 Unit to provide minimum surge current rating of 40,000 amperes per phase based on ANSI/IEEE C62.41 standard 8 by 20 microsecond current waveform.
- .6 Unit to have a short circuit current rating of 100,000A at rated voltage or greater.
- .7 EMI/RFI filtering.
- .8 Unit to include solid-state, long-life externally mounted LED visual status indicator that indicate the on-line status and operational integrity of the unit.
- .9 Response time no greater than 1 nanosecond for any of the individual protection modes.
- .10 Unit to have a Form C summary alarm output contact rated for at least 1 amp at 120VAC for remote annunciation of SPD status.
- .11 Include feature that tests the integrity of all modules, MOVs and fuses in the system.
- .12 Enclosure: NEMA 1 unless otherwise noted.

Part 3 - EXECUTION

3.1 INSTALLATION

- .1 Install surge suppression system where indicated on the drawings and in accordance with the manufacturer's written instructions.
- .2 Keep conductors between suppressor and point of attachment to service equipment as short and as straight as practically possible, preferably not exceeding 600 mm.
- .3 Grounding: connect suppressor ground to the equipment grounding conductor and service entrance ground.
- .4 Arrange and pay for a factory certified representative to set up and commission the SPD's at site for proper operation to the satisfaction of the Consultant. Document all testing and set up and submit to the Consultant.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

- .1 IEEE C62.41.1-02(R2008), Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits.
- .2 ANSI C62.45-1987, Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.
- .3 IES RP1-20, Practice for Office Lighting.
- .4 ASTM F1137/F1137M-19, Standard Specification for Phosphate/Oil Corrosion Protective Coatings for Fasteners.
- .5 47 CFR 0-19, Telecommunication.
- .6 NECA/NEIS 500-06, Standard for Installing Indoor Lighting Systems.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Submit shop drawings for the following:
 - .1 Luminaire.
 - .2 Lamp for each luminaire type.
 - .3 Driver for each luminaire type.
- .3 Shop Drawings:
 - .1 Shop drawings must clearly indicate the following:
 - .1 Luminaire ID number as identified in contract documents.
 - .2 Fixture specification as identified in Part 2 and on the drawings.
 - .3 Lamp specification as identified in Part 2 and on the drawings.
 - .4 Driver specification as identified in Part 2 and on the drawings.
 - .5 Photometric data for each luminaire type.
 - .6 Energy data for lamps.
- .4 Catalogue cuts lacking sufficient detail to indicate compliance with Contract documents will not be acceptable.
- .5 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by the Consultant. Photometric data to include:
 - .1 VCP Table, spacing criterion;
 - .2 Total input watts;
 - .3 Candlepower summary, candela distribution, zonal lumen summary;
 - .4 Luminaire efficiency, C.I.E. type, coefficient of utilization;
 - .5 Lamp type;
 - .6 Lumen ratings

1.3 OPERATION AND MAINTENANCE

- .1 Provide operation and maintenance data for inclusion in the manual in accordance with Section 01 78 00.

1.4 WASTE AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with 01 74 00.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Seal emptied containers and store safely for disposal away from children.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 All LED luminaires must be capable of having their LED array and driver field replaced. If the luminaire optical assembly is sealed, field replacement of the optical assembly is acceptable.
- .2 Apply paint after fabrication on all interior recessed troffers.
- .3 Recessed troffers, in order to eliminate raw edges and corrosion and to maximize efficiency, paint the fixture housing and ballast cover with a baked white polyester enamel powder coat with 90% minimum reflectivity after fabrication using an electrostatic process. This need not include the lens frame.

2.2 SPARES

- .1 Provide 10% spare LED array's of each type to a minimum quantity of ten (10). Each spare LED array must be clearly labelled with the fixture type, manufacturer's name, and manufacturer's part number.
- .2 Provide 10% spare drivers of each type to a minimum quantity of ten (10). Each spare LED array should be clearly labelled with the fixture type, manufacturer's name, and manufacturer's part number.

2.3 LUMINAIRES

- .1 LED luminaire design L1:
 - .1 Heavy duty, open strip type lighting fixture suitable for surface or chain mounting indoors as indicated on the drawings.
 - .2 Input voltage: 120V, 60Hz.
 - .3 Nominal dimensions: 1219mm long.
 - .4 Nominal fixture lumens: 4700 lumens.
 - .5 Nominal fixture wattage: 35W.
 - .6 Light source: LED, 4000K, minimum 80 CRI.
 - .7 LED driver: electronic, <20% THD, integral surge protection.

- .8 Housing: die formed cold rolled steel.
- .9 Finish: baked white enamel (metal parts).
- .10 Options: chain hangers, length as required for mounting height specified on the Drawings.
- .11 Acceptable material:
 - .1 Metalux ST2.
 - .2 Signify FSS.
 - .3 Lithonia CDS.
 - .4 Approved equivalent.
- .2 LED luminaire design L2:
 - .1 Wall mounted, enclosed and gasketed, LED luminaire suitable for outdoor mounting (wet location listed).
 - .2 Input voltage: 120V, 60Hz.
 - .3 Nominal fixture lumens: 3000 lumens.
 - .4 Nominal fixture wattage: 44w.
 - .5 Light source: LED, 4000K, minimum of 70CRI.
 - .6 LED driver: Electric, 0-10V dimming. Less than 20% THD. Greater than 0.9 power factor. -40°C minimum starting temperature. Integral surge protection.
 - .7 Housing: die cast aluminum.
 - .8 Optics: tempered glass lens, wide throw distribution.
 - .9 Finish: polyester power coat, bronze colour. Final colour to be confirmed with architectural prior to ordering of fixtures.
 - .10 Integral photocell control.
 - .11 Acceptable material:
 - .1 Eaton XTOR series.
 - .2 Phillips LED wall sconce 121 series.
 - .3 TWX2 series.
 - .4 Approved equivalent.
- .3 LED luminaire design L3:
 - .1 Stanchion mounted (25° angled), enclosed and gasketed LED area luminaire suitable for outdoor mounting in a wet and corrosive outdoor environment. Mounting height indicated on the drawings.
 - .2 Input voltage: 120V, 60Hz.
 - .3 Nominal fixture lumens: 5000 lumens.
 - .4 Nominal fixture wattage: 35w.
 - .5 Light source: LED, 4000K, minimum of 70CRI.
 - .6 LED driver: less than 20% THD. Greater than 0.9 power factor. -40°C minimum starting temperature. Integral surge protection.
 - .7 House: copper free (less than 0.4%) die cast aluminum with electrostatically applied baked powder polyester paint.
 - .8 Optics: borosilicate lens, Type III distribution.
 - .9 Finish: polyester powder coat, gray colour.

- .10 Acceptable material:
 - .1 Ledrays HLO VL.
 - .2 Eaton Crouse Hinds Champ Pro PVM series.
 - .3 Holophane Petrolux LED series.
 - .4 Approved equivalent.
- .4 LED luminaire design L4:
 - .1 Vapour proof, enclosed and gasketed, wide distribution, LED luminaire suitable for pendant mounting in a Zone 1 hazardous environment.
 - .2 Input voltage: 120 V, 60 Hz.
 - .3 Nominal dimensions: 1219mm long.
 - .4 Nominal fixture lumens: 3800 lumens.
 - .5 Nominal fixture wattage: 40W.
 - .6 Light source: LED, 4000K, minimum 80 CRI.
 - .7 LED driver: electronic, <20% THD, integral surge protection.
 - .8 Housing: copper free (less than 0.4%) die cast aluminum with electrostatically applied, baked powder polyester paint, type 316 stainless steel or fibreglass reinforced resin.
 - .9 Optics: prismatic impact resistant smooth glass lens.
 - .10 Options: all exposed metal surfaces shall be of type 316 stainless steel or aluminum.
 - .11 Include mounting brackets to allow for light to be suspended from ceiling.
 - .12 Acceptable material:
 - .1 Aimlite C4LA-L.
 - .2 Dialight Safelight LED Linear.
 - .3 LDPI LEXS series.
 - .4 Approved equivalent.

END OF SECTION

PART 1 - GENERAL

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00.
- .2 Data to indicate system components, mounting method, source of power and special attachments.

PART 2 - PRODUCTS

2.1 BATTERY UNIT - TYPE EML1

- .1 Supply voltage: 120 V ac.
- .2 Output voltage: 12 V dc.
- .3 Operating time: 30 minutes based on actual DC load plus 25%.
- .4 Battery: sealed, maintenance free, ten (10) year life expectancy.
- .5 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01 V for plus or minus 10% input variations.
- .6 Solid state transfer circuit.
- .7 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.
- .8 Signal lights: LED solid state, for 'AC Power ON' and 'High Charge'.
- .9 Lamp heads: two (2) integral heads on unit, 345° horizontal and 180° vertical adjustment. Lamp type: LED, 5W nominal, MR-16.
- .10 Cabinets: suitable for direct mounting to wall. Removable or hinged front panel for easy access to batteries.
- .11 Finish: white.
- .12 Auxiliary equipment:
 - .1 Test switch.
 - .2 Self diagnostic circuitry.
- .13 Acceptable material:
 - .1 Lumacell RGS series.
 - .2 Ready-Lite LDX series.
 - .3 Aimlite EBST series.
 - .4 Approved equivalent.

2.2 DOUBLE REMOTE HEAD - TYPE EML2

- .1 Supply voltage: 12VDC from battery pack as indicated on drawings.
- .2 Output voltage: 12 V dc.

- .3 Lamp heads: two (2) per unit. Lamp type: LED, 6W nominal, MR-16.
- .4 Enclosure: suitable for direct mounting to wall. Enclosure to be hazardous area rated for a Zone 2 rated location, gas groups IIA and IIB rating and a minimum T3 temperature code.
- .5 Housing: die cast copper free aluminum
- .6 Acceptable material:
 - .1 Lumacell RG-X LED series (Remote Head).
 - .2 Killark EBS series (Remote Head).
 - .3 Aimlite RMHZ series.
 - .4 Approved equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install unit equipment as indicated.
- .2 Direct heads as indicated.
- .3 Make connections.
- .4 Test and verify operation of units upon loss and restoration of normal ac power. Verify 30 minute battery life upon loss of power.
- .5 Coordinate location of emergency lighting with other trades.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 Supply and install a complete telecommunications cabling system.
- .2 Structured cabling system to be standards compliant based upon a structured cabling system and should be composed of the following interdependent sub-systems:
 - .1 Horizontal cabling system.
 - .2 Telecommunications outlet/connector associated cords and adapters.
 - .3 Patch Panels, patch cables and equipment cords.
 - .4 Backbone cabling system.

1.2 RELATED WORK

- .1 Section 26 05 00 - Electrical General Requirements.
- .2 Section 27 05 28 - Communications Raceway Systems.
- .3 Section 26 91 00 - Process Control System Equipment

1.3 REFERENCES

- .1 TIA 607-2019D, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
- .2 TIA 606-2021, Administration Standard for Telecommunications Infrastructure.
- .3 CSA 22.1-2021, Canadian Electrical Code.
- .4 CSA C22.2 No. 226-16, Protectors in Telecommunications Networks.
- .5 TIA 526-1992, Standard Test Procedures for Fibre Optic Systems.
- .6 TIA 568.2-2018D, Balanced Twisted Pair Telecommunications Cabling and Components Standard.
- .7 TIA 568.3-22, Optical Fibre Cabling and Components Standard.

1.4 QUALIFICATION OF CONTRACTOR

- .1 All installation staff must show proof of certification with Nova Scotia Department of Labour and Advanced Education for low voltage installations.
- .2 Source all structured cabling, termination hardware, and connecting cords from the certifying manufacturer to assure quality control and validity of the manufacturer's warranty.
- .3 Acceptable standard for structured cabling system is Belden/CDT, Hubbell and Leviton.
- .4 The Contractor, through the vendor, is responsible for the design, installation, certification, and support of the cabling system. Show proof that the vendor has the certifying manufacturer's support on all

of these issues.

- .5 Qualified vendors to provide technical field services in compliance with labour standards (e.g. Communications Cabling Specialist CCS).
- .6 Qualified vendors to maintain manufacturer recognition as a certified installation contractor for the telecommunications product solution being implemented.

1.5 QUALIFICATION OF SYSTEM

- .1 The cabling system, materials and installation practices must strictly conform to the current issue of industry standards, TIA 568, CSA C22.1 Canadian Electrical Code Part 1. All performance requirements of this document must be followed.
- .2 The cabling system must conform to applicable local building and electrical safety codes. Apply pay for and receive acceptance for the installation by the electrical inspector as per the Canadian Electrical Code as indicated in Section 26 05 00.

1.6 PRODUCT DATA

- .1 Submit product data indicating system components, mounting method, grounding and special attachments including tie ins to all external facilities.

1.7 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00.
 - .1 Submit:
 - .1 A complete telecommunications cabling system layout, including cable routing, telecommunications closet(s) and telecommunications outlet/connector designations. Layout to detail locations of all equipment and indicate all wiring pathways.
 - .2 Manufacturer's technical documentation on all devices used in cabling system.
 - .3 Results of all tests for review. Contractor will conduct and pay for all required testing as indicated herein.

1.8 IDENTIFICATION

- .1 Telecommunications Spaces:
 - .1 Identify telecommunications spaces within a building as part of a complete administration system.
 - .2 Use the room designation number within the administration system identifier as follows on "lamicoid" type nameplate minimum 51mm (H) X 305mm(L).
 - .3 Secure the lamicoid nameplate to the exterior of the door entering that space. All telecommunications equipment racks within each telecommunications space require a unique component

- identifier as part of the administration system by a "lamicoid" type nameplate, minimum (51mm H) X (610mm L) shown and secured to the upper horizontal rail of the equipment rack.
- .4 All telecommunications termination hardware within the telecommunications space requires a unique component identifier as part of the administration system. Identifiers are to be self-adhesive thermal transfer type (minimum 305mm long x 51mm high) and placed appropriately to indicate all ports.
 - .5 Labelling standards:
 - .1 Type: DM Label: FF-RRR; DM-XX
 - .2 Type: Speaker, Label: FF-RRR; SPK-XX
 - .3 Type: Microphone, Label: FF-RRR; MIC-XX
 - .4 Type: Other audio, Label: FF-RRR; AUD-XX. Where: FF = Floor; RRR = Room Number; XX = Cable ID.
 - .2 Work Area:
 - .1 For the purposes of system administration, work area to include the telecommunications outlet faceplate and all outlet termination hardware.
 - .2 All telecommunications outlet faceplates must be standard four port configuration with port assignments as shown.
 - .3 All Telecommunications Outlet (TO) locations require a unique component identifier as part of the administration system by a "lamicoid" type etched vinyl nameplate, minimum 127mm H X 76mm L and secured to the wall-space centered and above min. 12mm the telecommunications outlet faceplate.
 - .3 Backbone System:
 - .1 For the purposes of system administration, the backbone system must include all backbone system cabling only.
 - .2 Identify all backbone system cabling with a wrap type self-laminating adhesive label with mechanically generated (not hand written) identifier.
 - .3 Backbone cable identifiers to denote basic telecommunications system application and originating telecommunications space.
 - .4 Telecommunications Demarcation Facilities:
 - .1 For the purposes of system administration, the telecommunications demarcation facilities will include three basic components;
 - .1 Building cross-connect hardware.
 - .2 Building demarcation backbone cable.
 - .3 Building demarcation termination hardware.
 - .2 All Building cross-connect hardware within the telecommunications space requires a unique component identifier as part of the administration system. Identifiers must be self-adhesive thermal transfer type and placed appropriately to indicate applicable

- pair assignments as shown.
- .3 All administration system requirements for associated termination hardware located within the telecommunications spaces are addressed in clause 1.9 herein.
 - .4 Uniquely identify all telecommunications demarcation backbone cabling with a wrap type self-laminating adhesive label with mechanically generated (not hand written) identifier.
 - .5 All telecommunications demarcation backbone cable identifiers must denote basic telecommunications system application and originating telecommunications space.

PART 2 - PRODUCTS

2.1 FIBRE OPTIC CABLING

- .1 Fibre optic cabling general:
 - .1 Fibre optic cables consist of 12 strand single mode fibre optic cable.
 - .2 Fibre optic cabling to consist of LSZH single-mode, OS2 cable. Each end of all fibre runs to contain a slack loop of at least 5m of cable. Terminate fibres in rack mounted fibre optic patch panels with LC type connectors.
 - .3 Backbone cables to follow TIA-606 colour coding for first and second level backbone.
 - .4 Provide cables complete with a minimum CMR (FT-4) jacket.
 - .5 Cables in or passing through air plenums must be CMP (FT-6) rated.
 - .6 Outdoor Fiber Optic Cables to be loose tube type and OSP rated.

2.2 DATA AND TELEPHONE SYSTEM HORIZONTAL WIRING

- .1 Four (4) pair, #23 AWG unshielded twisted pair (UTP) construction with internal rip cord.
- .2 Thermoplastic insulated solid copper conductors.
- .3 Low smoke, flame retardant thermoplastic outer jacket, CSA FT4 fire rating, type CMR.
- .4 For use in 10/100/1000 BASE-T, Ethernet, other LAN protocols.
- .5 Category 6A (marked on cable sheath).
- .6 Horizontal cables to follow TIA-606 colour coding.
- .7 Acceptable manufacturers: Belden, Panduit, or approved equivalent.

2.3 DATA PATCH & EQUIPMENT CORDS

- .1 Four (4) pair 23 gauge, stranded, Category 6A, T568A (ISDN) wired.

- .1 Four (4) pair, #23 AWG unshielded twisted pair construction.
 - .2 Stranded copper conductors.
 - .3 Polyvinyl chloride outer jacket.
 - .4 Category 6A (marked on cable sheath).
 - .5 1.2m, 2.1m or 3.0m long as required.
 - .6 Manufacturer factory-built and tested connectorized patch cords.
 - .7 Colour coding to follow TIA-606 colour codes.
- .2 Patch cords to be of same type and of same manufacturer as horizontal cables.
 - .3 Supply one(1) patch and equipment cord for each horizontal cable plus an additional 25% as spares.

2.4 CONNECTORS

- .1 Telecommunications outlet/connector (modular jacks):
 - .1 Connectors to have as a minimum all of the performance parameters outlined in TIA 568 for Cat. 6A.
- .2 Fibre optic connectors:
 - .1 Size the fibre interconnect system in the Telecommunications racks to accommodate 12 or 24 fibres as required.
 - .2 Fit the fibre optic patch panels with LC type connectors and should be rugged and provide strain relief for fibre connections.
 - .3 The optical fibre patch panels should accommodate storage and management of at least 2m of slack per fibre.
 - .4 Make fibre connections with field installable connectors or fibre splices and pigtails.
 - .5 Equip fibre patch cords with appropriate connectors and shall use either single or dual fibre cables. Use buffered fibre overlaid with kevlar and a second PVC jacket. Maximum loss not to exceed manufacturer specified values.

2.5 RACK AND GROUNDING EQUIPMENT

- .1 Grounding network equipment, racks and cabinets and bond them to the wall mounted busbars as described in the TIA 607-B standard.
- .2 Bond smaller equipment without an integrated grounding pad to the vertical busbar through the use of a thread-forming grounding screw that is anodized green and includes serrations under the head to cut through oxidation or paint on the equipment flange.
- .3 Bond larger equipment (chassis switches) with a designated grounding terminal to the vertical busbar with an EBC (equipment bonding conductor) kit built to that purpose.
- .4 Clean (wire brush, scotchbrite pads) any metallic surface to be bonded down to bare metal and apply a film of anti-oxidation paste to the surfaces prior to effecting the bond.

- .5 Bonding lugs on racks and busbars to be of two-hole irreversible compression type.
- .6 Every rack or cabinet must have an individual bonding conductor into the grounding network, serially connecting (daisy-chaining) of racks is expressly forbidden and will not be accepted.
- .7 Outfit a minimum of every other rack or cabinet with a properly installed and bonded ESD (electro-static discharge) port along with a wrist strap and lead to be used by any technicians servicing network equipment. On four post racks and cabinets provide these ESC ports and straps on front and back to be accessible and able to reach any active equipment needing servicing.
- .8 Bond armoured cables to the earthing system with a kit built to that purpose.
- .9 Install wall-mounted zone boxes for equipment and cabling in modular rooms for properly bonding these to ground.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 All cabling to be continuous without joints, or splices from the work area to the telecommunications equipment.
- .2 Install all cables in conduit in accordance with Section 27 05 28. The maximum number of bends between cable pulling points are two (2) ninety degree bends over a maximum of 30m.
- .3 Horizontal fill ratios for conduit, and ducts must conform with standards and manufacturer recommendations plus 25% spare for future installation. Minimum conduit sizes to be 21mm diameter.
- .4 Follow applicable standards for separation distances between cables and sources of electromagnetic interference.
- .5 Handle, install and support all cables in accordance with the manufacturer's guidelines. During the pulling of the cable, take care not to overstress the cable.
- .6 Give appropriate attention to the handling of all cables to ensure that bending radius conforms to the manufacturer's requirements. Do not exceed the cable's static or dynamic bending radius.
- .7 Coordinate work with that of other trades.
- .8 Terminate all four (4) pairs of unshielded twisted pair (UTP) cable on a single port. The splitting of cable pairs between different jacks is not permitted.

3.2 INSPECTION AND FIELD TESTING

- .1 Conduct and pay for all tests required.

- .2 Conduct end-to-end testing for UTP copper for 100% of pairs as follows:
 - .1 Balanced twisted-pair cable testing:
 - .1 Use testing procedures applicable to the horizontal cabling configuration to meet field test compliance.
Consolidation/Transition points are optional interface points as specified and permitted under CAN/CSA and ANSI/TIA specifications and are considered a seamless link for acceptance testing.
 - .2 The field testing acceptance parameters for balanced twisted-pair cabling are as follows:
 - .1 Wire map (continuity).
 - .2 Length.
 - .3 Insertion loss.
 - .4 NEXT Loss.
 - .5 ELFEXT.
 - .6 Propagation delay and delay skew.
 - .7 Return loss.
 - .8 Power sum near-end crosstalk (PSNEXT) loss.
 - .9 Power sum equal level far-end crosstalk (PSELFEXT).
 - .3 Acceptance testing results are to be documented and provided.
- .3 Complete field testing of fibre optic cable after the fibre is installed as follows:
 - .1 Conduct:
 - .1 Attenuation testing (after fibre is installed.)
 - .2 OTDR testing.
 - .3 Document and provide a copy of acceptance testing results.
 - .4 ODTR testing to determine end to end loss:
 - .1 Testing at 850 nm and 1300 nm in both directions is required for multimode optical fiber as listed below:
 - .1 Connector - 0.5 dB
 - .2 Fiber - 3.5 dB
 - .3 dB/km @ 850 nm Fiber (3.0 dB)
 - .4 dB/km @ 1300 nm Fiber (1.5 dB)
 - .2 Testing at 1310 nm and 1550 nm in both directions is required for single mode optical fiber.
 - .1 Connector - 0.5 dB
 - .2 dB/km @ 1310 nm Fiber (1.0 dB)
 - .3 dB/km @ 1310 nm Fiber (1.0 dB)
 - .4 The required tests and acceptance may depend on the application and the system design requirements.
 - .5 Acceptance testing results are to be documented and provided.

- .6 Verify labelling of all wiring at all termination points.

3.3 PROJECT DOCUMENTATION

- .1 As-built Drawings:
 - .1 Provide record drawings in both hard copy and digital format.
 - .2 Drawings in AutoCAD .dwg file format shall be provided by the Consultant for preparation of the "As-built" drawings.
 - .3 As-built drawings to provide the following as constructed information:
 - .1 All work area telecommunications outlet locations.
 - .2 System identifiers for telecommunications outlets as specified.
 - .3 Identifiers for telecommunications spaces as specified.
 - .4 Provide hard copy format record drawings in "C" size drawings in two (2) complete sets as defined:
 - .1 One (1) complete floor plan drawing set black and white (colour optional).
 - .2 One (1) complete floor plan drawing set black and white (colour optional) laminated (encapsulated) to be placed in all associated telecommunications spaces.
 - .5 Laminated hard copy record drawings may be provided in sections (C size sheet) related to the telecommunications space servicing a specific floor section or area.
- .2 Test results:
 - .1 Provide Test Results in digital format as part of compliance with this requirement.
 - .2 Provide test results demonstrating compliance with this section.
- .3 Contractor Warranty: Provide a 12-month warranty covering both parts and labour. Warranty to allow for repair or replacement of any component or circuit that is shown to be faulty within 12-months of the date of site acceptance by the Owner.

END OF SECTION

PART 1 - GENERAL

1.1 SYSTEM DESCRIPTION

- .1 Telecommunications raceways system consists of outlet boxes, cover plates, terminal distribution cabinets, conduits, pull boxes, sleeves and caps, fish wires.

PART 2 - PRODUCTS

2.1 MATERIAL

- .1 Conduits: to Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Outlet boxes: to Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.
- .3 Fish wire: polypropylene type.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install raceway system, including fish wire, outlet boxes, pull boxes, cover plates, conduit, sleeves and caps, miscellaneous and positioning material to constitute complete system and in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Use conduit types in accordance with Section 26 05 34. Size in accordance with cable manufacturers recommendations. Under no circumstance, install more than 40% fill ratio in any conduit. Allow for 25% spare cables. Install bond conductor in all conduit.
- .3 Where the "grouping" of various systems outlets or multiple type outlets in dry-wall type construction is specified, the use of "box mounting brackets" are to be installed between and secured to both wall studs to install suitably sized 100mm square and/or 119mm boxes complete with raised tile rings as may be required.
- .4 Minimum conduit size to be 21mm diameter.
- .5 Size all telecommunications outlet boxes 100mm square and provide complete with single gang square raised tile ring.

END OF SECTION

PART 1 - GENERAL

1.1 DESCRIPTION OF SYSTEM

- .1 Existing alarm control panel to have additional door contacts installed and integrated into the existing system software, wiring, and conduits for a complete operating system.

1.2 RELATED WORK

- .1 Section 26 05 31 - Splitter, Junction, Pull Boxes and Cabinets.
- .2 Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .3 Section 26 05 34 - Conduits, Conduit Fittings and Fastenings.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.

PART 2 - PRODUCTS

2.1 INTRUSION DETECTION SYSTEM

- .1 Alarm Control Panel:
 - .1 Existing Chubb Alarm system control panel to have software updated & expansion modules added as required for additional door contacts in new Electrical room and new SBR Electrical Building.
- .2 Door Contacts:
 - .1 Door contacts to be recessed where possible.
 - .2 Magnetic type.
 - .3 24 VDC dry contact for remote monitoring.
 - .4 Suitable for doors or overhead doors where indicated.
 - .5 Compatible with manufacturer's control panel.
- .3 Expansion Modules:
 - .1 Module to have either eight (8) or sixteen (16) fully programmable, supervised zones to suit project requirements.
 - .2 CSA type 1 enclosure complete with lockable cover.
 - .3 Compatible with main control panel.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Supply and install new door contacts and expansion modules with all required components and wiring for complete and fully functional systems. Arrange and pay for the equipment manufacturer's certified

representative to supply and install all the equipment, devices, and make all the connections.

- .2 Verify wire type and gauge with manufacturer prior to installation.
- .3 Locate all components as indicated on drawings. Do not locate a motion detector within one meter of a supply air diffuser.
- .4 Security system wiring to incorporate a white coloured jacket and be in installed in a conduit system.
- .5 Provide all documentation associated with the security system alarm panel to the Owner, including all programming/contractor codes required for future modifications to the system.

3.2 TESTS

- .1 Prepare a written report detailing the security system verification and submit to the Consultant.

3.3 PROGRAMMING AND TRAINING

- .1 Provide the initial system software programming, customizing and data entry.
- .2 Provide for programming as required for complete and operational system.
- .3 Provide for onsite training as required.

3.4 DRAWINGS AND MANUALS

- .1 Provide three (3) copies of system operation and technical manuals.
- .2 At the close of installation, provide "as built" drawings on the wiring, networks and components.

3.5 VERIFICATION

- .1 Verify equipment installed meets the specifications.
- .2 Verify wiring connections to all equipment meets applicable codes and standards.
- .3 Verify correct operation of all devices.
- .4 Verify wiring to all equipment is complete.
- .5 Provide a copy of inspecting technician's report to user. Identify each device by location and certify the test results.
- .6 Issue a certificate of verification confirming the completion of the verification.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies requirements for clearing, grubbing, and disposal.

1.2 RELATED SECTIONS

- .1 Erosion and Sediment Control: Section 31 15 53
- .2 Excavating, Trenching, and Backfilling: Section 31 23 10

1.3 DEFINITIONS

- .1 Grubbing: excavation and disposal, removal of all stumps, roots, embedded timber, rock fragment, humus, root mat, topsoil, and grass surfaces.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not applicable.

PART 3 - EXECUTION

3.1 GENERAL

- .1 Obtain permits and/or approvals as required by the authorities having jurisdiction.
- .2 Comply with terms and/or conditions of permits and/or approvals.
- .3 Do not remove brush from outside limits indicated except for any tree or branch considered unsafe.
- .4 Cut brush close to ground leaving no stump higher than 300 mm.
- .5 In absence of directions provided either by a geotechnical report or the Project Drawing, remove grubblings to not less than 200 mm below existing ground surface to a maximum of 300 mm.
- .6 Grub out visible rock fragments and boulders, greater than 300 mm in any dimension, but less than 0.25 m³.

3.2 REMOVAL AND DISPOSAL

- .1 Remove grubbed material off-site unless permitted otherwise in writing.
- .2 If permitted by Owner or Consultant, bury in designated areas only. Consolidate and cover with soil and finish surface as shown on the Project Drawings.

- .3 Do not burn grubbed material unless permitted by the authorities having jurisdiction.
- .4 If permitted, chip or mulch and stockpile or spread vegetation matter on-site as directed. Dispose of surplus chips off-site at an Consultant approved location.

3.3 FINISHED SURFACES

- .1 Leave ground surface in condition suitable for immediate grading operation.

END OF SECTION

PART 1 – GENERAL

1.1 GENERAL

- .1 Supply, installation, maintain and after the Work is completed, remove the erosion and sediment measures specified herein.
- .2 Maintain erosion prevention and sediment control measures for the duration of the Work. Do not remove any measures until authorized by the Consultant.

1.2 REFERENCE DOCUMENTS

- .1 Nova Scotia Department of Environment and Climate Change: Erosion and Sedimentation Control Handbook for Construction Sites.
- .2 ASTM E449-18, Test Methods for Analysis of Calcium Chloride.
- .3 CAN/CGSB 15.1-92, Calcium Chloride.
- .4 CSA W208:20, Erosion and Sediment Control Installation and Maintenance
- .5 CAN/CSA-W202-18(R2023), Erosion and Sediment Control Inspection and Monitoring

PART 2 – PRODUCTS

2.1 SEDIMENT CONTROL FENCE

- .1 Sediment Control fence: preassembled sediment control fence with industrial woven geotextile fabric pre-stapled to wood posts spaced as indicated.

2.2 DUST CONTROL AGENT

- .1 Materials:
 - .1 Calcium chloride, Type I, to CAN/CGSB 15.1, flake, 35% aqueous solution.
 - .2 Magnesium chloride: magnesium liquid meeting the following:

Component	Minimum	Maximum
MgCl ₂	28	32
Ph	4 to 6	
Specific Gravity	1.29 to 1.3 g/mL	

Solution to contain minimum required percentage by mass concentration of MgCl₂ in accordance with ASTM A449.

- .3 Water: to Consultant's approval.

PART 3 - EXECUTION

3.1 TEMPORARY SOIL COVERS

- .1 If blown straw or hay is used as temporary soil cover, provide 100% cover to minimize soil erosion.
- .2 Where blown straw or hay is used as mulch to protect new seeding, control the thickness of the application to avoid smothering of the seed. If used in lieu of environmental blanket, uniformly apply straw and hay blown onto the seeded areas. Thickness depends on site conditions, seed mix, slope, and soil type.

3.2 SEDIMENT CONTROL FENCE

- .1 Excavate 100 mm x 100 mm trench along length of fence or as indicated by Project Documents. Lay fabric bottom in trench and backfill with selected excavated material.

3.3 MAINTENANCE OF EROSION PREVENTION AND SEDIMENT CONTROL MEASURES

- .1 Inspect and monitor erosion and sediment control measures in accordance with CSA W202.
- .2 Maintain erosion and sediment control measures in accordance with CSA W208.
- .3 Maintain erosion prevention and sediment control measures throughout the construction period. Repair damage to original condition.
- .4 Remove accumulated sediment from behind silt fence. Remove flow check berms when and as directed by Consultant.
- .5 Maintain vertical alignment of silt fence such that it is always plumb and straight.

3.4 DRAINAGE

- .1 Do not pump or drain water containing suspended materials into watercourses, sewer, or drainage systems.

3.5 CATCH BASIN FILTRATION

- .1 Install sediment traps on all existing catch basins to prevent sediment from entering stormwater system.

3.6 DUST CONTROL AGENT

- .1 Deliver approved dust control agent to site in moisture-proof bags. Indicate name of manufacturer, name of product, net weight or mass and percentage of dust control agent guaranteed by manufacturer.
- .2 Store bags of dust control agent in weather-proof enclosures.
- .3 Apply dust control agent or water for alleviation and prevention of dust nuisance caused by equipment and traffic movement when directed

by the Consultant.

- .4 Apply dust control agent or water with equipment approved by the Consultant, at a rate and in locations approved by Consultant.
- .5 Apply water in areas where use of other dust control agent is not permitted. Use distributors equipped with spray system that will promote uniform application and with means of shut-off.
- .6 Dust control waste to be appropriately disposed of. Waste from dust control measures is not to enter a watercourse or wetland.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Earthwork: Section 31 20 00.
- .2 Geonets: Section 31 05 19.29.
- .3 Geomembranes: Section 31 32 22.

1.2 GENERAL

- .1 This Section specifies the requirements for the supply and installation of geotextile material.

1.3 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM):
 - .1 ASTM D4491/D4491-22, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
 - .2 ASTM D4595-17, Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.
 - .3 ASTM D4632/D4632M-15a(R2023), Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
 - .4 ASTM D4716/D4716M-22, Test Method for Determining the (in-Plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic using a Constant Head.
 - .5 ASTM D4751-21A, Standard Test Method for Determining Apparent Opening Size of a Geotextile.
 - .6 ASTM D5261-10(R2024), Standard Test Method for Measuring Mass per Unit Area of Geotextile.
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-4.2 No. 11.2-M89(April 1997), Textile Test Methods - Bursting Strength - Ball Burst Test (Extension of September 1989).
 - .2 CAN/CGSB-148.1, Methods of Testing Geotextiles and Complete Geomembranes.
 - .1 No.2-M85, Methods of Testing Geosynthetics - Mass per Unit Area.
 - .2 No.3-M85, Methods of Testing Geosynthetics - Thickness of Geotextiles.
 - .3 No.6.1-93, Methods of Testing Geotextiles and Geomembranes - Bursting Strength of Geotextiles under No Compressive Load.
 - .4 No. 7.3-92, Methods of Testing Geotextiles and Geomembranes - Grab Tensile Test for Geotextiles.

.5 No.10-94, Methods of Testing Geosynthetics - Geotextiles -
Filtration Opening Size.

.3 Canadian Standards Association (CSA) International:

.1 CSA-G40.20/G40.21-13(R2023), General Requirements for Rolled or
Welded Structural Quality Steel / Structural Quality Steel.

.4 CAN/CSA-G164-18(2023), Hot Dip Galvanizing of Irregularly Shaped
Articles.

1.4 SUBMITTALS

.1 Submit to the Consultant, mill test data and certificate at least two
(2) weeks prior to start of Work.

1.5 DELIVERY, STORAGE AND HANDLING

.1 During delivery and storage, protect geotextiles from direct sunlight,
ultraviolet rays, excessive heat, mud, dirt, dust, debris and rodents.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste material for reuse and recycling.
- .2 Remove from site and dispose of all packing materials at appropriate
recycling facility.

PART 2 - GENERAL

2.1 MATERIALS

- .1 Geotextile: non-woven synthetic fibre fabric, supplied in rolls.
 - .1 Width: 3m minimum.
 - .2 Length: 20m minimum.
- .2 Physical properties:
 - .1 Mass per unit area: to ASTM D 5261, minimum 312g/m².
 - .2 Tensile strength and elongation (in any principal direction): to
ASTM D 4595.
 - .3 Grab tensile strength and elongation: to ASTM D 4632.
 - .4 Breaking force: minimum 1,330 N, wet condition.
 - .5 Grab elongation: 50% as per ASTM D 4632.
- .3 Hydraulic properties:
 - .1 Apparent opening size (AOS): to ASTM D 4751, 0.150mm.
 - .2 Permittivity: to ASTM D 4491, 1.00 sec⁻¹.
- .4 Security pins and washers: to CAN/CSA-G40.21, Grade 300W, hot-dipped
galvanized with minimum zinc coating of 600 g/m² to CAN/CSA G164.
- .5 Thread for sewn seams: equal or better resistance to chemical and
biological degradation than geotextile.

- .6 Standard of Acceptance: Terrafix 800R or approved equivalent.

PART 3 - GENERAL

3.1 INSTALLATION

- .1 Handle the geotextile in such a manner as to ensure that it is not damaged in any way. Should the geotextile be damaged to the extent that it is no longer usable as determined by these specifications or by the Consultant, replace the geotextile at no additional cost to the contract.
- .2 Install the geotextile to the lines and grades as shown on the contract drawings and as described herein.
- .3 Roll the geotextile down the slope in such a manner as to continuously keep the geotextile in tension by self weight. Securely anchor geotextile in an anchor trench where applicable, or by other approved or specified methods. Place geotextile smooth and free of tears or stress, folds, wrinkles, and creases.
- .4 Place geotextile or stoping surfaces in one continuous length from toes of slope to upper extent of geotextile.
- .5 In the presence of wind, weight all geotextiles by sandbags or approved equivalent. Install such anchors during placement and keep in place until replaced with cover material.
- .6 Take necessary precautions to prevent damage to adjacent or underlying materials during placement of the geotextile. Should damage to such material occur due to the fault of the Contractor, repair the damaged materials at no additional cost to the Contract and to the satisfaction of the Consultant.
- .7 During placement of the geotextile, take care not to entrap soil, stones or excessive moisture that could hamper subsequent seaming of the geotextile as judged by the Consultant.
- .8 Do not expose the geotextile to precipitation prior to being installed.
- .9 Seam geotextile using heat seaming or stitching methods as recommended by the manufacturer and approved by the Consultant. Make sewn seams using polymeric thread with chemical resistance equal to or exceeding that of the geotextile. All sewn seams must be continuous. Orient seams down slopes perpendicular to grading contours unless otherwise specified. For heat seaming, use fusion welding techniques recommended by the manufacturer (minimum 600mm overlap).
- .10 Do not permit passage of any vehicle directly on geotextile at anytime.
- .11 Carefully place material overlying the geotextile to avoid wrinkling or damage to the geotextile.

- .12 Maximum drop height for fill placed directly onto the geotextile must not exceed 1.0m.

3.2 CLEANING

- .1 Remove construction debris from Site and dispose of debris in an environmentally responsible and legal manner.

3.3 PROTECTION

- .1 Vehicular traffic not permitted directly on geotextile.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 31 10 00 - Grubbing.
- .2 Section 31 23 16.26 - Rock Removal.
- .3 Section 31 23 10 - Excavation, Trenching and Backfilling.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM D698-12(R2021), Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (600kN-m/m³),

1.3 EXISTING CONDITIONS

- .1 Examine subsurface investigation report which is available included as Appendix A.
- .2 Known underground and surface utility lines and buried objects are as indicated on site plan.
- .3 Refer to dewatering in Section 31 23 10 - Excavating Trenching and Backfilling.

1.4 PROTECTION

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

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Fill material: in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Excavated or graded material existing on site may be suitable to use as fill for grading work if approved by the Consultant.

PART 3 - EXECUTION

3.1 STRIPPING OF TOPSOIL

- .1 Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected as determined by the Consultant.
- .2 Commence topsoil stripping of areas as indicated after area has been cleared of brush, weeds and grasses and removed from site.
- .3 Strip topsoil to depths as indicated. Avoid mixing topsoil with subsoil.
- .4 Stockpile in locations as directed by the Consultant. Stockpile height not to exceed 2.0 m.
- .5 Dispose of unused topsoil as directed by the Consultant.

3.2 GRADING

- .1 Rough grade to levels, profiles, and contours allowing for surface treatment as indicated.
- .2 Rough grade to following depths below finish grades:
 - .1 250 mm for concrete slabs and walks precast paving units.
- .3 Slope rough grade away from building 1:50 minimum.
- .4 Grade ditches to depth as indicated.
- .5 Prior to placing fill over existing ground, scarify surface to depth of 150 mm. Maintain fill and existing surface at approximately same moisture content to facilitate bonding.
- .6 Compact filled and disturbed areas to corrected maximum dry density to ASTM D698, as follows:
 - .1 85% under landscaped areas.
 - .2 95% under paved and walk areas.
- .7 Do not disturb soil within branch spread of trees or shrubs to remain.

3.3 TESTING

- .1 Carry out testing of soil compaction using a testing laboratory designated by the Consultant. Conduct these tests at no additional cost to the Contract. Provide the Consultant with test results as requested and in accordance with the agreed procedure.
- .2 Submit testing procedure, frequency of tests, for the Consultant's approval.

3.4 SURPLUS MATERIAL

- .1 Remove surplus material and material unsuitable for fill, grading or landscaping as directed by the Consultant.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies requirements for all earthwork operations. Work includes supply of products, excavating, bedding, backfilling, compacting, shoring, dewatering, and disposal of unsuitable and surplus material.

1.2 RELATED SECTIONS

- .1 Environmental Procedures: Section 01 57 00

1.3 REFERENCE STANDARDS

- .1 ASTM C127 - Standard Test Method for Relative Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate; 2015.
- .2 ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)); 2012 (Reapproved 2021).
- .3 ASTM C131/C131M-20, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- .4 ASTM D4253-16E1, Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
- .5 ASTM D4254-16, Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
- .6 CAN/CSA A23.1:24/A23.2:24, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard for Concrete.
- .7 Nova Scotia Department of Transportation and Public Works - Standard Specification - Highway Construction and Maintenance.

1.4 DEFINITIONS

- .1 Rock: material which requires drilling, blasting, ripping or breaking up with power-operated tools for its removal, and boulders and pieces of concrete exceeding volume limits below. Frozen material will not be classified as rock.
 - .1 Volume limits:
 - .1 Trench excavation: 0.5 m³
 - .2 Mass excavation: 1.0 m³
- .2 Topsoil: soil capable of supporting good vegetative growth and suitable for use in top dressing and landscaping.
- .3 Borrow: well-graded material originating from approved off-site sources meeting the specification for Selected Backfill.
- .4 Common: in situ excavated soil which is not rock, unsuitable, or topsoil, and meeting the specification for Selected Backfill.

- .5 Unsuitable material: all material which is not suitable for use in work and must be disposed of.
- .6 Contaminated Material: material with exceedances of Provincial and CCME (Canadian Council of Ministers of the Environment) Soil Quality Guidelines and requiring management as mandated by this guideline.
- .7 Surplus material: excavated material not required for reuse.
- .8 Subgrade: the surface of mass excavation and embankment finished to lines and elevations indicated.

1.5 SUBMITTALS

- .1 Submit samples, and sieve analysis in accordance with Section 01 33 00 for items specified herein.

1.6 EXISTING CONDITIONS

- .1 A Geotechnical Investigation has been carried out at the Site. Information from the Geotechnical Investigation Report, dated April 12, 2022 prepared by Conquest Engineering, is included as Appendix A, herein.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Selected Backfill: common which is free from: stumps, trees, roots, sod, organics; rocks, boulders, and masonry larger than 200 mm in any dimension; and other deleterious materials.
- .2 Clear Stone: crushed and screened, hard, durable stone, free from clay and organic matter, and graded as follows:

Sieve	Percent Passing				
Size	C1	C2	C3	C4	C5
(µm)			(Surge)		
250 000	100				
190 000		100	100		
150 000	20-35	90-100	90-100		
125 000		30-50	40-60		
100 000		0-8	12-30	100	
90 000					
75 000			0-19	85-100	
50 000	0-10				
31 500				10-20	
25 000				0-8	100
19 000			0-10		85-100

9 500					0-40
4 750					0-10

- .3 Gravels: crushed and screened pit gravel or crushed and screened rock. Material shall consist of hard and durable stone particles. Gradation shall be dense, well graded and as follows:

Sieve Size (µm)	Percent Passing	
	Type 1	Type 2
75 000		100
63 000		
50 000		65-98
37 500		
31 500		
25 000	100	48-78
19 000	90-100	
16 000		
12 500	48-82 (2)	33-63
9 500		
4 750	20-50	20-50
2 360		
1 180		
600		
300		
150	5-12	3-10
75	3-8 (1)	0-7 (1)

⁽¹⁾For gravel sources not classified as quarries, the allowable percentage passing the 75 µm sieve shall be 3 to 5%.

⁽²⁾For gravel sources classified as quarries, the allowable percentage passing the 12,500 µm sieve shall be 50 to 90%.

- .4 Pipe bedding and backfill: type 1 gravel as specified herein.
.5 Lumber: construction grade stamped by Maritime Lumber Bureau or approved equal.

PART 3 - EXECUTION

3.1 EXCAVATION

- .1 Excavate all types of materials to lines and elevations indicated and as necessary for construction.
.2 Notify the Consultant if in doubt as to definition of material before material is excavated.

- .3 When rock is encountered, notify the Consultant for measurement.
 - .1 Where unknown rock is encountered, refer to Section 00 72 45 General Condition 6.4.
- .4 Select method of excavation, support, and dewatering unless otherwise indicated or directed. Protect property and structures from damage.
- .5 Where encountered, cut paved surfaces in straight lines.
- .6 Extend excavations sufficient distance from footings and walls to allow placing and removal of forms and for placing backfill materials indicated.
- .7 Prepare trench bottom so pipe can be laid to required line and grade. Remove any boulders or rock within theoretical trench payment area as shown on the Project Drawings.
- .8 Handle materials in a manner that will not endanger the public, personnel, property, or the work. Do not reduce sight distances or obstruct roadways or utilities. Do not obstruct flow of surface drainage or natural watercourses.
- .9 Protect granular material from the elements.
- .10 Stockpile materials a sufficient distance from excavations in such manner to prevent side failure or bottom uplift.
- .11 Replace over excavation of trench bottom with selected site material, granular material, or unshrinkable fill as directed.
- .12 Refer to subsection 3.3 herein for excavation of unsuitable and contaminated material.

3.2 TOPSOIL EXCAVATION

- .1 Strip topsoil to limits and depth indicated or directed by the Consultant.
- .2 Stockpile in designated areas or dispose as directed. Minimize loss and wastage.

3.3 UNSUITABLE OR CONTAMINATED EXCAVATION

- .1 Testing has been completed and the Geotechnical Investigation Report, and the Limited Environmental Site Assessment, are included as Appendices herein. Some of the soil has been confirmed contaminated. Disposal of soil permitted at the rear of the Site as noted on the Project Drawings. Removal all debris from fill and dispose at a licensed facility as mandated by Provincial and CCME (Canadian Council of Ministers of the Environment) Soil Quality Guidelines and as approved by the Consultant.
- .2 Notify the Consultant whenever unsuitable material is encountered, remove to depth and extent directed.
 - .1 If such Work is due to nature of soil, the Consultant and Contractor will jointly measure work for payment.

- .2 If such Work is due to any act or fault of Contractor, remedial work is responsibility of Contractor.
- .3 If such Work is required, refer to Section 00 72 45 General Condition 6.4.
- .3 Dispose of unsuitable, contaminated, or surplus materials off site unless otherwise indicated by the Owner or Consultant.

3.4 BLASTING

- .1 Obtain appropriate permits before proceeding with blasting.
- .2 Conduct blasting operations in accordance with the Nova Scotia Occupational Safety Act and NS Blasting Safety Regulations.
- .3 Conduct blasting with all possible care to avoid injury to persons and property.

3.5 SUPPORT OF EXCAVATION

- .1 Install and maintain shoring and underpinning as required by the Nova Scotia Occupational Health and Safety General Regulations.
- .2 When support of excavation is required, use a shielding and shoring system conforming to the Nova Scotia Occupational Health and Safety General Regulations or engage services of a professional engineer licensed to practice in the Province of Nova Scotia to design shoring and inspect its installation.
- .3 Provide record copy of drawings signed and sealed by professional engineer responsible for their preparation.
- .4 Provide a shoring plan prior to commencing construction.

3.6 DEWATERING

- .1 Keep bottom of excavation free of water by draining or pumping.
- .2 Dewater excavation in a manner which will not endanger stability of the work.
- .3 Dispose of water from excavation in accordance with Section 01 57 00 - Environmental Procedures, and in a manner that is not injurious to property, public health, or any operation of the work.
- .4 Take precautions to prevent uplift of pipe or structures.
- .5 Prior to draining water from excavation into sewer, obtain permission from regulatory authorities having jurisdiction.
- .6 A groundwater analysis report is included herein as Appendix B. Follow all instructions for dewatering included therein. Employ and maintain erosion and sediment control measures as specified in Section 31 15 53.

3.7 BEDDING AND BACKFILLING

- .1 Remove all timber, snow, ice, frozen material, and debris from excavation before backfilling. Allow Consultant to inspect excavation

prior to backfilling work.

- .2 Backfill with materials indicated.
- .3 Place and compact foundation layer of bedding to depth indicated, shaped to provide uniform support to pipe and structures.
- .4 After installation of pipe, place and compact bedding material in 150 mm layers to horizontal centreline of pipe.
- .5 Place and compact remaining bedding material to depth indicated above the top of pipe before further compaction.
- .6 Complete backfilling by placing and compacting material indicated in 300 mm layers. Bring backfill up evenly around structures.
- .7 Compact all materials to 95% Standard Proctor Density with the following exceptions:
 - .1 Top 300 mm below subgrade to 98% Standard Proctor Density.
 - .2 Gravel roadways and under concrete paved surface to 100% Standard Proctor Density.
 - .3 Clear Stone to 70% Relative Density.
- .8 Density Tests: Standard Proctor in accordance with Method B, ASTM D698. Relative Density in accordance with ASTM D4253 and D4254.
- .9 Control moisture content of backfill materials so that specified compaction may be obtained.
- .10 Place unshrinkable fill in areas as indicated. Consolidate and level unshrinkable fill with internal vibrators.
- .11 In areas of pedestrian and vehicular traffic, maintain surfaces level with existing surface until reinstatement.

3.8 BACKFILLING STRUCTURES

- .1 After installation of foundations, clean excavations of trash and debris. Backfill to consist of Selected Backfill material unless otherwise indicated. Place material to meet following requirements and approval of the Consultant.
 - .1 Place backfill in horizontal layers not more than 300 mm deep.
 - .2 Compact each layer using rollers, mechanical tampers, or other suitable equipment to obtain a density of not less than 98% Standard Proctor density.

3.9 MASS EXCAVATION AND EMBANKMENT

- .1 Manage excavated material on Site for use as backfill as indicated on the Project drawings.
- .2 Establish with the Consultant lead time required to take measurements. Notify the Consultant in accordance with agreed lead time.
- .3 Excavate and place fill to lines and grades indicated.
- .4 Maintain crowns and cross slopes to provide surface drainage.

- .5 When rock or unsuitable material is encountered, notify the Consultant for measurement.
- .6 Break rock to a depth 300 mm below subgrade. Excavate broken rock to subgrade or as indicated by the Project Drawings. Remove loose rock fragments from slopes.
- .7 Remove existing pavement encountered within 300 mm of subgrade elevation.
- .8 Do not place material which is frozen or place material on frozen surfaces unless approved by the Consultant.
- .9 When constructing embankment with common material place in uniform layers to full width of embankment. Compact to 95% Standard Proctor Density throughout full width and depth. Maximum rock size: 65% of compacted lift thickness.
- .10 When constructing embankment with rock fill, place to full width of embankment in layers of sufficient depth to contain maximum sized rocks, but in no case is thickness to exceed 1 metre. Fill interstices with rock fragments or earth to form compact mass. Fill voids at subgrade level to prevent migration of fine material.
- .11 Top 300 mm of subgrade to be free of boulders or broken rock fragments with dimensions greater than 200 mm.
- .12 Shape and compact material to within 40 mm of design subgrade elevation, but not uniformly high or low.
- .13 Finish side slopes uniformly to lines and elevations indicated. Remove boulders encountered in cut slopes and fill the resulting voids.

3.10 BREAKING ROCK WITHOUT REMOVAL

- .1 Break rock without removal to lines and grades indicated.
- .2 Break rock below street subgrade such that maximum dimension of rock fragments within 300 mm of subgrade is 200 mm.
- .3 Break rock for future removal as follows:
 - .1 Mass: maximum size of 90 percent of volume of rock broken is less than 0.5 cubic metre with no fragments exceeding one cubic metre.
 - .2 Trench: maximum size of 90 percent of volume of rock broken is less than 0.3 cubic metre with no fragments exceeding 0.5 cubic metre.
- .4 Excavate broken rock to depth indicated at test locations selected by the Consultant in accordance with following criteria:
 - .1 Mass: one test hole for each 1000 square metres of surface area with a minimum of one test hole in each location.
 - .2 Trench: one test hole for each 30 metres along trench with a minimum of one test hole at each separate trench.

- .5 Should test excavation indicate that breaking techniques do not give required results, do remedial work.
- .6 Backfill test excavations after inspection using excavated materials.

3.11 ROAD GRAVELS

- .1 Prior to placing gravels, compact top 300 mm to 98% Standard Proctor Density and proof-roll in accordance with the Project Documents.
- .2 Place gravels in uniform layers not exceeding 200 mm to thickness indicated. Grade intermediate gravel courses to within 30 mm of elevations and cross-sections indicated, but not uniformly high or low. Compact to 100% Standard Proctor Density.
- .3 Before the placement of new material, proof roll the lowest material type by means of a fully loaded tandem dump truck (20 t gross weight). Remove all unsuitable material, as observed by the Consultant, and replace with suitable material.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies requirements for constructing asphalt concrete pavement. Work includes fine grading, supply and placing of tack coat, hot mix asphalt concrete, and pavement markings.

1.2 RELATED SECTIONS

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

1.3 REFERENCE STANDARDS

- .1 Nova Scotia Transportation and Public Works - Standard Specification Highway Construction and Maintenance.
- .2 Transportation Association of Canada: Manual of Uniform Traffic Control Devices for Canada.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Asphalt materials: Nova Scotia Department of Public Works - Highway Construction and Maintenance Standard Specification.
- .2 Recycled engine oil binders (REOB) are not accepted in any PGAB to be used on streets and roads. Provide the Consultant with certification that the PGAB supplied does not contain REOBs.

2.2 ASPHALT CONCRETE

- .1 Asphalt concrete mix: to Nova Scotia Department of Public Works - Highway Construction and Maintenance Standard Specification, Division 4, Section 4, and type indicated in the Project Documents.

PART 3 - EXECUTION

3.1 FINE GRADING

- .1 Fine grade gravel surface to within 10 mm of elevations and cross sections indicated immediately prior to placement of asphalt materials. Add or remove gravel as required. Compact to 100% Standard Proctor Density or as directed by the Consultant.

3.2 ADJUSTING TOPS OF CASTINGS

- .1 Prior to placing asphalt surface course:
 - .1 Adjust manhole covers and catch basin frames to match asphalt surface, using manufactured or cast-in-place grade rings.

- .2 Adjust valve boxes to finished asphalt surface. Raise or lower top sections of valve boxes.

3.3 TACK COAT

- .1 Apply tack coat on existing asphalt concrete to Nova Scotia Department of Transportation and Active Transit - Highway Construction and Maintenance Standard Specification, Division 4, Section 1. Apply tack coat to contact surface of curbs, castings and structures.

3.4 PAVING

- .1 Transport, place, and compact asphalt concrete mix to Nova Scotia Department of Public Works - Highway Construction and Maintenance Standard Specification. Construct pavement within specified tolerances to lines, elevations, cross sections and dimensions at locations indicated.
- .2 Thickness of asphalt courses not to vary more than 6 mm from thickness indicated, with average thickness as indicated.
- .3 Finished asphalt surfaces to be within 6 mm of design elevation, but not uniformly high or low. Finished asphalt surface not to have irregularities exceeding 6 mm when checked with a 3-metre straightedge placed in any direction.

3.5 PAVEMENT MARKINGS

- .1 To Section 32 17 23 - Pavement Markings.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies requirements for constructing concrete curbs and gutters.

1.2 RELATED SECTIONS

- .1 Cast-in-Place Concrete: Section 03 30 00
- .2 Excavating, Trenching and Backfilling: Section 31 23 10

1.3 REFERENCE STANDARDS

- .1 ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2022.
- .2 ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); 2018.
- .3 CSA A23.1:24/A23.2:24, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .4 Nova Scotia Department of Transportation and Active Transit - Highway Construction and Maintenance Standard Specification.

1.4 PROTECTION

- .1 Provide protection, including security if necessary, to prevent damage to newly installed walks, curbs, and gutters.
- .2 Keep sufficient covering on site to protect fresh concrete from damage by weather.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Concrete: to Section 03 30 00, type GU or GU-L cement, minimum compressive strength of 32 MPa at 28 days, a maximum water cement ratio of 0.45, C-2 Class of Exposure, 5-8% total air content, slump to suit placement method.
- .2 Chemical admixtures: type as approved, and in accordance with ASTM C494
- .3 Isolation joint filler: to ASTM D 1751.
- .4 Granular base: Type 1 Gravel to Section 31 20 00.
- .5 Curing compound: to CSA A23.1-M, white in colour.

PART 3 - EXECUTION

3.1 FINE GRADING

- .1 Fine grade gravel surface to within 10 mm of elevations and cross sections indicated immediately prior to placement of finishing material. Add or remove gravel as required. Compact to 100% Standard Proctor Density or as directed by the Consultant.

3.2 ADJUSTING TOPS OF CASTINGS

- .1 Adjust castings to match finished surface prior to placing surface course of asphalt concrete or Portland Cement concrete.

3.3 CONCRETE SURFACES

- .1 Do concrete work in accordance with Section 03 30 00 and as specified herein:
 - .1 Placing: Place concrete in continuous operation beginning at lowest point. Tamp or vibrate to prevent honeycombing.
 - .2 Jointing:
 - .1 Control joints to be minimum of one quarter of section thickness.
 - .2 Space a control joint every 3 metres for curbs and every 1.5 metres for concrete walks unless otherwise indicated. Match joints in abutting curb and walk to extent practical.
 - .3 Provide a control joint within 150 mm of change in cross section of curbs, gutters and walks.
 - .4 Finish perimeter of all slabs with an edger.
 - .5 Saw cutting is permitted if done as soon as concrete has set sufficiently to resist ravelling and before shrinkage cracks appear.
 - .6 Install isolation joint filler where concrete abuts permanent structure or curb, or as indicated.
 - .7 Provide an expansion joint every 50m and at every cold joint.
 - .3 Finishing: Do not apply water to newly placed concrete surfaces.
 - .1 Broom finish concrete surfaces to provide evenly textured, non-skid surface.
 - .2 Curing: Apply curing compound in accordance with CSA A23.1.
 - .4 Form Stripping: Strip forms only when concrete has developed sufficient strength to resist damage to corners and edges.

3.4 BACKFILLING

- .1 Backfill when Portland Cement concrete or asphalt concrete have strength sufficient to resist damage from backfilling operations. Do backfilling to Section 31 23 10.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies requirements for constructing chain link fence. Work includes excavation, supply and installation of concrete footings, chain link fence, gates and accessories, and reinstatement.

1.2 RELATED SECTIONS

- .1 Concrete: Section 03 30 00
- .2 Excavating, Trenching and Backfilling: Section 31 23 10

1.3 REFERENCE STANDARDS

- .1 CAN/CGSB-138.1M-97, Fabric for Chain Link Fence.
- .2 CAN/CGSB-138.2M-96, Steel Framework for Chain Link Fence.
- .3 CAN/CGSB-138.3M-96, Installation of Chain Link Fence.
- .4 CAN/CGSB-138.4M-96, Gates for Chain Link Fence.
- .5 CGSB 1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 for items listed in Supplementary Specifications.

1.5 CERTIFICATES

- .1 Submit manufacturer's test data and certification that products and materials meet requirements of this Section in accordance with Section 01 78 00 for items listed in Supplementary Specifications.

1.6 HANDLING AND STORAGE

- .1 Handle and store fence materials in such a manner as to avoid damage to materials or coatings.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Height, fabric type and style, class and grade of coating: as indicated.

2.2 MATERIALS

- .1 Concrete: to Section 03 30 00, type GU cement minimum compressive strength 32 MPa at 28 days, slump 80 mm $\pm$ 20 mm.
- .2 Fabric and coating: to CAN2-138.1-M.

- .3 Posts, rails, and Fittings: to CAN2-138.2-M, galvanized steel. Dimensions in accordance with Table 2 and Table 3.
- .4 Gates and accessories: to CAN2-138.4-M, type as indicated. Framing dimensions in accordance with the following table:

Gate Type (metres)	OPENING O.D. (mm)	FRAMING	FRAMING Wall mm	FRAMING
Single swing	3.0 42.9 100	3.0	42.9	100
Double Swing	6.0 42.9 100	6.0	42.9	100
Single swing	4.5 42.9 100	4.5	42.9	100
Double swing	9.0 42.9 100	9.0	42.9	100

.1

PART 3 - EXECUTION

3.1 GRADING

- .1 Remove debris and correct ground undulations along fence line to obtain smooth uniform gradient between posts. Provide clearance between bottom of fence and ground surface of 30 mm to 50 mm unless otherwise indicated in the Project Documents.

3.2 ERECTION OF FENCE

- .1 Erect fence along lines as indicated and in accordance with CAN/CGSB-138.3.
- .2 Auger post holes to dimensions indicated by methods approved by the Consultant.
- .3 Space line posts 3 meter apart, as measured parallel to ground surface.
- .4 Space straining posts at equal intervals not exceeding 150 meter if distance between end or corner posts on straight continuous lengths of fence over reasonably smooth grade is greater than 150 m.
- .5 Install additional straining posts at sharp changes in grade and where directed by the Consultant.
- .6 Install corner post where change in alignment exceeds 10°.
- .7 Install end posts at end of fence and at buildings. Install gate posts on both sides of gate openings.
- .8 Place concrete in post holes then embed posts into concrete to depths indicated. Extend concrete 50 mm above ground level and slope to drain away from posts. Brace to hold posts in plumb position and true to alignment and elevation until concrete has set.
- .9 When driving posts directly into the ground or setting posts in bedrock as an approved method, driving depths, diameter of drill hole

and grouting compound as specified in the Project Documents.

- .10 Do not install fence fabric until concrete has cured sufficiently. Submit concrete mix to the Consultant for review.
- .11 Install brace between end and gate posts and nearest line post, at inclination as indicated. Install braces on both sides of corner and straining posts in similar manner.
- .12 Install overhang tops and caps.
- .13 Install top rail between posts and fasten securely to posts and secure waterproof caps and overhang tops.
- .14 Install bottom tension wire, stretch tightly and fasten securely to end, corner, gate and straining posts with turnbuckles and tension bar bands.
- .15 Lay out fence fabric. Stretch tightly to tension recommended by manufacturer and fasten to end, corner, gate and straining posts with tension bar secured to post with tension bar bands spaced at 300 mm intervals. Knuckled selvedge at bottom. Twisted selvedge at top.
- .16 Secure fabric to top rails, line posts and bottom tension wire with tie wires at 450 mm intervals. Give tie wires minimum two twists.
- .17 Install barbed wire strands and clip securely to lugs of each projection where indicated.
- .18 Install grounding rods as indicated.

3.3 INSTALLATION OF GATES

- .1 Install gates in locations as indicated.
- .2 Level ground between gate posts and set gate bottom approximately 40 mm above ground surface.
- .3 Install gate stops where indicated.

3.4 TOUCH UP

- .1 Clean damaged surfaces with wire brush removing loose and cracked coatings. Apply two (2) coats of organic zinc-rich paint, to CGSB 1.181, to damaged areas. Pre-treat damaged surfaces according to manufacturers' instructions for zinc-rich paint.

3.5 CLEANING

- .1 Clean and trim areas disturbed by operations. Dispose of surplus material and reinstate disturbed surfaces.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies requirements for fine grading and for the supply, placement, and compaction of topsoil prior to seeding operations.
- .2 All topsoil to be obtained from an off-site source as approved by the Consultant.

1.2 RELATED WORK

- .1 Grubbing: Section 31 10 00
- .2 Excavation, Trenching, and Backfilling: Section 31 23 10
- .3 Rough Grading: Section 31 22 13
- .4 Hydraulic Seeding: Section 32 92 21

1.3 SOURCE QUALITY CONTROL

- .1 Obtain approval from the Consultant of topsoil at source.
- .2 When proposed source of topsoil is approved, use no other source without written authorization.
- .3 Advise Consultant of source of topsoil to be used 7 days in advance of starting work.
- .4 Conduct soil analysis for amendments to topsoil as specified.

1.4 SCHEDULING

- .1 Schedule topsoil placement and fine grading operations to coincide with seeding operations.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Topsoil:
 - .1 Friable loam, neither heavy clay nor of very light sandy nature, containing minimum 4% organic matter for clay loam, and 2% for sandy loam, to maximum 20% by volume.
 - .2 Containing no toxic elements or growth inhibiting materials.
 - .3 Free from debris, subsoil, vegetation, and stones and roots over 25 mm diameter.
- .2 Soil amendments:
 - .1 Peatmoss:

- .1 Derived from partially decomposed species of Sphagnum mosses.
- .2 Elastic and homogeneous, brown in colour.
- .3 Free of wood and deleterious material which could inhibit growth.
- .4 Shredded particle minimum size: 5 mm.
- .2 Limestone:
 - .1 Ground agricultural limestone containing minimum calcium carbonate equivalent of 85%.
 - .2 Gradation requirements: percentage passing by weight, 90% passing 1.0 mm sieve, 50 % passing 0.125 mm sieve.
- .3 Fertilizer:
 - .1 Complete, commercial, with 35% soluble nitrogen.
- .3 Water: potable, free of impurities.

PART 3 - EXECUTION

3.1 PREPARATION OF EXISTING GRADE

- .1 Verify grades are correct. If discrepancies occur, notify the Consultant and do not commence work until instructed by Consultant.
- .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. Remove soil contaminated with calcium chloride, toxic materials and petroleum products. Remove debris which protrudes more than 75 mm above surface. Dispose of removed material off site.
- .4 Course cultivate entire area which is to receive topsoil to depth of 100 mm. Cross cultivate those areas where equipment used for hauling and spreading has compacted soil.

3.2 PLACING AND SPREADING OF TOPSOIL

- .1 Place topsoil after the Consultant has accepted subgrade.
- .2 Spread topsoil in uniform layers not exceeding 150 mm, over unfrozen subgrade free of standing water.
- .3 Lightly compact topsoil. Keep topsoil 25mm below finished grade for sodded areas. For seeded areas, bring topsoil to finished grade.

3.3 SOIL AMENDMENTS

- .1 Apply and thoroughly mix soil amendments and fertilizer into full specified depth of topsoil as determined by soil analysis.

3.4 FINISH GRADING

- .1 Grade to eliminate rough spots and low areas and ensure positive drainage.
- .2 Prepare loose friable bed by means of cultivation and subsequent raking.
- .3 Consolidate topsoil to required bulk density using equipment approved by the Consultant. Leave surfaces smooth, uniform and firm against deep footprinting.

3.5 ACCEPTANCE OF TOPSOIL

- .1 Consultant will inspect and test topsoil in place and determine acceptance of material, depth of topsoil and finish grading. Approval of topsoil material subject to soil testing and analysis.

3.6 PROTECTION

- .1 Protect topsoiled areas until seeding operations have proceeded. Repair and fine grade any rough or disturbed areas affected by the construction and before seeding operations.

END OF SECTION

Part 1 - General

1.1 RELATED SECTIONS

- .1 Section 32 91 21 - Topsoil Placement and Grading

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meetings: Conduct pre-installation meeting to verify project requirements, installation instructions and warranty requirements.
 - .1 Provide hydraulic seeding schedule for the Consultant review.
 - .2 Provide fertilizing schedule for the Consultant's review.
- .2 Scheduling:
 - .1 Schedule hydraulic seeding to coincide with preparation of soil surface.

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Requirements.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for seed, mulch, tackifier, fertilizer, liquid soil amendments, micronutrients and FRM product.
- .3 Submit in writing seven (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.
- .4 Samples: Submit 0.5 kg container of each type of fertilizer used.
- .5 Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .6 Test Reports: Submit certified test reports showing compliance with specified performance characteristics and physical properties.

1.4 QUALITY ASSURANCE

- .1 Qualifications: Work to be carried out by a member in good standing with the Canadian Nursery Landscaping Association (CNLA), unless otherwise approved by the Consultant.

1.5 SCHEDULE

- .1 Schedule fertilizing in accordance with soil test recommendations. Provide schedule to Consultant for approval.

- .2 Schedule hydraulic seeding to coincide with preparation of soil surface.
- .3 Schedule hydraulic seeding during local growing season when moisture level ensures and supports germination and growth (April-June or September-October).
 - .1 Should sod be required due to hydraulic seeding outside of local growing season, there shall not be an increased cost to the Owner.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Labelled bags of fertilizer identifying mass in kg, mix components and percentages, date of bagging, supplier's name and lot number.
 - .2 Inoculant containers to be tagged with expiry date.
- .3 Storage and Handling Requirements:
 - .1 Store fertilizer 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 of pallets, crates, padding, packaging materials.

1.7 WARRANTY

- .1 Provide a written warranty that seeding will remain free of defects for 1 full growing season.
- .2 End-of-warranty inspection will be conducted by the Consultant.

part 2 - PRODUCTS

2.1 MATERIALS

- .1 Seed: "Canada pedigree grade" in accordance with Government of Canada Seeds Act and Regulations.
 - .1 Grass mixture: "Certified", "Canada No. 1 Lawn Grass Mixture" in accordance with Government of Canada "Seeds Act" and "Seeds Regulations".
 - .1 General Site Mixture:
 - .2 35% Creeping Red Fescue.
 - .3 35% Chewing Fescue.
 - .4 10% Hard Fescue.

- .5 10% Sheep Fescue.
- .6 10% Perennial Ryegrass.
- .7 Seed rate: 2.56kg/100m².
- .2 Playfield Mixture:
 - .1 15% Kentucky Bluegrass.
 - .2 15% Kentucky Bluegrass Can. #1.
 - .3 25% Certified Chewing Fescue.
 - .4 30% Creeping Red Fescue Cana. #1.
 - .5 15% Affinity Perennial Ryegrass.
 - .6 Seed rate: 2.56kg/100m².
- .3 Sports Fields side slopes and slopes of 4:1 - Fiber Reinforced Matrix (FRM):
 - .1 40% Creeping Red Fescue.
 - .2 30% Kentucky Blue Grass.
 - .3 30% Perennial Rye Grass.
 - .4 Seed rate: 1.7kg/100m². (3500lbs/acre)
- .2 Mulch: Specially manufactured for use in hydraulic seeding equipment, non-toxic, water activated, green colouring, free of germination and growth inhibiting factors with following properties:
 - .1 Type I Mulch:
 - .1 Made from wood cellulose fibre.
 - .2 Organic matter content: 95% plus or minus 0.5%.
 - .3 Value of pH: 6.0.
 - .4 Potential water absorption: 900%.
 - .2 Type II Mulch:
 - .1 Made from newsprint, raw cotton fibre and straw, processed to produce fibre lengths of 15 mm minimum and 25 mm maximum. Greater proportions of ingredients to be straw.
- .3 Fiber Reinforced Matrix (FRM):
 - .1 All components of the FRM to be pre-packaged by the Manufacturer. Field Mixing will not be accepted.
 - .2 Thermally Processed Wood Fibers (moisture content 12%±3%) >83%±2%.
 - .3 Tackifiers and Activators <12%±2%.
 - .4 Synthetic Fiber 4%±1%.
- .4 Tackifier: Water dilutable, liquid dispersion.
- .5 Water: Free of impurities that would inhibit germination and growth.
- .6 Fertilizer:
 - .1 To Canada "Fertilizers Act" and Regulations.
 - .2 Complete synthetic, slow release with 35% of nitrogen content in water-insoluble form.
- .7 Inoculants: Inoculant containers to be tagged with expiry date.

Part 3 - Execution

3.1 EXAMINATION

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

3.2 PROTECTION OF EXISTING CONDITIONS

- .1 Protect structures, sewerage piping and drainage field systems, signs, flagpoles, guide rails, fences, plant material, utilities and other surfaces not intended for spray.
- .2 Immediately remove any material sprayed where not intended as directed by Consultant.

3.3 PREPARATION OF SURFACES

- .1 Do not perform work under adverse field conditions such as wind speeds over 10km/h, frozen ground or ground covered with snow, ice or standing water.
- .2 Fine grade areas to be seeded free of humps and hollows.
 - .1 Confirm areas are free of deleterious and refuse materials.
- .3 Cultivated areas identified as requiring cultivation to depth of 25mm.
- .4 Confirm areas to be seeded are moist to depth of 150mm before seeding.
- .5 Obtain Consultant approval of grade and topsoil depth before starting to seed.
- .6 Obtain Consultant approval of installation of all sewerage piping and drainage field installation prior to seeding areas identified on drawings.

3.4 FERTILIZING PROGRAM

- .1 Fertilize during establishment and warranty periods based on test results and recommendations. Fertilize minimum three (3) times within the warranty period, in accordance with fertilizing schedule and soils test recommendations.

3.5 PREPARATION OF SLURRY

- .1 Measure quantities of materials by weight or weight-calibrated volume measurement satisfactory to Consultant. Supply equipment required for this work.
- .2 Charge required water into seeder. Add material into hydraulic seeder under agitation. Pulverize mulch and charge slowly into seeder.
- .3 After materials are in seeder and well mixed, charge tackifier into seeder and mix thoroughly to complete slurry.

3.6 SLURRY APPLICATION

- .1 Hydraulic seeding equipment:
 - .1 Slurry tank.
 - .2 Agitation system for slurry to be capable of operating during charging of tank and during seeding, consisting of recirculation of slurry and/or mechanical agitation method.
 - .3 Capable of seeding by 50m hand operated hoses and appropriate nozzles.
 - .4 Tank volume to be certified by certifying authority and identified by authorities "Volume Certification Plate".
- .2 Slurry mixture applied per hectare.
 - .1 Seed: Grass mixture(s) as indicated.
 - .2 Mulch: Type I and II kg as recommended by supplier.
 - .3 Tackifier: As recommended by supplier.
 - .4 Water: Minimum 30,000 L.
 - .5 Fertilizer: As recommended by supplier.
 - .6 Lime: As determined by soils test recommendations for turf.
- .3 Apply slurry uniformly, at optimum angle of application for adherence to surfaces and germination of seed.
 - .1 Using correct nozzle for application.
 - .2 Using hoses for surfaces difficult to reach and to control application.
- .4 Blend application 300mm into adjacent grass areas or sodded areas to form uniform surfaces.
- .5 Re-apply where application is not uniform.
- .6 Remove slurry from items and areas not designated to be sprayed.

3.7 CLEANING

- .1 Progress 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.

- .1 Clean and reinstate areas affected by Work.

- .3 Waste Management: separate waste materials for reuse, recycling in accordance with Section 01 74 00.

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

- .2 Divert unused fertilizer from landfill to official hazardous material collections site approved by Consultant.

3.8 PROTECTION

- .1 Protect seeded areas from trespass until plants are established.
- .2 Remove protection devices as directed by Consultant.

3.9 MAINTENANCE DURING ESTABLISHMENT PERIOD

- .1 Have maintenance carried out under supervision of certified Landscape Maintenance Supervisor.
- .2 Perform following operations from time of seed application until acceptance by Consultant.
- .3 Grass Mixture(s):
 - .1 Repair and reseed dead or bare spots to allow establishment of seed prior to acceptance.
 - .2 Mow grass to 50 mm whenever it reaches height of 70 mm. Remove clippings which will smother grass as directed by Consultant.
 - .3 Fertilize seeded areas after mowing in accordance with fertilizing program. Spread half of required amount of fertilizer in one direction and remainder at right angles: water in well.
 - .4 Control weeds by mechanical means utilizing acceptable integrated pest management practices.
 - .5 Water seeded area to maintain optimum soil moisture level for germination and continued growth of grass. Control watering to prevent washouts.

3.10 ACCEPTANCE

- .1 Seeded areas will be accepted by Consultant provided that:
 - .1 Plants are uniformly established. Seeded areas are free of rutted, eroded, bare or dead spots.
 - .2 Areas have been mown at least three times.
 - .3 Areas have been fertilized.
- .2 Areas seeded in Autumn will achieve final acceptance in the following Spring, one month after start of growing season provided acceptance conditions are fulfilled.

3.11 MAINTENANCE DURING WARRANTY PERIOD

- .1 Perform following operations from time of acceptance until end of warranty period:
 - .1 Repair and reseed dead or bare spots to satisfaction of Consultant.
 - .2 Fertilize areas in accordance with approved fertilizing program/schedule. Spread half of required amount of fertilizer in one direction and remainder at right angles and water in well.
 - .3 Eliminate weeds by mechanical means to extent acceptable to Consultant.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies requirements for constructing yard piping and associated appurtenances. Work includes the supply, installation, and testing of pipe, valves, and fittings.
- .2 Yard piping is defined as all piping 1.5m outside the exterior wall of buildings, channels, chambers, and tanks to 1.5m outside of the property line (unless noted otherwise).

1.2 RELATED SECTIONS

- .1 Cast-in-Place Concrete: Section 03 30 00
- .2 Excavating Trenching and Backfilling: Section 31 23 10
- .3 Process Mechanical Piping, and Appurtenances: Section 40 20 00

1.3 REFERENCES

- .1 ASME B16.1-20, Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250.
- .2 AWWA C104/A21.4-22, Cement Mortar Lining for Ductile Iron Pipe and Fittings.
- .3 AWWA C105/A21.5-18, Polyethylene Encasement for Ductile Iron Pipe System.
- .4 AWWA C110/A21.10-21, Ductile Iron and Gray-Iron Fittings.
- .5 AWWA C111/A21.11-23, Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
- .6 AWWA C151/A21.51-23, Ductile Iron Pipe, Centrifugally Cast.
- .7 AWWA C153/A21.53-19, Ductile Iron Compact Fittings.
- .8 AWWA C509-23, Resilient Seated Gate Valves, for Water Supply Service.
- .9 AWWA C600-23, Installation of Ductile Iron Mains and Their Appurtenances.
- .10 AWWA C606-22, Grooved and Shoulder Joints.
- .11 ASTM A183-14(R2020), Standard Specification for Carbon Steel Track Bolts and Nuts.
- .12 ASTM A240/A240M-24a, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- .13 ASTM A276/A276M-24A, Standard Specification for Stainless Steel Bars and Shapes.
- .14 ASTM B418-16A(R2021), Standard Specification Cast and Wrought Galvanic Zinc Anodes.

- .15 AWWA C115/A21.15-20, Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges.
- .16 AWWA C500-19, Metal Seated Gate Valves for Water Supply Service.
- .17 ULC/CAN S701.1-22, Standard for Thermal Insulation, Polystyrene Boards.
- .18 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act, 1999 ((CEPA))
- .19 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992 (TDGA)

1.4 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 00 for all pipe, fittings, valves, and all other items necessary for a complete installation.
- .2 Submit manufacturer's test data and certification that products and materials meet requirement of this Section in accordance with Section 01 33 00.

1.5 HANDLING AND STORAGE

- .1 Handle and store pipe, valves, and fittings, in such manner as to avoid shock and damage. Do not use chains or cables passing through pipe bore. Do not damage coatings or linings.
- .2 Store gaskets in cool location, out of direct sunlight, and away from petroleum products.

1.6 SCHEDULING OF WORK

- .1 Coordinate schedule with other plans required in specifications.
- .2 Where applicable, coordinate and organize work to minimize interruptions to existing services.
- .3 Notify the Owner and the Consultant a minimum of 48 hours in advance of planned interruptions in service.

PART 2 - PRODUCTS

2.1 POLYVINYL CHLORIDE PIPE AND FITTINGS

- .1 Sanitary Sewer:
 - .1 Type PSM Polyvinyl Chloride: to CSA B1800.
 - .2 Pipe: DR 35, diameter as indicated.
 - .3 Joints: Bell & Spigot with rubber gasket.
- .2 Pressure Sewer:

- .1 Polyvinyl Chloride: to CSA B137, AWWA C900 or AWWA 909, cast-iron outside diameter, gasketed bell-end joint.
- .2 Pipe: SDR 26, pressure class 160, diameter as indicated.
- .3 Fittings:
 - .1 PVC: to CAN/CSA B137.
 - .2 Cast or ductile iron: to AWWA C110 and C153, cement mortar lined minimum pressure rating of 1035 kPa for cast, 1720 kPa for ductile iron.
 - .3 Cement mortar lining: to AWWA C104, provide internal seal coat as required.
 - .4 Joints, mechanical or push-on: to AWWA C153.

2.2 DUCTILE IRON PIPE AND FITTINGS

- .1 Pipe: Special Class 52, to AWWA C151, diameter as indicated.
- .2 Fittings: to AWWA C110 or C153, cement mortar lined, minimum pressure rating 1035 kPa for cast-iron, 1720 kPa for ductile-iron.
- .3 Pipe Coatings:
 - .1 Interior: cement mortar lined to AWWA C104.
 - .2 Exterior: manufacturer's standard coating.
- .4 Joints: mechanical or push-on to AWWA C111; flanged to AWWA C110 with Class 125 flanged ends to ASME B16.1, or Special Class 54 pipe.
- .5 Cement mortar lining for liquid service: formulated with 100% pure fused calcium aluminate aggregate and cement suitable for use in hydrogen sulfide environments.
 - .1 Acceptable product: SewperCoat.
- .6 Unlined pipe for air service complete with high temperature gaskets.
- .7 Gaskets: to suit alternating submersion and exposure to sewage and hydrogen sulfide gaseous environments.

2.3 POLYETHYLENE PIPE AND FITTINGS

- .1 Pipe:
 - .1 13mm to 76mm diameter: to AWWA C901.
 - .2 100mm and larger: to AWWA C906.
- .2 Joints:
 - .1 Thermal butt fusion.
 - .2 Mechanical Connections: polyethylene flange end with metal back-up ring.
 - .3 Electrofusion.
- .3 Fittings:
 - .1 Polyethylene: to AWWA C901 and AWWA C906.
 - .2 Flanged cast-iron: to AWWA C110.

2.4 WATER SERVICE PIPE AND FITTINGS

- .1 Polyethylene pipe: to CAN/CSA B137, AWWA C901, NSF 61, type PE, Series 160 or 200.
- .2 Joints: compression type, minimum pressure rating 1035 kPa. For polyethylene pipe, to CAN/CSA B137, with stainless steel inserts.
- .3 Corporation stop: brass to ASTM B62 and NSF 61-G, compression type, inlet threads to AWWA C800.
- .4 Curb stop and drain: brass to ASTM B62 and NSF 61-G, compression type joints and O-ring seal.
- .5 Service clamp: bronze body, confined O-ring seal cemented in place and straps suitable for connecting main. Outlet tapped and threaded to AWWA C800.
- .6 Service box: adjustable type, cast-iron bottom section, cast-iron lid with recessed pentagon nut and internal stem to suit depth of bury. Service box to have appropriate foot piece.

2.5 VALVES

- .1 Gate valves: standard buried type to AWWA C500, minimum pressure rating 1035 kPa.
 - .1 Body: cast-iron with mechanical joint ends.
 - .2 Mechanism: bronze mounted, solid wedge, epoxy coated, s.s. bonnet, and packing gland nuts and bolts, non-rising spindle, and O-ring seals.
 - .3 Direction to close: clockwise.
 - .4 Operating nut: 50 mm square.
 - .5 Coating: epoxy internal and external with minimum of 0.15 mm (6 mil).
 - .6 All buried gate valves to be product of a single manufacturer.
 - .7 Acceptable products:
 - .1 Clow, McAvity, AVK.

2.6 VALVE BOXES

- .1 Composite valve boxes: to AWWA C500 and as follows:
 - .1 Polymer bottom section, ductile iron top section, slide type, adjustable for depth of pipe below finish grade.
 - .2 Covers marked "Water" or "Sewer", accordingly.
 - .3 Acceptable product: Mueller MVB, 5.00 inch., complete box including guide plate.

2.7 POST HYDRANT

- .1 Exposed, non-freeze, galvanized steel casing, cast aluminum casing guard, fully bronze interior components, free floating compression closure valve, 6mm drain port in valve housing. 50mm hose connection.

Wheel handle

- .1 Acceptable manufacturers: Zurn, J.R. Smith, Mueller, Watts.

2.8 COUPLINGS

- .1 Solid sleeve type: cast ductile iron centre sleeve and end rings, complete with corrosion protection epoxy coating to AWWA C213. Assembly will have restrained mechanical joint ends, epoxy coated steel bolts, and SBR rubber gaskets.

- .1 Acceptable products: Romac, Robar, Smith-Blair or approved equivalent.

2.9 THRUST RESTRAINT

- .1 Concrete to Section 03 30 00, minimum 32 MPa compressive strength.
- .2 Mechanical joint restraint device: ductile iron follower gland to AWWA C153 and C111, multiple wedge restraining mechanism, minimum working pressure of 2410 kPa, and minimum safety factor of 2:1. Lugs to have twist-off torque nuts.

- .1 Acceptable products: EBBA Iron, Clow, Star Pipe Products or approved equivalent.

2.10 PROTECTIVE COATING

- .1 Anti-corrosion petrolatum paste, tape and mastic.
 - .1 Acceptable products: Winn & Coales (Denso) Ltd., Trenton, Petro, STAC or approved equivalent.

2.11 INSULATION

- .1 To Section 31 23 10.

2.12 DISINFECTANT AND REDUCING AGENT

- .1 Disinfectant:
 - .1 Sodium hypochlorite or calcium hypochlorite: to AWWA B300.
 - .2 Liquid chlorine: to AWWA B301.
- .2 Reducing Agent:
 - .1 Hydrogen peroxide: 35% by mass, commercial grade.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Carefully inspect products for defects and remove defective products from site.

- .2 Before installation, remove any water, debris, and foreign material from interior of pipe, fittings, and valves.

3.2 TRENCHING, BEDDING AND BACKFILLING

- .1 Provide Trenching, bedding, and backfilling to Section 31 23 10.
- .2 Use Type 1 for pipe bedding and protection unless otherwise specified. Clearstone is acceptable for wet applications.

3.3 BURIED PIPE INSTALLATION

- .1 Lay and join pipe, fittings, and valves, as specified herein and according to manufacturer's published instructions.
- .2 Do not lay pipe and fittings when trench bottom is frozen, under water or when trench conditions or weather are unsuitable.
- .3 Lay pipe and fittings on prepared bed, true to line and grade indicated, within the following tolerances:
 - .1 Horizontal Alignment: 150 mm
 - .2 Vertical Alignment: 75 mm
- .4 Face bell ends in direction of laying. On grades of 5% or greater, lay pipe up grade. For grades exceeding 16%, install appropriately designed gradient thrust restraint.
- .5 Prevent entry of bedding material, water, or other foreign matter into pipe. Use temporary watertight bulkheads when pipe laying is not in progress.
- .6 Do not use excessive force to join pipe sections.
- .7 Install gaskets and lubricate in accordance with manufacturer's published instructions. During cold weather, store gaskets in heated area to assure that gaskets remain flexible.
- .8 Align pipes carefully before joining.
- .9 Support pipes as required to assure concentricity until joint is properly completed.
- .10 Keep pipe joints free from mud, silt, gravel, or other foreign materials.
- .11 Avoid displacing gasket or contaminating with dirt, or other foreign material. Remove, clean, re-install and lubricate gaskets so disturbed. Do not reuse a gasket that has been contaminated with petroleum products.
- .12 Complete each joint before laying next length of pipe.
- .13 Where deflection at joints is permitted by the Consultant, deflect only after spigot is fully inserted in bell. Do not exceed joint deflection recommended by manufacturer.
- .14 At structures, provide flexible joint not more than 300 mm from outside face of structure. Support pipe between structure wall and first joint with 20 MPa concrete

- .15 Cut pipe as required for fittings or closure pieces, square to centreline, and as recommended by manufacturer. Do not damage pipe lining or coating. Leave smooth bevelled edge.
- .16 Provide concrete thrust blocks to undisturbed ground on all tees, bends, plugs and caps. Construct as indicated and keep joints and couplings free of concrete.
- .17 Install mechanical joint restraints to AWWA C111 and tighten lug nuts until all wedges are in firm contact with pipe surface. Continue to tighten alternately between bolts until lug nuts twist off.
- .18 Give sufficient notice so that appropriate inspection and approval of pipe installation can be undertaken by the Consultant or the authorities having jurisdiction.
- .19 When stoppage of Work occurs, block pipe as directed by the Consultant to prevent creep during downtime.

3.4 VALVES AND VALVE BOXES

- .1 Install valves at locations indicated. Joints and bedding as specified for pipe and fittings.
- .2 On direct buried valves, install valve boxes plumb and centered over operating nut, and true to line and grade.
- .3 Place select backfill material, maximum size 50 mm around valve box to subgrade.
- .4 When valves are installed with cover in excess of 2.0 m, provide a valve stem extension in accordance with Project Drawings.

3.5 THRUST RESTRAINT

- .1 Provide formed thrust blocks to undisturbed ground on all bends greater than 22 degrees. Keep joints and couplings free of concrete and construct, so as to avoid conflict with manholes in dual pipe trenches.
- .2 Backfill over thrust blocks when concrete has sufficient strength and can withstand earth pressure.
- .3 Provide mechanical joint restraint devices where specified.
- .4 Mechanical joint restraint alone is permitted on 11 and 22 degree horizontal bends.
- .5 Where mechanical joint restraint is used alone, provide a single length of pipe within the minimum pipe length.
- .6 Place double polyethylene on bend before pouring concrete thrust block.

3.6 HYDROSTATIC TESTING

- .1 Provide labour, equipment and materials required to perform hydrostatic test.
- .2 Include all appurtenances in the system test.

- .3 Do not carry out testing until the surface is at finished grade.
- .4 Perform tests in presence of the Consultant or his representative. Provide the Consultant with at least 24 hours notice prior to conducting any tests. Provide a ¼ inch NPT connection at an appropriate location for the Consultant's pressure gauge.
- .5 Provide isolated source potable water for performing tests. Direct cross-connection to potable water distribution system to provide water for tests is forbidden.
- .6 Pressure test all valves.
- .7 Open all valves in test section.
- .8 Expel air from main by slowly filling with potable water. Install corporation stops at high points where no air-vacuum release valves are installed.
- .9 Conduct the test at a minimum pressure of the greater of 1035 kPa or one and one-half (1.5) times the operating pressure at the lowest point of elevation of the system being tested. In any case, the test pressure must not exceed 1205 kPa. Do pressure testing in sections where necessary to meet testing requirements. Conduct testing in accordance with AWWA C600.
- .10 Conduct the test over a full two (2) hour period, maintaining a constant test pressure. No leakage is permitted during the test period.
- .11 Locate and repair defects if test fails. Retest until results show remedial measures have been successful.
- .12 All water used for pipe testing including pressure testing and flushing will be the responsibility of the Contractor and will be chlorinated potable water.
- .13 Following acceptance of field tests, the Consultant may order a second test. Cost of retesting will be paid by the Owner providing the test is satisfactory. If it is not satisfactory the Contractor will pay for the re-test.

3.7 WARNING TAPE

- .1 Place warning tape on top of first backfill layer above pipe, along entire length of new pipe and similarly over existing pipe exposed during construction.

3.8 DEFLECTION TESTING - PLASTIC PIPE

- .1 Measure deflection of plastic pipe by pulling a deflection gauge through each pipe from manhole to manhole after backfilling.
- .2 Provide deflection gauge to measure a 7-1/2% deflection.
- .3 Within thirty days after installation pull a deflection gauge measuring 7-1/2% deflection through the installed section of pipeline. If this test fails locate defect and repair. Retest using same

methodology.

- .4 Thirty days prior to completion of warranty period, pull a deflection gauge measuring 7-1/2% deflection through the installed section of pipe. If test fails, locate defect and repair. Retest using same methodology.
- .5 Record deflection test with CCTV inspection specified herein.

3.9 CLOSED CIRCUIT TELEVISION INSPECTION

- .1 Flush storm sewers and related appurtenances to remove foreign materials.
- .2 Conduct closed circuit television inspection procedures to meet National Association of Sewer Service Companies (NASSCO) Pipe Condition Assessment Using CCTV Performance Specification Guideline.
- .3 Equipment:
 - .1 Provide equipment meeting the following requirements:
 - .1 Self-contained, self-levelling monitoring unit and pan-tilt camera with remotely controlled lighting system capable of varying the illumination.
 - .2 Picture quality to produce continuous 600-line resolution picture, showing entire periphery of pipe.
 - .3 A meter device with readings to clearly identify exact location of camera.
- .4 Inspection:
 - .1 Perform inspection of pipe from manhole to manhole by passing TV camera through sewer in direction of flow.
 - .2 Classify results in accordance with NASSCO Performance Specification Guideline.
- .5 Records:
 - .1 Maintain inspection record in log form, during television inspection.
 - .2 Log to include location of each fault and service lateral distance measured from centreline of reference manhole and position reference to axis of pipe.
 - .3 Provide fault image from inspection record. All photographs to be clear and precise with distinct definition of fault.
 - .4 Include detailed technical description with images as supporting data for each fault.
 - .5 Provide minimum of two (2) images for each sewer main section, detailing typical joint, and typical building service lateral.
 - .6 All images and videos to be in colour.
- .6 Reports:

- .1 Provide a composite report of TV inspection in PDF format.
Include the following information:
 - .1 Title page identifying project, camera operator and dates of inspection.
 - .2 Index page identifying street name, section from manhole to manhole, page number or numbers where information for section is contained.
 - .3 Organize inspection records in sequence from upstream manhole to downstream manhole.
 - .4 Report on each sewer main section to contain:
 - .1 Heading:
 - .1 Street name.
 - .2 Manhole numbers applicable to section.
 - .3 Reference drawing number, if applicable.
 - .4 Weather on the day of inspection.
 - .5 Statement of soil condition in area of inspection, i.e., dry, damp, wet, frozen.
 - .6 Date of inspection.
 - .2 Key Plan, showing corresponding manhole numbers, magnetic north, horizontal distance, pipe and material between manholes, and direction of flow.
 - .3 Inspection findings for each sewer main section to include:
 - .1 Location of all faults.
 - .2 Images of all faults.
 - .3 Location of all service laterals.
 - .4 One (1) image each of typical joint and typical service laterals when faults are not found.
 - .4 Mount images on left-hand page and place corresponding description on right-hand page. Number all images in order. Number beside photograph to correspond with description number.
- .7 Accuracy:
 - .1 Maximum permissible error in accuracy to be within following limits of fault location:
 - .1 Up to 375mm pipe: $\pm 75\text{mm}$ per 100m of length.
 - .2 450mm - 600mm pipe: $\pm 225\text{mm}$ per 100m of length.
 - .3 750mm - 900mm pipe: $\pm 225\text{mm}$ per 100m of length.
- .8 Video Record:
 - .1 Supply a complete record of all inspections in digital format.
 - .2 Index all files, listing sections of inspections.
 - .3 Submit flash drive with PDF report to Consultant.
- .9 Repeat Inspection:

- .1 Prior to repairs, have methods reviewed by the Consultant. Repair faults detected during television inspection. Repeat television inspection at no additional cost.

3.10 LOW PRESSURE AIR TESTING

- .1 Locate and repair defects if test fails. Retest. Have repair method reviewed by the Consultant prior to retesting.
- .2 Repair visible leaks regardless of test results.
- .3 CAUTION: FOR SAFETY OF PERSONNEL AND PUBLIC, OBSERVE PROPER PRECAUTIONS DURING AIR TESTING. USE TEST EQUIPMENT DESIGNED TO OPERATE ABOVE GROUND. DO NOT PERMIT PERSONNEL IN TRENCH DURING TESTING. DO NO AIR TEST ON PIPE WITH DIAMETER GREATER THAN 600mm.
- .4 Provide air testing equipment meeting the following requirement:
 - .1 Air Blower: 14 litres/sec, maximum pressure 70 kPa continuous.
 - .2 Pressure Relief Valve: sized to relieve full blower capacity at maximum blower pressure. Range 20-70 kPa, adjustable.
 - .3 Pressure Gauges: range 0 to 70 kPa with accuracy +/- 0.25 kPa.
- .5 Provide plugs at each end of section, with one (1) plug equipped for air inlet connection.
- .6 Fill test section slowly until a constant pressure of 28 kPa is reached. If ground water is above section being tested, Consultant may recommend increase in air pressure.
- .7 Allow a minimum of two (2) minutes for air temperature to stabilize, adding only amount of air required to maintain pressure.
- .8 After two (2) minute period, shut off air supply.
- .9 Decrease pressure to 24 kPa. Measure time required for pressure to reach 17 kPa. Minimum time allowed for pressure drop is as follows:

Pipe Diameter (mm)	Minimum Time
	Min:Sec
100	1:53
150	2:50
200	3:47
250	4:43
300	5:40
375	7:05
450	8:30
525	9:55
600	11:20

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies requirements for constructing HDPE storm sewers and culverts. Work includes supply and installation of pipe and fittings.

1.2 RELATED SECTIONS

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

1.3 REFERENCE STANDARDS

- .1 CAN/CSA B1800 - Thermoplastic Nonpressure Piping Compendium; 2021.
- .2 CSA G164-18(R2023), Hot Dip Galvanizing of Irregularly Shaped Articles.
- .3 National Association of Sewer Service Companies (NASSCO) Pipe Condition Assessment Using CCTV Performance Specification Guideline.

1.4 CERTIFICATES

- .1 Upon request, submit manufacturer's test data and certification that products and materials meet requirements of this Section in accordance with Section 01 33 00 for items specified herein.

1.5 HANDLING AND STORAGE

- .1 Handle and store pipe and fittings in such a manner as to avoid damage. Do not use chains or cables passed through pipe bore.
- .2 Store gaskets in accordance with the manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 HIGH DENSITY POLYETHYLENE PIPE AND FITTINGS

- .1 Double walled HDPE: to CAN/CSA B1800 with smooth interior surfaces.
- .2 Fittings: bell and spigot.

2.2 MARKER STAKES

- .1 Timber, 38 mm x 89 mm, colour: green.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Inspect products for defects and remove defective products from site.

- .2 Confirm pipe and fittings are clean before installation.

3.2 EXCAVATING, BEDDING, AND BACKFILLING

- .1 Perform excavation, bedding, and backfilling in accordance with Section 31 23 10.

3.3 PIPE INSTALLATION

- .1 Lay and join pipe and fittings as specified herein and according to manufacturer's published instructions.
- .2 Lay pipe and fittings on prepared bed, true to line and grade indicated within following tolerances:
 - .1 Horizontal Alignment: 50 mm.
 - .2 Vertical Alignment: the lesser of 13 mm or one half the rise per pipe length.
- .3 Commence laying at outlet and proceed in upstream direction with bell ends facing upgrade.
- .4 Prevent entry of bedding material, water, or other foreign matter into pipe. Use temporary watertight bulkheads when pipelaying is not in progress.
- .5 Install gaskets in accordance with manufacturers published instructions.
- .6 Align pipe before joining.
- .7 Support pipes as required to achieve concentricity until joint is properly completed.
- .8 Keep pipe joints free from mud, silt, gravel, or other foreign material.
- .9 Avoid displacing gasket or contaminating with dirt, petroleum products, or other foreign material. Remove, clean, reinstall and lubricate gaskets so disturbed.
- .10 Complete each joint before laying next length of pipe.
- .11 Where deflection at joints is permitted, deflect only after the joint is completed. Do not exceed maximum joint deflection recommended by pipe manufacturer.
- .12 Where a flexible joint is not integral to the structure, provide flexible joint not more than 1 metre from outside face of structure.
- .13 Install pipe in accordance with CAN/CSA B1800.
- .14 Cut pipe as required for fittings or closure pieces, square to centreline, and as recommended by manufacturer.
- .15 Make watertight connections to manholes and catch basins. Do not use non-shrink grout unless approved by Consultant.

3.4 UNDERCROSSING

- .1 Provide shop drawings showing proposed method of installation for pipe in undercrossing.
- .2 Excavate working pit according to reviewed shop drawings.
- .3 Dewater area of excavation and undercrossing.
- .4 Place jacking, boring, or tunneling equipment in working pit to approved line and grade of the proposed pipe.
- .5 Install casing pipe to proposed line and grade as indicated.
- .6 Use mechanical or welded type joints for casing pipe.
- .7 After casing pipe has been installed, check line and grade for approval.
- .8 Remove any soil or debris that remains in the casing pipe.
- .9 Insert carrier pipe into casing pipe, starting from the working pit.
- .10 Place pipe one (1) length at time outside casing pipe.
- .11 Use a Consultant approved, pre-manufactured, non-degradable spacer to guide carrier pipe to specified alignment. Use pre-manufactured end seal to cap annular space at the end of pipe casing.

3.5 INSPECTION

- .1 Consultant may require inspection of installed sewers by television camera, photographic camera, or by other visual method.

3.6 DEFLECTION TESTING - PLASTIC PIPE

- .1 Provide deflection gauge to measure a 7.5% deflection. Gauges to be a "Go-No-Go" device
- .2 Measure deflection of plastic pipe by pulling a deflection gauge through each pipe from manhole to manhole. Notify the Consultant 24 hours prior to deflection testing.
- .3 Within thirty days after installation, pull a deflection gauge measuring 7.5% deflection through the installed section of pipeline. If this test fails locate defect and repair. Retest using same methodology.
- .4 Thirty days prior to completion of warranty period, pull a deflection gauge measuring 7.5% deflection through the installed section of pipe. If test fails, locate defect and repair. Retest using same methodology.
- .5 Record deflection test with CCTV inspection specified in subsection 3.8 herein.

3.7 CLOSED CIRCUIT TELEVISION INSPECTION

- .1 Flush storm sewers and related appurtenances to remove foreign materials.

- .2 Conduct closed circuit television inspection procedures to meet National Association of Sewer Service Companies (NASSCO) Pipe Condition Assessment Using CCTV Performance Specification Guideline.
- .3 Equipment:
 - .1 Provide equipment meeting following requirements:
 - .1 Self-contained, self-leveling monitoring unit and pan-tilt camera with remotely controlled lighting system capable of varying the illumination.
 - .2 Picture quality to produce continuous 600-line resolution picture, showing entire periphery of pipe.
 - .3 A meter device with readings to clearly identify exact location of camera.
- .4 Inspection:
 - .1 Perform inspection of pipe from manhole to manhole by passing CCTV camera through sewer in direction of flow.
 - .2 Classify results in accordance with NASSCO Performance Specification Guideline.
- .5 Records:
 - .1 Maintain inspection record in log form, during television inspection.
 - .2 Log to include location of each fault and service lateral distance measured from centreline of reference manhole and position referenced to axis of pipe.
 - .3 Provide fault image from inspection record. All photographs to be clear and precise with distinct definition of fault.
 - .4 Include detailed technical description with images as supporting data for each fault.
 - .5 Provide minimum of two (2) images for each sewer main section, detailing typical joint, and typical building service lateral.
 - .6 All images and videos to be in colour.
- .6 Reports:
 - .1 Provide a composite report of CCTV inspection in PDF format. Include following information:
 - .1 Title page identifying project, camera operator, and dates of inspection.
 - .2 Index page identifying street name, section from manhole to manhole, page number or numbers where information for section is contained.
 - .2 Organize inspection records in sequence from upstream manhole to downstream manhole.
 - .3 Report on each sewer main section to contain:
 - .1 Heading:

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- .1 Street name.
 - .2 Manhole numbers applicable to section.
 - .3 Reference drawing number, if applicable.
 - .4 Weather on the day of inspection.
 - .5 Statement of soil condition in area of inspection, i.e., dry, damp, wet, frozen.
 - .6 Date of inspection.
- .2 Key Plan, showing corresponding manhole numbers, magnetic north, horizontal distance, pipe and material between manholes, and direction of flow.
- .3 Inspection findings for each sewer main section to include:
 - .1 Location of all faults.
 - .2 Images of all faults.
 - .3 Location of all service laterals.
 - .4 One image each of typical joint and typical service laterals when faults are not found.
 - .5 Mount images on left-hand page and place corresponding description on right-hand page. Number all images in order. Number beside photograph to correspond with description number.
- .7 Accuracy:
 - .1 Maximum permissible error in accuracy to be within following limits of fault location:
 - .1 Up to 375 mm pipe: ± 75 mm per 100 m of length.
 - .2 450 mm - 600 mm pipe: ± 150 mm per 100 m of length.
 - .3 750 mm - 900 mm pipe: ± 225 mm per 100 m of length.
- .8 Video Record:
 - .1 Supply a complete record of all inspections in Owner approved digital format.
 - .2 Index all files, listing sections of inspections.
- .9 Repeat Inspection:
 - .1 Prior to repairs, have methods reviewed by the Consultant. Repair faults detected during CCTV inspection. Repeat television inspection at no additional cost.

END OF SECTION

PART 1 GENERAL

1.1 WORK INCLUDED

- .1 This section specifies requirements for providing perimeter subsurface foundation drainage where shown on the Drawings and as specified in this Section.

1.2 RELATED WORK

- .1 Excavating, Trenching and Backfilling: Section 31 23 10
- .2 Storm Sewers and Culverts: Section 33 40 00

1.3 REFERENCES

- .1 ASTM D 4254-16, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
- .2 CSA B1800:24, Thermoplastic Non- pressure Pipe Compendium.

PART 2 PRODUCTS

2.1 PERIMETER DRAINAGE

- .1 Rigid plastic pipe and fittings: to CSA-B1800, size as indicated, straight PVC, DR35, perforated, complete with fittings. Pipe perforated with 2 rows of 14 mm dia. holes at 4:00 and 8:00 position at 400 mm c.c.

2.2 BEDDING AND SURROUND MATERIALS

- .1 Bedding: 25 mm clear stone as specified in Section 31 23 10.
- .2 Geotextile filter: to Section 31 20 01.

PART 3 EXECUTION

3.1 INSPECTION

- .1 Confirm graded base conforms with required drainage pattern before placing bedding material.
- .2 Confirm improper slopes, unstable areas, areas requiring additional compaction or other unsatisfactory conditions are corrected to approval of Consultant.
- .3 Confirm foundation wall and waterproofing have been inspected by Consultant before placing bedding material or drainage composite.

3.2 PLACING OF GRANULAR BEDDING AND GEOTEXTILE

- .1 Cut trenches in base and install geotextile of sufficient width to receive clear stone bedding and pipe, and have minimum 450 mm of

overlap.

- .2 Place geotextile in trench bottom as shown on the drawings. Place clear stone bedding material in uniform layers not exceeding 150 mm compacted thickness to depth as indicated.
- .3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe. Do not use blocks when bedding pipe.
- .4 Shape transverse depressions, as required, to suit joints.
- .5 Carry granular bedding material horizontally across actual trench width. Mounding bedding will not be permitted.
- .6 After installation of pipe, place and compact bedding to haunch line of pipe. Place and compact bedding material from haunch line of pipe to 150 mm above the top of pipe. Compact to 70% relative density to ASTM D 4254.
- .7 Cover bedding material with the overlapping geotextile and secure in place with the first lift of backfill material.

3.3 PIPE INSTALLATION

- .1 Confirm pipe interior and coupling surfaces are clean before laying.
- .2 Lay perforated pipe minimum to slope as indicated. Face perforations and coupling slots downward.
- .3 Grade bedding to establish pipe slope.
- .4 Install end plugs at ends of collector drains to protect pipe ends from damage and ingress of foreign material.
- .5 Connect pipe to storm sewer by appropriate adapters manufactured for this purpose.

3.4 BACKFILL MATERIAL

- .1 Place backfill material above pipe surround in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated and in accordance with Section 31 23 10.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

- .1 CSA A3000:23, Cementitious Materials Compendium.
- .2 CSA A23.1:24/A23.2:24, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .3 CSA G30.18-21, Carbon Steel Bars for Concrete Reinforcement.
- .4 ASTM D1056-20, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings for precast manholes in accordance with Section 01 33 00.

PART 2 - PRODUCTS

2.1 PVC DUCTS

- .1 PVC ducts, type DBII, encased in reinforced concrete.

2.2 PVC DUCT FITTINGS

- .1 Rigid PVC opaque solvent welded type couplings, bell end fittings, plugs, caps, adaptors as required to make complete installation.
- .2 Expansion joints where ducts exit the ground.
- .3 Rigid PVC 5 degree angle couplings.

2.3 CABLE RACKS

- .1 Hot dipped galvanized cable racks and supports.
- .2 12 x 100 mm preset inserts for rack mounting.

2.4 CABLE PULLING EQUIPMENT

- .1 Pulling iron: galvanized steel rods, size and shape as indicated.
- .2 Pull rope: 6 mm stranded polypropylene, tensile strength 5 kN, continuous throughout each duct run with 3 m spare rope at each end.

2.5 MARKER TAPE

- .1 Refer to Section 31 23 10 for marker tape.

PART 3 - EXECUTION

3.1 INSTALLATION 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.
- .3 Open trench completely between connection points before ducts are laid and confirm 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 190 mm horizontally and vertically. Stagger joints in adjacent layers at least 150 mm and make joints watertight. Encase duct bank with 75 mm thick concrete cover.
- .7 Make transpositions, offsets and changes in direction using 5 degree bend sections, do not exceed a total of 20 degree with duct offset.
- .8 Use bell ends at duct terminations in manholes.
- .9 Use conduit to duct adapters when connecting to conduits.
- .10 Terminate duct runs with duct coupling set flush with end of concrete envelope when dead ending duct bank for future extension.
- .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. Tie ducts to spacers with twine or other non-metallic material. Remove weights or wood braces before concrete has set and fill voids.
- .14 Clean ducts before laying. Cap ends of ducts during construction and after installation to prevent entrance of foreign materials.
- .15 Immediately after placing of concrete, pull through each duct mandrel not less than 300 mm long and of diameter 6 mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign matter. Avoid disturbing or damaging ducts where concrete has not set completely. Pull stiff bristle brush through each duct immediately before pulling-in cables.

- .16 Install four (4) 3 m lengths of 10M reinforcing rods, one in each corner of duct bank when connecting duct to manholes or buildings. Wire rods to 10M dowels at manhole or building and support from duct spacers. Place concrete down sides of duct bank filling space under and around ducts. Rod concrete with flat bar between vertical rows filling voids.
- .17 In each duct install pull rope continuous throughout each duct run with 3 m spare rope at each end.

3.2 MARKERS

- .1 Install markers as specified in Section 31 23 10.

3.3 INSPECTIONS

- .1 Inspection of duct will be carried out by the Consultant concrete and duct cleanouts when the Consultant is present.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

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

1.2 RELATED SECTIONS

- .1 Canadian Standards Association (CSA):
 - .1 CSA C22.2 No. 211.1-06(R2011), Rigid PVC (Unplasticized) Conduit

PART 2 - PRODUCTS

2.1 PVC DUCTS AND FITTINGS

- .1 Rigid PVC ducts: to CSA C22.2 o. 211.2, with moulded fittings for direct burial.
- .2 Rigid PVC bends, couplings, reducers, bell end fittings, plugs, caps, adaptors of same product material as duct, to make complete installation.
- .3 Rigid PVC 90° and 45° bends.
- .4 Rigid PVC 5° angle couplings.
- .5 Expansion joints where conduits exit ground.

2.2 SOLVENT WELD COMPOUND

- .1 Solvent cement for PVC conduit joints.

2.3 CABLE PULLING EQUIPMENT

- .1 6 mm stranded polypropylene pull rope, tensile strength 5 kN, continuous throughout each conduit run with 3 m spare rope at each end.

2.4 MARKER TAPE

- .1 Plastic flagging tape, 50mm wide, clearly marked as follows:
 - .1 "CAUTION - BURIED ELECTRICAL LINE", coloured red.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install direct buried underground cable ducts in accordance with the requirements of the authorities having jurisdiction.
- .2 Install duct in accordance with manufacturer's instructions.

- .3 Clean inside of ducts before laying.
- .4 Open trench before conduits are laid and confirm no obstructions will necessitate change in grade of conduit.
- .5 Confirm full, even support every 1.5m throughout duct length.
- .6 Install conduits at elevations and slope ducts with 1:400 minimum slope.
- .7 During construction, cap ends of ducts to prevent entrance of foreign materials.
- .8 Pull through each duct mandrel not less than 300mm long and of diameter 6mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign matter. Pull stiff bristle brush through each duct immediately before pulling in cables.
- .9 In each duct, install pull rope continuous throughout each duct run with 3m spare rope at each end.

3.2 MARKERS

- .1 Mark duct bank every 100m along the run and at any change in direction.
- .2 Where markers are removed to permit installation of additional duct banks or conduit, reinstall existing markers.
- .3 Connect concrete markers flat and centered over the duct bank run with the top flush with finished grade.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL

- .1 This section covers items common to all sections of Divisions 40 through 46 and is intended to supplement the requirements of Division 01.

1.2 SCOPE OF WORK

- .1 Finish all materials, labour, tools and equipment and perform all operations necessary to complete all process systems specified under Division 40 and install all process equipment and material handling equipment specified under Divisions 44 through 46.
- .2 The division of responsibility between process mechanical (Division 40), and yard piping (as specified under Division 33) will be to the first joint of pipes that exits the walls of buildings, chambers and tanks or a maximum distance of 1500 mm from the exterior wall. The first fitting beyond the wall would be specified under Division 33. Piping located beneath foundations, floors, and tank slabs is included under the responsibility of Division 40, unless otherwise indicated on the Drawings.
- .3 The Work includes, but is not necessarily limited to: the supply and/or installation of equipment, gates, supports, fittings, valves, couplings, actuators, connections to equipment, conduit, wiring, control system components, instruments, and all other appurtenances.
- .4 The work also includes inspection, testing, start-up and commissioning of process systems and equipment. Coordinate commissioning in accordance with Section 01 91 13.
- .5 Work also includes filling process tankage, channels, and conduit structures with water to test for leakage and commission process equipment systems. Provide water for testing. Reuse and pump water from location to location as required for initial testing and commissioning.

1.3 DRAWINGS

- .1 The Drawings indicate the extent and general arrangement of the various systems and must be read in conjunction with these specifications. The Drawings are not to be considered as detailed as shop drawings but as a guide to the general intent based on the materials specified.
- .2 Where field conditions necessitate departures from the Drawings, submit working drawings for the proposed departures to the Consultant for review prior to installation.
- .3 Because of the small scale of the Drawings, it is not possible to indicate all offsets and accessories that may be required for the installation.

- .4 Investigate carefully the civil, architectural, mechanical, electrical, structural and finish conditions affecting this work and arrange details accordingly. Furnish and install items required to meet such conditions.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address. Refer to Section 01 61 00.
- .2 Protect from weather and construction traffic.
- .3 Protect against damage from any source.
- .4 Store at temperature and conditions required by manufacturer at no additional cost to the Contract.

1.5 REFERENCE STANDARDS

- .1 The Work must conform to the applicable requirements of the National Building Code and National Plumbing Code of Canada, National Fire Protection Association, Underwriters Laboratories of Canada (ULC), and referenced standards throughout these Specifications of the American National Standards Institute (ANSI), American Society of Mechanical Engineers (ASME), American Society of Testing and Materials (ASTM), Canadian Standards Association (CSA), the Canadian General Standards Board (CGSB), Canadian Gas Association (CGA), American Water Works Association (AWWA), Hydraulic Institute Standards, National Electrical Manufacturers' Association (NEMA), Institute of Electrical and Electronics Engineers (IEEE), Electrical Manufacturers' Association of Canada (EEMAC).
- .2 Equipment assemblies comprised of electro- mechanical components must be CSA approved where possible and bear the appropriate label. If the equipment in question is not CSA approved as an assembly, have the manufacturer arrange and pay for "spot approval" and labelling of the equipment prior to installation.

1.6 INSPECTION

- .1 All manufacturing operations and finished pipes, fittings and appurtenances are subject to inspection by the Consultant. Furnish all labour necessary to assist the Owner or their inspectors in inspecting the materials.

1.7 EQUIPMENT INSTALLATION

- .1 Provide unions and flanges to permit equipment maintenance and disassembly and to minimize disturbance to piping and duct systems without interfering with other equipment.
- .2 Provide means of access for servicing equipment including permanently lubricated lifetime bearings.
- .3 Pipe equipment drains to floor drains and/or as indicated.

- .4 Install equipment, piping, conduit and similar items parallel to or perpendicular to building lines.

1.8 CUTTING AND PATCHING

- .1 Provide equipment and inserts in time to prevent cutting of new work.
- .2 Coordinate and provide sizes of openings and locations (prior to work).

1.9 ANCHOR BOLTS AND TEMPLATES

- .1 Supply anchor bolts and templates for installation by other divisions.

1.10 TRIAL USAGE

- .1 Consultant or Owner may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Trial usage to apply to following equipment and systems:
 - .1 Process pipe systems.
 - .2 Process equipment.
 - .3 Pumping equipment.
 - .4 Process valves and gates.
 - .5 Process controls.
 - .6 Screening and conveyor system.
 - .7 SBR system.
 - .8 UV disinfection system.
 - .9 Aerated sludge holding tank.
 - .10 Sludge Dewatering Equipment.

1.11 PROTECTION OF OPENINGS

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

1.12 ELECTRICAL

- .1 Electrical work to conform to Division 26 including the following:
 - .1 Control wiring and conduit is specified in Division 26. Refer to Division 26 for quality of materials and workmanship.
 - .2 Run control wiring in conduit. Refer to Division 26 for materials and installation.

1.13 GUARDS

- .1 Provide guards for all unprotected rotating equipment.

1.14 EQUIPMENT SUPPORTS

- .1 Equipment supports and equipment pads as shown on drawings, and as required in Section 40 05 29.

1.15 SLEEVES

- .1 Pipe sleeves: at points where pipes pass through masonry, concrete or fire rated assemblies and as indicated.
- .2 Schedule 40 steel pipe or as indicated on the drawings.
- .3 Sleeves with annular fin continuously welded at midpoint:
 - .1 Through foundation and tank walls.
- .4 Sizes: minimum 6mm clearance all around, between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 Terminate sleeves flush with surface of concrete and masonry walls, concrete floors on grade and 25mm above other floors.
- .6 Fill voids around pipes:
 - .1 Caulk between sleeve and pipe in foundation walls and below grade floors with waterproof fire retardant non-hardening mastic.
 - .2 Where sleeves pass through walls or floors, provide space for firestopping in accordance with Division 07. Where pipes/ducts pass through fire rated or gas-tight walls, floors and partitions, maintain fire rating integrity.
 - .3 Allow for no contact between copper tube or pipe and ferrous sleeve.
 - .4 Fill future-use sleeves with lime plaster or other easily removable filler.
 - .5 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint to CAN/CGSB-1.181.

1.16 PREPARATION FOR FIRESTOPPING

- .1 Uninsulated unheated pipes not subject to movement: no special preparation.
- .2 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe to move without damaging firestopping material.
- .3 Insulated pipes and ducts: cut back insulation and vapour barrier at fire separation and prepare as above.

1.17 ESCUTCHEONS

- .1 On pipes passing through walls, partitions, floors and ceilings in finished areas.
- .2 Chrome or nickel plated brass or Type 302 stainless steel, split type with set screws.
- .3 Outside diameter to cover opening or sleeve.
- .4 Inside diameter to fit around finished pipe.
- .5 Secure only to bare pipe or flat surface.

1.18 TESTS

- .1 Give 24 h written notice of date for tests.
- .2 Insulate or conceal work only after testing and approval by the Consultant.
- .3 Conduct tests in presence of the Consultant or local authority having jurisdiction.
- .4 Bear costs including retesting and making good.
- .5 Piping systems:
 - .1 Record all data and provide an electronic copy of written report upon completion of work.
 - .2 Where applicable, test drainage, waste and vent piping to the National Plumbing Code and/or the local authorities having jurisdiction.
 - .3 Test all liquid service process piping in accordance with ASME B31.3 at $1\frac{1}{2}$ times system operating pressure or minimum 860 kPa, whichever is greater. Maintain test pressure without loss for 4 h unless otherwise specified.
 - .4 Subject low pressure air pipes to a pressure test. The pipe under test shall be filled with air to a pressure of 200 kPa. Examine pipe for leaks, or using soap solution applied at all joints, if air leaks observed. Repair leaks. Remove and replace cracked or defective pipes, fittings or valves with sound material. The pipe work will be accepted when the applied test pressure of 200 kPa is maintained for two hours without loss.
- .6 Provide supplemental tests as specified in relevant sections.
- .7 Prior to tests, remove or isolate all equipment or other parts which are not designed to withstand test pressures or test medium. Re-install after test is completed.

1.19 PAINTING

- .1 Apply at least one (1) coat of corrosion resistant primer paint to ferrous supports and site fabricated work, including pipe hangers. Use zinc rich primer on galvanized materials.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged too extensively to be merely primed and touched up.

1.20 SPARE PARTS

- .1 Furnish spare parts where specified or indicated on the Drawings.

1.21 SPECIAL TOOLS

- .1 Provide one (1) set of special tools required to service equipment as recommended by manufacturers.

1.22 DIELECTRIC COUPLINGS

- .1 General:
 - .1 Compatible with and to suit pressure and temperature rating of piping system.
 - .2 Where pipes of dissimilar metals are joined.
- .2 Pipes NPS 2 and under: isolating unions.
- .3 Pipes NPS 2-1/2 and over: isolating flanges.
- .4 Acceptable material: EBCO, Walter Valiet Co.

1.23 DRAIN VALVES

- .1 Locate at low points and at section isolating valves unless otherwise specified.

1.24 CO-OPERATION WITH OTHER TRADES

- .1 In areas where ducts, piping, and electrical fixtures are in close proximity to each other, cooperate fully with the other trade in laying out the location of same.
- .2 Report immediately to the Consultant for their comments in areas of conflict. Do not install work until corrective measures are approved.
- .3 Take special care with structural coordination.
- .4 If required, prepare interference layout drawings prior to construction and submit these to the Consultant for their review. Drawings to clearly indicate all necessary associated trade work such as light fixtures, etc.
- .5 Coordinate location and furnish all embedded items for installation in poured-in-place concrete and masonry.

1.25 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into Operations and Maintenance Manuals in accordance with Section 01 78 00.
- .2 Instructions to include step-by-step directions for starting up and shutting down process equipment and step-by-step directions for minor troubleshooting, and periodic maintenance instructions such as cleaning, oiling, etc., for all equipment provided under this Contract, including type of lubricant.
- .3 All bulletins must pertain to equipment installed on this job only. General bulletins describing any items of equipment not installed on this job will be rejected.

- .4 Include preparation of such instructions and schematic diagrams as part of the Work under this Section.
- .5 Each manufacturer to submit recommended list of spare parts with maintenance manuals.
- .6 Approvals:
 - .1 Submit copies of draft Operating and Maintenance Manual to the Consultant for approval in accordance with Section 01 78 00. Submission of individual data will not be accepted unless so directed by the Consultant.
 - .2 Make changes as required and resubmit data in accordance with Section 01 78 00.
 - .3 Submit hard copy sets and an electronic set of Operations and Maintenance Manuals for all process equipment systems and equipment to the Consultant in accordance with Section 01 78 00. These sets of Manuals will not be returned to the Contractor.
- .7 Additional data: prepare and insert into operation and maintenance manual when need for same becomes apparent during commissioning.

1.26 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00.
- .2 Shop drawings and product data to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances. eg. access door swing spaces.
 - .3 Roughing-in dimensions and all other physical characteristics pertinent to installation.
 - .4 Detailed drawings of bases, supports, and anchor bolts.
 - .5 Acoustical sound power data, where applicable.
 - .6 Points of operation on performance curves.
 - .7 Certification as to current model production.
 - .8 Certification of compliance to applicable codes.

1.27 CLEANING

- .1 Clean interior and exterior of all systems including strainers, exhaust fans, ducting and piping distribution systems, HRVs, boilers, pumps, process equipment, compressors, etc.
- .2 Upon completion of testing, remove all test equipment and cap holes to satisfaction of the Consultant.
- .3 In preparation for final acceptance, clean and refurbish all equipment, fixtures and trim and leave in operating condition including replacement of all filters in all air and piping systems in preparation for final acceptance.

- .4 Leave all areas cleaned of debris and unused materials.

1.28 RECORD DRAWINGS

- .1 Maintain record drawings on site for process mechanical work in accordance with Section 01 78 00.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not applicable.

PART 3 - EXECUTION

3.1 NOT USED

- .1 Not applicable.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 The work to be done under this Section includes, but is not limited to the supply and installation of valves, actuators, pressure gauges and all other appurtenances, and carrying out of all related start-up and testing.

1.2 RELATED WORK

- .1 Cast-in-Place Concrete: Section 03 30 00
- .2 Metal Fabrications: Section 05 50 00
- .3 Painting: Section 09 91 23
- .4 Process Mechanical General Requirements: Section 40 05 10
- .5 Electrical: Division 26
- .6 Equipment Identification: Section 40 05 53
- .7 Process: Divisions 40 to 46

1.3 REFERENCES

- .1 ASME B16.1-2020, Gray Iron Pipe Flanges And Flanged Fittings Classes 25, 125, And 250.
- .2 ANSI/AWWA C500-19, Metal-Sealed Gate Valves for Water Supply Service.
- .3 ANSI/AWWA C509-23, Resilient-Seated Gate Valves for Water Supply Service.
- .4 ANSI/AWWA C606-2022, Grooved and Shouldered Joints.
- .5 ASTM A126-04(R2023), Standard Specification for Gray-Iron Castings for Valves, Flanges and Pipe Fittings.
- .6 ASTM A240/A240M-24a, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications.
- .7 Underwriters Laboratory of Canada (ULC)
- .8 Factory Mutual Approved (FM)

1.4 LABELLING

- .1 Equipment assemblies comprised of electro- mechanical components to be CSA approved where possible and bear the appropriate label. If the equipment in question is not CSA approved as an assembly, have the manufacturer arrange and pay for "special approval" and labelling of the equipment prior to installation by an agency recognized by the applicable provincial Electrical Inspection Department.

1.5 INTENT

- .1 The intent of these specifications is to provide the works fully complete in every detail for the purpose designated. Furnish any apparatus, appliance, material or labour not herein specifically mentioned or included but requisite to the operation of the apparatus and equipment specified without additional expense to the Contract.

1.6 SHOP DRAWINGS

- .1 Provide shop drawings for valves, gates, and actuators.

1.7 IDENTIFICATION OF EQUIPMENT

- .1 Fit equipment with manufacturer's identification nameplates indicating size, equipment model, manufacturer's name and serial number.

PART 2 - PRODUCTS

2.1 CHECK VALVES

- .1 Check valves:
 - .1 Full body swing type check valve. Valve to be rated for 1735 kPa working pressure. Body to be ductile iron (ASTM A-536) with Buna-N reinforced disc and 125 lbs flanged connections. Acceptable Products: Golden-Anders Figure 200-D, Apco CRF 100, Valmatic Figure 500-A Swing-Flex or approved equivalent.

2.2 BALL VALVES

- .1 Size 100 mm and smaller (stainless steel): 3 piece body, 6900 kPa rated, full port ball valve with threaded end connections. Standard of acceptance: Flow-Tek Series 5000, Crane Series 9500, PMP Model A302, Velan V3P-1000, or approved equivalent.
- .2 Size 50 mm and smaller (stainless steel): 2 piece body, 5500 kPa rated, full port ball valve with stainless steel ball and with threaded end connections. Standard of acceptance: Watts Series S-FBV-1, Crane Series 9400, PMP Model A201, Flow-Tek Series 80, Velan VEE-2000 or approved equivalent.
- .3 Size 25mm and smaller (PVC): fabricated from polyvinyl chloride with Teflon seats and EPDM seals. True union (Safe-Blocking Valve) connections.
 - .1 Acceptable product: Chemline Series 21, Chemtrol, or approved equivalent.

2.3 PLUG VALVES

- .1 Rugged, eccentric type plug valves suitable for raw sewage or sludge service and minimum of 90% full port area.
- .2 Rating: 1050 kPa at 37°C.
- .3 Body: ASTM A126 Class B cast iron with nickel-welded raised seats, Class 125 flanged ANSI B16.1 end connections above 50 mm size. Grooved end connections to ANSI/AWWA C606 are an acceptable alternative.
- .4 Plug: Buna N or Neoprene coated for resilient plug face and bubble tight shut off.
- .5 Bearings: stainless steel and teflon permanently lubricated.
- .6 Packing: Buna N or Teflon combination.
- .7 Bolted bonnet design repackable without removing bonnet.
- .8 Direction to close: clockwise
- .9 Actuator: lever actuator for 100 mm and smaller valves; geared actuator for valves greater than 100 mm. Have actuator supplied by valve manufacturer. Geared actuators to indicate valve position and have permanently lubricated bearings, semi-steel housing and sealed against dirt and water. Actuators for gear operated valves to be by handwheel.
- .10 Accessories: Valves with centerlines greater than 2135 mm (7 ft) from the finished floor to be operated by chain operator and chain wheel provided by the valve manufacturer to operate that particular valve.
- .11 Acceptable products: Dezurik PEC, Milliken Figure 601 (Figure 606 is the grooved end valve), Valmatic Cam Centric, Keystone Ballcentric, Victualic-Series 365 (up to 450 mm size), or Golden Anderson.

2.4 BUTTERFLY VALVES

- .1 Wafer type butterfly valves, flangeless, resilient seated, cast iron, wafer style body suitable for installation between ANSI B16.1 type flanges. Seats to be EPDM, suitable for use with air or water. Shafts to be one (1) piece of 316 stainless steel, finish ground and polished with EPDM shaft seals. Provide shaft bushings above and below disk and below mounting flange for actuator. Discs to be bronze. The disc to shaft connections to be type 316 stainless steel. Pins, shaft and disc of all valves to be individually machines and completely interchangeable.
 - .1 Equip manually operated valves 200mm and smaller with manual lever actuators.
 - .2 Provide manually operated valves 250mm and larger complete with gear actuators.
 - .3 Acceptable products: Bray Series 31, Keystone - Figure AR1, DeZurik BRS, Jenkins NH, or approved equivalent.

2.5 AIR RELEASE VALVES

- .1 Clean water service: 12 mm pressure type air vent. Inlet connection to be 12 mm NPT, epoxy fusion coated (interior) cast iron body, 316 stainless steel trim.
 - .1 Acceptable products: Golden Anderson Fig. 905, Valmatic, APCO, or Crispin.
- .2 Wastewater service: pressure type air release valve designed for use on a wastewater system. Inlet connection to be 50mm NPT, epoxy fusion coated (interior), cast iron body, 316 stainless steel trim.
 - .1 Acceptable products: Golden Anderson Fig. 925, Valmatic, APCO, or Crispin.

2.6 SOLENOID VALVES

- .1 Brass body, normally closed, two-way, direct acting type with general purpose enclosures and manual overrides. Solenoids to operate on 120 volt (AC), single phase, 60Hz power supply.
- .2 Refer to service conditions for individual solenoid valves as shown on the drawings.
- .3 Acceptable product: ASCO - Red Hat 8210 Series or approved equivalent.

PART 3 - EXECUTION

3.1 GENERAL

- .1 Install valves in the locations indicated, and to the elevations as shown on the Drawings.
- .2 Load, haul, unload, store valves and appurtenances without damaging the equipment. Correct any damage to the valves or appurtenances and obtain acceptance from the Consultant and Owner before completion of work.
- .3 Where flanged pipe and fittings are used, make joints with 3 mm Buna N or EPDM gaskets, depending on pipe temperature, and bolts and nuts conforming to ASTM A307 for Grade B steel machine bolts and nuts. Tighten nuts alternately to a uniform torque to achieve even distribution of pressure on joint gasket and to avoid unequal stresses in flanges. Provide flanged adapter or vic-flange couple where shown on the Drawings or where required to install valves or to permit future equipment removal for maintenance purposes.
 - .1 Provide 304 stainless steel machine nuts and bolts for joints involving stainless steel pipe or in areas where nuts and bolts will not be painted.

- .4 Orient valves for ease of operation. Obtain Consultant's approval of a particular orientation before completing joints.
- .5 Install specialties and other like items in accordance with the manufacturer's instructions. Provide small piping, or tubing, with fittings where required for their proper operation and servicing whether shown on the Drawings or not.
- .6 Install valves and appurtenances in strict accordance with the manufacturer's instructions and as directed by the Consultant.
- .7 Install grooved end valves in accordance with the manufacturer's written installation instructions. Grooved ends to be clean and free from indentations, projections. Verify gaskets are suitable for the intended service prior to installation. Gaskets to be molded and produced by the coupling manufacturer. Remove and replace any joints deemed improperly installed.
 - .1 Supply grooved end valves by the same manufacturer of the grooved fittings.

3.2 PIPE SUPPORT

- .1 Provide permanent support in accordance with Section 40 05 29.
- .2 Restrain valves and fittings independently of the piping system.
- .3 Coordinate support work. Confirm permanent supports are complete before any temporary support is removed.

3.3 IDENTIFICATION

- .1 Complete valve and equipment identification in accordance with Section 40 05 53.
- .2 Equipment to be identified includes all equipment specified herein.
- .3 Coordinate identification work.

3.4 PAINTING

- .1 Paint piping, valves, fittings, fasteners and supports, etc., as specified in Section 09 91 23.
- .2 Follow painting schedule as described in Section 09 91 23.
- .3 Coordinate painting and pipe identification work to avoid conflicts. Do not paint over valve name plates.

3.5 CLEANUP

- .1 Upon completion of testing, remove all test equipment and demonstrate proper operation of the installation to the Consultant.

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- .2 Clean and refurbish all equipment and fixtures and leave in operating condition in preparation for final acceptance.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 The work includes, but is not limited to the supply and installation of hangers and supports, equipment supports and all other appurtenances. Pipe supports and appurtenances to be in accordance with details shown on the Drawings and must be suitable for the purpose for which they are specified.

1.2 RELATED WORK

- .1 Concrete Reinforcing: Section 03 20 00
- .2 Cast-in-Place Concrete: Section 03 30 00
- .3 Miscellaneous Metals: Section 05 50 00
- .4 Painting: Section 09 91 23
- .5 Equipment: Divisions 40 through 46
- .6 Mechanical General Requirements: Section 40 05 10
- .7 Process Mechanical Identification: Section 40 05 53
- .8 Electrical: Division 26

1.3 REFERENCES

- .1 ANSI/ASME B31.3-2022, Process Piping.
- .2 ANSI/MSS-SP-58-2018, Pipe Hangers and Supports - Materials, Design and Manufacture.

1.4 INTENT

- .1 The intent of these specifications is to provide the works fully complete in every detail for the purpose designated. Furnish any apparatus, appliance, material or labour not herein specifically mentioned or included but requisite to the operation of the apparatus and equipment specified without additional expense to the Contract.

1.5 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00.
- .2 Submit shop drawings and product data for the following items:
 - .1 Upper attachment.
 - .2 Middle attachment.
 - .3 Pipe attachment.
 - .4 Riser clamps.
 - .5 Shields and saddles.
 - .6 Sway braces.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Where pipe hangers are detailed on the drawings, these details govern. For small piping or where supports are not detailed, this section governs.
- .2 Fabricate hangers and supports in accordance with ANSI/ASME B31.3 and MSS-SP58.
- .3 Support only from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members. Provide supplementary members suitable for use of the products specified in this section.
- .4 Unless otherwise specified, all metal supports shall be hot dip galvanized prior to installation.

2.2 PIPE HANGERS

- .1 Finishes:
 - .1 All pipe hangers and supports to be hot dipped galvanized after fabrication.
 - .2 All inserts and fasteners shall be galvanized or stainless steel.
 - .3 Provide other materials where indicated on the Drawings for areas of higher corrosion potential.
- .2 Upper attachment:
 - .1 Concrete:
 - .1 Inserts for cast-in-place concrete: galvanized steel wedge to MSS-SP58, type 18. ULC listed for pipe NPS 3/4 through NPS 8.
 - .1 Acceptable material:
 - .1 Anvil (Grinnell) fig. 281.
 - .2 Capitol.
 - .3 Carpenter and Paterson.
 - .2 Carbon steel plate with clevis, for surface mount: malleable iron socket and expansion case and bolt. Galvanized finish. Minimum two expansion cases and bolts for each hanger.
 - .1 Acceptable material:
 - .1 Anvil (Grinnell), Plate fig. 51, Socket Fig. 290, Expansion Case fig. 117.
 - .2 Capitol.
 - .3 Carpenter and Paterson.
 - .2 Steel beam (bottom flange):

- .1 Welded beam attachment to MSS SP-58.
 - .2 Acceptable Material: Anvil (Grinnell) Fig. 66.
- .3 Steel joist:
 - .1 Piping NPS 2 and under: galvanized steel washer plate with double locking nuts.
 - .1 Acceptable material:
 - .1 Anvil (Grinnell) fig. 60
 - .2 Myatt
 - .3 Carpenter and Paterson
 - .2 Piping NPS 2-1/2 and larger and all hot piping: steel washer plates with double locking nut, carbon steel clevis (galvanized) and malleable iron socket.
 - .1 Acceptable material:
 - .1 Anvil (Grinnell) washer plate, fig. 60, socket, fig. 290
 - .2 Myatt
 - .3 Carpenter and Paterson
- .3 Hanger rods:
 - .1 Threaded rod material to MSS SP58.
 - .2 Only subject hanger rods to tensile loading only.
 - .3 Provide linkages where lateral or axial movement of pipework is anticipated.
 - .4 Acceptable material:
 - .1 Anvil (Grinnell) Fig. 146, galvanized
 - .2 Myatt
 - .3 Carpenter and Paterson
- .4 Adjustable clevis:
 - .1 Material to MSS SP58.
 - .2 Clevis bolts with nipple spacer and vertical adjustment nuts above and below clevis.
 - .3 Acceptable material:
 - .1 Anvil (Grinnell) Fig. 260, galvanized
 - .2 Myatt
 - .3 Carpenter and Paterson

2.3 U-BOLTS

- .1 Material to MSS SP58.
 - .1 Acceptable material:
 - .1 Anvil (Grinnell) Fig. 137, galvanized
 - .2 Myatt
 - .3 Carpenter and Paterson

2.4 SUPPORT BRACKETS

- .1 Heavy welded steel brackets. Galvanized finish.
 - .1 Acceptable material:
 - .1 Anvil (Grinnell) Fig. 199
 - .2 Myatt
 - .3 Carpenter and Paterson

2.5 RISER CLAMPS

- .1 Steel or cast iron pipe: galvanized black carbon steel to MSS SP58, type 42. For riser clamps inside tanks, 304 stainless steel is required.
 - .1 Acceptable material:
 - .1 Anvil (Grinnell) Fig. 261 (Fig. 261SS for inside tanks).
 - .2 Myatt
 - .3 Carpenter and Paterson

2.6 FABRICATED SUPPORTS

- .1 Fabricate pipe and equipment supports from structural grade steel or stainless steel meeting requirements of Section 05 50 00. Fabricated steel supports to be hot-dip galvanized after fabrication.

2.7 CONCRETE PADS

- .1 Provide minimum 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 85 mm larger than equipment all around; chamfer pad edges.
- .2 Provide concrete pipe supports where indicated. Concrete to extend to springline of pipe; pipe supports to be 65 mm wider than pipe on both sides; chamfer edges.
- .3 Concrete: to Section 03 30 00.

2.8 SUPPLEMENTARY STRUCTURAL STEEL MEMBERS

- .1 As required by hanger location and design loads.

PART 3 - EXECUTION

3.1 GENERAL

- .1 Provide permanent support in accordance with this Section.
- .2 Restrain valves, fittings and equipment so that all thrusts are supported independent of the piping system.
- .3 Support hangers from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

- .4 Coordinate support work. Confirm permanent supports are complete before any temporary support is removed.
- .5 Provide concrete pipe supports in areas as shown on the Drawings. All support locations are not shown on the Drawings.
- .6 Provide all supports unless otherwise provided by equipment manufacturers, for equipment specified under Division 46.

3.2 SUPPORT SPACING

- .1 Install pipe supports such as hangers, concrete supports or support legs with maximum support spacing as follows:

Pipe Size	SS Stainless Steel (ID/Sch.)	Stainless Steel (Sch.)	PVC Schedule	Ductile Iron
Up to				
19 mm	1980 mm	1980 mm	1000 mm	
25 mm	2100 mm	2100 mm	1200 mm	
50 mm	3000 mm	3000 mm	1500 mm	1800 mm
75 mm	3400 mm	3600 mm	2000 mm	1980 mm
100 mm	4000 mm	4270 mm	2500 mm	2585 mm
150 mm	4300 mm	4500 mm	3000 mm	2743 mm
200 mm	4900 mm	5000 mm		3200 mm
250 mm	4900 mm	5000 mm		4000 mm
300 mm	5200 mm	5500 mm		4000 mm
350 mm	5500 mm			4000 mm
450 mm	5500 mm			4000 mm
500 mm	5500 mm			4000 mm
750 mm	5500 mm			4000 mm
900 mm	5500 mm			4000 mm

- .2 The above spacing does not apply where there are concentrated loads between supports, such as flanges, valves, specialities. These shall be supported separately. Provide additional pipe supports where pipes connect to equipment or machinery, so that no load shall be exerted from piping to such equipment or machinery.
- .3 Critical or specific piping support locations are shown on the drawings for clarity. Where locations of miscellaneous piping supports are not detailed or are not located by dimensions, locate supports in accordance with clause .1 above.

3.3 FINAL ADJUSTMENT OF HANGERS

- .1 Adjust hangers and supports to:
 - .1 Maintain rod in vertical position under operating conditions.
 - .2 Equalize loads.
- .2 Adjustable clevis:

- .1 Tighten hanger load nut securely to ensure proper hanger performance.
- .2 Tighten upper nut after adjustment.
- .3 C-clamps: Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps: Hammer jaw firmly against underside of beam.
- .5 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
- .6 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.4 CONCRETE EQUIPMENT PADS AND SUPPORTS

- .1 Confirm precise location and size of equipment bases prior to preparation of pads and supports.
- .2 Roughen concrete floor surface and install suitable Epoxy anchors or provide cast-in reinforcement.
- .3 Provide reinforcement and concrete as required and as shown on the Drawings.
- .4 Provide templates for cast-in anchor bolts to ensure accurate location.
- .5 Grind smooth rough areas of finished concrete. Fill any voids in concrete with suitable non-shrink grout.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies requirements for providing all labour, tools, equipment and materials to complete all identification for Divisions 40 through 46.

1.2 REFERENCES

- .1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
- .2 CAN/CGSB-24.3-92, Identification of Piping Systems.
- .3 Provide ULC and CSA registration plates as required by respective agency and inspection authority.

1.3 RELATED WORK

- .1 Process Mechanical General Requirements: Section 40 05 10

1.4 SAMPLES

- .1 Submit samples and lists of proposed wording for approval before engraving in accordance with Section 01 33 00.

PART 2 - PRODUCTS

2.1 MANUFACTURERS NAMEPLATES

- .1 Provide metal nameplate on each piece of equipment, mechanically fastened complete with raised or recessed letters.
- .2 Indicate size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and HP of motors.

2.2 SYSTEM NAMEPLATES AND PROCESS EQUIPMENT

- .1 Colour:
 - .1 White letters, black background except where required otherwise by applicable codes.
- .2 Construction:
 - .1 3 mm thick, lamicoid plastic, square corners, letters accurately aligned and machine engraved into core.
 - .2 Use size 17 mm x 100 mm for terminal cabinets and control panels with 5 mm letters.
 - .3 Use size 35 mm x 150 mm with 17 mm letters for process equipment as specified under Division 46.

2.3 VALVES AND CONTROLLERS

- .1 3 mm thick, lamicoid plastic, black face, white core, square corners with letters accurately aligned and machine engraved into core.
- .2 Hang identification plates with either stainless steel, chrome or brass chains. Chrome-plated or brass plated chains are not acceptable. Do not hang on valve handles.
- .3 Size as follows:
 - .1 18 mm x 82 mm: 9.5 mm letters (one line).
 - .2 18 mm x 82 mm: 5 mm letters (two lines).
- .4 Process gates and controllers to include:
 - .1 All process gates, mud flaps and controllers.

2.4 CONTROLS IDENTIFICATION

- .1 Identify all systems, equipment, components, controls and sensors.
- .2 Inscription to identify function and, where applicable fail-safe position.

PART 3 - EXECUTION

3.1 GENERAL

- .1 Do identification work in accordance with CAN/CGSB-24.3 except where specified otherwise.
- .2 Secure nameplates with aluminum or stainless steel pop-rivets or other mechanical fasteners. Do not use adhesives.
- .3 Provide identification only after painting has been completed.

3.2 LOCATION OF NAMEPLATES

- .1 In conspicuous location to facilitate easy reading from operating floor and to properly identify equipment and/or system.
- .2 Provide stand-offs for nameplates on hot surfaces and insulated surfaces.
- .3 Do not insulate or paint over plates.

3.3 VALVES AND CONTROLLERS

- .1 Secure tags with non-ferrous chains (as noted in Clause 2.4) or closed "S" hooks for valves and operating controllers.
- .2 Consecutively number valves in system or as indicated on the drawings.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 The work to be done under this Section consists of furnishing all materials, labour, tools and equipment and performing all operations necessary to complete water, wastewater and process piping and connection to equipment.

1.2 RELATED WORK

- .1 Painting: Section 09 91 23
- .2 Process Mechanical General Requirements: Section 40 05 10
- .3 Process pipe Hangers and Equipment Supports: Section 40 05 29
- .4 Process Mechanical Identification: Section 40 05 53

1.3 REFERENCES

- .1 ANSI/ASME B16.1-2020, Gray Iron Pipe Flanges And Flanged Fittings Classes 25, 125, And 250.
- .2 ANSI/ASME B16.5-2020, Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard.
- .3 ANSI/ASME B36.19M-2022, Stainless Steel Pipe.
- .4 ANSI/ASTM D2564-20 (R2024), Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
- .5 AWWA C104/A21.4-2022, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
- .6 AWWA C110/A21.10-2021, Ductile-Iron and Gray Iron Fittings.
- .7 AWWA C111/A21.11-2023, Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
- .8 AWWA C115/A21.15-2020, Flanged Ductile-Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges.
- .9 AWWA C151/A21.51-23, Ductile-Iron Pipe, Centrifugally Cast.
- .10 ANSI/AWWA C606-22, Grooved and Shouldered Joints.
- .11 ANSI/AWWA C900-2022, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4" Through 60".
- .12 ASME B31.3-2022, Process Piping.
- .13 ASTM A181/A181M-2023, Standard Specification for Carbon Steel Forgings for General Purpose Piping.
- .14 ASTM A240/A240M-24A, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications.

- .15 ASTM A304-20, Standard Specification for Carbon and Alloy Steel Bars Subject to End-Quench Hardenability Requirements.
- .16 ASTM A307-21, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
- .17 ASTM F3125/F3125-23, Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat-Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength.
- .18 ASTM A536-24, Standard Specification for Ductile-Iron Castings.
- .19 ASTM A774/A774M-2024, Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.
- .20 ASTM A778/A778M-24a, Standard Specification for Welded, Unannealed Austenitic Stainless Steel tubular Products.
- .21 CSA B137 Series:23, Thermoplastic Pressure Piping Standards Package.
- .22 CSA B149.1-2020, Natural Gas and Propane Installation Code.

1.4 INTENT

- .1 The intent of these specifications is to provide the works fully complete in every detail for the purpose designated. Furnish any apparatus, appliance, material or labour not herein specifically mentioned or included but requisite to the operation of the apparatus and equipment specified without additional expense to the Contract.
- .2 Pipes and appurtenances to be in accordance with details shown on the Drawings and be suitable for the purpose for which they are specified.

1.5 SHOP DRAWINGS

- .1 Provide shop drawings for:
 - .1 Pipe and fittings.
 - .2 Piping layouts (piping 75 mm and larger).
- .2 Detail piping arrangements so as to relate specifically to the type of equipment and fittings to be installed. Any changes in the layout of piping or equipment due to the acceptance of alternates must be submitted with dimensioned scale drawings for approval by the Consultant.

PART 2 - PRODUCTS

2.1 DUCTILE IRON (DI)

- .1 Pipe material: ductile iron to AWWA C151, special class 54, cement mortar lined (liquid) or unlined (air) to AWWA C104, maximum working pressure 2400 kPa. Unlined pipe for air service to be bare metal

inside.

- .2 Pipe joints: flanged to AWWA C115/A21.15 with 125 lb. flange dimensions to ANSI/ASME B16.1.
- .3 Fittings: ductile iron or grey iron to AWWA C110/A21.10 with 125 lbs. flange connections to ANSI/ASME B16.1 and cement mortar lined (liquid) or unlined (air) to AWWA C104/A21.4.
- .4 Gaskets: neoprene rubber or high temperature EPDM gasket (air).
- .5 Couplings: Victaulic style 31 (or equivalent) and Dresser style 138 where shown on the Drawings.
- .6 Coatings: pipe and fittings to be coated with manufacturer's standard coating.
- .7 Bolt assemblies must conform to ASTM A307 for Grade B steel machine bolts and nuts.
- .8 Grooved end couplings are acceptable alternates to flanged coupling.
 - .1 Groove end couplings to be ductile iron to ASTM A536, Victaulic Style 31 (or equivalent), complete with flush seal "M" gasket.
 - .2 Groove end fittings to have rigid radius in accordance with ANSI/AWWA C606. Fittings must conform to ANSI/AWWA C110/A21.10. Acceptable product: Victaulic, Shurjoint, or approved equivalent.
- .9 Provide additional grounding rings as required for magnetic flow meters specified under Division 26.

2.2 DUCTILE IRON (BELOW FLOOR AND BELOW GRADE INCLUDING ALL BURIED AIR PIPING)

- .1 Pipe material: ductile iron to AWWA C151/A21.51, special class 54, cement mortar lined (liquid) or unlined (air) to AWWA C104, maximum working pressure 2400 kPa.
 - .1 Mechanical, high strength heat treated cast-iron or alloy steel tee head bolts with hex nuts.
- .2 Joints to AWWA C111/A21.11 and as follows:
 - .1 Push-on joint with continuous rubber-moulded ring gasket or high temperature EPDM gasket (air).
 - .2 Fittings: ductile iron to AWWA C110, cement mortar-lined (liquid) or unlined (air) to AWWA C104.
- .3 Coatings: coat pipe and fittings with manufacturers standard coating.
- .4 Provide flange joints and fittings where indicated on the drawings. Joints and fittings as specified in Section 2.1 herein.
- .5 Provide joint restraints where noted on the drawings as specified in Section 33 34 00.

2.3 STAINLESS STEEL (SS)

- .1 Pipe material: stainless steel.

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- .2 Fabricate pipe from stainless steel to ASTM A240, Type 316L. Fabricate pipe and fittings for service up to 1000 kPa operating pressure and maximum 95°C, in accordance with ASTM A778/A778M and provide in the following nominal wall thicknesses:

- .1 Up to 750 mm (schedule 5S).
- .2 Greater than 750 mm (5 mm).

- .3 Fittings: elbows to 600 mm to be smooth flow I.D. design. Fittings to be made from 316L stainless steel conforming to ASTM A240/A240M and have wall thickness equal or greater than the pipe to meet working pressure requirements of the intended system.

- .4 Van-stone rings: 316L stainless steel conforming to ASTM A240/A240M, pressed type, with minimum 11 USS gauge thickness for pipe up to 300 mm. Use rolled vanstone rings over 300 mm with thickness as follows:

Ring Size	Thickness
350 mm	3.2 mm
400 to 750 mm	4.8 mm

- .5 Backing flanges: carbon steel, hot dipped galvanized to ANSI/ASME B16.1, class 125 as follows:

Pipe Diameter	Thickness
Up to 250 mm	16 mm
250 to 350 mm	25 mm
400 to 900 mm	38 mm

- .6 Joints: up to 50 mm may be screwed; over 50 mm to be flanged or groove end. Maintenance joints at convenient locations for pipe disassembly to be flanged, groove end or union (50 mm or less). Pipe joints may be welded unless a maintenance joint is required.

- .7 Gaskets: 3.2 mm thick Buna N composition or Neoprene suitably reinforced or EPDM for high-temperature air.

- .8 Minimize field welding of pipe.

- .9 Grooved and couplings are an acceptable alternative to the flanged couplings.

- .1 Grooved end couplings:

- .1 Rigid Style 50mm to 300mm, Victaulic Style #489 (or approved equivalent).
- .2 Rigid Style 350mm to 600mm, Victaulic Style #W89 AGS Coupling (or approved equivalent).
- .3 Flexible Style 50mm to 300mm, Victaulic Style #475 or 77S (or approved equivalent).

- .2 Pipe to be as specified except material must be Schedule 10.

- .3 Groove end fittings to be as specified except material must be Schedule 10.

.10 Press-fit couplings for 50mm size or smaller.

.11 Bolt assemblies shall be stainless steel.

2.4 PVC (RIGID)

.1 Pipe material: polyvinyl chloride (PVC) pressure pipe to AWWA C900 and certified to CSA B137.3.

.2 Size: as indicated.

.3 Class: IPS Schedule 80.

.4 Pipe joints: solvent cemented, cement to ANSI/ASTM D2564 except clauses 5.5 and 6.3.3.

.5 Fittings: PVC Class 150, solvent weld moulded fittings.

.6 Flanges: PVC in accordance with ASTM A181, Grade 1-150 lbs., with neoprene gaskets.

.7 Provide flanges and flange to socket transitions where applicable and as shown on the drawings, suitable to connect to valves and equipment. Fittings 50 mm and below are not necessarily shown on the drawings and may be threaded or solvent cemented.

2.5 FLEXIBLE COUPLING

.1 For use above grade or for air pipes below grade use stainless steel sleeve casing type flexible coupling complete with inner stainless steel bridge, stainless steel hex head fasteners and a full length EPDM seal sleeve.

.1 Acceptable product: Straub, ARPOL or approved equivalent.

.2 For other pipe use below grade see Sections 33 31 15.

PART 3 - EXECUTION

3.1 GENERAL

.1 Install pipe in accordance with ASME B31.3.

.2 Install piping in the locations indicated, and to the elevations and lines as shown on the Drawings.

.3 Install pipes entering concrete tanks, or structures in accordance with the method specified on the Drawings, and if no detail is referenced, with one (1) of the methods shown on the Drawings.

.4 Co-ordinate location and furnish embedded items for installation in poured-in-place concrete.

.5 Cut pipes where necessary to obtain the exact location of fittings or valves.

- .6 Run piping as directly as practical and make provisions for expansion, jarring, vibrations and settling.
- .7 In the installation of piping, do not cut girders, beams or other members of building in such a manner as to reduce strength of the girder, beam, or other member of the building below that required for the purpose for which it was intended.
- .8 Run pipes to avoid conflicts between pipes of different functions. Where conflicts between pipe locations occur, process pipe will have precedence over plumbing and heating pressure pipes, gravity pipes will have precedence over pressure pipes and large diameter pressure pipes will have precedence over smaller diameter pipes. Notify the Consultant of conflicts. The Consultant will provide the resolution.
- .9 Load, haul, and unload pipes and appurtenances without damage to the same. Dropping of pipe and appurtenances on the ground will not be permitted. Correct any damage to the pipe or appurtenances until the Work is accepted.
- .10 Do not install any pipe until the manufacturer's name and test certificate have been submitted to the Consultant for approval.
- .11 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.
- .12 Provide space for disassembly and removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, components.
- .13 Protect stainless steel pipe and accessories from contamination by dust, shavings, scratches and similar from mild steel work and grinding.
- .14 All tools, brushes, wire wheels, grinding wheels etc. used with stainless steel must be compatible with stainless steel.

3.2 JOINTING OF PIPE AND FITTINGS

- .1 Where pipe is to be connected to equipment, fit pipe so that neither pipe nor equipment is strained during the joining procedure.
- .2 Where flanged pipe and fittings are used, make joints with 3 mm Buna N or neoprene (or EPDM for high-temperature air) gaskets and bolts and nuts conforming to ASTM A307 for Grade B steel machine bolts and nuts. Tighten nuts alternately to a uniform torque to achieve even distribution of pressure on joint gasket and to avoid unequal stresses in flanges. Provide sleeve coupling, flanged adapter, victaulic coupling or vic-flange couple where shown on the Drawings or where required to install pipe or to permit future equipment or pipe removal for maintenance purposes.
 - .1 Provide 304 stainless steel machine nuts and bolts for joints involving stainless steel pipe or in areas where nuts and bolts

will not be painted.

- .3 Install grooved end product in accordance with the manufacturer's written installation instructions. Clean grooved ends until they are free from indentations, projections. Verify gaskets as suitable for the intended service prior to installation. Gaskets to be molded and produced by the coupling manufacturer. Have the grooved coupling manufacturer's factory trained representative provide on-site training for field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. Have the manufacturer's representative periodically visit the jobsite and review installation. Remove and replace any joints deemed improperly installed.
- .4 Screwed pipes to be NPT. Make joints with graphite and oil filler and adequate unions provided for ease of future uncoupling. Ream cut ends of pipe to remove burrs.
- .5 Install specialties and other like items in accordance with the manufacturer's instructions. Provide small piping, or tubing, with fittings where required for their proper operation and servicing whether shown on the Drawings or not.
- .6 Where pipe joints or fitting joints have failed under test or during operation, replace the entire joint with new material.

3.3 DRAINS

- .1 Install piping with grade in direction of flow except as 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 to be visible.
- .4 Drain valves: NPS 3/4 SS ball valves unless indicated otherwise, with hose end male thread, cap and chain.

3.4 AIR VENTS

- .1 Install air vents at high points in piping systems.
- .2 Install isolating valve at each automatic air valve.
- .3 Install drain piping to approved location and terminate where discharge is visible.
- .4 Manual air vents shall be NPS 25 mm (1") SS ball valves unless indicated otherwise.

3.5 PIPE SUPPORT

- .1 Provide permanent support in accordance with Section 40 05 29.
- .2 Restrain pipe and fittings so that all thrusts are supported independently of the piping system.

- .3 Coordinate support work. Confirm permanent supports are complete before any temporary support is removed.
- .4 Provide pipe pads on piping as required for permanent supports.

3.6 PIPE CLEANING, TESTING & START-UP

- .1 Flush and clean pipes upon completion and prior to testing.
- .2 Pressure test piping as specified in Section 40 05 10.
- .3 Remove air from system. Check air vents and drains for proper operation.
- .4 Bring system up to pressure or temperature slowly. Monitor pipe movement. Adjust pipe supports, hangers, expansion joints as required. Re-tighten bolts or replace gaskets where necessary.
- .5 Continue to monitor piping throughout start-up and plant commissioning.

3.7 PIPING FOR GAUGES AND INSTRUMENTS

- .1 Fabricate and install piping, accessories and valve assemblies for pressure sensing gauges and transducers as indicated on the drawings.
- .2 Provide isolation valves for all devices and run piping to prevent air pockets or sediment from accumulating in sensing lines.
- .3 Unless otherwise indicated, piping to be stainless steel schedule 10.
- .4 Coordinate locations for gauges and instruments on piping layouts.

3.8 IDENTIFICATION

- .1 Complete piping identification in accordance with Section 40 05 53.

3.9 PAINTING

- .1 Paint piping, valves, fittings, fasteners and supports, etc., as specified in Section 09 91 23.
- .2 Follow painting schedule as described in Section 09 91 23.
- .3 Coordinate painting and pipe identification work to avoid conflicts.

3.10 CLEANUP

- .1 Upon completion of testing, remove all test equipment and cap holes to satisfaction of the Consultant.
- .2 Clean and refurbish all equipment and fixtures and leave in operating condition in preparation for final acceptance.

3.11 WELDING OF STAINLESS STEEL PIPING

- .1 Do welding in accordance with ASME B31.3.

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- .2 Perform welding of pipe with qualified welders in accordance with approved procedures in manufacturer's plant. Field welds should be kept to a minimum.
- .3 Welding rod or wire to be of the same composition or superior to the pipe and fitting material.
- .4 Weld deposit at the seam to have a slight crown on both sides of the weld and no cracks or crevices shall be allowed.
- .5 Remove any excessive weld deposits, splatter or slag on the inside and outside of pipe. After grinding, polish with stainless steel brush to remove iron deposits.
- .6 Treat field welds with pickling paste, then scrub with a stainless steel brush or power wheel.
- .7 Identify each weld with welder's identification symbol prior to inspection.
- .8 Do not conceal welds until they have been inspected and approved.
- .9 Protect stainless steel pipe and accessories from contamination by dust, shavings, scratches and similar from mild steel work and grinding.
- .10 Tools, brushes, wire wheels, grinding wheels use with stainless steel must be compatible with stainless steel.

3.12 NON- DESTRUCTIVE WELD EXAMINATION

- .1 Visually examine all welds for compliance with applicable codes.
- .2 Random examination of welds using radiographic examination procedures as specified in ASME B31.3 will be performed by a qualified independent testing agency at the discretion of the Consultant.
- .3 All such costs of non-destructive radiographic weld examinations to be borne by the Owner.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 The work for this section includes furnishing all labour, materials, tools and equipment necessary to furnish and install weir gates, hand gates and operators as specified herein and as indicated on the drawings.

1.2 RELATED WORK

- .1 Cast-in Place Concrete: Section 03 30 00
- .2 Process Valves and Miscellaneous Equipment: Section 40 05 23
- .3 Electrical: Division 26

1.3 REFERENCES

- .1 ASME Section IX-2023, Boiler and Pressure Vessel Code - Section IX: Welding and Brazing Qualifications.
- .2 AWWA C561-21, Fabricated Stainless Steel Slide.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00. Indicate principal dimensions, general construction and materials used in the gate and lift mechanism.
- .2 Submit complete engineering design calculations in compliance with AWWA C561.

1.5 OPERATIONS AND MAINTENANCE MANUALS

- .1 Provide Maintenance data for inclusion in the Operations and Maintenance manuals, in accordance with Section 01 78 00.

1.6 GENERAL

- .1 Fabricate the equipment provided under this section assembled, erected, and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions and recommendations of the equipment manufacturer.
- .2 Provide supply gates and operators complete with all the necessary parts and accessories indicated on the drawings, specified or otherwise required for a complete, properly operating installation, and of the latest standard product of a manufacturer regularly engaged in the production of water control gates.
- .3 Specific gate data is listed in the Control Gate Schedule shown on the Process Drawings.

1.7 QUALITY ASSURANCE

- .1 Manufacturer to have experience in the production of substantially similar equipment, and show evidence of satisfactory operation in at least fifty (50) installations. The manufacturer's shop welds, welding procedures and welders must be qualified and certified in accordance with the requirement ASME, Section IX.
- .2 Have gates shop inspected for operation before shipping.

1.8 PERFORMANCE

- .1 Leakage: substantially watertight under the design head conditions. Leakage must not exceed 0.05 US gallon per minute per foot (0.01 l/s per meter) of seal periphery under the design seating head and 0.1 US gallon per minute per foot (0.02 l/s per meter) of seal periphery for the design unseating head.
- .2 Design Head: design gates to withstand seating and unseating heads of 3m (10 feet), unless otherwise indicated.
- .3 Seal Performance Test: have the gate's sealing system tested through a cycle test in an abrasive environment and provide proof that the leakage requirements are still obtained after 25,000 cycles with a minimum deterioration.

PART 2 - PRODUCTS

2.1 WEIR GATES

- .1 Provide weir gate in strict compliance with AWWA C561.
- .2 General Design: furnish and install each weir gate complete with wall thimble (where noted on the drawings), operating stem, lifting mechanism required, and other appurtenances or accessories as specified herein and as shown on the contract drawings, and be downward opening weir gates. Weir gates to consist of a frame and guides as a single casting with a removable slide. All components must maintain leakage at or below the rate specified herein. All gates must be suitable for wastewater application.
- .3 Frame: constructed of material as indicated on the Control Gate Schedule and welded to form a rigid one piece-frame. The frame must be of the integral flange back design suitable for bolting directly to the machined face of embedded channel-type flanges, as specified in the drawings. Fabricate the guide slot of UHMWPE (ultra high molecular weight polyethylene).
- .4 Slide: slide to consist of a flat plate reinforced with formed plates or structural members to limit its deflection to 1/720 of the gate's span under the design head.
- .5 Guides and Seals: made of UHMWPE and of such length as to retain and support at least two thirds (2/3) of the vertical height of the slide

in the fully open position.

- .6 Fabricate the bottom and side seals of UHMWPE of the self adjusting type. A continuous compression cord will provide contact between the UHMWPE guide and the gate in all positions. Sealing system to maintain efficient sealing in any position of the slide.
- .7 Seals to maintain the specified leakage rate in both seating and unseating conditions.
- .8 Self-Contained Gates: to have extended side stainless steel guides to allow the gate to fully open. The stainless steel yoke, attached to machined pads on the side guards, must have a machined bearing surface for the stem thrust collar or a mounting plate for the operator. The gate operating thrust will be transferred to the yoke by the stem thrust collar or operator. The threaded operating stem must be stainless steel and furnished as part of the weir gate assembly. Operation to be by handwheel, crank-type bench stand, or T-handle wrench as shown on the drawings or specified herein. In the T-handle arrangement, stem extension to be supported by at least one (1) stem guide or a floor box with integral guide embedded in the operating floor.

2.2 LIFT ASSEMBLIES (WEIR GATES)

- .1 Stem and Couplings: operating stem to be of material as shown on gate schedule, designed to transmit in compression at least two (2) times the rated output of the operating manual mechanism with a 40 lb (178 N) effort on the crank or handwheel.
 - .1 Stem to have a slenderness ratio (L/R) less than 200. The threaded portion of the stem to have machined cut threads of the Acme type.
- .2 For stems in more than one piece and with a diameter of 1-3/4 inches (45 mm) and larger, join the different sections together by solid couplings. The couplings must be grooved and keyed and be of greater strength than the stem. Pin stems with a diameter smaller than 1-3/4 inches (45 mm) to an extension tube.
- .3 Provide gates having a width equal to or greater than two (2) times their height with two (2) lifting mechanisms connected by a tandem shaft.
- .4 Stem Guides: fabricated from stainless steel. Equip guide with a UHMWPE bushing. Guides must be adjustable and spaced in accordance with the manufacturer's recommendation. The L/R ratio must not be greater than 200.
- .5 Stem Cover: provide rising stem gates with a clear polycarbonate stem cover. Stem cover to have a cap and condensation vents as well as a clear mylar position indicating tape. Apply tape in field to the stem cover after the gate has been installed and positioned.
- .6 Provide gearboxes when required to maintain the operating force below 40 lb. All bearings and gears must be totally enclosed in a weather

tight housing. Construct the pinion shaft of crank-operated mechanisms of stainless steel and supported by roller or needle bearings. Fit the operating shaft with a 2 inch square operating nut and removable crank. Fit the crank with a corrosion-resistant rotating handle. Maximum crank radius shall be 15 inches (380 mm) and the maximum handwheel diameter to be 24 inches (600 mm). Handwheel to be manually de-clutchable independent of the motor.

- .7 Yoke: provide the self-contained gates with a yoke made of structural members or formed plates. Maximum deflection to be 1/360 of the gate's span.
- .8 Electric actuators as specified in Section 40 05 23.

2.3 ACCEPTABLE MANUFACTURERS

- .1 Supply all control gates, accessories and appurtenances from a single manufacturer for complete compatibility. Sluice, weir and hand gates supplied under this section shall be the series class noted on the drawings as manufactured by Fontaine-Aquanox.
- .2 Other acceptable manufacturers: Orbinox, Whipps, Dynamic Water Controls or approved equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Handle and install gates and appurtenances in accordance with the written manufacturer's recommendations and as approved.
- .2 Install all materials and equipment in a neat, workmanlike manner.

3.2 FIELD TESTS

- .1 Following the completion of each gate installation, the gates must be operated through at least two (2) complete open/close/open cycles, to confirm proper assembly and operation.
- .2 Check gates for leakage (refer to the "Performance" section for approval criteria). Prior to placing gates into operation, perform hydrostatic tests with clean water where possible.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies the requirements for supplying, installing and testing heat tracing for process piping.

1.2 RELATED SECTIONS

- .1 Electrical General Requirements: Section 26 05 00
- .2 Process Mechanical Insulation: Section 40 42 00
- .3 Process Mechanical General Requirements: Section 40 05 10

1.3 DESIGN PARAMETERS

- .1 This pipe heat tracing application is freeze protection for exposed exterior WAS piping at the SBR tanks. Exact heating requirements to be based on the following design parameters:
 - .1 Operating temperature: 2°C.
 - .2 Pipe length per circuit: refer to electrical and process drawings.
 - .3 Pipe diameters: 100 mm diameter.
 - .4 Pipe material: stainless steel.
 - .5 Quantity and size of pipe stands, flanges, valves: refer to process drawings.
 - .6 Minimum ambient temperature: -32°C.
 - .7 Insulation type: see Section 40 42 00.
 - .8 Insulation thickness: see Section 40 42 00.
 - .9 Power supply: 120V, 1-phase.
 - .10 Minimum watts/m: 5 watts/m.
- .2 This pipe heat tracing application is freeze protection for interior DCW piping in the headworks room. Exact heating requirements to be based on the following design parameters:
 - .1 Operating temperature: 2°C.
 - .2 Pipe length per circuit: refer to electrical and process drawings.
 - .3 Pipe diameters: as noted on the Project Drawings.
 - .4 Pipe material: stainless steel.
 - .5 Quantity and size of pipe stands, flanges, valves: refer to process drawings.
 - .6 Minimum ambient temperature: -10°C.
 - .7 Insulation type: see Section 23 07 19.
 - .8 Insulation thickness: see Section 23 07 19.
 - .9 Power supply: 120V, 1-phase.
 - .10 Minimum watts/m: 5 watts/m.

1.4 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 00. Shop drawings are to be reviewed and approved by the Consultant before equipment can be ordered. Shop drawings are to include the following information:
 - .1 Heat trace equipment including technical data sheets.
 - .2 Schematic diagrams indicating electrical connections.

1.5 MAINTENANCE DATA

- .1 Submit maintenance data for complete assembly, including components in accordance with Section 01 78 00.

PART 2 - PRODUCTS

2.1 ELECTRIC HEAT TRACE CABLES

- .1 5 W/m (minimum), 208VAC, 1-phase.
- .2 Self-regulating electric tracer.
- .3 Tinned copper braided jacket.
- .4 Fluoropolymer tracer jacket.
- .5 Minimum #16AWG nickel plated copper bus wires, embedded in self-regulating polymeric core.
- .6 In hazardous areas, cables to be suitable for a Zone 1 or Zone 2 hazardous area classification as indicated (North American Groups C & D).
- .7 Acceptable manufacturers: Pentair Raychem (or approved equivalent).

2.2 HEAT TRACE POWER CONNECTION

- .1 Power connection kit for heat trace cable complete with mounting hardware.
- .2 Junction box complete with integral terminal blocks.
- .3 Enclosure: non-metallic, NEMA 4X rated in non-hazardous areas and copper free aluminum enclosure with polyester powder coating in hazardous areas.
- .4 Voltage rating: 240VAC minimum.
- .5 Pipe (above insulation) or wall mounted to suit application.
- .6 In hazardous areas, equipment to be suitable for Zone 1 or Zone 2 hazardous classification as indicated (North American Gas Groups C&D).
- .7 Acceptable product:
 - .1 Non-hazardous areas: Pentair Raychem Cat. No. JBS-100A or approved equivalent.

- .2 Hazardous areas: Pentair Raychem HAK-JB3-100 junction box and HAK-C-100 connection kit.

2.3 HEAT TRACE END SEAL

- .1 Provide end seal kit for heat trace cable complete with mounting hardware.
- .2 Integral red LED indicator light (non-hazardous only).
- .3 Pipe mounted, suitable for insulation thickness.
- .4 Enclosure: non-metallic, NEMA 4X in non-hazardous areas and copper free aluminum enclosure with corrosion resistant polyester powder coating.
- .5 In hazardous areas, equipment to be suitable for a Zone 1 or Zone 2 hazardous classification as indicated (North American Gas Groups C&D).
- .6 Acceptable product:
 - .1 Non hazardous areas: Pentair Raychem Cat. No. E-100-L-A or approved equivalent.
 - .2 Hazardous areas: Pentair Raychem HAK-JB3-100 junction box and HAK-C-100 connection kit.

2.4 LABELS

- .1 Electric traced labels for identifying electrically traced pipelines.

PART 3 - EXECUTION

3.1 HEAT TRACE INSTALLATION

- .1 Install heat trace cable and associated components in accordance with the manufacturer's instructions.
- .2 Do not exceed the manufacturer's maximum heat trace circuit length (includes additional heat trace cable at pipe supports, valves and flanges).
- .3 Test and commission the heat trace cables in accordance with the manufacturer's instructions including but not limited to the following:
 - .1 Visually inspect the heating cables, control panel and power connection/end seal kits for damage.
 - .2 Megger the heating cables prior to and after installation. Verify the DC test voltage with the manufacturer. Confirm the insulation values are per manufacturer's requirements.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 The work of this Section consists of furnishing all materials, labour, tools and equipment and performing all operations necessary to complete insulation of process piping where indicated on the Drawings.

1.2 RELATED SECTIONS

- .1 Process Mechanical General Requirements: Section 40 05 10
- .2 Pipe Hangers and Equipment Supports: Section 40 05 29
- .3 Process Mechanical Piping, and Appurtenances: Section 40 20 00
- .4 Process Heat Tracing: Section 40 41 00

1.3 REFERENCES

- .1 ASTM C547-22a, Standard Specification for Mineral Fibre Pipe Insulation.
- .2 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .3 ASTM C335/C335M-23, Standard Test Method for Steady-State Heat Transfer Properties of Pipe Insulation.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with 01 33 00.
- .2 Submit for approval manufacturer's catalogue literature related to installation.

PART 2 - PRODUCTS

2.1 PIPE INSULATION

- .1 Application: for pipe sizes 25 mm and under: 25 mm insulation thickness, for pipe sizes 100 mm and under: 38 mm thick insulation, for pipe sizes 150 and over: 50 mm thick insulation.
- .2 Material:
 - .1 To ASTM C547, rigid mineral fiber sleeving for piping and CGSB 51-GP-52Ma, vapour barrier jacket and facing material.
 - .2 Acceptable material: Owens Corning SSL-II; Knauf ASJ; Manson Alley-K-APT; Manville Micro Lok-AP-T; Fattal Fat-lock ASJ; Schuller.
- .3 Thermal conductivity "k" must not exceed 0.035 watt/meter °k at 24°C mean temperature when tested in accordance with ASTM C335.

- .4 Exterior surface to be enclosed with preformed 0.76mm thick PVC (white) jacket complete with pre-formed elbows, sealant tape.
- .1 Acceptable material: Plasticor-Insulguard; Manville-Zeston.

2.2 REMOVABLE PRE-FABRICATED INSULATION AND ENCLOSURES

- .1 Use removable pre-fabricated insulation and enclosures for expansion joints, valves, and couplings.
- .2 Provide removable pre-fabricated insulation and enclosures designed to permit the movement of expansion joints and periodic removal and replacement without damage to adjacent insulation.
- .3 Insulation to be preformed, at a thickness to meet application requirements, to fit components. Enclosure to match adjacent pipe jacketing.
- .4 Acceptable Material: No Sweat Wraps or approved equal.

PART 3 - EXECUTION

3.1 APPLICATION

- .1 Apply material in accordance with the manufacturer's specifications by skilled trades people regularly engaged in this type of work.
- .2 Thoroughly clean all surfaces to be insulated. Where paint will be applied, the painted surface must be clean and dry.
- .3 All nameplates, code inspection plates or stampings must remain visible after the insulation has been applied. Bevel the surrounding insulation to suit.
- .4 All jacketing must overlap by at least 40 mm, longitudinally and peripherally. Position all exterior jacketing to shed water. Caulk joints where necessary to eliminate ingress of water.
- .5 Prior to the supplier proceeding with the insulation, have all hydrostatic testing completed and approved by the Consultant.

3.2 PIPE AND FITTINGS

- .1 Straight Pipe Runs:
 - .1 Use factory fabricated sections of insulation on all straight pipe runs. The ends must be firmly butted together and sealed.
- .2 Fittings:
 - .1 Fittings in general must be insulated either with pre-formed fitting covers or mitred segments, thickness of which is equal to that of the adjoining pipe insulation. Secure the segments with stainless steel banding. Firmly butt all ends together and seal.
- .3 Flanges:

- .1 Insulated with removable sections so that the flange bolts and nuts can be removed without damage to the insulation.

- .4 Valves:

- .1 Insulated with the mitred moulded sectional insulation or pre-formed coverings equivalent in thickness to the adjacent insulation. Taper the insulation on the valves at the top of the bonnet to expose the packing gland so that the gland bolts and nuts can be removed without damage to the insulation.

3.3 EQUIPMENT

- .1 Insulation:

- .1 All insulation must be grooved or mitred to fit the shape of the equipment and held in place using banding. Use weld pins and speed washers on equipment only if written consent has been given by the equipment Vendor. Use insulating cement to cover high points of all irregularities and trowelled smooth.

- .2 Jacketing: canvas cloth jacketing fabricated to the shape of the equipment.

3.4 INSTALLATION

- .1 Preformed insulation must be sectional.
- .2 Multi-layered insulation to have a staggered butt joint construction.
- .3 Insulation for vertical pipe over NPS 3 to have insulation supports welded or bolted directly to the pipe above the lowest pipe fitting. Thereafter, locate supports on 4.5 m centres.
- .4 Insulation for expansion joints shall be terminated in straight cut. Leave a void of 25 mm between terminations. Lightly pack this void with P3 flexible mineral insulation.
- .5 Seal exposed ends and termination points and finish with insulating cement.
- .6 Insulation on expansion joints and flexible hoses in piping to provide for adequate movement of expansion joints without damage to insulation or finishes.
- .7 Install insulation and finish to permit easy disassembly and replacement to flanges, valves and other fittings without damage to adjacent insulation and finishes.
- .8 Gouge insulation out where interferences prevent tight fit to pipe.
- .9 Provide guides, saddles and shields with a full thickness of insulation.
- .10 Trim saddles, supports, hangers, clamps and guides closely and seal with insulating cement.
- .11 Insulation, finishes and jackets must not be damaged by pipe movement.

3.5 FASTENINGS

- .1 Secure pipe insulation by tape at each end and the centre of each section, but not greater than 900 mm on centres.

3.6 HEAT TRACING

- .1 Coordinate insulation work with heat tracing specified in Section 40 41 00 - Process Heat Tracing.

END OF SECTION

Part 1 - GENERAL

1.1 WORK INCLUDED

- .1 This Section and its associated drawings specifies the requirements for the supply, calibration, installation, cabling, termination, testing and commissioning of the instrumentation and controls equipment.
- .2 The Instrumentation and Controls Scope of Work as described in this section and as shown on the drawings consists of, but is not limited to, the following:
 - .1 Supply, calibrate, store, install, cable, terminate, test and commission instrumentation and controls equipment as identified on the drawings, and as specified herein.
 - .2 Receive, store, mount, cable, terminate, test and commission instrumentation and controls associated with equipment as supplied under other Divisions including pre-selected equipment.
 - .3 Supply, install, test and commission PLC control panels and field termination junction boxes as indicated on the drawings and specified herein.
 - .4 Connect new PLC I/O identified on the drawings to the plant PLC control system.
 - .5 Install and terminate process equipment as indicated on the drawings and specified herein. Refer to Vendor issued shop drawings for installation and termination details.
 - .6 Assist the Owner's Control system integrator during testing and commissioning of the PLC application.
- .3 The drawings supplement this specification section in defining the Instrumentation & Controls scope of work required.
- .4 Determine the final instrumentation/ controls cabling requirements after equipment shop drawings have been approved, to meet the control requirements as indicated or implied by the Contract Documents. There was an effort to include for "spare" conductors on the drawings to help accommodate for any required cabling changes during construction. The Contractor is free to use these "spare" conductors as required.
- .5 Determine the instrumentation and controls equipment/cabling termination details (for all plant instrumentation and controls cabling) to reflect the equipment and panels actually supplied (after shop drawing approval) and match the intent as indicated or implied in the Contract Documents, to supply a complete and functioning plant. Document the above instrumentation and controls cabling termination details in the form of "As-built" termination detail drawings/loop drawings.

- .6 Prepare, document and provide a testing and commissioning plan for the Plant. Coordinate this plan with the Owner, the Consultant and the control system integrator.

1.2 RELATED WORK

- .1 Electrical General Requirements: Section 26 05 00.
- .2 Process Mechanical Piping and Appurtenances: Section 40 20 00.
- .3 Process Control System Equipment and Cabling: Section 26 91 00.

1.3 REFERENCES

- .1 Carry out the Work of this section in accordance with all applicable Federal, Provincial, Municipal and other laws/ordinances, and with the latest edition of the following standards which will be deemed to be and form part of this specification:
 - .1 American Society of Mechanical Engineers.
 - .2 Institute of Electrical and Electronic Engineers.
 - .3 American Society for Testing Materials.
 - .4 Manufacturers Standardization Society.
 - .5 Canadian Standards Association.
 - .6 Instrument Society of America.
 - .7 Canadian Electrical Code.
- .2 NSF 61-2023, Drinking Water System Components - Health Effects.
- .3 ASME/ANSI B16.5-2020, Pipe Flanges and Flanged Fittings: NPS 1/2 through 24.
- .4 EIA/TIA 568-Set-2020, Commercial Building Telecommunications Cable Standard: General Requirements.
- .5 EIA/TIA 569-2019, Commercial Building Standard for Telecommunications Pathways and Spaces.
- .6 CSA C22.1-24, Canadian Electrical Code Part 1.
- .7 ASTM A269/A269M-24, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- .8 In the event of a conflict between the above-mentioned standards, this specification, or the attached drawings, notify the Consultant, who will then advise on which standard is to be followed.
- .9 Carry out all Instrumentation and controls works (Instrumentation mounting, tubing, cabling, terminating, calibration, testing, and commissioning) by certified inter-provincial ticketed Instrument Tradesmen.

1.4 SUBMITTALS

- .1 Submit instrumentation and controls equipment shop drawings in accordance with 01 78 00. Have shop drawings reviewed and approved by

the Consultant prior to instrumentation and controls equipment purchase or use.

- .2 Instrumentation equipment shop drawings to include, but not be limited to, the following:
 - .1 Complete model number of each instrument being proposed, with model number breakdown codes.
 - .2 Identify applicable instrument/equipment tag numbers on every shop drawing.
 - .3 Equipment operational specifications.
 - .4 Equipment dimensions, weight, mounting details, and materials of construction.
 - .5 Equipment power requirements, air supply requirements, process signal type, etc.
 - .6 Electrical termination information specific to the device being purchased in this contract.
 - .7 Complete parts list with recommended inventory of spare parts.
 - .8 Frequency and method of calibration (if applicable).
 - .9 Manufacturer's installation recommendations/requirements.
 - .10 Any sizing calculations (if applicable).
- .3 Submit operations and maintenance manuals for all instrumentation and controls equipment in accordance with Section 01 78 00. Include information based on the following requirements:
 - .1 Operation and maintenance instructions to be sufficiently detailed with respect to design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, calibration, maintenance and repair of the supplied equipment.
 - .2 Include names and addresses of local suppliers for all items included in maintenance manuals.
 - .3 Include all instrumentation calibration sheets.
 - .4 Include "As-Built" shop drawings for control panels.

Part 2 - PRODUCT

2.1 GENERAL INSTRUMENTATION

- .1 Instrumentation and controls equipment must be of a proven design for each application and designed, manufactured, inspected, and tested to comply with the applicable regulations, codes, and standards.
- .2 Select instrumentation and controls equipment to suit the process and environmental requirements for each application as described or implied in this specification and the drawings.

- .3 Construct all instrumentation and controls equipment to operate safely and reliably under all operating conditions without undue wear, vibration, heat, noise, or other operating problems. Parts subject to wear, corrosion, or other deterioration, or requiring adjustment, inspection or repair, must be accessible and capable of convenient field maintenance.
- .4 Provide proposed instrumentation and controls equipment that is certified by an agency (preferably CSA) recognized by the applicable provincial Electrical Inspection Department. Where there is no alternative to supplying equipment that is not appropriately certified, special approval from the applicable provincial Electrical Inspection Department will be required. Bear all costs associated with obtaining such approval at no additional cost to the Contract.
- .5 Instrumentation and controls equipment located in process areas and outdoors must have a minimum enclosure rating of NEMA 4X. Those located in other areas shall have a minimum enclosure rating of NEMA 12.
- .6 Instrumentation and control equipment installed in hazardous areas must be rated to match its corresponding hazardous area classification and gas types.
- .7 Equipment requiring intrinsically safe wiring to meet a hazardous area classification must be complete with all recommended intrinsically safe barriers, etc., as required to meet the applicable hazardous classification.
- .8 The minimum instrumentation and controls equipment electrical connection size will be 13 mm (1/2") NPT.
- .9 Instrumentation and controls equipment requiring a power supply will be 120VAC, 60 Hz unless otherwise noted.
- .10 All "wired" instrumentation and controls equipment must have provision for externally grounding the instrument housing/enclosure.
- .11 Provide instrumentation and controls equipment complete with a securely fastened manufacturer's nameplate indicating instrument model, serial number, calibrated range, etc., as required for ordering a replacement item.
- .12 Mount any instruments not directly coupled to a process connection on manufactured instrument stands (2 NPS pipe construction with sealed ends, stainless steel) or on a nearby wall. All mounting hardware for mounting instrument stands and instruments must be 316 SS. Mount instruments as per manufacturer's recommendations.
- .13 Process impulse line tubing from a process connection to an instrument to be a minimum 13mm x 1.2 mm, 316 SS seamless and annealed to ASTM A 269.
- .14 Instrument air tubing lines must be a minimum of 10mm x 0.9mm, 316 SS seamless and annealed.

- .15 Use 316 SS twin-ferrule design tube fitting on all instrument impulse and air supply tubing. All threaded fittings to be tapered NPT. Accomplish sealing of threaded connections by using high quality PTFE tape. Acceptable tube fitting manufacturer's: Swagelok, Parker, or approved alternate.
- .16 Supply instrument tags for all plant instruments indicated on the drawings. Affix a stainless steel tag indicating the instrument tag number to the instrument using stainless steel wire. The tag must be approximately 50 mm x 25 mm and stamped in a legible manner, with a minimum 10 mm character size, and in the same format as shown on the drawings.

2.2 PRESSURE INSTRUMENTS

- .1 Select the range of pressure measuring instruments so that full scale reading will equal 200% of maximum operating pressure, or 120% of system design pressure, whichever is greater.
- .2 Mount pressure gauges (complete with isolation valves) to the process connections and oriented for easy viewing by an operator. In areas of excessive vibration or inaccessibility, remote mount the gauges on an instrument stand (keeping process impulse line lengths to a minimum). General pressure gauge design and performance requirements will be as follows:
 - .1 115 mm dial, glycerine filled, black thermoplastic or 304SS case construction, safety glass, with rear blow-out disc.
 - .2 316SS wetted parts and movement (unless specified otherwise).
 - .3 White dial with black scale and balanced pointer, dual scale (kPag and psig).
 - .4 13 mm NPT bottom process connection.
 - .5 Minimum accuracy of $\pm 1.0\%$ of full scale (ASME B40.1, Grade 1A) or better.
 - .6 Capable of 150% overpressure for short durations without incurring damage.
 - .7 Acceptable manufacturers: WIKA, Ametek, Ashcroft, US Gauge, Winters.
- .3 Mount pressure and differential pressure transmitters (complete with isolation manifolds) directly to the process connections where practical. In areas of excessive vibration or inaccessibility, Mount transmitters on 2 NPS instrument stands and orient for easy viewing and adjustment by an operator. General pressure transmitter design and performance requirements shall be as follows:
 - .1 Pressure Range: as indicated on the drawings.
 - .2 2-wire, "smart" microprocessor based electronics with HART, loop powered (24VDC), with a 4-20mA output signal.
 - .3 Minimum accuracy of 0.5% full range.

- .4 Capable of local and remote calibration/setup, with continuous self-diagnostics.
 - .5 Output signal to be immune from EM and RF interference.
 - .6 All wetted parts and gaskets to be of a material suited for the specified process conditions (316SS as a minimum).
 - .7 Complete with programmable indicator to provide a digital readout in engineering units.
 - .8 Complete with all mounting hardware (316SS) for 2 NPS instrument stand mounting if remote mounted.
 - .9 Capable of 150% overpressure without incurring damage or requiring recalibration.
 - .10 Differential pressure transmitters must be capable of withstanding the full pressure rating on either side of the pressure element with the other side vented to atmosphere without damage.
 - .11 Differential pressure transmitters shall have a selectable linear or square root output.
 - .12 Acceptable manufacturers: ABB, Foxboro, Honeywell, Rosemount, Siemens, Endress and Hauser. Inclusion on this list does not exempt the requirement that any proposed model must be compliant with the above equipment specifications.
- .4 Provide pressure measuring instruments complete with isolation manifolds. Also provide pressure instruments complete with two-valve block and bleed manifolds (either mounted directly on the process connection or on an instrument stand, depending on instrument mounting), and differential pressure instruments (except where diaphragm seals are fitted) with 5-valve manifolds. Isolation manifolds to be of 316SS construction, with seat type, seals, packing materials, etc. selected to meet the specified process conditions for each application. Manifolds to have at least a five-year warranty on stem seal leakage with no maintenance requirements. Process connections on manifolds to be 13mm NPT. Instrument connections on manifolds can be either 13mm FNPT or flanged, depending on the application. Provide isolation manifolds mounted directly to insulated piping/equipment complete with the required lagging extension.
- .1 Acceptable manufacturer's: PGI International, Parker Hannifin Corporation, Century Valve, Anderson Greenwood, or approved equivalent.

2.3 LEVEL INSTRUMENTS

- .1 Level switch design and performance requirements to be as follows:
 - .1 Top mounted suspendable float type switch.
 - .2 Unit complete with integral cable, length to suit application as determined by the Contractor.

- .3 One (1) SPDT contact, rated for at least 5 amps @ 120VAC (continuous use).
- .4 Suitable for immersion in liquid type indicated.
- .5 Include intrinsically safe barrier where level switch is installed in a hazardous location.
- .6 Flygt, Conery.
- .2 Submersible level sensor for the existing Sludge Tank:
 - .1 Stainless steel housing, suitable for sanitary sewage, complete with 4-20 mA output. Install as per the Project Drawings and the manufacturer's written instructions.
 - .2 Sensors: suitable for Zone 1 hazardous area. Provide intrinsically safe barrier.
 - .3 Sensor range to be suitable for the wet well depth. Shielded cable to be of sufficient length and include a vent tube and aneroid bellows. Locate bellows in the junction box.
 - .4 Provide sensor complete with surge protection.
 - .5 Acceptable manufacturers: KPSI, Ametek, or approved equivalent.
- .3 Float hanger for submersible sensors:
 - .1 Stainless steel float hanger complete with squeeze connectors and supports to hang access cable and cable grips.
 - .2 Acceptable product: Flygt or approved equivalent.

2.4 ANALYTICAL INSTRUMENTS

- .1 Instrument controllers/transmitters must meet the following design and performance requirements:
 - .1 Microprocessor based multi-variable analyzer, with menu driven self-contained LCD/keypad entry for equipment setup, calibration and troubleshooting.
 - .2 Able to accept at least two (2) analytical sensors, with simple "plug and play" setup for the different sensor types. Sensor types to include, but not be limited to pH, and turbidity.
 - .3 120VAC, 60Hz power supply.
 - .4 Graphic LCD display with LED back lighting and keypad with easy menu driven software for instrument setup, calibration and troubleshooting.
 - .5 Complete with two (2) fully configurable 4-20mA analog outputs and two (2) dry form 'C' alarm contacts.
 - .6 All user settings to be retained indefinitely in non-volatile memory (EPROM).
 - .7 Data storage and transfer via SD card.
 - .8 Enclosure rating of NEMA 4X. Where unit is installed outdoors, include weather and sun shield (or equivalent).

- .9 Minimum two (2) year warranty.
- .10 Acceptable manufacturer: HACH SC200, YSI, or approved equivalent.
- .2 pH sensors must meet the following design and performance requirements:
 - .1 Compatible with the analytical controller/transmitter selected (plug and play connection).
 - .2 Differential electrode measurement technique with three (3) electrodes for increased accuracy and elimination of sensor electronics with built-in preamplifier.
 - .3 Totally encapsulated sensor electronics with built-in preamplifier.
 - .4 Measuring range of 2 to 14 pH.
 - .5 Sensitivity of ± 0.01 pH.
 - .6 Built-in temperature element for automatic temperature compensation.
 - .7 One inch MNPT process connection.
 - .8 Sensor body to be constructed complete with salt bridge of matching material, glass process electrodes, titanium ground electrodes and viton O-ring seals.
 - .9 Complete with integral sensor cable for connection to the analytical controller/transmitter and required mounting hardware.
 - .10 Probe signal cable must be capable of separation from probe without calibration loss.
 - .11 Probe must be suitable for immersion in wastewater applications.
 - .12 Operating temperature range: -5°C to 50°C .
 - .13 Acceptable manufacturers: Hach, YSI, or approved equivalent.
- .3 Gas sensor/transmitter assembly must meet the following design and performance requirements:
 - .1 Gas monitor to continuously measure the identified gases as follows:
 - .1 Methane (0-100% LEL). Sensing element to be catalytic.
 - .2 Hydrogen sulphide gas (0-50 ppm). Sensing to be electromechanical.
 - .2 Operating temperature range: -20 to 50°C .
 - .3 Accuracy: maximum $\pm 5\%$.
 - .4 Stability: maximum $\pm 5\%$ full scale/year.
 - .5 Gas sensor to be remote from the transmitter where sensor is located in an inaccessible location.
 - .6 Input power: 24 VDC.
 - .7 Gas monitor to be factory calibrated and ready for use.
 - .8 Gas monitor to contain no potentiometers or jumpers.
 - .9 Gas monitor output signal to be 4 to 20 mA.

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- .10 Gas monitor must be complete with dry output relay contacts, rated minimum 5A at 120 VAC (one (1) for instrument fault and one (1) for gas alarm). Gas alarm and fault contacts to be failsafe, open on alarm. Alarms to be reset via external reset pushbutton and via reset button on the instrument.
- .11 Provide gas monitor suitable for installation in a Zone 1 hazardous location.
- .12 Gas monitor to be complete with and LCD display to indicate gas concentration and status/alarms.
- .13 Gas monitor to include all required mounting hardware and interconnecting cables to validate warranty.
- .14 Sensing elements to have a minimum two (2) year operating life.
- .15 Acceptable materials: MSA Ultima XIR gas monitor or approved equivalent. Include wireless programmer and gas calibration kit.
- .4 Total suspended solids sensor (TSS) to meet the following design and performance requirements:
 - .1 Compatible with the analytical controller/ transmitter selected (plug and play connection).
 - .2 Of the continuous reading on-line dual beam optics and back scatter detector measurement principle type.
 - .3 Provide sensor with complete self cleaning device to prevent erroneous values and maintenance problems caused by biological activity.
 - .4 Sensor to be factory calibrated and require no calibration prior to use.
 - .5 Sensor to be corrosion resistant and fully submersible.
 - .6 Measurement range: 0.001 mg/L to 50 g/L SS.
 - .7 Accuracy: less than 5% of measured volume.
 - .8 Repeatability: <3%.
 - .9 Complete with integral sensor cable and extension cable for connection to the analytical controller/transmitter.
 - .10 Provide miscellaneous metal brackets and/or hardware for wall mounted (backboard) installation as required.
 - .11 Operating temperature range: 0 degrees C to 50 degrees C.
 - .12 Acceptable manufacturer: HACH, YSI, or approved alternate.

2.5 INSTRUMENTATION CABLING/WIRING

- .1 All instrumentation and controls cabling must be rated for the hazardous area classification that each cable is run through.
- .2 For 24VDC or 120VAC instrumentation digital control wiring in conduits, use multi-conductor industrial control cable, #14 gauge copper conductors, 600V, TEW or RW90 with overall PVC jacket.

- .3 For 24VDC instrumentation cables routed in free air or direct buried, use single or multi-paired (or triad), ACIC armoured cables, individually and overall shielded, #16 gauge copper conductors, 600V, suitable for direct buried where required.
- .4 For 24 VDC instrumentation cables routed in conduit use single or multi-paired (or triad) CIC cables, individually and overall shielded, #16 gauge copper conductors, 600V.
- .5 For 24VDC or 120VAC instrumentation digital control wiring routed in free air or direct buried, use multi-conductor TECK cable, XLPE insulation, PVC inner/outer jacket, interlocked armour, #14 gauge copper conductors, 600V, suitable for direct burial where required.
- .6 Supply RS232, RS485 and Cat 6A ethernet cables, CAT 6A patch cords, connectors and adaptors, etc., as required to make a complete functional communications networks as indicated on the Drawings. Patch cord lengths must be confirmed on site.
- .7 Handle, install and support all cables in accordance with manufacturer's guidelines.
- .8 Ground shields for 24VDC twisted pair and triad Instrumentation signal cables on the end supplying the loop power, and tape on the opposite end. All shield grounds to be continuous through any intermediate field junction boxes (individually terminated and isolated).
- .9 Ground 120VAC multi-conductor Instrumentation digital control cable grounds on both ends. When run through intermediate junction boxes, bring 120VAC cable grounds to a common junction box ground bar, and connect to earth ground via a junction box ground.
- .10 Ground all Field Control Panels and Junction Boxes to building ground using a #6 green copper grounding cable.
- .11 In wet/damp areas and outdoors, all cables and conduits to enter field instruments, control panels and junction boxes from the bottom only.
- .12 Install unarmoured 24VDC instrumentation signal wiring and instrumentation digital control wiring in conduits.
- .13 Inside all Instruments, Control Panels, and Termination Junction Boxes, identify all cable conductors using wire markers (Weidmuller PT transparent sleeves with TM-I labels, or approved alternate). Mark conductors with their corresponding instrument tag number and Instrument terminal block number (ex: HS3004/C, where HS3004 is the Instrument tag number, and "C" is the Instrument terminal block number the conductor is terminated on). This "conductor identifier" must remain the same through any intermediate junction boxes, etc., all the way back to its corresponding PLC/control cabinet.
- .14 Clearly identify cables at both ends with its cable number using flexible PVC slip-on wire markers on a carrier strip and fastened to the cable using chemical resistant ty-raps (Electrovert K-Markers, or approved equivalent). Label at all cable terminal points and on the armour at the point of junction box/instrument entry.

- .15 Use watertight aluminum TECK connectors with integral seal rings to gland TECK cables. Standard of acceptance to be Thomas & Betts Star TECK series, Crouse Hinds Terminator series, or approved alternate. Glands to be rated for the specified hazardous area classification.
- .16 Leave conductors being terminated within a junction box/control panel long enough to be removed from its assigned terminal block and reassigned to anywhere within the junction box/control panel.
- .17 Coil together spare conductors of a cable inside its associated junction box/control panel and clearly identified with the cable number (ex: Spare-JB3000), unless indicated to be terminated on spare terminals. Leave adequate length to run the spare conductors anywhere within the junction box/control panel. Terminate spare conductors where identified.
- .18 Fit stranded conductors with vinyl insulated wire end ferrules when terminating to terminal blocks, and vinyl insulated locking fork terminal connectors when terminating to screw terminals.
- .19 For instruments with integral wire leads that are unarmoured (for example: ultrasonic transducers), install an intermediate field junction box (rated for its specified area classification) close to the instrument as practical, complete with required terminal blocks. Protect any exposed "non-armoured" wire leads using liquid-tight flexible metallic conduit. Where sensor leads are long enough to reach the transmitter, provide conduit for routing "non-armoured" sensor wiring between sensor and transmitter.

2.6 MISCELLANEOUS

- .1 Pushbuttons to be 30.5mm heavy duty, watertight/oiltight, flush, momentary contact (unless indicated otherwise on drawings), NEMA 12 (dry areas) and 4X (wet/damp areas including below grade locations) and rated for the applicable hazardous area classification (minimum NEMA 4X), complete with one (1) normally closed and one (1) normally open contact (start, stop, etc.). Emergency stop pushbuttons to have a large red mushroom head, push/twist to release, with at least two (2) NC contacts (refer to control schematic drawings for the required number of switch contacts). Acceptable manufacturers: Allen Bradley 800T and 800H type, or approved equivalent.
- .2 Selector switches to be 30.5mm heavy duty, watertight/oiltight, NEMA 12 (dry areas) and 4X (wet/damp areas including below grade locations) and rated for the applicable hazardous area classification (minimum NEMA 4X), front-mounted, two or three position (refer to control schematic drawings), either maintained or spring returned contacts (refer to control schematic drawings), and complete with at least one (1) normally open and one (1) normally closed contact per position, or as required. Acceptable manufacturers: Allen Bradley 800T and 800H type, or approved equivalent.
- .3 Indicating lights to be 30.5mm heavy duty, watertight/oiltight, NEMA 12 (dry areas) and 4X (wet/damp areas including below grade locations)

and rated for the applicable hazardous area classification (minimum NEMA 4X), 120 VAC, LED and coloured as per the drawings. Acceptable manufacturers: Allen Bradley 800T and 800H Type, or approved equivalent.

- .4 Enclosure: NEMA Type 12 (dry areas) and 4X (wet/damp including below grade locations) and rated for the applicable hazardous area classification, surface mounted.
- .5 Field-mounted speed potentiometers to be heavy duty, watertight/oiltight, NEMA 12 (dry areas) and NEMA 4X (wet/damp areas including below grade locations) front mounted, compatible with its associated VFD manufacturer, and rated for the applicable hazardous area classification (minimum NEMA 4X).
- .6 Indoor and outdoor indicating/alarm lights to be 120 VAC, CSA certified, LED lamp type, rated for the applicable hazardous area classification (minimum NEMA 4X), corrosion resistant, with guard over glass globe, have two 19 mm NPT cable entries, available in multiple colours, steady or flashing or strobe, easy lamp replacement, suitable for wall or pendant mounting, etc., as indicated on the drawings. Acceptable manufacturers: any that meet the above specifications. Suggested manufacturers: Federal Signal, Edwards, Crouse-Hinds, etc. Inclusion in this list does not exempt the requirement that any proposed model must be compliant with the equipment specifications.
- .7 Warning horns to be explosion-proof, at least 100 dBA at 3m, 120 VAC, CSA certified, corrosion resistant, have two 19 mm NPT cable entries, and suitable for surface mounting (wall or ceiling). Acceptable manufacturers: any that meet the above specifications. Suggested manufacturers: Federal Signal, etc. Inclusion in this list does not exempt the requirement that any proposed model must be compliant with the equipment specifications.
- .8 Smoke and heat detectors:
 - .1 Smoke detectors to be ceiling mounted, ionization type.
 - .2 Heat detectors to be ceiling mounted, combination rate-of-rise and fixed temperature type (58 degrees Celsius).
 - .3 In hazardous areas, smoke/heat detectors must also be rated for Class 1, Zone 1 or 2 areas as noted on the Project Drawings.
 - .4 Detectors to be 120 VAC type with isolated normally closed contact (rated 5A, 120V) for alarm to PLC.
 - .5 Wire detectors to PLC as indicated on the Project Drawings.
 - .6 Acceptable products:
 - .1 Smoke detectors (non-hazardous): Edwards #ESA5011KA, or approved equivalent.
 - .2 Heat detectors (non-hazardous, dry areas): Edwards CF135-2 Series, or approved equivalent.
 - .3 Heat detectors (non-hazardous damp or wet areas): Edwards CF135MP, or approved equivalent.

- .4 Heat detectors (hazardous, Class 1, Groups C and D): GE #CR135EWT, or approved equivalent.

Part 3 - EXECUTION

3.1 INSTALLATION

- .1 Execute Work in a professional manner so that it presents a neat appearance when completed.
- .2 Install all instrumentation and control equipment being supplied by, or issued to, where and as indicated on the drawings, and in accordance with the manufacturer's instructions. Strictly adhere to the manufacturer's installation instructions.
- .3 The Drawings indicate the extent and general arrangement of the instrumentation and controls equipment. Exact installation locations, distances and levels will be governed by actual field conditions and is subject to approval by the Consultant.
- .4 If any departures from the original intent of the Drawings and/or the Specifications are deemed necessary by the Contractor, submit details of such departures with Drawings if necessary, together with reasons for the departure to the Consultant as soon as practical for approval. No such departure will be made without prior written consent of the Consultant.
- .5 Unless otherwise specified, fabricate and erect all support brackets or mounting brackets required. Purchase with all necessary mounting brackets from the instrument vendor.
- .6 Locate instruments to minimize the possibility of damage from high temperature, vibration or humidity, and not to interfere with, or be damaged by, maintenance of other equipment. Instrument installation must also provide for easy accessibility for operation, inspection, and maintenance purposes.
- .7 Only use qualified riggers and handlers of the appropriate trades with suitable lifting gear to move field junction boxes, instruments, etc., and take all necessary precautions to avoid distortion or other damage.
- .8 Store materials in a manner as to maintain the preservation of their quality and fitness for the work, and to facilitate inspection by the Consultant/Owner at any time. Keep instruments and equipment clean and protect against damage, dirt, and moisture.
- .9 Protect installed equipment against water or dirt until it is commissioned. Use clear plastic sheeting of not less than 8-mil thickness for this purpose.
- .10 Keep all enclosures, rooms, trenches, etc., free from construction debris, materials, dirt and water at all times during construction.

- .11 Coordinate equipment delivery, storage and installation requirements with all of the vendors.
- .12 Repair/replace equipment damaged during construction, or otherwise deemed defective or non-compliant with this specification, at no additional expense to the Contract. These expenses include all material, labour and other fees.
- .13 Connect the PLC I/O in the specified PLC control panel.

3.2 TESTING AND CALIBRATION EQUIPMENT

- .1 Calibrate test and calibration equipment to an industry recognized standard and affix proof of calibration along with date of next calibration on the equipment.

3.3 TESTING AND CHECK-OUT

- .1 Conduct all tests necessary to confirm the material and workmanship are of the required degree of excellence, and that the supplied equipment will perform as specified and guaranteed (verify wiring, wire continuity checks, tubing leak tests, etc.).
- .2 Calibrate instruments before installation. Secure the services of qualified personnel (manufacturer's representative) and equipment to conduct field instrument calibration.
- .3 Document the results of all tests/calibrations and make available to the Consultant. Include in the project Operations and Maintenance manual as specified in Section 01 78 00.
- .4 Coordinate with suppliers of other Divisions for their required testing and commissioning procedures.

3.4 COMMISSIONING AND START-UP

- .1 Arrange and pay for the services of a manufacturer's factory service representative to supervise the installation, start-up, check, adjust, balance and calibrate all supplied instruments to the satisfaction of the Consultant. Provide these services for such period, and for as many visits as necessary to put the installation in working order, and to ensure that the operating personnel are conversant with all aspects of equipment and operation.
- .2 Submit a written report signed by the manufacturer's representative to the Consultant stating the following:
 - .1 That a satisfactory installation of the equipment has been performed outlining modifications that have been made as a result of testing/ commissioning the equipment; and
 - .2 The maintenance instructions for the equipment have been presented to the Consultant and Owner.
- .3 After the instrumentation and controls equipment and vendor packages have been installed, calibrated, checked out and tested by the

Contractor, the plant PLC programming and HMI SCADA system testing/commissioning can begin. Coordinate this Work with the control system integrator. This will involve a point-by-point check for all PLC and HMI system-monitored field I/O points, logic checks, communication checks, complete plant controls integration and equipment start-ups.

- .4 Provide technical personnel during this phase of the work for instrument recalibration, re-wiring, reprogramming, etc., as required until the integrated plant control system is deemed ready for plant operation.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section and its associated drawings specify the requirements for the design, fabrication, supply, installation, testing, and commissioning of the process control system equipment, including but not limited to PLCs, relay control panels, termination junction boxes, and remote I/O panels.
- .2 Arrange and pay for a Control System Integrator to complete the control system integration HMI development and remote monitoring. This work includes, but is not necessarily limited to, the following:
 - .1 Design, supply, fabricate, install, test and commission the new PLC control panel (PLC-01) and gas detection relay control panel (LCP-600) and mechanical equipment at the Sites.
 - .2 Test and commission the PLC Control System and Gas detection control panel to monitor, control and alarm process and mechanical equipment at the Site.
 - .3 Develop, program, test and commission the graphic HMI screens to monitor, control and alarm process and mechanical at the Sites.
 - .4 Support owner's system integrator to program, test and commission PLC-01 and vendor supplied packages specified in Division 40.
- .3 The electrical drawings supplement this specification section in defining the scope of Work required.
- .4 The following drawings supplement this specification section in defining the control panel and termination junction box scope of work required:
 - .1 Control System Block Diagram: identifies the new components of the plant control system architecture, number of PLC panels, control system hardware and the control system interconnecting cabling required.
 - .2 Instrumentation Cabling Diagrams: shows the number of cables entering each control panel or termination junction box. Confirm each panel/junction box is large enough to accommodate the required number of glanded cables/conduits.
 - .3 PLC I/O Lists: lists all of the hardwired I/O required for the PLC control panels.
 - .4 Electrical Control Schematic Drawings: use to assist in the design of relay control panels, indicating the number of relays, pushbuttons, switches, field I/O, etc., required for each panel.
 - .5 Control Panel and Field Junction Box Layout details: provide basic control panel and field box layouts, required equipment, terminal block arrangements, termination details etc.

1.2 RELATED SECTIONS

- .1 Section 26 33 53 - Uninterruptible Power Supply
- .2 Section 40 90 00 - Primary Process Instrumentation Devices.
- .3 Section 27 05 13 Telecommunication Cabling systems.

1.3 REFERENCES

- .1 Carry out the Work under this section in accordance with all applicable Federal, Provincial, Municipal and other laws, ordinances and with the latest edition of the following standards which shall be deemed to be and form part of this specification.
 - .1 American Society of Mechanical Engineers.
 - .2 Institute of Electrical and Electronic Engineers.
 - .3 American Society for Testing Materials.
 - .4 Manufacturers Standardization Society.
 - .5 Canadian Standards Association.
 - .6 Instrument Society of America.
 - .7 Canadian Electrical Code.
- .2 In the event of a conflict between the above mentioned standards, this specification, or the attached drawings, notify the Consultant, who will then advise on which standard is to be followed.

1.4 SUBMITTALS

- .1 Supply shop drawings for all control panels and termination junction boxes being supplied. Shop drawings will be reviewed and approved by the Consultant before equipment can be ordered. Submit shop drawings in accordance with 01 33 00.
- .2 Control panel and termination junction box shop drawings to include the following information:
 - .1 Dimensional outlines, sections, and details of all equipment.
 - .2 Detailed Bill of Materials.
 - .3 Equipment layout details.
 - .4 Equipment labeling details.
 - .5 Terminal block arrangements.
 - .6 Field cable termination details. Identify field connections of PLC I/O to field terminal blocks.
 - .7 All equipment specifications and instruction manuals (PLC, I/O cards, relays, etc.). Have the supplier provide a cross reference indicating which specifications refer to which panel.
 - .8 Instructions for the mounting of the control panels/junction boxes.
- .3 For control panels and field termination junction boxes, provide a layout and wiring diagram, complete with a detailed Bill of Materials.

- .4 Submit data for operations and maintenance manuals. Include in manuals information based on the following requirements:
 - .1 Operation and maintenance instructions to be sufficiently detailed with respect to design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification extension and expansion of any portion or feature of the installation.
- .5 Provide "Record" wiring and schematic diagrams and general arrangement drawings for control panels and junction boxes including a bill of materials.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Each control panel, remote I/O panel and termination junction box must be supplied, completely tested and ready for terminating field cables. This includes all hardware (terminal blocks, relays, power supplies, pushbuttons, etc.), terminal blocks (for power supplies and field I/O), wire ducts, internal panel wiring etc., as required.
- .2 All indoor control panels and termination junction boxes are to be either wall mounted or free-standing depending on the panel size and be NEMA 4X rated and reinforced plastic for installations in non-hazardous areas, use NEMA 4X, 316 stainless steel, increased safety enclosures rated for Class 1 Zone 2 for hazardous area installations. All conduits must be bottom entry. Top entry cables are acceptable for control panels and PLC I/O cabinets located in electrical rooms only. Provide free-standing panels with at least 300mm floor stands.
- .3 All outdoor control panels and termination junction boxes are to be either wall mounted or mounted on unistrut frames and be NEMA 4X rated and of 316 SS construction rated for Class 1 Zone 2. All conduits must be bottom entry.
- .4 Inside all panels and junction boxes, label terminal blocks, terminal block strips, and all internal wire conductors in accordance with the panel fabricator standards.
- .5 All NEMA 4x panel and junction box hardware (hinges, latches, etc.) must be 316 SS. Provide all panels and junction boxes complete with a back mounting plate.
- .6 Provide at least a 32 mm clearance between the terminal blocks and the plastic wiring duct. Wire ducts to be slotted and complete with covers. Wiring ducts to be a minimum size of 25 mm wide x 75 mm high (supplier to determine if a larger size is required).
- .7 Generally, terminate field wiring on the right hand side (or bottom side) of terminal strips, and internal panel wiring, or multi-

- conductor homerun cables (for intermediate junction boxes), shall be terminated on the left hand side (or top side) of terminal strips.
- .8 Wire analog and digital signals within the same panel or junction box to separate terminal strips.
 - .9 Completed relay control panels and junction boxes, hazardous area junction boxes to have CSA approval.
 - .10 All panels and junction boxes must be adequately sized to accommodate the required hardware, terminal blocks, wire ducts, etc., as well as the number of cables/conduits.
 - .11 Any required intrinsically safe wiring/equipment must be identified and isolated from non-intrinsically safe wiring/equipment in accordance with the Canadian Electrical Code.
 - .12 Individually label all panels and junction boxes with a lamicaid tag on the outside of the door and include the cabinet tag number and its associated description. Nameplates to have a white background with black undercut lettering (316 SS screw mounted). Minimum lettering size to be 25 mm.
 - .13 All pushbutton and switch legend plates to be white (anodized or engraved) on a black background, except emergency stops, which shall have a red background.
 - .14 All panels and junction boxes to include a drawing pocket to be installed on the inside of the door to hold "As Built" termination drawings.
 - .15 All panels and junction boxes to have an adequately sized pre-drilled and tapped copper ground bar and to be provided with a grounding lug for a #6 AWG external ground connection. Where applicable, control panels will also have a separate "isolated" copper ground bar for grounding of analog type 4-20 mA control signal cabling.
 - .16 Terminal blocks to be rated for at least 600V, 35A, minimum 6mm wide, capable of accepting a 10AWG conductor size, DIN rail mounted, complete with white marking tags with black lettering.
 - .1 Acceptable manufacturers: Weidmuller WDU4, or approved equivalent.
 - .17 Control wiring circuit breaker type terminal blocks to be rated for 250V, up to 16A, single pole, pushbutton operated, DIN rail mounted, complete with white marking tags with black lettering.
 - .1 Acceptable manufacturers: Weidmuller 4201 Series, or approved equivalent.
 - .18 Arrange terminal blocks so that no more than two (2) wires are terminated on any, one (1) terminal block (including field wiring). The use of "wire jumpers" between terminal blocks will not be permitted. Only terminal block vendor approved "cross-connection systems" can be used for cross wiring between panel terminal blocks.

- .19 Panel pushbuttons to be 30.5 mm heavy duty, watertight/ oiltight, NEMA rating to match enclosure rating, flush, momentary contact (unless indicated otherwise on drawings), complete with one (1) normally open and one (1) normally closed contact (start, stop, etc.).
 - .1 Acceptable manufacturers: Allen Bradley 800series or approved equivalent.
- .20 Panel internal wiring to be 16 AWG type TEW as a minimum. All 120 VAC power and control wiring to be black (#14AWG minimum). All 120 VAC neutral wiring to be white (#14AWG minimum). All DC digital signal wiring to be blue (#16AWG minimum). All analog signal wiring to be twisted, pair (Bk/Wh) or triad (Bk/Wh/Rd), shielded (#16AWG minimum). All ground wiring to be green (#14AWG minimum). Provide stranded copper wiring throughout. Segregate AC and DC wiring and install on separate terminal strips.
- .21 Panel pushbuttons to be 30.5mm heavy duty, watertight/oiltight, NEMA rating to match enclosure rating, flush, momentary contact (unless indicated otherwise on drawings), complete with one (1) normally open and one (1) normally closed contact (start, stop, etc.).
 - .1 Acceptable manufacturers: Allen Bradley 800Series or approved equivalent.
- .22 Panel selector switches to be 30.5mm heavy duty, watertight\oiltight, NEMA rating to match enclosure rating, front-mounted, two or three position (refer to control schematic drawings), either maintained or spring returned contacts (refer to control schematic drawings), and complete with at least one (1) normally open and one (1) normally closed contact per position, or as required.
 - .1 Acceptable manufacturers: Allen Bradley 800Series or approved equivalent.
- .23 Panel mounted indicating lights to be 30.5mm heavy duty, watertight/oiltight, NEMA rating to match enclosure rating, 120 VAC, LED and coloured as per the drawings.
 - .1 Acceptable manufacturers: Allen Bradley 800series or approved equivalent.
- .24 Control relays to have either 24 VDC or 120 VAC operating coil as required, plug-in socket, minimum 15 amp @ 120 VAC rated contacts (2 form 'C') and LED indicator.
 - .1 Acceptable materials: Allen Bradley 700-HB Series, or approved equivalent.
- .25 Provide a 24 VDC power supply for any 24 VDC I/O, panel equipment requirements and for the transmitters that are loop powered. It must be sized to accommodate at least 150% of its present load requirements (minimum 100 Watt). Fuse the 24 VDC supply to each piece of equipment or protect by a circuit breaker.
 - .1 Acceptable materials: Omron S8VM series, or approved equivalent.

- .26 For breaker circuits, provide 120 VAC, single pole distribution circuit breakers, toggle type, DIN rail mounted, continuous current rating as required, 10 kA interrupting capacity.
 - .1 Acceptable product: Weidmuller 9926 series or approved equivalent.
- .27 For fused circuits, provide Class CC HRC fuses, complete with a 600V, 30A fuse holder, single pole, blown fuse indicator.
 - .1 Acceptable product: Mersen Cat. No. USCC1I or approved equivalent.
- .28 Intrinsically safe relays to be dual channel, 120 Vac input voltage, 1 form 'C' contact per channel (rated 5A @ 120 VAC), Phoenix type P1-EX-ME-2NAM-COC-120VAC or approved equivalent.
- .29 Ethernet CAT6 and Fiber Optic cabling for PLC & SCADA communications supply, installation, testing and commissioning covered under Section 27 05 13.

2.2 RELAY CONTROL PANEL

- .1 Supply the following relay control panels completely tested and ready for terminating field cables. Include all hardware (relays, power supplies, pushbuttons, etc.), terminal blocks (for power supplies and field I/O), wire ducts, internal panel wiring etc., as required.
 - .1 Gas Detection Relay Control Panel (LCP-600).
- .2 Refer to the Electrical drawings for related control schematics.
- .3 Provide 20% spare terminals for each terminal strip.

2.3 TERMINATION JUNCTION BOXES

- .1 Generally, instrumentation and control conduits will run directly from the field device to the associated control panel. Where junction boxes are indicated, or otherwise deemed necessary, provide as follows:
 - .1 Provide sufficient terminals to accommodate spare wires plus 20% additional unused terminals.
 - .2 Provide junction boxes with hinged covers.
 - .3 For junction boxes 200 mm square or less, boxes with screw or hinged covers may be used.
 - .4 Minimum NEMA 4X enclosure rating, use PVC enclosure in interior non-hazardous areas. Use 316SS, increased safety assemblies for hazardous areas and in exterior installations.

2.4 PLANT PLC PANEL

- .1 Design, supply, fabricate, and install one (1) PLC control panel (PLC-01) at the wastewater treatment plant. Refer to Drawing J01 for its associated I/O list.

- .2 The PLC control panel is to be complete with a programmable logic controller (PLC) having the following functionality/features:
 - .1 Support up to sixteen (16) local expansion modules.
 - .2 Control of local and distributed I/O modules.
 - .3 Include minimum one (10) 10/100 Ethernet/IP port and one (1) USB port.
 - .4 User memory: minimum 2MB.
 - .5 Non-volatile memory storage of programming and set-up.
 - .6 Non-volatile memory storage of programming and set-up.
 - .7 On-line editing.
 - .8 Input power: 24VDC
 - .9 Operating temperature: 0 to +60 degree Celsius.
 - .10 Expansion I/O Modules as follows:
 - .1 Digital Input modules: 16 point, 24VDC or 120 Vac to suit application.
 - .2 Digital Output modules: 16 point, dry contact type.
 - .3 Analog input modules: 8 point, 4-20 mA, differential inputs, individually configurable channels, able to accept both loop power and instrument powered signals.
 - .4 Analog output modules: 4 point, 4-20mA.
 - .11 Include required mounting hardware, end caps, interconnecting cables and accessories for a complete and functioning system.
 - .12 Acceptable Materials: Rockwell Automation CompactLogix L3 series (#1769-L33ER) c/w expansion I/O modules as required.
- .3 within the control panel by the panel fabricators. Install RTU hardware as per the manufacturer's instructions (clearances, grounding, etc.)..
- .4 Provide a 24VDC power supply for any 24VDC I/O, panel equipment requirements and for the transmitters that are loop powered. Size to accommodate at least 150% of its present load requirements (minimum 100 Watt). 24VDC supply to each piece of equipment to be fused. Acceptable materials: Omron S8VM series, or approved equivalent.
- .5 interposing relays where indicated on drawings, or as required.
- .6 Provide the PLC panel with one (1) 120V power feed.
- .7 specified herein.
- .8 Include a 20A, 120VAC, power conditioner and wired as indicated. Acceptable materials: Leviton Wired-inSurge protective module, or approved equivalent..
- .9 Ethernet switch to be Din-rail mounting type, Ethernet ports (RJ45) as indicated, 10/100Mbps/sec, 24Vdc input power, industrial type. Acceptable materials:.1 NTRON 304-TX or approved equivalent..
- .10 NEMA 4X rated..
- .11 Include an internal 15A, 120V duplex receptacle..

- .12 Include an internal LED light complete with door switch.
- .13 PLC-01 panel to include 120VAC UPS installation in PLC panel inner floor as specified in Section 26 33 53.

2.5 SYSTEM INTEGRATION

- .1 Support Owner's system integrator to test and commission all PLC, HMI and VCC programs required for the safe and reliable functioning of the WWTP.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install control panels, remote I/O panel and field termination junction boxes.
- .2 Install unarmoured communications cables in conduit systems in accordance with Section 26 05 34.
- .3 Terminate cables and equipment per the drawings and the manufacturer's instructions and pre-selected equipment shop drawings.
- .4 Terminate ethernet, fibre and serial communications cables with the appropriate connector and test. The splitting of cable pairs between different jacks is not permitted.
- .5 Ground cabling, patch panels, racks and equipment as per manufacturer's instructions (use min. #6).
- .6 Terminate each conductor with the appropriate connector and test.
- .7 Mount and position equipment, etc., in such a way as to allow for easy access for maintenance purposes.
- .8 Store materials in a manner to ensure the preservation of their quality and fitness for the work, and to facilitate inspection by the Consultant at any time. Keep equipment clean and protected against damages, dirt and moisture.

3.2 TESTING

- .1 Panel fabricator to test (power-up) all panel components and auxiliary devices to confirm functionality, verify all internal panel wiring, and conduct functionality testing in accordance with the control schematics prior to delivery to site. Provide test reports to the Consultant.
- .2 Coordinate testing with the Owner's system integrator.
- .3 Test communication system cables in accordance with the manufacturer's requirements.
- .4 Provide a hard copy of test results.
- .5 Refer to specification section 40 90 00 for additional testing.

3.3 TRAINING

- .1 Coordinate with Owner's System integrator to provide training to Operations Staff on the operation of the SCADA system as per Section 01 79 00 following the completion of all system integration and testing work.

END OF SECTION

Tag No.	Description	Spec. Section	P&ID Dwg. #	Cabling Dwg. #	Layout Dwg. #	Mntg	Location Conditions	Instrument Specific Specs					
UL-603B	Red Alarm Beacons	26 90 00	-	J03	E08	Wall Mntd	Zone 2, IIA & IIB,Indoors	NEMA 4X, STEADY RED WARNING LIGHTS, LED, 120VAC, c/w WIRE GUARDS, SUITABLE FOR HAZARDOUS AREA					
UL-603A	Green Alarm Beacons	26 90 00	-	J03	E08	Wall Mntd	Zone 2, IIA & IIB,Indoors	NEMA 4X, STEADY GREEN WARNING LIGHTS, LED, 120VAC, c/w WIRE GUARDS, SUITABLE FOR HAZARDOUS AREA					
UL-601B	Red Alarm Beacons	26 90 00	-	J03	E08	Wall Mntd	Unclassified, Indoors	NEMA 12, STEADY RED WARNING LIGHTS, LED, 120VAC, c/w WIRE GUARDS					
UL-601A	Green Alarm Beacons	26 90 00	-	J03	E08	Wall Mntd	Unclassified, Indoors	NEMA 12, STEADY GREEN WARNING LIGHTS, LED, 120VAC, c/w WIRE GUARDS					
SD-01	Smoke Detector - New Electrical Room	26 90 00	-	J03	E07	Ceiling Mntd	Unclassified, Indoors	SMOKE DETECTOR C/W RELAY BASE (120VAC RATED NC CONTACT)					
PLC-01	PLC Control Panel (PLC-01)	26 91 00	P03-P05	J01-J04	E07	Stand Mntd	Unclassified, Indoors	NEMA 12, TOP ENTRY, PLC I/O CONTROL PANEL, SIZED TO SUIT					
PIT-431	Pressure Transmitter - Blower Header	26 90 00	P04	J04	E08	Inline	Unclassified, Indoors	NEMA 4X, 4-20mA OUTPUT SIGNAL, CALIBRATED RANGE OF 0 TO 20 PSI					
PIT-411	Pressure Transmitter - Blower Header	26 90 00	P04	J04	E08	Inline	Unclassified, Indoors	NEMA 4X, 4-20mA OUTPUT SIGNAL, CALIBRATED RANGE OF 0 TO 20 PSI					
LSH-512	Float Switch - UV-510 Channel	43 32 63	P05	J04	E08	Suspended	Unclassified, Indoors	SUSPENDED FLOAT TYPE, INTEGRAL CABLE (LENGTH TO SUIT)					
LSH-311	Float Switch - High Inlet Level Alarm	26 90 00	P04	J03	E02	Suspended	Zone 2, IIA & IIB, Outdoors	SUSPENDED FLOAT TYPE, INTEGRAL CABLE (LENGTH TO SUIT) C/W MANUFACTURER REQUIRED INTRINSIC BARRIER, SUITABLE FOR HAZARDOUS AREA					
LSH-223	Float Switch - SBR Tank No. 2 TK-220	46 53 53	P04	J02	E09	Suspended	Zone 2, IIA & IIB, Outdoors	SUSPENDED FLOAT TYPE, INTEGRAL CABLE (LENGTH TO SUIT) C/W MANUFACTURER REQUIRED INTRINSIC BARRIER, SUITABLE FOR HAZARDOUS AREA					
LSH-213	Float Switch - SBR Tank No. 1 TK-210	46 53 53	P04	J02	E09	Suspended	Zone 2, IIA & IIB, Outdoors	SUSPENDED FLOAT TYPE, INTEGRAL CABLE (LENGTH TO SUIT) C/W MANUFACTURER REQUIRED INTRINSIC BARRIER, SUITABLE FOR HAZARDOUS AREA					
LSH-113	Float Switch - Fine Screen	43 22 76	P03	J03	E07	Suspended	Zone 1, IIA & IIB, Indoors	SUSPENDED FLOAT TYPE, INTEGRAL CABLE (LENGTH TO SUIT) C/W MANUFACTURER REQUIRED INTRINSIC BARRIER, SUITABLE FOR HAZARDOUS AREA					
LIT-311	Level Transmitter - Upstream Level	26 90 00	P04	J03	E02	Stand Mntd	Zone 2, IIA & IIB, Outdoors	NEMA 4X, LEVEL TRANSMITTER CALIBRATED ON-SITE TO MATCH "INSTALLED" CONDITIONS, SUITABLE FOR HAZARDOUS AREA					
LIT-115	Level Transmitter - Fine Screen	43 22 76	P03	J03	E07	Wall Mntd	unclassified Indoors	NEMA 4X, LEVEL TRANSMITTER CALIBRATED ON-SITE TO MATCH "INSTALLED" CONDITIONS, SUITABLE FOR HAZARDOUS AREA					
LE-222	Pressure Transducer (Level) - SBR Tank No. 2 TK-220	46 53 53	P04	J02	E09	Suspended	Zone 1, IIA & IIB, Outdoors	PRESSURE TRANSDUCER SENSOR c/w 10m OF INTEGRAL CABLE, SUITABLE FOR HAZARDOUS AREA					
LE-222	Level Transmitter - SBR Tank No. 1 TK-210	46 53 53	P04	J02	E09	Suspended	Zone 2, IIA & IIB, Outdoors	SUSPENDED LEVEL ELEMENT, INTEGRAL CABLE, SUITABLE FOR HAZARDOUS AREA					
LE-212	Pressure Transducer (Level) - SBR Tank No. 1 TK-210	46 53 53	P04	J02	E09	Suspended	Zone 1, IIA & IIB, Outdoors	PRESSURE TRANSDUCER SENSOR c/w 10m OF INTEGRAL CABLE, SUITABLE FOR HAZARDOUS AREA					
LE-212	Level Transmitter - SBR Tank No. 1 TK-210	46 53 53	P04	J02	E09	Suspended	Zone 2, IIA & IIB, Outdoors	SUSPENDED LEVEL ELEMENT, INTEGRAL CABLE, SUITABLE FOR HAZARDOUS AREA					
LE-115B	Level Element - Fine Screen	43 22 76	P03	J03	E07	Suspended	Zone 1, IIA & IIB, Indoors	SUSPENDED LEVEL ELEMENT, INTEGRAL CABLE, SUITABLE FOR HAZARDOUS AREA					
LE-115A	Level Element - Fine Screen	43 22 76	P03	J03	E07	Suspended	Zone 1, IIA & IIB, Indoors	SUSPENDED LEVEL ELEMENT, INTEGRAL CABLE, SUITABLE FOR HAZARDOUS AREA					
LCP-601	Ventilation Control Panel (EF-1)	26 29 03	0	J04	E06	Wall Mntd	Unclassified, Indoors	NEMA 12, BOTTOM & TOP ENTRY CABLES, MOTOR STARTER CONTROL PANEL, SIZED TO SUIT					
LCP-600	Relay Control Panel - Gas Detection & Alarms	26 91 00	-	J03	E08	Wall Mntd	Unclassified, Indoors	NEMA 12, BOTTOM & TOP ENTRY CABLES,GAS DETECTION RELAY CONTROL PANEL, SIZED TO SUIT					
JB-06	Termination Junction Box	26 91 00	-	J04	E08	Wall Mntd	Unclassified, Indoors	NEMA 4X, BOTTOM ENTRY CABLES, TERMINATION JUNCTION BOX					
JB-05	Termination Junction Box	26 91 00	-	J03	E07	Wall Mntd	Zone 1, IIA & IIB, Indoors	NEMA 4X, BOTTOM ENTRY CABLES, TERMINATION JUNCTION BOX, SUITABLE FOR HAZARDOUS AREA					
JB-04	Termination Junction Box	26 91 00	-	J03	E08	Stand Mntd	Unclassified, Indoors	NEMA 4X, BOTTOM ENTRY CABLES, TERMINATION JUNCTION BOX					
JB-03	Termination Junction Box	26 91 00	-	J04	E08	Stand Mntd	Unclassified, Indoors	NEMA 4X, BOTTOM ENTRY CABLES, TERMINATION JUNCTION BOX					
JB-02	Termination Junction Box	26 91 00	-	J02	E09	Stand Mntd	Zone 2, IIA & IIB, Outdoors	NEMA 4X, BOTTOM ENTRY CABLES, TERMINATION JUNCTION BOX, SUITABLE FOR HAZARDOUS AREA					
JB-01	Termination Junction Box	26 91 00	-	J02	E09	Stand Mntd	Zone 2, IIA & IIB, Outdoors	NEMA 4X, BOTTOM ENTRY CABLES, TERMINATION JUNCTION BOX, SUITABLE FOR HAZARDOUS AREA					
HS-430A/HS-430B/XI-430	Local Station - H/O/A with Speed Pot with Indicator Lights	26 29 03	P04	J03	E08	Stand Mntd	Unclassified, Indoors	NEMA 4X, LOCAL CONTROL STATION, c/w MAINTAINED 3-POSITION "H/O/A" SELECTOR SWITCH, 0-100% SPEED POTENTIOMETER (MUST BE COMPATIBLE WITH VFD), GREEN PILOT LIGHTS (LED), 120VAC					
HS-420A/HS-420B/XI-420	Local Station - H/O/A with Speed Pot with Indicator Lights	26 29 03	P04	J03	E08	Stand Mntd	Unclassified, Indoors	NEMA 4X, LOCAL CONTROL STATION, c/w MAINTAINED 3-POSITION "H/O/A" SELECTOR SWITCH, 0-100% SPEED POTENTIOMETER (MUST BE COMPATIBLE WITH VFD), GREEN PILOT LIGHTS (LED), 120VAC					
HS-410A/HS-410B/XI-410	Local Station - H/O/A with Speed Pot with Indicator Lights	26 29 03	P04	J03	E08	Stand Mntd	Unclassified, Indoors	NEMA 4X, LOCAL CONTROL STATION, c/w MAINTAINED 3-POSITION "H/O/A" SELECTOR SWITCH, 0-100% SPEED POTENTIOMETER (MUST BE COMPATIBLE WITH VFD), GREEN PILOT LIGHTS (LED), 120VAC					
HS-226A/XI-226	Local Station - H/O/A with Indicator Lights	26 29 03	P04	J02	E09	Stand Mntd	Unclassified, Outdoors	NEMA 4X, LOCAL CONTROL STATION, c/w MAINTAINED 3-POSITION "H/O/A" SELECTOR SWITCH C/W GREEN PILOT LIGHTS (LED), 120VAC					
HS-216A/XI-216	Local Station - H/O/A with Indicator Lights	26 29 03	P04	J02	E09	Stand Mntd	Unclassified, Outdoors	NEMA 4X, LOCAL CONTROL STATION, c/w MAINTAINED 3-POSITION "H/O/A" SELECTOR SWITCH C/W GREEN PILOT LIGHTS (LED), 120VAC					
HRN-602	Alarm Horn - Dewatering Room	26 90 00	-	J03	E08	Wall Mntd	Zone 2, IIA & IIB, Indoors	NEMA 4X, ALARM HORM, 120VAC, SUITABLE FOR HAZARDOUS AREA					
FY-114	Solenoid - Fine Screen	43 22 76	P03	J03	E07	Inline	Zone 1, IIA & IIB, Indoors	SOLENOID VALVE, SUITABLE FOR HAZARDOUS AREA					
FY-113	Solenoid - Fine Screen	43 22 76	P03	J03	E07	Inline	Zone 1, IIA & IIB, Indoors	SOLENOID VALVE, SUITABLE FOR HAZARDOUS AREA					
FSL-604	Air Flow Switch	Div 23	0	J03	E08	Inline	Zone 2, IIA & IIB,Indoors	NEMA 4X, AIR SWITCH SET TO TRIP BELOW 6 AIR CHANGERS PER HOUR, SUITABLE FOR HAZARDOUS AREA					
FMV-423	Motor Operated Valve - Blower	46 53 53	P04	J04	E08	Inline	Unclassified, Indoors	NEMA 12, "OPEN" AND "CLOSE" COMMANDS, "OPENED", "CLOSED" AND "IN AUTO" STATUS BACK					
FMV-413	Motor Operated Valve - Blower	46 53 53	P04	J04	E08	Inline	Unclassified, Indoors	NEMA 12, "OPEN" AND "CLOSE" COMMANDS, "OPENED", "CLOSED" AND "IN AUTO" STATUS BACK					
DCN-430	Local Disconnect for Blower M-430	26 28 26	-	J04	E08	Wall Mntd	Unclassified, Indoors	NEMA 12, LOCAL DISCONNECT C/W AUX. CONTACT					
	Rev	Date	Description							Date Nov-24	Office HFX	Title: WASTEWATER TREAMENT PLANT UPGRADES & EXPANSION INSTRUMENTATION & CONTROLS EQUIPMENT LIST	
										Designed JRK			
										Project No. : 240800		Client: TOWN OF LUNENBURG	
												Project: WWTP UPGRADE & EXPANSION	
												Drawing No.	
	0	Nov-24	Issued for Tender										
	By	JRK	Ckd	LTC	Appr.	SHE							
										26 91 01		240800.00-J05	
												Rev. 0	

[illegible]

NOTES:

1. Refer to referenced specification sections for general instrument specifications common to each instrument type.
2. Consult with Owner for final equipment locations.
3. Fabricate freestanding unistrut frame/ support to suit equipment size.
4. Contractor to confirm all instrument process connection sizes / materials against the mechanical/process drawings before shop drawing submission. Any discrepancies to be clarified with the engineer.
5. Refer to the electrical control schematics for the number of contacts required for each pushbutton/switch/etc., identified for each local control station.

	Rev	Date	Description		Date Nov-24 Office HFX Designed JRK Project No. : 240800 Specification No.: 26 91 01	Title: WASTEWATER TREAMENT PLANT UPGRADES & EXPANSION INSTRUMENTATION & CONTROLS EQUIPMENT LIST Client: TOWN OF LUNENBURG Project: WWTP UPGRADE & EXPANSION Drawing No. 240800.00-J05 Rev. 0			
	0	Nov-24	Issued for Tender						
	By	JRK	Ckd	LTC		Appr.	SHE		

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This Section specifies requirements for the coordination of delivery, installation, testing, and start-up of one (1) fully assembled mechanical screening system with a dedicated washer/compactor unit. The screenings from one (1) screening unit will be discharged into a compactor/washer, the washed screenings will be discharged into a receiving bin.
- .2 The fine screening equipment has been pre-selected by the Owner. The pre-selected Equipment Supplier is Veolia Water Technologies Canada Inc. Copies of the reviewed shop drawings are available upon request to the Consultant. Terms and conditions applicable to the screening equipment can be found in Appendix C: Terms and Conditions for Preselected Suppliers.

1.2 INTENT

- .1 The intent of these specifications is to provide the works fully complete in every detail for the purpose designated. Provide any apparatus, appliance material or labour not specifically mentioned or included, but requisite to the operation of the apparatus and equipment specified without additional expense to the Contract.

1.3 REFERENCES

- .1 The work under this Section must conform to the applicable requirements of the National Building Code and National Plumbing Code of Canada, National Fire Protection Association, Underwriters Laboratories of Canada, and referenced standards throughout these Specifications of the American National Standards Institute (ANSI), American Society of Mechanical Engineers (ASME), American Water Works Association (AWWA), American Society of Testing and Materials (ASTM), Canadian Standards Association (CSA) , and the Canadian General Standards Board (CGSB).
- .2 Equipment assemblies comprised of electro-mechanical components must be CSA or cUL certified or certified by an agency approved by the applicable provincial Electrical Inspection Department and bear the appropriate label. Where there is no alternative to supplying equipment that is not appropriately certified, special approval from the applicable provincial Electrical Inspection Department will be required. Pay all costs associated with obtaining such approval.
- .3 ASTM A380/A380M-17, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
- .4 CSA C22.2 No. 100-14(R2024), Motors and Generators.
- .5 IEEE 112-2017, IEEE Standard Test Procedure for Polyphase Induction Motors and Generators.
- .6 NEMA MG1-2021, Motors and Generators.

1.4 DESIGN CRITERIA (FOR INFORMATION)

- .1 Mechanical screening system: the pre-selected system has been designed for continuous operation under the following design conditions:
 - .1 Maximum flow: 4,150 m³/d.
 - .2 Average flow: 1,400 m³/d.
 - .3 Number of screening units: one (1).
 - .4 Maximum unit flow: 4,150 m³/d.
 - .5 Average unit flow: 1,400 m³/d.
 - .6 Screen opening size: 3 mm in two dimensions.
 - .7 Maximum headloss at peak flow with 50% screen clogging, assuming dimension indicated in Section 2.2.
 - .8 Supply one (1) new mechanical screening system.
- .2 Washer/compactor unit: the pre-selected system has been designed for continuous operation under the following design conditions:
 - .1 Capacity: 1.0 m³/h.
 - .2 Screening volume reduction: 45-70%.
 - .3 Supply one (1) washer compactors.
- .3 Shaftless screw conveyor: the pre-selected system has been designed for continuous operation under the following design conditions:
 - .1 Capacity: 2.0 m³/h.
 - .2 Installation angle: to suit screen and washer/compactor.
- .4 The scope of supply from the Pre-Selected Equipment Supplier includes one (1) shaftless screw conveyor.

1.5 SUBMITTALS

- .1 The Pre-Selected Equipment Supplier will provide shop drawings showing any required installation details for review.

1.6 IDENTIFICATION OF EQUIPMENT

- .1 Confirm the pre-selected equipment has been fitted with the manufacturer's identification nameplates indicating size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power motors, all factory supplied.

1.7 OPERATION AND MAINTENANCE MANUALS

- .1 Assist the Equipment Supplier in providing operation and maintenance data for incorporation into Operation and Maintenance Manuals as specified in Section 01 78 00.

PART 2 - PRODUCTS

2.1 PRE-SELECTED FINE SCREENING EQUIPMENT

- .1 Copies of the reviewed shop drawings are available upon request to the Consultant.

PART 3 - EXECUTION

3.1 DELIVERY

- .1 Have equipment shipped to the Site pre-assembled where possible, taking into account the access points.
- .2 Coordinate delivery and storage with the Owner and pre-selected Equipment Supplier.

3.2 INSTALLATION

- .1 Handle and install equipment in strict accordance with manufacturer's instructions. Confirm such instructions are issued at time of shop drawing issue and are available on site when required.
- .2 Take all necessary field dimensions to ensure accurate and proper fitting of the work and equipment supplied into the building. Make up or break down equipment into sections sized for easy transportation into and through the building to final location without alteration or damage to the building.
- .3 Provide openings as required to accommodate shafts, stems, beams, conduit and the like passing through the structure, at no additional cost to the Contract.
- .4 Provide temporary supports, hoists, and bracing to prevent overloading of the structure while equipment is being installed. Confirm weights of equipment with the manufacturer.
- .5 Provide cast-in-place concrete equipment attachments as required by the equipment and as shown on the Drawings.
- .6 Provide correct type and full number, size and length of anchor bolts and other connecting bolts as required by equipment manufacturer. Preset anchor bolts in concrete where convenient; otherwise leave suitable openings in concrete and set anchor bolts later using Red-Head Epoxy anchors or other approved fastening methods.
- .7 Coordinate location and provide items for embedding into cast-in-place concrete.

3.3 RESPONSIBILITY OF TEMPORARY TRAIL USAGE

- .1 Obtain written permission from the Consultant to use and test permanent equipment and systems prior to acceptance by the Owner.

- .2 The guarantee period must not be affected by temporary trial use of the equipment.
- .3 Clean and renew equipment and systems used before acceptance. Restore to original or new working condition.
- .4 Protect equipment and systems openings from dirt, dust and other foreign materials during temporary usage.

3.4 INSPECTION, TESTING AND START-UP

- .1 The Pre-Selected Equipment Supplier will provide the services of competent servicemen, mechanics or other trained personnel to check the complete installation and be present for start-up of the equipment. The Pre-Selected Equipment Supplier will submit a written report to the Consultant stating the following:
 - .1 That a satisfactory installation of equipment has been performed and outlining any modifications that have been made as a result of the commissioning or testing of the equipment at no additional cost to the Contract.
 - .2 That the equipment is now ready for permanent operation.
 - .3 Test installed equipment with actual plant operation to verify hydraulic balancing, head loss and effluent quality. Make adjustments required to place equipment into operation and to optimize the operation.
- .2 The Pre-Selected Equipment Supplier will fully instruct the permanent operator of the equipment in the proper operation and maintenance of all equipment at no additional cost to the Contract.
- .3 Replace defective material or equipment with new material or equipment. Bear costs including re-testing and repairing.
- .4 Coordinate with the Pre-Selected Equipment Supplier to provide a minimum period of ten (10) days on site for skilled supervision and instruction and a minimum of three (3) trips to the site should be assumed by the equipment manufacturer. Provide as many trips and days on site to complete the installation and put the equipment into satisfactory operation.

3.5 PERFORMANCE TESTING AND COMMISSIONING

- .1 Along with the Pre-Selected Equipment Supplier, commission equipment in accordance with Section 01 91 13.
- .2 Final acceptance includes the successful completion of commission at the design criteria indicated herein.
- .3 Provide all necessary labour, equipment and accessories to complete commissioning.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This Section covers the supply, delivery, installation, testing, and placement into operation of sludge dewatering equipment and all appurtenances required for an operating sludge dewatering system, including both new components to increase the capacity of the existing equipment and replacing parts of existing equipment to refurbish it. Copies of the scope of refurbishment are available upon request from the Consultant.

1.2 INTENT

- .1 The intent of these specifications is to provide the mechanical and electrical works fully complete in every detail for the purpose designated. Furnish any apparatus, appliance, material, or labour not herein specifically mentioned or included but requisite to the operation of the apparatus and equipment specified without additional expense to the Owner.

1.3 REFERENCES

- .1 ASTM A1011/A1011M-23, Steel, Sheet and Strip, Hot Rolled, Carbon Structure, High-Strength Low-Alloy, High Strength Low-Alloy with Improved Formability and Ultra-High Strength.
- .2 CAN/CSA W47.1:19(R2024), Certification of Companies for Fusion Welding of Steel.
- .3 CAN/CSA W48:23, Filler Metals and Allied Materials for Metal Arc Welding.
- .4 CAN/CSA W59:24, Welded Steel Construction (Metal Arc Welding).

1.4 DESIGN CRITERIA PERFORMANCE REQUIREMENTS

- .1 Under normal operating conditions waste activated sludge at around 0.85% TS will be fed to the dewatering equipment. The nature of the sludge prior to dewatering will be as follows:
 - .1 Waste activated sludge 380 kg/d at 0.85% TS.
 - .2 Weekly sludge processing: 2,700 kg/week.
- .2 Size the dewatering system for operation 5-days per week and 8 hours per day, at peak. Provide a system designed for continuous operation under the following conditions:
 - .1 Peak system hour flow (inlet): 32 m³/h.
 - .2 Peak system solids loading rate (inlet): 90 kg/hr.
 - .3 Feed sludge concentration: 0.5 - 1.5% solids.
 - .4 Feed sludge temperature: 8 - 25°C.
 - .5 Solids capture (with polymer addition): + 95%.
 - .6 Finished sludge cake 15% to 20% total solids.

- .3 Install the unit in a heated and ventilated building. Space limitations are a consideration.
- .4 Provide points of discharge and typical placement of interconnecting pipes and electrical connections.
- .5 Control panel to control and indicate the status of all components in the sludge dewatering system. All activities of the dewatering system must be operable in an automatic mode without supervision.

1.5 RELATED WORK

- .1 Piping, valves, equipment supports identification instrumentation: Division 40
- .2 Electrical: Division 26

1.6 QUALIFICATIONS OF EQUIPMENT SUPPLIERS

- .1 All items of equipment supplied must be produced by companies regularly engaged in manufacturing this type of equipment and who maintain service and parts departments from which service, repairs and replacements may be obtained quickly at all times.

1.7 IDENTIFICATION OF EQUIPMENT

- .1 Fit process equipment with the manufacturer's identification nameplates indicating size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power motors, all factory supplied.

1.8 SHOP DRAWINGS

- .1 Submit shop drawings for all process equipment to the Consultant for review prior to shipment, in accordance with Section 01 33 00.

1.9 MAINTENANCE MANUALS

- .1 Provide Maintenance data for inclusion in the Operations and Maintenance manuals, in accordance with Section 01 78 00.

PART 2 - PRODUCTS

2.1 ROTARY PRESS

- .1 Rotary Press to consist of a number of channels, each having a 900 mm diameter. Flocculating sludge is fed continuously into the channels where it is dewatered. The Rotary Press comprises the following components:
 - .1 Dewatering channels:
 - .1 Dewatering Channels: supply and install one (1) additional channel. Every channel will be identified and numbered with a plastic laminated plate. Channel housing to be made of

304 stainless steel.

- .1 Filtration elements: the filtration elements will be chosen according to the sludge characteristics and the performances specification. Elements to be made of 316 stainless steel and chrome plated for wear resistance.
 - .2 End covers: each end cover to be identical and act as gland to maintain the seal in proper position. End cover to also include in the lower part a piping outlet to drain filtrate. Outlet to be 100 mm dia. oval pipe. Channel bearing to be stainless steel.
 - .3 Spray nozzles: install spray nozzles inside the channel. Those spray nozzles will serve daily to clean the inside and the outside of the rotating wheel. Install one (1) set of spray nozzles to clean the inside of the rotating wheel. The water will be fed to the spray nozzles by a manifold through the deflector. Mount the second set of spray nozzles on a manifold to clean the outside of the wheel. Pipe each set of spray nozzles to a quick connect attachment.
 - .4 Acceptable manufacturer: Fournier Industries Inc.
- .2 Cake outlet chute:
- .1 Every cake outlet to have a chute with an inspection door. Chute to be made of LLDPE.
- .2 Provide an extended feed manifold, as required, to allow feed of three (3) channels simultaneously.
- .3 Provide a fabricated 304L stainless steel filtrate collection manifold extension, as required, for the rotary press units.
- .4 Painting:
- .1 Paint the external surfaces of the equipment that require protection in accordance with this procedure:
 - .1 Surface preparation: sand blasting according to SSPC-SP10.
 - .2 Primer:
 - .1 Type: Epoxy Resin (high built).
 - .2 Note: according to the ONGC-1 GP165A norm.
 - .3 Dry thickness: (5-7 mils), 5 mils minimum.
 - .4 The surfaces in contact with feed sludge, filtrates and cake will also be painted except when those surfaces are made out of stainless steel or polymer based product.
- .5 Materials:
- .1 Steel used in the construction to meet the following standards:
 - .1 Tubing: 40.21 44 W
 - .2 Profile: 40.21 44W

- .3 Plate: 40.21 44W
 - .4 Sheet: to ASTM A1011
 - .5 Shaft: ANSI-1045
 - .6 General Hardware: SAE GR 5
 - .7 Specific Hardware: SAE GR 8
 - .8 Stainless Steel: ANSI 304 & ANSI 316
- .6 Welding:
- .1 Perform weldings in accordance with CSA W47.1.
 - .2 Following techniques which are most appropriate for the particular steel.
 - .3 Welding electrodes to be in accordance with the W48 Standard.
- .7 The noise level of each component of the equipment will not exceed 85 dBA measured at one(1) meter from the equipment.
- .8 Instrumentation and controls:
- .1 The dewatering unit consists of three (3) rotary press channels along with a number of control devices necessary to maintain adequately proportion flow and pressure, resulting in a more uniform feed of sludge and diluted polymer to the press.
 - .2 Modify control as required to allow for the control of all three(3) channels.
- .9 Carry out refurbishment of existing Rotary press channels and appurtenances as detailed in manufacturer's scope.

2.2 SLUDGE FEED PUMP

- .1 Supply and install one (1) positive cavity pump to pump raw sludge to the rotary press, sized to supply three (3) channels simultaneously.
- .2 Acceptable manufacturer: Seepex, Netzsch.

2.3 CAKE CONVEYOR SYSTEM (EXISTING)

- .1 General: shaftless screw conveyor to be new and of current manufacture and designed to transfer dewatered municipal sludge as shown on the drawings.

2.4 INSTRUMENTATION AND CONTROLS (EXISTING)

- .1 The dewatering unit consists of two (2) rotary presses along with a number of control devices necessary to maintain adequately proportion flow and pressure, resulting in a more uniform feed of sludge and diluted polymer to the press.

PART 3 - EXECUTION

3.1 DELIVERY

- .1 Ship equipment to the site pre-assembled where possible.

3.2 INSTALLATION

- .1 Handle and install equipment in strict accordance with manufacturer's instructions. Ensure such instructions are issued at time of shop drawing issue and are available on site when required.
- .2 Take all necessary field dimensions to ensure accurate and proper fitting of the work and equipment supplied into the building. Make up or break down equipment into sections sized for easy transportation into and through the building to final location without alteration or damage to the building.
- .3 Provide openings as required to accommodate shafts, stems, beams, conduit and the like passing through the structure, at no additional cost to the Contract.
- .4 Provide temporary supports, hoists, and bracing to prevent overloading of the structure while equipment is being installed. Confirm weights of equipment with the manufacturer.
- .5 Provide cast-in-place concrete equipment attachments as required by the equipment and as shown on the Drawings.
- .6 Provide correct type and full number, size and length of anchor bolts and other connecting bolts as required by equipment manufacturer. Preset anchor bolts in concrete where convenient; otherwise leave suitable openings in concrete and set anchor bolts later using Red-Head Epoxy anchors or other approved fastening methods.
- .7 Coordinate location and provide items for embedding into cast-in-place concrete.

3.3 RESPONSIBILITY OF TEMPORARY TRIAL USAGE

- .1 Obtain written permission from the Consultant to use and test permanent equipment and systems prior to acceptance by the Owner.
- .2 The guarantee period will not be affected by temporary trial use of the equipment.
- .3 Clean and renew equipment and systems used before acceptance. Restore to original or new working condition.
- .4 Protect equipment and systems openings from dirt, dust, and other foreign materials during temporary usage.

3.4 INSPECTION, TESTING AND START-UP

- .1 Provide the service of a competent manufacturer's representative to check the complete installation and be present for start-up of the

equipment. Submit a written report signed by the equipment manufacturer's representative to the Consultant stating the following:

- .1 That a satisfactory installation of equipment has been performed and outlining any modifications that have been made as a result of the commissioning or testing of the equipment at no additional cost to the Contract.
 - .2 That the equipment is now ready for permanent operation.
 - .3 That the operation, lubrication and maintenance instructions for the equipment have been presented to the Consultant.
 - .4 That the equipment has been properly lubricated with the correct lubricants.
- .2 Have the equipment manufacturer's representative fully instruct the permanent operator of the equipment in the proper operation and maintenance of all equipment at no additional cost to the Contract.
 - .3 A minimum period of three (3) days on site for skilled supervision and instruction and a minimum of two (2) trips to the site should be assumed by the equipment supplier. Provide as many trips and days on site as required to complete the installation and put the equipment into satisfactory operation.

3.5 PERFORMANCE TESTING

- .1 Conduct final acceptance of the equipment requires field tests that with sludge from the treatment plant to verify performance characteristics of the system as defined in clause 1.3.2.4 at design flow conditions. Performance requirements must be met for three (3) consecutive days for approval.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This specification describes the coordination of delivery, installation, field testing, and commissioning of a Sequencing Batch Reactor (SBR) treatment system.
- .2 The three-basin SBR treatment system includes a sludge digestion/holding tank. The equipment includes an SBR process control system, blowers, oxygen transfer system, solids excluding effluent decanters, decanter freeze protection, automatic valves as required for the system proposed, sludge wasting mechanisms, instrumentation, controls, in-basin air piping, and supports.
- .3 The SBR process equipment has been pre-selected by the Owner. The pre-selected Equipment Supplier is Xylem Canada LP. Copies of the reviewed shop drawings are available upon request to the Consultant. Terms and conditions applicable to the screening equipment can be found in Appendix C: Terms and Conditions for Preselected Suppliers.

1.2 INTENT

- .1 The intent of these specifications is to provide the works fully complete in every detail for the purpose designated. Provide any apparatus, appliance material or labour not specifically mentioned or included, but requisite to the operation of the apparatus and equipment specified without additional expense to the Contract.

1.3 REFERENCES

- .1 ASTM D2241-24, Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe, SDR Series.
- .2 ASTM D1785-21A, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
- .3 ASTM A126-04(R2023), Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
- .4 CSA C22.2 No. 100-14(R2024), Motors and Generators.
- .5 ASTM A240/A240M-24A, Standard Specification for Chromium and Chromium - Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications.
- .6 IEEE 112-2017, Standard Test Method Procedures for Polyphase Induction Motors and Generators.
- .7 Equipment assemblies, composed of electro-mechanical components must be CSA or cUL certified or certified by an agency approved by the Electrical Inspection authority having jurisdiction and bear the appropriate label. If the Equipment is not certified by an approved certification agency, the Pre-Selected Equipment Supplier will arrange and pay for spot approval of the Equipment prior to installation.

1.4 DESIGN CRITERIA (FOR INFORMATION)

- .1 The control system will be capable of controlling/monitoring the following equipment:
 - .1 SBR Blowers.
 - .2 Sludge Blowers.
 - .3 Automated influent, decant, and air control valves (as required for the system proposed).
 - .4 Submersible WAS pumps.
 - .5 SBR decanter assemblies.
 - .6 Level indicating equipment.
 - .7 Dissolved oxygen sensors.
 - .8 Grit chamber air flow meter.

1.5 SUBMITTALS

- .1 The Pre-Selected Equipment Supplier will provide shop drawings, showing any required installation details, in accordance with Section 01 33 00.
- .2 Provide any additional shop drawings as required by the Consultant for a complete review of the SBR installation.

1.6 IDENTIFICATION OF EQUIPMENT

- .1 Confirm pre-selected equipment has been fitted with the manufacturer's identification nameplates indicating size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power motors, all factory supplied.

1.7 OPERATION AND MAINTENANCE MANUALS

- .1 Assist the Pre-Selected Equipment Supplier in providing operation and maintenance data for incorporation into Operation and Maintenance Manuals as specified in Section 01 78 00.
- .2 Provide one (1) complete set of special tools in the equipment supply.

PART 2 - PRODUCTS

2.1 PRE-SELECTED SBR PROCESS EQUIPMENT

- .1 Copies to the reviewed shop drawings are available upon request to the Consultant.

PART 3 - EXECUTION

3.1 DELIVERY

- .1 Have equipment shipped to the Site pre-assembled where possible, taking into account the access points.
- .2 Coordinate delivery and storage with the Owner and Pre-Selected Equipment Supplier.

3.2 INSTALLATION

- .1 Handle and install equipment in strict accordance with manufacturer's instructions. Confirm such instructions are issued at time of shop drawing issue and are available on site when required.
- .2 Take all necessary field dimensions to ensure accurate and proper fitting of the work and equipment supplied into the building. Make up or break down equipment into sections sized for easy transportation into and through the building to final location without alteration or damage to the building.
- .3 Provide openings as required to accommodate shafts, stems, beams, conduit and the like passing through the structure, at no additional cost to the Contract.
- .4 Provide temporary supports, hoists, and bracing to prevent overloading of the structure while equipment is being installed. Confirm weights of equipment with the manufacturer.
- .5 Provide cast-in-place concrete equipment attachments as required by the equipment and as shown on the Drawings.
- .6 Provide correct type and full number, size and length of anchor bolts and other connecting bolts as required by equipment manufacturer. Preset anchor bolts in concrete where convenient; otherwise leave suitable openings in concrete and set anchor bolts later using Red-Head Epoxy anchors or other approved fastening methods.
- .7 Coordinate location and provide items for embedding into cast-in-place concrete.

3.3 RESPONSIBILITY OF TEMPORARY TRAIL USAGE

- .1 Obtain written permission from the Consultant to use and test permanent equipment and systems prior to acceptance by the Owner.
- .2 The guarantee period must not be affected by temporary trial use of the equipment.
- .3 Clean and renew equipment and systems used before acceptance. Restore to original or new working condition.
- .4 Protect equipment and systems openings from dirt, dust, and other foreign materials during temporary usage.

3.4 INSPECTION, TESTING AND START-UP

- .1 The Pre-Selected Equipment Supplier will provide the services of competent servicemen, mechanics or other trained personnel to check the complete installation and be present for start-up of the equipment. The Pre-Selected Equipment Supplier will submit a written report to the Consultant stating the following:
 - .1 That a satisfactory installation of equipment has been performed and outlining any modifications that have been made as a result of the commissioning or testing of the equipment at no additional cost to the Contract.
 - .2 That the equipment is now ready for permanent operation.
 - .3 Test installed equipment with actual plant operation to verify hydraulic balancing, head loss and effluent quality. Make adjustments required to place equipment into operation and to optimize the operation.
- .2 The Pre-Selected Equipment Supplier will fully instruct the permanent operator of the equipment in the proper operation and maintenance of all equipment at no additional cost to the Contract.
- .3 Replace defective material or equipment with new material or equipment. Bear costs including re-testing and repairing.
- .4 Coordinate with the Pre-Selected Equipment Supplier for the duration of a minimum period of twelve (12) days on site for skilled supervision and instruction and a minimum of three (3) trips to the site by the Pre-Selected Equipment Supplier. Provide as many trips and days on site as required to complete the installation and put the equipment into satisfactory operation.

3.5 PERFORMANCE TESTING AND COMMISSIONING

- .1 Along with the Pre-Selected Equipment Supplier, commission equipment in accordance with Section 01 91 13.
- .2 Final acceptance includes the successful completion of commission at the design criteria indicated herein.
- .3 Provide all necessary labour, equipment and accessories to complete commissioning.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This Section specifies requirements for the coordination of delivery, installation, field testing and placement into operation of the Ultraviolet (UV) disinfection equipment and all appurtenances required for an operating ultraviolet disinfection system.
- .2 The UV system disinfection system has been pre-selected by the Owner. The Pre-Selected Equipment Supplier is Trojan Technologies. Copies of the reviewed shop drawings are available upon request to the Consultant.

1.2 INTENT

- .1 The intent of these specifications is to provide the mechanical and electrical works fully complete in every detail for the purpose designated. Furnish any apparatus, appliance, material, or labour not herein specifically mentioned or included but requisite to the operation of the apparatus and equipment specified without additional expense to the Owner.

1.3 REFERENCE

- .1 The Work must conform to the applicable requirements of the National Building Code and National Plumbing Code of Canada, National Fire Protection Association, Underwriters Laboratories of Canada, and referenced standards throughout these Specifications of the American National Standards Institute (ANSI), American Society of Mechanical Engineers (ASME), American Water Works Association (AWWA), American Society of Testing and Materials (ASTM), Canadian Standards Association (CSA) , and the Canadian General Standards Board (CGSB).
- .2 Equipment assemblies comprised of electro-mechanical components must be CSA certified or certified by an agency approved by the Electrical Inspection authority having jurisdiction and bear the appropriate label. If the equipment in question is not certified by an approved certification agency as an assembly, arrange and pay for Spot approval and labelling of the equipment prior to installation.

1.4 DESIGN CRITERIA (FOR INFORMATION)

- .1 Pre-selected equipment will disinfect an effluent with the following characteristics:
 - .1 Design Peak Flow: Nominal 101 L/s (1600 USgpm) but not less than peak decant rate of SBR Process Equipment specified in Section 46 53 53.
 - .2 Total Suspended solids: 25 mg/L, 30-day average of grab samples.
- .2 Annual Effluent Temperature Range: 8 to 25°C.
 - .1 Ultraviolet Transmittance at 253.7 nm: 60%, minimum.

- .2 Upstream Process: Sequencing Batch Reactor (SBR).
- .3 Performance Requirements:
 - .1 Effluent standard to be achieved: 200 MPN fecal coliform/100mL (based on 30 day geometric mean), with no limit on incoming fecal coliforms.
 - .2 Minimum design dosage: MS2 Reduction Equivalent Dose (RED) of 30 mJ/cm² at peak flow, in effluent with a UV Transmission of 60% at end of lamp life after reductions for quartz sleeve fouling. The basis for evaluating the RED will be the independent third-party bioassay, without exception. Bioassay validation methodology to follow applicable protocols described in NWRI Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse (May 2003, 2012) and 2006 USEPA UVDGM.

1.5 SUBMITTALS

- .1 The Pre-Selected Equipment Supplier will provide shop drawings showing any required installation details in accordance with Section 01 33 00.

1.6 IDENTIFICATION OF EQUIPMENT

- .1 Confirm equipment has been fitted with the manufacturer's identification nameplates indicating size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power motors, all factory supplied.

1.7 OPERATION AND MAINTENANCE

- .1 Assist the Pre-Selected Equipment Supplier in providing operation and maintenance data for inclusion in the Operations and Maintenance manuals, in accordance with Section 01 78 00.

PART 2 - PRODUCTS

2.1 PRE-SELECTED ULTRAVIOLET DISINFECTION SYSTEM

- .1 Copies of the approved shop drawings are available upon request to the Consultant.

PART 3 - EXECUTION

3.1 DELIVERY

- .1 Have equipment shipped to the Site pre-assembled where possible, taking into account the access points.
- .2 Coordinate delivery and storage with the Owner and Pre-Selected Equipment Supplier.

3.2 INSTALLATION

- .1 Handle and install equipment in strict accordance with manufacturer's instructions. Confirm such instructions are issued at time of shop drawing issue and are available on site when required.
- .2 Take all necessary field dimensions to ensure accurate and proper fitting of the work and equipment supplied into the building. Make up or break down equipment into sections sized for easy transportation into and through the building to final location without alteration or damage to the building.
- .3 Provide openings as required to accommodate shafts, stems, beams, conduit and the like passing through the structure, at no additional cost to the Contract.
- .4 Provide temporary supports, hoists, and bracing to prevent overloading of the structure while equipment is being installed. Confirm weights of equipment with the manufacturer.
- .5 Provide cast-in-place concrete equipment attachments as required by the equipment and as shown on the Drawings.
- .6 Provide correct type and full number, size and length of anchor bolts and other connecting bolts as required by equipment manufacturer. Preset anchor bolts in concrete where convenient; otherwise leave suitable openings in concrete and set anchor bolts later using Red-Head Epoxy anchors or other approved fastening methods.
- .7 Coordinate location and provide items for embedding into cast-in-place concrete.

3.3 RESPONSIBILITY OF TEMPORARY TRAIL USAGE

- .1 Obtain written permission from the Consultant to use and test permanent equipment and systems prior to acceptance by the Owner.
- .2 The guarantee period must not be affected by temporary trial use of the equipment.
- .3 Clean and renew equipment and systems used before acceptance. Restore to original or new working condition.
- .4 Protect equipment and systems openings from dirt, dust and other foreign materials during temporary usage.

3.4 INSPECTION, TESTING, AND START-UP

- .1 The Pre-Selected Equipment Supplier will provide the services of competent servicemen, mechanics or other trained personnel to check the complete installation and be present for start-up of the equipment. The Pre-Selected Equipment Supplier will submit a written report to the Consultant stating the following:
 - .1 That a satisfactory installation of equipment has been performed and outlining any modifications that have been made as a result of the commissioning or testing of the equipment at no additional

cost to the Contract.

- .2 That the equipment is now ready for permanent operation.
- .3 Test installed equipment with actual plant operation to verify hydraulic balancing, head loss and effluent quality. Make adjustments required to place equipment into operation and to optimize the operation.
- .2 The Pre-Selected Equipment Supplier will fully instruct the permanent operator of the equipment in the proper operation and maintenance of all equipment at no additional cost to the Contract.
- .3 Replace defective material or equipment with new material or equipment. Bear costs including re-testing and repairing.
- .4 Coordinate with the Pre-Selected Equipment Supplier to provide a minimum period of two (2) days on site for skilled supervision and instruction and a minimum of two (2) trips, by the Pre-Selected Equipment Supplier. Provide as many trips and days on site as required to complete the installation and put the equipment into satisfactory operation.

3.5 PERFORMANCE TESTING AND COMMISSIONING

- .1 Along with the Pre-Selected Equipment Supplier, commission equipment in accordance with Section 01 91 13.
- .2 Final acceptance includes the successful completion of commission at the design criteria indicated herein.
- .3 Provide all necessary labour, equipment and accessories to complete commissioning.

END OF SECTION

APPENDIX A

Geotechnical Investigation Report, Wastewater Treatment Plant, Lunenburg, NS



Geotechnical Investigation Report

Wastewater Treatment Plant
Lunenburg, NS

Lisa Kendall, EIT
Town of Lunenburg



Geotechnical and Materials Engineers

Project # 210803.03 | April 12, 2022

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1 | Introduction

Conquest Engineering, a division of CBCL Limited, have conducted a geotechnical investigation for the proposed equalization and sequencing batch reactor tanks at 125 Starr Street (Wastewater Treatment Plant) in Lunenburg, Nova Scotia, at the request of the Town of Lunenburg. The purpose of this investigation was to evaluate the subsurface conditions at the site and to provide geotechnical recommendations for construction and design.

This report presents our findings and our geotechnical recommendations for foundation design and general site work.

2 | Site Description and Geology

The site is located at the existing wastewater treatment plant along Starr Road in Lunenburg, NS.

The tanks are proposed to the north of the existing bioreactor. This area is generally flat with a gravel surface. It is understood this area was previously used as a landfill.

A small embankment, approximately 1 m to 1.5 m high, is located on the north side of the existing bioreactor.

Surficial geologic mapping indicates the area generally consists of silty till plains and drumlins. Bedrock in the area is mapped as slate with minor siltstone and metasandstone of the Cunard Formation, which is part of the Halifax Group. This formation is known to commonly have sulphide minerals and be prone to acid rock drainage.

3 | Summarized Subsurface Conditions

The field program consisted of five (5) boreholes completed between February 22 and 24, 2022. A monitoring well was installed within borehole BH-22-01. Slug testing was conducted within the monitoring well on March 16, 2022. Following the test, water levels were measured between March 16 and 22, 2022, using a data logger.

The borehole locations are shown in Drawing 1 in Appendix A.

The boreholes were conducted using a tracked drill rig. Representative samples were taken during the field work and the conditions at the boreholes were logged in detail. The subsurface conditions encountered at the site are described in detail on the appended Borehole Records and summarized below in the following paragraphs and Table 1.

The subsurface conditions encountered throughout the site generally consist of the following profile:

- FILL
- GLACIAL TILL (encountered in boreholes BH-22-02, BH-22-04, and BH-22-05)
- RESIDUAL SOIL (encountered in borehole BH-22-01)
- BEDROCK

The fill generally consisted of silty sand to silty sand with gravel. Debris (metal, brick, plastic, wood, etc.) was encountered throughout. Within borehole BH-22-01, a 1.6 m layer of the fill primarily consisted of wood fragments. Fill ranged in thickness from 4.0 m to 5.0 m.

Glacial till was encountered in most boreholes beneath the fill. The glacial till generally consisted of compact to dense silty SAND with gravel (SM) to silty GRAVEL with sand (GM). Clasts of slate were common throughout the TILL. Where encountered, the TILL ranged in thickness from 1.2 m to 1.4 m.

Residual soil (bedrock that has weathered into soil) was encountered in borehole BH-22-01, below the fill. The residual soil generally consisted of silty GRAVEL with sand (GM). Particles predominately consisted of slate fragments.

One (1) sample of the fill and one (1) sample of the TILL/RESIDUAL SOIL were sent to Dalhousie University for acid producing potential testing. The samples all showed less than 0.4% sulphide sulphur by weight. The results of the analysis are attached in Appendix D.

Bedrock was encountered at all the borehole locations at depths between 5.0 m and 5.9 m. Bedrock generally consisted of slate with quality increasing with depth. Pyrite crystals were observed throughout the bedrock.

Unconfined compressive strength testing conducted on one (1) sample of the bedrock showed a result of 58.4 MPa. This is considered strong.

Several samples of bedrock were sent to Dalhousie University for acid producing potential testing. Bedrock samples all showed more than 0.4% sulphide sulphur by weight. The results of the analysis are attached in Appendix D.

Groundwater was observed within borehole BH-22-01 at a depth of 3.7 m on February 24, 2022. Between March 16 and 22, 2022, it was observed at a depth of 4.0 m. Its level does not appear to be influenced by the tides.

The groundwater level was not determined at the other borehole locations due to the influence of drilling water.

Slug testing was conducted within the monitoring well in borehole BH-22-01. Results showed the hydraulic conductivity, K, of the material below the groundwater level to be 21.6 m/day (2.5×10^{-2} cm/s).

Table 1: Summary of Findings

Location	Approximate Elevation (m) ¹	Coordinates (m) ²	Thickness of FILL (m)	Depth to TILL (m)	Depth to RESIDUAL SOIL (m)	Depth to BEDROCK (m)	Groundwater Depth (m)	Depth of Borehole (m)
BH-22-01	4.9	N 4915264.0 E 394969.0	4.4	--	4.4	5.9	3.7 ³	9.2
BH-22-02	4.9	N 4915263.0 E 394984.0	4.1	4.1	--	5.4	ND ⁴	9.3
BH-22-03	4.8	N 4915249.7 E 394963.2	5.0	--	--	5.0	ND ⁴	9.3
BH-22-04	4.8	N 4915266.0 E 394954.0	4.7	4.7	--	5.9	ND ⁴	9.3
BH-22-05	4.8	N 4915280.0 E 394972.0	4.0	4.0	--	5.4	ND ⁴	9.1

Notes:

¹Geodetic Datum (CGVD2013). Elevation based on LiDAR data.

²Coordinate system UTM Zone 20, NAD83.

³Measured on February 24, 2022.

⁴ND – Not determined (due to influence of drilling water).

4 | Discussions and Recommendations

It is understood that a new equalization tank and two (2) sequencing batch reactor (herein referred to as SBR) tanks are proposed. The equalization tank is proposed to be 26.5 m long and 4 m wide. The SBR tanks are each proposed to be 26.5 m long and 8.8 m wide. It is currently understood that all tanks will be 6 m to 7 m high and will extend 1 m above the existing ground surface.

4.1 | Main Findings

The main findings/recommendations from our investigation are as follows:

- ▶ Based on proposed depth of the tanks, the foundation should be within the glacial till, residual soil, or bedrock.
- ▶ A foundation system with footings founded on bedrock, glacial till or residual soil would be practical for this site; however, a 300 mm thick layer of DTIR Type 1 Gravel is recommended below the footings in the case that till or residual soil is encountered at the footing base elevation.
- ▶ Excavations will be complicated by groundwater inflow. Installation of water controls prior to the commencement of excavations will be important.

► Geotechnical inspection of earthworks is recommended.

The following sections outline our geotechnical recommendations for site preparation and design.

4.2 | Earthworks

4.2.1 Surface Water and Erosion Control

Prior to excavations, surface water drainage controls should be provided on the up-gradient side of the site to minimize run-off onto exposed soils. Suitable erosion and sedimentation control measures should be employed. These may include silt fences, check dams in ditches, and granular working pads.

4.2.2 Excavation

Within the proposed tank areas, the existing fill should be removed. Where the material encountered at footing base elevation consists of glacial till or residual soil, we recommend a 300 mm thick layer of DTIR Type 1 Gravel below the footing.

Depending on the proposed footing elevation, excavation into bedrock may be required. Bedrock was encountered at depths between 5.0 m and 5.9 m. Any reuse or disposal of the sulphide-bearing material must be done according to the requirements of Nova Scotia Environment.

Assuming that the water table has been lowered to a depth below the planned excavation prior to construction, a three horizontal to one vertical (3H:1V) slope may be required. However, temporary slopes should be reviewed by geotechnical personnel during construction.

Care will have to be taken to ensure that any surrounding structures are not undermined due to site excavations. Assuming the tanks are founded 6 m below grade, anything within 18 m of the edge of the tank may have to be supported with shoring. We should be contacted as the design progresses to review the need for shoring.

4.2.3 Dewatering of Excavations

The contractor undertaking the earthworks must be prepared to dewater excavations. Structural fill and footings should not be placed in standing water, slough, or over softened bearing soils.

Excavations will be complicated by groundwater inflow. Installation of water controls prior to the commencement of excavations will be important.

A preliminary review of the conditions indicates a pumping rate of at least 100 m³/day may be required to dewater the excavation within two (2) hours.

Discharge from the dewatering activities must be carried out in strict accordance with environmental regulations. Discharge may have to be collected and/or filtered to meet environmental guidelines.

4.2.4 Structural Fill Placement and Compaction

Structural fill required throughout the site should consist of the following:

- ▶ Approved, imported, quarried rockfill or gravel

Structural fill should be placed at or near the optimum moisture content (ASTM D698).

The lift thickness used during placement of structural fill must be compatible with the compaction equipment and the material type to ensure the specified density throughout. For preliminary consideration, the lift thickness should not exceed approximately 300 mm for mass filling and 200 mm for backfilling foundations. The maximum particle size should be no larger than $\frac{2}{3}$ of the lift thickness.

Structural fill should be compacted to the following percentage of maximum Standard Proctor dry density:

▶ Structural fill within building areas	100%

Where structural fill is needed below footings, the fill must be extended laterally beyond the edges of the footings to include a 0.3 m bench and the conventional 1H:1V splay.

4.2.5 Building Area Subgrade

The contractor must take precautions to avoid disturbance of the site soils or reinstate the material to the required condition. The condition of the subgrade should be reviewed prior to placement of gravel.

4.2.6 Slopes

Permanent structural fill or cut slopes are not currently anticipated. If permanent structural fill or cut slopes are proposed, we should be contacted to review our recommendations.

4.2.7 Winter Construction

Undertaking construction in the winter is not ideal and even with the best intentions and good practices, it is very difficult to prevent all detrimental frost effects from entering the work. Winter construction guidelines are attached in Appendix E.

4.2.8 Observation and Testing

It is recommended that all footing bearing surfaces be observed by an experienced geotechnical engineer prior to placement of concrete. Observation and testing are also recommended during site grading and backfilling operations.

4.3 | Foundations

Conventional strip and spread footings may be utilized for the proposed foundation system. Recommendations for site preparation are provided in Section 4.2.

4.3.1 Spread/Strip Footings

For strip (continuous) and spread (square) founded directly on undisturbed bedrock, the following geotechnical bearing resistance is recommended for design:

- ▶ Factored Geotechnical Bearing Resistance (ULS): 1000 kPa
 - The settlement for footings bearing on bedrock would be negligible (<5 mm).

For foundations on bedrock, the use of lean concrete may be considered to provide a level surface for footing construction.

For strip (continuous) and spread (square) footings founded on structural fill overlying glacial till or residual soil, the following geotechnical bearing resistances are recommended for design:

- ▶ Factored Geotechnical Bearing Resistance (ULS): 275 kPa
- ▶ Geotechnical Bearing Resistance (SLS): 175 kPa

The above noted resistances for footings bearing on structural fill are based on the following assumptions:

- ▶ Footings are under level ground and are loaded concentrically
- ▶ Strip footings
 - founded a minimum of 0.6 m below grade
 - footing width of 1.0 m
- ▶ Spread footings
 - founded a minimum of 0.6 m below grade
 - footing width between 1.2 m and 2.5 m

Geotechnical bearing resistances for other footing sizes or conditions can be provided upon request.

Under service loading, total and differential settlement will be less than 25 mm and 20 mm respectively for footings on structural fill at the service bearing pressure (SLS) mentioned

above. Differential settlement may be as high as 25 mm between footings founded on bedrock and footings founded structural fill.

Exterior footings on structural fill should be founded a minimum of 1.2 m below grade for frost protection. To reduce the amount of cover, the use of insulation could be considered.

4.3.2 Tank Slab

A 150 mm thick layer of DTIR Type 1 Gravel is recommended below the tank slab for levelling and support purposes. The gravel should be compacted to 100% Standard Proctor.

A modulus of subgrade reaction, k , of 50 MPa/m may be used for design. This is based on the assumption that the slab will be uniformly loaded with a maximum pressure of 70 kPa (6 m to 7 m of water in tank). Different loading conditions will result in a different modulus of subgrade reaction.

4.3.3 Tank Walls

It is recommended that underground tank walls be designed based on backfill consisting of a granular wedge within a zone bounded by the wall and a line drawn upwards and outwards at 45 degrees from the base of the wall. Drainage from the backfill zone with a positive outlet is recommended.

For wall design, the following parameters can be used:

▶ Total unit weight of soil (saturated),	$\gamma_T = 22 \text{ kN/m}^3$ (granular backfill, such as DTIR Type 2 Gravel)
▶ Effective unit weight of soil (submerged),	$\gamma_T = 12.2 \text{ kN/m}^3$ (granular backfill, such as DTIR Type 2 Gravel)
▶ Ultimate friction factor for sliding,	$\mu = 0.4$ (cast-in-place concrete to structural fill)
▶ Ultimate friction factor for sliding,	$\mu = 0.6$ (cast-in-place concrete to bedrock)
▶ At-rest earth pressure coefficient,	$K_0 = 0.4$
▶ Angle of internal friction,	$\Phi = 38 \text{ degrees}$ (granular backfill, such as DTIR Type 2 Gravel)

The wall design should include the influence of sloping backfill, surcharge loads behind the wall, and the effects of compaction equipment.

4.4 | Seismic Classification

With the building areas prepared as discussed in the sections above, the recommended site classification for seismic site response, as per Table 4.1.8.4.B of NBCC 2020 is Site Class C.

4.5 | Additional Geotechnical Services

We should be contacted as the design progresses to review our recommendations.

5 | Closure

This report has been prepared for the sole benefit of the Client. All information, documentation or other material contained in, attached to, or forming part of this report reflects Conquest's opinion and best judgment based on the information available to us at the time of preparation. Any use or reliance on this report by the Client in circumstances where there has been a change in site conditions or for any purpose not expressly intended by or delineated in this report shall be the sole responsibility of the Client and Conquest accepts no liability for such use or reliance. Any use or reliance on this report by any third party, without Conquest's prior express written consent, shall be the sole responsibility of that third party. Conquest accepts no liability whatsoever for such use or reliance.

The information and conclusions contained in this report are generally consistent with professional standards for engineering and scientific professionals providing similar services at the same time, in similar locations and under similar circumstances.

A geotechnical field investigation is a limited sampling of a site. Some variation between sampling locations should be expected. The conclusions presented in this report represent the technical judgment of Conquest, based on the data obtained from the work and on Conquest's understanding of the project. The data obtained by Conquest is specific to the time the work was performed at the specific testing and/or sampling locations and can only be extrapolated to an undefined limited area surrounding these locations. The extent of the limited area depends on the soil and groundwater conditions, as well as the history of the site reflecting natural, construction and other activities. Due to the nature of the investigation and the limited data available, Conquest cannot and does not warrant that undiscovered environmental liabilities and/or undetected subsurface conditions may not arise.

If any conditions become apparent that differ significantly from our understanding of conditions as presented in this report, we require that we be notified immediately to allow for reassessment of the conclusions provided herein. Further, if there are changes to Client's design, we require that we be notified to allow for review and possible changes to our recommendations.

We trust this is the information you require at this time. We are available to discuss the contents of this report at your convenience.

Sincerely,

Conquest Engineering, a division of CBCL Limited



Devan McKenney, P.Eng.

Geotechnical Engineer

902-789-6046

Email: DMckenney@conquest-eng.com

APPENDIX A

Borehole Location Plan – Drawing 1



LEGEND



APPROXIMATE CONQUEST BOREHOLE LOCATIONS (FEB 2022)



PROJECT
BOREHOLE LOCATION PLAN

WASTEWATER TREATMENT PLANT
LUNENBURG, NS

JOB #: 210803.03
SCALE: NTS
DATE: 07-APR-2022
DRAWN BY: DM
CHECKED BY: MD

DOCUMENTS PREPARED BY CONQUEST ENGINEERING LTD. ARE TO BE USED ONLY FOR THE SPECIFIC PROJECT AND SPECIFIC USE FOR WHICH THEY WERE PREPARED. ANY EXTENSION OF USE TO OTHER PROJECTS, BY OWNER, OR ANY OTHER PARTY, WITHOUT THE EXPRESSED, WRITTEN AUTHORIZATION OF CONQUEST ENGINEERING LTD. IS DONE AT THE USER'S OWN RISK. IF USED IN A WAY OTHER THAN WHAT WAS SPECIFICALLY INTENDED, THE OWNER WILL HOLD CONQUEST ENGINEERING LTD. HARMLESS FROM ALL CLAIMS AND LOSSES.

DRAWING:
1
REV:
0

APPENDIX B

Symbols and Terms used on Borehole and Test Pit Records

SOIL DESCRIPTION

Terminology describing common soil genesis:

<i>Topsoil</i>	variable mixture of mineral particles and organic matter
<i>Peat</i>	decomposing vegetative matter having fibrous and/or amorphous structure
<i>Till</i>	unstratified glacial deposit which may range from clay to boulders
<i>Fill</i>	any materials below the surface identified as placed by humans (excluding buried services)

Terminology describing soil structure:

<i>Desiccated</i>	having visible signs of weathering by oxidation of clay minerals, shrinkage cracks, etc.
<i>Fissured</i>	having cracks, and hence a blocky structure
<i>Varved</i>	composed of regular alternating layers of silt and clay
<i>Stratified</i>	composed of alternating successions of different soil types, e.g. silt and sand
<i>Layer</i>	>75 mm
<i>Seam</i>	2 mm to 75 mm
<i>Parting</i>	< 2 mm
<i>Well Graded</i>	having wide range in grain sizes and substantial amounts of all intermediate particle sizes
<i>Uniformly Graded</i>	predominantly of one grain size

Terminology describing soils on the basis of grain size and plasticity is based on the ASTM D2488 – Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). The classification excludes particles larger than 76 mm (3 inches). This system provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification.

Terminology describing materials outside the USCS, (e.g. particles larger than 76 mm, visible organic matter, construction debris) is based upon the proportion of these materials present:

<i>Trace, or occasional</i>	Less than 10%
<i>Some</i>	10-20%
<i>Frequent</i>	Greater than 20%

The standard terminology to describe cohesionless soils includes the compactness as determined by laboratory test or by the Standard Penetration Test 'N' – value.

Relative Density	'N' Value	Compactness %
<i>Very Loose</i>	<4	<15
<i>Loose</i>	4-10	15-35
<i>Compact</i>	10-30	35-65
<i>Dense</i>	30-50	65-85
<i>Very Dense</i>	>50	>85

The standard terminology to describe cohesive soils includes the consistency, which is based on undrained shear strength as measured by in-situ vane tests, penetrometer tests, unconfined compression tests, or occasionally by standard penetration tests.

Consistency	Undrained Shear Strength (Su)		'N' Value
	Kips/sq.ft.	KPa	
<i>Very Soft</i>	< 0.25	< 12.5	< 2
<i>Soft</i>	0.25 – 0.5	12.5 – 25	2 – 4
<i>Firm</i>	0.5 – 1.0	25 – 50	4 – 8
<i>Stiff</i>	1.0 – 2.0	50 – 100	8 – 15
<i>Very Stiff</i>	2.0 – 4.0	100 – 200	15 – 30
<i>Hard</i>	> 4.0	> 200	> 30

ROCK DESCRIPTION

Rock Quality Designation (RQD)

The classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be due to close shearing, jointing, faulting, or weathering in the rock mass and are not counted. RQD was originally intended to be done on N-size (45 mm) core; however, it can be used on different core sizes if the bulk of the fractures caused by drilling stresses are easily distinguishable from in situ fractures.

RQD	ROCK QUALITY
90 – 100	Excellent, intact, very sound
75 – 90	Good, massive, moderately jointed or sound
50 – 75	Fair, blocky and seamy, fractured
25 – 50	Poor, shattered and very seamy or blocky, severely fractured
0 – 25	Very poor, crushed, very severely fractured

Terminology describing rock mass:

Spacing (mm)	Bedding, Laminations, Bands	Discontinuities
2000 – 6000	<i>Very Thick</i>	<i>Very Wide</i>
600 – 2000	<i>Thick</i>	<i>Wide</i>
200 – 600	<i>Medium</i>	<i>Moderate</i>
60 – 200	<i>Thin</i>	<i>Close</i>
20 – 60	<i>Very Thin</i>	<i>Very Close</i>
< 20	<i>Laminated</i>	<i>Extremely Close</i>
< 6	<i>Thinly Laminated</i>	

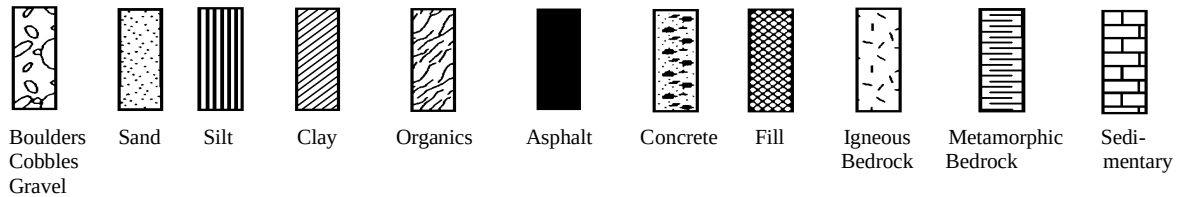
Strength Classification	Uniaxial Compressive Strength (MPa)
<i>Very Weak</i>	1 – 5
<i>Weak</i>	5 – 25
<i>Medium Strong</i>	25 – 50
<i>Strong</i>	50 – 100
<i>Very Strong</i>	100 – 250
<i>Extremely Strong</i>	> 250

Terminology describing weathering:

<i>Slight</i>	- Weathering limited to the surface of major discontinuities. Typically iron stained.
<i>Moderate</i>	- Weathering extends throughout rock mass. Rock is not friable.
<i>High</i>	- Weathering extends throughout rock mass. Rock is friable.

STRATA PLOT

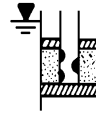
Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols:



WATER LEVEL MEASUREMENT



Borehole or
Standpipe



Piezometer

SAMPLE TYPE AND/OR FIELD TESTS

SS	Split Spoon Sample (obtained by performing the Standard Penetration Test)	AS	Auger Sample
ST	Shelby Tube or Thin Wall Tube	BS	Bulk Sample
PS	Piston sample	WS	Wash Sample
DC	Dynamic Cone Penetration	HQ, NQ, BQ, etc.	Rock Core Samples (obtained with the use of standard size diamond drilling bits)
FSV	Field Shear Vane		

N- VALUE

Numbers in this column are the results of the SPT (Standard Penetration Test): the number of blows of a 140 pound (64kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (305 mm) into the soil. For split spoon samples where insufficient penetration was achieved and 'N' values cannot be presented, the abbreviation SSR (Split Spoon Refusal) will appear in place of a numerical value.

OTHER TESTS

Symbols in this column indicate that the following laboratory tests have been carried out and the results are presented separately.

S	Sieve analysis	H	Hydrometer analysis
G _s	Specific gravity of soil particles	γ	Unit weight
k	Permeability	C	Consolidation
	Single packer permeability test; test interval from depth shown to bottom of borehole	CD	Consolidated drained triaxial
	Double packer permeability test; Test interval as indicated	CU	Consolidated undrained triaxial with pore pressure measurements
	Falling head permeability test using casing	UU	Unconsolidated undrained triaxial
	Falling head permeability test using well point or piezometer	DS	Direct shear
		Q _u	Unconfined compression
		I _p	Point Load Index (I _p on Borehole Records equals I _p (50); the index corrected to a reference diameter of 50 mm)
		MSV	Laboratory Miniature Shear Vane

APPENDIX C

Borehole Records

Conquest Engineering
Experience commitment.

A division of CBCL Limited

Water Level: 3.7 m

Water Level Date: Feb 24, 2022

[illegible]

CE **Conquest Engineering**
Experience commitment.

CBCL A division of CBCL Limited

Water Level: --

Water Level Date: --

[illegible]

BH - 22-03
Date Drilled: February 23, 2022
Page: 1 of 1
Datum: Geodetic (CGVD2013)
Water Level Date: --

CE **Conquest Engineering**
Experience commitment.

CBCL A division of CBCL Limited

Water Level: --

Water Level Date: --

[illegible]

Conquest Engineering
Experience commitment.

A division of CBCL Limited

Water Level: --

Water Level Date: --

[illegible]

APPENDIX D

Acid Producing Potential Test Results – Dalhousie University

March 3, 2022

Conquest Engineering Ltd.
348 Bluewater Road
Bedford, NS
B4B 1J6
Attention: Matt Davidson

minerals.engineering.dal.ca
Tel: 902.497.3958
Email: mec@dal.ca

Re: Results of analysis on submitted samples, acid producing potential based on sulphide sulphur content if available.

Project # 210803.03

Sample	Wt. %		kg/t
	S(Total)	S(Sulphide)	Acid Producing Potential
BH22-01, 21'6"	3.843	3.836	117.36
BH22-02, 27'4"	4.733	4.721	144.40
BH22-02, 27'4"	4.912		150.25
BH22-05, 12'8"	0.114		3.50
BH22-05, 17'7"	0.367		11.22
BH22-05, 17'7" Dup	0.344		10.53

Reference Sample:	Wt. %
	S (Total)
KZK-1 (0.80% S)	0.808



Digitally signed by
Daniel Chevalier,
MAsc
Date: 2022.03.07
10:53:50 -04'00'

Daniel Chevalier, MAsc
Manager, Minerals Engineering Centre

APPENDIX E

Geotechnical Guidelines for Winter Construction

Geotechnical and Materials Engineers

The following are general geotechnical recommendations for earthworks for building areas in winter conditions.

General

- Earthworks conducted during freezing conditions are suspect. Special procedures and precautions must be exercised to minimize the risk of future problems.
- A site meeting should be held at project start-up to discuss the schedules of the various contractors in relation to the following geotechnical recommendations.

Excavation

- The rootmat/topsoil layer and any overlying snow will reduce the frost penetration. Conducting only the excavation work required for each day of work is recommended to minimize freezing of the soil in the foundation areas.
- Excavated material to be used as structural fill should not be stockpiled, but should be placed and compacted immediately after excavation.

Fill Placement

Based on our experience, it is generally impractical to place well-graded gravel, sand, or fine-grained soils in temperatures lower than about -5 degrees Celsius. On very cold days, loose material starts to freeze within about 15 minutes. At temperatures below -5 degrees Celsius, clear gravel or clear rockfill is recommended but subject to design considerations governing the work.

The following provides recommendations for all structural fill types.

- Structural fill placement should be conducted in small areas. Depending on the temperature, this may allow for continuous placement of fill lifts during the work day without the requirement for excavation of frozen material prior to placement of the next lift.
- Material containing snow or ice should not be incorporated in the work. During snow events, fill placement should be stopped. When the earthwork restart, all snow and ice should be removed from the fill surface prior to subsequent fill placement. In order to remove all snow and/or ice after a snow event, some of the underlying fill may have to be removed and wasted.
- For intermediate fill lifts, frost protection (e.g.; straw, insulated tarp, etc) should be provided at the end of the work day, or alternatively, fill that freezes overnight should be removed in the morning. Also, any snow or ice should also be removed. Fill surfaces should be sloped to prevent ponding of water during milder weather.

- The final fill surface, the base of footing excavations and slab subgrade should be protected from freezing. If the final fill surface is exposed to freezing temperatures, heat will be required to thaw the soil. Test pits and temperature readings could be completed to determine if the soil is above freezing. Consideration should also be given to the installation of thermocouples in the fill during placement, as a means of reading temperatures at depth. The areas that were frozen should be proof-rolled.
- The moisture content of fill materials should be approximately 2% below optimum. Fill materials with moisture contents above the optimum should not be used.
- Loose edges of the structural fill lifts should be avoided to reduce frost penetration. Edges of fill lifts should be tapered and compacted.
- Regular checks of the temperature of the fill should be made. The soil temperature should be greater than +2°C to allow for compaction to the specified degree.

Footing Construction

- Footings should not be placed on frozen material.
- Where the footing elevation is within approved finer-grained materials, we recommend over-excavation by at least 6 inches and placement of nominal 1 inch stone or other clean gravel. This will reduce disturbance of the bearing surface.
- Following construction of footings, temporary frost protection must be provided to avoid freezing of the bearing surface and for protection of the concrete during curing.
- Consideration should be given to specifying that the footing depth for interior foundations be 1.2 m below slab subgrade for frost protection during construction; or alternatively, fill could be temporary bermed over interior footings to provide insulation.
- Foundations should be backfilled with a free-draining granular material and drainage provided to prevent adfreeze of foundations, particularly during construction.
- Cast-in-place concrete should be protected during colder weather conditions as per CSA A23.1-2009.

Geotechnical Inspection and Testing

The information herein should be reviewed by geotechnical personnel and customized to the specific geotechnical aspects and design considerations of a site. Full-time inspection and testing by experience geotechnical personnel is particularly important during earthworks in winter conditions and is strongly recommended.



Geotechnical and Materials Engineers

Saint John | Moncton | Fredericton | Halifax
<https://www.conquest-eng.com/>

APPENDIX B

Limited Environmental Site Assessment

June 7, 2024

Town of Lunenburg
119 Cumberland Street
Lunenburg, NS B0J 2C0

*RE: Limited Environmental Site Assessment, Town of Lunenburg WWTP Upgrade & Expansion
Design & Engineering Services, Lunenburg, Nova Scotia*

Introduction

CBCL Limited (CBCL) was commissioned by the Town of Lunenburg (TOL) to complete a Limited Environmental Site Assessment (ESA) at a property located at 125 Starr St, Lunenburg, NS B0J 2C0 (PID 60057791), as part of the TOL WWTP Upgrades Design and Engineering Services project (TOL 2023016).

The purpose of this investigation was to conduct a Limited ESA of subsurface soils and groundwater conditions at the Site; with the objective of confirming the absence/presence of contamination within the area(s) studied.

Background

The subject property is situated at 125 Starr Street and is home to the TOL's existing wastewater treatment plant. In its entirety, the property (PID 60057791) is 13.5 acres in area, however, this Limited ESA focused on an approximate 2.2 acre portion of the property that borders Starr Street (i.e., in the vicinity of the extent of the TOL WWTP Upgrade and Expansion.

The property currently houses the TOL's existing wastewater treatment plant and associated administrative offices. A parking area and driveway off Starr Street are located to the southwest and southeast of the building, and a driveway connects the parking area to the WWTP, located on the north side of the administrative building.

A site location plan and site plan are provided in Figures 1 and 2 (Attachment A). As noted, this Limited ESA focused investigative efforts in the vicinity of the existing WWTP, a location that CBCL understands to be historically occupied by a landfill and incinerator. The spatial limitation of the ESA is important to distinguish at the outset of this report, as CBCL also understands there to have been other potentially contaminating activities conducted within PID 60057791 historically (i.e., a former ESSO Bulk Oil Storage facility and a C&D disposal site), which were not studied as part of this Limited ESA.

Methodology

A Limited ESA consisting of soil and groundwater sampling throughout the infilled area in the vicinity of the former landfill area (i.e., the current WWTP facility) was conducted in order to confirm the absence/presence of contamination within the area studied. The Limited ESA consisted of the following scope items, as further described herein.

Underground Utility Locates

Underground utility locates were performed by MacIsaac Locating Ltd. on April 11, 2024 in the vicinity of the proposed borehole installation locations.

Borehole Drilling and Monitoring Well Installation

CBCL mobilized to the site on April 12, 2024, alongside Nova Drilling of Mount Uniacke, NS, and drilled a total of five boreholes, as detailed on the soil boring / monitoring well installation logs provided in Attachment E. Boreholes were advanced using solid stem auger methodology to depths ranging from 4.57 to 6.10 metres below ground surface (mbgs). Split spoon samples, collected at 0.6 metres intervals, provided insight into subsurface conditions which were logged continuously during drilling (dependent on core recovery).

Soil samples for laboratory analysis were collected from discrete intervals within each of the boreholes, as detailed in Table 1 below. All of the soil samples were screened for volatile organic compounds (VOCs) using a MiniRAE Photoionization detector (PID) meter. As detailed in Table 1 below, depending on location, soil samples were submitted to Bureau Veritas Laboratories for the analysis of petroleum hydrocarbons (BTEX/TPH), metals, polycyclic aromatic hydrocarbons (PAHs), glycols, cyanide, pesticides/herbicides, and dioxins/furans . Site photographs are provided in Attachment B. A description of the soil samples is provided in Table 1 below.

Table 1: Soil Sample Descriptions

Sample ID	Depth (mbgs)	Description	PID Readings (ppm)	Laboratory Analyses
24MW01 SS4	1.8-2.4	Fine dark brown silty sand with some gravel	5.8	PHCs, Metals, PAHs,
24MW02 SS2	0.61-1.2	Fine to medium brown/black sand, Some glass present within.	2.4	PHCs, Metals, PAHs,
24MW03 SS2	0.61-1.8	Fine to medium brown/black sand with some gravel	1.8	Glycols, Cyanide, Pesticides/Herbicides, Dioxins/Furans

Sample ID	Depth (mbgs)	Description	PID Readings (ppm)	Laboratory Analyses
24MW03 SS3 ¹	1.8-3.0	Coarse brown sand and gravel	3.4	PHCs, Metals, PAHs,
24MW04 SS2	1.8-2.4	Brown medium to coarse silty sand and gravel	20.6	PHCs, Metals, PAHs, VOCs,
24MW05 SS4	3.0-3.7	Brown medium to coarse silty sand and gravel	0.6	PHCs, Metals, PAHs,

Notes:

1. Field duplicate 24MW100 collected here (PHC analysis only)

The soil results were compared to the Nova Scotia Environment and Climate Change (NSECC) Tier 1 Environmental Quality Standards (EQS) for soil, for a commercial property with non-potable groundwater, and coarse-grained soil. Additionally, soil results were compared to the Nova Scotia Guidelines for Disposal of Contaminated Solids in Landfills. The results are discussed in Section 4.0, analytical tables and laboratory certificates are provided in Appendices C and D, respectively.

Monitoring Well Development

The newly installed monitoring wells were developed in an effort to minimize the amount of turbidity in the wells. The wells were developed using dedicated Waterra tubing by removing three to five well volumes during the drilling program and purged using the below low flow sampling technique prior to sampling.

Groundwater Sampling

CBCL mobilized to the site on April 16, 2024, to collect a total of six groundwater samples (five field samples and one field duplicate samples) from the recently installed monitoring wells 24MW01 to 24MW05. Low flow groundwater sampling, using a peristaltic pump, was conducted at each well.

Field parameters were monitored using a decontaminated flow-through cell and readings were collected every three to five minutes (along with pump rate). Specific conductivity, pH, dissolved oxygen (DO) and temperature were measured until at least three consecutive stabilized readings are obtained. Stabilization of parameters is determined as follows: pH +/-0.1 units; conductivity +/- 3%; and, DO +/- 10% (temperature to be measured but stabilization not required). Drawdown was also monitored during low flow purging and recorded every three to five minutes, as per other parameters above.

There was sufficient water in each well to stabilize the groundwater chemistry parameters while pumping at a low flow rate (i.e., approximately 150 mL/min). Samples were collected in laboratory supplied sampling bottles and kept on ice until they were transported to the lab for analysis. All

metals samples were field filtered and preserved prior to transport to the lab. Groundwater samples were submitted for laboratory analyses as detailed in Table 2 below.

Table 2: Groundwater Sample Descriptions

Sample ID	Laboratory Analyses
24MW01	PHCs, Metals, PAHs
24MW02	PHCs, Metals, PAHs
24MW03 ¹	PHCs, Metals, PAHs, Glycols, Cyanide, Pesticides/Herbicides, Dioxins/Furans
24MW04	PHCs, VOCs, Metals, PAHs
24MW05	PHCs, Metals, PAHs

Notes:

1. Field duplicate 24MW100 collected here (PHC analysis only)

Results

Soil Analytical Results

All parameters analyzed for PHC, PAH, VOC, Glycol, and Pesticides/Herbicides analytical suites were reported below laboratory detection limits and/or the NSECC Tier 1 EQS in all of the soil samples submitted for laboratory analysis.

Laboratory analysis of available metals showed exceedances of the NSECC Tier 1 EQS for antimony, iron, lead, and manganese (Table C2, Attachment C). Additionally, one location (24MW03 SS3) detected a concentration of lead (1,200 mg/kg) greater than the Nova Scotia Guideline for Disposal of Contaminated Solids in Landfills (NS Landfill Guidelines) of 1,000 mg/kg. Additionally, although not in exceedance of NSECC Tier 1 EQS, copper was also detected at a concentration (3,500 mg/kg) at 24MW02 SS2 that exceeded the NS Landfill Guideline (500 mg/kg). All other metals parameters were reported below laboratory detection limits and/or the NSECC Tier 1 EQS and NS Landfill Guidelines.

In each instance of NSECC Tier 1 EQS metals exceedances, soil samples collected from the site were also greater than the published EC Recommended Background Concentrations (95% UCL) for Central Uplands Soil Zone. Considering this, it is assumed that the observed metals concentrations are representative of site-related impacts in this area of the property, and are not exempt from notification to NSECC as per Section 5.2.4 of the NSECC Contaminated Sites Regulations.

Table 3: NSECC Tier 1 EQS Metals Exceedances Comparison to Background

NSECC Tier 1 Exceedance Metal	NSECC Tier 1 EQS Value (mg/kg)	EC Recommended Background Concentrations (95% UCL) for Central Uplands Soil Zoneq ¹ (mg/kg)	Location of Exceedance	Exceedance Concentration (mg/kg)
Antimony	7.5	i.d.	24MW02 SS2	25
Iron	11000	25739	24MW01 SS4 24MW02 SS2 24MW03 SS3 24MW04 SS2 24MW05 SS4	38000 40000 66000 34000 56000
Lead	260	13	24MW02 SS2 24MW03 SS3	440 1200
Manganese	360	216	24MW01 SS4 24MW02 SS2 24MW03 SS3 24MW04 SS2 24MW05 SS4	840 1600 730 800 390

Notes:

1. Source: Review of Environment Canada's Background Soil Database (2004-2009), Version No. 1. March 2011. Public Works and Government Services Canada. Submitted by: Dillon Consulting.

Concentrations of dioxins and furans within sample 24MW03 SS2, represented by the Total Toxic Equivalency (TEQ) value, also exceeded the NSECC Tier 1 EQS (Table C2, Attachment C).

Groundwater Analytical Results

All parameters analyzed for PHC, metals, PAH, VOC, Glycol, Pesticides/Herbicides, and Dioxins/Furans analytical suites were reported below laboratory detection limits and/or the NSECC Tier 1 EQS in all of the analysed groundwater samples.

QA/QC Results

QA/QC sampling consisted of the collection and analysis of approximately 10% of the samples collected. One blind field duplicate was collected during the field program:

- Soil sample 24MW100 SS3, collected from borehole soil 24MW03 SS3, was submitted for analysis of PHCs.
- Groundwater sample 24MW100, collected from monitoring well 24MW03, was submitted for analysis of PHCs.

QA/QC analytical results are presented in Tables C.16 and C.17 (PHCs in Soil and Groundwater, respectively), where the duplicate information is presented along with the original sample data for comparison. The purpose of the blind duplicate was to determine the integrity of the samples.

The relative percent difference (RPD) between a sample and its duplicate is expressed as an absolute value in the tables and was calculated using the following formula:

$$RPD = 100\% \times [(A - B) / ((A + B) / 2)]$$

Where, A = Original concentration

B = Duplicate concentration

RPD calculations are only considered applicable when one concentration is greater than five times the laboratory Reportable Detection Limits (RDLs). When one (or both) values are less than the RDL, the RPD is not calculated.

Once RPD values were calculated for analytical results of original and field duplicate samples, RPD values were compared to laboratory-recommended, industry standard targets, including a 40% RPD for groundwater, and a 60% RPD for soil results. Results of this RPD analysis include:

- ▶ No RPD calculations were completed for PHCs in groundwater as all parameters were non-detect in both the original and blind duplicate sample.
- ▶ RPD calculations were calculated for PHCs in soil, with one RPD greater than the recommended target; 97% RPD for the xylenes analysis compared between field duplicate 24MW100 SS3, and sample 24MW03 SS3. Although this elevated RPD exceeds the recommended target, CBCL notes that even so, the higher of these two concentrations (0.15 mg/kg at duplicate 24MW100 SS3) is approximately 400x less than the applicable Tier 1 EQS guideline, and around 330x less the applicable NS Guideline for Disposal of Contaminated Solids in Landfills. Therefore, although the elevated RPD indicates slight inconsistency in laboratory imprecision in reported laboratory values for xylenes in soil at this location, CBCL's review of the remainder of the field and laboratory data indicate that the analytical data produced by this investigation are representative and meet the objectives of the project's scope of work.

Conclusions & Recommendations

CBCL was commissioned by the TOL to complete a Limited ESA at a property located at 125 Starr St, Lunenburg, NS B0J 2C0 (PID 60057791), as part of the TOL WWTP Upgrades Design and Engineering Services project. The purpose of this investigation was to conduct a Limited ESA of subsurface soils and groundwater conditions at the Site; with the objective of confirming the absence/presence of contamination within the area(s) studied.

Of the five groundwater samples collected and submitted for laboratory analysis of BTEX/TPH, metals, PAHs, glycols, cyanide, pesticides/herbicides, and dioxins/furans, no groundwater samples report any exceedance of the NSECC Tier 1 EQSs.

Metals and dioxins/furans exceeded the NSECC Tier 1 EQS at the site, and resultingly, these concentrations must be identified to NSECC through the Contaminated Sites Protocol process.

Considering the metals (lead and copper) exceedances greater the Nova Scotia Guideline for Disposal of Contaminated Solids in Landfills, CBCL recommends that, if future off-site disposal is required or preferred by the TOL (as opposed to on-site soils management), waste characterization samples from excavated soils be analyzed for leachability to further evaluate disposal options.

Closure

This report has been prepared for the sole benefit of the TOL. The report may not be relied upon by any other person or entity without the express written consent of CBCL Limited and TOL. Any use which a third party makes of this report and any reliance on decisions made based on it, are the responsibility of such third parties. CBCL Limited accepts no responsibility for damages, if any, suffered by any third party as a result of decisions or actions made based on this report.

Some of the information presented in this report was provided through existing documents. Although attempts were made whenever possible to obtain a minimum of two confirmatory sources of information, CBCL Limited, in certain instances, has been required to assume that the information provided is accurate. The conclusions and recommendations presented represent the best judgement of the assessor based on current environmental standards and on the observed site conditions. Due to the nature of the investigation and the limited data available, the assessor cannot warrant against undiscovered environmental liabilities.

The conclusions are based on results from specific testing and/or sampling locations, and can only be extrapolated to an undefined limited area around these locations. The extent of the limited area depends on the soil, surface water, sediment and/or groundwater conditions, as well as the history of the site reflecting natural, construction and other activities. In addition, analysis has been carried out for a limited number of chemical parameters, and it should not be inferred that other chemical species are not present.

Should additional information become available, CBCL Limited requests that this information be brought to our attention so that we may re-assess the conclusions presented herein.

Town of Lunenburg
June 7, 2024

Yours very truly,

CBCL Limited

DRAFT

Dylan Farrell, M.Sc.
Environmental Scientist
Direct: 421-7241
E-mail: dfarrell@cbcl.ca

DRAFT

Brad Trask, P. Eng.
Manager, Environmental Engineering
Direct: 421-7241, ext. 2253
E-mail: bradt@cbcl.ca

Attachments:

- A Figures
- B Photographic Log
- C Analytical Chemistry Tables
- D Laboratory Certificates of Analysis
- E Field Data Records

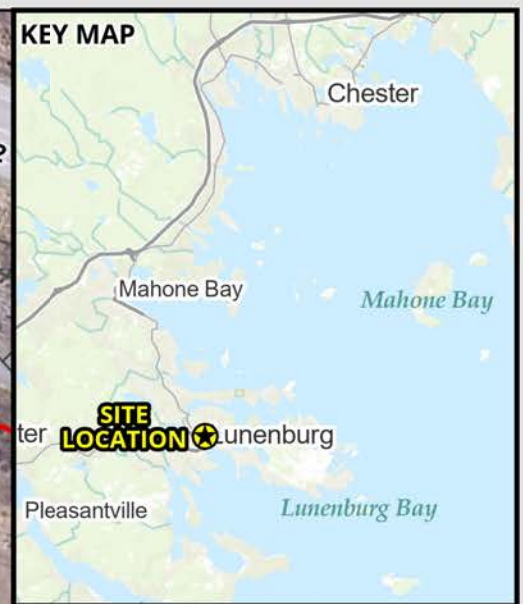
Project No: 240800.00

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Attachment A

Figures

Document Path: D:\00 CBCL PROJECTS\TOL WWTU\UPGRADE\PCS\204800 TownOfLunenburg\WWTU - Figure1 - Site Location Overview
16/May/2024 - LYT:204800 TownOfLunenburg\WWTU - Figure1 - Site Location Overview



LEGEND

Subject Property Boundary

Property Boundary



Town of Lunenburg
Wastewater Treatment Plant
Upgrade & Expansion

**Site Location &
Overview**

DATE: 2024-05-16	PROJ N°: 204800	FIGURE: 1
DRAWN BY: SF	CHECKED BY: DF	APPROVED: BT

NOTES:

- Eagleview Imagery Date: 22-APR-2023
- Property Boundaries presented on this figure are graphic representations only, and are not the product of legal survey

SCALE: 1:900

Coordinate System: NAD 1983 UTM Zone 20N
Units: Meter

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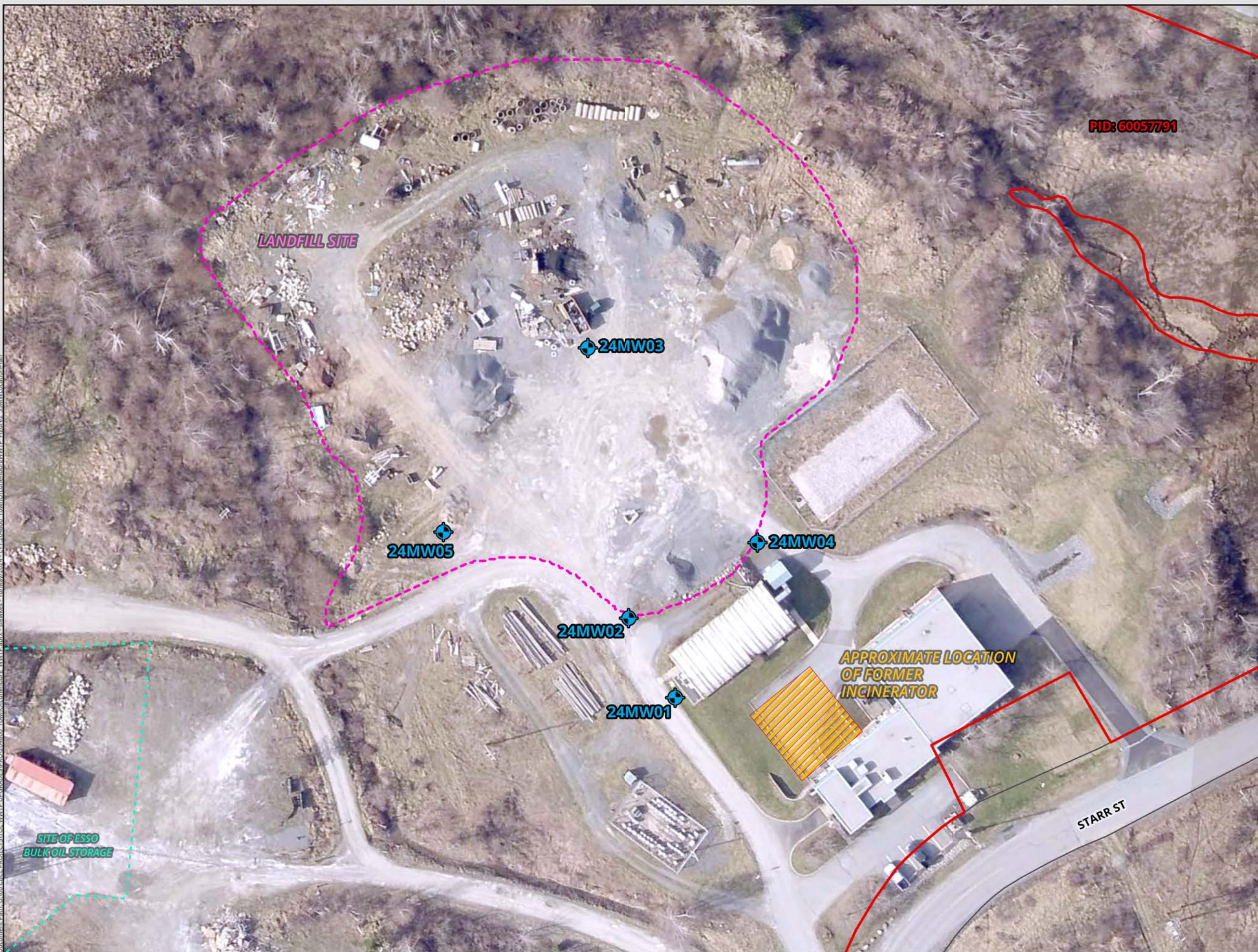
10

20

40 m



Document Path: D:\00 CBCL PROJECTS\TOL WWTP UPGRADES\PS0204800 TownOfLunenburgWWTP Efigure2_SSMWLocationPlan



- LEGEND**
- Soil Sample / Monitoring Well Location
 - Subject Property Boundary
 - Property Boundary

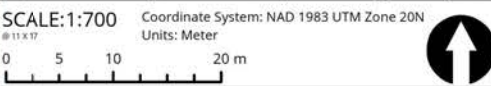


Town of Lunenburg
Wastewater Treatment Plant
Upgrade & Expansion

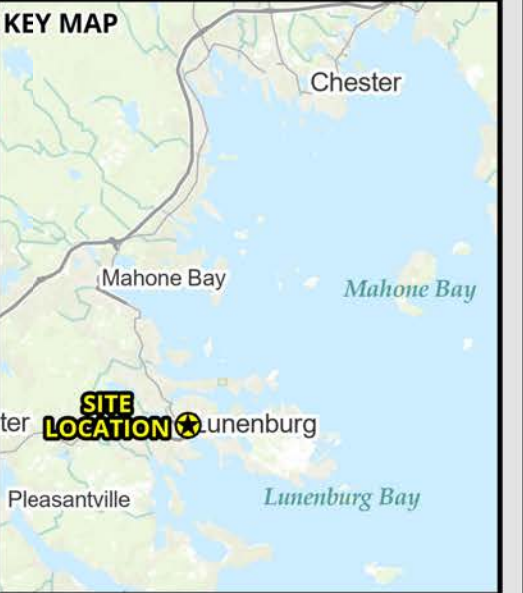
**Soil Boreholes / Monitoring
Well Installations**

DATE: 2024-05-16	PROJ N°: 204800	FIGURE: 2
DRAWN BY: SF	CHECKED BY: DF	APPROVED: BT

NOTES:
- Eagleview Imagery Date: 22-APR-2023
- Property Boundaries presented on this figure are graphic representations only, and are not the product of legal survey



Document Path: D:\00 CBCL PROJECTS\TOL WWTU\UPGRADE\PCS\204800 TownOfLunenburg\WWTU\Figures\SoilExceedances



- LEGEND**
- Soil sample with NSE Tier 1 Guideline Exceedance
 - Subject Property Boundary
 - Property Boundary



Town of Lunenburg
Wastewater Treatment Plant
Upgrade & Expansion

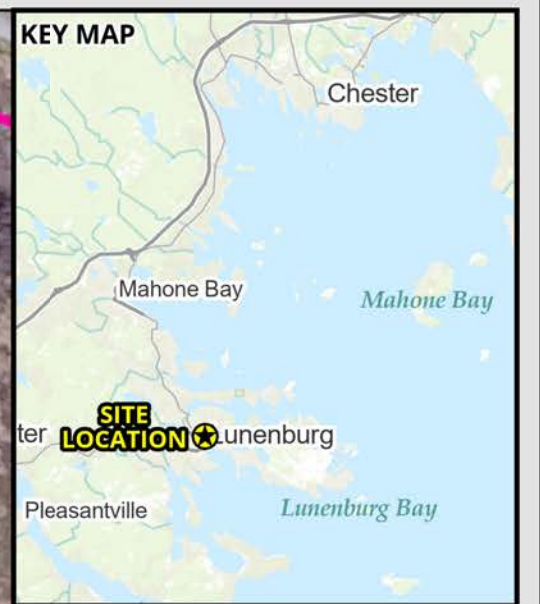
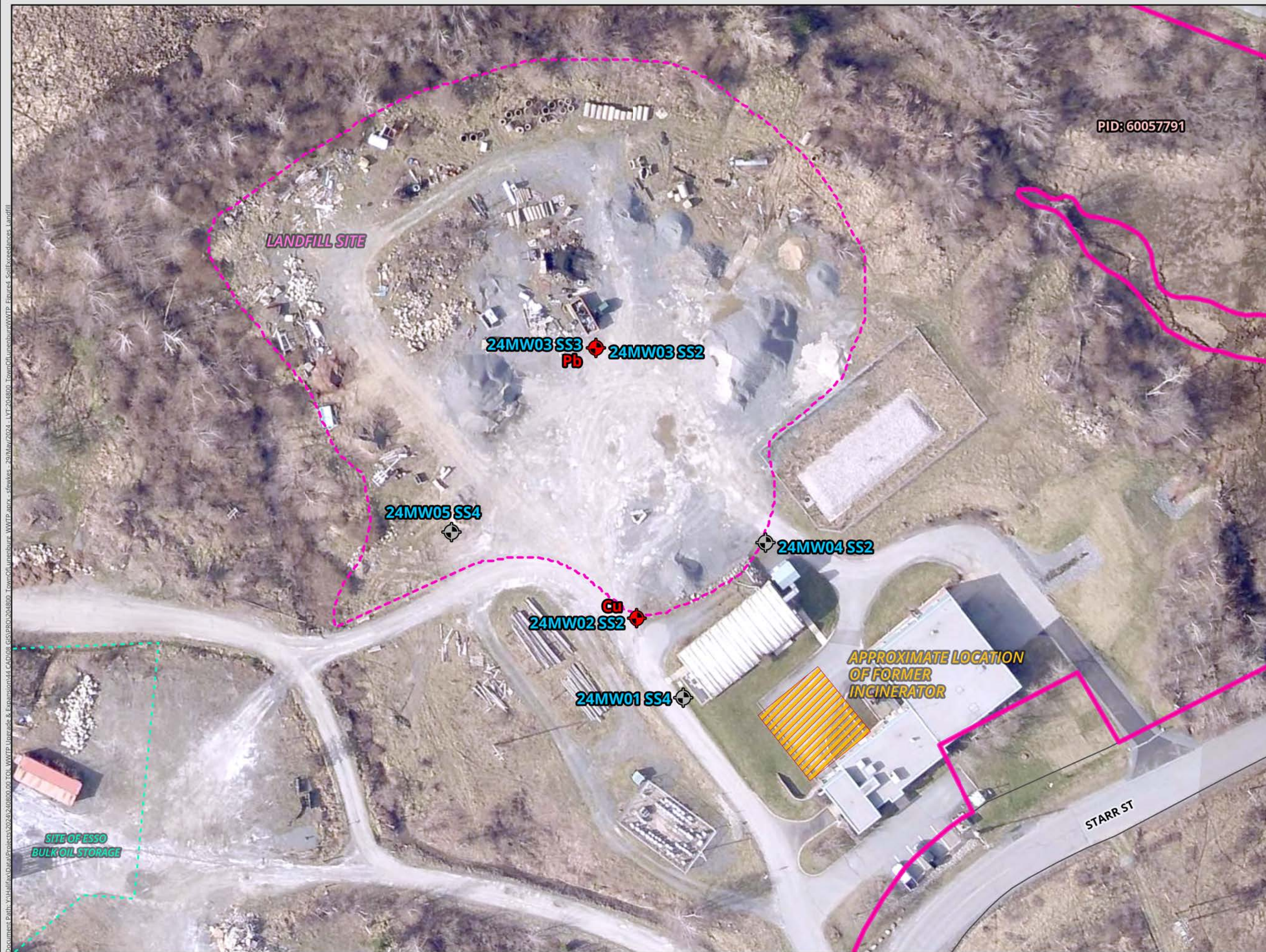
**Exceedances of the NSE
Tier 1 Guidelines in Soil**

DATE: 2024-05-21	PROJ N°: 204800	FIGURE: 3
DRAWN BY: SF	CHECKED BY: DF	APPROVED: BT

NOTES:
- Eagleview Imagery Date: 22-APR-2023
- Property Boundaries presented on this figure are graphic representations only, and are not the product of legal survey



Document Path: Y:\Halifax\Projects\2024\240800\TOI\WWTP Upgrade & Expansion\44 CAD\08 GIS\PROJ\204800 TownOfLunenburg WWTP.aprx - sfewkes - 29/May/2024 - LVT-204800 TownOfLunenburg WWTP Figure4 SoilExceedances Landfill



LEGEND

- Exceedance of the Nova Scotia Guidelines for Disposal of Contaminated Soils in Landfills
- No exceedance of the Nova Scotia Guidelines for Disposal of Contaminated Soils in Landfills
- Subject Property Boundary
- Property Boundary

CBC L

Town of Lunenburg
Wastewater Treatment Plant
Upgrade & Expansion

**Exceedances of the NS
Guidelines for Disposal of
Contaminated Solids in Landfills**

DATE: 2024-05-29	PROJ N°: 204800	FIGURE: 4
DRAWN BY: SF	CHECKED BY: DF	APPROVED: BT

NOTES:
- Eagleview Imagery Date: 22-APR-2023
- Property Boundaries presented on this figure are graphic representations only, and are not the product of legal survey

SCALE: 1:700 Coordinate System: NAD 1983 UTM Zone 20N
Units: Meter

0 5 10 20 m

Attachment B

Site Photographs



Photo 1: Drilling 24MW02, looking north.



Photo 2: Drilling 24MW03, looking west.



Photo 3: Drilling 24MW05, looking south.



Photo 4: View of 24MW01, looking southeast.



Photo 5: View of 24MW02, adjacent to cone. Looking southwest



Photo 6: View of 24MW03, looking southeast.



Photo 7: View of 24MW04, looking southeast.



Photo 8: View of 24MW05, looking southeast.



Photo 9: View of north end of site area, looking northwest.



Photo 10: View of northeastern end of site area, looking northeast.



Photo 11: View of south entry driveway, looking southeast.

Attachment C

Analytical Chemistry Tables

TABLE C.1
PETROLEUM HYDROCARBONS IN SOIL
Town of Lunenburg WWTP Upgrade and Expansion
Project No. 240800.00

Sample ID: Lab Sample ID: Sample Date: Sample Depth (mbgs): Units:	RDL ¹ (mg/kg)	Tier 1 NSE EQS ² Commercial, Non- Potable, Coarse- Grained (mg/kg)	NS Guidelines for Disposal of Contaminated Solids in Landfills ³ (mg/kg)	24MW01 SS4 YXD177 12-Apr-24 1.8-2.4 (mg/kg)	24MW02 SS2 YXD178 12-Apr-24 0.61-1.2 (mg/kg)	24MW03 SS3 YXD179 12-Apr-24 1.8-3.0 (mg/kg)	24MW04 SS2 YXD180 12-Apr-24 1.8-2.4 (mg/kg)	24MW05 SS4 YXD181 12-Apr-24 3.0-3.7 (mg/kg)	24MW100 SS3 YXD182 12-Apr-24 FD of 24MW03 SS3 (mg/kg)
BTEX Parameters									
Benzene	0.005	0.52	5	0.013	0.011	0.029	0.007	<0.0050	0.044
Toluene	0.05	1,400	30	<0.050	<0.050	<0.050	<0.050	<0.050	0.12
Ethylbenzene	0.01	3,100	50	<0.010	<0.010	<0.010	0.015	<0.010	0.036
Total Xylenes	0.05	60	50	<0.050	<0.050	0.052	<0.050	<0.050	0.15
Petroleum Hydrocarbon Fraction Concentrations									
C ₆ -C ₁₀ (less BTEX)	2.5	-	-	<2.5	<2.5	<2.5	13	<2.5	<2.5
>C ₁₀ -C ₁₆	10	-	-	<10	<10	24	<10	<10	19
>C ₁₆ -C ₂₁	10	-	-	34	47	220	23	<10	160
>C ₂₁ -C ₃₂	15	-	-	190	420	1900	82	45	1500
Modified TPH	15	2000 (Gas) 10,000 (Fuel) 10,000 (Lube)	2000 (Gas) 10,000 (Fuel) 10,000 (Lube)	220	470	2100	120	45	1700
Reached Baseline at C ₃₂	N/A	-	-	No	No	No	Yes	Yes	No
Resemblance	N/A	-	-	Lube oil fraction	Lube oil fraction	Lube oil fraction	One product in the gasoline range. Lube oil fraction.	Lube oil fraction	Lube oil fraction
F2 (C10-C16 Hydrocarbons)	10	-	-	<10	37	28	-	-	-
F3 (C16-C34 Hydrocarbons)	50	-	-	250	720	2800	-	-	-
F4 (C34-C50 Hydrocarbons)	50	-	-	210	390	1000	-	-	-
Reached Baseline at C50	N/A	-	-	Yes	No	No	-	-	-

Notes:

1. RDL = Reportable Detection Limit;
2. Nova Scotia Environment (NSE) Tier 1 Environmental Quality Standards (EQS) for Soil at a Non-Potable Site (Table 1B); commercial land use and coarse-grained soils.
3. NS Landfill Disposal = Nova Scotia Guidelines for the Disposal of Contaminated Solids in Landfills, Amendment 2016.

-' = no guideline available or parameter not analyzed; NA: Not Applicable; <X: Below RDL; mbgs = metres below grade surface;

Bold shaded results indicate an exceedance of the Tier 1 EQS Commercial Guidelines

TABLE C.2
METALS IN SOIL
Town of Lunenburg WWTP Upgrade and Expansion
Project No. 240800.00

Sample ID: Lab Sample ID: Sample Date:	RDL ¹	Tier 1 NSE EQS ² Commercial, Non-Potable, Coarse-Grained	NS Guidelines for Disposal of Contaminated Solids in Landfills ³	24MW01 SS4 YXD177 12-Apr-24	24MW02 SS2 YXD178 12-Apr-24	24MW03 SS3 YXD179 12-Apr-24	24MW04 SS2 YXD180 12-Apr-24	24MW05 SS4 YXD181 12-Apr-24
Sample Depth (mbgs): Units:	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Parameters								
Aluminum	10	15,400	-	13000	14000	13000	13000	12000
Antimony	2.0	7.5	40	<2.0	25	4.3	<2.0	2.2
Arsenic	2.0	31	50	28	22	20	30	19
Barium	5.0	10,000	2,000	70	190	580	71	110
Beryllium	1.0	110	8	<1.0	<1.0	<1.0	<1.0	<1.0
Bismuth	2.0	-	-	<2.0	<2.0	<2.0	<2.0	<2.0
Boron	50	4,300	2	<50	<50	<50	<50	<50
Cadmium	0.30	49	20	<0.30	1.3	3	<0.30	0.67
Chromium	2.0	630	800	26	38	43	26	29
Cobalt	1.0	22	300	12	15	10	12	7
Copper	2.0	4,000	500	88	<u>3500</u>	460	50	96
Iron	50	11,000	-	38000	40000	66000	34000	56000
Lead	0.5	260	1000	87	440	<u>1200</u>	66	190
Lithium	2.0	-	-	33	29	23	35	26
Manganese	2.0	360	-	840	1600	730	800	390
Mercury	0.10	24	10	0.14	0.24	0.15	2.1	<0.10
Molybdenum	2.0	110	40	3.8	4.2	4.9	2.2	5.3
Nickel	2.0	310	500	27	65	42	24	27
Rubidium	2.0	-	-	9	13	7.6	14	5.8
Selenium	0.50	125	10	0.56	<0.50	<0.50	<0.50	0.64
Silver	0.50	77	40	<0.50	1.4	0.93	<0.50	<0.50
Strontium	5.0	9,400	-	20	37	130	16	18
Thallium	0.10	1	1	0.1	0.11	<0.10	0.11	<0.10
Tin	1.0	9,400	300	9.9	150	130	3.6	90
Uranium	0.10	33	-	1.2	1	0.88	1.5	0.94
Vanadium	2.0	39	200	34	34	24	34	29
Zinc	5.0	16,000	1,500	140	980	1200	170	760

Notes:

1. RDL = Reportable Detection Limit;

2. Nova Scotia Environment (NSE) Tier 1 Environmental Quality Standards (EQS) for Soil at a Non-Potable Site (Table 1B); commercial land use and coarse-grained soils.

3. NS Landfill Disposal = Nova Scotia Guidelines for the Disposal of Contaminated Solids in Landfills, Amendment 2016.

- = no guideline available or parameter not analyzed; NA: Not Applicable; <X: Below RDL; mbgs = metres below grade surface;

Bold shaded results indicate an exceedance of the Tier 1 EQS Commercial Guidelines

TABLE C.3
POLYCYCLIC AROMATIC HYDROCARBONS (PAHS) IN SOIL
Town of Lunenburg WWTP Upgrade and Expansion
Project No. 240800.00

Sample ID: Lab Sample ID: Sample Date:	RDL ¹	Tier 1 NSE EQS ² Commercial, Non-Potable, Coarse-Grained	NS Guidelines for Disposal of Contaminated Solids in Landfills ³	B[a]P PEF	24MW01 SS4 YXD177 12-Apr-24 1.8-2.4 (mg/kg)	24MW02 SS2 YXD178 12-Apr-24 0.61-1.2 (mg/kg)	24MW03 SS3 YXD179 12-Apr-24 1.8-3.0 (mg/kg)	24MW04 SS2 YXD180 12-Apr-24 1.8-2.4 (mg/kg)	24MW05 SS4 YXD181 12-Apr-24 3.0-3.7 (mg/kg)
Sample Depth (mbgs): Units:	(mg/kg)	(mg/kg)	(mg/kg)						
Parameters									
1-Methylnaphthalene	0.010	72	10		0.0180	0.0170	<0.010	<0.010	<0.010
2-Methylnaphthalene	0.010	72	10		0.0240	0.0270	0.0130	<0.010	<0.010
Acenaphthene	0.010	8,000	10		0.0170	<0.010	<0.010	<0.010	<0.010
Acenaphthylene	0.010	66	10		<0.010	<0.010	<0.010	<0.010	<0.010
Anthracene	0.010	37,000	10		0.0320	0.0240	<0.010	<0.010	<0.010
Fluoranthene	0.010	5,300	10		0.1600	0.2100	0.0840	0.0230	<0.010
Fluorene	0.010	4,100	10		<0.020	0.0200	<0.010	<0.010	<0.010
Naphthalene	0.010	25	10		0.0160	0.0160	<0.010	<0.010	<0.010
Perylene	0.010	-	10		0.0180	0.0250	0.0170	<0.010	0.0320
Phenanthrene	0.010	-	10		0.1200	0.1600	0.0560	0.0230	<0.020
Pyrene	0.010	3,200	10		0.1400	0.1800	0.1400	0.0260	<0.010
Carcinogenic PAHs									
Benzo(a)anthracene	0.010	-	10	0.1	0.07	0.1	0.051	<0.010	<0.010
Benzo(a)pyrene	0.010	-	10	1	0.066	0.1	0.063	<0.010	<0.010
Benzo(b)fluoranthene	0.010	-	10	0.1	0.056	0.1	0.069	<0.010	<0.010
Benzo(b/j)fluoranthene	0.020	-	10	0.1	0.089	0.16	0.11	<0.020	<0.020
Benzo(ghi)perylene	0.010	-	10	0.01	0.069	0.087	0.2	0.015	<0.010
Benzo(j)fluoranthene	0.010	-	10	0.1	0.032	0.061	0.036	<0.010	<0.010
Benzo(k)fluoranthene	0.010	-	10	0.1	0.032	0.056	0.033	<0.010	<0.010
Chrysene	0.010	-	10	0.01	<0.20	0.16	0.087	0.034	<0.010
Dibenz(a,h)anthracene	0.010	-	10	1	<0.010	0.019	0.013	<0.010	<0.010
Indeno(1,2,3-cd)pyrene	0.010	-	10	0.1	0.036	0.065	0.047	<0.010	<0.010
B[a]P TPE⁴	-	5.3	-	-	0.103	0.176	0.113	0.013	0.013

Notes:

1. RDL = Reportable Detection Limit;

2. Nova Scotia Environment (NSE) Tier 1 Environmental Quality Standards (EQS) for Soil at a Non-Potable Site (Table 1B); commercial land use and coarse-grained soils.

3. NS Landfill Disposal = Nova Scotia Guidelines for the Disposal of Contaminated Solids in Landfills, Amendment 2016.

4. B[a]P TPE = Benzo[a]pyrene Total Potency Equivalents. The B[a]P TPE is calculated by multiplying the concentration of each PAH in the sample by its B[a]P PEF and summing the products. If the concentration is less than the RDL, 1/2 RDL is used in the B[a]P TPE calculations.

-' = no guideline available or parameter not analyzed; NA: Not Applicable; <X: Below RDL; mbgs = metres below grade surface;

Bold shaded results indicate an exceedance of the Tier 1 EQS Commercial Guidelines

TABLE C.4
VOLATILE ORGANIC COMPOUNDS (VOCs) IN SOIL
Town of Lunenburg WWTP Upgrade and Expansion
Project No. 240800.00

Sample ID: Lab Sample ID: Sample Date: Sample Depth (mbgs): Units:	RDL ¹ (µg/kg)	Tier 1 NSE EQS ² Commercial, Non- Potable, Coarse- Grained (µg/kg)	NS Guidelines for Disposal of Contaminated Solids in Landfills ³ (µg/kg)	24MW04 SS2 YXD180 12-Apr-24 1.8-2.4 (µg/kg)
Parameters				
1,1,1-Trichloroethane	25	6100	50000	<25
1,1,2,2-Tetrachloroethane	25	190	50000	<25
1,1,2-Trichloroethane	25	420	50000	<25
1,1-Dichloroethane	25	56000	50000	<25
1,1-Dichloroethylene	25	490	50000	<25
1,2-Dichlorobenzene	25	130000	10000	<25
1,2-Dichloroethane	25	33	50000	<25
1,2-Dichloropropane	10	160	50000	<10
1,3-Dichlorobenzene	25	420000	10000	<25
1,4-Dichlorobenzene	25	8000	10000	<25
Benzene	20	-	5000	<20
Bromodichloromethane	25	130000	-	<25
Bromoform	25	6100	-	<25
Bromomethane	50	1.6	-	<50
Carbon Tetrachloride	25	6.9	50000	<25
Chlorobenzene	10	220	10000	<10
Chloroethane	200	-	50000	<200
Chloroform	10	140	50000	<10
cis-1,2-Dichloroethylene	10	240	50000	<10
cis-1,3-Dichloropropene	25	250	50000	<25
Dibromochloromethane	25	2500	-	<25
Ethylbenzene	25	-	50000	<25
Ethylene Dibromide	25	15	-	<25
Methyl t-butyl ether (MTBE)	25	570	-	<25
Methylene Chloride(Dichloromethane)	25	9000	50000	<25
o-Xylene	25	-	50000	<25
p+m-Xylene	25	-	50000	<25
Styrene	25	42000	50000	<25
Tetrachloroethylene	10	200	50000	<10
Toluene	50	-	30000	<50
Total Xylenes	50	-	50000	<50
trans-1,2-Dichloroethylene	10	-	50000	<10
trans-1,3-Dichloropropene	25	-	50000	<25
Trichloroethylene	10	10	50000	<10
Trichlorofluoromethane (FREON 11)	25	-	-	<25
Vinyl Chloride	20	7.9	50000	<20

Notes:
1. RDL = Reportable Detection Limit;
2. Nova Scotia Environment (NSE) Tier 1 Environmental Quality Standards (EQS) for Soil at a Non-Potable Site (Table 1B); commercial land use and coarse-grained soils.
3. NS Landfill Disposal = Nova Scotia Guidelines for the Disposal of Contaminated Solids in Landfills, Amendment 2016.
-' = no guideline available or parameter not analyzed; NA: Not Applicable; <X: Below RDL; mbgs = metres below grade surface;

Bold shaded results indicate an exceedance of the Tier 1 EQS Commercial Guidelines

TABLE C.5
GLYCOLS IN SOIL
Town of Lunenburg WWTP Upgrade and Expansion
Project No. 240800.00

Sample ID:	RDL¹ (mg/kg)	Tier 1 NSE EQS²	24MW03 SS2
Lab Sample ID:		Commercial, Non-	YXD180
Sample Date:		Potable, Coarse-	12-Apr-24
Sample Depth (mbgs):		Grained	0.61-1.8
Units:	(mg/kg)	(mg/kg)	(mg/kg)
Parameters			
Extractable (Water) Ethylene Glycol	10	110000	<10
Extractable (Water) Diethylene Glycol	9.0	-	<9.0
Extractable (Water) Triethylene Glycol	10	-	<10
Extractable (Water) Propylene Glycol	10	-	<10

Notes:

1. RDL = Reportable Detection Limit;
 2. Nova Scotia Environment (NSE) Tier 1 Environmental Quality Standards (EQS) for Soil at a Non-Potable Site (Table 1B); commercial land use and coarse-grained soils.
 3. The Nova Scotia Guidelines for the Disposal of Contaminated Solids in Landfills do not present guidelines for glycols.
- ' = no guideline available or parameter not analyzed; NA: Not Applicable; <X: Below RDL; mbgs = metres below grade surface;

Bold shaded results indicate an exceedance of the Tier 1 EQS Commercial Guidelines

TABLE C.6
CYANIDE IN SOIL
Town of Lunenburg WWTP Upgrade and Expansion
Project No. 240800.00

Sample ID: Lab Sample ID: Sample Date: Sample Depth (mbgs): Units:	RDL ¹ (mg/kg)	Tier 1 NSE EQS ² Commercial, Non- Potable, Coarse- Grained (mg/kg)	NS Guidelines for Disposal of Contaminated Solids in Landfills ³ (mg/kg)	24MW03 SS2 YXD180 12-Apr-24 0.61-1.8 (mg/kg)
Parameters				
Total Cyanide (CN)	0.50	110	500	<0.50

Notes:

1. RDL = Reportable Detection Limit;
 2. Nova Scotia Environment (NSE) Tier 1 Environmental Quality Standards (EQS) for Soil at a Non-Potable Site (Table 1B); commercial land use and coarse-grained soils.
 3. NS Landfill Disposal = Nova Scotia Guidelines for the Disposal of Contaminated Solids in Landfills, Amendment 2016.
- ' = no guideline available or parameter not analyzed; NA: Not Applicable; <X: Below RDL; mbgs = metres below grade surface;

Bold shaded results indicate an exceedance of the Tier 1 EQS Commercial Guidelines

TABLE C.7
PESTICIDES AND HERBICIDES IN SOIL
Town of Lunenburg WWTP Upgrade and Expansion
Project No. 240800.00

Sample ID: Lab Sample ID: Sample Date: Sample Depth (mbgs): Units:	RDL ¹ (µg/g)	Tier 1 NSE EQS ² Commercial, Non- Potable, Coarse- Grained (µg/g)	Tier 1 NSE EQS ² Commercial, Non- Potable, Coarse- Grained (µg/g)	24MW03 SS2 YXD180 12-Apr-24 0.61-1.8 (µg/g)
Calculated Parameters				
Aldrin + Dieldrin	0.01	-	-	<0.010
Chlordane (Total)	0.01	-	-	<0.010
DDT+ Metabolites	0.04	340	-	<0.040
Heptachlor + Heptachlor epoxide	0.01	-	-	<0.010
o,p-DDD + p,p-DDD	0.03	-	-	<0.030
o,p-DDE + p,p-DDE	0.01	-	-	<0.010
o,p-DDT + p,p-DDT	0.04	340	-	<0.040
Total Endosulfan	0.01	320	-	<0.010
Total PCB	0.075	33	50	0.900
Pesticides & Herbicides				
Aldrin	0.01	5.1	-	<0.010
a-Chlordane	0.01	-	-	<0.010
g-Chlordane	0.01	-	-	<0.010
o,p-DDD	0.01	-	-	<0.010
p,p-DDD	0.03	-	-	<0.030
o,p-DDE	0.01	-	-	<0.010
p,p-DDE	0.01	-	-	<0.010
o,p-DDT	0.01	340	-	<0.010
p,p-DDT	0.04	340	-	<0.040
Dieldrin	0.01	5.1	-	<0.010
Lindane	0.01	10	-	<0.010
Endosulfan I (alpha)	0.01	320	-	<0.010
Endosulfan II (beta)	0.01	320	-	<0.010
Endrin	0.01	15	-	<0.010
Heptachlor	0.01	0.094	-	<0.010
Heptachlor epoxide	0.01	-	-	<0.010
Hexachlorobenzene	0.01	-	10	<0.010
Methoxychlor	0.025	5,300	-	<0.025
Aroclor 1016	0.075	-	-	<0.075
Aroclor 1221	0.075	-	-	<0.075
Aroclor 1232	0.075	-	-	<0.075
Aroclor 1242	0.075	-	-	<0.075
Aroclor 1248	0.075	-	-	<0.075
Aroclor 1254	0.075	-	-	<0.075
Aroclor 1260	0.075	-	-	0.9
Aroclor 1262	0.075	-	-	<0.075
Aroclor 1268	0.075	-	-	<0.075
alpha-BHC	0.01	-	-	<0.010
beta-BHC	0.01	-	-	<0.010
delta-BHC	0.01	-	-	<0.010
Endosulfan sulfate	0.01	-	-	<0.010
Endrin aldehyde	0.01	-	-	<0.010
Endrin ketone	0.01	-	-	<0.010
Mirex	0.01	-	-	<0.010
Octachlorostyrene	0.01	-	-	<0.010
Toxaphene	0.08	7.3	-	<0.080

Notes:
1. RDL = Reportable Detection Limit;
2. Nova Scotia Environment (NSE) Tier 1 Environmental Quality Standards (EQS) for Soil at a Non-Potable Site (Table 1B); commercial land use and coarse-grained soils.
3. NS Landfill Disposal = Nova Scotia Guidelines for the Disposal of Contaminated Solids in Landfills, Amendment 2016.
- ' = no guideline available or parameter not analyzed; NA: Not Applicable; <X: Below RDL; mbgs = metres below grade surface;

Bold shaded results indicate an exceedance of the Tier 1 EQS Commercial Guidelines

TABLE C.8
DIOXINS AND FURANS IN SOIL
Town of Lunenburg WWTP Upgrade and Expansion
Project No. 240800.00

Sample ID:			24MW03 SS2	
Lab Sample ID:			YXD180	
Sample Date:			12-Apr-24	
Sample Depth (mbgs):			0.61-1.8	
Units:	(pg/g)	(pg/g)	(pg/g)	
Dioxins & Furans				TEQ (DL)
2,3,7,8-Tetra CDD *	0.01	-	0.614	0.614
1,2,3,7,8-Penta CDD *	0.01	-	1.450	1.450
1,2,3,4,7,8-Hexa CDD *	0.04	-	1.280	0.128
1,2,3,6,7,8-Hexa CDD *	0.01	-	4.570	0.457
1,2,3,7,8,9-Hexa CDD *	0.03	-	6.180	0.618
1,2,3,4,6,7,8-Hepta CDD *	0.01	-	108.000	1.080
Octa CDD *	0.04	-	1000.000	0.300
Total Tetra CDD *	0.01	-	16.600	-
Total Penta CDD *	0.075	-	18.200	-
Total Hexa CDD *	0.01	-	40.000	-
Total Hepta CDD *	0.01	-	198.000	-
2,3,7,8-Tetra CDF **	0.01	-	<21.2 (1)	2.120
1,2,3,7,8-Penta CDF **	0.01	-	<3.80 (2)	0.114
2,3,4,7,8-Penta CDF **	0.03	-	5.670	1.700
1,2,3,4,7,8-Hexa CDF **	0.01	-	9.750	0.975
1,2,3,6,7,8-Hexa CDF **	0.01	-	3.830	0.383
2,3,4,6,7,8-Hexa CDF **	0.01	-	3.800	0.380
1,2,3,7,8,9-Hexa CDF **	0.04	-	0.274	0.027
1,2,3,4,6,7,8-Hepta CDF **	0.01	-	13.900	0.139
1,2,3,4,7,8,9-Hepta CDF **	0.01	-	1.240	0.012
Octa CDF **	0.01	-	14.100	0.004
Total Tetra CDF **	0.01	-	128	-
Total Penta CDF **	0.01	-	76.7	-
Total Hexa CDF **	0.01	-	42.2	-
Total Hepta CDF **	0.01	-	24.7	-
TCDF Confirmation				
Confirmation 2,3,7,8-Tetra CDF **		-	5.54	0.554
TOTAL TOXIC EQUIVALENCY		4	-	8.94

Notes:

1. RDL = Reportable Detection Limit;
 2. Nova Scotia Environment (NSE) Tier 1 Environmental Quality Standards (EQS) for Soil at a Non-Potable Site (Table 1B); commercial land use and coarse-grained soils.
 3. The Nova Scotia Guidelines for the Disposal of Contaminated Solids in Landfills do not present guidelines for glycols.
- = no guideline available or parameter not analyzed; NA: Not Applicable; <X: Below RDL; mbgs = metres below grade surface;

Bold shaded results indicate an exceedance of the Tier 1 EQS Commercial Guidelines

TABLE C.9
PETROLEUM HYDROCARBONS IN GROUNDWATER
Town of Lunenburg WWTP Upgrade and Expansion
Project No. 240800.00

Sample ID: Lab Sample ID: Sample Date: Units:	RDL ¹ (mg/L)	Tier 1 NSE EQS ² Commercial, Non- Potable, Coarse- Grained (mg/L)	24MW01 YXQ258 16-Apr-24 (mg/L)	24MW02 YXQ259 16-Apr-24 (mg/L)	24MW03 YXQ260 16-Apr-24 (mg/L)	24MW04 YXQ261 16-Apr-24 (mg/L)	24MW05 YXQ262 16-Apr-24 (mg/L)	24MW100 YXQ263 16-Apr-24 (mg/L)
BTEX Parameters								
Benzene	0.001	6.3	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Toluene	0.001	20	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Ethylbenzene	0.001	20	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Xylenes	0.002	20	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Petroleum Hydrocarbon Fraction Concentrations								
C ₆ -C ₁₀ (less BTEX)	0.09	-	<0.090	<0.090	<0.090	<0.090	<0.090	<0.090
>C ₁₀ -C ₁₆	0.05	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
>C ₁₆ -C ₂₁	0.05	-	<0.050	0.076	<0.050	<0.050	<0.050	<0.050
>C ₂₁ -C ₃₂	0.09	-	<0.090	0.15	<0.090	<0.090	<0.090	<0.090
Modified TPH (lube oil)	0.09	20 (Gas) 20 (Fuel) 20 (Lube)	<0.090	0.22	<0.090	<0.090	<0.090	<0.090
Reached Baseline at C ₃₂	N/A	-	NA	Yes	NA	NA	NA	NA
Resemblance	N/A	-	NA	One product in fuel / lube range. Unidentified compound(s) in fuel / lube range.	NA	NA	NA	NA

Notes:

1. RDL = Reportable Detection Limit;

2. Nova Scotia Environment (NSE) Tier 1 Environmental Quality Standards (EQS) for Groundwater at a Potable Site (Table 4B); commercial land use and coarse-grained soils.

- ' = no guideline available or parameter not analyzed; NA: Not Applicable; <X: Below RDL; mbgs = metres below grade surface;

Bold shaded results indicate an exceedance of the Tier 1 EQS Commercial Guidelines

TABLE C.10
METALS IN GROUNDWATER
Town of Lunenburg WWTP Upgrade and Expansion
Project No. 240800.00

Sample ID: Lab Sample ID: Sample Date: Units:	RDL ¹ (µg/L)	Tier 1 NSE EQS ² Commercial, Non- Potable, Coarse- Grained (µg/L)	24MW01 YXQ258 16-Apr-24 (µg/L)	24MW02 YXQ259 16-Apr-24 (µg/L)	24MW03 YXQ260 16-Apr-24 (µg/L)	24MW04 YXQ261 16-Apr-24 (µg/L)	24MW05 YXQ262 16-Apr-24 (µg/L)
Parameters							
Dissolved Aluminum (Al)	5	-	<5.0	<5.0	<5.0	<5.0	<5.0
Dissolved Antimony (Sb)	1.0	-	<1.0	<1.0	<1.0	<1.0	<1.0
Dissolved Arsenic (As)	1.0	-	1	3	<1.0	<1.0	1.4
Dissolved Barium (Ba)	1.0	-	35	500	49	36	27
Dissolved Beryllium (Be)	0.1	-	<0.10	<0.10	<0.10	<0.10	<0.10
Dissolved Bismuth (Bi)	2.0	-	<2.0	<2.0	<2.0	<2.0	<2.0
Dissolved Boron (B)	50	-	<50	220	1600	72	110
Dissolved Cadmium (Cd)	0.01	-	0.037	<0.010	0.028	0.084	<0.010
Dissolved Calcium (Ca)	100.0	-	44000	40000	140000	77000	54000
Dissolved Chromium (Cr)	1.0	-	<1.0	<1.0	<1.0	<1.0	<1.0
Dissolved Cobalt (Co)	0.4	-	1.4	<0.40	0.42	2	<0.40
Dissolved Copper (Cu)	1	-	2.1	0.97	0.82	1.8	1
Dissolved Iron (Fe)	50.0	-	100	1800	6800	<50	23000
Dissolved Lead (Pb)	0.5	-	<0.50	<0.50	<0.50	<0.50	<0.50
Dissolved Magnesium (Mg)	100.0	-	5200	11000	44000	5800	18000
Dissolved Manganese (Mn)	2.00	-	990	480	3700	1200	1400
Dissolved Molybdenum (Mo)	2.0	-	<2.0	8.8	11	<2.0	<2.0
Dissolved Nickel (Ni)	2.0	-	2.9	<2.0	<2.0	5.7	<2.0
Dissolved Phosphorus (P)	100.0	-	<100	<100	<100	<100	<100
Dissolved Potassium (K)	100.00	-	3000	14000	89000	5000	20000
Dissolved Selenium (Se)	0.50	-	<0.50	<0.50	<0.50	<0.50	<0.50
Dissolved Silver (Ag)	0.1	-	<0.10	<0.10	<0.10	<0.10	<0.10
Dissolved Sodium (Na)	100.00	-	13000	79000	150000	32000	68000
Dissolved Strontium (Sr)	2.0	-	150	290	650	240	200
Dissolved Thallium (Tl)	0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10
Dissolved Tin (Sn)	2.0	-	<2.0	<2.0	<2.0	<2.0	<2.0
Dissolved Titanium (Ti)	2.0	-	<2.0	<2.0	<2.0	<2.0	<2.0
Dissolved Uranium (U)	0.10	-	0.12	<0.10	1.6	0.23	0.21
Dissolved Vanadium (V)	2.0	-	<2.0	<2.0	<2.0	<2.0	<2.0
Dissolved Zinc (Zn)	5.0	-	8.9	<5.0	48	59	13

Notes:

1. RDL = Reportable Detection Limit;

2. Nova Scotia Environment (NSE) Tier 1 Environmental Quality Standards (EQS) for Groundwater at a Potable Site (Table 4B); commercial land use and coarse-grained soils.

-' = no guideline available or parameter not analyzed; NA: Not Applicable; <X: Below RDL; mbgs = metres below grade surface;

Bold shaded results indicate an exceedance of the Tier 1 EQS Commercial Guidelines

TABLE C.11
POLYCYCLIC AROMATIC HYDROCARBONS (PAHS) IN GROUNDWATER
Town of Lunenburg WWTP Upgrade and Expansion
Project No. 240800.00

Sample ID: Lab Sample ID: Sample Date: Units:	RDL ¹ (µg/L)	Tier 1 NSE EQS ² Commercial, Non- Potable, Coarse- Grained (µg/L)	B[a]P PEF	24MW01 YXQ258 16-Apr-24 (µg/L)	24MW02 YXQ259 16-Apr-24 (µg/L)	24MW03 YXQ260 16-Apr-24 (µg/L)	24MW04 YXQ261 16-Apr-24 (µg/L)	24MW05 YXQ262 16-Apr-24 (µg/L)
Parameters				-				
1-Methylnaphthalene	0.010	-	-	<0.050	0.072	<0.050	<0.050	<0.050
2-Methylnaphthalene	0.010	-	-	<0.050	0.058	<0.050	0.077	0.066
Acenaphthene	0.010	7.5	-	0.01	0.057	<0.010	<0.010	<0.010
Acenaphthylene	0.010	-	-	<0.010	<0.010	<0.010	<0.010	<0.010
Anthracene	0.010	-	-	<0.010	<0.010	<0.010	<0.010	<0.010
Fluoranthene	0.010	-	-	<0.010	0.024	<0.010	<0.010	<0.010
Fluorene	0.010	-	-	0.01	0.035	<0.010	<0.010	<0.010
Naphthalene	0.010	7.0	-	<0.20	<0.20	<0.20	<0.20	<0.20
Perylene	0.010	-	-	<0.010	<0.010	<0.010	<0.010	<0.010
Phenanthrene	0.010	-	-	0.021	0.053	<0.010	0.021	0.012
Pyrene	0.010	-	-	<0.010	0.02	<0.010	0.01	<0.010
Carcinogenic PAHs								
Benzo(a)anthracene	0.010	-	0.10	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(a)pyrene	0.010	-	1.00	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(b)fluoranthene	0.010	-	0.10	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(b,j)fluoranthene	0.020	-	0.10	<0.020	<0.020	<0.020	<0.020	<0.020
Benzo(ghi)perylene	0.010	-	0.01	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(j)fluoranthene	0.010	-	0.10	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(k)fluoranthene	0.010	-	0.10	<0.010	<0.010	<0.010	<0.010	<0.010
Chrysene	0.010	-	0.01	<0.010	<0.010	<0.010	<0.010	<0.010
Dibenz(a,h)anthracene	0.010	-	1.00	<0.010	<0.010	<0.010	<0.010	<0.010
Indeno(1,2,3-cd)pyrene	0.010	-	0.10	<0.010	<0.010	<0.010	<0.010	<0.010
B[a]P TPE³	-	-	-	0.013	0.013	0.013	0.013	0.013

Notes:

1. RDL = Reportable Detection Limit;

2. Nova Scotia Environment (NSE) Tier 1 Environmental Quality Standards (EQS) for Groundwater at a Potable Site (Table 4B); commercial land use and coarse-grained soils.

3. B[a]P TPE = Benzo[a]pyrene Total Potency Equivalents. The B[a]P TPE is calculated by multiplying the concentration of each PAH in the sample by its B[a]P PEF and summing the products. If the concentration is less than the RDL, 1/2 RDL is used in the B[a]P TPE calculations.

-' = no guideline available or parameter not analyzed; NA: Not Applicable; <X: Below RDL; mbgs = metres below grade surface;

Bold shaded results indicate an exceedance of the Tier 1 EQS Commercial Guidelines

TABLE C.12
VOLATILE ORGANIC COMPOUNDS (VOCs) IN GROUNDWATER
Town of Lunenburg WWTP Upgrade and Expansion
Project No. 240800.00

Sample ID: Lab Sample ID: Sample Date: Sample Depth (mbgs): Units:	RDL ¹ (µg/L)	Tier 1 NSE EQS ² Commercial, Non- Potable, Coarse- Grained (µg/L)	24MW04 YXQ261 16-Apr-24 (µg/L)
Parameters			
1,1-Dichloroethane	2.0	6600	<2.0
1,1-Dichloroethylene	0.5	5600	<0.50
1,1,1-Trichloroethane	1.0	13000	<1.0
1,1,2-Trichloroethane	1.0	910	<1.0
1,1,2,2-Tetrachloroethane	0.5	630	<0.50
Ethylene Dibromide	0.2	51	<0.20
1,2-Dichlorobenzene	0.5	64000	<0.50
1,2-Dichloroethane	1.0	130	<1.0
cis-1,2-Dichloroethylene	0.5	4600	<0.50
trans-1,2-Dichloroethylene	0.5	4900	<0.50
1,2-Dichloropropane	0.5	330	<0.50
1,3-Dichlorobenzene	1.0	100	<1.0
cis-1,3-Dichloropropene	0.5	-	<0.50
trans-1,3-Dichloropropene	0.5	-	<0.50
1,4-Dichlorobenzene	1.0	2600	<1.0
Benzene	1.0	6300	<1.0
Bromodichloromethane	1.0	-	<1.0
Bromoform	1.0	84000	<1.0
Bromomethane	0.5	33	<0.50
Carbon Tetrachloride	0.5	6.9	<0.50
Chlorobenzene	1.0	180	<1.0
Chloroethane	8.0	-	<8.0
Chloroform	1.0	380	<1.0
Chloromethane	8.0	-	<8.0
Dibromochloromethane	1.0	10,000	<1.0
Methylene Chloride (Dichloromethane)	3.0	43,000	<3.0
Ethylbenzene	1.0	-	<1.0
Methyl t-butyl ether (MTBE)	2.0	4,300	<2.0
Styrene	1.0	26000	<1.0
Tetrachloroethylene	1.0	1,200	<1.0
Toluene	1.0	20,000	<1.0
Trichloroethylene	1.0	110	<1.0
Trichlorofluoromethane (FREON 11)	8.0	-	<8.0
Vinyl Chloride	0.5	99	<0.50
o-Xylene	1.0	-	<1.0
p+m-Xylene	2.0	-	<2.0
Total Xylenes	1.0	20000	<1.0
Total Trihalomethanes	1.0	-	<1.0

Notes:
1. RDL = Reportable Detection Limit;
2. Nova Scotia Environment (NSE) Tier 1 Environmental Quality Standards (EQS) for Groundwater at a Potable Site (Table 4B); commercial land use and coarse-grained soils.
- = no guideline available or parameter not analyzed; NA: Not Applicable; <X: Below RDL; mbgs = metres below grade surface;

Bold shaded results indicate an exceedance of the Tier 1 EQS Commercial Guidelines

TABLE C.13
GLYCOLS IN GROUNDWATER
Town of Lunenburg WWTP Upgrade and Expansion
Project No. 240800.00

Sample ID: Lab Sample ID: Sample Date: Sample Depth (mbgs): Units:	RDL¹ (mg/L)	Tier 1 NSE EQS² Commercial, Non- Potable, Coarse- Grained (mg/L)	24MW03 YXQ260 16-Apr-24 (mg/L)
Parameters			
Ethylene Glycol	3.0	-	<3.0
Diethylene Glycol	5.0	-	<5.0
Triethylene Glycol	5.0	-	<5.0
Propylene Glycol	5.0	-	<5.0

Notes:

1. RDL = Reportable Detection Limit;
 2. Nova Scotia Environment (NSE) Tier 1 Environmental Quality Standards (EQS) for Groundwater at a Potable Site (Table 4B); commercial land use and coarse-grained soils.
- ' = no guideline available or parameter not analyzed; NA: Not Applicable; <X: Below RDL; mbgs = metres below grade surface;

Bold shaded results indicate an exceedance of the Tier 1 EQS Commercial Guidelines

TABLE C.14
CYANIDE IN GROUNDWATER
Town of Lunenburg WWTP Upgrade and Expansion
Project No. 240800.00

Sample ID:	RDL¹ (mg/kg)	Tier 1 NSE EQS²	24MW03
Lab Sample ID:		Commercial, Non-	YXQ260
Sample Date:		Potable, Coarse-	16-Apr-24
Sample Depth (mbgs):		Grained	
Units:	(mg/kg)	(mg/kg)	(mg/kg)
Parameters			
Total Cyanide (CN)	0.005	-	<0.0050

Notes:

1. RDL = Reportable Detection Limit;

2. Nova Scotia Environment (NSE) Tier 1 Environmental Quality Standards (EQS) for Groundwater at a Potable Site (Table 4B); commercial land use and coarse-grained soils.

-' = no guideline available or parameter not analyzed; NA: Not Applicable; <X: Below RDL; mbgs = metres below grade surface;

Bold shaded results indicate an exceedance of the Tier 1 EQS Commercial Guidelines

TABLE C.15
PESTICIDES AND HERBICIDES IN GROUNDWATER
Town of Lunenburg WWTP Upgrade and Expansion
Project No. 240800.00

Sample ID: Lab Sample ID: Sample Date: Sample Depth (mbgs): Units:	RDL ¹ (µg/L)	Tier 1 NSE EQS ² Commercial, Non- Potable, Coarse- Grained (µg/L)	24MW03 YXQ260 16-Apr-24 (µg/L)
Calculated Parameters			
Aldrin + Dieldrin	0.005	-	<0.005
Chlordane (Total)	0.005	-	<0.005
DDT+ Metabolites	0.005	-	<0.005
Heptachlor + Heptachlor epoxide	0.005	-	<0.005
o,p-DDD + p,p-DDD	0.005	-	<0.005
o,p-DDE + p,p-DDE	0.005	-	<0.005
o,p-DDT + p,p-DDT	0.005	-	<0.005
Total Endosulfan	0.005	-	<0.005
Total PCB	0.2	180	<0.2
Pesticides & Herbicides			
Aldrin	0.005	-	<0.005
Dieldrin	0.005	-	<0.005
a-Chlordane	0.005	-	<0.005
g-Chlordane	0.005	-	<0.005
o,p-DDD	0.005	-	<0.005
p,p-DDD	0.005	-	<0.005
o,p-DDE	0.005	-	<0.005
p,p-DDE	0.005	-	<0.005
o,p-DDT	0.005	-	<0.005
p,p-DDT	0.005	-	<0.005
Lindane	0.003	-	<0.003
Endosulfan I (alpha)	0.005	-	<0.005
Endosulfan II (beta)	0.005	-	<0.005
Endrin	0.005	-	<0.005
Heptachlor	0.005	2	<0.005
Heptachlor epoxide	0.005	-	<0.005
Hexachlorobenzene	0.005	-	<0.005
Methoxychlor	0.01	-	<0.01
Aroclor 1016	0.2	-	<0.2
Aroclor 1221	0.2	-	<0.2
Aroclor 1232	0.2	-	<0.2
Aroclor 1242	0.2	-	<0.2
Aroclor 1248	0.2	-	<0.2
Aroclor 1254	0.2	-	<0.2
Aroclor 1260	0.2	-	<0.2
alpha-BHC	0.005	-	<0.005
beta-BHC	0.005	-	<0.005
delta-BHC	0.005	-	<0.005
Endosulfan sulfate	0.005	-	<0.005
Endrin aldehyde	0.005	-	<0.005
Endrin ketone	0.005	-	<0.005
Mirex	0.005	-	<0.005
Octachlorostyrene	0.005	-	<0.005
Oxychlordane	0.005	-	<0.005
Toxaphene	0.2	2900	<0.2

Notes:
1. RDL = Reportable Detection Limit;
2. Nova Scotia Environment (NSE) Tier 1 Environmental Quality Standards (EQS) for Groundwater at a Potable Site (Table 4B); commercial land use and coarse-grained soils.
- = no guideline available or parameter not analyzed; NA: Not Applicable; <X: Below RDL; mbgs = metres below grade surface;
Bold shaded results indicate an exceedance of the Tier 1 EQS Commercial Guidelines

TABLE C.16
DIOXINS AND FURANS IN GROUNDWATER
Town of Lunenburg WWTP Upgrade and Expansion
Project No. 240800.00

Sample ID: Lab Sample ID: Sample Date: Sample Depth (mbgs): Units:	RDL ¹ (pg/g)	Tier 1 NSE EQS ² Commercial, Potable, Coarse- Grained (pg/g)	24MW04 SS2 YXD180 12-Apr-24 (pg/g)	
Dioxins & Furans				
2,3,7,8-Tetra CDD *	10	-	<1.41	1.410
1,2,3,7,8-Penta CDD *	50	-	<1.32	1.320
1,2,3,4,7,8-Hexa CDD *	50	-	<1.31	0.131
1,2,3,6,7,8-Hexa CDD *	50	-	1.840	0.184
1,2,3,7,8,9-Hexa CDD *	50	-	4.730	0.473
1,2,3,4,6,7,8-Hepta CDD *	50	-	9.360	0.094
Octa CDD *	100	-	41.100	0.012
Total Tetra CDD *	10	-	7.610	-
Total Penta CDD *	50	-	21.700	-
Total Hexa CDD *	50	-	25.500	-
Total Hepta CDD *	50	-	26.300	-
2,3,7,8-Tetra CDF **	10	-	<1.27	0.127
1,2,3,7,8-Penta CDF **	50	-	<1.50	0.045
2,3,4,7,8-Penta CDF **	50	-	<1.28	0.384
1,2,3,4,7,8-Hexa CDF **	50	-	<1.16	0.116
1,2,3,6,7,8-Hexa CDF **	50	-	<1.14	0.114
2,3,4,6,7,8-Hexa CDF **	50	-	<1.16	0.116
1,2,3,7,8,9-Hexa CDF **	50	-	<1.31	0.131
1,2,3,4,6,7,8-Hepta CDF **	50	-	<1.96 (1)	0.020
1,2,3,4,7,8,9-Hepta CDF **	50	-	<1.32	0.013
Octa CDF **	100	-	<1.34	0.000
Total Tetra CDF **	10	-	5.15	-
Total Penta CDF **	50	-	<1.38	-
Total Hexa CDF **	50	-	<1.19	-
Total Hepta CDF **	50	-	<2.05	-
TOTAL TOXIC EQUIVALENCY	50	370,000	-	4.69

Notes:

1. RDL = Reportable Detection Limit;

2. Nova Scotia Environment (NSE) Tier 1 Environmental Quality Standards (EQS) for Groundwater at a Potable Site (Table 4B); commercial land use and coarse-grained soils.

-' = no guideline available or parameter not analyzed; NA: Not Applicable; <X: Below RDL; mbgs = metres below grade surface;

Bold shaded results indicate an exceedance of the Tier 1 EQS Commercial Guidelines

TABLE C.17
SOIL QA/QC DATA - PETROLEUM HYDROCARBONS (PHCs)
Town of Lunenburg WWTP Upgrade and Expansion
Project No. 240800.00

Parameter	Units	RDL	RDL (x5)	Apr-24		
				24MW03 SS3	24MW100 SS3	% Difference
Benzene	mg/kg	0.0010	0.005	0.029	0.044	41.1
Toluene	mg/kg	0.0010	0.005	<0.050	0.12	-
Ethylbenzene	mg/kg	0.0010	0.005	<0.010	0.036	-
Xylenes	mg/kg	0.0020	0.01	0.052	0.15	97.0
C6-C10 (less BTEX)	mg/kg	0.090	0.45	<2.5	<2.5	-
>C10-C16	mg/kg	0.050	0.25	24	19	23.3
>C16-C21	mg/kg	0.050	0.25	220	160	31.6
>C21-C32	mg/kg	0.090	0.45	1900	1500	23.5
Modified TPH (fuel oil)	mg/kg	0.090	0.45	2100	1700	21.1

- Notes:
- 1. RDL - Reported Detection Limit
 - 2. RPD calculations are only applicable when concentrations are greater than 5 times the laboratory RDL.
 - 3. " - " = Not calculated due to parameter(s) equal to <RDL; or <5 times RDL

Shaded cell indicates % Difference > 60%

TABLE C.18
GROUNDWATER QA/QC DATA - PETROLEUM HYDROCARBONS (PHCs)
Town of Lunenburg WWTP Upgrade and Expansion
Project No. 240800.00

Parameter	Units	RDL	RDL (x5)	Apr-24		
				24MW03	24MW100	% Difference
Benzene	mg/L	0.0010	0.005	<0.0010	<0.0010	-
Toluene	mg/L	0.0010	0.005	<0.0010	<0.0010	-
Ethylbenzene	mg/L	0.0010	0.005	<0.0010	<0.0010	-
Xylenes	mg/L	0.0020	0.01	<0.0020	<0.0020	-
C6-C10 (less BTEX)	mg/L	0.090	0.45	<0.090	<0.090	-
>C10-C16	mg/L	0.050	0.25	<0.050	<0.050	-
>C16-C21	mg/L	0.050	0.25	<0.050	<0.050	-
>C21-C32	mg/L	0.090	0.45	<0.090	<0.090	-
Modified TPH (fuel oil)	mg/L	0.090	0.45	<0.090	<0.090	-

- Notes:
- 1. RDL - Reported Detection Limit
 - 2. RPD calculations are only applicable when concentrations are greater than 5 times the laboratory RDL.
 - 3. " - " = Not calculated due to parameter(s) equal to <RDL; or <5 times RDL

Shaded cell indicates % Difference > 40%

Attachment D

Laboratory Certificates of Analysis



Your Project #: 240800
Site Location: LUNENBURG
Your C.O.C. #: N/A

Attention: Brad Trask

CBCL Limited
Halifax - Standing offer
1505 Barrington Street
Suite 901 / PO Box 606
Halifax, NS
CANADA B3J 3Y6

Report Date: 2024/05/09

Report #: R8141845

Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C4B1377

Received: 2024/04/15, 16:55

Sample Matrix: Soil
Samples Received: 7

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Benzo(b/j)fluoranthene Sum (soil)	5	N/A	2024/04/22	N/A	Auto Calc.
Dioxins/Furans in Soil (1613B) (1, 4)	1	2024/04/27	2024/05/01	BRL SOP-00410	EPA 1613B m
2378TCDF Confirmation (M8290A/M1613) (1)	1	2024/04/27	2024/05/01	BRL SOP-00406/00410	EPA 8290A m/1613B m
TEH in Soil (PIRI) (5)	5	2024/04/19	2024/04/21	ATL SOP 00111	Atl. RBCA v3.1 m
TEH in Soil (PIRI) (5)	1	2024/04/19	2024/04/22	ATL SOP 00111	Atl. RBCA v3.1 m
Petroleum Hydrocarbons F2-F4 in Soil (1, 6)	2	2024/04/25	2024/04/25	CAM SOP-00316	CCME CWS m
Petroleum Hydrocarbons F2-F4 in Soil (1, 6)	2	2024/04/25	2024/04/26	CAM SOP-00316	CCME CWS m
Metals Solids Acid Extr. ICPMS	5	2024/04/19	2024/04/19	ATL SOP 00058	EPA 6020B R2 m
Total Cyanide in soils (2)	1	2024/04/18	2024/04/19	STL SOP-00035	MA300-CN 1.2 R4 m
Glycols in Soil by GC/FID (3)	1	2024/04/19	2024/04/19	CAL SOP-00093	BCMOE Glycols 09/17
Water Content (Subcontracted) (2, 7)	1	N/A	2024/04/22	STL SOP-00021	MA. 100-S.T. 1.1 R5m
Moisture (Subcontracted) (3, 7)	1	N/A	2024/04/20	AB SOP-00002	CCME PHC-CWS m
Moisture	6	N/A	2024/04/19	ATL SOP 00001	OMOE Handbook 1983 m
Moisture (1)	1	N/A	2024/04/18	CAM SOP-00445	Carter 2nd ed 70.2 m
OC Pesticides (Selected) & PCB (1, 8)	1	2024/04/23	2024/04/26	CAM SOP-00307	EPA 8081B/ 8082A
OC Pesticides Summed Parameters (1)	1	N/A	2024/04/19	CAM SOP-00307	EPA 8081B/ 8082A
PAH Compounds by GCMS (SIM) (5)	5	2024/04/19	2024/04/20	ATL SOP 00102	EPA 8270E R6 m
ModTPH (T1) Calc. for Soil	6	N/A	2024/04/22	N/A	Atl. RBCA v3.1 m
VOCs in Soil - Field Preserved (9)	1	N/A	2024/04/17	ATL SOP 00133	EPA 8260D R4 m
VPH in Soil (PIRI) - Field Preserved (9)	4	N/A	2024/04/17	ATL SOP 00119	Atl. RBCA v3.1 m
VPH in Soil (PIRI) - Field Preserved (9)	2	N/A	2024/04/19	ATL SOP 00119	Atl. RBCA v3.1 m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, EPA, APHA or the Quebec Ministry of Environment.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas 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.



Your Project #: 240800
Site Location: LUNENBURG
Your C.O.C. #: N/A

Attention: Brad Trask

CBCL Limited
Halifax - Standing offer
1505 Barrington Street
Suite 901 / PO Box 606
Halifax, NS
CANADA B3J 3Y6

Report Date: 2024/05/09

Report #: R8141845

Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C4B1377

Received: 2024/04/15, 16:55

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas 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 Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas 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 Bureau Veritas, results relate to the supplied samples tested.

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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) This test was performed by Bureau Veritas Mississauga, 6740 Campobello Rd , Mississauga, ON, L5N 2L8
- (2) This test was performed by Bureau Veritas Montreal, 889 Montée De Liesse , Saint Laurent, QC, H4T 1P5
- (3) This test was performed by Bureau Veritas Calgary, 4000-19th Street North-East , Calgary, AB, T2E 6P8
- (4) Soils are reported on a dry weight basis unless otherwise specified.

Confirmatory runs for 2,3,7,8-TCDF are performed only if the primary result is greater than the RDL.

(5) Soils are reported on a dry weight basis unless otherwise specified.

(6) All CCME PHC results met required criteria unless otherwise stated in the report. The CWS PHC methods employed by Bureau Veritas 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.

(7) Offsite analysis requires that subcontracted moisture be reported.

(8) Chlordane (Total) = Alpha Chlordane + Gamma Chlordane

(9) No lab extraction date is given for C6-C10/BTEX and VOC samples that are field preserved with methanol. Extraction date is date sampled unless otherwise stated.



Your Project #: 240800
Site Location: LUNENBURG
Your C.O.C. #: N/A

Attention: Brad Trask

CBCL Limited
Halifax - Standing offer
1505 Barrington Street
Suite 901 / PO Box 606
Halifax, NS
CANADA B3J 3Y6

Report Date: 2024/05/09
Report #: R8141845
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C4B1377
Received: 2024/04/15, 16:55

Encryption Key

Please direct all questions regarding this Certificate of Analysis to:

Cynthia Kendall MacKenzie, M.Sc., Project Manager 2

Email: cynthia.kendallmackenzie@bureauveritas.com

Phone# (902)420-0203

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Bureau Veritas 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 Signatures page if included, otherwise available by request. For Department specific Analyst/Supervisor validation names, please refer to the Test Summary section if included, otherwise available by request. This report is authorized by Suzanne Rogers, General Manager responsible for Nova Scotia Environmental laboratory operations.



BUREAU
VERITAS

Bureau Veritas Job #: C4B1377

Report Date: 2024/05/09

CBCL Limited

Client Project #: 240800

Site Location: LUNENBURG

Sampler Initials: BC

RBCA HYDROCARBONS IN SOIL (FIELD PRES.)

Bureau Veritas ID		YXD177				YXD177			
Sampling Date		2024/04/12				2024/04/12			
COC Number		N/A				N/A			
	UNITS	24MW01 SS4	RDL	MDL	QC Batch	24MW01 SS4 Lab-Dup	RDL	MDL	QC Batch
Petroleum Hydrocarbons									
Benzene	mg/kg	0.013	0.0050	N/A	9338888	0.013	0.0050	N/A	9338888
Toluene	mg/kg	<0.050	0.050	N/A	9338888	<0.050	0.050	N/A	9338888
Ethylbenzene	mg/kg	<0.010	0.010	0.025	9338888	<0.010	0.010	0.025	9338888
Total Xylenes	mg/kg	<0.050	0.050	N/A	9338888	<0.050	0.050	N/A	9338888
C6 - C10 (less BTEX)	mg/kg	<2.5	2.5	N/A	9338888	<2.5	2.5	N/A	9338888
>C10-C16 Hydrocarbons	mg/kg	<10	10	N/A	9343992	<10	10	N/A	9343992
>C16-C21 Hydrocarbons	mg/kg	34	10	N/A	9343992	32	10	N/A	9343992
>C21-<C32 Hydrocarbons	mg/kg	190	15	N/A	9343992	190	15	N/A	9343992
Modified TPH (Tier1)	mg/kg	220	15	N/A	9335576				
Reached Baseline at C32	mg/kg	No	N/A	N/A	9343992				
Hydrocarbon Resemblance	mg/kg	COMMENT (1)	N/A	N/A	9343992				
Surrogate Recovery (%)									
Isobutylbenzene - Extractable	%	100			9343992	96			9343992
n-Dotriacontane - Extractable	%	110			9343992	104			9343992
Isobutylbenzene - Volatile	%	107			9338888	102			9338888
RDL = Reportable Detection Limit QC Batch = Quality Control Batch Lab-Dup = Laboratory Initiated Duplicate N/A = Not Applicable (1) Lube oil fraction.									



BUREAU
VERITAS

Bureau Veritas Job #: C4B1377

Report Date: 2024/05/09

CBCL Limited

Client Project #: 240800

Site Location: LUNENBURG

Sampler Initials: BC

RBCA HYDROCARBONS IN SOIL (FIELD PRES.)

Bureau Veritas ID		YXD178	YXD179	YXD180		YXD181			
Sampling Date		2024/04/12	2024/04/12	2024/04/12		2024/04/12			
COC Number		N/A	N/A	N/A		N/A			
	UNITS	24MW02 SS2	24MW03 SS3	24MW04 SS2	QC Batch	24MW05 SS4	RDL	MDL	QC Batch
Petroleum Hydrocarbons									
Benzene	mg/kg	0.011	0.029	0.0071	9338888	<0.0050	0.0050	N/A	9343386
Toluene	mg/kg	<0.050	<0.050	<0.050	9338888	<0.050	0.050	N/A	9343386
Ethylbenzene	mg/kg	<0.010	<0.010	0.015	9338888	<0.010	0.010	0.025	9343386
Total Xylenes	mg/kg	<0.050	0.052	<0.050	9338888	<0.050	0.050	N/A	9343386
C6 - C10 (less BTEX)	mg/kg	<2.5	<2.5	13	9338888	<2.5	2.5	N/A	9343386
>C10-C16 Hydrocarbons	mg/kg	<10	24	<10	9343992	<10	10	N/A	9343992
>C16-C21 Hydrocarbons	mg/kg	47	220	23	9343992	<10	10	N/A	9343992
>C21-<C32 Hydrocarbons	mg/kg	420	1900	82	9343992	45	15	N/A	9343992
Modified TPH (Tier1)	mg/kg	470	2100	120	9335576	45	15	N/A	9335576
Reached Baseline at C32	mg/kg	No	No	Yes	9343992	Yes	N/A	N/A	9343992
Hydrocarbon Resemblance	mg/kg	COMMENT (1)	COMMENT (1)	COMMENT (2)	9343992	COMMENT (1)	N/A	N/A	9343992
Surrogate Recovery (%)									
Isobutylbenzene - Extractable	%	103	96	94	9343992	98			9343992
n-Dotriacontane - Extractable	%	122	111	112	9343992	111			9343992
Isobutylbenzene - Volatile	%	106	100	96	9338888	96			9343386
RDL = Reportable Detection Limit QC Batch = Quality Control Batch N/A = Not Applicable (1) Lube oil fraction. (2) One product in the gasoline range. Lube oil fraction.									



BUREAU
VERITAS

Bureau Veritas Job #: C4B1377

Report Date: 2024/05/09

CBCL Limited

Client Project #: 240800

Site Location: LUNENBURG

Sampler Initials: BC

RBCA HYDROCARBONS IN SOIL (FIELD PRES.)

Bureau Veritas ID		YXD181				YXD182			
Sampling Date		2024/04/12				2024/04/12			
COC Number		N/A				N/A			
	UNITS	24MW05 SS4 Lab-Dup	RDL	MDL	QC Batch	24MW100 SS3	RDL	MDL	QC Batch
Petroleum Hydrocarbons									
Benzene	mg/kg	<0.0050	0.0050	N/A	9343386	0.044	0.0050	N/A	9343386
Toluene	mg/kg	<0.050	0.050	N/A	9343386	0.12	0.050	N/A	9343386
Ethylbenzene	mg/kg	<0.010	0.010	0.025	9343386	0.036	0.010	0.025	9343386
Total Xylenes	mg/kg	<0.050	0.050	N/A	9343386	0.15	0.050	N/A	9343386
C6 - C10 (less BTEX)	mg/kg	<2.5	2.5	N/A	9343386	<2.5	2.5	N/A	9343386
>C10-C16 Hydrocarbons	mg/kg					19	10	N/A	9343992
>C16-C21 Hydrocarbons	mg/kg					160	10	N/A	9343992
>C21-<C32 Hydrocarbons	mg/kg					1500	15	N/A	9343992
Modified TPH (Tier1)	mg/kg					1700	15	N/A	9335576
Reached Baseline at C32	mg/kg					No	N/A	N/A	9343992
Hydrocarbon Resemblance	mg/kg					COMMENT (1)	N/A	N/A	9343992
Surrogate Recovery (%)									
Isobutylbenzene - Extractable	%					93			9343992
n-Dotriacontane - Extractable	%					119			9343992
Isobutylbenzene - Volatile	%	96			9343386	90			9343386
RDL = Reportable Detection Limit QC Batch = Quality Control Batch Lab-Dup = Laboratory Initiated Duplicate N/A = Not Applicable (1) Lube oil fraction.									



BUREAU
VERITAS

Bureau Veritas Job #: C4B1377

Report Date: 2024/05/09

CBCL Limited

Client Project #: 240800

Site Location: LUNENBURG

Sampler Initials: BC

ATLANTIC VOC IN SOIL (FIELD PRES.)

Bureau Veritas ID		YXD180			
Sampling Date		2024/04/12			
COC Number		N/A			
	UNITS	24MW04 SS2	RDL	MDL	QC Batch
Volatile Organics					
1,1,1-Trichloroethane	ug/kg	<25	25	0.00010	9337941
1,1,2,2-Tetrachloroethane	ug/kg	<25	25	0.00040	9337941
1,1,2-Trichloroethane	ug/kg	<25	25	0.00040	9337941
1,1-Dichloroethane	ug/kg	<25	25	0.00010	9337941
1,1-Dichloroethylene	ug/kg	<25	25	0.00010	9337941
1,2-Dichlorobenzene	ug/kg	<25	25	0.00020	9337941
1,2-Dichloropropane	ug/kg	<10	10	0.00020	9337941
1,3-Dichlorobenzene	ug/kg	<25	25	0.00020	9337941
1,4-Dichlorobenzene	ug/kg	<25	25	0.00030	9337941
Benzene	ug/kg	<20	20	0.00010	9337941
Bromodichloromethane	ug/kg	<25	25	0.00020	9337941
Bromoform	ug/kg	<25	25	0.00030	9337941
Bromomethane	ug/kg	<50	50	0.00040	9337941
Carbon Tetrachloride	ug/kg	<25	25	0.00010	9337941
Chlorobenzene	ug/kg	<10	10	0.00010	9337941
Chloroethane	ug/kg	<200	200	0.00030	9337941
Chloroform	ug/kg	<10	10	0.00010	9337941
cis-1,2-Dichloroethylene	ug/kg	<10	10	0.00010	9337941
cis-1,3-Dichloropropene	ug/kg	<25	25	0.00020	9337941
Dibromochloromethane	ug/kg	<25	25	0.00030	9337941
Ethylbenzene	ug/kg	<25	25	0.00010	9337941
Ethylene Dibromide	ug/kg	<25	25	0.00040	9337941
Methyl t-butyl ether (MTBE)	ug/kg	<25	25	0.00010	9337941
Methylene Chloride(Dichloromethane)	ug/kg	<25	25	0.00020	9337941
o-Xylene	ug/kg	<25	25	0.00010	9337941
p+m-Xylene	ug/kg	<25	25	0.00010	9337941
Styrene	ug/kg	<25	25	0.00020	9337941
Tetrachloroethylene	ug/kg	<10	10	0.00030	9337941
Toluene	ug/kg	<50	50	0.00010	9337941
Total Xylenes	ug/kg	<50	50	N/A	9337941
trans-1,2-Dichloroethylene	ug/kg	<10	10	0.00020	9337941
trans-1,3-Dichloropropene	ug/kg	<25	25	0.00030	9337941
Trichloroethylene	ug/kg	<10	10	0.00020	9337941
RDL = Reportable Detection Limit					
QC Batch = Quality Control Batch					
N/A = Not Applicable					



ATLANTIC VOC IN SOIL (FIELD PRES.)

Bureau Veritas ID		YXD180			
Sampling Date		2024/04/12			
COC Number		N/A			
	UNITS	24MW04 SS2	RDL	MDL	QC Batch
Trichlorofluoromethane (FREON 11)	ug/kg	<25	25	0.00030	9337941
Vinyl Chloride	ug/kg	<20	20	0.00020	9337941
Surrogate Recovery (%)					
4-Bromofluorobenzene	%	100			9337941
D10-o-Xylene	%	97			9337941
D4-1,2-Dichloroethane	%	92			9337941
D8-Toluene	%	102			9337941
RDL = Reportable Detection Limit					
QC Batch = Quality Control Batch					



RESULTS OF ANALYSES OF SOIL

Bureau Veritas ID		YXD177	YXD178	YXD179	YXD180	YXD181	YXD182			
Sampling Date		2024/04/12	2024/04/12	2024/04/12	2024/04/12	2024/04/12	2024/04/12			
COC Number		N/A	N/A	N/A	N/A	N/A	N/A			
	UNITS	24MW01 SS4	24MW02 SS2	24MW03 SS3	24MW04 SS2	24MW05 SS4	24MW100 SS3	RDL	MDL	QC Batch

Inorganics

Moisture	%	14	14	12	13	16	11	1.0	0.20	9341504

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

Bureau Veritas ID		YXM919			
Sampling Date		2024/04/12			
COC Number		N/A			
	UNITS	24MW03 SS2	RDL	MDL	QC Batch

Inorganics

Moisture	%	5.6	1.0	0.50	9342591

Physical Testing

Moisture-Subcontracted	%w/w	5.7	0.50	N/A	9349473
Moisture-Subcontracted	%	5.4	0.30	N/A	9347967

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

N/A = Not Applicable



GLYCOLS BY GC-FID (SOIL)

Bureau Veritas ID		YXM919			
Sampling Date		2024/04/12			
COC Number		N/A			
	UNITS	24MW03 SS2	RDL	MDL	QC Batch
Glycols					
Extractable (Water) Ethylene Glycol	mg/kg	<10	10	N/A	9344631
Extractable (Water) Diethylene Glycol	mg/kg	<9.0	9.0	N/A	9344631
Extractable (Water) Triethylene Glycol	mg/kg	<10	10	N/A	9344631
Extractable (Water) Propylene Glycol	mg/kg	<10	10	N/A	9344631
Surrogate Recovery (%)					
Extractable (Water) Methyl sulfone	%	102			9344631
RDL = Reportable Detection Limit					
QC Batch = Quality Control Batch					
N/A = Not Applicable					



BUREAU
VERITAS

Bureau Veritas Job #: C4B1377
Report Date: 2024/05/09

CBCL Limited
Client Project #: 240800
Site Location: LUNENBURG
Sampler Initials: BC

CONVENTIONALS (SOIL)

Bureau Veritas ID		YXM919			
Sampling Date		2024/04/12			
COC Number		N/A			
	UNITS	24MW03 SS2	RDL	MDL	QC Batch
Inorganics					
Total Cyanide (CN)	mg/kg	<0.50	0.50	N/A	9349472
RDL = Reportable Detection Limit					
QC Batch = Quality Control Batch					
N/A = Not Applicable					



**BUREAU
VERITAS**

Bureau Veritas Job #: C4B1377

Report Date: 2024/05/09

CBCL Limited

Client Project #: 240800

Site Location: LUNENBURG

Sampler Initials: BC

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

Bureau Veritas ID		YXD177	YXD178	YXD179	YXD180	YXD181			
Sampling Date		2024/04/12	2024/04/12	2024/04/12	2024/04/12	2024/04/12			
COC Number		N/A	N/A	N/A	N/A	N/A			
	UNITS	24MW01 SS4	24MW02 SS2	24MW03 SS3	24MW04 SS2	24MW05 SS4	RDL	MDL	QC Batch

Metals									
Acid Extractable Aluminum (Al)	mg/kg	13000	14000	13000	13000	12000	10	N/A	9343540
Acid Extractable Antimony (Sb)	mg/kg	<2.0	25	4.3	<2.0	2.2	2.0	N/A	9343540
Acid Extractable Arsenic (As)	mg/kg	28	22	20	30	19	2.0	N/A	9343540
Acid Extractable Barium (Ba)	mg/kg	70	190	580	71	110	5.0	N/A	9343540
Acid Extractable Beryllium (Be)	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	N/A	9343540
Acid Extractable Bismuth (Bi)	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	N/A	9343540
Acid Extractable Boron (B)	mg/kg	<50	<50	<50	<50	<50	50	N/A	9343540
Acid Extractable Cadmium (Cd)	mg/kg	<0.30	1.3	3.0	<0.30	0.67	0.30	N/A	9343540
Acid Extractable Chromium (Cr)	mg/kg	26	38	43	26	29	2.0	N/A	9343540
Acid Extractable Cobalt (Co)	mg/kg	12	15	10	12	7.0	1.0	N/A	9343540
Acid Extractable Copper (Cu)	mg/kg	88	3500	460	50	96	2.0	N/A	9343540
Acid Extractable Iron (Fe)	mg/kg	38000	40000	66000	34000	56000	50	N/A	9343540
Acid Extractable Lead (Pb)	mg/kg	87	440	1200	66	190	0.50	N/A	9343540
Acid Extractable Lithium (Li)	mg/kg	33	29	23	35	26	2.0	N/A	9343540
Acid Extractable Manganese (Mn)	mg/kg	840	1600	730	800	390	2.0	N/A	9343540
Acid Extractable Mercury (Hg)	mg/kg	0.14	0.24	0.15	2.1	<0.10	0.10	N/A	9343540
Acid Extractable Molybdenum (Mo)	mg/kg	3.8	4.2	4.9	2.2	5.3	2.0	N/A	9343540
Acid Extractable Nickel (Ni)	mg/kg	27	65	42	24	27	2.0	N/A	9343540
Acid Extractable Rubidium (Rb)	mg/kg	9.0	13	7.6	14	5.8	2.0	N/A	9343540
Acid Extractable Selenium (Se)	mg/kg	0.56	<0.50	<0.50	<0.50	0.64	0.50	N/A	9343540
Acid Extractable Silver (Ag)	mg/kg	<0.50	1.4	0.93	<0.50	<0.50	0.50	N/A	9343540
Acid Extractable Strontium (Sr)	mg/kg	20	37	130	16	18	5.0	N/A	9343540
Acid Extractable Thallium (Tl)	mg/kg	0.10	0.11	<0.10	0.11	<0.10	0.10	N/A	9343540
Acid Extractable Tin (Sn)	mg/kg	9.9	150	130	3.6	90	1.0	N/A	9343540
Acid Extractable Uranium (U)	mg/kg	1.2	1.0	0.88	1.5	0.94	0.10	N/A	9343540
Acid Extractable Vanadium (V)	mg/kg	34	34	24	34	29	2.0	N/A	9343540
Acid Extractable Zinc (Zn)	mg/kg	140	980	1200	170	760	5.0	N/A	9343540

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

N/A = Not Applicable

BUREAU
VERITAS

Bureau Veritas Job #: C4B1377

Report Date: 2024/05/09

CBCL Limited

Client Project #: 240800

Site Location: LUNENBURG

Sampler Initials: BC

SEMI-VOLATILE ORGANICS BY GC-MS (SOIL)

Bureau Veritas ID		YXD177		YXD178	YXD179	YXD180		YXD181			
Sampling Date		2024/04/12		2024/04/12	2024/04/12	2024/04/12		2024/04/12			
COC Number		N/A		N/A	N/A	N/A		N/A			
	UNITS	24MW01 SS4	RDL	24MW02 SS2	24MW03 SS3	24MW04 SS2	RDL	24MW05 SS4	RDL	MDL	QC Batch

Polyaromatic Hydrocarbons

1-Methylnaphthalene	mg/kg	0.018	0.010	0.017	<0.010	<0.010	0.010	<0.010	0.010	N/A	9343486
2-Methylnaphthalene	mg/kg	0.024	0.010	0.027	0.013	<0.010	0.010	<0.010	0.010	N/A	9343486
Acenaphthene	mg/kg	0.017	0.010	<0.010	<0.010	<0.010	0.010	<0.010	0.010	N/A	9343486
Acenaphthylene	mg/kg	<0.010	0.010	<0.010	<0.010	<0.010	0.010	<0.010	0.010	N/A	9343486
Anthracene	mg/kg	0.032	0.010	0.024	<0.010	<0.010	0.010	<0.010	0.010	N/A	9343486
Benzo(a)anthracene	mg/kg	0.070	0.010	0.10	0.051	<0.010	0.010	<0.010	0.010	N/A	9343486
Benzo(a)pyrene	mg/kg	0.066	0.010	0.10	0.063	<0.010	0.010	<0.010	0.010	N/A	9343486
Benzo(b)fluoranthene	mg/kg	0.056	0.010	0.10	0.069	<0.010	0.010	<0.010	0.010	N/A	9343486
Benzo(b,j)fluoranthene	mg/kg	0.089	0.020	0.16	0.11	<0.020	0.020	<0.020	0.020	N/A	9335575
Benzo(g,h,i)perylene	mg/kg	0.069	0.010	0.087	0.20	0.015	0.010	<0.010	0.010	N/A	9343486
Benzo(j)fluoranthene	mg/kg	0.032	0.010	0.061	0.036	<0.010	0.010	<0.010	0.010	N/A	9343486
Benzo(k)fluoranthene	mg/kg	0.032	0.010	0.056	0.033	<0.010	0.010	<0.010	0.010	N/A	9343486
Chrysene	mg/kg	<0.20 (1)	0.20	0.16	0.087	0.034	0.010	<0.010	0.010	N/A	9343486
Dibenzo(a,h)anthracene	mg/kg	<0.010	0.010	0.019	0.013	<0.010	0.010	<0.010	0.010	N/A	9343486
Fluoranthene	mg/kg	0.16	0.010	0.21	0.084	0.023	0.010	<0.010	0.010	N/A	9343486
Fluorene	mg/kg	<0.020 (1)	0.020	0.020	<0.010	<0.010	0.010	<0.010	0.010	N/A	9343486
Indeno(1,2,3-cd)pyrene	mg/kg	0.036	0.010	0.065	0.047	<0.010	0.010	<0.010	0.010	N/A	9343486
Naphthalene	mg/kg	0.016	0.010	0.016	<0.010	<0.010	0.010	<0.010	0.010	N/A	9343486
Perylene	mg/kg	0.018	0.010	0.025	0.017	<0.010	0.010	0.032	0.010	N/A	9343486
Phenanthrene	mg/kg	0.12	0.010	0.16	0.056	0.023	0.010	<0.020 (1)	0.020	N/A	9343486
Pyrene	mg/kg	0.14	0.010	0.18	0.14	0.026	0.010	<0.010	0.010	N/A	9343486

Surrogate Recovery (%)

D10-Anthracene	%	98		108	104	106		106			9343486
D14-Terphenyl (FS)	%	100		106	102	101		102			9343486
D8-Acenaphthylene	%	98		100	98	97		101			9343486

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

N/A = Not Applicable

(1) Elevated PAH RDL(s) due to matrix / co-extractive interference.



BUREAU
VERITAS

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CBCL Limited

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Sampler Initials: BC

PETROLEUM HYDROCARBONS (CCME)

Bureau Veritas ID		YXD177	YXD178	YXD179	YXD182			
Sampling Date		2024/04/12	2024/04/12	2024/04/12	2024/04/12			
COC Number		N/A	N/A	N/A	N/A			
	UNITS	24MW01 SS4	24MW02 SS2	24MW03 SS3	24MW100 SS3	RDL	MDL	QC Batch
F2-F4 Hydrocarbons								
F2 (C10-C16 Hydrocarbons)	ug/g	<10	37	28	21	10	5.0	9355303
F3 (C16-C34 Hydrocarbons)	ug/g	250	720	2800	2000	50	5.0	9355303
F4 (C34-C50 Hydrocarbons)	ug/g	210	390	1000	890	50	10	9355303
Reached Baseline at C50	ug/g	Yes	No	No	No			9355303
Surrogate Recovery (%)								
o-Terphenyl	%	113	113	115	111			9355303
RDL = Reportable Detection Limit								
QC Batch = Quality Control Batch								



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Sampler Initials: BC

ORGANOCHLORINATED PESTICIDES BY GC-ECD (SOIL)

Bureau Veritas ID		YXM919			
Sampling Date		2024/04/12			
COC Number		N/A			
	UNITS	24MW03 SS2	RDL	MDL	QC Batch
Calculated Parameters					
Aldrin + Dieldrin	ug/g	<0.010	0.010	N/A	9338533
Chlordane (Total)	ug/g	<0.010	0.010	N/A	9338533
DDT+ Metabolites	ug/g	<0.040	0.040	N/A	9338533
Heptachlor + Heptachlor epoxide	ug/g	<0.010	0.010	N/A	9338533
o,p-DDD + p,p-DDD	ug/g	<0.030	0.030	N/A	9338533
o,p-DDE + p,p-DDE	ug/g	<0.010	0.010	N/A	9338533
o,p-DDT + p,p-DDT	ug/g	<0.040	0.040	N/A	9338533
Total Endosulfan	ug/g	<0.010	0.010	N/A	9338533
Total PCB	ug/g	0.90	0.075	N/A	9338533
Pesticides & Herbicides					
Aldrin	ug/g	<0.010	0.010	0.0020	9350919
a-Chlordane	ug/g	<0.010	0.010	0.0020	9350919
g-Chlordane	ug/g	<0.010	0.010	0.0020	9350919
o,p-DDD	ug/g	<0.010	0.010	0.0020	9350919
p,p-DDD	ug/g	<0.030	0.030	0.0060	9350919
o,p-DDE	ug/g	<0.010	0.010	0.0020	9350919
p,p-DDE	ug/g	<0.010	0.010	0.0020	9350919
o,p-DDT	ug/g	<0.010	0.010	0.0020	9350919
p,p-DDT	ug/g	<0.040	0.040	0.0080	9350919
Dieldrin	ug/g	<0.010	0.010	0.0020	9350919
Lindane	ug/g	<0.010	0.010	0.0020	9350919
Endosulfan I (alpha)	ug/g	<0.010	0.010	0.0020	9350919
Endosulfan II (beta)	ug/g	<0.010	0.010	0.0020	9350919
Endrin	ug/g	<0.010	0.010	0.0020	9350919
Heptachlor	ug/g	<0.010	0.010	0.0020	9350919
Heptachlor epoxide	ug/g	<0.010	0.010	0.0020	9350919
Hexachlorobenzene	ug/g	<0.010	0.010	0.0020	9350919
Methoxychlor	ug/g	<0.025	0.025	0.0080	9350919
Aroclor 1016	ug/g	<0.075	0.075	0.015	9350919
Aroclor 1221	ug/g	<0.075	0.075	0.015	9350919
Aroclor 1232	ug/g	<0.075	0.075	0.015	9350919
Aroclor 1242	ug/g	<0.075	0.075	0.015	9350919
Aroclor 1248	ug/g	<0.075	0.075	0.015	9350919
Aroclor 1254	ug/g	<0.075	0.075	0.015	9350919
RDL = Reportable Detection Limit					
QC Batch = Quality Control Batch					
N/A = Not Applicable					



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ORGANOCHLORINATED PESTICIDES BY GC-ECD (SOIL)

Bureau Veritas ID		YXM919			
Sampling Date		2024/04/12			
COC Number		N/A			
	UNITS	24MW03 SS2	RDL	MDL	QC Batch
Aroclor 1260	ug/g	0.90	0.075	0.015	9350919
Aroclor 1262	ug/g	<0.075	0.075	0.015	9350919
Aroclor 1268	ug/g	<0.075	0.075	0.015	9350919
alpha-BHC	ug/g	<0.010	0.010	0.0020	9350919
beta-BHC	ug/g	<0.010	0.010	0.0020	9350919
delta-BHC	ug/g	<0.010	0.010	0.0020	9350919
Endosulfan sulfate	ug/g	<0.010	0.010	0.0020	9350919
Endrin aldehyde	ug/g	<0.010	0.010	0.0020	9350919
Endrin ketone	ug/g	<0.010	0.010	0.0020	9350919
Mirex	ug/g	<0.010	0.010	0.0020	9350919
Octachlorostyrene	ug/g	<0.010	0.010	0.0020	9350919
Toxaphene	ug/g	<0.080	0.080	0.020	9350919
Surrogate Recovery (%)					
2,4,5,6-Tetrachloro-m-xylene	%	119			9350919
Decachlorobiphenyl	%	123			9350919
RDL = Reportable Detection Limit					
QC Batch = Quality Control Batch					



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Sampler Initials: BC

DIOXINS AND FURANS BY HRMS (SOIL)

Bureau Veritas ID		YXM919							
Sampling Date		2024/04/12							
COC Number		N/A				TOXIC EQUIVALENCY		# of	
	UNITS	24MW03 SS2	EDL	RDL	MDL	TEF (2005 WHO)	TEQ(DL)	Isomers	QC Batch
Dioxins & Furans									
2,3,7,8-Tetra CDD *	pg/g	0.614	0.154	0.999	0.227	1.00	0.614	1	9362091
1,2,3,7,8-Penta CDD *	pg/g	1.45	0.180	4.99	0.258	1.00	1.45	1	9362091
1,2,3,4,7,8-Hexa CDD *	pg/g	1.28	0.167	4.99	0.204	0.100	0.128	1	9362091
1,2,3,6,7,8-Hexa CDD *	pg/g	4.57	0.161	4.99	0.173	0.100	0.457	1	9362091
1,2,3,7,8,9-Hexa CDD *	pg/g	6.18	0.162	4.99	0.179	0.100	0.618	1	9362091
1,2,3,4,6,7,8-Hepta CDD *	pg/g	108	0.185	4.99	0.743	0.0100	1.08	1	9362091
Octa CDD *	pg/g	1000	0.280	9.99	0.800	0.000300	0.300	1	9362091
Total Tetra CDD *	pg/g	16.6	0.154	0.999	0.400			11	9362091
Total Penta CDD *	pg/g	18.2	0.180	4.99	0.400			11	9362091
Total Hexa CDD *	pg/g	40.0	0.163	4.99	0.400			6	9362091
Total Hepta CDD *	pg/g	198	0.185	4.99	0.400			2	9362091
2,3,7,8-Tetra CDF **	pg/g	<21.2 (1)	21.2	0.999	0.181	0.100	2.12	0	9362091
1,2,3,7,8-Penta CDF **	pg/g	<3.80 (2)	3.80	4.99	0.242	0.0300	0.114	0	9362091
2,3,4,7,8-Penta CDF **	pg/g	5.67	0.167	4.99	0.211	0.300	1.70	1	9362091
1,2,3,4,7,8-Hexa CDF **	pg/g	9.75	0.135	4.99	0.228	0.100	0.975	1	9362091
1,2,3,6,7,8-Hexa CDF **	pg/g	3.83	0.129	4.99	0.203	0.100	0.383	1	9362091
2,3,4,6,7,8-Hexa CDF **	pg/g	3.80	0.139	4.99	0.177	0.100	0.380	1	9362091
1,2,3,7,8,9-Hexa CDF **	pg/g	0.274	0.171	4.99	0.185	0.100	0.0274	1	9362091
1,2,3,4,6,7,8-Hepta CDF **	pg/g	13.9	0.138	4.99	0.185	0.0100	0.139	1	9362091
1,2,3,4,7,8,9-Hepta CDF **	pg/g	1.24	0.180	4.99	0.194	0.0100	0.0124	1	9362091
Octa CDF **	pg/g	14.1	0.292	9.99	0.919	0.000300	0.00423	1	9362091
Total Tetra CDF **	pg/g	128	0.104	0.999	0.400			19	9362091
Total Penta CDF **	pg/g	76.7	0.176	4.99	0.400			14	9362091
Total Hexa CDF **	pg/g	42.2	0.142	4.99	0.400			12	9362091
EDL = Estimated Detection Limit RDL = Reportable Detection Limit TEF = Toxic Equivalency Factor, TEQ = Toxic Equivalency Quotient, The Total Toxic Equivalency (TEQ) value reported is the sum of Toxic Equivalent Quotients for the congeners tested. WHO(2005): The 2005 World Health Organization, Human and Mammalian Toxic Equivalency Factors for Dioxins and Dioxin-like Compounds QC Batch = Quality Control Batch * CDD = Chloro Dibenzo-p-Dioxin ** CDF = Chloro Dibenzo-p-Furan (1) RT > 3 seconds - PCDD/DF analysis - Peak detected exceeds expected retention time (from internal standard) by greater than 3 seconds (2) EMPC / DPE - Diphenylether interference present caused dibenzofuran detected to become a "non-detect" with an elevated detection limit.									



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CBCL Limited

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DIOXINS AND FURANS BY HRMS (SOIL)

Bureau Veritas ID		YXM919							
Sampling Date		2024/04/12							
COC Number		N/A				TOXIC EQUIVALENCY		# of	
	UNITS	24MW03 SS2	EDL	RDL	MDL	TEF (2005 WHO)	TEQ(DL)	Isomers	QC Batch
Total Hepta CDF **	pg/g	24.7	0.156	4.99	0.400			4	9362091
TCDF Confirmation									
Confirmation 2,3,7,8-Tetra CDF **	pg/g	5.54	0.14	1.0	0.090	0.100	0.554		9367411
TOTAL TOXIC EQUIVALENCY	pg/g						8.94		
Surrogate Recovery (%)									
37CL4 2378 Tetra CDD *	%	96							9362091
C13-1234678 HeptaCDD *	%	88							9362091
C13-1234678 HeptaCDF **	%	93							9362091
C13-123478 HexaCDD *	%	101							9362091
C13-123478 HexaCDF **	%	109							9362091
C13-1234789 HeptaCDF **	%	87							9362091
C13-123678 HexaCDD *	%	100							9362091
C13-123678 HexaCDF **	%	109							9362091
C13-12378 PentaCDD *	%	90							9362091
C13-12378 PentaCDF **	%	84							9362091
C13-123789 HexaCDF **	%	105							9362091
C13-234678 HexaCDF **	%	107							9362091
C13-23478 PentaCDF **	%	86							9362091
C13-2378 TetraCDD *	%	92							9362091
C13-2378 TetraCDF **	%	104							9362091
C13-OCDD *	%	54							9362091
Confirmation C13-2378 TetraCDF **	%	78							9367411
EDL = Estimated Detection Limit RDL = Reportable Detection Limit TEF = Toxic Equivalency Factor, TEQ = Toxic Equivalency Quotient, The Total Toxic Equivalency (TEQ) value reported is the sum of Toxic Equivalent Quotients for the congeners tested. WHO(2005): The 2005 World Health Organization, Human and Mammalian Toxic Equivalency Factors for Dioxins and Dioxin-like Compounds QC Batch = Quality Control Batch ** CDF = Chloro Dibenzo-p-Furan * CDD = Chloro Dibenzo-p-Dioxin									



GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	5.3°C

Samples which did not reach baseline for hydrocarbon analysis submitted for F2-F4 analysis as per B. Trask (2024/04/22 CKN):

YXD177: 24MW01 SS4

YXD178: 24MW02 SSW

YXD179: 24MW03 SS3

YXD182: 24MW100 SS3

Sample YXM919 [24MW03 SS2] : OC Pesticide Analysis: Due to the sample matrix, sample required dilution. Detection limits were adjusted accordingly.

Results relate only to the items tested.



BUREAU
VERITAS

Bureau Veritas Job #: C4B1377
Report Date: 2024/05/09

CBCL Limited
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QUALITY ASSURANCE REPORT

QA/QC	Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
	9337941	DBF	Matrix Spike	4-Bromofluorobenzene	2024/04/17		101	%	60 - 140
				D10-o-Xylene	2024/04/17		99	%	60 - 130
				D4-1,2-Dichloroethane	2024/04/17		95	%	60 - 140
				D8-Toluene	2024/04/17		103	%	60 - 140
				1,1,1-Trichloroethane	2024/04/17		95	%	60 - 140
				1,1,2,2-Tetrachloroethane	2024/04/17		90	%	60 - 140
				1,1,2-Trichloroethane	2024/04/17		99	%	60 - 140
				1,1-Dichloroethane	2024/04/17		90	%	60 - 140
				1,1-Dichloroethylene	2024/04/17		90	%	60 - 140
				1,2-Dichlorobenzene	2024/04/17		95	%	60 - 140
				1,2-Dichloroethane	2024/04/17		91	%	60 - 140
				1,2-Dichloropropane	2024/04/17		95	%	60 - 140
				1,3-Dichlorobenzene	2024/04/17		92	%	60 - 140
				1,4-Dichlorobenzene	2024/04/17		95	%	60 - 140
				Benzene	2024/04/17		99	%	60 - 140
				Bromodichloromethane	2024/04/17		99	%	60 - 140
				Bromoform	2024/04/17		94	%	60 - 140
				Bromomethane	2024/04/17		96	%	60 - 140
				Carbon Tetrachloride	2024/04/17		90	%	60 - 140
				Chlorobenzene	2024/04/17		96	%	60 - 140
				Chloroethane	2024/04/17		86	%	60 - 140
				Chloroform	2024/04/17		94	%	60 - 140
				cis-1,2-Dichloroethylene	2024/04/17		84	%	60 - 140
				cis-1,3-Dichloropropene	2024/04/17		87	%	60 - 140
				Dibromochloromethane	2024/04/17		93	%	60 - 140
				Ethylbenzene	2024/04/17		96	%	60 - 140
				Ethylene Dibromide	2024/04/17		86	%	60 - 140
				Methyl t-butyl ether (MTBE)	2024/04/17		85	%	60 - 140
				Methylene Chloride(Dichloromethane)	2024/04/17		87	%	60 - 140
				o-Xylene	2024/04/17		98	%	60 - 140
				p+m-Xylene	2024/04/17		95	%	60 - 140
				Styrene	2024/04/17		91	%	60 - 140
				Tetrachloroethylene	2024/04/17		99	%	60 - 140
				Toluene	2024/04/17		95	%	60 - 140
				trans-1,2-Dichloroethylene	2024/04/17		88	%	60 - 140
				trans-1,3-Dichloropropene	2024/04/17		87	%	60 - 140
				Trichloroethylene	2024/04/17		99	%	60 - 140
				Trichlorofluoromethane (FREON 11)	2024/04/17		89	%	60 - 140
				Vinyl Chloride	2024/04/17		90	%	60 - 140
	9337941	DBF	Spiked Blank	4-Bromofluorobenzene	2024/04/17		101	%	60 - 140
				D10-o-Xylene	2024/04/17		105	%	60 - 130
				D4-1,2-Dichloroethane	2024/04/17		94	%	60 - 140
				D8-Toluene	2024/04/17		103	%	60 - 140
				1,1,1-Trichloroethane	2024/04/17		113	%	60 - 130
				1,1,2,2-Tetrachloroethane	2024/04/17		106	%	60 - 130
				1,1,2-Trichloroethane	2024/04/17		116	%	60 - 130
				1,1-Dichloroethane	2024/04/17		106	%	60 - 130
				1,1-Dichloroethylene	2024/04/17		103	%	60 - 130
				1,2-Dichlorobenzene	2024/04/17		114	%	60 - 130
				1,2-Dichloroethane	2024/04/17		108	%	60 - 130
				1,2-Dichloropropane	2024/04/17		112	%	60 - 130
				1,3-Dichlorobenzene	2024/04/17		104	%	60 - 130
				1,4-Dichlorobenzene	2024/04/17		112	%	60 - 130



BUREAU
VERITAS

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9337941	DBF	Method Blank	Benzene	2024/04/17		117	%	60 - 130
			Bromodichloromethane	2024/04/17		117	%	60 - 130
			Bromoform	2024/04/17		111	%	60 - 130
			Bromomethane	2024/04/17		109	%	60 - 140
			Carbon Tetrachloride	2024/04/17		107	%	60 - 130
			Chlorobenzene	2024/04/17		112	%	60 - 130
			Chloroethane	2024/04/17		96	%	60 - 140
			Chloroform	2024/04/17		111	%	60 - 130
			cis-1,2-Dichloroethylene	2024/04/17		100	%	60 - 130
			cis-1,3-Dichloropropene	2024/04/17		105	%	60 - 130
			Dibromochloromethane	2024/04/17		110	%	60 - 130
			Ethylbenzene	2024/04/17		113	%	60 - 130
			Ethylene Dibromide	2024/04/17		102	%	60 - 130
			Methyl t-butyl ether (MTBE)	2024/04/17		105	%	60 - 130
			Methylene Chloride(Dichloromethane)	2024/04/17		104	%	60 - 130
			o-Xylene	2024/04/17		116	%	60 - 130
			p+m-Xylene	2024/04/17		113	%	60 - 130
			Styrene	2024/04/17		107	%	60 - 130
			Tetrachloroethylene	2024/04/17		118	%	60 - 130
			Toluene	2024/04/17		113	%	60 - 130
			trans-1,2-Dichloroethylene	2024/04/17		103	%	60 - 130
			trans-1,3-Dichloropropene	2024/04/17		107	%	60 - 130
			Trichloroethylene	2024/04/17		117	%	60 - 130
			Trichlorofluoromethane (FREON 11)	2024/04/17		100	%	60 - 140
			Vinyl Chloride	2024/04/17		96	%	60 - 140
			4-Bromofluorobenzene	2024/04/17		101	%	60 - 140
			D10-o-Xylene	2024/04/17		106	%	60 - 130
			D4-1,2-Dichloroethane	2024/04/17		92	%	60 - 140
			D8-Toluene	2024/04/17		103	%	60 - 140
			1,1,1-Trichloroethane	2024/04/17	<25		ug/kg	
			1,1,2,2-Tetrachloroethane	2024/04/17	<25		ug/kg	
			1,1,2-Trichloroethane	2024/04/17	<25		ug/kg	
			1,1-Dichloroethane	2024/04/17	<25		ug/kg	
			1,1-Dichloroethylene	2024/04/17	<25		ug/kg	
			1,2-Dichlorobenzene	2024/04/17	<25		ug/kg	
			1,2-Dichloroethane	2024/04/17	<25		ug/kg	
			1,2-Dichloropropane	2024/04/17	<10		ug/kg	
			1,3-Dichlorobenzene	2024/04/17	<25		ug/kg	
			1,4-Dichlorobenzene	2024/04/17	<25		ug/kg	
			Benzene	2024/04/17	<20		ug/kg	
			Bromodichloromethane	2024/04/17	<25		ug/kg	
			Bromoform	2024/04/17	<25		ug/kg	
			Bromomethane	2024/04/17	<50		ug/kg	
			Carbon Tetrachloride	2024/04/17	<25		ug/kg	
			Chlorobenzene	2024/04/17	<10		ug/kg	
			Chloroethane	2024/04/17	<200		ug/kg	
			Chloroform	2024/04/17	<10		ug/kg	
			cis-1,2-Dichloroethylene	2024/04/17	<10		ug/kg	
			cis-1,3-Dichloropropene	2024/04/17	<25		ug/kg	
			Dibromochloromethane	2024/04/17	<25		ug/kg	
			Ethylbenzene	2024/04/17	<25		ug/kg	
			Ethylene Dibromide	2024/04/17	<25		ug/kg	
			Methyl t-butyl ether (MTBE)	2024/04/17	<25		ug/kg	



BUREAU
VERITAS

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Sampler Initials: BC

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9337941	DBF	RPD	Methylene Chloride(Dichloromethane)	2024/04/17	<25		ug/kg	
			o-Xylene	2024/04/17	<25		ug/kg	
			p+m-Xylene	2024/04/17	<25		ug/kg	
			Styrene	2024/04/17	<25		ug/kg	
			Tetrachloroethylene	2024/04/17	<10		ug/kg	
			Toluene	2024/04/17	<50		ug/kg	
			Total Xylenes	2024/04/17	<50		ug/kg	
			trans-1,2-Dichloroethylene	2024/04/17	<10		ug/kg	
			trans-1,3-Dichloropropene	2024/04/17	<25		ug/kg	
			Trichloroethylene	2024/04/17	<10		ug/kg	
			Trichlorofluoromethane (FREON 11)	2024/04/17	<25		ug/kg	
			Vinyl Chloride	2024/04/17	<20		ug/kg	
			1,1,1-Trichloroethane	2024/04/17	NC		%	50
			1,1,2,2-Tetrachloroethane	2024/04/17	NC		%	50
			1,1,2-Trichloroethane	2024/04/17	NC		%	50
			1,1-Dichloroethane	2024/04/17	NC		%	50
			1,1-Dichloroethylene	2024/04/17	NC		%	50
			1,2-Dichlorobenzene	2024/04/17	NC		%	50
			1,2-Dichloroethane	2024/04/17	NC		%	50
			1,2-Dichloropropane	2024/04/17	NC		%	50
			1,3-Dichlorobenzene	2024/04/17	NC		%	50
			1,4-Dichlorobenzene	2024/04/17	NC		%	50
			Benzene	2024/04/17	NC		%	50
			Bromodichloromethane	2024/04/17	NC		%	50
			Bromoform	2024/04/17	NC		%	50
			Bromomethane	2024/04/17	NC		%	50
			Carbon Tetrachloride	2024/04/17	NC		%	50
			Chlorobenzene	2024/04/17	NC		%	50
			Chloroethane	2024/04/17	NC		%	50
			Chloroform	2024/04/17	NC		%	50
			cis-1,2-Dichloroethylene	2024/04/17	NC		%	50
			cis-1,3-Dichloropropene	2024/04/17	NC		%	50
			Dibromochloromethane	2024/04/17	NC		%	50
			Ethylbenzene	2024/04/17	NC		%	50
			Ethylene Dibromide	2024/04/17	NC		%	50
			Methyl t-butyl ether (MTBE)	2024/04/17	NC		%	50
			Methylene Chloride(Dichloromethane)	2024/04/17	NC		%	50
			o-Xylene	2024/04/17	NC		%	50
			p+m-Xylene	2024/04/17	NC		%	50
			Styrene	2024/04/17	NC		%	50
			Tetrachloroethylene	2024/04/17	NC		%	50
			Toluene	2024/04/17	NC		%	50
			Total Xylenes	2024/04/17	NC		%	50
			trans-1,2-Dichloroethylene	2024/04/17	NC		%	50
			trans-1,3-Dichloropropene	2024/04/17	NC		%	50
			Trichloroethylene	2024/04/17	NC		%	50
			Trichlorofluoromethane (FREON 11)	2024/04/17	NC		%	50
			Vinyl Chloride	2024/04/17	NC		%	50
9338888	SHL	Matrix Spike [YXD177-07]	Isobutylbenzene - Volatile	2024/04/17		102	%	60 - 130
			Benzene	2024/04/17		97	%	60 - 130
			Toluene	2024/04/17		98	%	60 - 130
			Ethylbenzene	2024/04/17		102	%	60 - 130
			Total Xylenes	2024/04/17		106	%	60 - 130



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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9338888	SHL	Spiked Blank	Isobutylbenzene - Volatile	2024/04/17		98	%	60 - 130
			Benzene	2024/04/17		100	%	60 - 140
			Toluene	2024/04/17		102	%	60 - 140
			Ethylbenzene	2024/04/17		98	%	60 - 140
			Total Xylenes	2024/04/17		102	%	60 - 140
9338888	SHL	Method Blank	Isobutylbenzene - Volatile	2024/04/17		99	%	60 - 130
			Benzene	2024/04/17	<0.0050		mg/kg	
			Toluene	2024/04/17	<0.050		mg/kg	
			Ethylbenzene	2024/04/17	<0.010		mg/kg	
			Total Xylenes	2024/04/17	<0.050		mg/kg	
9338888	SHL	RPD [YXD177-07]	C6 - C10 (less BTEX)	2024/04/17	<2.5		mg/kg	
			Benzene	2024/04/17	3.0		%	50
			Toluene	2024/04/17	NC		%	50
			Ethylbenzene	2024/04/17	NC		%	50
			Total Xylenes	2024/04/17	NC		%	50
9341504	RD4	RPD	C6 - C10 (less BTEX)	2024/04/17	NC		%	50
			Moisture	2024/04/19	3.2		%	25
9342591	MUC	RPD	Moisture	2024/04/18	2.5		%	20
9343386	SHL	Matrix Spike [YXD181-07]	Isobutylbenzene - Volatile	2024/04/19		94	%	60 - 130
			Benzene	2024/04/19		97	%	60 - 130
			Toluene	2024/04/19		99	%	60 - 130
			Ethylbenzene	2024/04/19		106	%	60 - 130
			Total Xylenes	2024/04/19		104	%	60 - 130
9343386	SHL	Spiked Blank	Isobutylbenzene - Volatile	2024/04/19		92	%	60 - 130
			Benzene	2024/04/19		104	%	60 - 140
			Toluene	2024/04/19		104	%	60 - 140
			Ethylbenzene	2024/04/19		105	%	60 - 140
			Total Xylenes	2024/04/19		106	%	60 - 140
9343386	SHL	Method Blank	Isobutylbenzene - Volatile	2024/04/19		95	%	60 - 130
			Benzene	2024/04/19	<0.0050		mg/kg	
			Toluene	2024/04/19	<0.050		mg/kg	
			Ethylbenzene	2024/04/19	<0.010		mg/kg	
			Total Xylenes	2024/04/19	<0.050		mg/kg	
9343386	SHL	RPD [YXD181-07]	C6 - C10 (less BTEX)	2024/04/19	<2.5		mg/kg	
			Benzene	2024/04/19	NC		%	50
			Toluene	2024/04/19	NC		%	50
			Ethylbenzene	2024/04/19	NC		%	50
			Total Xylenes	2024/04/19	NC		%	50
9343486	SA9	Matrix Spike	C6 - C10 (less BTEX)	2024/04/19	NC		%	50
			D10-Anthracene	2024/04/19		106	%	50 - 130
			D14-Terphenyl (FS)	2024/04/19		108	%	50 - 130
			D8-Acenaphthylene	2024/04/19		99	%	50 - 130
			1-Methylnaphthalene	2024/04/19		98	%	50 - 130
			2-Methylnaphthalene	2024/04/19		102	%	50 - 130
			Acenaphthene	2024/04/19		100	%	50 - 130
			Acenaphthylene	2024/04/19		102	%	50 - 130
			Anthracene	2024/04/19		107	%	50 - 130
			Benzo(a)anthracene	2024/04/19		125	%	50 - 130
			Benzo(a)pyrene	2024/04/19		90	%	50 - 130
			Benzo(b)fluoranthene	2024/04/19		90	%	50 - 130
			Benzo(g,h,i)perylene	2024/04/19		73	%	50 - 130
			Benzo(j)fluoranthene	2024/04/19		93	%	50 - 130
			Benzo(k)fluoranthene	2024/04/19		93	%	50 - 130



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QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9343486	SA9	Spiked Blank	Chrysene	2024/04/19		116	%	50 - 130
			Dibenzo(a,h)anthracene	2024/04/19		78	%	50 - 130
			Fluoranthene	2024/04/19		111	%	50 - 130
			Fluorene	2024/04/19		100	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2024/04/19		79	%	50 - 130
			Naphthalene	2024/04/19		98	%	50 - 130
			Perylene	2024/04/19		86	%	50 - 130
			Phenanthrene	2024/04/19		108	%	50 - 130
			Pyrene	2024/04/19		107	%	50 - 130
			D10-Anthracene	2024/04/19		114	%	50 - 130
			D14-Terphenyl (FS)	2024/04/19		112	%	50 - 130
			D8-Acenaphthylene	2024/04/19		107	%	50 - 130
			1-Methylnaphthalene	2024/04/19		111	%	50 - 130
			2-Methylnaphthalene	2024/04/19		117	%	50 - 130
			Acenaphthene	2024/04/19		113	%	50 - 130
			Acenaphthylene	2024/04/19		115	%	50 - 130
			Anthracene	2024/04/19		118	%	50 - 130
			Benzo(a)anthracene	2024/04/19		110	%	50 - 130
			Benzo(a)pyrene	2024/04/19		98	%	50 - 130
			Benzo(b)fluoranthene	2024/04/19		107	%	50 - 130
			Benzo(g,h,i)perylene	2024/04/19		95	%	50 - 130
			Benzo(j)fluoranthene	2024/04/19		105	%	50 - 130
			Benzo(k)fluoranthene	2024/04/19		108	%	50 - 130
			Chrysene	2024/04/19		118	%	50 - 130
			Dibenzo(a,h)anthracene	2024/04/19		96	%	50 - 130
			Fluoranthene	2024/04/19		115	%	50 - 130
			Fluorene	2024/04/19		113	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2024/04/19		95	%	50 - 130
			Naphthalene	2024/04/19		112	%	50 - 130
			Perylene	2024/04/19		95	%	50 - 130
			Phenanthrene	2024/04/19		123	%	50 - 130
			Pyrene	2024/04/19		110	%	50 - 130
9343486	SA9	Method Blank	D10-Anthracene	2024/04/19		86	%	50 - 130
			D14-Terphenyl (FS)	2024/04/19		83	%	50 - 130
			D8-Acenaphthylene	2024/04/19		78	%	50 - 130
			1-Methylnaphthalene	2024/04/19	<0.010		mg/kg	
			2-Methylnaphthalene	2024/04/19	<0.010		mg/kg	
			Acenaphthene	2024/04/19	<0.010		mg/kg	
			Acenaphthylene	2024/04/19	<0.010		mg/kg	
			Anthracene	2024/04/19	<0.010		mg/kg	
			Benzo(a)anthracene	2024/04/19	<0.010		mg/kg	
			Benzo(a)pyrene	2024/04/19	<0.010		mg/kg	
			Benzo(b)fluoranthene	2024/04/19	<0.010		mg/kg	
			Benzo(g,h,i)perylene	2024/04/19	<0.010		mg/kg	
			Benzo(j)fluoranthene	2024/04/19	<0.010		mg/kg	
			Benzo(k)fluoranthene	2024/04/19	<0.010		mg/kg	
			Chrysene	2024/04/19	<0.010		mg/kg	
			Dibenzo(a,h)anthracene	2024/04/19	<0.010		mg/kg	
			Fluoranthene	2024/04/19	<0.010		mg/kg	
			Fluorene	2024/04/19	<0.010		mg/kg	
			Indeno(1,2,3-cd)pyrene	2024/04/19	<0.010		mg/kg	
			Naphthalene	2024/04/19	<0.010		mg/kg	
			Perylene	2024/04/19	<0.010		mg/kg	



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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9343486	SA9	RPD	Phenanthrene	2024/04/19	<0.010		mg/kg	
			Pyrene	2024/04/19	<0.010		mg/kg	
			1-Methylnaphthalene	2024/04/19	NC		%	50
			2-Methylnaphthalene	2024/04/19	NC		%	50
			Acenaphthene	2024/04/19	NC		%	50
			Acenaphthylene	2024/04/19	NC		%	50
			Anthracene	2024/04/19	NC		%	50
			Benzo(a)anthracene	2024/04/19	NC		%	50
			Benzo(a)pyrene	2024/04/19	NC		%	50
			Benzo(b)fluoranthene	2024/04/19	NC		%	50
			Benzo(g,h,i)perylene	2024/04/19	NC		%	50
			Benzo(j)fluoranthene	2024/04/19	NC		%	50
			Benzo(k)fluoranthene	2024/04/19	NC		%	50
			Chrysene	2024/04/19	26		%	50
			Dibenzo(a,h)anthracene	2024/04/19	NC		%	50
			Fluoranthene	2024/04/19	NC		%	50
			Fluorene	2024/04/19	NC		%	50
			Indeno(1,2,3-cd)pyrene	2024/04/19	NC		%	50
			Naphthalene	2024/04/19	NC		%	50
			Perylene	2024/04/19	NC		%	50
9343540	MTZ	Matrix Spike	Phenanthrene	2024/04/19	NC		%	50
			Pyrene	2024/04/19	NC		%	50
			Acid Extractable Antimony (Sb)	2024/04/19		102	%	75 - 125
			Acid Extractable Arsenic (As)	2024/04/19		101	%	75 - 125
			Acid Extractable Barium (Ba)	2024/04/19		NC	%	75 - 125
			Acid Extractable Beryllium (Be)	2024/04/19		98	%	75 - 125
			Acid Extractable Bismuth (Bi)	2024/04/19		102	%	75 - 125
			Acid Extractable Boron (B)	2024/04/19		94	%	75 - 125
			Acid Extractable Cadmium (Cd)	2024/04/19		103	%	75 - 125
			Acid Extractable Chromium (Cr)	2024/04/19		105	%	75 - 125
			Acid Extractable Cobalt (Co)	2024/04/19		101	%	75 - 125
			Acid Extractable Copper (Cu)	2024/04/19		103	%	75 - 125
			Acid Extractable Lead (Pb)	2024/04/19		103	%	75 - 125
			Acid Extractable Lithium (Li)	2024/04/19		105	%	75 - 125
			Acid Extractable Manganese (Mn)	2024/04/19		NC	%	75 - 125
			Acid Extractable Mercury (Hg)	2024/04/19		100	%	75 - 125
			Acid Extractable Molybdenum (Mo)	2024/04/19		105	%	75 - 125
			Acid Extractable Nickel (Ni)	2024/04/19		103	%	75 - 125
			Acid Extractable Rubidium (Rb)	2024/04/19		102	%	75 - 125
			Acid Extractable Selenium (Se)	2024/04/19		104	%	75 - 125
			Acid Extractable Silver (Ag)	2024/04/19		103	%	75 - 125
			Acid Extractable Strontium (Sr)	2024/04/19		106	%	75 - 125
			Acid Extractable Thallium (Tl)	2024/04/19		103	%	75 - 125
			Acid Extractable Tin (Sn)	2024/04/19		103	%	75 - 125
			Acid Extractable Uranium (U)	2024/04/19		102	%	75 - 125
			Acid Extractable Vanadium (V)	2024/04/19		104	%	75 - 125
			Acid Extractable Zinc (Zn)	2024/04/19		NC	%	75 - 125
		Spiked Blank	Acid Extractable Antimony (Sb)	2024/04/19		96	%	75 - 125
			Acid Extractable Arsenic (As)	2024/04/19		96	%	75 - 125
			Acid Extractable Barium (Ba)	2024/04/19		94	%	75 - 125
			Acid Extractable Beryllium (Be)	2024/04/19		93	%	75 - 125
			Acid Extractable Bismuth (Bi)	2024/04/19		97	%	75 - 125
			Acid Extractable Boron (B)	2024/04/19		97	%	75 - 125



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QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Acid Extractable Cadmium (Cd)	2024/04/19		98	%	75 - 125
			Acid Extractable Chromium (Cr)	2024/04/19		96	%	75 - 125
			Acid Extractable Cobalt (Co)	2024/04/19		95	%	75 - 125
			Acid Extractable Copper (Cu)	2024/04/19		95	%	75 - 125
			Acid Extractable Lead (Pb)	2024/04/19		94	%	75 - 125
			Acid Extractable Lithium (Li)	2024/04/19		96	%	75 - 125
			Acid Extractable Manganese (Mn)	2024/04/19		96	%	75 - 125
			Acid Extractable Mercury (Hg)	2024/04/19		97	%	75 - 125
			Acid Extractable Molybdenum (Mo)	2024/04/19		101	%	75 - 125
			Acid Extractable Nickel (Ni)	2024/04/19		95	%	75 - 125
			Acid Extractable Rubidium (Rb)	2024/04/19		95	%	75 - 125
			Acid Extractable Selenium (Se)	2024/04/19		100	%	75 - 125
			Acid Extractable Silver (Ag)	2024/04/19		98	%	75 - 125
			Acid Extractable Strontium (Sr)	2024/04/19		97	%	75 - 125
			Acid Extractable Thallium (Tl)	2024/04/19		96	%	75 - 125
			Acid Extractable Tin (Sn)	2024/04/19		101	%	75 - 125
			Acid Extractable Uranium (U)	2024/04/19		95	%	75 - 125
			Acid Extractable Vanadium (V)	2024/04/19		95	%	75 - 125
			Acid Extractable Zinc (Zn)	2024/04/19		96	%	75 - 125
9343540	MTZ	Method Blank	Acid Extractable Aluminum (Al)	2024/04/19	<10		mg/kg	
			Acid Extractable Antimony (Sb)	2024/04/19	<2.0		mg/kg	
			Acid Extractable Arsenic (As)	2024/04/19	<2.0		mg/kg	
			Acid Extractable Barium (Ba)	2024/04/19	<5.0		mg/kg	
			Acid Extractable Beryllium (Be)	2024/04/19	<1.0		mg/kg	
			Acid Extractable Bismuth (Bi)	2024/04/19	<2.0		mg/kg	
			Acid Extractable Boron (B)	2024/04/19	<50		mg/kg	
			Acid Extractable Cadmium (Cd)	2024/04/19	<0.30		mg/kg	
			Acid Extractable Chromium (Cr)	2024/04/19	<2.0		mg/kg	
			Acid Extractable Cobalt (Co)	2024/04/19	<1.0		mg/kg	
			Acid Extractable Copper (Cu)	2024/04/19	<2.0		mg/kg	
			Acid Extractable Iron (Fe)	2024/04/19	<50		mg/kg	
			Acid Extractable Lead (Pb)	2024/04/19	<0.50		mg/kg	
			Acid Extractable Lithium (Li)	2024/04/19	<2.0		mg/kg	
			Acid Extractable Manganese (Mn)	2024/04/19	<2.0		mg/kg	
			Acid Extractable Mercury (Hg)	2024/04/19	<0.10		mg/kg	
			Acid Extractable Molybdenum (Mo)	2024/04/19	<2.0		mg/kg	
			Acid Extractable Nickel (Ni)	2024/04/19	<2.0		mg/kg	
			Acid Extractable Rubidium (Rb)	2024/04/19	<2.0		mg/kg	
			Acid Extractable Selenium (Se)	2024/04/19	<0.50		mg/kg	
			Acid Extractable Silver (Ag)	2024/04/19	<0.50		mg/kg	
			Acid Extractable Strontium (Sr)	2024/04/19	<5.0		mg/kg	
			Acid Extractable Thallium (Tl)	2024/04/19	<0.10		mg/kg	
			Acid Extractable Tin (Sn)	2024/04/19	<1.0		mg/kg	
			Acid Extractable Uranium (U)	2024/04/19	<0.10		mg/kg	
			Acid Extractable Vanadium (V)	2024/04/19	<2.0		mg/kg	
			Acid Extractable Zinc (Zn)	2024/04/19	<5.0		mg/kg	
9343540	MTZ	RPD	Acid Extractable Aluminum (Al)	2024/04/19	5.1		%	35
			Acid Extractable Antimony (Sb)	2024/04/19	NC		%	35
			Acid Extractable Arsenic (As)	2024/04/19	1.9		%	35
			Acid Extractable Barium (Ba)	2024/04/19	0.84		%	35
			Acid Extractable Beryllium (Be)	2024/04/19	NC		%	35
			Acid Extractable Bismuth (Bi)	2024/04/19	NC		%	35
			Acid Extractable Boron (B)	2024/04/19	NC		%	35



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QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Acid Extractable Cadmium (Cd)	2024/04/19	NC		%	35
			Acid Extractable Chromium (Cr)	2024/04/19	5.6		%	35
			Acid Extractable Cobalt (Co)	2024/04/19	3.7		%	35
			Acid Extractable Copper (Cu)	2024/04/19	4.3		%	35
			Acid Extractable Iron (Fe)	2024/04/19	3.6		%	35
			Acid Extractable Lead (Pb)	2024/04/19	5.7		%	35
			Acid Extractable Lithium (Li)	2024/04/19	4.0		%	35
			Acid Extractable Manganese (Mn)	2024/04/19	5.7		%	35
			Acid Extractable Mercury (Hg)	2024/04/19	NC		%	35
			Acid Extractable Molybdenum (Mo)	2024/04/19	NC		%	35
			Acid Extractable Nickel (Ni)	2024/04/19	4.4		%	35
			Acid Extractable Rubidium (Rb)	2024/04/19	3.1		%	35
			Acid Extractable Selenium (Se)	2024/04/19	NC		%	35
			Acid Extractable Silver (Ag)	2024/04/19	NC		%	35
			Acid Extractable Strontium (Sr)	2024/04/19	0.93		%	35
			Acid Extractable Thallium (Tl)	2024/04/19	3.4		%	35
			Acid Extractable Tin (Sn)	2024/04/19	0.84		%	35
			Acid Extractable Uranium (U)	2024/04/19	2.7		%	35
			Acid Extractable Vanadium (V)	2024/04/19	2.9		%	35
			Acid Extractable Zinc (Zn)	2024/04/19	0.24		%	35
9343992	ABJ	Matrix Spike [YXD177-06]	Isobutylbenzene - Extractable	2024/04/21		101	%	60 - 130
			n-Dotriacontane - Extractable	2024/04/21		106	%	60 - 130
			>C10-C16 Hydrocarbons	2024/04/21		93	%	30 - 130
			>C16-C21 Hydrocarbons	2024/04/21		97	%	30 - 130
			>C21-<C32 Hydrocarbons	2024/04/21		NC	%	30 - 130
9343992	ABJ	Spiked Blank	Isobutylbenzene - Extractable	2024/04/21		103	%	60 - 130
			n-Dotriacontane - Extractable	2024/04/21		105	%	60 - 130
			>C10-C16 Hydrocarbons	2024/04/21		97	%	60 - 130
			>C16-C21 Hydrocarbons	2024/04/21		98	%	60 - 130
			>C21-<C32 Hydrocarbons	2024/04/21		83	%	60 - 130
9343992	ABJ	Method Blank	Isobutylbenzene - Extractable	2024/04/21		102	%	60 - 130
			n-Dotriacontane - Extractable	2024/04/21		108	%	60 - 130
			>C10-C16 Hydrocarbons	2024/04/21	<10		mg/kg	
			>C16-C21 Hydrocarbons	2024/04/21	<10		mg/kg	
			>C21-<C32 Hydrocarbons	2024/04/21	<15		mg/kg	
9343992	ABJ	RPD [YXD177-06]	>C10-C16 Hydrocarbons	2024/04/21	NC		%	50
			>C16-C21 Hydrocarbons	2024/04/21	6.1		%	50
			>C21-<C32 Hydrocarbons	2024/04/21	3.1		%	50
9344631	éC6	Matrix Spike	Extractable (Water) Methyl sulfone	2024/04/18		97	%	50 - 130
			Extractable (Water) Ethylene Glycol	2024/04/18		95	%	60 - 140
			Extractable (Water) Diethylene Glycol	2024/04/18		105	%	60 - 140
			Extractable (Water) Triethylene Glycol	2024/04/18		92	%	60 - 140
			Extractable (Water) Propylene Glycol	2024/04/18		95	%	60 - 140
9344631	éC6	Spiked Blank	Extractable (Water) Methyl sulfone	2024/04/18		99	%	50 - 130
			Extractable (Water) Ethylene Glycol	2024/04/18		95	%	60 - 140
			Extractable (Water) Diethylene Glycol	2024/04/18		102	%	60 - 140
			Extractable (Water) Triethylene Glycol	2024/04/18		84	%	60 - 140
			Extractable (Water) Propylene Glycol	2024/04/18		96	%	60 - 140
9344631	éC6	Method Blank	Extractable (Water) Methyl sulfone	2024/04/18		101	%	50 - 130
			Extractable (Water) Ethylene Glycol	2024/04/18	<10		mg/kg	
			Extractable (Water) Diethylene Glycol	2024/04/18	<9.0		mg/kg	
			Extractable (Water) Triethylene Glycol	2024/04/18	<10		mg/kg	
			Extractable (Water) Propylene Glycol	2024/04/18	<10		mg/kg	



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9347967	OKO	Method Blank	Moisture-Subcontracted	2024/04/20	<0.30		%	
9349472	GXL	Spiked Blank	Total Cyanide (CN)	2024/04/19		96	%	80 - 120
9349472	GXL	Method Blank	Total Cyanide (CN)	2024/04/19	<0.50		mg/kg	
9350919	MAK	Matrix Spike	2,4,5,6-Tetrachloro-m-xylene	2024/04/24		82	%	50 - 130
			Decachlorobiphenyl	2024/04/24		101	%	50 - 130
			Aldrin	2024/04/24		68	%	50 - 130
			a-Chlordane	2024/04/24		84	%	50 - 130
			g-Chlordane	2024/04/24		83	%	50 - 130
			o,p-DDD	2024/04/24		98	%	50 - 130
			p,p-DDD	2024/04/24		106	%	50 - 130
			o,p-DDE	2024/04/24		81	%	50 - 130
			p,p-DDE	2024/04/24		103	%	50 - 130
			o,p-DDT	2024/04/24		99	%	50 - 130
			p,p-DDT	2024/04/24		102	%	50 - 130
			Dieldrin	2024/04/24		99	%	50 - 130
			Lindane	2024/04/24		81	%	50 - 130
			Endosulfan I (alpha)	2024/04/24		101	%	50 - 130
			Endosulfan II (beta)	2024/04/24		97	%	50 - 130
			Endrin	2024/04/24		117	%	50 - 130
			Heptachlor	2024/04/24		70	%	50 - 130
			Heptachlor epoxide	2024/04/24		85	%	50 - 130
			Hexachlorobenzene	2024/04/24		71	%	50 - 130
			Methoxychlor	2024/04/24		98	%	50 - 130
			alpha-BHC	2024/04/24		80	%	30 - 130
			beta-BHC	2024/04/24		87	%	30 - 130
			delta-BHC	2024/04/24		88	%	30 - 130
			Endosulfan sulfate	2024/04/24		106	%	30 - 130
			Endrin aldehyde	2024/04/24		82	%	30 - 130
			Endrin ketone	2024/04/24		110	%	30 - 130
			Mirex	2024/04/24		87	%	30 - 130
			Octachlorostyrene	2024/04/24		73	%	30 - 130
9350919	MAK	Spiked Blank	2,4,5,6-Tetrachloro-m-xylene	2024/04/24		87	%	50 - 130
			Decachlorobiphenyl	2024/04/24		102	%	50 - 130
			Aldrin	2024/04/24		78	%	50 - 130
			a-Chlordane	2024/04/24		94	%	50 - 130
			g-Chlordane	2024/04/24		98	%	50 - 130
			o,p-DDD	2024/04/24		109	%	50 - 130
			p,p-DDD	2024/04/24		116	%	50 - 130
			o,p-DDE	2024/04/24		94	%	50 - 130
			p,p-DDE	2024/04/24		107	%	50 - 130
			o,p-DDT	2024/04/24		107	%	50 - 130
			p,p-DDT	2024/04/24		104	%	50 - 130
			Dieldrin	2024/04/24		107	%	50 - 130
			Lindane	2024/04/24		92	%	50 - 130
			Endosulfan I (alpha)	2024/04/24		117	%	50 - 130
			Endosulfan II (beta)	2024/04/24		110	%	50 - 130
			Endrin	2024/04/24		129	%	50 - 130
			Heptachlor	2024/04/24		80	%	50 - 130
			Heptachlor epoxide	2024/04/24		96	%	50 - 130
			Hexachlorobenzene	2024/04/24		82	%	50 - 130
			Methoxychlor	2024/04/24		121	%	50 - 130
			alpha-BHC	2024/04/24		90	%	30 - 130
			beta-BHC	2024/04/24		97	%	30 - 130



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9350919	MAK	RPD	delta-BHC	2024/04/24		99	%	30 - 130
			Endosulfan sulfate	2024/04/24		119	%	30 - 130
			Endrin aldehyde	2024/04/24		91	%	30 - 130
			Endrin ketone	2024/04/24		118	%	30 - 130
			Mirex	2024/04/24		94	%	30 - 130
			Octachlorostyrene	2024/04/24		83	%	30 - 130
			Aldrin	2024/04/24	16		%	40
			a-Chlordane	2024/04/24	15		%	40
			g-Chlordane	2024/04/24	16		%	40
			o,p-DDD	2024/04/24	17		%	40
			p,p-DDD	2024/04/24	14		%	40
			o,p-DDE	2024/04/24	14		%	40
			p,p-DDE	2024/04/24	19		%	40
			o,p-DDT	2024/04/24	15		%	40
			p,p-DDT	2024/04/24	4.4		%	40
			Dieldrin	2024/04/24	0.85		%	40
			Lindane	2024/04/24	16		%	40
			Endosulfan I (alpha)	2024/04/24	14		%	40
			Endosulfan II (beta)	2024/04/24	13		%	40
			Endrin	2024/04/24	14		%	40
			Heptachlor	2024/04/24	16		%	40
			Heptachlor epoxide	2024/04/24	15		%	40
			Hexachlorobenzene	2024/04/24	16		%	40
			Methoxychlor	2024/04/24	6.4		%	40
			alpha-BHC	2024/04/24	16		%	50
			beta-BHC	2024/04/24	15		%	50
			delta-BHC	2024/04/24	14		%	50
			Endosulfan sulfate	2024/04/24	13		%	50
			Endrin aldehyde	2024/04/24	9.7		%	50
			Endrin ketone	2024/04/24	11		%	50
			Mirex	2024/04/24	12		%	50
			Octachlorostyrene	2024/04/24	16		%	50
			Aldrin	2024/04/24	NC		%	40
			a-Chlordane	2024/04/24	NC		%	40
			g-Chlordane	2024/04/24	NC		%	40
			o,p-DDD	2024/04/24	NC		%	40
			p,p-DDD	2024/04/24	NC		%	40
			o,p-DDE	2024/04/24	NC		%	40
			p,p-DDE	2024/04/24	NC		%	40
			o,p-DDT	2024/04/24	NC		%	40
			p,p-DDT	2024/04/24	NC		%	40
			Dieldrin	2024/04/24	NC		%	40
			Lindane	2024/04/24	NC		%	40
			Endosulfan I (alpha)	2024/04/24	NC		%	40
			Endosulfan II (beta)	2024/04/24	NC		%	40
			Endrin	2024/04/24	NC		%	40
			Heptachlor	2024/04/24	NC		%	40
			Heptachlor epoxide	2024/04/24	NC		%	40
			Hexachlorobenzene	2024/04/24	NC		%	40
			Methoxychlor	2024/04/24	NC		%	40
9350919	MAK	Method Blank	2,4,5,6-Tetrachloro-m-xylene	2024/04/24		85	%	50 - 130
			Decachlorobiphenyl	2024/04/24		84	%	50 - 130
			Aldrin	2024/04/24	<0.0020		ug/g	



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			a-Chlordane	2024/04/24	<0.0020		ug/g	
			g-Chlordane	2024/04/24	<0.0020		ug/g	
			o,p-DDD	2024/04/24	<0.0020		ug/g	
			p,p-DDD	2024/04/24	<0.0020		ug/g	
			o,p-DDE	2024/04/24	<0.0020		ug/g	
			p,p-DDE	2024/04/24	<0.0020		ug/g	
			o,p-DDT	2024/04/24	<0.0020		ug/g	
			p,p-DDT	2024/04/24	<0.0020		ug/g	
			Dieldrin	2024/04/24	<0.0020		ug/g	
			Lindane	2024/04/24	<0.0020		ug/g	
			Endosulfan I (alpha)	2024/04/24	<0.0020		ug/g	
			Endosulfan II (beta)	2024/04/24	<0.0020		ug/g	
			Endrin	2024/04/24	<0.0020		ug/g	
			Heptachlor	2024/04/24	<0.0020		ug/g	
			Heptachlor epoxide	2024/04/24	<0.0020		ug/g	
			Hexachlorobenzene	2024/04/24	<0.0020		ug/g	
			Methoxychlor	2024/04/24	<0.0050		ug/g	
			Aroclor 1016	2024/04/24	<0.015		ug/g	
			Aroclor 1221	2024/04/24	<0.015		ug/g	
			Aroclor 1232	2024/04/24	<0.015		ug/g	
			Aroclor 1242	2024/04/24	<0.015		ug/g	
			Aroclor 1248	2024/04/24	<0.015		ug/g	
			Aroclor 1254	2024/04/24	<0.015		ug/g	
			Aroclor 1260	2024/04/24	<0.015		ug/g	
			Aroclor 1262	2024/04/24	<0.015		ug/g	
			Aroclor 1268	2024/04/24	<0.015		ug/g	
			alpha-BHC	2024/04/24	<0.0020		ug/g	
			beta-BHC	2024/04/24	<0.0020		ug/g	
			delta-BHC	2024/04/24	<0.0020		ug/g	
			Endosulfan sulfate	2024/04/24	<0.0020		ug/g	
			Endrin aldehyde	2024/04/24	<0.0020		ug/g	
			Endrin ketone	2024/04/24	<0.0020		ug/g	
			Mirex	2024/04/24	<0.0020		ug/g	
			Octachlorostyrene	2024/04/24	<0.0020		ug/g	
			Toxaphene	2024/04/24	<0.080		ug/g	
9355303	DN0	Matrix Spike	o-Terphenyl	2024/04/25		101	%	60 - 130
			F2 (C10-C16 Hydrocarbons)	2024/04/25		106	%	60 - 130
			F3 (C16-C34 Hydrocarbons)	2024/04/25		115	%	60 - 130
			F4 (C34-C50 Hydrocarbons)	2024/04/25		118	%	60 - 130
9355303	DN0	Spiked Blank	o-Terphenyl	2024/04/25		100	%	60 - 130
			F2 (C10-C16 Hydrocarbons)	2024/04/25		103	%	80 - 120
			F3 (C16-C34 Hydrocarbons)	2024/04/25		111	%	80 - 120
			F4 (C34-C50 Hydrocarbons)	2024/04/25		114	%	80 - 120
9355303	DN0	Method Blank	o-Terphenyl	2024/04/25		111	%	60 - 130
			F2 (C10-C16 Hydrocarbons)	2024/04/25	<10		ug/g	
			F3 (C16-C34 Hydrocarbons)	2024/04/25	<50		ug/g	
			F4 (C34-C50 Hydrocarbons)	2024/04/25	<50		ug/g	
9355303	DN0	RPD	F2 (C10-C16 Hydrocarbons)	2024/04/26	NC		%	30
			F3 (C16-C34 Hydrocarbons)	2024/04/26	28		%	30
			F4 (C34-C50 Hydrocarbons)	2024/04/26	12		%	30
9362091	YQI	Matrix Spike	37CL4 2378 Tetra CDD	2024/04/30		94	%	35 - 197
			C13-1234678 HeptaCDD	2024/04/30		85	%	23 - 140
			C13-1234678 HeptaCDF	2024/04/30		89	%	28 - 143



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			C13-123478 HexaCDD	2024/04/30		98	%	32 - 141
			C13-123478 HexaCDF	2024/04/30		100	%	26 - 152
			C13-1234789 HeptaCDF	2024/04/30		94	%	26 - 138
			C13-123678 HexaCDD	2024/04/30		87	%	28 - 130
			C13-123678 HexaCDF	2024/04/30		99	%	26 - 123
			C13-12378 PentaCDD	2024/04/30		91	%	25 - 181
			C13-12378 PentaCDF	2024/04/30		79	%	24 - 185
			C13-123789 HexaCDF	2024/04/30		100	%	29 - 147
			C13-234678 HexaCDF	2024/04/30		97	%	28 - 136
			C13-23478 PentaCDF	2024/04/30		91	%	21 - 178
			C13-2378 TetraCDD	2024/04/30		87	%	25 - 164
			C13-2378 TetraCDF	2024/04/30		97	%	24 - 169
			C13-OCDD	2024/04/30		64	%	17 - 157
			2,3,7,8-Tetra CDD	2024/04/30		113	%	67 - 158
			1,2,3,7,8-Penta CDD	2024/04/30		96	%	25 - 181
			1,2,3,4,7,8-Hexa CDD	2024/04/30		99	%	70 - 164
			1,2,3,6,7,8-Hexa CDD	2024/04/30		106	%	76 - 134
			1,2,3,7,8,9-Hexa CDD	2024/04/30		103	%	64 - 162
			1,2,3,4,6,7,8-Hepta CDD	2024/04/30		110	%	70 - 140
			Octa CDD	2024/04/30		112	%	78 - 144
			2,3,7,8-Tetra CDF	2024/04/30		99	%	75 - 158
			1,2,3,7,8-Penta CDF	2024/04/30		102	%	80 - 134
			2,3,4,7,8-Penta CDF	2024/04/30		99	%	68 - 160
			1,2,3,4,7,8-Hexa CDF	2024/04/30		107	%	72 - 134
			1,2,3,6,7,8-Hexa CDF	2024/04/30		103	%	84 - 130
			2,3,4,6,7,8-Hexa CDF	2024/04/30		109	%	70 - 156
			1,2,3,7,8,9-Hexa CDF	2024/04/30		110	%	78 - 130
			1,2,3,4,6,7,8-Hepta CDF	2024/04/30		104	%	82 - 122
			1,2,3,4,7,8,9-Hepta CDF	2024/04/30		105	%	78 - 138
			Octa CDF	2024/04/30		106	%	63 - 170
9362091	YQI	Spiked Blank	37CL4 2378 Tetra CDD	2024/04/30		84	%	35 - 197
			C13-1234678 HeptaCDD	2024/04/30		84	%	23 - 140
			C13-1234678 HeptaCDF	2024/04/30		85	%	28 - 143
			C13-123478 HexaCDD	2024/04/30		100	%	32 - 141
			C13-123478 HexaCDF	2024/04/30		96	%	26 - 152
			C13-1234789 HeptaCDF	2024/04/30		89	%	26 - 138
			C13-123678 HexaCDD	2024/04/30		89	%	28 - 130
			C13-123678 HexaCDF	2024/04/30		92	%	26 - 123
			C13-12378 PentaCDD	2024/04/30		96	%	25 - 181
			C13-12378 PentaCDF	2024/04/30		85	%	24 - 185
			C13-123789 HexaCDF	2024/04/30		96	%	29 - 147
			C13-234678 HexaCDF	2024/04/30		94	%	28 - 136
			C13-23478 PentaCDF	2024/04/30		89	%	21 - 178
			C13-2378 TetraCDD	2024/04/30		85	%	25 - 164
			C13-2378 TetraCDF	2024/04/30		93	%	24 - 169
			C13-OCDD	2024/04/30		68	%	17 - 157
			2,3,7,8-Tetra CDD	2024/04/30		107	%	67 - 158
			1,2,3,7,8-Penta CDD	2024/04/30		94	%	25 - 181
			1,2,3,4,7,8-Hexa CDD	2024/04/30		98	%	70 - 164
			1,2,3,6,7,8-Hexa CDD	2024/04/30		101	%	76 - 134
			1,2,3,7,8,9-Hexa CDD	2024/04/30		104	%	64 - 162
			1,2,3,4,6,7,8-Hepta CDD	2024/04/30		104	%	70 - 140
			Octa CDD	2024/04/30		101	%	78 - 144



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9362091	YQI	Method Blank	2,3,7,8-Tetra CDF	2024/04/30		102	%	75 - 158
			1,2,3,7,8-Penta CDF	2024/04/30		102	%	80 - 134
			2,3,4,7,8-Penta CDF	2024/04/30		99	%	68 - 160
			1,2,3,4,7,8-Hexa CDF	2024/04/30		104	%	72 - 134
			1,2,3,6,7,8-Hexa CDF	2024/04/30		101	%	84 - 130
			2,3,4,6,7,8-Hexa CDF	2024/04/30		103	%	70 - 156
			1,2,3,7,8,9-Hexa CDF	2024/04/30		104	%	78 - 130
			1,2,3,4,6,7,8-Hepta CDF	2024/04/30		93	%	82 - 122
			1,2,3,4,7,8,9-Hepta CDF	2024/04/30		91	%	78 - 138
			Octa CDF	2024/04/30		101	%	63 - 170
			37CL4 2378 Tetra CDD	2024/04/30		81	%	35 - 197
			C13-1234678 HeptaCDD	2024/04/30		89	%	23 - 140
			C13-1234678 HeptaCDF	2024/04/30		85	%	28 - 143
			C13-123478 HexaCDD	2024/04/30		87	%	32 - 141
			C13-123478 HexaCDF	2024/04/30		87	%	26 - 152
			C13-1234789 HeptaCDF	2024/04/30		88	%	26 - 138
			C13-123678 HexaCDD	2024/04/30		89	%	28 - 130
			C13-123678 HexaCDF	2024/04/30		91	%	26 - 123
			C13-12378 PentaCDD	2024/04/30		78	%	25 - 181
			C13-12378 PentaCDF	2024/04/30		68	%	24 - 185
			C13-123789 HexaCDF	2024/04/30		95	%	29 - 147
			C13-234678 HexaCDF	2024/04/30		91	%	28 - 136
			C13-23478 PentaCDF	2024/04/30		75	%	21 - 178
			C13-2378 TetraCDD	2024/04/30		74	%	25 - 164
			C13-2378 TetraCDF	2024/04/30		83	%	24 - 169
			C13-OCDD	2024/04/30		71	%	17 - 157
			2,3,7,8-Tetra CDD	2024/04/30	<0.133, EDL=0.133		pg/g	
			1,2,3,7,8-Penta CDD	2024/04/30	<0.161, EDL=0.161		pg/g	
			1,2,3,4,7,8-Hexa CDD	2024/04/30	<0.106, EDL=0.106		pg/g	
			1,2,3,6,7,8-Hexa CDD	2024/04/30	0.260, EDL=0.0996		pg/g	
			1,2,3,7,8,9-Hexa CDD	2024/04/30	0.643, EDL=0.102		pg/g	
			1,2,3,4,6,7,8-Hepta CDD	2024/04/30	0.979, EDL=0.0907		pg/g	
			Octa CDD	2024/04/30	2.05, EDL=0.144		pg/g	
			Total Tetra CDD	2024/04/30	1.44, EDL=0.133		pg/g	
			Total Penta CDD	2024/04/30	1.85, EDL=0.157		pg/g	
			Total Hexa CDD	2024/04/30	4.89, EDL=0.102		pg/g	
			Total Hepta CDD	2024/04/30	3.24, EDL=0.0907		pg/g	
			2,3,7,8-Tetra CDF	2024/04/30	<0.0960, EDL=0.0960		pg/g	
			1,2,3,7,8-Penta CDF	2024/04/30	<0.143, EDL=0.143		pg/g	



**BUREAU
VERITAS**

Bureau Veritas Job #: C4B1377
Report Date: 2024/05/09

CBCL Limited
Client Project #: 240800
Site Location: LUNENBURG
Sampler Initials: BC

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			2,3,4,7,8-Penta CDF	2024/04/30	<0.119, EDL=0.119		pg/g	
			1,2,3,4,7,8-Hexa CDF	2024/04/30	<0.105, EDL=0.105		pg/g	
			1,2,3,6,7,8-Hexa CDF	2024/04/30	<0.0965, EDL=0.0965		pg/g	
			2,3,4,6,7,8-Hexa CDF	2024/04/30	<0.101, EDL=0.101		pg/g	
			1,2,3,7,8,9-Hexa CDF	2024/04/30	<0.118, EDL=0.118		pg/g	
			1,2,3,4,6,7,8-Hepta CDF	2024/04/30	<0.105, EDL=0.105		pg/g	
			1,2,3,4,7,8,9-Hepta CDF	2024/04/30	<0.125, EDL=0.125		pg/g	
			Octa CDF	2024/04/30	<0.167, EDL=0.167		pg/g	
			Total Tetra CDF	2024/04/30	<0.0960, EDL=0.0960		pg/g	
			Total Penta CDF	2024/04/30	<0.131, EDL=0.131		pg/g	
			Total Hexa CDF	2024/04/30	<0.105, EDL=0.105		pg/g	
			Total Hepta CDF	2024/04/30	<0.114, EDL=0.114		pg/g	
9362091	YQI	RPD	2,3,7,8-Tetra CDD	2024/04/30	NC		%	25
			1,2,3,7,8-Penta CDD	2024/04/30	NC		%	25
			1,2,3,4,7,8-Hexa CDD	2024/04/30	NC		%	25
			1,2,3,6,7,8-Hexa CDD	2024/04/30	NC		%	25
			1,2,3,7,8,9-Hexa CDD	2024/04/30	NC		%	25
			1,2,3,4,6,7,8-Hepta CDD	2024/04/30	NC		%	25
			Octa CDD	2024/04/30	NC		%	25
			Total Tetra CDD	2024/04/30	NC		%	25
			Total Penta CDD	2024/04/30	NC		%	25
			Total Hexa CDD	2024/04/30	21		%	25
			Total Hepta CDD	2024/04/30	NC		%	25
			2,3,7,8-Tetra CDF	2024/04/30	NC (1)		%	25
			1,2,3,7,8-Penta CDF	2024/04/30	NC		%	25
			2,3,4,7,8-Penta CDF	2024/04/30	NC		%	25
			1,2,3,4,7,8-Hexa CDF	2024/04/30	NC		%	25
			1,2,3,6,7,8-Hexa CDF	2024/04/30	NC		%	25
			2,3,4,6,7,8-Hexa CDF	2024/04/30	NC		%	25
			1,2,3,7,8,9-Hexa CDF	2024/04/30	NC (2)		%	25
			1,2,3,4,6,7,8-Hepta CDF	2024/04/30	NC (2)		%	25
			1,2,3,4,7,8,9-Hepta CDF	2024/04/30	NC		%	25
			Octa CDF	2024/04/30	NC		%	25
			Total Tetra CDF	2024/04/30	NC		%	25
			Total Penta CDF	2024/04/30	NC		%	25
			Total Hexa CDF	2024/04/30	NC		%	25
			Total Hepta CDF	2024/04/30	NC		%	25
9367411	YQI	Method Blank	Confirmation 2,3,7,8-Tetra CDF	2024/05/01	<1.4, EDL=1.4		pg/g	



Bureau Veritas Job #: C4B1377
Report Date: 2024/05/09

CBCL Limited
Client Project #: 240800
Site Location: LUNENBURG
Sampler Initials: BC

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC		QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
Batch	Init							
			Confirmation C13-2378 TetraCDF	2024/05/01		57	%	40 - 135
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement. Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference. Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy. Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination. Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency. NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration) NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL). (1) RT > 3 seconds - PCDD/DF analysis - Peak detected exceeds expected retention time (from internal standard) by greater than 3 seconds. (2) EMPC / NDR - Peak detected does not meet ratio criteria and has resulted in an elevated detection limit.								



BUREAU
VERITAS

Bureau Veritas Job #: C4B1377

Report Date: 2024/05/09

CBCL Limited

Client Project #: 240800

Site Location: LUNENBURG

Sampler Initials: BC

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:



Caroline Bougie

Caroline Bougie, B.Sc. Chemist

Cristina Carriere

Cristina Carriere, Senior Scientific Specialist

Cathy Xu

Cathy Xu, Scientific Specialist, Ultra Trace Analysis, HRMS

Veronica Falk

Veronica Falk, B.Sc., P.Chem., QP, Scientific Specialist, Organics

Gita Pokhrel

Gita Pokhrel, Senior Analyst

Janah M. Rhyno

Janah Rhyno, Scientific Specialist

Philippe Deveau

Phil Deveau, Scientific Specialist (Organics)



BUREAU
VERITAS

Bureau Veritas Job #: C4B1377

Report Date: 2024/05/09

CBCL Limited

Client Project #: 240800

Site Location: LUNENBURG

Sampler Initials: BC

VALIDATION SIGNATURE PAGE(CONT'D)

The analytical data and all QC contained in this report were reviewed and validated by:



Shu Yang

Shu Yang, Analyst 2

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Your Project #: 240800
Site Location: LUNENBURG
Your C.O.C. #: N/A

Attention: Brad Trask

CBCL Limited
Halifax - Standing offer
1505 Barrington Street
Suite 901 / PO Box 606
Halifax, NS
CANADA B3J 3Y6

Report Date: 2024/05/09
Report #: R8141884
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C4B3919

Received: 2024/04/17, 10:27

Sample Matrix: Water
Samples Received: 6

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Benzo(b/j)fluoranthene Sum (water)	4	N/A	2024/04/23	N/A	Auto Calc.
Benzo(b/j)fluoranthene Sum (water)	1	N/A	2024/04/24	N/A	Auto Calc.
Total Cyanide (1)	1	2024/04/22	2024/04/22	CAM SOP-00457	OMOE E3015 5 m
Dioxins/Furans in Water (1613B) (1, 3)	1	2024/04/26	2024/05/02	BRL SOP-00410	EPA 1613B m
TEH in Water (PIRI)	6	2024/04/19	2024/04/21	ATL SOP 00113	Atl. RBCA v3.1 m
Metals Water Diss. MS (as rec'd)	4	N/A	2024/04/22	ATL SOP 00058	EPA 6020B R2 m
Metals Water Diss. MS (as rec'd)	1	N/A	2024/04/23	ATL SOP 00058	EPA 6020B R2 m
Glycol in Water (2)	1	N/A	2024/04/23	CAL SOP-00093	BCMOE Glycols 09/17
OC Pesticides (Selected) & PCB (1, 4)	1	2024/04/22	2024/04/23	CAM SOP-00307	EPA 8081B/ 8082A
OC Pesticides Summed Parameters (1)	1	N/A	2024/04/22	CAM SOP-00307	EPA 8081B/ 8082A
PAH in Water by GC/MS (SIM)	5	2024/04/22	2024/04/22	ATL SOP 00103	EPA 8270E R6 m
ModTPH (T1) Calc. for Water	6	N/A	2024/04/23	N/A	Atl. RBCA v3 m
Volatile Organic Compounds in Water	1	N/A	2024/04/22	ATL SOP 00133	EPA 8260D R4 m
VPH in Water (PIRI)	6	N/A	2024/04/22	ATL SOP 00130	Atl. RBCA v3.1 m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, EPA, APHA or the Quebec Ministry of Environment.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas 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.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas 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 Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas 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



Your Project #: 240800
Site Location: LUNENBURG
Your C.O.C. #: N/A

Attention: Brad Trask

CBCL Limited
Halifax - Standing offer
1505 Barrington Street
Suite 901 / PO Box 606
Halifax, NS
CANADA B3J 3Y6

Report Date: 2024/05/09

Report #: R8141884

Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C4B3919

Received: 2024/04/17, 10:27

dilution methods.

Results relate to samples tested. When sampling is not conducted by Bureau Veritas, 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) This test was performed by Bureau Veritas Mississauga, 6740 Campobello Rd , Mississauga, ON, L5N 2L8

(2) This test was performed by Bureau Veritas Calgary, 4000-19th Street North-East , Calgary, AB, T2E 6P8

(3) Confirmatory runs for 2,3,7,8-TCDF are performed only if the primary result is greater than the RDL.

(4) Chlordane (Total) = Alpha Chlordane + Gamma Chlordane

Encryption Key

Please direct all questions regarding this Certificate of Analysis to:

Cynthia Kendall MacKenzie, M.Sc., Project Manager 2

Email: cynthia.kendallmackenzie@bureauveritas.com

Phone# (902)420-0203

=====

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For Service Group specific validation, please refer to the Validation Signatures page if included, otherwise available by request. For Department specific Analyst/Supervisor validation names, please refer to the Test Summary section if included, otherwise available by request. This report is authorized by Suzanne Rogers, General Manager responsible for Nova Scotia Environmental laboratory operations.



BUREAU
VERITAS

Bureau Veritas Job #: C4B3919

Report Date: 2024/05/09

CBCL Limited

Client Project #: 240800

Site Location: LUNENBURG

Sampler Initials: BC

RBCA HYDROCARBONS IN WATER (WATER)

Bureau Veritas ID		YXQ258				YXQ258			
Sampling Date		2024/04/16 14:30				2024/04/16 14:30			
COC Number		N/A				N/A			
	UNITS	24MW01	RDL	MDL	QC Batch	24MW01 Lab-Dup	RDL	MDL	QC Batch
Petroleum Hydrocarbons									
Benzene	mg/L	<0.0010	0.0010	N/A	9346935	<0.0010	0.0010	N/A	9346935
Toluene	mg/L	<0.0010	0.0010	N/A	9346935	<0.0010	0.0010	N/A	9346935
Ethylbenzene	mg/L	<0.0010	0.0010	N/A	9346935	<0.0010	0.0010	N/A	9346935
Total Xylenes	mg/L	<0.0020	0.0020	N/A	9346935	<0.0020	0.0020	N/A	9346935
C6 - C10 (less BTEX)	mg/L	<0.090	0.090	N/A	9346935	<0.090	0.090	N/A	9346935
>C10-C16 Hydrocarbons	mg/L	<0.050	0.050	N/A	9343693				
>C16-C21 Hydrocarbons	mg/L	<0.050	0.050	N/A	9343693				
>C21-<C32 Hydrocarbons	mg/L	<0.090	0.090	N/A	9343693				
Modified TPH (Tier1)	mg/L	<0.090	0.090	N/A	9342003				
Reached Baseline at C32	mg/L	NA	N/A	N/A	9343693				
Hydrocarbon Resemblance	mg/L	NA	N/A	N/A	9343693				
Surrogate Recovery (%)									
Isobutylbenzene - Extractable	%	92			9343693				
n-Dotriacontane - Extractable	%	84			9343693				
Isobutylbenzene - Volatile	%	98			9346935	97			9346935
RDL = Reportable Detection Limit QC Batch = Quality Control Batch Lab-Dup = Laboratory Initiated Duplicate N/A = Not Applicable									



BUREAU
VERITAS

Bureau Veritas Job #: C4B3919

Report Date: 2024/05/09

CBCL Limited

Client Project #: 240800

Site Location: LUNENBURG

Sampler Initials: BC

RBCA HYDROCARBONS IN WATER (WATER)

Bureau Veritas ID		YXQ259	YXQ260	YXQ261	YXQ262	YXQ263			
Sampling Date		2024/04/16 13:20	2024/04/16 10:50	2024/04/16 12:35	2024/04/16 09:50	2024/04/16 10:55			
COC Number		N/A	N/A	N/A	N/A	N/A			
	UNITS	24MW02	24MW03	24MW04	24MW05	24MW100	RDL	MDL	QC Batch

Petroleum Hydrocarbons									
Benzene	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	N/A	9346935
Toluene	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	N/A	9346935
Ethylbenzene	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	N/A	9346935
Total Xylenes	mg/L	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	N/A	9346935
C6 - C10 (less BTEX)	mg/L	<0.090	<0.090	<0.090	<0.090	<0.090	0.090	N/A	9346935
>C10-C16 Hydrocarbons	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	N/A	9343693
>C16-C21 Hydrocarbons	mg/L	0.076	<0.050	<0.050	<0.050	<0.050	0.050	N/A	9343693
>C21-<C32 Hydrocarbons	mg/L	0.15	<0.090	<0.090	<0.090	<0.090	0.090	N/A	9343693
Modified TPH (Tier1)	mg/L	0.22	<0.090	<0.090	<0.090	<0.090	0.090	N/A	9342003
Reached Baseline at C32	mg/L	Yes	NA	NA	NA	NA	N/A	N/A	9343693
Hydrocarbon Resemblance	mg/L	COMMENT (1)	NA	NA	NA	NA	N/A	N/A	9343693
Surrogate Recovery (%)									
Isobutylbenzene - Extractable	%	92	87	83	87	93			9343693
n-Dotriacontane - Extractable	%	83	79	82	85 (2)	89 (2)			9343693
Isobutylbenzene - Volatile	%	98	99	98	99	100			9346935

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

N/A = Not Applicable

(1) One product in fuel / lube range. Unidentified compound(s) in fuel / lube range.

(2) TEH sample contained sediment.



BUREAU
VERITAS

Bureau Veritas Job #: C4B3919
Report Date: 2024/05/09

CBCL Limited
Client Project #: 240800
Site Location: LUNENBURG
Sampler Initials: BC

ATLANTIC VOCS - NON-CHLORINATED WATER (WATER)

Bureau Veritas ID		YXQ261			
Sampling Date		2024/04/16 12:35			
COC Number		N/A			
	UNITS	24MW04	RDL	MDL	QC Batch
Volatile Organics					
1,1-Dichloroethane	ug/L	<2.0	2.0	N/A	9346938
1,1-Dichloroethylene	ug/L	<0.50	0.50	1.0	9346938
1,1,1-Trichloroethane	ug/L	<1.0	1.0	N/A	9346938
1,1,2-Trichloroethane	ug/L	<1.0	1.0	N/A	9346938
1,1,2,2-Tetrachloroethane	ug/L	<0.50	0.50	N/A	9346938
Ethylene Dibromide	ug/L	<0.20	0.20	0.50	9346938
1,2-Dichlorobenzene	ug/L	<0.50	0.50	N/A	9346938
1,2-Dichloroethane	ug/L	<1.0	1.0	N/A	9346938
cis-1,2-Dichloroethylene	ug/L	<0.50	0.50	N/A	9346938
trans-1,2-Dichloroethylene	ug/L	<0.50	0.50	N/A	9346938
1,2-Dichloropropane	ug/L	<0.50	0.50	N/A	9346938
1,3-Dichlorobenzene	ug/L	<1.0	1.0	N/A	9346938
cis-1,3-Dichloropropene	ug/L	<0.50	0.50	N/A	9346938
trans-1,3-Dichloropropene	ug/L	<0.50	0.50	N/A	9346938
1,4-Dichlorobenzene	ug/L	<1.0	1.0	N/A	9346938
Benzene	ug/L	<1.0	1.0	N/A	9346938
Bromodichloromethane	ug/L	<1.0	1.0	0.20	9346938
Bromoform	ug/L	<1.0	1.0	0.20	9346938
Bromomethane	ug/L	<0.50	0.50	N/A	9346938
Carbon Tetrachloride	ug/L	<0.50	0.50	N/A	9346938
Chlorobenzene	ug/L	<1.0	1.0	N/A	9346938
Chloroethane	ug/L	<8.0	8.0	N/A	9346938
Chloroform	ug/L	<1.0	1.0	0.20	9346938
Chloromethane	ug/L	<8.0	8.0	N/A	9346938
Dibromochloromethane	ug/L	<1.0	1.0	0.20	9346938
Methylene Chloride(Dichloromethane)	ug/L	<3.0	3.0	N/A	9346938
Ethylbenzene	ug/L	<1.0	1.0	N/A	9346938
Methyl t-butyl ether (MTBE)	ug/L	<2.0	2.0	N/A	9346938
Styrene	ug/L	<1.0	1.0	N/A	9346938
Tetrachloroethylene	ug/L	<1.0	1.0	N/A	9346938
Toluene	ug/L	<1.0	1.0	N/A	9346938
Trichloroethylene	ug/L	<1.0	1.0	N/A	9346938
Trichlorofluoromethane (FREON 11)	ug/L	<8.0	8.0	N/A	9346938
RDL = Reportable Detection Limit QC Batch = Quality Control Batch N/A = Not Applicable					



ATLANTIC VOCS - NON-CHLORINATED WATER (WATER)

Bureau Veritas ID		YXQ261			
Sampling Date		2024/04/16 12:35			
COC Number		N/A			
	UNITS	24MW04	RDL	MDL	QC Batch
Vinyl Chloride	ug/L	<0.50	0.50	2.0	9346938
o-Xylene	ug/L	<1.0	1.0	N/A	9346938
p+m-Xylene	ug/L	<2.0	2.0	N/A	9346938
Total Xylenes	ug/L	<1.0	1.0	1.0	9346938
Total Trihalomethanes	ug/L	<1.0	1.0	N/A	9346938
Surrogate Recovery (%)					
4-Bromofluorobenzene	%	99			9346938
D4-1,2-Dichloroethane	%	104			9346938
D8-Toluene	%	98			9346938
RDL = Reportable Detection Limit QC Batch = Quality Control Batch N/A = Not Applicable					



BUREAU
VERITAS

Bureau Veritas Job #: C4B3919

Report Date: 2024/05/09

CBCL Limited

Client Project #: 240800

Site Location: LUNENBURG

Sampler Initials: BC

RESULTS OF ANALYSES OF WATER

Bureau Veritas ID		YXQ260			
Sampling Date		2024/04/16 10:50			
COC Number		N/A			
	UNITS	24MW03	RDL	MDL	QC Batch
Inorganics					
Total Cyanide (CN)	mg/L	<0.0050	0.0050	0.00028	9346987
RDL = Reportable Detection Limit					
QC Batch = Quality Control Batch					



GLYCOLS BY GC-FID (WATER)

Bureau Veritas ID		YXQ260			
Sampling Date		2024/04/16 10:50			
COC Number		N/A			
	UNITS	24MW03	RDL	MDL	QC Batch
Glycols					
Ethylene Glycol	mg/L	<3.0	3.0	N/A	9353478
Diethylene Glycol	mg/L	<5.0	5.0	N/A	9353478
Triethylene Glycol	mg/L	<5.0	5.0	N/A	9353478
Propylene Glycol	mg/L	<5.0	5.0	N/A	9353478
Surrogate Recovery (%)					
Methyl sulfone	%	100			9353478
RDL = Reportable Detection Limit QC Batch = Quality Control Batch N/A = Not Applicable					



BUREAU
VERITAS

Bureau Veritas Job #: C4B3919
Report Date: 2024/05/09

CBCL Limited
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Sampler Initials: BC

ELEMENTS BY ICP/MS (WATER)

Bureau Veritas ID		YXQ258	YXQ259	YXQ259	YXQ260	YXQ261	YXQ262			
Sampling Date		2024/04/16 14:30	2024/04/16 13:20	2024/04/16 13:20	2024/04/16 10:50	2024/04/16 12:35	2024/04/16 09:50			
COC Number		N/A	N/A	N/A	N/A	N/A	N/A			
	UNITS	24MW01	24MW02	24MW02 Lab-Dup	24MW03	24MW04	24MW05	RDL	MDL	QC Batch

Metals										
Dissolved Aluminum (Al)	ug/L	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5.0	N/A	9347050
Dissolved Antimony (Sb)	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	N/A	9347050
Dissolved Arsenic (As)	ug/L	1.0	3.0	3.0	<1.0	<1.0	1.4	1.0	N/A	9347050
Dissolved Barium (Ba)	ug/L	35	500	500	49	36	27	1.0	N/A	9347050
Dissolved Beryllium (Be)	ug/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	N/A	9347050
Dissolved Bismuth (Bi)	ug/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	N/A	9347050
Dissolved Boron (B)	ug/L	<50	220	220	1600	72	110	50	N/A	9347050
Dissolved Cadmium (Cd)	ug/L	0.037	<0.010	<0.010	0.028	0.084	<0.010	0.010	N/A	9347050
Dissolved Calcium (Ca)	ug/L	44000	40000	41000	140000	77000	54000	100	N/A	9347050
Dissolved Chromium (Cr)	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	N/A	9347050
Dissolved Cobalt (Co)	ug/L	1.4	<0.40	<0.40	0.42	2.0	<0.40	0.40	N/A	9347050
Dissolved Copper (Cu)	ug/L	2.1	0.97	1.0	0.82	1.8	1.0	0.50	N/A	9347050
Dissolved Iron (Fe)	ug/L	100	1800	1900	6800	<50	23000	50	N/A	9347050
Dissolved Lead (Pb)	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	N/A	9347050
Dissolved Magnesium (Mg)	ug/L	5200	11000	11000	44000	5800	18000	100	N/A	9347050
Dissolved Manganese (Mn)	ug/L	990	480	480	3700	1200	1400	2.0	N/A	9347050
Dissolved Molybdenum (Mo)	ug/L	<2.0	8.8	8.8	11	<2.0	<2.0	2.0	N/A	9347050
Dissolved Nickel (Ni)	ug/L	2.9	<2.0	<2.0	<2.0	5.7	<2.0	2.0	N/A	9347050
Dissolved Phosphorus (P)	ug/L	<100	<100	<100	<100	<100	<100	100	N/A	9347050
Dissolved Potassium (K)	ug/L	3000	14000	14000	89000	5000	20000	100	N/A	9347050
Dissolved Selenium (Se)	ug/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	N/A	9347050
Dissolved Silver (Ag)	ug/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	N/A	9347050
Dissolved Sodium (Na)	ug/L	13000	79000	80000	150000	32000	68000	100	N/A	9347050
Dissolved Strontium (Sr)	ug/L	150	290	300	650	240	200	2.0	N/A	9347050
Dissolved Thallium (Tl)	ug/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	N/A	9347050
Dissolved Tin (Sn)	ug/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	N/A	9347050
Dissolved Titanium (Ti)	ug/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	N/A	9347050
Dissolved Uranium (U)	ug/L	0.12	<0.10	<0.10	1.6	0.23	0.21	0.10	N/A	9347050
Dissolved Vanadium (V)	ug/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	N/A	9347050
Dissolved Zinc (Zn)	ug/L	8.9	<5.0	<5.0	48	59	13	5.0	N/A	9347050

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

Lab-Dup = Laboratory Initiated Duplicate

N/A = Not Applicable



BUREAU
VERITAS

Bureau Veritas Job #: C4B3919
Report Date: 2024/05/09

CBCL Limited
Client Project #: 240800
Site Location: LUNENBURG
Sampler Initials: BC

SEMI-VOLATILE ORGANICS BY GC-MS (WATER)

Bureau Veritas ID		YXQ258	YXQ259	YXQ260	YXQ261	YXQ262			
Sampling Date		2024/04/16 14:30	2024/04/16 13:20	2024/04/16 10:50	2024/04/16 12:35	2024/04/16 09:50			
COC Number		N/A	N/A	N/A	N/A	N/A			
	UNITS	24MW01	24MW02	24MW03	24MW04	24MW05	RDL	MDL	QC Batch
Polyaromatic Hydrocarbons									
1-Methylnaphthalene	ug/L	<0.050	0.072	<0.050	<0.050	<0.050	0.050	N/A	9344818
2-Methylnaphthalene	ug/L	<0.050	0.058	<0.050	0.077	0.066	0.050	N/A	9344818
Acenaphthene	ug/L	0.010	0.057	<0.010	<0.010	<0.010	0.010	N/A	9344818
Acenaphthylene	ug/L	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	N/A	9344818
Anthracene	ug/L	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	N/A	9344818
Benzo(a)anthracene	ug/L	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	N/A	9344818
Benzo(a)pyrene	ug/L	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	N/A	9344818
Benzo(b)fluoranthene	ug/L	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	N/A	9344818
Benzo(b,j)fluoranthene	ug/L	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	N/A	9340818
Benzo(g,h,i)perylene	ug/L	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	N/A	9344818
Benzo(j)fluoranthene	ug/L	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	N/A	9344818
Benzo(k)fluoranthene	ug/L	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	N/A	9344818
Chrysene	ug/L	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	N/A	9344818
Dibenzo(a,h)anthracene	ug/L	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	N/A	9344818
Fluoranthene	ug/L	<0.010	0.024	<0.010	<0.010	<0.010	0.010	N/A	9344818
Fluorene	ug/L	0.010	0.035	<0.010	<0.010	<0.010	0.010	N/A	9344818
Indeno(1,2,3-cd)pyrene	ug/L	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	N/A	9344818
Naphthalene	ug/L	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	N/A	9344818
Perylene	ug/L	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	N/A	9344818
Phenanthrene	ug/L	0.021	0.053	<0.010	0.021	0.012	0.010	N/A	9344818
Pyrene	ug/L	<0.010	0.020	<0.010	0.010	<0.010	0.010	N/A	9344818
Surrogate Recovery (%)									
D10-Anthracene	%	75	75	67	65	45 (1)			9344818
D14-Terphenyl	%	77	77 (2)	67 (2)	61 (2)	44 (1)			9344818
D8-Acenaphthylene	%	72	73	64	66	67			9344818
RDL = Reportable Detection Limit									
QC Batch = Quality Control Batch									
N/A = Not Applicable									
(1) PAH surrogate(s) not within acceptance limits. Analysis was repeated with similar results.									
(2) PAH sample contained sediment.									



BUREAU
VERITAS

Bureau Veritas Job #: C4B3919

Report Date: 2024/05/09

CBCL Limited

Client Project #: 240800

Site Location: LUNENBURG

Sampler Initials: BC

ORGANOCHLORINATED PESTICIDES BY GC-ECD (WATER)

Bureau Veritas ID		YXQ260			
Sampling Date		2024/04/16 10:50			
COC Number		N/A			
	UNITS	24MW03	RDL	MDL	QC Batch
Calculated Parameters					
Aldrin + Dieldrin	ug/L	<0.005	0.005	N/A	9341822
Chlordane (Total)	ug/L	<0.005	0.005	N/A	9341822
DDT+ Metabolites	ug/L	<0.005	0.005	N/A	9341822
Heptachlor + Heptachlor epoxide	ug/L	<0.005	0.005	N/A	9341822
o,p-DDD + p,p-DDD	ug/L	<0.005	0.005	N/A	9341822
o,p-DDE + p,p-DDE	ug/L	<0.005	0.005	N/A	9341822
o,p-DDT + p,p-DDT	ug/L	<0.005	0.005	N/A	9341822
Total Endosulfan	ug/L	<0.005	0.005	N/A	9341822
Total PCB	ug/L	<0.2	0.2	N/A	9341822
Pesticides & Herbicides					
Aldrin	ug/L	<0.005	0.005	0.002	9349089
Dieldrin	ug/L	<0.005	0.005	0.0008	9349089
a-Chlordane	ug/L	<0.005	0.005	0.0007	9349089
g-Chlordane	ug/L	<0.005	0.005	0.0009	9349089
o,p-DDD	ug/L	<0.005	0.005	0.0007	9349089
p,p-DDD	ug/L	<0.005	0.005	0.0006	9349089
o,p-DDE	ug/L	<0.005	0.005	0.001	9349089
p,p-DDE	ug/L	<0.005	0.005	0.0005	9349089
o,p-DDT	ug/L	<0.005	0.005	0.0004	9349089
p,p-DDT	ug/L	<0.005	0.005	0.0007	9349089
Lindane	ug/L	<0.003	0.003	0.001	9349089
Endosulfan I (alpha)	ug/L	<0.005	0.005	0.001	9349089
Endosulfan II (beta)	ug/L	<0.005	0.005	0.0005	9349089
Endrin	ug/L	<0.005	0.005	0.0005	9349089
Heptachlor	ug/L	<0.005	0.005	0.0004	9349089
Heptachlor epoxide	ug/L	<0.005	0.005	0.001	9349089
Hexachlorobenzene	ug/L	<0.005	0.005	0.001	9349089
Methoxychlor	ug/L	<0.01	0.01	0.002	9349089
Aroclor 1016	ug/L	<0.2	0.2	0.04	9349089
Aroclor 1221	ug/L	<0.2	0.2	0.04	9349089
Aroclor 1232	ug/L	<0.2	0.2	0.04	9349089
Aroclor 1242	ug/L	<0.2	0.2	0.04	9349089
Aroclor 1248	ug/L	<0.2	0.2	0.04	9349089
RDL = Reportable Detection Limit					
QC Batch = Quality Control Batch					
N/A = Not Applicable					



BUREAU
VERITAS

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ORGANOCHLORINATED PESTICIDES BY GC-ECD (WATER)

Bureau Veritas ID		YXQ260			
Sampling Date		2024/04/16 10:50			
COC Number		N/A			
	UNITS	24MW03	RDL	MDL	QC Batch
Aroclor 1254	ug/L	<0.2	0.2	0.04	9349089
Aroclor 1260	ug/L	<0.2	0.2	0.04	9349089
alpha-BHC	ug/L	<0.005	0.005	0.0005	9349089
beta-BHC	ug/L	<0.005	0.005	0.0005	9349089
delta-BHC	ug/L	<0.005	0.005	0.0005	9349089
Endosulfan sulfate	ug/L	<0.005	0.005	0.0006	9349089
Endrin aldehyde	ug/L	<0.005	0.005	0.0009	9349089
Endrin ketone	ug/L	<0.005	0.005	0.0007	9349089
Mirex	ug/L	<0.005	0.005	0.0007	9349089
Octachlorostyrene	ug/L	<0.005	0.005	0.002	9349089
Oxychlordane	ug/L	<0.005	0.005	0.0007	9349089
Toxaphene	ug/L	<0.2	0.2	0.04	9349089
Surrogate Recovery (%)					
2,4,5,6-Tetrachloro-m-xylene	%	70			9349089
Decachlorobiphenyl	%	87			9349089
RDL = Reportable Detection Limit					
QC Batch = Quality Control Batch					



BUREAU
VERITAS

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DIOXINS AND FURANS BY HRMS (WATER)

Bureau Veritas ID		YXQ260							
Sampling Date		2024/04/16 10:50							
COC Number		N/A				TOXIC EQUIVALENCY		# of	
	UNITS	24MW03	EDL	RDL	MDL	TEF (2005 WHO)	TEQ(DL)	Isomers	QC Batch
Dioxins & Furans									
2,3,7,8-Tetra CDD *	pg/L	<1.41	1.41	10.0	1.45	1.00	1.41	0	9358961
1,2,3,7,8-Penta CDD *	pg/L	<1.32	1.32	50.0	1.86	1.00	1.32	0	9358961
1,2,3,4,7,8-Hexa CDD *	pg/L	<1.31	1.31	50.0	2.25	0.100	0.131	0	9358961
1,2,3,6,7,8-Hexa CDD *	pg/L	1.84	1.33	50.0	1.40	0.100	0.184	1	9358961
1,2,3,7,8,9-Hexa CDD *	pg/L	4.73	1.31	50.0	1.13	0.100	0.473	1	9358961
1,2,3,4,6,7,8-Hepta CDD *	pg/L	9.36	1.39	50.0	1.90	0.0100	0.0936	1	9358961
Octa CDD *	pg/L	41.1	1.29	100	3.13	0.000300	0.0123	1	9358961
Total Tetra CDD *	pg/L	7.61	1.41	10.0	4.00			2	9358961
Total Penta CDD *	pg/L	21.7	1.32	50.0	4.00			4	9358961
Total Hexa CDD *	pg/L	25.5	1.32	50.0	4.00			4	9358961
Total Hepta CDD *	pg/L	26.3	1.39	50.0	4.00			2	9358961
2,3,7,8-Tetra CDF **	pg/L	<1.27	1.27	10.0	1.68	0.100	0.127	0	9358961
1,2,3,7,8-Penta CDF **	pg/L	<1.50	1.50	50.0	1.33	0.0300	0.0450	0	9358961
2,3,4,7,8-Penta CDF **	pg/L	<1.28	1.28	50.0	1.23	0.300	0.384	0	9358961
1,2,3,4,7,8-Hexa CDF **	pg/L	<1.16	1.16	50.0	1.85	0.100	0.116	0	9358961
1,2,3,6,7,8-Hexa CDF **	pg/L	<1.14	1.14	50.0	1.52	0.100	0.114	0	9358961
2,3,4,6,7,8-Hexa CDF **	pg/L	<1.16	1.16	50.0	1.97	0.100	0.116	0	9358961
1,2,3,7,8,9-Hexa CDF **	pg/L	<1.31	1.31	50.0	1.66	0.100	0.131	0	9358961
1,2,3,4,6,7,8-Hepta CDF **	pg/L	<1.96 (1)	1.96	50.0	2.00	0.0100	0.0196	0	9358961
1,2,3,4,7,8,9-Hepta CDF **	pg/L	<1.32	1.32	50.0	1.87	0.0100	0.0132	0	9358961
Octa CDF **	pg/L	<1.34	1.34	100	3.99	0.000300	0.000402	0	9358961
Total Tetra CDF **	pg/L	5.15	1.27	10.0	4.00			1	9358961
Total Penta CDF **	pg/L	<1.38	1.38	50.0	4.00			0	9358961
Total Hexa CDF **	pg/L	<1.19	1.19	50.0	4.00			0	9358961
Total Hepta CDF **	pg/L	<2.05	2.05	50.0	4.00			0	9358961
EDL = Estimated Detection Limit									
RDL = Reportable Detection Limit									
TEF = Toxic Equivalency Factor, TEQ = Toxic Equivalency Quotient,									
The Total Toxic Equivalency (TEQ) value reported is the sum of Toxic Equivalent Quotients for the congeners tested.									
WHO(2005): The 2005 World Health Organization, Human and Mammalian Toxic Equivalency Factors for Dioxins and Dioxin-like Compounds									
QC Batch = Quality Control Batch									
* CDD = Chloro Dibenzo-p-Dioxin									
** CDF = Chloro Dibenzo-p-Furan									
(1) EMPC / NDR - Peak detected does not meet ratio criteria and has resulted in an elevated detection limit.									



BUREAU
VERITAS

Bureau Veritas Job #: C4B3919

Report Date: 2024/05/09

CBCL Limited

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Site Location: LUNENBURG

Sampler Initials: BC

DIOXINS AND FURANS BY HRMS (WATER)

Bureau Veritas ID		YXQ260							
Sampling Date		2024/04/16 10:50							
COC Number		N/A				TOXIC EQUIVALENCY		# of	
	UNITS	24MW03	EDL	RDL	MDL	TEF (2005 WHO)	TEQ(DL)	Isomers	QC Batch
TOTAL TOXIC EQUIVALENCY	pg/L						4.69		
Surrogate Recovery (%)									
37CL4 2378 Tetra CDD *	%	96							9358961
C13-1234678 HeptaCDD *	%	113							9358961
C13-1234678 HeptaCDF **	%	109							9358961
C13-123478 HexaCDD *	%	103							9358961
C13-123478 HexaCDF **	%	103							9358961
C13-1234789 HeptaCDF **	%	121							9358961
C13-123678 HexaCDD *	%	97							9358961
C13-123678 HexaCDF **	%	101							9358961
C13-12378 PentaCDD *	%	109							9358961
C13-12378 PentaCDF **	%	91							9358961
C13-123789 HexaCDF **	%	111							9358961
C13-234678 HexaCDF **	%	104							9358961
C13-23478 PentaCDF **	%	98							9358961
C13-2378 TetraCDD *	%	90							9358961
C13-2378 TetraCDF **	%	106							9358961
C13-OCDD *	%	113							9358961
EDL = Estimated Detection Limit RDL = Reportable Detection Limit TEF = Toxic Equivalency Factor, TEQ = Toxic Equivalency Quotient, The Total Toxic Equivalency (TEQ) value reported is the sum of Toxic Equivalent Quotients for the congeners tested. WHO(2005): The 2005 World Health Organization, Human and Mammalian Toxic Equivalency Factors for Dioxins and Dioxin-like Compounds QC Batch = Quality Control Batch * CDD = Chloro Dibenzo-p-Dioxin ** CDF = Chloro Dibenzo-p-Furan									



GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	5.0°C

Sample YXQ260 [24MW03] : OC Pesticide Analysis: Detection Limits were raised due to matrix interferences.

ORGANOCHLORINATED PESTICIDES BY GC-ECD (WATER)

OC Pesticides (Selected) & PCB: The recovery is below the control limit stipulated by Ont Reg 153, however, this recovery is still within Bureau Veritas' performance based limits. Results reported with recoveries within this range are still valid but may have a low bias.

Results relate only to the items tested.



**BUREAU
VERITAS**

Bureau Veritas Job #: C4B3919

Report Date: 2024/05/09

CBCL Limited

Client Project #: 240800

Site Location: LUNENBURG

Sampler Initials: BC

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9343693	MSK	Matrix Spike	Isobutylbenzene - Extractable	2024/04/21		88	%	70 - 130
			n-Dotriacontane - Extractable	2024/04/21		84	%	70 - 130
			>C10-C16 Hydrocarbons	2024/04/21		87	%	70 - 130
			>C16-C21 Hydrocarbons	2024/04/21		92	%	70 - 130
			>C21-<C32 Hydrocarbons	2024/04/21		79	%	70 - 130
9343693	MSK	Spiked Blank	Isobutylbenzene - Extractable	2024/04/21		94	%	70 - 130
			n-Dotriacontane - Extractable	2024/04/21		80	%	70 - 130
			>C10-C16 Hydrocarbons	2024/04/21		96	%	70 - 130
			>C16-C21 Hydrocarbons	2024/04/21		97	%	70 - 130
			>C21-<C32 Hydrocarbons	2024/04/21		83	%	70 - 130
9343693	MSK	Method Blank	Isobutylbenzene - Extractable	2024/04/21		95	%	70 - 130
			n-Dotriacontane - Extractable	2024/04/21		84	%	70 - 130
			>C10-C16 Hydrocarbons	2024/04/21	<0.050		mg/L	
			>C16-C21 Hydrocarbons	2024/04/21	<0.050		mg/L	
			>C21-<C32 Hydrocarbons	2024/04/21	<0.090		mg/L	
9343693	MSK	RPD	>C10-C16 Hydrocarbons	2024/04/21	NC		%	40
			>C16-C21 Hydrocarbons	2024/04/21	NC		%	40
			>C21-<C32 Hydrocarbons	2024/04/21	NC		%	40
9344818	SA9	Matrix Spike [YXQ258-04]	D10-Anthracene	2024/04/22		79	%	50 - 130
			D14-Terphenyl	2024/04/22		80	%	50 - 130
			D8-Acenaphthylene	2024/04/22		78	%	50 - 130
			1-Methylnaphthalene	2024/04/22		75	%	50 - 130
			2-Methylnaphthalene	2024/04/22		80	%	50 - 130
			Acenaphthene	2024/04/22		77	%	50 - 130
			Acenaphthylene	2024/04/22		81	%	50 - 130
			Anthracene	2024/04/22		85	%	50 - 130
			Benzo(a)anthracene	2024/04/22		76	%	50 - 130
			Benzo(a)pyrene	2024/04/22		76	%	50 - 130
			Benzo(b)fluoranthene	2024/04/22		73	%	50 - 130
			Benzo(g,h,i)perylene	2024/04/22		72	%	50 - 130
			Benzo(j)fluoranthene	2024/04/22		76	%	50 - 130
			Benzo(k)fluoranthene	2024/04/22		76	%	50 - 130
			Chrysene	2024/04/22		84	%	50 - 130
			Dibenzo(a,h)anthracene	2024/04/22		68	%	50 - 130
			Fluoranthene	2024/04/22		80	%	50 - 130
			Fluorene	2024/04/22		80	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2024/04/22		70	%	50 - 130
			Naphthalene	2024/04/22		74	%	50 - 130
			Perylene	2024/04/22		71	%	50 - 130
			Phenanthrene	2024/04/22		83	%	50 - 130
			Pyrene	2024/04/22		80	%	50 - 130
9344818	SA9	Spiked Blank	D10-Anthracene	2024/04/22		92	%	50 - 130
			D14-Terphenyl	2024/04/22		92	%	50 - 130
			D8-Acenaphthylene	2024/04/22		91	%	50 - 130
			1-Methylnaphthalene	2024/04/22		98	%	50 - 130
			2-Methylnaphthalene	2024/04/22		104	%	50 - 130
			Acenaphthene	2024/04/22		100	%	50 - 130
			Acenaphthylene	2024/04/22		104	%	50 - 130
			Anthracene	2024/04/22		106	%	50 - 130
			Benzo(a)anthracene	2024/04/22		94	%	50 - 130
			Benzo(a)pyrene	2024/04/22		97	%	50 - 130
			Benzo(b)fluoranthene	2024/04/22		98	%	50 - 130
			Benzo(g,h,i)perylene	2024/04/22		93	%	50 - 130



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QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9344818	SA9	Method Blank	Benzo(j)fluoranthene	2024/04/22		97	%	50 - 130
			Benzo(k)fluoranthene	2024/04/22		99	%	50 - 130
			Chrysene	2024/04/22		105	%	50 - 130
			Dibenzo(a,h)anthracene	2024/04/22		84	%	50 - 130
			Fluoranthene	2024/04/22		100	%	50 - 130
			Fluorene	2024/04/22		104	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2024/04/22		89	%	50 - 130
			Naphthalene	2024/04/22		97	%	50 - 130
			Perylene	2024/04/22		87	%	50 - 130
			Phenanthrene	2024/04/22		109	%	50 - 130
			Pyrene	2024/04/22		100	%	50 - 130
			D10-Anthracene	2024/04/22		92	%	50 - 130
			D14-Terphenyl	2024/04/22		93	%	50 - 130
			D8-Acenaphthylene	2024/04/22		92	%	50 - 130
			1-Methylnaphthalene	2024/04/22	<0.050		ug/L	
			2-Methylnaphthalene	2024/04/22	<0.050		ug/L	
			Acenaphthene	2024/04/22	<0.010		ug/L	
			Acenaphthylene	2024/04/22	<0.010		ug/L	
			Anthracene	2024/04/22	<0.010		ug/L	
			Benzo(a)anthracene	2024/04/22	<0.010		ug/L	
			Benzo(a)pyrene	2024/04/22	<0.010		ug/L	
			Benzo(b)fluoranthene	2024/04/22	<0.010		ug/L	
			Benzo(g,h,i)perylene	2024/04/22	<0.010		ug/L	
			Benzo(j)fluoranthene	2024/04/22	<0.010		ug/L	
			Benzo(k)fluoranthene	2024/04/22	<0.010		ug/L	
			Chrysene	2024/04/22	<0.010		ug/L	
			Dibenzo(a,h)anthracene	2024/04/22	<0.010		ug/L	
			Fluoranthene	2024/04/22	<0.010		ug/L	
			Fluorene	2024/04/22	<0.010		ug/L	
			Indeno(1,2,3-cd)pyrene	2024/04/22	<0.010		ug/L	
			Naphthalene	2024/04/22	<0.20		ug/L	
			Perylene	2024/04/22	<0.010		ug/L	
			Phenanthrene	2024/04/22	<0.010		ug/L	
			Pyrene	2024/04/22	<0.010		ug/L	
9344818	SA9	RPD	1-Methylnaphthalene	2024/04/22	NC		%	40
			2-Methylnaphthalene	2024/04/22	NC		%	40
			Acenaphthene	2024/04/22	NC		%	40
			Acenaphthylene	2024/04/22	NC		%	40
			Anthracene	2024/04/22	NC		%	40
			Benzo(a)anthracene	2024/04/22	NC		%	40
			Benzo(a)pyrene	2024/04/22	NC		%	40
			Benzo(b)fluoranthene	2024/04/22	NC		%	40
			Benzo(g,h,i)perylene	2024/04/22	NC		%	40
			Benzo(j)fluoranthene	2024/04/22	NC		%	40
			Benzo(k)fluoranthene	2024/04/22	NC		%	40
			Chrysene	2024/04/22	NC		%	40
			Dibenzo(a,h)anthracene	2024/04/22	NC		%	40
			Fluoranthene	2024/04/22	NC		%	40
			Fluorene	2024/04/22	NC		%	40
			Indeno(1,2,3-cd)pyrene	2024/04/22	NC		%	40
			Naphthalene	2024/04/22	NC		%	40
			Perylene	2024/04/22	NC		%	40
			Phenanthrene	2024/04/22	NC		%	40



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QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9346935	JPA	Matrix Spike [YXQ259-06]	Pyrene	2024/04/22	NC		%	40
			Isobutylbenzene - Volatile	2024/04/22		98	%	70 - 130
			Benzene	2024/04/22		91	%	70 - 130
			Toluene	2024/04/22		89	%	70 - 130
			Ethylbenzene	2024/04/22		94	%	70 - 130
9346935	JPA	Spiked Blank	Total Xylenes	2024/04/22		93	%	70 - 130
			Isobutylbenzene - Volatile	2024/04/22		102	%	70 - 130
			Benzene	2024/04/22		93	%	70 - 130
			Toluene	2024/04/22		93	%	70 - 130
			Ethylbenzene	2024/04/22		98	%	70 - 130
9346935	JPA	Method Blank	Total Xylenes	2024/04/22		98	%	70 - 130
			Isobutylbenzene - Volatile	2024/04/22		100	%	70 - 130
			Benzene	2024/04/22	<0.0010		mg/L	
			Toluene	2024/04/22	<0.0010		mg/L	
			Ethylbenzene	2024/04/22	<0.0010		mg/L	
9346935	JPA	RPD [YXQ258-06]	Total Xylenes	2024/04/22	<0.0020		mg/L	
			C6 - C10 (less BTEX)	2024/04/22	<0.090		mg/L	
			Benzene	2024/04/22	NC		%	40
			Toluene	2024/04/22	NC		%	40
			Ethylbenzene	2024/04/22	NC		%	40
9346938	DBF	Matrix Spike	Total Xylenes	2024/04/22	NC		%	40
			C6 - C10 (less BTEX)	2024/04/22	NC		%	40
			4-Bromofluorobenzene	2024/04/22		99	%	70 - 130
			D4-1,2-Dichloroethane	2024/04/22		105	%	70 - 130
			D8-Toluene	2024/04/22		97	%	70 - 130
			1,1-Dichloroethane	2024/04/22		106	%	70 - 130
			1,1-Dichloroethylene	2024/04/22		109	%	70 - 130
			1,1,1-Trichloroethane	2024/04/22		110	%	70 - 130
			1,1,2-Trichloroethane	2024/04/22		109	%	70 - 130
			1,1,2,2-Tetrachloroethane	2024/04/22		104	%	70 - 130
			Ethylene Dibromide	2024/04/22		98	%	70 - 130
			1,2-Dichlorobenzene	2024/04/22		105	%	70 - 130
			1,2-Dichloroethane	2024/04/22		107	%	70 - 130
			cis-1,2-Dichloroethylene	2024/04/22		101	%	70 - 130
			trans-1,2-Dichloroethylene	2024/04/22		105	%	70 - 130
			1,2-Dichloropropane	2024/04/22		105	%	70 - 130
			1,3-Dichlorobenzene	2024/04/22		102	%	70 - 130
			cis-1,3-Dichloropropene	2024/04/22		111	%	70 - 130
			trans-1,3-Dichloropropene	2024/04/22		120	%	70 - 130
			1,4-Dichlorobenzene	2024/04/22		103	%	70 - 130
			Benzene	2024/04/22		107	%	70 - 130
			Bromodichloromethane	2024/04/22		109	%	70 - 130
			Bromoform	2024/04/22		106	%	70 - 130
			Bromomethane	2024/04/22		124	%	60 - 140
			Carbon Tetrachloride	2024/04/22		105	%	70 - 130
			Chlorobenzene	2024/04/22		104	%	70 - 130
			Chloroethane	2024/04/22		100	%	60 - 140
			Chloroform	2024/04/22		110	%	70 - 130
			Chloromethane	2024/04/22		112	%	60 - 140
			Dibromochloromethane	2024/04/22		104	%	70 - 130
			Methylene Chloride(Dichloromethane)	2024/04/22		106	%	70 - 130
			Ethylbenzene	2024/04/22		103	%	70 - 130
			Methyl t-butyl ether (MTBE)	2024/04/22		104	%	70 - 130



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QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9346938	DBF	Spiked Blank	Styrene	2024/04/22		105	%	70 - 130
			Tetrachloroethylene	2024/04/22		105	%	70 - 130
			Toluene	2024/04/22		104	%	70 - 130
			Trichloroethylene	2024/04/22		103	%	70 - 130
			Trichlorofluoromethane (FREON 11)	2024/04/22		103	%	60 - 140
			Vinyl Chloride	2024/04/22		105	%	60 - 140
			o-Xylene	2024/04/22		106	%	70 - 130
			p+m-Xylene	2024/04/22		102	%	70 - 130
			4-Bromofluorobenzene	2024/04/22		99	%	70 - 130
			D4-1,2-Dichloroethane	2024/04/22		98	%	70 - 130
			D8-Toluene	2024/04/22		99	%	70 - 130
			1,1-Dichloroethane	2024/04/22		103	%	70 - 130
			1,1-Dichloroethylene	2024/04/22		107	%	70 - 130
			1,1,1-Trichloroethane	2024/04/22		107	%	70 - 130
			1,1,2-Trichloroethane	2024/04/22		103	%	70 - 130
			1,1,2,2-Tetrachloroethane	2024/04/22		97	%	70 - 130
			Ethylene Dibromide	2024/04/22		91	%	70 - 130
			1,2-Dichlorobenzene	2024/04/22		102	%	70 - 130
			1,2-Dichloroethane	2024/04/22		102	%	70 - 130
			cis-1,2-Dichloroethylene	2024/04/22		97	%	70 - 130
			trans-1,2-Dichloroethylene	2024/04/22		102	%	70 - 130
			1,2-Dichloropropane	2024/04/22		102	%	70 - 130
			1,3-Dichlorobenzene	2024/04/22		101	%	70 - 130
			cis-1,3-Dichloropropene	2024/04/22		100	%	70 - 130
			trans-1,3-Dichloropropene	2024/04/22		104	%	70 - 130
			1,4-Dichlorobenzene	2024/04/22		100	%	70 - 130
			Benzene	2024/04/22		105	%	70 - 130
			Bromodichloromethane	2024/04/22		105	%	70 - 130
			Bromoform	2024/04/22		99	%	70 - 130
			Bromomethane	2024/04/22		112	%	60 - 140
			Carbon Tetrachloride	2024/04/22		103	%	70 - 130
			Chlorobenzene	2024/04/22		101	%	70 - 130
			Chloroethane	2024/04/22		97	%	60 - 140
			Chloroform	2024/04/22		106	%	70 - 130
			Chloromethane	2024/04/22		108	%	60 - 140
			Dibromochloromethane	2024/04/22		98	%	70 - 130
			Methylene Chloride(Dichloromethane)	2024/04/22		100	%	70 - 130
			Ethylbenzene	2024/04/22		102	%	70 - 130
			Methyl t-butyl ether (MTBE)	2024/04/22		101	%	70 - 130
			Styrene	2024/04/22		103	%	70 - 130
			Tetrachloroethylene	2024/04/22		104	%	70 - 130
			Toluene	2024/04/22		103	%	70 - 130
			Trichloroethylene	2024/04/22		101	%	70 - 130
			Trichlorofluoromethane (FREON 11)	2024/04/22		101	%	60 - 140
			Vinyl Chloride	2024/04/22		103	%	60 - 140
			o-Xylene	2024/04/22		105	%	70 - 130
			p+m-Xylene	2024/04/22		101	%	70 - 130
9346938	DBF	Method Blank	4-Bromofluorobenzene	2024/04/22		100	%	70 - 130
			D4-1,2-Dichloroethane	2024/04/22		99	%	70 - 130
			D8-Toluene	2024/04/22		100	%	70 - 130
			1,1-Dichloroethane	2024/04/22	<2.0		ug/L	
			1,1-Dichloroethylene	2024/04/22	<0.50		ug/L	
			1,1,1-Trichloroethane	2024/04/22	<1.0		ug/L	



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9346938	DBF	RPD	1,1,2-Trichloroethane	2024/04/22	<1.0		ug/L	
			1,1,2,2-Tetrachloroethane	2024/04/22	<0.50		ug/L	
			Ethylene Dibromide	2024/04/22	<0.20		ug/L	
			1,2-Dichlorobenzene	2024/04/22	<0.50		ug/L	
			1,2-Dichloroethane	2024/04/22	<1.0		ug/L	
			cis-1,2-Dichloroethylene	2024/04/22	<0.50		ug/L	
			trans-1,2-Dichloroethylene	2024/04/22	<0.50		ug/L	
			1,2-Dichloropropane	2024/04/22	<0.50		ug/L	
			1,3-Dichlorobenzene	2024/04/22	<1.0		ug/L	
			cis-1,3-Dichloropropene	2024/04/22	<0.50		ug/L	
			trans-1,3-Dichloropropene	2024/04/22	<0.50		ug/L	
			1,4-Dichlorobenzene	2024/04/22	<1.0		ug/L	
			Benzene	2024/04/22	<1.0		ug/L	
			Bromodichloromethane	2024/04/22	<1.0		ug/L	
			Bromoform	2024/04/22	<1.0		ug/L	
			Bromomethane	2024/04/22	<0.50		ug/L	
			Carbon Tetrachloride	2024/04/22	<0.50		ug/L	
			Chlorobenzene	2024/04/22	<1.0		ug/L	
			Chloroethane	2024/04/22	<8.0		ug/L	
			Chloroform	2024/04/22	<1.0		ug/L	
			Chloromethane	2024/04/22	<8.0		ug/L	
			Dibromochloromethane	2024/04/22	<1.0		ug/L	
			Methylene Chloride(Dichloromethane)	2024/04/22	<3.0		ug/L	
			Ethylbenzene	2024/04/22	<1.0		ug/L	
			Methyl t-butyl ether (MTBE)	2024/04/22	<2.0		ug/L	
			Styrene	2024/04/22	<1.0		ug/L	
			Tetrachloroethylene	2024/04/22	<1.0		ug/L	
			Toluene	2024/04/22	<1.0		ug/L	
			Trichloroethylene	2024/04/22	<1.0		ug/L	
			Trichlorofluoromethane (FREON 11)	2024/04/22	<8.0		ug/L	
			Vinyl Chloride	2024/04/22	<0.50		ug/L	
			o-Xylene	2024/04/22	<1.0		ug/L	
			p+m-Xylene	2024/04/22	<2.0		ug/L	
			Total Xylenes	2024/04/22	<1.0		ug/L	
			Total Trihalomethanes	2024/04/22	<1.0		ug/L	
			1,1-Dichloroethane	2024/04/22	NC		%	40
			1,1-Dichloroethylene	2024/04/22	NC		%	40
			1,1,1-Trichloroethane	2024/04/22	NC		%	40
			1,1,2-Trichloroethane	2024/04/22	NC		%	40
			1,1,2,2-Tetrachloroethane	2024/04/22	NC		%	40
			Ethylene Dibromide	2024/04/22	NC		%	40
			1,2-Dichlorobenzene	2024/04/22	NC		%	40
			1,2-Dichloroethane	2024/04/22	NC		%	40
			cis-1,2-Dichloroethylene	2024/04/22	NC		%	40
			trans-1,2-Dichloroethylene	2024/04/22	NC		%	40
			1,2-Dichloropropane	2024/04/22	NC		%	40
			1,3-Dichlorobenzene	2024/04/22	NC		%	40
			cis-1,3-Dichloropropene	2024/04/22	NC		%	40
			trans-1,3-Dichloropropene	2024/04/22	NC		%	40
			1,4-Dichlorobenzene	2024/04/22	NC		%	40
			Benzene	2024/04/22	NC		%	40
			Bromodichloromethane	2024/04/22	NC		%	40
			Bromoform	2024/04/22	NC		%	40



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			Bromomethane	2024/04/22	NC		%	40
			Carbon Tetrachloride	2024/04/22	NC		%	40
			Chlorobenzene	2024/04/22	NC		%	40
			Chloroethane	2024/04/22	NC		%	40
			Chloroform	2024/04/22	NC		%	40
			Chloromethane	2024/04/22	NC		%	40
			Dibromochloromethane	2024/04/22	NC		%	40
			Methylene Chloride(Dichloromethane)	2024/04/22	NC		%	40
			Ethylbenzene	2024/04/22	NC		%	40
			Methyl t-butyl ether (MTBE)	2024/04/22	NC		%	40
			Styrene	2024/04/22	NC		%	40
			Tetrachloroethylene	2024/04/22	NC		%	40
			Toluene	2024/04/22	NC		%	40
			Trichloroethylene	2024/04/22	NC		%	40
			Trichlorofluoromethane (FREON 11)	2024/04/22	NC		%	40
			Vinyl Chloride	2024/04/22	NC		%	40
			o-Xylene	2024/04/22	NC		%	40
			p+m-Xylene	2024/04/22	NC		%	40
			Total Xylenes	2024/04/22	NC		%	40
			Total Trihalomethanes	2024/04/22	NC		%	40
9346987	CPO	Matrix Spike	Total Cyanide (CN)	2024/04/22		108	%	80 - 120
9346987	CPO	Spiked Blank	Total Cyanide (CN)	2024/04/22		108	%	80 - 120
9346987	CPO	Method Blank	Total Cyanide (CN)	2024/04/22	<0.0050		mg/L	
9346987	CPO	RPD	Total Cyanide (CN)	2024/04/22	NC		%	20
9347050	MTZ	Matrix Spike [YXQ259-03]	Dissolved Aluminum (Al)	2024/04/22		96	%	80 - 120
			Dissolved Antimony (Sb)	2024/04/22		96	%	80 - 120
			Dissolved Arsenic (As)	2024/04/22		100	%	80 - 120
			Dissolved Barium (Ba)	2024/04/22		NC	%	80 - 120
			Dissolved Beryllium (Be)	2024/04/22		99	%	80 - 120
			Dissolved Bismuth (Bi)	2024/04/22		92	%	80 - 120
			Dissolved Boron (B)	2024/04/22		95	%	80 - 120
			Dissolved Cadmium (Cd)	2024/04/22		101	%	80 - 120
			Dissolved Calcium (Ca)	2024/04/22		NC	%	80 - 120
			Dissolved Chromium (Cr)	2024/04/22		102	%	80 - 120
			Dissolved Cobalt (Co)	2024/04/22		102	%	80 - 120
			Dissolved Copper (Cu)	2024/04/22		101	%	80 - 120
			Dissolved Iron (Fe)	2024/04/22		NC	%	80 - 120
			Dissolved Lead (Pb)	2024/04/22		96	%	80 - 120
			Dissolved Magnesium (Mg)	2024/04/22		NC	%	80 - 120
			Dissolved Manganese (Mn)	2024/04/22		NC	%	80 - 120
			Dissolved Molybdenum (Mo)	2024/04/22		99	%	80 - 120
			Dissolved Nickel (Ni)	2024/04/22		102	%	80 - 120
			Dissolved Phosphorus (P)	2024/04/22		102	%	80 - 120
			Dissolved Potassium (K)	2024/04/22		NC	%	80 - 120
			Dissolved Selenium (Se)	2024/04/22		103	%	80 - 120
			Dissolved Silver (Ag)	2024/04/22		88	%	80 - 120
			Dissolved Sodium (Na)	2024/04/22		NC	%	80 - 120
			Dissolved Strontium (Sr)	2024/04/22		NC	%	80 - 120
			Dissolved Thallium (Tl)	2024/04/22		95	%	80 - 120
			Dissolved Tin (Sn)	2024/04/22		98	%	80 - 120
			Dissolved Titanium (Ti)	2024/04/22		104	%	80 - 120
			Dissolved Uranium (U)	2024/04/22		103	%	80 - 120
			Dissolved Vanadium (V)	2024/04/22		104	%	80 - 120



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9347050	MTZ	Spiked Blank	Dissolved Zinc (Zn)	2024/04/22		100	%	80 - 120
			Dissolved Aluminum (Al)	2024/04/22		99	%	80 - 120
			Dissolved Antimony (Sb)	2024/04/22		101	%	80 - 120
			Dissolved Arsenic (As)	2024/04/22		102	%	80 - 120
			Dissolved Barium (Ba)	2024/04/22		101	%	80 - 120
			Dissolved Beryllium (Be)	2024/04/22		106	%	80 - 120
			Dissolved Bismuth (Bi)	2024/04/22		99	%	80 - 120
			Dissolved Boron (B)	2024/04/22		105	%	80 - 120
			Dissolved Cadmium (Cd)	2024/04/22		100	%	80 - 120
			Dissolved Calcium (Ca)	2024/04/22		96	%	80 - 120
			Dissolved Chromium (Cr)	2024/04/22		101	%	80 - 120
			Dissolved Cobalt (Co)	2024/04/22		101	%	80 - 120
			Dissolved Copper (Cu)	2024/04/22		100	%	80 - 120
			Dissolved Iron (Fe)	2024/04/22		100	%	80 - 120
			Dissolved Lead (Pb)	2024/04/22		102	%	80 - 120
			Dissolved Magnesium (Mg)	2024/04/22		102	%	80 - 120
			Dissolved Manganese (Mn)	2024/04/22		104	%	80 - 120
			Dissolved Molybdenum (Mo)	2024/04/22		102	%	80 - 120
			Dissolved Nickel (Ni)	2024/04/22		101	%	80 - 120
			Dissolved Phosphorus (P)	2024/04/22		103	%	80 - 120
			Dissolved Potassium (K)	2024/04/22		103	%	80 - 120
			Dissolved Selenium (Se)	2024/04/22		101	%	80 - 120
			Dissolved Silver (Ag)	2024/04/22		99	%	80 - 120
			Dissolved Sodium (Na)	2024/04/22		102	%	80 - 120
			Dissolved Strontium (Sr)	2024/04/22		104	%	80 - 120
			Dissolved Thallium (Tl)	2024/04/22		99	%	80 - 120
			Dissolved Tin (Sn)	2024/04/22		101	%	80 - 120
			Dissolved Titanium (Ti)	2024/04/22		104	%	80 - 120
			Dissolved Uranium (U)	2024/04/22		105	%	80 - 120
			Dissolved Vanadium (V)	2024/04/22		103	%	80 - 120
			Dissolved Zinc (Zn)	2024/04/22		102	%	80 - 120
9347050	MTZ	Method Blank	Dissolved Aluminum (Al)	2024/04/22	<5.0		ug/L	
			Dissolved Antimony (Sb)	2024/04/22	<1.0		ug/L	
			Dissolved Arsenic (As)	2024/04/22	<1.0		ug/L	
			Dissolved Barium (Ba)	2024/04/22	<1.0		ug/L	
			Dissolved Beryllium (Be)	2024/04/22	<0.10		ug/L	
			Dissolved Bismuth (Bi)	2024/04/22	<2.0		ug/L	
			Dissolved Boron (B)	2024/04/22	<50		ug/L	
			Dissolved Cadmium (Cd)	2024/04/22	<0.010		ug/L	
			Dissolved Calcium (Ca)	2024/04/22	<100		ug/L	
			Dissolved Chromium (Cr)	2024/04/22	<1.0		ug/L	
			Dissolved Cobalt (Co)	2024/04/22	<0.40		ug/L	
			Dissolved Copper (Cu)	2024/04/22	<0.50		ug/L	
			Dissolved Iron (Fe)	2024/04/22	<50		ug/L	
			Dissolved Lead (Pb)	2024/04/22	<0.50		ug/L	
			Dissolved Magnesium (Mg)	2024/04/22	<100		ug/L	
			Dissolved Manganese (Mn)	2024/04/22	<2.0		ug/L	
			Dissolved Molybdenum (Mo)	2024/04/22	<2.0		ug/L	
			Dissolved Nickel (Ni)	2024/04/22	<2.0		ug/L	
			Dissolved Phosphorus (P)	2024/04/22	<100		ug/L	
			Dissolved Potassium (K)	2024/04/22	<100		ug/L	
			Dissolved Selenium (Se)	2024/04/22	<0.50		ug/L	
			Dissolved Silver (Ag)	2024/04/22	<0.10		ug/L	



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9347050	MTZ	RPD [YXQ259-03]	Dissolved Sodium (Na)	2024/04/22	<100		ug/L	
			Dissolved Strontium (Sr)	2024/04/22	<2.0		ug/L	
			Dissolved Thallium (Tl)	2024/04/22	<0.10		ug/L	
			Dissolved Tin (Sn)	2024/04/22	<2.0		ug/L	
			Dissolved Titanium (Ti)	2024/04/22	<2.0		ug/L	
			Dissolved Uranium (U)	2024/04/22	<0.10		ug/L	
			Dissolved Vanadium (V)	2024/04/22	<2.0		ug/L	
			Dissolved Zinc (Zn)	2024/04/22	<5.0		ug/L	
			Dissolved Aluminum (Al)	2024/04/22	NC		%	20
			Dissolved Antimony (Sb)	2024/04/22	NC		%	20
			Dissolved Arsenic (As)	2024/04/22	0.21		%	20
			Dissolved Barium (Ba)	2024/04/22	0.044		%	20
			Dissolved Beryllium (Be)	2024/04/22	NC		%	20
			Dissolved Bismuth (Bi)	2024/04/22	NC		%	20
			Dissolved Boron (B)	2024/04/22	2.4		%	20
			Dissolved Cadmium (Cd)	2024/04/22	NC		%	20
			Dissolved Calcium (Ca)	2024/04/22	0.28		%	20
			Dissolved Chromium (Cr)	2024/04/22	NC		%	20
			Dissolved Cobalt (Co)	2024/04/22	NC		%	20
			Dissolved Copper (Cu)	2024/04/22	3.6		%	20
			Dissolved Iron (Fe)	2024/04/22	1.6		%	20
			Dissolved Lead (Pb)	2024/04/22	NC		%	20
			Dissolved Magnesium (Mg)	2024/04/22	0.76		%	20
			Dissolved Manganese (Mn)	2024/04/22	0.93		%	20
			Dissolved Molybdenum (Mo)	2024/04/22	0.32		%	20
			Dissolved Nickel (Ni)	2024/04/22	NC		%	20
			Dissolved Phosphorus (P)	2024/04/22	NC		%	20
			Dissolved Potassium (K)	2024/04/22	1.1		%	20
			Dissolved Selenium (Se)	2024/04/22	NC		%	20
			Dissolved Silver (Ag)	2024/04/22	NC		%	20
			Dissolved Sodium (Na)	2024/04/22	0.91		%	20
			Dissolved Strontium (Sr)	2024/04/22	0.84		%	20
			Dissolved Thallium (Tl)	2024/04/22	NC		%	20
			Dissolved Tin (Sn)	2024/04/22	NC		%	20
			Dissolved Titanium (Ti)	2024/04/22	NC		%	20
			Dissolved Uranium (U)	2024/04/22	NC		%	20
			Dissolved Vanadium (V)	2024/04/22	NC		%	20
			Dissolved Zinc (Zn)	2024/04/22	NC		%	20
9349089	MAK	Matrix Spike	2,4,5,6-Tetrachloro-m-xylene	2024/04/23		53	%	50 - 130
			Decachlorobiphenyl	2024/04/23		66	%	50 - 130
			Aldrin	2024/04/23		53	%	50 - 130
			Dieldrin	2024/04/23		70	%	50 - 130
			a-Chlordane	2024/04/23		63	%	50 - 130
			g-Chlordane	2024/04/23		65	%	50 - 130
			o,p-DDD	2024/04/23		76	%	50 - 130
			p,p-DDD	2024/04/23		72	%	50 - 130
			o,p-DDE	2024/04/23		72	%	50 - 130
			p,p-DDE	2024/04/23		67	%	50 - 130
			o,p-DDT	2024/04/23		76	%	50 - 130
			p,p-DDT	2024/04/23		49 (1)	%	50 - 130
			Lindane	2024/04/23		58	%	50 - 130
			Endosulfan I (alpha)	2024/04/23		68	%	50 - 130
			Endosulfan II (beta)	2024/04/23		63	%	50 - 130



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9349089	MAK	Spiked Blank	Endrin	2024/04/23		61	%	50 - 130
			Heptachlor	2024/04/23		44 (1)	%	50 - 130
			Heptachlor epoxide	2024/04/23		65	%	50 - 130
			Hexachlorobenzene	2024/04/23		55	%	50 - 130
			Methoxychlor	2024/04/23		39 (1)	%	50 - 130
			alpha-BHC	2024/04/23		56	%	30 - 130
			beta-BHC	2024/04/23		54	%	30 - 130
			delta-BHC	2024/04/23		60	%	30 - 130
			Endosulfan sulfate	2024/04/23		76	%	30 - 130
			Endrin aldehyde	2024/04/23		56	%	30 - 130
			Endrin ketone	2024/04/23		67	%	30 - 130
			Mirex	2024/04/23		56	%	30 - 130
			Octachlorostyrene	2024/04/23		61	%	30 - 130
			Oxychlordane	2024/04/23		68	%	30 - 130
			2,4,5,6-Tetrachloro-m-xylene	2024/04/23		46 (2)	%	50 - 130
			Decachlorobiphenyl	2024/04/23		82	%	50 - 130
			Aldrin	2024/04/23		58	%	50 - 130
			Dieldrin	2024/04/23		92	%	50 - 130
			a-Chlordane	2024/04/23		82	%	50 - 130
			g-Chlordane	2024/04/23		84	%	50 - 130
			o,p-DDD	2024/04/23		98	%	50 - 130
			p,p-DDD	2024/04/23		94	%	50 - 130
			o,p-DDE	2024/04/23		92	%	50 - 130
			p,p-DDE	2024/04/23		81	%	50 - 130
			o,p-DDT	2024/04/23		99	%	50 - 130
			p,p-DDT	2024/04/23		65	%	50 - 130
			Lindane	2024/04/23		80	%	50 - 130
			Endosulfan I (alpha)	2024/04/23		85	%	50 - 130
			Endosulfan II (beta)	2024/04/23		81	%	50 - 130
			Endrin	2024/04/23		78	%	50 - 130
			Heptachlor	2024/04/23		53	%	50 - 130
			Heptachlor epoxide	2024/04/23		85	%	50 - 130
			Hexachlorobenzene	2024/04/23		66	%	50 - 130
			Methoxychlor	2024/04/23		54	%	50 - 130
			alpha-BHC	2024/04/23		81	%	30 - 130
			beta-BHC	2024/04/23		74	%	30 - 130
			delta-BHC	2024/04/23		84	%	30 - 130
			Endosulfan sulfate	2024/04/23		98	%	30 - 130
			Endrin aldehyde	2024/04/23		70	%	30 - 130
			Endrin ketone	2024/04/23		85	%	30 - 130
			Mirex	2024/04/23		77	%	30 - 130
			Octachlorostyrene	2024/04/23		73	%	30 - 130
			Oxychlordane	2024/04/23		86	%	30 - 130
9349089	MAK	RPD	Aldrin	2024/04/23	5.4		%	30
			Dieldrin	2024/04/23	2.4		%	30
			a-Chlordane	2024/04/23	2.7		%	30
			g-Chlordane	2024/04/23	2.5		%	30
			o,p-DDD	2024/04/23	2.8		%	30
			p,p-DDD	2024/04/23	2.8		%	30
			o,p-DDE	2024/04/23	1.7		%	30
			p,p-DDE	2024/04/23	0.99		%	30
			o,p-DDT	2024/04/23	2.8		%	30
			p,p-DDT	2024/04/23	1.5		%	30



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			Lindane	2024/04/23	4.2		%	30
			Endosulfan I (alpha)	2024/04/23	1.1		%	30
			Endosulfan II (beta)	2024/04/23	0.50		%	30
			Endrin	2024/04/23	1.7		%	30
			Heptachlor	2024/04/23	1.7		%	30
			Heptachlor epoxide	2024/04/23	3.2		%	30
			Hexachlorobenzene	2024/04/23	0.21		%	30
			Methoxychlor	2024/04/23	2.3		%	30
			Aroclor 1242	2024/04/23	200 (1)		%	30
			alpha-BHC	2024/04/23	3.5		%	40
			beta-BHC	2024/04/23	4.7		%	40
			delta-BHC	2024/04/23	6.1		%	40
			Endosulfan sulfate	2024/04/23	1.8		%	40
			Endrin aldehyde	2024/04/23	1.6		%	40
			Endrin ketone	2024/04/23	1.5		%	40
			Mirex	2024/04/23	1.5		%	40
			Octachlorostyrene	2024/04/23	2.3		%	40
			Oxychlorodane	2024/04/23	2.0		%	30
			Toxaphene	2024/04/23	200 (1)		%	40
			Aldrin	2024/04/23	NC		%	30
			Dieldrin	2024/04/23	NC		%	30
			a-Chlordane	2024/04/23	NC		%	30
			g-Chlordane	2024/04/23	NC		%	30
			o,p-DDD	2024/04/23	NC		%	30
			p,p-DDD	2024/04/23	NC		%	30
			o,p-DDE	2024/04/23	NC		%	30
			p,p-DDE	2024/04/23	NC		%	30
			o,p-DDT	2024/04/23	NC		%	30
			p,p-DDT	2024/04/23	NC		%	30
			Lindane	2024/04/23	NC		%	30
			Endosulfan I (alpha)	2024/04/23	NC		%	30
			Endosulfan II (beta)	2024/04/23	NC		%	30
			Endrin	2024/04/23	NC		%	30
			Heptachlor	2024/04/23	NC		%	30
			Heptachlor epoxide	2024/04/23	NC		%	30
			Hexachlorobenzene	2024/04/23	NC		%	30
			Methoxychlor	2024/04/23	NC		%	30
			Aroclor 1016	2024/04/23	NC		%	30
			Aroclor 1221	2024/04/23	NC		%	30
			Aroclor 1232	2024/04/23	NC		%	30
			Aroclor 1242	2024/04/23	NC		%	30
			Aroclor 1248	2024/04/23	NC		%	30
			Aroclor 1254	2024/04/23	NC		%	30
			Aroclor 1260	2024/04/23	NC		%	30
			alpha-BHC	2024/04/23	NC		%	40
			beta-BHC	2024/04/23	NC		%	40
			delta-BHC	2024/04/23	NC		%	40
			Endosulfan sulfate	2024/04/23	NC		%	40
			Endrin aldehyde	2024/04/23	NC		%	40
			Endrin ketone	2024/04/23	NC		%	40
			Mirex	2024/04/23	NC		%	40
			Octachlorostyrene	2024/04/23	NC		%	40
			Oxychlorodane	2024/04/23	NC		%	30



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9349089	MAK	Method Blank	Toxaphene	2024/04/23	NC		%	40
			2,4,5,6-Tetrachloro-m-xylene	2024/04/23		45 (2)	%	50 - 130
			Decachlorobiphenyl	2024/04/23		91	%	50 - 130
			Aldrin	2024/04/23	<0.005		ug/L	
			Dieldrin	2024/04/23	<0.005		ug/L	
			a-Chlordane	2024/04/23	<0.005		ug/L	
			g-Chlordane	2024/04/23	<0.005		ug/L	
			o,p-DDD	2024/04/23	<0.005		ug/L	
			p,p-DDD	2024/04/23	<0.005		ug/L	
			o,p-DDE	2024/04/23	<0.005		ug/L	
			p,p-DDE	2024/04/23	<0.005		ug/L	
			o,p-DDT	2024/04/23	<0.005		ug/L	
			p,p-DDT	2024/04/23	<0.005		ug/L	
			Lindane	2024/04/23	<0.003		ug/L	
			Endosulfan I (alpha)	2024/04/23	<0.005		ug/L	
			Endosulfan II (beta)	2024/04/23	<0.005		ug/L	
			Endrin	2024/04/23	<0.005		ug/L	
			Heptachlor	2024/04/23	<0.005		ug/L	
			Heptachlor epoxide	2024/04/23	<0.005		ug/L	
			Hexachlorobenzene	2024/04/23	<0.005		ug/L	
			Methoxychlor	2024/04/23	<0.01		ug/L	
			Aroclor 1016	2024/04/23	<0.05		ug/L	
			Aroclor 1221	2024/04/23	<0.05		ug/L	
			Aroclor 1232	2024/04/23	<0.05		ug/L	
			Aroclor 1242	2024/04/23	<0.05		ug/L	
			Aroclor 1248	2024/04/23	<0.05		ug/L	
			Aroclor 1254	2024/04/23	<0.05		ug/L	
			Aroclor 1260	2024/04/23	<0.05		ug/L	
			alpha-BHC	2024/04/23	<0.005		ug/L	
			beta-BHC	2024/04/23	<0.005		ug/L	
			delta-BHC	2024/04/23	<0.005		ug/L	
			Endosulfan sulfate	2024/04/23	<0.005		ug/L	
			Endrin aldehyde	2024/04/23	<0.005		ug/L	
			Endrin ketone	2024/04/23	<0.005		ug/L	
			Mirex	2024/04/23	<0.005		ug/L	
			Octachlorostyrene	2024/04/23	<0.005		ug/L	
			Oxychlordane	2024/04/23	<0.005		ug/L	
			Toxaphene	2024/04/23	<0.2		ug/L	
9353478	éC6	Matrix Spike	Methyl sulfone	2024/04/23		93	%	70 - 130
			Ethylene Glycol	2024/04/23		NC	%	60 - 140
			Diethylene Glycol	2024/04/23		104	%	60 - 140
			Triethylene Glycol	2024/04/23		100	%	60 - 140
			Propylene Glycol	2024/04/23		93	%	60 - 140
9353478	éC6	Spiked Blank	Methyl sulfone	2024/04/23		100	%	70 - 130
			Ethylene Glycol	2024/04/23		94	%	70 - 130
			Diethylene Glycol	2024/04/23		110	%	70 - 130
			Triethylene Glycol	2024/04/23		101	%	70 - 130
			Propylene Glycol	2024/04/23		99	%	70 - 130
9353478	éC6	Method Blank	Methyl sulfone	2024/04/23		94	%	70 - 130
			Ethylene Glycol	2024/04/23	<3.0		mg/L	
			Diethylene Glycol	2024/04/23	<5.0		mg/L	
			Triethylene Glycol	2024/04/23	<5.0		mg/L	
			Propylene Glycol	2024/04/23	<5.0		mg/L	



**BUREAU
VERITAS**

Bureau Veritas Job #: C4B3919

Report Date: 2024/05/09

CBCL Limited

Client Project #: 240800

Site Location: LUNENBURG

Sampler Initials: BC

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9358961	YQI	Spiked Blank	37CL4 2378 Tetra CDD	2024/05/02		93	%	35 - 197
			C13-1234678 HeptaCDD	2024/05/02		114	%	23 - 140
			C13-1234678 HeptaCDF	2024/05/02		112	%	28 - 143
			C13-123478 HexaCDD	2024/05/02		103	%	32 - 141
			C13-123478 HexaCDF	2024/05/02		101	%	26 - 152
			C13-1234789 HeptaCDF	2024/05/02		128	%	28 - 138
			C13-123678 HexaCDD	2024/05/02		96	%	28 - 130
			C13-123678 HexaCDF	2024/05/02		98	%	26 - 123
			C13-12378 PentaCDD	2024/05/02		113	%	25 - 181
			C13-12378 PentaCDF	2024/05/02		102	%	24 - 185
			C13-123789 HexaCDF	2024/05/02		113	%	29 - 147
			C13-234678 HexaCDF	2024/05/02		106	%	28 - 136
			C13-23478 PentaCDF	2024/05/02		104	%	21 - 178
			C13-2378 TetraCDD	2024/05/02		84	%	25 - 164
			C13-2378 TetraCDF	2024/05/02		106	%	24 - 169
			C13-OCDD	2024/05/02		109	%	17 - 157
			2,3,7,8-Tetra CDD	2024/05/02		113	%	67 - 158
			1,2,3,7,8-Penta CDD	2024/05/02		88	%	25 - 181
			1,2,3,4,7,8-Hexa CDD	2024/05/02		95	%	70 - 164
			1,2,3,6,7,8-Hexa CDD	2024/05/02		98	%	76 - 134
			1,2,3,7,8,9-Hexa CDD	2024/05/02		103	%	64 - 162
			1,2,3,4,6,7,8-Hepta CDD	2024/05/02		103	%	70 - 140
			Octa CDD	2024/05/02		98	%	78 - 144
			2,3,7,8-Tetra CDF	2024/05/02		108	%	75 - 158
			1,2,3,7,8-Penta CDF	2024/05/02		99	%	80 - 134
			2,3,4,7,8-Penta CDF	2024/05/02		97	%	68 - 160
			1,2,3,4,7,8-Hexa CDF	2024/05/02		103	%	72 - 134
			1,2,3,6,7,8-Hexa CDF	2024/05/02		103	%	84 - 130
			2,3,4,6,7,8-Hexa CDF	2024/05/02		102	%	70 - 156
			1,2,3,7,8,9-Hexa CDF	2024/05/02		104	%	78 - 130
			1,2,3,4,6,7,8-Hepta CDF	2024/05/02		100	%	82 - 122
			1,2,3,4,7,8,9-Hepta CDF	2024/05/02		100	%	78 - 138
			Octa CDF	2024/05/02		101	%	63 - 170
9358961	YQI	RPD	2,3,7,8-Tetra CDD	2024/05/02	2.7		%	25
			1,2,3,7,8-Penta CDD	2024/05/02	4.4		%	25
			1,2,3,4,7,8-Hexa CDD	2024/05/02	5.1		%	25
			1,2,3,6,7,8-Hexa CDD	2024/05/02	5.9		%	25
			1,2,3,7,8,9-Hexa CDD	2024/05/02	8.4		%	25
			1,2,3,4,6,7,8-Hepta CDD	2024/05/02	1.9		%	25
			Octa CDD	2024/05/02	4.0		%	25
			2,3,7,8-Tetra CDF	2024/05/02	0		%	25
			1,2,3,7,8-Penta CDF	2024/05/02	4.0		%	25
			2,3,4,7,8-Penta CDF	2024/05/02	3.0		%	25
			1,2,3,4,7,8-Hexa CDF	2024/05/02	1.9		%	25
			1,2,3,6,7,8-Hexa CDF	2024/05/02	0.98		%	25
			2,3,4,6,7,8-Hexa CDF	2024/05/02	3.8		%	25
			1,2,3,7,8,9-Hexa CDF	2024/05/02	0.96		%	25
			1,2,3,4,6,7,8-Hepta CDF	2024/05/02	1.0		%	25
			1,2,3,4,7,8,9-Hepta CDF	2024/05/02	0		%	25
			Octa CDF	2024/05/02	6.7		%	25
9358961	YQI	Method Blank	37CL4 2378 Tetra CDD	2024/05/02		89	%	35 - 197
			C13-1234678 HeptaCDD	2024/05/02		108	%	23 - 140
			C13-1234678 HeptaCDF	2024/05/02		107	%	28 - 143



BUREAU
VERITAS

Bureau Veritas Job #: C4B3919
Report Date: 2024/05/09

CBCL Limited
Client Project #: 240800
Site Location: LUNENBURG
Sampler Initials: BC

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			C13-123478 HexaCDD	2024/05/02		95	%	32 - 141
			C13-123478 HexaCDF	2024/05/02		100	%	26 - 152
			C13-1234789 HeptaCDF	2024/05/02		118	%	28 - 138
			C13-123678 HexaCDD	2024/05/02		93	%	28 - 130
			C13-123678 HexaCDF	2024/05/02		99	%	26 - 123
			C13-12378 PentaCDD	2024/05/02		103	%	25 - 181
			C13-12378 PentaCDF	2024/05/02		89	%	24 - 185
			C13-123789 HexaCDF	2024/05/02		105	%	29 - 147
			C13-234678 HexaCDF	2024/05/02		100	%	28 - 136
			C13-23478 PentaCDF	2024/05/02		102	%	21 - 178
			C13-2378 TetraCDD	2024/05/02		84	%	25 - 164
			C13-2378 TetraCDF	2024/05/02		103	%	24 - 169
			C13-OCDD	2024/05/02		103	%	17 - 157
			2,3,7,8-Tetra CDD	2024/05/02	<1.32, EDL=1.32		pg/L	
			1,2,3,7,8-Penta CDD	2024/05/02	<1.59, EDL=1.59		pg/L	
			1,2,3,4,7,8-Hexa CDD	2024/05/02	<1.53, EDL=1.53		pg/L	
			1,2,3,6,7,8-Hexa CDD	2024/05/02	<1.50, EDL=1.50		pg/L	
			1,2,3,7,8,9-Hexa CDD	2024/05/02	4.78, EDL=1.50		pg/L	
			1,2,3,4,6,7,8-Hepta CDD	2024/05/02	5.48, EDL=1.31		pg/L	
			Octa CDD	2024/05/02	2.73, EDL=1.40		pg/L	
			Total Tetra CDD	2024/05/02	4.26, EDL=1.32		pg/L	
			Total Penta CDD	2024/05/02	<7.44, EDL=7.44		pg/L	
			Total Hexa CDD	2024/05/02	24.8, EDL=1.51		pg/L	
			Total Hepta CDD	2024/05/02	5.48, EDL=1.31		pg/L	
			2,3,7,8-Tetra CDF	2024/05/02	<1.50, EDL=1.50		pg/L	
			1,2,3,7,8-Penta CDF	2024/05/02	<1.91, EDL=1.91		pg/L	
			2,3,4,7,8-Penta CDF	2024/05/02	<1.54, EDL=1.54		pg/L	
			1,2,3,4,7,8-Hexa CDF	2024/05/02	<1.39, EDL=1.39		pg/L	
			1,2,3,6,7,8-Hexa CDF	2024/05/02	<1.35, EDL=1.35		pg/L	
			2,3,4,6,7,8-Hexa CDF	2024/05/02	<1.40, EDL=1.40		pg/L	
			1,2,3,7,8,9-Hexa CDF	2024/05/02	<1.61, EDL=1.61		pg/L	
			1,2,3,4,6,7,8-Hepta CDF	2024/05/02	<1.61, EDL=1.61		pg/L	
			1,2,3,4,7,8,9-Hepta CDF	2024/05/02	<1.78, EDL=1.78		pg/L	



QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Octa CDF	2024/05/02	<1.31, EDL=1.31		pg/L	
			Total Tetra CDF	2024/05/02	4.20, EDL=1.50		pg/L	
			Total Penta CDF	2024/05/02	<1.71, EDL=1.71		pg/L	
			Total Hexa CDF	2024/05/02	<1.43, EDL=1.43		pg/L	
			Total Hepta CDF	2024/05/02	<1.69, EDL=1.69		pg/L	
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement. Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference. Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy. Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination. Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency. NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration) NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL). (1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria. (2) Surrogate recovery is below the control limit stipulated by Ont Reg 153, however, this recovery is still within Bureau Veritas' performance based limits. Results reported with recoveries within this range are still valid but may have a low bias.								



BUREAU
VERITAS

Bureau Veritas Job #: C4B3919
Report Date: 2024/05/09

CBCL Limited
Client Project #: 240800
Site Location: LUNENBURG
Sampler Initials: BC

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:

Colleen Acker, B.Sc, Scientific Service Specialist

Cristina Carriere, Senior Scientific Specialist

Cathy Xu, Scientific Specialist, Ultra Trace Analysis, HRMS

Gita Pokhrel, Senior Analyst

Janah Rhyno, Scientific Specialist

Phil Deveau, Scientific Specialist (Organics)



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Bureau Veritas 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



**BUREAU
VERITAS**

Bureau Veritas Job #: C4B3919

Report Date: 2024/05/09

CBCL Limited

Client Project #: 240800

Site Location: LUNENBURG

Sampler Initials: BC

VALIDATION SIGNATURE PAGE(CONT'D)

The analytical data and all QC contained in this report were reviewed and validated by:

reports. For Service Group specific validation, please refer to the Validation Signatures page if included, otherwise available by request. For Department specific Analyst/Supervisor validation names, please refer to the Test Summary section if included, otherwise available by request. This report is authorized by Suzanne Rogers, General Manager responsible for Nova Scotia Environmental laboratory operations.

Attachment E

Field Data Records



Monitoring Well 24MW01

PROJECT NUMBER 240800.00	DRILLING COMPANY Nova Drilling	COORDINATES 394975.0611 4915228.315
PROJECT NAME WWTP Upgrade & Expansion	DRILLING METHOD Solid Stem Auger	COORD SYS NAD 1983 UTM Z 20N
CLIENT Town of Lunenburg	TOTAL DEPTH 15 ft	SURFACE ELEVATION
ADDRESS 524 NS-324, Lunenburg, NS	DIAMETER 3 1/2"	WELL TOC Flush Mount
DRILLING DATE 12 April, 2024		LOGGED BY B.C.
		CHECKED BY D.F.

COMPLETION	CASING uPVC	SCREEN uPVC Factory Slotted

Depth (ft)	Drilling Method	Samples	% Recovery	Graphic Log	Material Description	PID	Lab Sample	Water	Moisture	Well Installation	Additional Observations	Elevation (m)				
1	AU	SS1 (0-2)	45		GRAVELLY SAND: Grey coarse sand and gravel.	0.2			D			45				
2																44
3		SS2 (2-4)	90						D				43			
4		SS3 (4-6)	50		SILTY SAND WITH GRAVEL: Fine dark brown silty sand with some gravel. Wet.	1.6			W		42					
5																
6												40				
7		SS4 (6-8)	55		SAND; Fine dark brown sand with coarse sand. Wet.	3.4	24MW01 SS4; PHCs, PAHs, Metals			W			39			
8																
9		SS5 (8-10)	50			5.8				W			37			
10																
11					Augered remaining depth from 10 - 15'.	1.0						35				
12				Based on cuttings, assumed to be an overburden (sand with slate fragments) / very fractured grey slate interface zone.												34
13																33
14																32
15																31
					Termination Depth at 15 ft							30				

Disclaimer This bore log is intended for environmental not geotechnical purposes.

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Monitoring Well 24MW02

PROJECT NUMBER 240800.00	DRILLING COMPANY Nova Drilling	COORDINATES 394966.1121 4915243.598
PROJECT NAME WWTP Upgrade & Expansion	DRILLING METHOD Solid Stem Auger	COORD SYS NAD 1983 UTM Z 20N
CLIENT Town of Lunenburg	TOTAL DEPTH 15 ft	SURFACE ELEVATION
ADDRESS 524 NS-324, Lunenburg, NS	DIAMETER 3 1/2"	WELL TOC Flush Mount
DRILLING DATE 12 April, 2024		LOGGED BY B.C.
		CHECKED BY D.F.

COMPLETION	CASING uPVC	SCREEN uPVC Factory Slotted

Depth (ft)	Drilling Method	Samples	% Recovery	Graphic Log	Material Description	PID	Lab Sample	Water	Moisture	Well Installation	Additional Observations	Elevation (m)
1	AU	SS1 (0-2)	50		GRAVELLY SAND: Brown coarse sand and gravel.	0.7			D			45
2		SS2 (2-4)	95		SAND; Fine to medium brown/black sand. Some glass present within black lenses. Wet	2.4	24MW02 SS2; PHCs, PAHs, Metals		D			43
3												42
4		SS3 (4-6)	30		SILTY SAND WITH GRAVEL: Fine dark brown silty sand with some gravel. Wet.	2.4		∇	W			41
5												40
6	AU	SS4 (6-8)	10			2.4			W			39
7												38
8					Augered remaining depth from 10 - 15'.				W			37
9					Based on cuttings, assumed to be an overburden (sand with slate fragments) / very fractured grey slate interface zone.							36
10												35
11												34
12												33
13												32
14												31
15					Termination Depth at 15 ft							30

Disclaimer This bore log is intended for environmental not geotechnical purposes.

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Monitoring Well 24MW03

PROJECT NUMBER 240800.00	DRILLING COMPANY Nova Drilling	COORDINATES 394958.2091 4915295.548
PROJECT NAME WWTP Upgrade & Expansion	DRILLING METHOD Solid Stem Auger	COORD SYS NAD 1983 UTM Z 20N
CLIENT Town of Lunenburg	TOTAL DEPTH 20 ft	SURFACE ELEVATION
ADDRESS 524 NS-324, Lunenburg, NS	DIAMETER 3 1/2"	WELL TOC Flush Mount
DRILLING DATE 12 April, 2024		LOGGED BY B.C.
		CHECKED BY D.F.

COMPLETION	CASING uPVC	SCREEN uPVC Factory Slotted

Depth (ft)	Drilling Method	Samples	% Recovery	Graphic Log	Material Description	PID	Lab Sample	Water	Moisture	Well Installation	Additional Observations	Elevation (m)
1	AU	SS1 (0-2)	90		GRAVELLY SAND: Brown coarse sand and gravel. Ceramic shards present.	1.0			D			45
2		SS2 (2-4)	40		SAND; Fine to medium brown/black sand with few gravel.	1.8	24MW03 SS2;		D			44
3							Dioxins/ Furans, Glycols, Pesticides, Cyanide					43
4			2						W			42
5												41
6		SS3 (6-8)	50		GRAVELLY SAND: Brown coarse sand and gravel.	3.4	24MW03 SS3;					40
7							PHCs, PAHs, Metals					39
8			10									38
9												37
10		SS4 (10-12)	5			0.3						36
11												35
12			5		GRAVELLY SAND: Brown coarse sand and some very severely weathered shale flakes.							34
13					Augered from 13.2 to 15'							33
14												32
15		SS5 (15-16)	20		GRAVELLY SAND: Brown coarse sand and some very severely weathered shale flakes.	0.5						31
16												30
17					BEDROCK (assumed); Very severely fractured to fractured dark grey SLATE: BEDROCK							29
18												28
19												27
20												26
20					Termination Depth at 20 ft							25

Disclaimer This bore log is intended for environmental not geotechnical purposes.

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Monitoring Well 24MW04

PROJECT NUMBER 240800.00	DRILLING COMPANY Nova Drilling	COORDINATES 394990.8671 4915258.125
PROJECT NAME WWTP Upgrade & Expansion	DRILLING METHOD Solid Stem Auger	COORD SYS NAD 1983 UTM Z 20N
CLIENT Town of Lunenburg	TOTAL DEPTH 20 ft	SURFACE ELEVATION
ADDRESS 524 NS-324, Lunenburg, NS	DIAMETER 3 1/2"	WELL TOC Flush Mount
DRILLING DATE 12 April, 2024		LOGGED BY B.C.
		CHECKED BY D.F.

COMPLETION	CASING uPVC	SCREEN uPVC Factory Slotted

Depth (ft)	Drilling Method	Samples	% Recovery	Graphic Log	Material Description	PID	Lab Sample	Water	Moisture	Well Installation	Additional Observations	Elevation (m)
1	AU	SS1 (0-2)	100		GRAVELLY SAND: Brown medium to coarse sand and gravel.	1.4	24MW04 SS2; PHCs, PAHs, Metals		D			45
2		SS2 (2-4)	50			56.1						44
3					GRAVELLY SILTY SAND: Brown medium to coarse silty sand and gravel. Damp							43
4			30									42
5					GRAVELLY SILTY SAND: Brown medium to coarse silty sand and gravel. Damp							41
6		SS3 (6-8)	20			20.6						40
7					GRAVELLY SILTY SAND: Brown medium to coarse silty sand and gravel. Damp							39
8			20									38
9					GRAVELLY SILTY SAND: Brown medium to coarse silty sand and gravel. Damp							37
10		SS4 (10-12)	10			1.3						36
11					SAND BEDROCK INTERFACE (assumed); Very severely fractured to fractured dark grey SLATE: BEDROCK			W				35
12			100									34
13												33
14												32
15												31
16												30
17												29
18												28
19												27
20												26
					Termination Depth at 20 ft Cave in, final depth 18 ft							25

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Monitoring Well 24MW05

PROJECT NUMBER 240800.00	DRILLING COMPANY Nova Drilling	COORDINATES 394930.476 4915260.152
PROJECT NAME WWTP Upgrade & Expansion	DRILLING METHOD Solid Stem Auger	COORD SYS NAD 1983 UTM Z 20N
CLIENT Town of Lunenburg	TOTAL DEPTH 20 ft	SURFACE ELEVATION
ADDRESS 524 NS-324, Lunenburg, NS	DIAMETER 3 1/2"	WELL TOC Flush Mount
DRILLING DATE 12 April, 2024		LOGGED BY B.C.
		CHECKED BY D.F.

COMPLETION	CASING uPVC	SCREEN uPVC Factory Slotted

Depth (ft)	Drilling Method	Samples	% Recovery	Graphic Log	Material Description	PID	Lab Sample	Water	Moisture	Well Installation	Additional Observations	Elevation (m)
1	AU	SS1 (0-2)	85		GRAVELLY SAND: Brown fine sand and gravel.	0.5	24MW05 SS4; PHCs, PAHs, Metals		D			45
2		SS2 (2-4)	50			2.4						44
3												43
4		SS3 (4-6)	10									42
5						9.6						41
6												40
7			15									39
8												38
9			2		GRAVELLY SILTY SAND: Brown medium to coarse silty sand and gravel. Wet							37
10		SS4 (10-12)	60			0.6						36
11												35
12		SS5 (12-14)	55									34
13						0.5						33
14												32
15												31
16												30
17												29
18												28
19												27
20												26
					SAND BEDROCK INTERFACE (assumed); Very severely fractured to fractured dark grey SLATE: BEDROCK							31
												30
												29
												28
												27
												26
												25
					Termination Depth at 20 ft							25

Disclaimer This bore log is intended for environmental not geotechnical purposes.

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FIELD REPORT - SAMPLING / MONITORING

Site: <u>WWTP</u>	Location: <u>WONGWICK</u>	Well/Site ID: <u>24mW01</u>
GPS Coordinates (NAD 83 UTM Zone _____):		
☐ Monitoring Well ☐ Pumping Well ☐ Surface Water ☐ Spring/Seep ☐ Discharge Pipe ☐ Other: _____		
Site Conditions		
Air Temp: <u>10</u> ☒ °C ☐ °F	Weather: <u>SUN</u>	Photograph Taken? ☒ Yes ☐ No
Well / Site Conditions: Locked? ☐ Yes ☐ No		
Damaged/Repairs Needed?: ☐ Yes ☐ No		
Site Remarks (nearby wells pumping, relevant site activities, current or changing weather, etc.):		

Fluid Level Data

☐ Solinst 101☐ Solinst 122☐ Measuring Tape:☐ Other: _____

	Measure	Remarks
Date (d.m.y)	<u>APR 16, 20</u>	
Time (hh:mm)		
Well Depth (mbTOC) (☐ Table Lookup or ☐ Measured?)	<u>4.48</u>	
Depth to Floating Product (mbTOC)		
Depth to Water (mbTOC/mbGrade) Note: both are to be recorded	<u>3.48</u>	
Depth to Sinking Product (mbTOC)		
Tape Correction (m) (recorded values already adjusted Yes/No?)		
Surface Water Depth (m)		
Stream depth/width (m)		
Stream Flow Rate ☐ L/s ☐ l/gpm		

Purge and Field WQ Data

Purge Method: ☐ Waterra ☐ Bailer ☐ Pump (State type of Pump under Other) ☐ Other: _____

Casing Volume (L) ≈ Height of Water Column (m) x [2L/m for a 2" diam. well casing] OR [8.1L/m for a 4" diam. well casing] OR [18.2L/m for a 6" diam. well casing]		Casing Volume (L):	
Date (d.m.y)	<u>1:55</u>	<u>2:00</u>	<u>2:05</u>
Time (hh:mm) - include for <u>all measurements</u>	<u>1:50</u>	<u>"</u>	<u>"</u>
Pump Rate (mL/min)	<u>3.48</u>	<u>3.49</u>	<u>3.49</u>
Water Level (mbTOC)			
Final Water Level (mbTOC)			
Volume Purged (L)			
Product Recovered (L)			
pH Temp. Compensated? ☐ Yes ☐ No	<u>7.46</u>	<u>7.40</u>	<u>7.28</u>
Temperature ☐ °C, ☐ °F	<u>10.5</u>	<u>10.4</u>	<u>10.2</u>
Conductance ☐ Specific or ☐ Electrical ☐ µS/cm	<u>577</u>	<u>512</u>	<u>461</u>
Dissolved Oxygen (mg/L)	<u>1.61</u>	<u>1.92</u>	<u>1.94</u>
Other (colour, odour, turbidity, redox, sheen, etc.)	<u>COLOUR</u>	<u>BKN</u>	<u>"</u>
	<u>TURB</u>	<u>MOD</u>	<u>MILD</u>

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Sample Data Sample Method: ☐ Grab ☐ Waterra ☐ Bailer ☐ Pump (State type of Pump under Other) ☐ Other: _____

Field Sample ID (ID on bottles and Chain-of-Custody)	Sample Date (d.m.y)	Sample Time (hh:mm)	Analytical Parameter Set	Bottles		Filtered (0.45µm)	Preservative	Remarks (include type of preservative)
				No.	Size/ Type			
						Yes No N/A	Yes No N/A	
						Yes No N/A	Yes No N/A	
						Yes No N/A	Yes No N/A	
						Yes No N/A	Yes No N/A	
						Yes No N/A	Yes No N/A	
						Yes No N/A	Yes No N/A	
						Yes No N/A	Yes No N/A	

Note: For Filtered / Preserved columns Yes = sample required to be filtered or preserved & this was done in the field; No = sample required to be filtered or preserved & this was not done in the field; N/A = sample not required to be filtered or preserved in the field.

Additional Comments

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FIELD REPORT - SAMPLING / MONITORING

Site: <u>WWTP</u>	Location: <u>LUNSBURG</u>	Well/Site ID: <u>24mW02</u>
GPS Coordinates (NAD 83 UTM Zone ____):		
☐ Monitoring Well ☐ Pumping Well ☐ Surface Water ☐ Spring/Seep ☐ Discharge Pipe ☐ Other: _____		
Site Conditions		
Air Temp: <u>10</u> °C ☒ °F Weather: <u>Sun</u>		Photograph Taken? ☒ Yes ☐ No
Well / Site Conditions: Locked? ☐ Yes ☐ No Damaged/Repairs Needed?: ☐ Yes ☐ No		
Site Remarks (nearby wells pumping, relevant site activities, current or changing weather, etc.):		

Fluid Level Data ☐ Solinst 101 ☐ Solinst 122 ☐ Measuring Tape: ☐ Other: _____

	Measure	Remarks
Date (d.m.y)	<u>APR 16, 24</u>	
Time (hh:mm)		
Well Depth (mbTOC) (☐ Table Lookup or ☐ Measured?)	<u>4.62</u>	
Depth to Floating Product (mbTOC)		
Depth to Water (mbTOC/mbGrade) Note: both are to be recorded	<u>2.88</u>	
Depth to Sinking Product (mbTOC)		
Tape Correction (m) (recorded values already adjusted Yes/No?)		
Surface Water Depth (m)		
Stream depth/width (m)		
Stream Flow Rate ☐ L/s ☐ l/gpm		

Purge and Field WQ Data Purge Method: ☐ Waterra ☐ Bailor ☐ Pump (State type of Pump under Other) ☐ Other: _____

Casing Volume (L) ≈ Height of Water Column (m) x [2L/m for a 2" diam. well casing] OR [8.1L/m for a 4" diam. well casing] OR [18.2L/m for a 6" diam. well casing]						Casing Volume (L):	
Date (d.m.y)						☐ Well goes dry while purging?	
Time (hh:mm) - include for <u>all measurements</u>	<u>1:10</u>	<u>1:15</u>	<u>1:20</u>	<u>1:25</u>		Meter / Probe Details ↓	Remarks ↓
Pump Rate (mL/min)	<u>150</u>	<u>"</u>	<u>"</u>				
Water Level (mbTOC)	<u>2.88</u>	<u>"</u>	<u>"</u>				
Final Water Level (mbTOC)							
Volume Purged (L)							
Product Recovered (L)							
pH Temp. Compensated? ☐ Yes ☐ No	<u>8.09</u>	<u>8.07</u>	<u>8.08</u>				
Temperature ☐ °C, ☐ °F	<u>10.2</u>	<u>10.1</u>	<u>10.2</u>				
Conductance ☒ Specific or ☐ Electrical (☐ μS/cm or ☐ mS/cm)	<u>816</u>	<u>815</u>	<u>813</u>				
Dissolved Oxygen (mg/L)	<u>1.49</u>	<u>1.47</u>	<u>1.42</u>				
Other (colour, odour, turbidity, redox, sheen, etc.)	<u>COLOUR</u>	<u>NONE</u>	<u>"</u>	<u>"</u>			
	<u>TURB</u>	<u>LOW</u>	<u>"</u>	<u>"</u>			

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Sample Data Sample Method: ☐ Grab ☐ Waterra ☐ Bailer ☐ Pump (State type of Pump under Other) ☐ Other: _____

Field Sample ID (ID on bottles and Chain-of-Custody)	Sample Date (d.m.y)	Sample Time (hh:mm)	Analytical Parameter Set	Bottles		Filtered (0.45µm)	Preservative	Remarks (include type of preservative)
				No.	Size/ Type			
						Yes No N/A	Yes No N/A	
						Yes No N/A	Yes No N/A	
						Yes No N/A	Yes No N/A	
						Yes No N/A	Yes No N/A	
						Yes No N/A	Yes No N/A	
						Yes No N/A	Yes No N/A	
						Yes No N/A	Yes No N/A	

Note: For Filtered / Preserved columns Yes = sample required to be filtered or preserved & this was done in the field; No = sample required to be filtered or preserved & this was not done in the field; N/A = sample not required to be filtered or preserved in the field.

Additional Comments

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FIELD REPORT - SAMPLING / MONITORING

Site: <u>WWTP</u>	Location: <u>LUNENBURG</u>	Well/Site ID: <u>24MW103</u>
GPS Coordinates (NAD 83 UTM Zone ____):		
☐ Monitoring Well ☐ Pumping Well ☐ Surface Water ☐ Spring/Seep ☐ Discharge Pipe ☐ Other: _____		
Site Conditions		
Air Temp: <u>10</u> ☒ °C ☐ °F Weather: <u>SUN</u> Photograph Taken? ☒ Yes ☐ No		
Well / Site Conditions: Locked? ☐ Yes ☐ No Damaged/Repairs Needed?: ☐ Yes ☐ No		
Site Remarks (nearby wells pumping, relevant site activities, current or changing weather, etc.):		

Fluid Level Data ☐ Solinst 101 ☐ Solinst 122 ☐ Measuring Tape: ☐ Other: _____

	Measure	Remarks
Date (d.m.y)	<u>APR 16, 24</u>	
Time (hh:mm)		<u>24MW100 DUPLICATE</u>
Well Depth (mbTOC) (☐ Table Lookup or ☐ Measured?)	<u>6.05</u>	<u>SAMPLE COLLECTED</u>
Depth to Floating Product (mbTOC)		<u>HERE (FOR P4C ONLY)</u>
Depth to Water (mbTOC/mbGrade) Note: both are to be recorded	<u>3.48</u>	
Depth to Sinking Product (mbTOC)		
Tape Correction (m) (recorded values already adjusted Yes/No?)		
Surface Water Depth (m)		
Stream depth/width (m)		
Stream Flow Rate ☐ L/s ☐ l/gpm		

Purge and Field WQ Data Purge Method: ☐ Waterra ☐ Bailer ☐ Pump (State type of Pump under Other) ☐ Other: _____

Casing Volume (L) ≈ Height of Water Column (m) x [2L/m for a 2" diam. well casing] OR [8.1L/m for a 4" diam. well casing] OR [18.2L/m for a 6" diam. well casing]						Casing Volume (L):	
Date (d.m.y)						☐ Well goes dry while purging?	
Time (hh:mm) - include for <u>all measurements</u>	<u>1030</u>	<u>1035</u>	<u>1040</u>	<u>1045</u>	<u>1050</u>	Meter / Probe Details ↓	Remarks ↓
Pump Rate (mL/min)	<u>150</u>	<u>100</u>	<u>"</u>	<u>"</u>	<u>"</u>		
Water Level (mbTOC)	<u>3.74</u>	<u>3.83</u>	<u>3.90</u>	<u>3.97</u>	<u>4.06</u>		
Final Water Level (mbTOC)							
Volume Purged (L)							
Product Recovered (L)							
pH Temp. Compensated? ☐ Yes ☐ No	<u>7.50</u>	<u>7.52</u>	<u>7.52</u>	<u>7.54</u>	<u>7.47</u>		
Temperature ☐ °C, ☐ °F	<u>10.6</u>	<u>10.6</u>	<u>10.6</u>	<u>10.6</u>	<u>10.5</u>		
Conductance ☒ Specific or ☐ Electrical (☒ μS/cm or ☐ mS/cm)	<u>2253</u>	<u>2253</u>	<u>2246</u>	<u>2232</u>	<u>2232</u>		
Dissolved Oxygen (mg/L)	<u>1.17</u>	<u>1.01</u>	<u>0.93</u>	<u>0.90</u>	<u>0.92</u>		
Other (colour, odour, turbidity, redox, sheen, etc.)	<u>COLOUR</u>	<u>GREY</u>	<u>"</u>	<u>"</u>	<u>"</u>		
	<u>TURB.</u>	<u>MILD</u>	<u>"</u>	<u>"</u>	<u>LOW</u>		

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Sample Data Sample Method: ☐ Grab ☐ Waterra ☐ Bailer ☐ Pump (State type of Pump under Other) ☐ Other:

Field Sample ID (ID on bottles and Chain-of-Custody)	Sample Date (d.m.y)	Sample Time (hh:mm)	Analytical Parameter Set	Bottles		Filtered (0.45µm)	Preservative	Remarks (include type of preservative)
				No.	Size/ Type			
						Yes No N/A	Yes No N/A	
						Yes No N/A	Yes No N/A	
						Yes No N/A	Yes No N/A	
						Yes No N/A	Yes No N/A	
						Yes No N/A	Yes No N/A	
						Yes No N/A	Yes No N/A	
						Yes No N/A	Yes No N/A	

Note: For Filtered / Preserved columns Yes = sample required to be filtered or preserved & this was done in the field; No = sample required to be filtered or preserved & this was not done in the field; N/A = sample not required to be filtered or preserved in the field.

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FIELD REPORT - SAMPLING / MONITORING

Site: <u>WWTP</u>	Location: <u>LUNSBURG</u>	Well/Site ID: <u>24MW04</u>
GPS Coordinates (NAD 83 UTM Zone <u> </u>):		
☐ Monitoring Well ☐ Pumping Well ☐ Surface Water ☐ Spring/Seep ☐ Discharge Pipe ☐ Other: <u> </u>		
Site Conditions		
Air Temp: <u>10</u> ☒ °C ☐ °F Weather: <u>SUN</u>		Photograph Taken? ☐ Yes ☐ No
Well / Site Conditions: Locked? ☐ Yes ☐ No Damaged/Repairs Needed?: ☐ Yes ☐ No		
Site Remarks (nearby wells pumping, relevant site activities, current or changing weather, etc.):		

Fluid Level Data ☐ Solinst 101 ☐ Solinst 122 ☐ Measuring Tape: ☐ Other:

	Measure	Remarks
Date (d.m.y)	<u>APR 16, 24</u>	
Time (hh:mm)		
Well Depth (mbTOC) (☐ Table Lookup or ☐ Measured?)	<u>546</u>	
Depth to Floating Product (mbTOC)		
Depth to Water (mbTOC/mbGrade) Note: both are to be recorded	<u>2.97</u>	
Depth to Sinking Product (mbTOC)		
Tape Correction (m) (recorded values already adjusted Yes/No?)		
Surface Water Depth (m)		
Stream depth/width (m)		
Stream Flow Rate ☐ L/s ☐ l/gpm		

Purge and Field WQ Data Purge Method: ☐ Waterra ☐ Bailer ☐ Pump (State type of Pump under Other) ☐ Other:

Casing Volume (L) ≈ Height of Water Column (m) x [2L/m for a 2" diam. well casing] OR [8.1L/m for a 4" diam. well casing] OR [18.2L/m for a 6" diam. well casing]						Casing Volume (L):	
Date (d.m.y)						☐ Well goes dry while purging?	
Time (hh:mm) - include for <u>all measurements</u>	<u>1220</u>	<u>1225</u>	<u>1230</u>	<u>1235</u>		Meter / Probe Details ↓	Remarks ↓
Pump Rate (mL/min)	<u>150</u>	<u>"</u>	<u>"</u>	<u>"</u>			
Water Level (mbTOC)	<u>2.97</u>	<u>"</u>	<u>"</u>	<u>"</u>			
Final Water Level (mbTOC)							
Volume Purged (L)							
Product Recovered (L)							
pH Temp. Compensated? ☐ Yes ☐ No	<u>7.34</u>	<u>7.27</u>	<u>7.35</u>	<u>7.32</u>			
Temperature ☐ °C, ☐ °F	<u>11.4</u>	<u>11.5</u>	<u>11.1</u>	<u>11.1</u>			
Conductance ☒ Specific or ☐ Electrical (☐ μS/cm or ☐ mS/cm)	<u>630</u>	<u>628</u>	<u>629</u>	<u>629</u>			
Dissolved Oxygen (mg/L)	<u>0.95</u>	<u>0.84</u>	<u>0.80</u>	<u>0.79</u>			
Other (colour, odour, turbidity, redox, sheen, etc.)	<u>COLOUR</u>	<u>NONE</u>	<u>"</u>				
	<u>TURB</u>	<u>LOW</u>	<u>"</u>				

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Sample Data Sample Method: ☐ Grab ☐ Waterra ☐ Bailer ☐ Pump (State type of Pump under Other) ☐ Other: _____

Field Sample ID (ID on bottles and Chain-of-Custody)	Sample Date (d.m.y)	Sample Time (hh:mm)	Analytical Parameter Set	Bottles		Filtered (0.45µm)	Preservative	Remarks (include type of preservative)
				No.	Size/ Type			
						Yes No N/A	Yes No N/A	
						Yes No N/A	Yes No N/A	
						Yes No N/A	Yes No N/A	
						Yes No N/A	Yes No N/A	
						Yes No N/A	Yes No N/A	
						Yes No N/A	Yes No N/A	
						Yes No N/A	Yes No N/A	

Note: For Filtered / Preserved columns Yes = sample required to be filtered or preserved & this was done in the field; No = sample required to be filtered or preserved & this was not done in the field; N/A = sample not required to be filtered or preserved in the field.

Additional Comments

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FIELD REPORT - SAMPLING / MONITORING

Site: <u>WWTP</u>	Location: <u>LINGENBURG</u>	Well/Site ID: <u>24M405</u>
GPS Coordinates (NAD 83 UTM Zone ____):		
☐ Monitoring Well ☐ Pumping Well ☐ Surface Water ☐ Spring/Seep ☐ Discharge Pipe ☐ Other: _____		
Site Conditions		
Air Temp: <u>8</u> °C ☒ °F Weather: <u>SUN</u>		Photograph Taken? ☒ Yes ☐ No
Well / Site Conditions: Locked? ☐ Yes ☐ No Damaged/Repairs Needed?: ☐ Yes ☐ No		
Site Remarks (nearby wells pumping, relevant site activities, current or changing weather, etc.):		

Fluid Level Data ☐ Solinst 101 ☐ Solinst 122 ☐ Measuring Tape: ☐ Other: _____

	Measure	Remarks
Date (d.m.y)	<u>APR 16, 24</u>	
Time (hh:mm)		
Well Depth (mbTOC) (☐ Table Lookup or ☐ Measured?)	<u>6.01</u>	
Depth to Floating Product (mbTOC)		
Depth to Water (mbTOC/mbGrade) Note: both are to be recorded	<u>2.75m.</u>	
Depth to Sinking Product (mbTOC)		
Tape Correction (m) (recorded values already adjusted Yes/No?)		
Surface Water Depth (m)		
Stream depth/width (m)		
Stream Flow Rate ☐ L/s ☐ l/gpm		

Purge and Field WQ Data Purge Method: ☐ Waterra ☐ Bailor ☐ Pump (State type of Pump under Other) ☐ Other: _____

Casing Volume (L) ≈ Height of Water Column (m) x [2L/m for a 2" diam. well casing] OR [8.1L/m for a 4" diam. well casing] OR [18.2L/m for a 6" diam. well casing]							Casing Volume (L):	
Date (d.m.y)							Well goes dry while purging?	
Time (hh:mm) - include for <u>all measurements</u>	<u>9:30</u>	<u>9:35</u>	<u>9:40</u>	<u>9:45</u>	<u>9:50</u>	<u>9:55</u>	Meter / Probe Details ↓	Remarks ↓
Pump Rate (mL/min)	<u>150</u>	<u>"</u>	<u>"</u>	<u>"</u>				
Water Level (mbTOC)	<u>2.71</u>	<u>2.71</u>	<u>"</u>	<u>"</u>				
Final Water Level (mbTOC)								
Volume Purged (L)								
Product Recovered (L)								
pH Temp. Compensated? ☐ Yes ☐ No	<u>6.85</u>	<u>6.87</u>	<u>6.87</u>	<u>6.77</u>	<u>6.86</u>			
Temperature °C, °F	<u>9.8</u>	<u>9.7</u>	<u>9.8</u>	<u>9.8</u>	<u>9.8</u>			
Conductance ☒ Specific or ☐ Electrical (☒ μS/cm or ☐ mS/cm)	<u>1024</u>	<u>1011</u>	<u>1024</u>	<u>996</u>	<u>972</u>			
Dissolved Oxygen (mg/L)	<u>5.21</u>	<u>1.87</u>	<u>1.22</u>	<u>1.11</u>	<u>1.10</u>			
Other (colour, odour, turbidity, redox, sheen, etc.)	<u>COLOUR</u>	<u>GREY.</u>	<u>"</u>	<u>"</u>				
	<u>TURB.</u>	<u>MILD</u>	<u>"</u>	<u>"</u>				

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APPENDIX C

Terms and Conditions for Pre-Selected Suppliers



The following Terms and Conditions are provided to apply to the contract between the Fine Screen Preselected Equipment Supplier (Veolia) and the Contractor.

1. AGREEMENT BETWEEN OWNER AND CONTRACTOR

1.1. Article A-3 CONTRACT DOCUMENTS is hereby deleted in its entirety and replaced by the following new Article A-3:

"ARTICLE A-3 CONTRACT DOCUMENTS

3.1 The following are the Contract Documents referred to in Article A-1 of the Agreement - THE WORK:

- *The Letter;*
- *The Veolia Proposal;*
- *The Supplementary General Conditions;*
- *CCDC-2 2020 Definitions; and*
- *CCDC-2 2020 General Conditions*

In the event of any inconsistency, conflict, or ambiguity among the Contract Documents, the documents shall govern in the above listed order of precedence. To the extent possible, the provisions of the documents shall be construed in a manner that is consistent with, and gives effect to, all provisions. However, where such reconciliation is not possible, the provision in the document with higher precedence shall control".

1.2. Article A-10 TIME IS OF THE ESSENCE is hereby deleted in its entirety and replaced by the following new Article A-10:

"ARTICLE A-10 CONFIDENTIALITY. *Each party (the "Receiving Party") agrees that all Confidential Information already or subsequently communicated to it by the other party (the "Disclosing Party") in connection with this Agreement will be received in confidence, will be used only for the purposes of this Agreement, and will not be disclosed to any person except the Receiving Party's directors, officers, employees, agents and professional advisors who have a need to know the Confidential Information and provided such persons may only receive such Confidential Information subject to their undertaking to maintain the confidentiality of same on terms and conditions that are at least as onerous as those that apply to the parties pursuant to this Agreement. Each party to this Agreement agrees to use the same means it uses to protect its own Confidential Information, but in any event, no less than commercially reasonable means, to prevent the disclosure of the Disclosing Party's Confidential Information to third parties (except to the extent that more stringent means are set out in this Agreement, in which case such means shall apply.*

Exceptions. *Neither party shall be prevented from disclosing information which is (a) already known by the Receiving Party without an obligation of confidentiality; (b) publicly known or becomes publicly known through no breach of any obligation owed to the Disclosing Party; (c) rightfully received from a third-party without an obligation of confidentiality; (d) independently developed without use of*



Disclosing Party's Confidential Information; or (e) generally disclosed without similar restrictions to third-parties by the Disclosing Party. Receiving Party may disclose the Confidential Information of the Disclosing Party in response to a request for disclosure by a court or another governmental authority, if the Receiving Party (i) promptly notifies the Disclosing Party of the terms and the circumstances of that request; (ii) consults with the Disclosing Party and cooperates with the Disclosing Party's reasonable requests to resist or narrow that request; (iii) furnishes only information that, according to the advice of its legal counsel, Receiving Party is legally compelled to disclose; and (iv) uses commercially reasonable efforts to obtain assurance that confidential treatment will be accorded to the information disclosed. The provisions of the article will survive the expiration or termination of this Agreement".

1.3.The following new Article A-11 INTELLECTUAL PROPERTY is hereby added after Article A-10:

"Article A-11 INTELLECTUAL PROPERTY RIGHTS. *The Owner acknowledges that the Contractor preserves all the Intellectual Property rights on all Products or Works provided under the Agreement. Accordingly, the plans, technical drawings and specifications supplied by Contractor and more generally any documents or information communicated pursuant to the Agreement remain the full and whole property of the Contractor and can in no way be used by the Owner for any other purpose other than that set out in the Purchase Order. As such, Contractor grants to the Owner a non-exclusive license to use such documents exclusively for the purpose of installing, maintaining and repairing the Products. During the execution and for five years following the termination date of the Purchase Order, the Owner commits not to reveal to any third party, officially or not, directly or indirectly, in writing or by other means, all or any of the information which would have been communicated to the Owner by the Contractor within the framework of the Purchase Order, except if the Owner obtains the Contractor's prior written approval. The term "information" includes, without limitation, the knowledge, the plans and the worksheets, and generally, all the technical, financial or commercial information that was exchanged or communicated in relation to the Order. In the event of termination for convenience such license shall immediately lapse".*

2.DEFINITIONS

2.1.The definition for Approved or Approval, is hereby deleted in its entirety and replaced with the following new definition:

“Approved or Approval. Approved or Approval means acceptance by the Consultant in accordance with the requirements of Article A-3 Contract Documents”.

2.2.The definition for Period of Delay is hereby deleted in its entirety.

2.3.The definition for Total amount Payable is hereby deleted in its entirety.

3.GENERAL CONDITIONS OF THE STIPULATED PRICE CONTRACT

3.1.PART 3 - EXECUTION OF THE WORK

3.1.1.GC 3.4 CONSTRUCTION SCHEDULE

- o clause 3.4.1.1 delete *“not later than two (2) weeks after receipt of the notice of award”* and refer to the schedule provided in the Veolia Proposal.

3.1.2.GC 3.5 SUPERVISION, the new clause 3.5.3 as revised in the Supplemental General Conditions is hereby deleted as it does not apply to Contractor.

3.1.3.GC 3.8 SHOP DRAWINGS, the new clause 3.8.2 is hereby deleted in its entirety. References regarding schedule shall comply with the schedules stipulated in the Veolia Proposal.

3.2.PART 4 - ALLOWANCES

3.2.1.4.1 CASH ALLOWANCES. Clause 4.1.7 is hereby deleted in its entirety. References regarding schedule shall comply with the schedules stipulated in the Veolia Proposal.

3.2.2.Clause 4.1.8 is hereby deleted in its entirety.

3.3.PART 5 - PAYMENT

3.3.1.GC 5.4 SUBSTANTIAL PERFORMANCE OF THE WORK AND PAYMENT OF THE HOLDBACK. Clauses 5.4.1.3, 5.4.1.4, 5.4.1.5 and 5.4.1.6 are hereby deleted in their entirety.

3.3.2.Clause 5.4.3 is hereby reinstated as originally drafted in the General Conditions of the CCDC-2.

3.3.3.Clause 5.4.4.1 is hereby deleted in its entirety.

3.4.PART 6 - CHANGES IN THE WORK

3.4.1.Clause 6.1.1.3 is hereby deleted in its entirety.

3.4.2.Clauses 6.2.3, 6.2.4, 6.2.5, 6.2.6 and 6.2.7 are hereby deleted in their entirety.

3.4.3.Clause 6.4.5 is hereby deleted in its entirety.

3.4.4.Clauses 6.5.6 and 6.5.7 are hereby deleted in their entirety.

3.4.5.The new clause 6.6.6 is hereby deleted in its entirety.

3.5.PART 9 - PROTECTION OF PERSONS AND PROPERTY

3.5.1.Clause 9.4.6 is hereby deleted in its entirety. Note to draft: Liability and indemnity are addressed within the terms. No new provision is required.



3.6.PART 12 - OWNER TAKEOVER

3.6.1.Clause 12.3.1 is hereby amended as follows: after *"has been attained"* add the following new language:

"or eighteen (18) months from delivery, whichever comes first".

3.6.2.Clause 12.3.5 is hereby deleted in its entirety and replaced with the following new language:

"With respect to defects, Contractor shall repair or replace Ex-Works. THE WARRANTIES EXPRESSLY SET FORTH IN THESE TERMS AND CONDITIONS ARE THE SOLE AND EXCLUSIVE WARRANTIES OF CONTRACTOR. CONTRACTOR MAKES NO OTHER WARRANTIES OF ANY KIND WHATSOEVER, EXPRESS, IMPLIED, ORAL, WRITTEN, STATUTORY OR OTHERWISE, INCLUDING, WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, OR WARRANTIES ARISING BY CUSTOM, TRADE USAGE, PROMISE, EXAMPLE OR DESCRIPTION, ALL OF WHICH WARRANTIES ARE EXPRESSLY DISCLAIMED BY CONTRACTOR AND WAIVED BY THE OWNER."

3.7.PART 13- INDEMNIFICATION

3.7.1.Clause 13.1.1 is hereby amended to insert the word *"third-party"* in front of the word *"claims"*.

3.7.2.Clause 13.1.1.1(2) is hereby deleted in its entirety.

3.7.3.Clause 13.1.2 is hereby deleted in its entirety and replaced with the following new language:

"The total and aggregate liability of the Contractor to the Owner, whether in contract, tort (including negligence) statute or under any other legal theory whatsoever shall in no event exceed one hundred percent (100%) of the Purchase Order price. Contractor shall in no event be held liable to Owner or Consultant for any indirect, special, punitive or consequential damages whatsoever arising under the Purchase Order, including any loss of profits, loss of revenues, loss of opportunities, loss of use, loss of production, loss of contracts. The present clause shall apply notwithstanding any other provision of any Purchase Order. "

The following Terms and Conditions are provided to apply to the contract between the Sequencing Batch Reactor (SBR) Preselected Equipment Supplier (Xylem) and the Contractor.

INFORMATION TO PROPONENTS

5.3 – Payment Schedule: Please modify to read: **80%** following delivery; **10%** following installation, 10% following start-up and commissioning.

20 – Warranty – add: Supplier makes no implied warranties, including those of merchantability or fitness for any particular purpose.

GENERAL CONDITIONS – CCDC-2-2020

GC 1.3 RIGHTS AND REMEDIES

1.3.1 Except as expressly provided in the *Contract Documents*, the duties and obligations imposed by the *Contract Documents* and the rights and remedies available thereunder shall be in addition to and not a limitation of any duties, obligations, rights, and remedies otherwise imposed or available by law; however to the extent the Contract Documents provide a remedy for a given default, it is the sole and exclusive remedy available in lieu of any/all other remedies available at law, in equity, or otherwise.

GC 13.1 – INDEMNIFICATION

Arising from and to the extent of Supplier's negligence, Supplier shall indemnify, defend, and hold harmless the Owner, its affiliates, and their respective officers, directors, employees, consultants, and agents (the "Owner Indemnified Parties") from and against any and all claims, demands, losses and expenses, arising out of or resulting from suits, claims and demands by third parties (including owner) for (a) damage to any tangible property; and b) for injury or death of any person(s) attributable solely to the Supplier, its subcontractors and their officers, agents or employees. Supplier also will indemnify, defend, and hold harmless the Owner Indemnified Parties from and against claims respective to the Goods that, without further combination, infringe or violate the Intellectual Property Rights of any other person/entity. These indemnities apply unless claims or losses are due to the negligence or willful misconduct of Indemnified Parties or any one of them. It is the express intention of the parties, that each of them shall be liable for the consequences of their own negligent acts or omissions whether those acts or omission are the sole, joint, or concurring causes of any claims, demands, proceedings, losses or other liabilities.

(NEW) MUTUAL WAIVER AND LIMITATION OF LIABILITY – Owner and Supplier (inclusive of their respective officers, directors, members, partners, subcontractors, and employees) will not be liable to each other for loss of profit or revenue, loss of use or business opportunity, loss of contract, cost of obtaining alternative performance, or for any indirect, consequential, special, incidental, and punitive damages. The aggregate liability of each party to the other, whether under contract law, in tort (including negligence), or under any other legal theory, is limited to the Supplier's Purchase Order price ("**Cap**"). This Cap does not apply to: (a) respective costs, losses, or damages awarded to third parties for destruction of tangible property, (b) bodily injury, sickness, or death; and (c) gross negligence or willful misconduct.