TENDER SPECIFICATIONS

McKay Ranch Lift Station

Prepared for:
The Town of Blackfalds
5018 Waghorn Street Blackfalds, AB

Prepared by:
Stantec Consulting Ltd.
#1100, 4900 – 50 Street
Red Deer, AB T4N 1X7

March 19, 2026

Project #: 1101000459

INVITATION TO TENDER
Town of Blackfalds, McKay Ranch Lift Station

The TENDER submittals shall be made via email.

The email TENDER submission should have a file size under 15 MB. The email must be clearly titled **"Town of Blackfalds, McKay Ranch Lift Station"** and must be **received no later than Friday, April 17, 2026, at 2:00:00 PM local time** by Stantec to:

Brad Vander Heyden, P. Eng.
brad.vanderheyden@stantec.com

Tenders received and not conforming to the foregoing will be returned to the Tenderer(s) without consideration.

The Work is comprised of, but is not limited to the construction of a sewage lift station with pumphouse superstructure, associated facilities, and outgoing / incoming sewage main tie-ins as detailed on the design drawings and as specified in the CONTRACT DOCUMENTS.

The tender package will be available to download from Alberta Purchasing Connection and Build Works.

Tenders must be accompanied by

- Bid Bond or Certified Cheque in the amount of 10% of the Tender Price,
- Consent of Surety for 50% Performance and 50% Labor and Materials Bonds,
- Copy of Current Safety Certificate or Temporary Letter of Certification, and
- Preliminary schedule in Gannt Format

Contractors are encouraged to perform an independent site visit and submit inquiries via email as needed. A **non-mandatory** pre-tender meeting will be held on Microsoft Teams on March 26, 2026 at 2:00 PM. **An email request can be sent to (brad.vanderheyden@stantec.com) for an invite to the Microsoft Teams meeting.**

The Owner may decide, at its sole discretion, that no bid submitted will be accepted and no Contract will be awarded pursuant to this Tender process. In that event, all Tenderers will be notified and the Owner will have no liability to any Tenderer. If the Owner decides to accept a Tender and award a Contract, the selection of the successful Tenderer will be based on a number of criteria which will include, but not limited to, price, delivery date, and qualification of the Tenderer. Receipt of an Invitation to Tender and evaluation by the Owner of a bid does not imply that the Tenderer is qualified. The Owner reserves the right to waive informalities in, reject any or all Tenders, or to accept the Tender deemed most favorable in the interest of the Owner.

The successful Tenderer shall be the Principal or Prime Contractor for the Project pursuant to the applicable construction safety legislation and shall have primary responsibility for the safety of all workers and equipment on the Project in accordance with such legislation.

Email Inquiries regarding this Project shall be submitted to:

Brad Vander Heyden, P.Eng.
Stantec Consulting Ltd.
1100, 4900 50 Street
Red Deer, AB T4N 1X7
Brad.vanderheyden@stantec.com

McKay Ranch Lift Station

The following is a list of Drawings, which are bound separately from the Contract Documents and form part of the Contract.

GENERAL	
G-001	COVER
G-002	LOCATION PLAN & LIST OF DRAWINGS
CIVIL	
C-001	GENERAL NOTES, ABBREVIATIONS & LEGEND
C-002	OVERALL LOCATION PLAN
C-101	SITE AND LANDSCAPING PLAN
C-102	SITE PLAN
C-103	UTILITY PLAN
C-501	DETAILS 1
C-502	DETAILS 2
ARCHITECTURAL	
A-001	GENERAL NOTES & LEGEND
A-101	MAIN PLAN & ROOF PLAN
A-201	BUILDING SECTIONS
A-202	BUILDING SECTIONS
A-301	ARCHITECTURAL ELEVATIONS
A-401	ARCHITECTURAL DETAILS
STRUCTURAL	
S-001	DESIGN NOTES AND TABLES
S-002	DESIGN NOTES AND TABLES
S-101	MAIN FLOOR, WETWELL AND ROOF FRAMING PLANS
S-201	SECTIONS
S-202	SECTIONS
S-301	SECTIONS AND DETAILS
S-401	STANDARD DETAILS
S-402	STANDARD DETAILS
S-403	STANDARD DETAILS
S-404	STANDARD DETAILS
S-601	CAMERA VIEWS
PROCESS	
P-001	NOTES ABBREVIATIONS AND SYMBOL LEGEND
P-002	INSTRUMENTATION SYMBOLS
P-003	PROCESS AND INSTRUMENTATION DIAGRAM
P-101	LOWER FLOOR PLAN
P-102	OPERATING FLOOR PLAN
P-201	SECTIONS
P-202	SECTIONS
P-501	STANDARD DETAILS
P-502	STANDARD DETAILS

MECHANICAL	
M-001	LEGENDS & SCHEDULES
M-100	BELOW GRADE PLUMBING LAYOUT
M-101	GROUND LEVEL PLUMBING LAYOUT
M-102	BELOW GRADE – WET WELL HEATING & VENTILATION LAYOUT
M-103	WET & DRY WELL – MAIN LEVEL HEATING & VENTILATION LAYOUT
M-104	SECTION A HEATING & VENTILATION LAYOUT
M-105	SECTIONS B & C HEATING & VENTILATION LAYOUT
M-106	DETAILS
M-107	SCHEMATICS
ELECTRICAL	
E-001	LEGEND & BILL OF MATERIALS
E-101	SITE PLAN
E-102	AREA CLASSIFICATION LAYOUTS
E-103	120-208V POWER PLAN
E-104	600VAC POWER PLAN
E-105	SITE GROUNDING PLAN
E-501	STANDARD DETAILS 1 OF 2
E-502	STANDARD DETAILS 2 OF 2
E-601	SINGLE LINE DIAGRAM
E-602	MCC ELEVATION
E-603	VFD SCHEMATIC
E-604	SCHEDULES
INSTRUMENTATION	
I-101	OPERATING FLOOR LAYOUT
I-102	LOWER FLOOR LAYOUT
I-501	STANDARD DETAILS
I-601	CABLE AND CONDUIT SCHEDULE
PROCESS CONTROL	
PC-101	PLC CONTROL PANEL EXTERIOR LAYOUT
PC-102	PLC CONTROL PANEL INTERIOR LAYOUT
PC-103	PLC CONTROL PANEL BILL OF MATERIALS
PC-104	PLC CHASIS LAYOUT
PC-105	POWER DISTRIBUTION DIAGRAM
PC-106	NETWORK COMMUNICATIONS SCHEMATIC
PC-107	PLC PANEL TERMINAL STRIP DETAILS
PC-108	DIGITAL INPUT MODULE SLOT 01
PC-109	DIGITAL INPUT MODULE SLOT 02
PC-110	RELAY OUTPUT MODULE SLOT 03
PC-111	RELAY OUTPUT MODULE SLOT 04
PC-112	ANALOG INPUT MODULE SLOT 05
PC-113	ANALOG INPUT MODULE SLOT 06
PC-114	ANALOG OUTPUT MODULE SLOT 07
PC-501	FLOAT CONTROL WIRING SCHEMATIC 1 OF 2
PC-502	FLOAT CONTROL WIRING SCHEMATIC 2 OF 2
PC-601	OVERALL COMMUNICATIONS PLAN

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1. Tendering Conditions

.1 The TENDER shall be submitted in a email, directed to the attention of the OWNER's Receiving Officer: Brad Vander Heyden, P.Eng., Suite 1100, 4900 50th Street, Red Deer, Alberta, T4N 1X7.

.2 The TENDER, including all Schedules, shall be submitted on the separate forms provided. The Tenderer's legal status and business address shall be disclosed. The TENDER shall be signed by a duly authorized official and in the case of a corporation, shall be sealed with the corporate seal.

.3 The Tendering Period shall end at the time and date specified in the "Invitation to Tender," or at an extended time and date specified in a Written Notice.

.4 After a Tender has been received by the Owner's Receiving Officer designated in Paragraph 1.1, but before the expiry of the Tendering Period specified in Paragraph 1.3, the Tenderer may withdraw or modify its Tender but only in accordance with the following procedure:

.1 Notify the Owner's Receiving Officer in writing or by email

.2 Proof of receipt of the Written Notice will be an acknowledgment by return email.

.5 The Instructions to Tenderers are provided as information for the tendering process in the period prior to submission of a TENDER. The Instructions to Tenderers are not a part of the CONTRACT DOCUMENTS nor of the CONTRACT.

2. Information Concerning Conditions of the Work

.1 TENDERERS shall carefully examine the CONTRACT DOCUMENTS and the WORKSITE, and shall fully inform themselves as to all existing conditions and limitations which will affect the execution of the CONTRACT. No consideration will be given after submission of a TENDER to any claim that there was any misunderstanding with respect to the conditions imposed by the CONTRACT.

.2 In preparation of a TENDER, TENDERERS shall use only those drawings listed in the CONTRACT DOCUMENTS that are clearly labeled "ISSUED FOR TENDER". TENDERERS shall not rely on any documents that are not so labeled.

.3 Discussions at TENDER Briefings or other oral discussions shall not become a part of the CONTRACT DOCUMENTS nor modify the CONTRACT DOCUMENTS unless confirmed by Addenda issued to all TENDERERS before closing.

3. Addenda

.1 If there are to be any changes in THE WORK, TENDERERS will be informed, prior to the close of the period allowed for receiving TENDERS, by means of an ADDENDUM, a written communication issued by the OWNER. All ADDENDA shall become a part of the

CONTRACT DOCUMENTS, and receipt of ADDENDA shall be acknowledged by the TENDERER in the TENDER.

.2 ADDENDA will not be issued later than five (5) calendar days before the TENDER closing date.

.3 After TENDERS have been opened, no changes, additions, or deletions to any TENDER, except those specifically provided for in the Tendering Conditions shall be made either by or on behalf of the OWNER, or by or on behalf of the TENDERER.

4. Discrepancies, Omissions and Constructability

.1 If a TENDERER finds discrepancies or errors or omissions in the drawings, specifications, or other documents or has any doubt as to the meaning or intent of any part thereof, he shall at once inform the OWNER. Any necessary changes, or additions, or further explanations, will be made by the OWNER by issuing an ADDENDUM.

.2 Every request for an interpretation shall be made in writing, and forwarded to the address given on the Invitation to Tender. Oral discussions, unless confirmed in writing in an Addendum, shall not modify the CONTRACT DOCUMENTS nor the tendering procedure.

.3 The TENDERER is responsible for gaining an understanding of the intent of the design as conveyed by the CONTRACT DOCUMENTS, adequate to allow the TENDERER to prepare a valid TENDER. The TENDERER shall be responsible for determining that THE WORK is constructable in accordance with the intent of the design.

5. Requests for Review of Equivalent Alternatives

.1 Reviews of equivalent alternatives will be undertaken only after the TENDER closing date.

.2 Where the specifications and/or TENDER specifically state that equivalent alternatives will be considered, the TENDERER may submit with a TENDER a request for a review of an equivalent alternative for any PRODUCT so specified.

.3 In such cases, the request for consideration of an alternative PRODUCT shall be submitted in writing to the OWNER and shall contain pertinent data such as construction and operational characteristics.

.4 The OWNER may reject the alternative and the TENDERER shall then use the item originally specified. The OWNER may allow the alternative as a basis for CONTRACT award on condition that at review of shop drawings, if the alternative is found not acceptable, the item as originally specified must be used. The TENDERER must assume the risk of obtaining final acceptance.

.5 Whenever alternatives are accepted, the TENDERER shall be responsible for making all consequent adjustments to make the alternative fit into THE WORK as specified, and these consequent costs shall be deemed to be included in the TENDER prices.

6. Alternative Proposals

.1 A TENDERER may submit a Schedule of Alternative Proposals as provided in the Supplementary Tender Forms in which he may list one or more alternative MATERIAL, PRODUCT or construction methods, regardless of whether the specifications provide for consideration of equivalent alternatives. Full descriptive details shall be submitted with a statement for each alternative, including the increase in cost or decrease in cost if the OWNER accepts that alternative. The Alternative Proposals will be considered only after TENDERS close, and the OWNER may accept or reject any or all of the Alternative Proposals. Any Alternative Proposal which is not specifically accepted shall be considered rejected.

.2 For every item for which an Alternative Proposal is submitted, the TENDERER must tender a price for that item as originally specified and his proposed increase or decrease if the alternative is used. The change in price tendered in the Alternative Proposal shall be added to or subtracted from the price tendered for the item as originally specified.

.3 Whenever alternatives are accepted, the TENDERER shall be responsible for making all consequent adjustments to make the alternative fit into THE WORK as specified, and these consequent costs shall be deemed to be included in the price difference tendered for the alternative proposal.

7. Subcontractors

.1 The TENDERER shall submit in the Schedule of Subcontractors the names of SUBCONTRACTORS proposed for the work.

.2 Where the Schedule of Subcontractors shows specific items of work the TENDERER shall name his SUBCONTRACTOR; or if the work will not be subcontracted he shall so indicate using the words "Own Forces".

.3 The SUBCONTRACTORS listed in the Tender may not be changed without the written consent of the OWNER. If the OWNER so requires, the TENDERER shall be prepared to confirm to the OWNER the competence of SUBCONTRACTORS prior to their acceptance on THE WORK.

.4 If at the time of Contract Award a SUBCONTRACTOR named in the Tender is not acceptable to the OWNER, the TENDERER shall name an alternative SUBCONTRACTOR acceptable to the owner.

8. Suppliers and Manufacturers

.1 The TENDERER shall submit in the Schedule of Suppliers and Manufacturers of MATERIAL and PRODUCT, the names of Manufacturers, and if MATERIAL and PRODUCT are obtained through intermediate agents, the agents shall be indicated as the Suppliers.

.2 The Suppliers and Manufacturers named in the TENDER shall not be changed without the written consent of the OWNER.

.3 If, at the time of Contract Award a Supplier and/or Manufacturer named in the TENDER is not acceptable to the OWNER, the TENDERER shall name an alternative Supplier or Manufacturer acceptable to the Owner.

9. Tender Guarantee

.1 The TENDER shall be accompanied by a Bid Bond in the amount of ten (10) percent of the CONTRACT PRICE and a Consent of Surety for the Performance Bond and Labour and Materials Payment Bond, in the amounts specified in the Tender Invitation. The Bid Bond and Consent of Surety shall be provided in an acceptable form by an agency that is acceptable to the OWNER, and licensed in the jurisdiction of the project. Alternatively the TENDERER may provide a certified cheque for the ten (10) percent of the CONTRACT PRICE or other form of TENDER Guarantee acceptable to the OWNER.

.2 The obligation of the Tender Guarantee shall be that if the OWNER accepts a TENDER and the TENDERER refuses to sign the AGREEMENT and to provide the specified performance guarantees, then the Tender Guarantee shall be forfeited to the OWNER.

.3 In the event that the OWNER's damages arising from default of the Tenderer in failing to perform the CONTRACT after acceptance of its Tender are greater than the amount of the Tender Guarantee, the Tender Guarantee shall not be construed to limit or eliminate the OWNER's right to sue for the balance of its damages or for all of its damages and that right may be exercised by the OWNER in its sole discretion.

10. Tender Evaluation

1. The bidder shall supply the name of a proposed construction manager/project manager. The construction manager shall have a minimum of ten (10) years of related construction experience. The construction manager need not be the bidder's superintendent. A resume of the manager shall be provided by the bidder.

2. The bidder shall supply the name of a proposed construction foreman. The construction foreman shall have a minimum of eight (8) years of related construction experience. The bidder shall supply three (3) references for the named construction foreman for projects of similar scope. A resume of the foreman shall be provided by the bidder.

3. The CONTRACTOR shall have recent experience working on projects of similar scope. The bidder shall supply three (3) references for projects of similar scope. Similar scope being defined as lift station or pump stations. The references shall include a brief description of the project along with a contact name and number for the CLIENT with whom you completed the work for.

.4 In evaluation of TENDERS the OWNER may, but is not obligated to, consider previous or on-going disputes from other CONTRACTS, with a TENDERER.

11. Acceptance or Rejection of Tenders

.1 The OWNER reserves the right to reject any or all TENDERS, to waive irregularities and informalities at his discretion and to accept the TENDER which the OWNER deems to

be in its best interest. The lowest TENDER will not necessarily be accepted. Without limiting the generality of the foregoing, any TENDER may be rejected for any of the following reasons:

- Incomplete TENDER.
- Obscured or irregular erasures or corrections in the Schedule Of Prices.
- Prices omitted or unbalanced.
- Insufficient or irregular Tender Guarantees.
- Evidence of inadequate experience, or of inadequate capacity to perform the contract, or failure to qualify under conditions of the Tendering Requirement.
- Evidence of previous failure to perform adequately on similar work.
- The insertion by the Tenderer of conditions which vary the Tendering Requirements or the Tender Forms.
- Phase 4 of the McKay Ranch Subdivision not proceeding

.2 No action of the OWNER other than a written "Notice of Acceptance" shall constitute an acceptance of a TENDER. Such written notice shall be in the form included in the Contract Documents (Document 00305) and shall be signed by officials properly authorized by the OWNER to do so, and either under the seal of the OWNER, or witnessed, as may be appropriate for the OWNER.

.3 The OWNER reserves its right to negotiate at the time of acceptance, with the lowest TENDERER only, for a lower TENDER PRICE, or for the removal from the TENDER of qualifying conditions, or both.

12. Tender Forms

.1 In Section 00304 of the Tender, TENDERERS may submit subtotal pricing only for Divisions 2 through 16 in their sealed tenders, provided that all line item process comprised in the respective division item subtotals are forwarded to, and received by the receiving officer via facsimile, or in writing within 24 hours of the tender close.

END OF DOCUMENT 00100

1. Construction Schedule

.1 The Contractor shall be responsible to determine a construction schedule which will achieve completion of the work within 365 calendar days, starting on the date of mobilization.

.2 The Contractor will need to coordinate with the McKay Ranch Developer (1574997 Alberta Ltd.) for all off-site utilities and determination of the project schedule.

.3 Construction Completion

.1 Failure to Complete on Time

.1 The CONTRACTOR must complete all work within 365 calendar days. If this condition is not met, liquidated damages as described in item 1.3.1.2 will be applied.

.2 Liquidated Damages as referenced in Clause 1.3.1.1 is one thousand five hundred dollars ($1,500) per calendar day starting on the day of mobilization.

END OF DOCUMENT 00210

1. Geotechnical Reports

.1 Geotechnical reporting documents prepared by the OWNER are appended to the TENDER DOCUMENTS use in design and it is appended to the TENDER DOCUMENTS for the TENDERER'S information only. The geotechnical reports found in Appendix A include:

- "*Geotechnical Investigation, McKay Ranch Lift Station, Blackfalds, Alberta,*" by ParklandGEO, November 25, 2021.
- Supplementary ParklandGEO letter "*Geotechnical Investigation – Groundwater Level, Mckay Ranch Lift Station*", February 9, 2026

.2 Any information pertaining to soils and borehole logs is furnished by the OWNER as a matter of general information only and borehole descriptions or logs are not to be interpreted as descriptive of conditions at locations other than those of the boreholes themselves. Neither the OWNER nor the ENGINEER warrants or makes any representation with respect to data or interpretations of data or opinions expressed in any geotechnical report available for the perusal of the CONTRACTOR, whether or not such report is included as part of the TENDER or CONTRACT DOCUMENTS.

.3 The TENDERER should familiarize himself with the purpose and limitations of the geotechnical report when interpreting subsurface conditions for TENDER preparation purposes.

END OF DOCUMENT 00220

1. Existing Site Conditions

.1 TENDERERS must visit the site and examine site conditions.

.2 TENDERERS may make tests, inspections and measurements, but such investigations must be performed under time schedules and arrangements with the OWNER and Alberta Transportation, and TENDERERS must comply with the OWNER'S requirements.

.3 A geotechnical investigation report of the conditions for the project was undertaken by ParklandGEO. The report is included in Appendix A for information purposes.

END OF DOCUMENT 00230

CONTENTS OF THE CONTRACT DOCUMENTS

CONTRACT FORMS & CONDITIONS

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Section 00100	Instructions to Tenderers
Section 00210	Schedule
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Section 00230	Existing Site Condition
Section 00303	Contents of the Contract Documents
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Section 00305	Notice of Acceptance
Section 00400	Supplementary Tender Forms
Section 00500	Agreement
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Section 00700	General Conditions
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DIVISION 1 GENERAL REQUIREMENTS

Section 01010	Summary of the Work
Section 01015	Contractor's Use of the Premises
Section 01021	Cash Allowances
Section 01022	Testing Allowances
Section 01030	Special Project Procedures
Section 01040	Coordination
Section 01060Alta	Regulatory Requirements
Section 01070	Abbreviations
Section 01080	Identification Systems
Section 01100	Alternatives
Section 01150	Measurement and Payment
Section 01200	Project Meetings
Section 01300	Submittals
Section 01310	Construction Schedules
Section 01340	Shop Drawings
Section 01390	Drawings of Record
Section 01400	Quality Control
Section 01500	Construction Facilities
Section 01600	Material and Installation
Section 01650	Commissioning
Section 01700	Contract Closeout

DIVISION 2 SITEWORK

Section 02240	Dewatering
Section 02325	Excavating and Backfilling for Structures
Section 02465	Pile Foundations
Section 02755	New Wet Well Manhole Interior Coring

DIVISION 3 CONCRETE

Section 03100	Concrete Formwork
Section 03200	Concrete Reinforcement
Section 03300	Cast-In-Place Concrete
Section 03350	Concrete Finishes
Section 03362	Concrete Finishing
Section 03420	Precast Structural Concrete

DIVISION 4 MASONRY

Section 04100	Mortar
Section 04200	Concrete Unit Masonry

DIVISION 5 METALS

Section 05410	Structural Metal Stud Framing
Section 05500	Miscellaneous Metal

DIVISION 6 WOOD AND PLASTICS

Section 06100	Rough Carpentry

DIVISION 7 THERMAL AND MOISTURE PROTECTION

Section 07150	Below Grade Waterproofing
Section 07212	Board Insulation
Section 07213	Batt Insulation
Section 07214	Foam in Place Insulation
Section 07240	Exterior Insulation and Finish System
Section 07261	Under Slab Sheet Vapour Barrier
Section 07270	Air Vapour Barrier
Section 07423	Standing Seam Metal Roof and Wall Panels
Section 07600	Metal Flashing
Section 07712	Gutters and Downspouts
Section 07723	Roof Accessories
Section 07830	Floor Hatches
Section 07840	Firestopping
Section 07900	Sealants

DIVISION 8 DOORS AND WINDOWS

Section 08100	Hollow Metal Doores and Frames
Section 08700	Door Hardware
Section 08915	Louvres

DIVISION 9 FINISHES

Section 09110	Non Structural Metal Framing
Section 09260	Gypsum Board Assemblies
Section 09670	Epoxy Flooring
Section 09900	Painting

DIVISION 10 SPECIALTIES

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DIVISION 11 EQUIPMENT

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Section 11101	Equipment Installation
Section 11102	Testing
Section 11150	Process Piping Materials and Methods
Section 11160	Process Valves
Section 11210	Pump Equipment and Controls

DIVISION 13 SPECIAL CONSTRUCTION

Section 13110	Scope of Work
Section 13115	Instrumentation Spare Parts
Section 13130	SCADA Hardware
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Section 13180	Testing and Commissioning
Section 13190	Documentation
Section 13300	Process Controls & Instrumentation General Provisions
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Section 13320	Programmable Logic Controller
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Section 13345	Wireless Communication Devices and Antennas

DIVISION 14 CONVEYING SYSTEMS

Section 14300	Hoist Equipment

DIVISION 15 MECHANICAL

Section 15010	Common Work Results
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Section 15054	Use Of Mechanical Systems During Construction
Section 15061	Hangers And Supports for HVAC Piping And Equipment
Section 15075	Mechanical Identification
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Section 15084	Acoustic Duct Lining
Section 15095	Mechanical Startup
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Section 15142	Domestic Water Piping Copper
Section 15151	Drainage Waste and Vent Piping – Cast Iron and

Copper
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Section 15192 Facility Natural Gas Piping
Section 15401 Plumbing Specialties and Accessories
Section 15411 Plumbing Fixtures
Section 15501 Heat Recovery Equipment
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DIVISION 16 ELECTRICAL

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Section 16020 Scope of Work
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Section 16022 Electrical Operations and Maintenance Data
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Section 16114 Cable Tray
Section 16122 Wire and Cable
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Section 16150 Motors and Motorized Actuators
Section 16151 Wire and Box Connectors
Section 16190 Supporting Devices
Section 16200 Power Generation
Section 16210 Generator
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Section 16230 Cooling Equipment
Section 16240 Exhaust Equipment
Section 16250 Starting System
Section 16260 Automatic Transfer Equipment
Section 16270 Alarms and Instrumentation
Section 16280 Uninterruptable Power Source (UPS)
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Section 16690 AC Adjustable Speed Drives
Section 16742 Incoming Telephone Service
Section 16820 Motor Control Centers
Section 16857 Heating Cable

	Section 16960	Starting of Electrical Equipment and Systems by Manufacturer's Representative
	Section 16970	Electrical Startup and Commissioning
	Section 16980	Electrical Equipment Systems Demonstrations and Instruction

APPENDICES

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T-1 Contractor

Name --

Address --
-- --

T-2 Owner

Name Town of Blackfalds

Address 5018 Waghorn Street
Blackfalds, AB T0M 0J0

T-3 Project Description

McKay Ranch Lift Station

T-4 Basis of the Tender

1. The CONTRACTOR has carefully examined the CONTRACT DOCUMENTS for the construction of THE WORK.

2. The CONTRACT DOCUMENTS are an integral part of this TENDER.

3. The CONTRACTOR has examined the WORKSITE and understands the conditions under which THE WORK is to be performed. The CONTRACTOR has satisfied himself that THE WORK is constructible.

4. The CONTRACTOR offers to furnish all of the MATERIAL and PRODUCT (except as otherwise specified to be supplied by others), together with all of the labour, PLANT and transportation to perform THE WORK described in the CONTRACT DOCUMENTS, in the manner prescribed therein, for the prices quoted in the Schedule of Prices, and in accordance with the other Schedules in this TENDER.

5. Where Prime Cost Sums for provision of MATERIAL or PRODUCT are included in the Schedule of Prices, only actual expenditures made upon the written authority of the OWNER, shall be paid out of these Prime Cost Sums, and if a Prime Cost Sum is not sufficient to cover that component of the work, then the CONTRACT PRICE shall be increased, and if the Prime Cost Sum is greater than required, the CONTRACT PRICE shall be decreased.

   Prime Cost Sums shall include the net cost of the item, applicable taxes and duties and delivery to the Site. Prime Cost Sums shall not include handling at the site, protection, installation or overhead and profit. Allowance for handling, protection, installation, overhead and profit shall be made by the CONTRACTOR in his tendered prices for installation. The tendered prices for installation will not be adjusted if the actual cost of the Prime Cost item has increased or decreased from the Prime Cost Sum in the TENDER.

6. Where Provisional Cost Sums for portions of THE WORK are included in the Schedule of Prices, only actual expenditures made upon the written authority of the OWNER, shall be paid out of these Provisional Cost Sums, and if the Provisional Cost Sum is not sufficient to cover THE WORK, then the CONTRACT PRICE shall be increased, and if the Provisional Cost Sum is greater than required for THE WORK, the CONTRACT PRICE shall be decreased.

7. Where a Contingency Allowance is included in the Schedule of Prices, only actual expenditures for increases in the quantities and changes in THE WORK, made upon the written authority of the OWNER, will be paid out of such allowance, and the CONTRACT PRICE will be changed in the amount by which the Contingency Allowance either exceeds or is exceeded by such expenditures.

8. Any equivalent alternatives used in this TENDER shall receive a final detailed review at the time of submission of shop drawings, and if an equivalent alternative is rejected at that time, the CONTRACTOR shall provide the item as originally specified at no change in the CONTRACT PRICE.

9. The estimated quantities of work are approximate only and are subject to increase or decrease, and whether the quantities are increased or decreased, the unit prices stated in the Schedule of Prices shall apply, and the CONTRACT PRICE shall be adjusted accordingly.

10. If a discrepancy is found between a Unit Price and an Amount, the Unit Price shall be considered as representing the intention of the CONTRACTOR, and the OWNER will recalculate the Amount. The addition of the Amounts will be corrected and a corrected TENDER Amount and CONTRACT PRICE will be established.

    If a discrepancy is found between the sum of the corrected Amounts and the Tender Price shown, the sum of Amounts, as corrected shall be deemed to represent the intent of the Tenderer.

11. If a discrepancy is found between a Lump Sum Price and the corresponding Breakdown Prices, the Lump Sum Price shall be considered as representing the intention of the CONTRACTOR.

12. No action of the Owner other than sending a "Notice of Acceptance" in writing to the CONTRACTOR, shall constitute acceptance of a Tender. The Notice of Acceptance shall be in the form included in the CONTRACT DOCUMENTS as Document 00305.

T-5 Schedule of Prices

1. The CONTRACTOR offers the following Schedule of Prices for performance of the CONTRACT.

No.	Item of Work	Unit	Est. Quantity	Unit Price	Total (CAN $)
1.1	**DIVISION 1 - MOBILIZATION AND DEMOBILIZATION**				
.1	Mobilization and Demobilization	ls	1		
.2	ECO Plan	ls	1		
	SUBTOTAL ITEM 1.1				
1.2	**DIVISION 2 – CIVIL**				
.1	Lift Station Excavation and Backfill	ls	1		
.2	Deep Utilities (Water and Sanitary)	ls	1		
.3	Shallow Utilities (Power, Gas, Communications)	ls	1		
.4	Site Grading, Landscaping, Surface Work	ls	1		
.5	450mm Plug Valve (Deletable Item)	ls	1		
.6	Dewatering	Days	28		
.7	Additional Site Import of Fill, Placement, and Compaction (PROVISIONAL)	m^3	1,000		
	SUBTOTAL ITEM 1.2				
1.3.1	**DIVISION 3 – CONCRETE**				
.1	Lift Station - Concrete	ls	1		
	SUBTOTAL ITEM 1.3.1				
1.3.2	**DIVISION 4 – MASONRY**				
.1	Lift Station - Masonry	ls	1		
	SUBTOTAL ITEM 1.3.2				
1.3.3	**DIVISION 5 – METALS**				
.1	Lift Station - Metals	ls	1		
	SUBTOTAL ITEM 1.3.3				

No.	Item of Work	Unit	Est. Quantity	Unit Price	Total (CAN $)
1.3.4	**DIVISION 6 – WOOD AND PLASTICS**				
.1	Lift Station - Wood and Plastics	ls	1		
	SUBTOTAL ITEM 1.3.4				
1.3.5	**DIVISION 7 – THERMAL AND MOISTURE PROTECTION**				
.1	Lift Station - Thermal and Moisture Protection	ls	1		
	SUBTOTAL ITEM 1.3.5				
1.3.6	**DIVISION 8 – DOORS AND WINDOWS**				
.1	Lift Station - Doors and Windows	ls	1		
	SUBTOTAL ITEM 1.3.6				
1.3.7	**DIVISION 9 – FINISHES**				
.1	Lift Station - Finishes	ls	1		
	SUBTOTAL ITEM 1.3.7				
1.3.8	**DIVISION 10 – SPECIALITES**				
.1	Lift Station - Specialities	ls	1		
	SUBTOTAL ITEM 1.3.8				
1.3.9	**DIVISION 11 – PROCESS**				
.1	Lift Station - Process	ls	1		
	SUBTOTAL ITEM 1.3.9				
1.3.10	**DIVISION 13 – INSTRUMENTATION**				
.1	Lift Station - Instrumentation	ls	1		
	SUBTOTAL ITEM 1.3.10				
1.3.11	**DIVISION 14 – CONVEYING SYSTEMS**				
.1	Lift Station - Conveying Systems	ls	1		
	SUBTOTAL ITEM 1.3.11				

No.	Item of Work	Unit	Est. Quantity	Unit Price	Total (CAN $)
1.3.12	**DIVISION 15 – MECHANICAL**				
.1	Lift Station - Mechanical	ls	1		
	SUBTOTAL ITEM 1.3.12				
1.3.13	**DIVISION 16 – ELECTRICAL**				
.1	Lift Station - Electrical	ls	1		
	SUBTOTAL ITEM 1.3.13				
1.4	**COMMISSIONING AND STARTUP**				
.1	Lift Station Commissioning and Startup	ls	1		
	SUBTOTAL ITEM 1.4				
1.5 PRIME COST SUM ITEMS					
.1	Coordination and Payment for Power and Gas Connection	ls	1		$ 40,000.00
.2	SCADA Communications	ls	1		$ 50,000.00
	SUBTOTAL ITEM 1.5				$ 90,000.00
	SUBTOTAL (WITHOUT CONTINGENCY)				
	Contingency (10%)				
	TOTAL (WITH CONTINGENCY)				
	GST (5%)				
	TOTAL INCLUDING GST				

T-6 Schedule of Completions

1. The CONTRACTOR offers to begin THE WORK within the period specified in the "Notice to Proceed," and to prosecute THE WORK in such a manner as to achieve the following completion periods. Completion includes all clean-up and rectification of all deficiencies.

   THE WORK shall be completed entirely in 365 calendar days from the date of commencement specified in the “Notice to Proceed”.

2. Time is of the Essence in this CONTRACT, and in the event that THE WORK is not completed within the period named above, the CONTRACTOR shall be responsible for all damages accruing to the OWNER due to late completion.

T-7 Schedule of Addenda

1. The CONTRACTOR states that he has received the following ADDENDA which have been considered and taken into account in determining the Prices tendered in the Schedule of Prices. The ADDENDA are issued by or in behalf of the Owner.

Addendum Number	Date Issued	Number of Pages

T-8 Performance Guarantee and Insurance Certificate

1. After receipt of Notice of Acceptance, the CONTRACTOR shall provide a Performance Bond in the amount of 50% of the CONTRACT PRICE and a standard Labour and Materials Payment Bond in the amount of 50% of the CONTRACT PRICE and the Bonds shall remain in effect for the duration of construction and the Warranty Period.

2. The bonds shall be in a form that is acceptable to the OWNER and shall be supplied by an agency that is acceptable to the OWNER and that is licensed in the jurisdiction in which THE WORK is located.

3. In the event that a Security Deposit is provided in lieu of a Performance Bond, the Security Deposit shall be retained to the end of the Warranty Period.

4. After receipt of Notice of Acceptance, the CONTRACTOR shall provide the required Insurance Certificate.

5. The costs of bonds and insurance shall be borne by the CONTRACTOR.

6. No Progress Payments shall be made until the required Bonds or Security Deposit and Insurance Certificate have been delivered to the OWNER.

T-9 Agreement

1. The CONTRACTOR shall sign the AGREEMENT within fourteen (14) calendar days after receipt of the Notice of Acceptance.

T-10 Notice to Proceed

1. After acceptance, the OWNER will issue a "Notice to Proceed" and the date specified in this Notice shall be the date of commencement entered into the AGREEMENT.

2. The CONTRACTOR shall not enter onto the WORKSITE nor commence work before the date of commencement specified in the "Notice to Proceed."

T-11 Period of Irrevocability

This TENDER is irrevocable for 60 days after the TENDER closing date.

TENDER Closing Date: Friday, April 17, 2026 at 2:00:00 pm.

T-12 Signatures

Name of CONTRACTOR

Legal Status Corporation, Partnership or Sole Ownership

Correct Mailing Address

Names and Addresses of Corporation Officers or Members of the Organization:

Name	Address	Position
Name	Address	Position
Name	Address	Position

SIGNED, SEALED AND DELIVERED BY:

Signature of Witness

Signature of CONTRACTOR

_____ _____ (Corporate
Name (
(
_____ _____ (Seal Here
Address

END OF DOCUMENT 00304

1. Written Notice of Acceptance

   .1 The TENDER of _____.--

   .2 For the project entitled **McKay Ranch Lift Station** to perform THE WORK described as: **McKay Ranch Lift Station**

   .3 For the TOTAL CONTRACT PRICE (including GST) of: **$**_____--

   .4 Submitted to Town of Blackfalds (OWNER)

   c/o Stantec Consulting Ltd., 1100 - 4900 50th Street, Red Deer, Alberta T4N 1X7

   .5 On Friday, April 10, 2026 at 2:00:00 pm

   .6 Is hereby accepted on this date: --

2. Authorization

   .1 This notice of Acceptance is authorized by: Town of Blackfalds (OWNER)

3. Condition Precedent

   .1 The award of this project in part or in whole is subject to approved project funding.

_____
Signature of the OWNER

_____ (Seal)

END OF DOCUMENT 00305

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1. Content of Supplementary Tender Forms

.1 The Schedules in the Supplementary Tender Forms are offered for information and are subject to review by the OWNER, who may require these Schedules to be modified before the award of the CONTRACT. Modifications may be required for good cause, including but not limited to:

- unbalanced breakdown prices.
- unacceptable SUBCONTRACTORS or Suppliers and Manufacturers.
- unacceptable Force Account Rates.
- unacceptable provisional unit prices.
- unacceptable supervisory personnel.
- other causes.

The CONTRACTOR warrants that all of the information given in these Schedules is current and correct. Changes to any schedule in the supplementary Tender Forms, agreed upon by the OWNER and the CONTRACTOR, after closing of the Tender Period but before Contract Award shall not in any way affect the Validity of the Tender.

.2 Upon acceptance by the OWNER, all Schedules in the Supplementary Tender Forms shall become a part of the CONTRACT DOCUMENTS.

.3 Table of Contents:

2 SCHEDULE OF BREAKDOWN PRICES
3 SCHEDULE OF UNIT PRICES FOR PROVISIONAL WORK ITEMS
4 SCHEDULE OF FORCE ACCOUNT RATES
5 SCHEDULE OF ALTERNATIVE PROPOSALS
6 SCHEDULE OF CONTRACTOR'S QUALIFICATIONS
7 SCHEDULE OF EQUIPMENT
8 SCHEDULE OF CONTRACTOR'S SUPERVISORY PERSONNEL
9 SCHEDULE OF SUBCONTRACTORS
10 SCHEDULE OF MANUFACTURERS / SUPPLIERS OF MATERIAL AND PRODUCT

2. Schedule of Breakdown Prices

.1 The CONTRACTOR offers the following Schedule of Breakdown Prices to be used as a basis for progress payments. The CONTRACTOR understands that the OWNER may refuse to accept any breakdown which he considers to be unbalanced and may require an adjustment to correct any such imbalance, without changing the Total Contract Price tendered.

Item Number	Description and/or Specification	Lump Sum Amount

3. Schedule of Unit Prices for Provisional Work Items

.1 The CONTRACTOR offers the following Schedule of Unit Prices to be used as information for the specific provisional work items listed. Actual expenditures for provisional work made upon the written authority of the OWNER will be paid out of the Provisional Cost Sum changes negotiated in the Unit Prices shall not change the provisional cost sum tendered.

Item No.	Description	Unit	Unit Price

4. Schedule of Force Account Rates

.1 The CONTRACTOR offers to do force account work for the following rates for personnel and equipment. Equipment rates include operator, fuel, maintenance, profit and overhead. Personnel rates include payroll cost of labour, all payroll burdens, room and board, if applicable, overhead and profit. The cost of superintendents, time keepers, and other administrative and supervisory personnel and their vehicles are included in overhead. The cost of Bonding and Insurance is included in overhead.

.2 The CONTRACTOR understands that the OWNER may review these Force Account Rates and require changes for good cause.

EQUIPMENT:

Description and Make	Model and Size	Hourly Rate

PERSONNEL:

Occupation Or Trade	Hourly Rate	Overtime Rate

5. Schedule of Alternative Proposals

.1 The CONTRACTOR offers the following alternative units of PRODUCT, MATERIAL or methods of doing THE WORK, and offers to increase or decrease the Price as stated for each unit of PRODUCT, MATERIAL or methods of doing THE WORK, and to increase or decrease the CONTRACT PRICE. The increase or decrease includes allowance for the cost of making any adjustments to THE WORK which may be required in order to make the proposed alternative fit into THE WORK as originally specified. The tendered increase or decrease in price shall be added to or subtracted from the price tendered for the work as originally specified.

.2 If the OWNER accepts an Alternative Proposal, as offered, or after negotiation, the increase or decrease in the price tendered for the work as originally specified, shall be implemented by a CHANGE ORDER after Award of the CONTRACT and the CONTRACT price shall then be changed.

.3 Alternative Proposals not specifically accepted by the OWNER are deemed to be rejected.

Item No.	Specifications Section No.	Original Item	Tendered Price	Alternative Item	Alternative Price	Price Difference

Item No.	Specifications Section No.	Original Item	Tendered Price	Alternative Item	Alternative Price	Price Difference

6. Schedule of Contractor's Qualifications

.1 The CONTRACTOR states that the following is a true account of his qualifications and experience on work similar to THE WORK.

Work	Year	Construction Cost	Owner/Engineer

7. Schedule of Equipment

.1 The CONTRACTOR states that the equipment listed or its equivalent shall be available for THE WORK on this CONTRACT.

Description of Unit	Size or Capacity	Condition	Age	Present Location

8. Schedule of Contractor's Supervisory Personnel

.1 The CONTRACTOR states that the following supervisory personnel shall be employed on this CONTRACT.

Name	Position	Experience

9. Schedule of Subcontractors

.1 The CONTRACTOR states that the following SUBCONTRACTORS shall be utilized on this CONTRACT:

.2 The CONTRACTOR agrees that if a named SUBCONTRACTOR is not acceptable to the OWNER, the CONTRACTOR shall name an alternative SUBCONTRACTOR, which is acceptable to the OWNER, before Award of the CONTRACT.

Items of Work	Subcontractor

10. Schedule of Manufacturers/Suppliers of Material and Product

.1 The CONTRACTOR states that the following MANUFACTURERS/SUPPLIERS of MATERIAL and PRODUCT shall be utilized for the major supply items on this CONTRACT.

Item	Supplier	Manufacturer

.2 The CONTRACTOR agrees that, if a named MANUFACTURER/SUPPLIER is not acceptable to the OWNER, the CONTRACTOR shall name an alternative, acceptable to the OWNER, before Award of the CONTRACT.

END OF DOCUMENT 00400

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1. The Parties to the Contract and the Date of the Agreement

THIS AGREEMENT made in triplicate on the _____ day of _____ by and between:

Town of Blackfalds

Hereinafter called the "OWNER" and

--

Hereinafter called the "CONTRACTOR"

The OWNER and the CONTRACTOR agree as follows:

2. Scope of the Work

.1 The CONTRACTOR agrees to furnish all of the MATERIAL and PRODUCT (except as otherwise specified to be supplied by others) together with all of the equipment, labour and transportation necessary to perform entirely THE WORK as described in the CONTRACT DOCUMENTS entitled:

McKay Ranch Lift Station

The CONTRACT DOCUMENTS have been prepared by Stantec Consulting Ltd. and include all documents listed in the "Contents of the Contract Documents." The CONTRACT DOCUMENTS are an integral part of this AGREEMENT.

.2 In preparing these Contract Documents, Stantec Consulting Ltd. has relied on information or work product provided by the Owner or by Others on behalf of the Owner, and Stantec Consulting Ltd. does not warrant or guarantee the adequacy or reliability of such information or work product.

3. Completion Dates

.1 THE WORK to be performed under this CONTRACT shall be commenced on the date specified in the “Notice to Proceed”. Components shall be completed and THE WORK in its entirety shall be fully completed, including clean-up and rectification of all deficiencies, within the time allotments specified in Document 00304, Paragraph T-6.1, “Schedule of Completions”, which paragraph is incorporated herein by reference.

THE WORK shall be completed entirely in 365 calendar days from the date of commencement specified in the “Notice to Proceed”.

.2 Time is of the essence of this AGREEMENT and in the event that THE WORK is not completed as specified, the CONTRACTOR shall become liable for any added engineering expense and any other costs incurred as damages to the OWNER. The amount of such damages may be deducted from any monies due the CONTRACTOR.

.3 It is agreed between the OWNER and the CONTRACTOR that in the event of such delay in completion, the OWNER will suffer damages estimated to be 1500 dollars per calendar day, and the CONTRACTOR agrees to pay such damages as liquidated damages and not as a penalty.

4. Payment

.1 The OWNER shall pay the CONTRACTOR in Canadian currency for the performance of the CONTRACT at the Prices named in the TENDER, and subject to the conditions set forth in the CONTRACT DOCUMENTS.

5. Contract Price

.1 The CONTRACT PRICE shall be $ -- which shall be subject to additions or subtractions as provided in the CONTRACT DOCUMENTS.

6. Performance Guarantees

.1 The CONTRACTOR hereby deposits with the OWNER a Performance Bond in the amount of 50% of the CONTRACT PRICE and a Labour and Materials Payment Bond in the amount of 50% of the CONTRACT PRICE.

7. Written Notice

.1 Written notice shall be deemed to have been duly served if delivered in person to the individual, or to a member of the firm, or to an officer of the corporation for which it is intended; or sent by double registered mail to its business address.

.2 Written Notice must be served to:

The OWNER:

Town of Blackfalds
5018 Waghorn Street
Blackfalds, AB T0M 0J0

The CONTRACTOR:

--
--
-- --

8. Signatures

.1 IN WITNESS WHEREOF the Parties hereto have executed this AGREEMENT, the day and year first above written.

SIGNED, SEALED, AND DELIVERED
in the presence of:

Witness to the Signature
of the OWNER

1. _____

Address:

2. _____

Address:

Town of Blackfalds

1. _____

Title: _____

Address: 5018 Waghorn Street
Blackfalds, AB
T0M 0J0

(SEAL)

2. _____

Title: _____

Address: 5018 Waghorn Street
Blackfalds, AB
T0M 0J0

Witness to the Signature
of the CONTRACTOR

1. _____

Address:

2. _____

Address:

--

1. _____

Title: _____

Address: --
--
--

(SEAL)

2. _____

Title: _____

Address: --
--
--

END OF DOCUMENT 00500

STANTEC CONSULTING LTD.

CERTIFICATE OF INSURANCE

This is to certify that the insurances as described herein have been arranged for the insured named herein on whose behalf this Certificate is executed, and we hereby certify that such insurances are in full force and effect.

NAME OF INSURED _____

ADDRESS OF INSURED _____

INSURANCE COVERAGE PROVIDED

1. COMPREHENSIVE GENERAL LIABILITY INSURANCE covering property damage and contractual liability.

Policy No.	_____	Insurer	_____
Date Effective	_____	Date of Expiration	_____
Limits of Liability	_____	Each Person	_____
		Each Occurrence	_____
		Aggregate Cover	_____
		Inclusive Limits	_____

2. AUTOMOBILE INSURANCE covering all vehicles owned, operated, leased or hired.

Policy No.	_____	Insurer	_____
Date Effective	_____	Date of Expiration	_____
Limits of Liability	_____	Each Person	_____
		Each Accident	_____
		Inclusive Limits	_____

3. COURSE OF CONSTRUCTION INSURANCE either All Risks Builders Risk Policy or (Specify)

Policy No.		Insurer	
Date Effective		Date of Expiration	
Limits of Liability			

If any of the policies described herein are changed in any manner, for any reason during the period of coverage as stated herein, so as to effect this Certificate, or if any of the policies are cancelled or terminated, 15 days written notice shall be given to the Owner and to the Engineer prior to such change, cancellation or termination becoming effective.

This Certificate is executed and issued to the Owner the day and date written below.

OWNER: Town of Blackfalds

Address: 5018 Waghorn Street
Blackfalds, AB T0M 0J0

DATE:

NAME OF AGENT OR BROKER:

Address:

NAME OF AUTHORIZED OFFICIAL:

SIGNATURE OF AUTHORIZED OFFICIAL: _____

4. WRAP-UP LIABILITY INSURANCE covering all Subcontractors, Suppliers, and the OWNER, and its CONSULTANTS and SUBCONSULTANTS (if required by the CONTRACT).

END OF SECTION 00600

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1. Definitions

.1 The contents of the CONTRACT DOCUMENTS are limited to:

Contract Forms:

- the TENDER Forms
- the Supplementary TENDER Forms
- Notice of Acceptance
- the AGREEMENT
- the Performance Bond
- the Labour and Materials Payment Bond
- the Certificate of Insurance;

Conditions of the Contract:

- the General Conditions
- the Supplementary General Conditions;

Drawings;

Specifications;

Appendices;

Addenda;

Field Orders;

Change Orders.

.2 The following definitions shall apply throughout the CONTRACT DOCUMENTS:

.1 The term ENGINEER shall mean Stantec Consulting Ltd. or such other engineering firm as may from time to time be duly authorized and appointed in writing by the OWNER to act for the purposes of this CONTRACT within the authority and responsibility defined in the CONTRACT DOCUMENTS.

.2 The term OWNER REPRESENTATIVE shall mean an employee of the OWNER or an agent of the OWNER, specifically designated in writing by the OWNER to have special responsibilities and authorities as set out in the CONTRACT DOCUMENTS.

.3 The term THE WORK shall mean the entirety of the work described in these contract documents, including MATERIAL, PRODUCT, labour, PLANT, transportation and other facilities and items ancillary to the foregoing required to furnish and perform the CONTRACT by the CONTRACTOR in accordance with the intent of the design as expressed in the CONTRACT DOCUMENTS.

.4 The term THE PROJECT shall mean the total construction contemplated by the OWNER, of which THE WORK may be the whole or only a part.

.5 The term WORKSITE shall mean the spatial limits within which THE WORK is located, during the period of performance of THE WORK from the date of Notice to Proceed to the date of the CONSTRUCTION COMPLETION CERTIFICATE.

.6 The term CONTRACTOR'S SUPERINTENDENT shall mean an employee or representative of the CONTRACTOR who is specifically authorized to be in full charge of the CONTRACTOR's operations at the WORKSITE and is so designated in writing by the CONTRACTOR to the OWNER.

.7 The term SUBCONTRACTOR shall mean a person neither contracting with nor employed directly by the OWNER for doing any of THE WORK, but contracting with or being employed directly by the CONTRACTOR, provided however that the term SUBCONTRACTOR shall not include one who merely supplies MATERIAL or PRODUCT for THE WORK to the CONTRACTOR.

.8 The term OTHER CONTRACTOR shall mean any person, firm or corporation employed by the OWNER on the site of THE PROJECT other than through the CONTRACTOR.

.9 The term CONTRACT PRICE shall mean the total amount of the CONTRACT as defined in the AGREEMENT, adjusted during the course of THE WORK as required by these CONTRACT DOCUMENTS.

.10 Certificates

a) The term PROGRESS PAYMENT CERTIFICATE shall mean a claim for payment for work done, prepared by the CONTRACTOR, reviewed and certified by the ENGINEER, upon which payment on account is made periodically by the OWNER.

b) The term CONSTRUCTION COMPLETION CERTIFICATE shall mean a certificate issued by the ENGINEER upon full completion of THE WORK, including cleanup and rectification of all deficiencies.

c) The term FINAL CERTIFICATE shall mean the certificate issued by the ENGINEER on behalf of the OWNER or by the OWNER, only at the request of the CONTRACTOR, after expiry of the WARRANTY PERIOD, provided that the conditions of the CONTRACT have been met.

.11 The term WARRANTY PERIOD shall mean the period beginning on the date specified in the "CONSTRUCTION COMPLETION CERTIFICATE," and ending after all conditions of the CONTRACT have been met, and the specified period has expired.

.12 The term FIELD ORDER (F.O.) shall mean a written communication from the OWNER, or from the ENGINEER on behalf of the OWNER, to the CONTRACTOR, clarifying the CONTRACT DOCUMENTS, issuing additional instructions, requesting information, or ordering a change in THE WORK within the general scope of THE WORK.

.13 The term CHANGE ORDER shall mean a written communication issued by the OWNER, with the agreement of the CONTRACTOR, setting forth the authorized amount and time to be added to or deducted from the CONTRACT PRICE on account of changes in THE WORK described by a NOTICE OF CONTEMPLATED CHANGE and subsequent correspondence.

.14 The term NOTICE OF CONTEMPLATED CHANGE (NCC) shall mean a written communication from the ENGINEER, on behalf of the OWNER, describing a change in THE WORK and requesting a quotation, complete with a narrative description of the details of the work to be done by the CONTRACTOR to achieve the intent of the contemplated change.

.15 The term QUOTATION FOR CONTEMPLATED CHANGE (QCC) shall mean a written proposal by the CONTRACTOR to the OWNER for doing the work required to achieve the contemplated change, including both cost and time implications for doing the work.

.16 The term PLANT shall mean collectively all tools, implements, machinery, vehicles, structures, equipment and other things required for the execution of THE WORK, and provided by the CONTRACTOR.

.17 The term MATERIAL shall mean collectively all materials and commodities required to be furnished under the CONTRACT for THE WORK except those specifically provided for otherwise in the CONTRACT DOCUMENTS.

.18 The term PRODUCT shall mean collectively machinery or assembled components specifically provided for THE WORK and standard PRODUCT such as motors, pumps, etc. designed and produced for a specific use.

.19 The term "PROVIDE" shall mean supply and install.

.3 Words importing the singular only shall also include the plural and vice-versa, where the context requires.

.4 MATERIAL, PRODUCT, PLANT or methods described in words which so applied have a well-known technical or trade meaning shall be held to refer to such recognized meaning.

2. Agreement

.1 The AGREEMENT shall be signed in triplicate by the OWNER and the CONTRACTOR.

3. Drawings and Instructions

.1 The OWNER will furnish to the CONTRACTOR 3 working copies of the CONTRACT DOCUMENTS.

.2 A current set of the complete CONTRACT DOCUMENTS, in good order, shall be kept at the WORKSITE and shall be available there to the ENGINEER and the OWNER.

.3 All drawings, specifications and copies thereof furnished by the ENGINEER are his property. They shall not be used on other work and, with the exception of the signed CONTRACT DOCUMENT set, are to be returned to the ENGINEER on request, upon completion of THE WORK.

.4 All models prepared by the ENGINEER for the OWNER's use and paid for by the OWNER, are the property of the OWNER, and not the CONTRACTOR, unless specifically agreed otherwise.

4. Reference Points and Layout

.1 The ENGINEER will establish base lines and reference points, for the location of principal components of THE WORK, as well as bench marks in reasonable proximity to THE WORK.

.2 The CONTRACTOR shall be responsible for protection and preservation of bench marks, reference points and stakes, and legal survey pins, and in case of willful or careless destruction, he shall be charged with the resulting expense and shall be responsible for any mistakes that may be caused by their loss or disturbance.

.3 The CONTRACTOR shall provide all detailed layout of dimensions, locations, and elevations of THE WORK from the base lines, reference points, and bench marks set by the ENGINEER.

.4 The CONTRACTOR shall not proceed with THE WORK until he has received from the ENGINEER such base lines, reference points, elevations, and other points and instructions as are required for the execution of THE WORK.

.5 The CONTRACTOR shall, before commencing work at any point, satisfy himself as to the meaning and correctness of all stakes and instructions. No claims shall be considered for any allowance based on alleged inaccuracies, failure to read reference points correctly, or failure to interpret instructions correctly.

.6 If the CONTRACTOR, in the course of executing THE WORK, finds any discrepancy between the drawings and the physical conditions of the locality, or any errors, omissions or discrepancies in drawings or in the layout as given by points and instructions, he shall inform the OWNER immediately in writing, and the OWNER or the ENGINEER shall promptly verify the same and issue appropriate instructions. Any work done after discovery of errors, omissions or discrepancies, before further work is authorized, will be done at the CONTRACTOR'S risk.

5. The Engineer and the Contractor

.1 The ENGINEER shall administer the CONTRACT and shall, in the first instance, be the interpreter of the CONTRACT and shall assess the adequacy of performance by the Parties.

The ENGINEER shall provide full time resident services at the WORKSITE and general engineering services for THE WORK.

The duties, responsibilities and limitations of authority of the ENGINEER are defined in the CONTRACT DOCUMENTS and they may not be changed except with the written consent of the OWNER, the CONTRACTOR and the ENGINEER. They are delegated to the ENGINEER by the OWNER.

.2 The efforts of the ENGINEER shall be directed to reviewing construction progress, providing interpretation of the CONTRACT DOCUMENTS, where required, and assisting in the expeditious carrying out of THE WORK.

.3 The ENGINEER does not guarantee the CONTRACTOR's work nor undertake to check the quality and quantity of work on behalf of the CONTRACTOR. The ENGINEER is not responsible to the CONTRACTOR for discovering defects in THE WORK nor for advising the CONTRACTOR of defects in THE WORK.

.4 The CONTRACTOR shall bring to THE WORK the expertise, skill and experience required for the execution of THE WORK.

.5 During the course of execution of THE WORK, if the CONTRACTOR becomes aware of any error, discrepancy or omission in the drawings or the specifications, the CONTRACTOR shall immediately notify the ENGINEER in writing and request instructions. The CONTRACTOR shall not proceed any further with that portion of THE WORK until he has received such instructions in writing from the ENGINEER.

The ENGINEER may, by FIELD ORDER, put a "hold" on any portion of THE WORK while an error, discrepancy or omission, whether discovered by the CONTRACTOR or the ENGINEER, is investigated. Such a "hold" order shall not constitute a basis for a claim by the CONTRACTOR for delay, unless and until it critically affects the performance of THE WORK and the Schedule for Completion of THE WORK.

.6 The CONTRACTOR shall have complete control of THE WORK and shall direct and supervise THE WORK to ensure conformance with the intent of design as expressed in the CONTRACT DOCUMENTS. The CONTRACTOR shall be solely responsible for construction means, methods, techniques, sequences and procedures, and for coordinating the various aspects of THE WORK under the CONTRACT. The CONTRACTOR shall have determined that THE WORK is constructable.

.7 The CONTRACTOR shall have the sole responsibility for the design, erection, operation, maintenance and removal of temporary structures and other temporary facilities, and for the design and execution of methods required in their use.

When required by law or by the CONTRACT, the CONTRACTOR shall engage and pay for registered professional engineering personnel to perform the design of temporary facilities and methods of execution to ensure safety and satisfactory performance.

When required by the Specifications or drawings, the CONTRACTOR shall submit to the ENGINEER a written description and Drawings to show its proposed methods and means for doing certain specified items of THE WORK. These submissions are to made to allow the ENGINEER on the OWNER's behalf to:

a) determine the general conformance of the proposed means and methods with the intent of the design;

b) determine whether there are or could be any serious affects of a permanent nature on THE WORK, the WORKSITE, or the contiguous area outside the Worksite.

The OWNER, or the ENGINEER in the OWNER's behalf may, but they are not obligated to, comment, give approval or with hold approval of the proposed means and methods.

The OWNER may stop the CONTRACTOR from implementing the proposed means and methods by issuing a FIELD ORDER.

.8 The CONTRACTOR shall employ a competent CONTRACTOR'S SUPERINTENDENT who shall be in attendance at the WORKSITE while THE WORK is being performed. The CONTRACTOR'S SUPERINTENDENT shall be acceptable to the OWNER and shall not be removed or changed without good reason, and then only with the approval of the OWNER.

The CONTRACTOR'S SUPERINTENDENT shall represent the CONTRACTOR at the WORKSITE and additional instructions given to him by the ENGINEER shall be deemed to have been given to the CONTRACTOR.

.9 Nothing contained in the CONTRACT DOCUMENTS shall be construed to form any contractual obligation between the ENGINEER and the CONTRACTOR.

6. Subcontractors

.1 The CONTRACTOR shall preserve and protect the rights of the OWNER with respect to all work performed under the Contract and shall:

a) Require all SUBCONTRACTORS to perform work in accordance with and subject to the terms and conditions of the CONTRACT;

b) Be as fully responsible to the OWNER for acts and omissions of SUBCONTRACTORS and of persons directly or indirectly employed by them as for acts and omissions of persons directly employed by the CONTRACTOR;

c) Incorporate all terms and conditions of the CONTRACT DOCUMENTS into all Subcontract Agreements he enters into with his SUBCONTRACTORS, insofar as they are applicable.

.2 The CONTRACTOR shall employ those SUBCONTRACTORS proposed in the Schedule of SUBCONTRACTORS for portions of THE WORK designated and as accepted by the OWNER prior to Acceptance of the TENDER..

.3 Nothing contained in the CONTRACT DOCUMENTS shall create any contractual obligation between any SUBCONTRACTOR and the OWNER.

7. Other Contractors

.1 The OWNER reserves the right to let other contracts on the WORKSITE related to the Project and to do work with his own forces on the Project.

.2 The OWNER shall coordinate the work, insurance coverages, and compliance of OTHER CONTRACTORS with rules and procedures for the WORKSITE insofar as these affect THE WORK of this CONTRACT.

.3 The CONTRACTOR shall coordinate his work with that of OTHER CONTRACTORS and tie into works constructed by others as specified or shown in the CONTRACT DOCUMENTS.

.4 The CONTRACTOR shall report to the OWNER or the ENGINEER any apparent deficiencies in OTHER CONTRACTORS' work which would affect THE WORK of this CONTRACT as soon as they come to his attention and shall confirm such report in writing. Failure by the CONTRACTOR to so report shall invalidate any claims against the OWNER by reason of the deficiencies of OTHER CONTRACTORS' work except as to those of which the CONTRACTOR could not reasonably be aware.

8. Assignment

.1 Neither Party to the CONTRACT shall assign the CONTRACT or any portion thereof, nor any monies due to either Party, without the written consent of the other; which consent shall not be unreasonably withheld.

9. Indemnity

.1 The CONTRACTOR shall indemnify and hold harmless the OWNER, the ENGINEER, OTHER CONTRACTORS and any and all representatives or employees of the OWNER, from and against all third party actions, claims, demands or suits, or payments, losses, judgment or expenses arising out of or in consequence of the acts, omissions or negligence of the CONTRACTOR in performing THE WORK during the period of performance of THE WORK and during the Warranty Period.

.2 In the event of such a third party action, claim, demand or suit, the OWNER shall give written notice thereof to the CONTRACTOR and the CONTRACTOR shall thereupon defend against or otherwise dispose of the same, and shall pay any losses, judgments and expenses promptly after they are determined.

.3 If the CONTRACTOR fails, refuses or neglects to defend, or otherwise dispose of such third party action, claim, demand or suit, within reasonable time and within legal time constraints, the OWNER may dispose of such action, claim, demand or suit on such terms as the OWNER, in his sole discretion, shall deem reasonable. The CONTRACTOR shall thereupon, and forthwith, pay to the OWNER the sums paid out by the OWNER and all reasonable costs incurred by the OWNER in disposing of the matter, including the OWNER’S legal costs on the Solicitor and Client basis.

.4 The obligation of the CONTRACTOR to indemnify the OWNER shall not apply to liability arising out of acts, omissions or negligence of the OWNER, the ENGINEER, OTHER CONTRACTORS or any other representative or employee of the OWNER.

10. Dispute Resolution

.1 The Engineer shall, in the first instance, interpret the CONTRACT and make any determinations for which he is responsible and which he is authorized to make under the CONTRACT. Should either the CONTRACTOR or the OWNER dispute the written interpretation or determination made by the ENGINEER in the first instance, that party shall, within six (6) calendar days of receiving the determination or interpretation, submit to the ENGINEER a written notice of his dispute setting out all of the relevant details.

.2 Upon receipt of a Notice of Dispute, the ENGINEER shall immediately notify in writing the other party to the CONTRACT and provide to the other party a copy of the Notice of Dispute.

.3 The OWNER and the CONTRACTOR shall, within six (6) calendar days of receiving such notification, review the dispute jointly and attempt a resolution by negotiation.

.4 If the OWNER and the CONTRACTOR are not able to resolve the dispute by negotiation, they may, by mutual agreement, engage a mediator to assist them in further negotiation towards reaching a resolution.

.5 Alternatively, or after mediation has failed, the OWNER and the CONTRACTOR may, by mutual agreement, submit the dispute to arbitration under the laws of the jurisdiction in which THE WORK is situated. Insofar as it is compatible with the law in the jurisdiction in which THE WORK is situated, the Recommended Procedures for Arbitration of Construction Disputes of the Canadian Construction Association, the most current edition, shall be followed. The arbitrator's decision shall be binding.

.6 Alternatively, the CONTRACTOR or the OWNER may commence an action at law with respect to the dispute if it cannot be resolved by negotiation either with or without mediation.

Neither negotiation with or without mediation, nor arbitration, shall be conditions precedent to proceeding with an action at law.

.7 If the dispute is not resolved promptly, the ENGINEER shall give instructions in writing to the CONTRACTOR to do such work or to take such actions or refrain from taking such actions as may be required to avoid delay, mitigate damage and continue the proper performance of THE WORK pending resolution of the dispute. The CONTRACTOR shall act promptly in accordance with such instructions and by so doing shall not jeopardize any claim he may have with respect to the dispute.

11. Delays

.1 If the CONTRACTOR is delayed in the performance of THE WORK by weather, labour disputes, strikes or lock-outs of the CONTRACTOR'S forces, or delay by common carriers, the CONTRACTOR shall not be compensated for any additional costs thereby incurred, nor shall the completion dates be changed, because it is agreed that the CONTRACTOR is more competent than the OWNER to assess the probability and impact of these events. The CONTRACTOR'S forces in this context includes

SUBCONTRACTORS and Suppliers and Manufacturers supplying or providing PRODUCTS or MATERIALS.

.2 If the CONTRACTOR is delayed in the performance of THE WORK by failure of the OWNER to make decisions respecting THE WORK, late delivery of MATERIALS or PRODUCTS furnished by the OWNER, or acts or omissions of the OWNER, or by strikes or lock-outs of the OWNER'S forces, the CONTRACTOR shall be compensated for any additional costs thereby incurred, and the completion date, subject to paragraph 11.5 shall be changed. The amount of the compensation and the extent of change in completion date shall be determined in the first instance by the ENGINEER.

.3 If the CONTRACTOR is delayed in performance of THE WORK by a Suspension of THE WORK Notice by the OWNER and if the period of suspension is thirty (30) calendar days or less, the CONTRACT time shall be extended by the period of suspension plus six (6) calendar days, subject to the condition of paragraph 11.5.

.4 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 provided that such Order was not issued as a result of any act or fault of the CONTRACTOR, or of anyone employed by him directly or indirectly, then the CONTRACTOR shall be entitled to claim compensation for additional costs thereby incurred, and the completion date, subject to paragraph 11.5, shall be changed. The amount of compensation and the extent of change in completion date shall be determined in the first instance by the ENGINEER.

.5 If the Completion Date is changed in accordance with paragraphs 11.2, 11.3 or 11.4, then, with respect to the new Completion Date, time is of the essence.

.6 The CONTRACTOR shall provide to the OWNER timely written notice of all delays for which it is the CONTRACTOR'S intention to claim either an extension of completion time or costs resulting from the delay or both.

12. Owner's Right To Do Work

.1 If the CONTRACTOR should refuse or fail to supply adequate PRODUCT, MATERIAL, PLANT or workmanship for the scheduled performance of THE WORK, or neglect to prosecute THE WORK properly, or fail to perform any of the provisions of the CONTRACT, then the OWNER may give written notice to the CONTRACTOR and his Surety that the CONTRACTOR is in default of his contractual obligations, and instruct him to correct the default within five (5) working days.

.2 If the correction of the default cannot be completed within the five (5) working days specified, the CONTRACTOR shall be considered to be in compliance with the OWNER'S instruction if he:

a) Commences the correction of the default within the specified time; and

b) Provides the OWNER with an acceptable schedule for such correction; and

c) Completes the correction in accordance with such schedule.

.3 If the CONTRACTOR fails to comply with the provisions of General Conditions 12.1 and 12.2, the OWNER may, without prejudice to any other right or remedy he may have, correct such default and may deduct the cost thereof from the payment then or thereafter due the CONTRACTOR. The ENGINEER shall, in the first instance, determine that both the corrective action and the amount subsequently charged to the CONTRACTOR are reasonable.

13. Owner's Right to Terminate the Contract

.1 If the CONTRACTOR should:

a) Be adjudged bankrupt, or make a general assignment for the benefit of creditors, or if a receiver is appointed on account of his insolvency; or

b) Fail to make sufficient payments due to his creditors for labour, PLANT, PRODUCT and MATERIAL used or reasonably required for use on or in THE WORK; or

c) Disregard laws or ordinances, or the ENGINEER'S instructions; or

d) Abandon THE WORK, or fail to adhere to THE WORK Schedule to such an extent that there is danger of failing to meet Completion dates; or

e) Otherwise violate the fundamental conditions of the Contract;

the OWNER shall, by written notice, instruct the CONTRACTOR to correct the default within five (5) working days. If the default is not corrected within five (5) working days, then the OWNER may, without prejudice to any other right or remedy he may have, terminate the CONTRACTOR'S right to continue THE WORK or terminate the CONTRACT.

.2 If the OWNER terminates the CONTRACTOR'S right to continue with THE WORK or terminates the CONTRACT under the conditions set out above, and if the performance Warranty is unconditional, the OWNER shall be entitled to:

a) Take possession of the premises, PRODUCT, MATERIAL and PLANT and utilize them to finish THE WORK by whatever method he may deem expedient but without undue delay or expense; and

b) Withhold any further payments to the CONTRACTOR until THE WORK is finished; and

c) Upon completion of THE WORK, determine the full cost of finishing THE WORK as certified by the ENGINEER, including compensation to the ENGINEER for his additional services and a reasonable allowance as determined by the ENGINEER to cover the cost of any corrections required under the WARRANTY PERIOD, and charge the CONTRACTOR the amount by which the full cost exceeds the unpaid balance of the CONTRACT PRICE; or if such cost of finishing THE WORK is less than the unpaid balance of the CONTRACT PRICE, pay the CONTRACTOR the difference; and

d) On expiry of the WARRANTY PERIOD, charge the CONTRACTOR the cost of corrections required under the warranty.

The CONTRACTOR'S obligation under the CONTRACT as to the quality of that portion of THE WORK and warranty of that portion of THE WORK performed by the CONTRACTOR prior to termination of the CONTRACTOR'S right to continue with THE WORK shall continue in force after the termination.

.3 If the CONTRACTOR has provided a Performance Bond, the OWNER shall have the option of:

a) Terminating the CONTRACTOR'S right to continue with THE WORK; or

b) Terminating the CONTRACT; or

c) Exercising the OWNER'S rights in accordance with conditions of the Performance Bond.

14. Suspension of the Work by the Owner

.1 The OWNER may suspend the execution of THE WORK by giving written notice to the CONTRACTOR to that effect.

.2 The CONTRACTOR, upon receiving such written notice, shall immediately suspend all operations except those necessary for the care and preservation of the portions of THE WORK already executed, and the WORKSITE.

.3 During the period of suspension, the CONTRACTOR shall not remove from the WORKSITE any part of THE WORK or any MATERIAL, PRODUCT or PLANT without the written approval of the OWNER.

.4 If the period of suspension is thirty (30) calendar days or less, the CONTRACTOR shall, upon expiry of the suspension, resume the execution of THE WORK and he shall be paid additionally all of his reasonable costs incurred because of the suspension. The additional costs shall be claimed by the CONTRACTOR and shall be verified by a determination of the ENGINEER in the first instance.

.5 After thirty (30) calendar days, of suspension of THE WORK the OWNER at its sole option shall:

a) Negotiate terms under which the CONTRACTOR shall continue with the execution of THE WORK and the CONTRACTOR shall then resume operations in accordance with the terms of that negotiation; or

b) Deem the Notice of Suspension to be a Notice of Termination of the CONTRACT. In the event of Termination, the CONTRACTOR shall be paid his reasonable costs incurred due to the suspension. The additional costs shall be claimed by the CONTRACTOR and verified in the first instance by a determination of the ENGINEER. The CONTRACTOR shall not have a claim for loss of profit on that portion of THE WORK not performed.

.6 After thirty (30) calendar days of suspension of THE WORK, the CONTRACTOR shall be allowed to remove any or all of its PLANT from the WORKSITE without further approval from the OWNER.

15. Contractor's Right to Stop Work or Terminate the Contract

.1 If the OWNER should be adjudged bankrupt, or makes a general assignment for the benefit of creditors, or if a receiver is appointed on account of his insolvency, the CONTRACTOR may, without prejudice to any other right or remedy he may have, by giving the OWNER five (5) days written notice, terminate the CONTRACT.

.2 If THE WORK should be stopped or otherwise delayed for a period of thirty days or more under an order of any court, or other public authority, and provided that such order was not issued as the result of any act or fault of the CONTRACTOR or of anyone directly or indirectly employed by him, the CONTRACTOR may, without prejudice to any other right or remedy he may have, by giving the OWNER written notice, terminate the CONTRACT.

.3 The CONTRACTOR may notify the OWNER in writing, with a copy to the ENGINEER, that the OWNER is in default of his contractual obligations if:

a) The ENGINEER fails to certify a Progress Payment Certificate in accordance with these General Conditions; or,

b) The OWNER, subject to requirements of these General Conditions, fails to pay to the CONTRACTOR when due, any amount certified by the ENGINEER, or awarded by arbitrators; or,

c) The OWNER fails to furnish, upon written request from the CONTRACTOR, reasonable evidence of ability to fulfill the OWNER's financial obligation under the CONTRACT.

Such written notice shall advise the OWNER that if such default is not corrected within fifteen (15) calendar days from the receipt of the written notice the CONTRACTOR may, without prejudice to any other right or remedy he may have, stop THE WORK and terminate the Contract.

.4 If the CONTRACTOR terminates the Contract under the conditions set out above, he shall be paid for all work performed and for any loss sustained upon MATERIAL, PRODUCT and PLANT, with reasonable profit.

16. Changes in the Work

.1 The OWNER may order changes in the work through additions, deletions, modifications or variations without invalidating the CONTRACT. The value of such changes shall be taken into account in ascertaining the final amount of the CONTRACT PRICE. All such work shall be executed under the conditions of the CONTRACT. No extension of the CONTRACT Completion Time shall be made on account of changes in the work unless expressly provided for in the CHANGE ORDER.

.2 No changes in the work shall be made unless pursuant to a FIELD ORDER or a CHANGE ORDER and no payment shall be made or credit given unless authorized by a CHANGE ORDER.

.3 The authority of the ENGINEER to order payment without prior approval of the OWNER, through a CHANGE ORDER is limited in any one instance to 10% of the Contingency Allowance or Five Thousand Dollars ($5,000) whichever is the lesser, and cumulatively to the amount of the Contingency Allowance. The CONTRACTOR shall not depend upon the order of the ENGINEER for claiming payments for changes in the work carried out in excess of those limits, without prior approval of the OWNER in each instance.

.4 The CONTRACTOR may, in writing, propose changes in the work, including the amount of additional payment or credit entailed in the proposal. If the OWNER accepts the CONTRACTOR'S proposal, the OWNER and the CONTRACTOR will authorize a CHANGE ORDER to that effect.

.5 When the OWNER desires to make a change in the work it shall issue a NOTICE OF CONTEMPLATED CHANGE (NCC) to the CONTRACTOR and the CONTRACTOR shall return to the OWNER a QUOTATION FOR CONTEMPLATED CHANGE (QCC). If the QUOTATION FOR CONTEMPLATED CHANGE is accepted the change in the work shall be authorized by a CHANGE ORDER signed by the OWNER and the CONTRACTOR.

.6 If the CONTRACTOR claims that any instruction by drawings, or otherwise, involves a change in THE WORK under this CONTRACT, he shall give the OWNER written notice thereof immediately, and he shall then follow the OWNER'S instruction regarding doing the work in question. No such claim shall be valid unless so made. If the CONTRACTOR'S claim for a change in THE WORK is approved a CHANGE ORDER shall be issued. The ENGINEER shall, in the first instance, determine the validity of the CONTRACTOR'S claim.

.7 Any work outside the scope of the CONTRACT for which the CONTRACTOR might be entitled to compensation, including any claim on the basis of quantum merit, shall be considered a change in THE WORK. No claim by the CONTRACTOR for additional payment on the basis of a change in THE WORK shall be valid and enforceable against the OWNER unless it is made pursuant to the provisions of General Condition 16.1 to 16.6.

17. Valuation of Changes in the Work

.1 The valuation of changes in THE WORK due to differences between actual measured quantities at the time of construction and the approximate estimated quantities shown in the TENDER shall be determined on the basis of the Unit Prices named in the TENDER. No CHANGE ORDER is required.

.2 The valuation of changes in THE WORK due to deletion of work within the scope of the CONTRACT or addition of work to the scope of the CONTRACT shall be determined by Unit Prices named in the TENDER. A CHANGE ORDER is required.

.3 When there are changes in THE WORK which are not covered by Unit Prices named in the TENDER, the valuation of such changes shall be determined by:

a) An agreement on a Lump Sum in each instance between the OWNER and the CONTRACTOR; or

b) At the rates for the provision of labour and PLANT named in the Schedule of Force Account Rates in the Supplementary TENDER Forms, plus the CONTRACTOR'S cost plus 20% for MATERIAL and PRODUCT F.O.B. the job site, as established by invoices; or

c) On a CONTRACTOR'S cost basis as follows:

i) Payroll Cost of Labour, defined as direct wages and salaries for the hours worked, plus 20% to cover Workers' Compensation, Unemployment Insurance, Holiday Pay, Paid Statutory Holidays and other valid payroll burdens; plus

ii) The CONTRACTOR'S cost of providing room and board for labour, if room and board is normally provided by the CONTRACTOR on THE WORK; plus

iii) The CONTRACTOR'S cost for MATERIAL and PRODUCT F.O.B. the job site, less trade discounts, as established by invoices; plus

iv) Twenty percent (20%) fee on the sum of items i), ii) and iii) to cover office and general overhead, use of small tools and profit. Overhead includes the cost of superintendence, foremen, timekeepers and other administrative and supervisory personnel and their vehicles and other job site costs, plus all office overhead costs; plus

v) The cost of rental of PLANT for the hours worked, at locally-accepted rates, or at provincial or territorial rates, for complete units including operator, fuel, grease, maintenance and all such other costs as are normal to an operating unit on the job site; plus

vi) A 10% markup on item v) to the CONTRACTOR (but not to a Subcontractor) provided that the CONTRACTOR does not own the equipment; plus

vii) Valid transportation costs for PLANT, specifically required for the change in the work, with no markup.

The choice of valuation methods a), b) or c) shall be made by the OWNER in his sole discretion.

.4 When the change in THE WORK is being done on a cost basis, that is, options b) or c), the CONTRACTOR shall be paid for work performed by his Subcontractors on the basis of a valuation in accordance with b) or c), depending upon which was selected by the OWNER for the change in THE WORK. The CONTRACTOR shall be allowed a markup

of 10% on the SUBCONTRACTOR'S charges to cover the CONTRACTOR'S coordination.

.5 When a change in THE WORK is being done on a cost basis, either option b) or c), the CONTRACTOR shall submit to the ENGINEER or the OWNER on a daily basis an accounting in triplicate for work done on the preceding calendar day. The accounting shall include a listing of the hours of labour and PLANT and a listing of the MATERIAL and PRODUCT used. The ENGINEER shall, each day, check the CONTRACTOR'S accounting and, if it is numerically correct, he shall sign the three copies and return one signed copy to the CONTRACTOR. Only those items which are eligible in accordance with the CONTRACT shall be certified for payment by a CHANGE ORDER. The ENGINEER's signature shall not constitute an approval for payment.

.6 If, on any day, the CONTRACTOR fails to submit an account of the change in THE WORK being done on a cost basis, either option b) or c), the ENGINEER shall prepare the accounting, and this accounting shall be used as the basis of payment for that portion of the change in THE WORK, and no payment will be made for any other amount subsequently claimed by the CONTRACTOR for that portion of the change in THE WORK.

18. Payments

.1 At the end of each month during the performance of THE WORK, the CONTRACTOR shall prepare a Progress Payment Claim for that portion of THE WORK done during that month.

A holdback of 10% of the total value of that portion of THE WORK performed to the end of that month, as shown on the Progress Payment Claim, shall be retained for various purposes of the OWNER, including conformance with the lien enactment, along with any other deductions from the Progress Payment Claim which may be warranted or may be required in accordance with conditions of this CONTRACT.

.2 The Progress Payment Claim shall be certified by the ENGINEER on the PROGRESS PAYMENT CERTIFICATE. Provided that the CONTRACTOR has submitted his Progress Payment Claim by the end of the month, the PROGRESS PAYMENT CERTIFICATE shall be submitted to the OWNER within seven (7) calendar days after the end of the month during which that portion of THE WORK covered by the PROGRESS PAYMENT CERTIFICATE was performed.

.3 Within 45 calendar days after receipt of the PROGRESS PAYMENT CERTIFICATE the OWNER shall make payment to the CONTRACTOR in the amount certified on the PROGRESS PAYMENT CERTIFICATE, provided there are no valid reasons for withholding payment.

.4 The OWNER may withhold payment on any PROGRESS PAYMENT CERTIFICATE as may be necessary or prudent to protect himself from loss on account of:

a) Unsatisfactory progress by the CONTRACTOR;

b) Defective work which is not remedied;

c) Claims filed, or reasonable expectation that claims will be filed, against the OWNER or the CONTRACTOR;

d) The failure of the CONTRACTOR to make payments properly to SUBCONTRACTORS or for MATERIAL, PRODUCT, PLANT and labour, or otherwise;

e) Damages caused by the CONTRACTOR to an OTHER CONTRACTOR;

f) Any other evidence of loss or danger of loss by the OWNER, on account of the CONTRACTOR'S operations.

When the grounds are removed, payment shall be made of accounts withheld because of them.

.5 In the event that THE WORK has been nearly completed, but minor items remain uncompleted and deficiencies have not all been rectified, the OWNER may withhold payment on PROGRESS PAYMENT CERTIFICATES in amounts sufficient, in the estimation of the ENGINEER, to ensure that the CONTRACTOR will complete such items and rectify such deficiencies in a timely manner. When the deficiencies have been rectified, the deficiency holdback applied shall be released.

.6 The holdback in total shall be retained until FINAL PAYMENT is made and the holdback shall be released after the FINAL PAYMENT is made.

.7 The holdback shall be released by the OWNER to the CONTRACTOR after the following conditions have been met:

a) The ENGINEER has issued a CONSTRUCTION COMPLETION CERTIFICATE.

b) The CONTRACTOR has filed with the ENGINEER a certification from the Workers' Compensation Board, stating that all assessments due to them from the CONTRACTOR have been paid.

c) The CONTRACTOR has filed with the ENGINEER a statutory declaration that:

> With exception of holdbacks retained by the OWNER, all claims for payment of MATERIAL, PRODUCT, PLANT and labour incurred by the CONTRACTOR directly or indirectly on account of THE WORK have been paid and no lien exists against the premises in respect of anything done or furnished under this CONTRACT; all claims and demands for payment in connection with this CONTRACT have been submitted and approved, thus establishing the final CONTRACT PRICE, and the amount of the FINAL PAYMENT.

This statutory declaration shall be dated no sooner than five (5) days after expiry of the latest Statutory Limitation Period for filing liens, applicable in the jurisdiction where THE WORK has been performed.

.8 FINAL PAYMENT and holdback release do not constitute a waiver of the WARRANTY PERIOD, nor shall they or attendant acts of the ENGINEER or the OWNER prejudice their rights under any requirement of the CONTRACT, nor relieve the CONTRACTOR of any of his responsibilities thereunder.

19. Construction Completion Certificate

.1 Upon receipt of Written Notice from the CONTRACTOR that THE WORK is complete, that all deficiencies have been rectified, and all cleanup finished, the ENGINEER shall make an inspection, and when he finds THE WORK complete under the CONTRACT, he shall issue the CONSTRUCTION COMPLETION CERTIFICATE over his signature and the date specified in this Certificate shall be the date of commencement of the WARRANTY PERIOD.

.2 If, upon inspection, the ENGINEER determines that THE WORK is not completed, he shall instruct the CONTRACTOR, and issue a list of work items to be done, of cleanup items remaining, and of deficiencies to be rectified and when these have been done, he shall issue to the CONTRACTOR, the CONSTRUCTION COMPLETION CERTIFICATE, and the date specified in this Certificate, shall be the date of commencement of the WARRANTY PERIOD. The issuance of the CONSTRUCTION COMPLETION CERTIFICATE does not release the CONTRACTOR from his responsibilities under the CONTRACT.

20. Final Certificate

.1 Upon the expiration of the WARRANTY PERIOD, the successful conclusion of any tests required by the CONTRACT and satisfactory performance under operating conditions meeting THE WORK performance Warranty, the OWNER shall accept THE WORK and a FINAL CERTIFICATE may be issued if required by the CONTRACTOR. It shall be the responsibility of the CONTRACTOR to apply in writing to the ENGINEER for a FINAL CERTIFICATE.

.2 The issuance of a FINAL CERTIFICATE shall not release the CONTRACTOR from responsibility for any defects in his work, PRODUCT or MATERIAL for which the CONTRACTOR may in future be found liable in a court of law or otherwise.

21. Taxes and Duties

.1 The CONTRACTOR shall pay all government sales taxes, customs duties and excise taxes and comply with laws, Acts, and regulations for collection and remittance of taxes with respect to the CONTRACT.

.2 Where an exemption of government sales taxes, customs duties or excise taxes is applicable to the CONTRACT by way of the CONTRACTOR filing claims for, or cooperating fully with the OWNER and the proper authorities in seeking to obtain such refunds, the procedure shall be established in a Supplementary General Condition.

.3 The Federal Goods and Services Tax (GST) or the Harmonized Sales Tax (HST) is included in the TENDER PRICE and in the CONTRACT PRICE.

The CONTRACTOR shall show separately on each Progress Payment Claim the amount of GST or HST required by the Act for the total amount of the Progress Payment Claim before Holdback deduction. GST or HST on the net amount of payment after Holdback deduction will be paid to the CONTRACTOR by the OWNER in addition to the Net payment of each Progress Payment Claim.

GST or HST applicable to the Holdback will be paid to the CONTRACTOR upon release of the Holdback. The CONTRACTOR shall remit the GST or HST in accordance with the Act.

22. Patent Fees

.1 The CONTRACTOR shall pay all royalties and patent license fees required for the performance of the CONTRACT. He shall hold the OWNER harmless from and against all 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 any patent of invention, by the CONTRACTOR, or anyone for whose acts it may be liable.

.2 In the event that the CONTRACTOR claims that, during the performance of THE WORK, he has encountered a claim for a patent license fee, for use of a MATERIAL, PRODUCT, process or method which was specified by the ENGINEER, and that he was not previously aware that use of such MATERIAL, PRODUCT, process or method was restricted under patent, or that a patent license fee was required, he shall immediately notify the OWNER, in writing, setting out the details of such claim and evidence of his previous lack of awareness of such license fee being required. The ENGINEER shall immediately investigate the claim and if it is judged valid, and the MATERIAL, PRODUCT, process or method is used, the OWNER shall pay the patent license fee.

23. Laws, Regulations, Surveys and Permits

.1 The Laws and Regulations of the place where THE WORK is performed shall govern.

.2 The OWNER shall provide all legal surveys except legal surveys required to replace survey pins destroyed or damaged by the CONTRACTOR.

.3 The CONTRACTOR shall obtain all Permits, Licenses and Certificates, and pay all fees required for the performance of THE WORK.

.4 The OWNER shall obtain all easements and rights-of-way, and the CONTRACTOR shall have free use thereof for the purposes of this CONTRACT, provided that such use shall not interfere with or impede the operation of any OTHER CONTRACTORS or workmen employed by the OWNER, nor be in conflict with conditions of easement agreement or right-of-way limits. The CONTRACTOR shall indemnify and defend the OWNER against any claims, demands, or losses due to failure to meet all conditions of an easement agreement.

.5 The CONTRACTOR shall give all required notices, and comply with all laws, ordinances, regulations, codes and orders of all authorities having jurisdiction relating to THE WORK, to preservation of public health, and to construction safety. If the

CONTRACTOR observes anything in the CONTRACT DOCUMENTS to be at variance with the foregoing, he shall promptly notify the ENGINEER in writing, and shall await the ENGINEER'S instructions. If the CONTRACTOR performs any work, knowing it to be contrary to such laws, ordinances, regulations, codes or orders, and without giving notice to and requesting instructions from the ENGINEER, he shall bear all costs arising therefrom.

.6 The CONTRACTOR shall make all arrangements with local authorities, operating departments, railway and highway officials, utility and service companies and the like, for detours, crossings, traffic control and similar requirements relating to performance of THE WORK, and he shall at his own cost observe their requirements and regulations.

24. Compliance With Occupational Health and Safety Enactments

.1 The CONTRACTOR shall be primarily responsible for ensuring compliance with the applicable Occupational Health and Safety enactment and Regulations thereunder on the WORKSITE.

.2 In any case where, pursuant to the provisions of the applicable Occupational Health and Safety Act or its Regulations, an order is given to the CONTRACTOR or to one of his SUBCONTRACTORS with respect to their operations under this CONTRACT to cease operations for any reason (for examples, because of failure to install or adopt safety devices or appliances or methods as directed or required by the Act or Regulations thereunder, or because conditions of immediate danger exist that would be likely to result in injury to any person), the CONTRACTOR shall immediately obey such order and shall immediately take whatever steps are necessary to eliminate the cause of the order.

.3 In the event that the ENGINEER discovers a dangerous condition which in the ENGINEER’s opinion is likely to result in injury to any person, and there is no one in authority from the CONTRACTOR available or capable of removing the danger resultant from the CONTRACTOR'S operations, and no Officer of the Crown is available to take charge, then the ENGINEER may:

a) issue a Field Order to the CONTRACTOR’s workers to vacate the area of danger;

b) issue a Field Order to the CONTRACTOR requiring the immediate correction of the dangerous condition; and

c) notify the appropriate Officer(s) under the applicable Occupational Health and Safety Act,

and no such action by the ENGINEER shall in any way remove the responsibility for the matter from the CONTRACTOR, and the CONTRACTOR shall bear all related costs without recourse.

.4 In the event that the ENGINEER discovers a dangerous condition which in the ENGINEER’s opinion is likely to result in damage to any property, and there is no one in authority from the CONTRACTOR available or capable of removing the danger resultant from the CONTRACTOR'S operations, and no Officer of the Crown is available to take

charge, then the ENGINEER may issue Written Notice to the CONTRACTOR and may immediately arrange for the removal of this danger and the CONTRACTOR shall be liable for the costs of such arrangements, but such act by the ENGINEER shall not relieve the CONTRACTOR of responsibility for injury, loss of life, or damage which may occur in that situation. The ENGINEER may also invoke Section 27.5 of this Specification.

.5 In the event that the CONTRACTOR refuses or fails to comply with an order under the Act or Regulations thereunder, so that the performance of THE WORK is stopped, the OWNER may, upon written notice, terminate the CONTRACT and proceed in accordance with General Conditions 13.2.

.6 No action or lack of action by the ENGINEER or the OWNER under any of the provisions of this Section shall relieve the CONTRACTOR of his responsibilities under 24.1 above.

25. Liability Insurance

.1 Comprehensive General Liability Insurance

a) The CONTRACTOR shall provide and maintain, either by way of a separate policy or by an endorsement to its existing policy, Comprehensive General Liability Insurance in a form and with an insurer acceptable to the OWNER and subject to limits of not less than five million dollars ($5,000,000) inclusive per occurrence for bodily injury, death, and damage to property including loss of use thereof.

b) The insurance shall be in the joint names of the CONTRACTOR, the OWNER and the ENGINEER, and shall also cover as Unnamed Insureds all SUBCONTRACTORS and anyone employed directly or indirectly by the CONTRACTOR or his SUBCONTRACTORS to perform a part or parts of THE WORK and including suppliers while on the WORKSITE to deliver MATERIAL or PRODUCT.

c) The insurance shall also include as Unnamed Insureds the consultants of the OWNER and of the ENGINEER, on THE WORK.

d) The Comprehensive General Liability Insurance shall include coverage for:

1) premises and operations liability
2) products or completed operations liability
3) blanket contractual liability
4) cross liability
5) elevator and hoist liability, as applicable
6) contingent employer's liability
7) personal injury liability arising of false arrest, detention or imprisonment or malicious prosecution, libel, slander or defamation of character; invasion of privacy, wrongful eviction or wrongful entry.

8) shoring, blasting, excavating, underpinning, demolition, pile driving and caisson work, work below ground surface, tunnelling and grading, as applicable.
9) liability with respect to non-owned licensed vehicles.

e) Comprehensive General Liability Insurance shall remain in effect continuously until the Construction Completion Certificate has been issued and then a Completed Operation Extension for 24 months shall be provided by the CONTRACTOR.

.2 Automobile Liability Insurance

a) The CONTRACTOR shall provide and maintain liability insurance in respect of owned, non-owned and leased or rented licensed vehicles, aircraft or water craft, subject to limits of not less than three million dollars ($3,000,000) inclusive.

b) Automobile liability insurance shall be maintained continuously until the end of the WARRANTY PERIOD.

.3 The CONTRACTOR shall provide the OWNER with three certified copies of the Certificate of Insurance prior to the commencement of THE WORK and shall promptly provide the OWNER with a certified true copy of each insurance policy if requested.

.4 All liability insurance policies shall contain an endorsement to provide all Named Insureds with prior notice of material changes and cancellations. Such endorsement shall be in the following form:

"It is understood and agreed that the coverage provided by this policy will not be changed or amended materially nor cancelled until 30 days after written notice of such change or cancellation shall have been given to all Named Insureds."

26. Property Insurance (Course of Construction Insurance)

.1 The CONTRACTOR shall provide and maintain property (course of construction) insurance in a form and by an insurer acceptable to the OWNER, insuring the full value of THE WORK in the amount of the CONTRACT PRICE. The policies shall include as named insureds the CONTRACTOR, the OWNER, and the ENGINEER. The policies shall also include as unnamed insureds all SUBCONTRACTORS and the OWNER'S and the ENGINEER'S consultants on THE WORK.

.2 Such coverage shall be provided for by a standard All Risks Builders' Risk Policy, including flood and earthquake and with only the following exclusions:

a) Any loss of use or occupancy howsoever caused;
b) Penalties for non-completion of or delay in completion of contract or non-compliance with contract conditions;
c) Cost of making good faulty or defective workmanship, material, construction or design, but this exclusion shall not apply to damage resulting from such faulty or defective workmanship, material, construction or design;

d) Wear and tear, normal upkeep, inherent vice, latent defect, vermin or normal making good, but this exclusion shall not apply to damage resulting from wear and tear, normal upkeep, inherent vice, latent defect, vermin or normal making good;
e) Loss or damage caused by war, invasion, act of foreign enemy, hostilities (whether war be declared or not), civil war, rebellion, revolution, insurrection or military power;
f) Loss or damage caused by contamination by radioactive materials;
g) Loss or damage caused by frost or freezing caused by natural forces unless resulting from a peril insured hereunder;
h) Mysterious disappearance of property (except property in the custody of carriers or bailees for hire) or shortage disclosed by taking inventory;
i) Mechanical breakdown, but this exclusion shall not be deemed to exclude loss or damage arising as a consequence of mechanical breakdown;
j) Infidelity of the Insured's employees.

.3 The policies shall insure against all risks of direct loss or damage, and damage or loss due to delayed start-up, or due to delay in beneficial use in the amount of $100,000.

.4 Property Insurance shall cover:

a) All PRODUCT, MATERIAL, labour and supplies of any nature whatsoever, the property of the Insureds or of others for which the Insureds may have assumed responsibility, to be used in or pertaining to the site preparations, demolition of existing structures, erection and/or fabrication and/or reconstruction and/or repair of THE WORK while on the site or in transit;
b) The installation, testing and any subsequent use of machinery and equipment including boilers, pressure vessels or vessels under vacuum related to THE WORK;
c) Damage to THE WORK caused by an accident to and/or the explosion of any boiler(s) or pressure vessel(s) forming part of THE WORK.

Such coverage shall exclude construction machinery, equipment, temporary structural and other temporary facilities, tools and supplies used in the construction of THE WORK.

.5 The CONTRACTOR shall provide the OWNER with three certified copies of the Certificate of Insurance to be incorporated, as Document 00650, into the signed copies of the CONTRACT DOCUMENT prior to commencement of THE WORK and shall promptly provide the OWNER with a certified true copy of each insurance policy if requested.

Policies provided shall contain an endorsement to provide all Named Insureds with prior notice of changes and cancellations. Such endorsement shall be in the following form:

"It is understood and agreed that the coverage provided by this policy will not be changed or amended in any way nor cancelled until 30 days after written notice of such change or cancellation shall have been given to all Named Insureds."

.6 All such insurance shall be maintained continuously until ten (10) days after the date of the Construction Completion Certificate. All such insurance shall provide for the OWNER to take occupancy of THE WORK or any part thereof during the term of this insurance. Any increase in the cost of this insurance arising out of such occupancy shall be at the OWNER'S expense.

.7 The policies shall provide that, in the event of a loss, payment for damage to THE WORK shall be made to the OWNER and the CONTRACTOR as their respective interests may appear. The CONTRACTOR shall act on behalf of the OWNER and himself for the purpose of adjusting the amount of such loss with the Insurers. On the determination of the extent of the loss, the CONTRACTOR shall immediately proceed to restore THE WORK and shall be entitled to receive from the OWNER (in addition to any sum due under the CONTRACT) the amount at which the OWNER'S interest in the restoration THE WORK has been appraised, such amount to be paid as the restoration proceeds and in accordance with the ENGINEER'S certificates for payment. 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 time for Completion of THE WORK as the ENGINEER may determine in the first instance and subject to General Condition 11.5.

.8 The CONTRACTOR and SUBCONTRACTORS as may be applicable shall be responsible for any deductible amounts under the policies and for providing such additional insurance as may be required to protect them against loss on items excluded from the policies.

27. Protection of Work and Property

.1 The CONTRACTOR shall continuously maintain adequate protection of all of THE WORK from damage, and protect the OWNER'S property from damage or loss arising in connection with this CONTRACT. He shall make good any such damage or loss.

.2 The CONTRACTOR shall provide and maintain all passageways, guard fences, lights and other facilities for protection required by public authority or local conditions, or laws and regulations.

.3 The CONTRACTOR shall also protect all of the property outside of THE WORK from damage as a result of his operations. Any such damage shall be corrected by the CONTRACTOR at his expense.

.4 In an emergency affecting the safety of life, or of THE WORK, or adjoining property, the CONTRACTOR, without special instruction or authorization from the ENGINEER, shall act at his discretion to prevent such threatened loss or injury. Liability for payment for such action and the amount thereof shall be determined in the first instance by the ENGINEER.

.5 If the ENGINEER becomes aware of an emergency affecting the safety of life, or of THE WORK, or of adjoining property, and the CONTRACTOR, having been advised in writing of the emergency, fails or refuses to act to prevent such threatened loss, injury or damage, or if the ENGINEER is unable to advise the CONTRACTOR, the ENGINEER

may order labour, material, and PLANT to be applied to prevent loss, injury or damage. The cost of labour, materials and equipment so used shall be the responsibility of the CONTRACTOR, and such action by the ENGINEER shall not relieve the CONTRACTOR of any responsibility for loss, injury, or damage which does occur.

28. Warranty Period

.1 The WARRANTY PERIOD shall begin on the date specified in the CONSTRUCTION COMPLETION CERTIFICATE.

.2 The duration of the WARRANTY PERIOD shall be a minimum of one year.

.3 The CONTRACTOR shall correct, at his own expense, any defects in THE WORK due to faulty products or workmanship appearing within the WARRANTY PERIOD.

.4 The CONTRACTOR shall correct or pay for any damage to THE WORK or other property resulting from such defects or their correction.

.5 The OWNER shall notify the CONTRACTOR promptly of such defects. If the CONTRACTOR does not cause repairs to be made within ten (10) days after such notice, the OWNER shall have the right to purchase MATERIAL and employ men to execute said repairs, and the cost of the same shall be the responsibility of the CONTRACTOR or his Surety.

.6 Where repairs must be made immediately by reason of an emergency existing or otherwise, the OWNER shall have the right to undertake such repairs and charge the cost to the CONTRACTOR, except that the OWNER shall immediately notify the CONTRACTOR and shall withdraw from the work of repair if and as soon as the CONTRACTOR'S forces are ready to start work.

.7 The CONTRACTOR shall be responsible for all costs attributable to defective work, PRODUCT or MATERIAL, including the cost of engineering required for investigation of any repair of defects in THE WORK.

.8 At least one month prior to expiry of the WARRANTY PERIOD, the OWNER shall notify the CONTRACTOR in writing of any final tests which the CONTRACTOR may be required to carry out under the CONTRACT. The CONTRACTOR shall arrange to have such tests carried out promptly, and to provide opportunity for the OWNER to inspect or supervise such tests.

.9 At least one month prior to expiry of the WARRANTY PERIOD, the OWNER shall advise the CONTRACTOR of defects which the CONTRACTOR is required to remedy under the CONTRACT, and the CONTRACTOR shall promptly remedy such defects. The WARRANTY PERIOD shall not expire until all such defects are remedied.

29. Inspection of the Work

.1 The ENGINEER and his representatives shall at all times have access to THE WORK whenever it is in preparation or progress and the CONTRACTOR shall provide proper

facilities for such access and for inspection. The ENGINEER shall have authority to reject work which does not conform to the requirements of the CONTRACT.

.2 If the specifications, the ENGINEER'S instructions, laws, ordinances, or any public authority require any part of THE WORK to be specially tested or approved, the CONTRACTOR shall give the ENGINEER timely notice of his readiness for inspection, and if the inspection is by an authority other than the ENGINEER, of the date fixed for such inspection.

.3 Inspections by the ENGINEER shall be made promptly. If any part of THE WORK should be covered up without approval or consent of the ENGINEER, it must, if required by the ENGINEER, be uncovered for examination at the CONTRACTOR'S expense.

.4 Re-examination of questioned parts of THE WORK may be ordered by the ENGINEER and if so ordered those parts of THE WORK shall be uncovered by the CONTRACTOR. If such parts of THE WORK are found not in accordance with the CONTRACT DOCUMENTS through the fault of the CONTRACTOR, the CONTRACTOR shall pay the cost of examination and replacement of THE WORK. If such parts of THE WORK are found in accordance with the CONTRACT DOCUMENTS, the OWNER shall pay these costs.

.5 MATERIAL and PRODUCT to be used in THE WORK are subject to inspection and approval of the ENGINEER at his discretion. MATERIAL and PRODUCT condemned as being unsuitable and not in conformity with the specifications, shall be removed from THE WORK and its vicinity without delay, and if the CONTRACTOR fails to do so within forty-eight (48) hours after having been so directed by the ENGINEER, the rejected MATERIAL and PRODUCT may be destroyed or removed by the OWNER and the cost shall be charged to the CONTRACTOR.

.6 The ENGINEER shall inspect THE WORK in the OWNER'S interest for the purpose of promoting effective completion of THE WORK until the CONSTRUCTION COMPLETION CERTIFICATE is issued, and such inspection or lack of it shall not relieve the CONTRACTOR of his responsibility to perform THE WORK in accordance with the CONTRACT.

30. Rejected Work

.1 Defective Work which has been rejected by the ENGINEER as failing to conform to the intent of design as expressed in the CONTRACT DOCUMENTS whether the result of poor workmanship, use of defective MATERIAL or PRODUCT, or damage through carelessness or other act or omission of the CONTRACTOR, and whether incorporated in THE WORK or not, shall be removed promptly from the premises by the CONTRACTOR and replaced or re-executed promptly at the CONTRACTOR'S expense.

Work that has not been rejected specifically by the ENGINEER shall not therefore be deemed accepted or approved by the Engineer.

.2 OTHER CONTRACTORS' work destroyed or damaged by such removals or replacements shall be made good promptly at the CONTRACTOR'S expense.

.3 If in the opinion of the ENGINEER it is not expedient to correct defective Work or Work not done in accordance with the intent of design as expressed in the CONTRACT DOCUMENTS, the OWNER may deduct from the CONTRACT PRICE the difference in value between THE WORK as done and that called for by the CONTRACT. The difference shall be determined in the first instance by the ENGINEER.

31. Labour

.1 The CONTRACTOR shall employ Canadian Labour to the fullest practical extent and shall ensure that no person will be discriminated against because of race, colour, gender, age, religion, or origin.

.2 Wages and hours of labour shall be in compliance with Federal, Provincial or Territorial enactment, whichever governs.

.3 The CONTRACTOR shall at all times enforce discipline and good order among his employees, and shall not employ on THE WORK any unfit person or anyone not skilled to do THE WORK assigned to him. Any person employed on THE WORK who becomes intoxicated, intemperate, disorderly, incompetent or willfully negligent, shall be removed from THE WORK.

32. Material and Product Supplied by the Contractor

.1 The CONTRACTOR shall use MATERIAL and PRODUCT of Canadian manufacture to the fullest extent practicable.

.2 Unless otherwise specified, all MATERIAL and PRODUCT shall be new and of good quality. The CONTRACTOR shall furnish satisfactory evidence as to the kind and quality of MATERIAL and PRODUCT. The CONTRACTOR shall be responsible for replacement at his own cost of all MATERIAL and PRODUCT that are found to be defective in manufacture or that have become damaged in handling.

.3 The CONTRACTOR shall be responsible for the safe storage of MATERIAL and PRODUCT furnished by or to him, and accepted by him, and intended for THE WORK, until it has been incorporated into THE WORK.

.4 Where, in the specifications or on the drawings, any MATERIAL, PRODUCT or method is specified, the CONTRACTOR may not use another MATERIAL, PRODUCT, equipment or method unless the ENGINEER has issued to the CONTRACTOR a written authorization for the use. The CONTRACTOR shall submit in writing an application for review to the ENGINEER. All submissions shall be accompanied by sufficient data including the following:

a) Delivery
b) Manufacture
c) Technical Data and Specifications in accordance with the International System of Units (S.I.) - metric units
d) Specified MATERIAL, PRODUCT or method for which the alternative is submitted
e) Prices in relation to the MATERIAL; method or PRODUCT specified originally.

Where required by the ENGINEER, samples shall be submitted.

.5 Whenever alternatives of MATERIAL, PRODUCT or methods are accepted for THE WORK, whether as a result of an alternative Proposal by the CONTRACTOR or an equivalent alternative submitted by the CONTRACTOR, the CONTRACTOR shall guarantee that the performance of the alternative MATERIAL, PRODUCT, or method shall be equivalent to what was originally specified.

.6 Whenever alternatives of MATERIAL, PRODUCT or methods are accepted for use on THE WORK, whether as a result of an alternative proposal by the CONTRACTOR or an equivalent alternative submitted by the CONTRACTOR, the CONTRACTOR shall be responsible for making all consequent adjustments, at his own expense, to make the alternative fit into THE WORK as specified.

33. Material and Product Supplied by the Owner

.1 The OWNER undertakes to supply only such MATERIAL or PRODUCT as are specifically shown in the CONTRACT DOCUMENTS as being provided by the OWNER.

.2 It shall be the responsibility of the CONTRACTOR to arrange for and schedule delivery and storage of MATERIAL and PRODUCT supplied by the OWNER.

.3 The CONTRACTOR'S responsibility for MATERIAL and PRODUCT furnished by the OWNER shall begin at the time and place of delivery thereof to the CONTRACTOR. MATERIAL and PRODUCT already on the site shall become the CONTRACTOR'S responsibility on the date specified in the Notice to Proceed. The CONTRACTOR shall be responsible for unloading all OWNER-supplied MATERIAL and PRODUCT and the CONTRACTOR and the ENGINEER shall jointly examine them at the time and place of delivery to the CONTRACTOR, and shall prepare a statement of acceptance, specifically noting any defects and rejecting any defective MATERIAL or PRODUCT. The CONTRACTOR shall sign a Statement of Acceptance of MATERIAL and PRODUCT when accepting them into his charge. Any MATERIAL and PRODUCT furnished by the OWNER and installed by the CONTRACTOR shall, if found defective, be replaced by the CONTRACTOR. The CONTRACTOR, shall, at his own expense, furnish supplies, labour and facilities necessary to remove the defective MATERIAL and PRODUCT and install the sound MATERIAL and PRODUCT in a satisfactory manner.

34. Storage Facilities and Use of Premises

.1 The CONTRACTOR may use such facilities and areas as the OWNER may be willing and able to designate for the storage of MATERIAL and PRODUCT for THE WORK, without charge to the CONTRACTOR.

.2 Should the CONTRACTOR require additional facilities or areas he shall make all the necessary arrangements with the owners or occupants of such other facilities or areas and shall pay all rentals and all damages caused by such occupancy.

.3 The CONTRACTOR shall confine his apparatus, the storage of MATERIAL and PRODUCT and the operations of his workmen to limits indicated by law, ordinances,

permits or directions of the ENGINEER and shall not unreasonably encumber the premises with his MATERIAL, PRODUCT or PLANT.

.4 The CONTRACTOR shall enforce all regulations and rules for the WORKSITE regarding signs, advertisements, fires, smoking, and storage of inflammable MATERIAL or PRODUCT, and disposal of wastes.

.5 The CONTRACTOR shall not load or permit any part of THE WORK or of the OWNER'S structures to be loaded in any way that will endanger their safety.

35. Use of Completed Portions of the Work

.1 The OWNER shall have the right to take possession of and use any completed or partially completed portions of THE WORK, notwithstanding that the time for completing THE WORK or such portions of THE WORK may not have expired; but such taking possession of and use shall not be deemed an acceptance of THE WORK.

.2 If such prior use increases the cost of THE WORK, the CONTRACTOR shall be entitled to such compensation as the ENGINEER in the first instance may determine.

.3 If a planned taking possession of and use of portions of THE WORK has been stipulated in the CONTRACT DOCUMENTS, then the CONTRACTOR shall have no claim for extra compensation on that account.

36. Cleanup and Final Cleaning of the Work

.1 The CONTRACTOR shall maintain THE WORK in a tidy condition, free from accumulation of waste products and debris caused by his own operations.

.2 When THE WORK is fully completed, the CONTRACTOR shall remove all surplus MATERIAL and PRODUCT, tools and PLANT. He shall also remove any waste products and debris, other than those caused by the OWNER, OTHER CONTRACTORS or their employees. He shall generally leave the WORKSITE in a neat and orderly condition.

37. Remedies

.1 The specific remedies to which the CONTRACTOR and the OWNER may resort under the terms of the CONTRACT DOCUMENTS are cumulative and are not intended to be exclusive of any other remedies to which the CONTRACTOR and the OWNER may be lawfully entitled in a case of breach or threatened breach of any covenant, term or provision of the CONTRACT.

.2 The waiver by the OWNER or ENGINEER of any breach of any covenant or warrant in the CONTRACT shall not be construed as a waiver of any future breach of the same terms of the Contract, and the approval by the OWNER or ENGINEER of any act by the CONTRACTOR or SUBCONTRACTOR shall not be construed as an approval to any subsequent similar acts by the CONTRACTOR or SUBCONTRACTOR.

END OF DOCUMENT 00700

1. General

.1 These Supplementary General Conditions modify, delete or add to the General Conditions.

.2 In the event of a conflict between the General Conditions and the Supplementary General Conditions, the Supplementary General Conditions take precedence.

.3 Clauses of the General Conditions which have not been specifically modified shall remain in effect.

2. Article 3 - Drawings and Instructions

.4 Delete Clause 3.1 and substitute with the following:

a) The ENGINEER will furnish to the CONTRACTOR five (5) working copies of the CONTRACT DOCUMENTS. Additional copies of the CONTACT DOCUMENTS, if required by the CONTRACTOR, will be furnished by the ENGINEER at cost.

3. General Condition 5 - The Engineer and the Contractor

.1 Reference Clause 5.1

Delete the second paragraph and replace it with the following:

"The ENGINEER shall provide only general engineering services for THE WORK, including periodic visits to the WORKSITE to observe the progress of THE WORK and general conformance to the intent of the design."

.2 Reference Clause 5.8

Add the following paragraph.

"The CONTRACTOR shall designate, in writing, a CONTRACTOR'S PROJECT MANAGER who shall have authority to issue QUOTATIONS for CONTEMPLATED CHANGE, sign CHANGE ORDERS, attend meetings on and off the WORKSITE, give instructions to the CONTRACTORS SUPERINTENDENT all on behalf of the CONTRACTOR and generally represent the CONTRACTOR with respect to the CONTRACT."

4. General Condition 10 – Dispute Resolution

.1 Add to clause 10.1

"The OWNER shall make the final decisions on interpretations regarding time extension, extra payments and liquidated damages."

5. General Condition 11 - Delays

.1 After Paragraph 11.6, ADD Paragraph 11.7:

.7 Impact Delays are those delays that arise out of the OWNER'S requirement of the CONTRACTOR to perform CHANGES IN THE WORK.

Impact delays may be a) certain to occur, b) foreseeable, but not certain to occur, or c) not foreseeable. At the time of submitting a QUOTATION FOR CONTEMPLATED CHANGE, the CONTRACTOR shall identify his intention, if any, to claim for Impact Delays, and provide justification for such claims or intentions to claim so that these can be negotiated and agreed upon in the CHANGE ORDER.

No claim for Impact Delays shall be valid or enforceable except as provided for in a CHANGE ORDER."

6. General Condition 16 - Changes in the Work

.1 Reference Clause 16.3

Delete this clause and substitute the following:

".3 The ENGINEER shall have no authority to issue CHANGE ORDERS without prior approval by the OWNER. The OWNER and the CONTRACTOR shall approve and sign every CHANGE ORDER prior to payment."

.2 Delete 16.7 and substitute:

".7 Impact costs are those costs and delays which arise from the OWNER'S requirement of the CONTRACTOR to perform CHANGES IN THE WORK, and which impact on performance of other parts of the WORK as originally specified.

.1 At the time that the CONTRACTOR submits a QUOTATION FOR CONTEMPLATED CHANGE, there may be expected Impact costs which are certain to occur if the CHANGES IN THE WORK are performed. Such costs shall be stated separately in the CONTRACTOR'S QUOTATION FOR CONTEMPLATED CHANGE with justification of their validity and quantum, so that the OWNER can accept, reject or negotiate their inclusion in a CHANGE ORDER.

.2 There may be expected some impact costs which have some probability of occurring, but not a certainty. In the QUOTATION

FOR CONTEMPLATED CHANGE, the CONTRACTOR shall describe such impacts, with justification for the expectation that they may occur, an estimate (if possible) of the probability of occurrence and an estimate of quantum of costs of the impacts.

.3 There may actually occur some impacts which could not have been foreseen at the time of submission of the QUOTATION FOR CONTEMPLATED CHANGE, and the CONTRACTOR shall make reference to that possibility in the QUOTATION FOR CONTEMPLATED CHANGE.

.4 No claim by the CONTRACTOR for additional payment arising from a CHANGE IN THE WORK shall be valid and enforceable against the OWNER unless it is made pursuant to the Provisions of General Condition 16."

.5 The CONTRACTOR in seeking recovery of Impact Cost as defined in General Condition 16 (Supplementary General Condition Document 00816), shall submit weekly accounts to the ENGINEER, justifying its claims in accordance with the requirements of the CHANGE ORDER."

7. General Condition 17 - Valuation of Changes in the Work

.1 After paragraph 17.6, ADD the following:

".7 The CONTRACTOR in seeking recovery of Impact Cost as defined in General Condition 16 (Supplementary General Condition Document 00816), shall submit weekly accounts to the ENGINEER, justifying its claims in accordance with the requirements of the CHANGE ORDER."

.2 Replace all markups in clause 17.3 with a markup of 10%.

8. General Condition 18 - Payments

.1 Reference Clause 18.2 and 18.3

a) Delete Clause 18.2 and REPLACE with the following:

".2 The CONTRACTOR'S Progress Payment Claim shall be reviewed by the ENGINEER based on those selective and intermittent observations he has made during construction of that portion of THE WORK for which payment is claimed. The ENGINEER shall then prepare a Progress Payment Certificate within seven (7) calendar days. The CONTRACTOR shall certify the Progress Payment Claim prior to submittal of the Progress Payment Claim to the OWNER by the ENGINEER."

b) In clause 18.3, DELETE “within 14 calendar days” and replace with “within 28 calendar days".

.2 Reference Clauses 18.6 and 18.7

c) DELETE Clauses 18.6 and 18.7 and REPLACE with a new clause 18.6.

"18.6 The CONTRACTOR may claim the Holdback, either in total, or in increments, in accordance with applicable Lien Act.

The OWNER shall pay the CONTRACTOR'S claim for Holdback release after the following conditions have been satisfied:

i) The CONTRACTOR, or the OWNER, or the ENGINEER on behalf of the OWNER, has issued a Certificate of Completion, or a Certificate of Substantial Completion, in accordance with requirements of the Lien Act.

ii) The CONTRACTOR has submitted to the OWNER, a Certification from the Worker's Compensation Board stating that all assessments due to them from the CONTRACTOR are currently paid up.

iii) The CONTRACTOR has filed with the OWNER, a Statutory Declaration that, with the exception of Holdbacks retained by the OWNER, all payments have been made to eligible Lien claimants and that there are no liens existing against the premises of THE WORK.

The Statutory Declaration shall be dated 5 days after the latest date for filing Liens in accordance with the applicable Lien Act.”

10. General Condition 19 - Construction Completion Certificate

.3 ADD New Clause 19.3

".3 FINAL PAYMENT shall be made on the CONTRACTOR'S Final Progress Payment Claim after the date of the CONSTRUCTION COMPLETION CERTIFICATE and after the following conditions have been satisfied:

a) The CONTRACTOR has submitted to the OWNER a certificate by the Worker's Compensation Board that all assessments due to them from the CONTRACTOR have been paid.

b) The CONTRACTOR has submitted to the OWNER a Statutory Declaration stating that all claims for payment for MATERIAL, PRODUCT, PLANT, and labour incurred by the CONTRACTOR directly or indirectly on account of THE WORK have been paid no liens exist against the premises in respect of anything done or furnished under this CONTRACT, all claims and demands for payment in connection with this CONTRACT have been submitted and approved, thus establishing the final CONTRACT PRICE and the amount of the FINAL PAYMENT.

The Statutory Declaration shall be dated 5 days after expiry of the limitation period for filing liens in the jurisdiction where THE WORK has been performed."

10. General Condition 21 - Taxes And Duties

ADD to Clause 21.1

"a) For those items of PRODUCT and MATERIAL for which the OWNER has an exemption from Federal Sales Tax, the OWNER will provide an Exemption Number and Certification that the PRODUCT and MATERIAL was used in a manner consistent with the requirements for Federal Sales Tax Exemption.

b) The CONTRACTOR may then recover the Federal Sales Tax paid on exempt PRODUCT and MATERIAL under this CONTRACT."

11. General Condition 24 - Compliance With Occupational Health And Safety Act

Add the following clauses:

"24.7 The CONTRACTOR will be assigned the responsibilities and duties of the "Prime Contractor" as defined in the Occupational Health and Safety Act. The Prime Contractor shall, to the extent required by the Occupational Health and Safety Act, establish and maintain a Health and Safety system or process to ensure compliance with the Act and Regulations by all his employees, subcontractors and others on the site.

24.8 The CONTRACTOR shall provide to the ENGINEER a copy of the CONTRACTORS Safety Management Program and Safety Policy. A copy of such manual shall be available for review by the Contractor's employees and subcontractors at all times.

24.9 The CONTRACTOR shall conduct regular safety meetings and shall submit minutes of such meetings to the ENGINEER in a timely manner.

24.10 The CONTRACTOR and all of his subcontractors, shall maintain First Aid personnel and facilities on the job site in accordance with the requirements of the Occupational Health and Safety Act.

24.11 The CONTRACTOR shall, in a timely manner, provide to the ENGINEER copies of all safety inspection reports, incident/accident reports; and any reports, directives or orders received from Alberta Labour.

24.12 The ENGINEER shall have authority to issue orders and instructions orally or in writing, with respect to any matter affecting occupational health and safety on the WORKSITE and the CONTRACTOR, and its SUBCONTRACTORS, SUPPLIERS and PROVIDERS shall carry out and heed such orders and instructions in a timely manner.

24.13 If, in the opinion of the ENGINEER, the CONTRACTOR, or his SUB-CONTRACTORS, SUPPLIERS, or PROVIDERS, fail materially to comply with, carry out or heed the ENGINEER's directions with respect to WORKSITE health and safety, the ENGINEER in his sole discretion may stop THE WORK until assurance of compliance is given in a manner satisfactory to the ENGINEER, OR if the non-compliance persists, the OWNER may terminate the CONTRACT and proceed in accordance with General Condition 13.2.

24.14 Neither the CONTRACTOR nor the OWNER shall have any cause of action, either in contract or in tort, nor bring any action for damages against the ENGINEER arising out of the ENGINEER's Health and Safety Policy for the WORKSITE, or Health and Safety Rules and Procedures Policy for the WORKSITE, or the ENGINEER's orders, or instructions with respect to safety and health or any or all of them."

12. General Condition 25 - Liability Insurance

Refer to Clause 25.1, paragraph b) and add the following:

"The insurance shall also include as Named Insured Town of Blackfalds and Stantec Consulting Ltd.".

13. General Condition 26 - Property Insurance (Course Of Construction Insurance)

Refer to Clause 26.1 and add the following:

"The insurance shall also include as Named Insured Town of Blackfalds and Stantec Consulting Ltd. ".

14. General Condition 28 - Warranty Period

Delete clause 28.2 and replace with:

28.2 The duration of the WARRANTY PERIOD shall be a minimum of two years."

15. General Condition 38 - Construction Schedule

Add General Condition 38 – Construction Schedule as follows:

38.1 The Contractor shall be responsible to determine a construction schedule which will achieve completion of the entire work within 365 calendar days.

16. General Condition 39 – Liquidated Damages

Add General Condition 39 – Liquidated Damages as follows:

"39.1 Should the CONTRACTOR fail to complete the Work under this Contract within the milestone dates specified, the OWNER shall be entitled to make deductions from payments due to the CONTRACTOR to compensate himself for the following:

a) Loss of revenue during the extra time required to complete the Contract, if the completed project is revenue-producing. This loss shall be calculated on the basis of the schedule of water rates established by the OWNER for users of the system.

b) The cost of engineering services and associated expenses incurred during the extra time required to complete the Contract, valued at fifteen hundred dollars ($1,500.00) per day.

END OF DOCUMENT 00800

1. Work Under this Contract

.1 THE WORK under this CONTRACT consists of construction of the McKay Ranch Lift Station for the Town of Blackfalds, hereinafter called the OWNER.

2. Work Included

.1 THE WORK includes, but is not limited to, the following components:

McKay Ranch Lift Station:

a) the construction of a sewage lift station with pumphouse superstructure, associated facilities, and outgoing / incoming sewage main tie-ins as detailed on the design drawings and as specified in the CONTRACT DOCUMENTS.

.2 THE WORK, unless specifically stated otherwise, shall include the furnishing of all MATERIAL, PRODUCT, PLANT, labour and transportation necessary to complete THE WORK. The intent is that the CONTRACTOR provides a complete job.

.3 THE WORK shall not be deemed complete until all components are placed in operation by the CONTRACTOR, and are operating satisfactorily.

.4 Any minor item of THE WORK not called for in the specifications or shown on the drawings but clearly required to meet the intent of design and normally provided for the proper operation of THE WORK shall be provided as if specifically called for in the CONTRACT DOCUMENTS.

3. Work Not Included

.1 The following components of the project are not included in THE WORK under this CONTRACT:

- Grading outside of site limits;
- Concrete sidewalk, curb and gutter, and roadway work on Eastpointe Drive.

4. Documents Required

.1 Maintain at the job site at least one copy of each of the following:

- Contract Drawings
- Specifications
- Addenda
- Change Orders, Field Orders, Notices
- Reviewed Shop Drawings
- Modifications to the Contract
- Field Test Reports

- Construction Schedule
- Manufacturer's Installation and Application Instructions
- Occupational Health and Safety Regulations and Workers' Compensation Board Regulations;

and have readily available any referenced or specified Standards.

5. Specifications

.1 Sentence structure in parts of the specifications is abbreviated, and phrases such as "shall be," and "the Contractor shall" are deliberately omitted. Such sentences shall be read as though they are complete.

.2 The use of the word "PROVIDE" means "supply and install"; or "supply labour and materials for the installation of". It does not mean supply only.

.3 The word "concealed" in connection with piping, electrical work, controls and wherever used in other sections shall mean "hidden from sight" as in ceiling spaces or furred out spaces, and not normally visible to persons in the construction area.

.4 The word "exposed" in connection with piping, electrical work, controls and whenever used in other sections shall mean visible to persons within a building, in normal working areas.

6. Standards

.1 Wherever standards (e.g., CSA, ASTM and others), are referred to in these CONTRACT DOCUMENTS the current edition at the date of closing of TENDERS shall apply.

.2 Where there is a clear conflict between the referenced Standard and the CONTRACT DOCUMENTS, the CONTRACT DOCUMENTS shall apply.

.3 Where there is an ambiguity between a Standard and any term of these CONTRACT DOCUMENTS, the ENGINEER shall, in the first instance, give an interpretation of the intent of the CONTRACT.

END OF SECTION 01010

1. The Worksite

.1 The OWNER will provide the lands as delimited on the Drawings upon which THE WORK is to be constructed.

2. Contractor's Use of the Worksite

.1 The CONTRACTOR shall have exclusive use and control of the WORKSITE, provided that the CONTRACTOR shall permit access to the OWNER, the ENGINEER and OTHER CONTRACTORS on the WORKSITE for purposes of inspections, reviews, tests and carrying out work related to THE WORK.

.2 CONTRACTOR'S use of the WORKSITE for storage is limited to the following areas, as delimited on the Drawing.

.3 The OWNER shall have unfettered use of thoroughfares, streets, lanes and other areas within the WORKSITE until the CONTRACTOR requires those areas for execution of THE WORK, and after the CONTRACTOR has finished the portions of THE WORK in those areas.

.4 Unless otherwise agreed with the OWNER, the CONTRACTOR shall give 48 hours' notice to the OWNER before entering a particular Area of the WORKSITE to execute THE WORK.

.5 Up to the end of the period of Notice and after the CONTRACTOR has fully completed its operations in a particular Area, the OWNER shall have use of the Area and shall be responsible for Health and Safety Requirements and security in that Area.

During the CONTRACTOR'S use of a particular Area of the WORKSITE to execute THE WORK, the CONTRACTOR shall be responsible primarily for security and for ensuring compliance with Health and Safety Regulations.

.6 The CONTRACTOR shall be responsible for access to the WORKSITE by means of temporary roads, tote roads, or agreements with the appropriate authorities to use existing means of access.

END OF SECTION 01015

1.1 General

.1 Include in the Contract Price, cash allowances stated herein. The stated values of all Cash Allowances will be included in the Contract Price by the General Contractor and are not to be added into the amount of any subtrade bid.

.2 The cost of administrating, supervising, and all other overhead, profit and fees relative to any Cash Allowance specified, are to be included by the General Contractor, and are not part of the Cash Allowances.

.3 Include in Cash Allowances, all applicable taxes and duties, excluding GST.

.4 The adjustment to the Contract for Cash Allowance expenditures by the General Contractor will be made on the total balance of all Cash Allowances. If over-expended by more than 15%, an allowance of 5% of the over-expenditure will be added for administration expenses.

.5 If cash allowances are under-expended, the amount of under-expenditure will be a deduction, net, from the current contract sum.

.6 Cash allowances, unless otherwise specified, cover the net cost to the Trade Contractor, of services, products, construction machinery and equipment, freight, delivery, handling, unloading, storage, installation, and other authorized expenses incurred in performing the Work.

.7 The Consultant reserves the right to increase the indicated scope of any cash allowance work, or add work which involves normal subcontract administration, after award of contract.

.8 The Contract price will be adjusted by Change Order to recognize expenditures of Cash Allowances.

.9 Include in the monthly certificate of payment, progress payments on accounts of Work authorized under cash allowances.

.10 Prepare a schedule jointly by the Consultant and the Contractor to show when items called for under cash allowance must be authorized by the Consultant for ordering purposes so that the progress of the Work will not be delayed.

1.2 Performance of Work Covered By Allowances

.1 If not specified, the Consultant will determine by whom and for what amounts Work by allowances will be performed. Allowance break-down is for information only. Final distribution of total allowances may vary.

.2 If not specified, the Consultant will determine the manner in which prices for Work covered by allowances will be obtained.

.3 When requested or specified, assist the Consultant by identifying potential suppliers and Subcontractors and by obtaining prices for work covered by Allowances.

.4 Changes to the structure of the Allowance distribution are at the discretion of the Owner without further compensation.

1.3 Contractor's Responsibilities

.1 Contractor is responsible for Work covered by allowances same as for other Work of this Contract.

.2 On notification in writing of selection of Supplier or Subcontractor by Owner, execute purchase agreement with designated supplier or enter into a subcontract or amend existing Subcontract with designated Subcontractor.

1.4 Prime Cost Sums: Prime Cost Sums have been included in the TENDER for the following items:

.1 Coordination and Payment for Power and Gas Connection $40,000

This work shall payment for the connection service to the power and gas services adjacent to the site. No mark-up will be applied to the connection costs and coordination efforts for this cash allowance are to be accounted for in the Shallow Utilities line item.

.2 SCADA Communications $50,000.00

The prime cost sum for SCADA Communications shall include PLC and HMI programming of the lift station.

.3 The Prime Cost (PC) covers supply or supply/installation of the specified work. Other related Contractor costs (equipment handling, installation, coordination, startup/commissioning, warranty, overhead, profit, and any other incidental costs) shall be included elsewhere in the Tender Price, and no separate payment will be made.

.4 After the general contract has been awarded, the Contractor shall obtain firm quotations from designated vendors/suppliers for the specified work of PC item. Upon receipt of quotations, the Contractor shall submit the quotations complete with technical data to the Engineer for review and selection. The lowest quotation will not necessarily be accepted. The selection will be made in the best interest of the Owner. Upon selection of the vendor and equipment, the Contractor shall purchase the equipment, the vendor’s work or services as required to perform the specified work. The Contractor shall be fully and solely responsible for the equipment supply and installation.

.5 The contractor shall be paid the net invoice (original quotation price) plus 10% markup to cover the Contractor’s costs as described above unless otherwise

noted above.

.6 Payment will be made out of the Prime Cost allowance. If the PC sum is not sufficient to cover the invoices, the Contract Price will be increased, or alternately the additional funds required will be taken from the Contract Contingency Allowance at Owner's discretion. If the PC Sum is greater than that required for the work, the balance of the PC allowance will be credited to the Owner, and the total Contract Price will be decreased accordingly.

END OF SECTION 1021

1. Testing Allowance

.1 The OWNER may retain the services of one or more testing agencies for the purpose of quality assurance. This does not relieve the CONTRACTOR of his sole responsibility for quality control and testing.

.2 The testing agencies retained by the OWNER shall be responsible directly to the OWNER and not to the CONTRACTOR, nor shall the CONTRACTOR have any responsibility for quality or performances of their services.

END OF SECTION 01022

1. GENERAL.1 The CONTRACTOR shall supply all materials required for construction of THE WORK and be responsible for organizing delivery, handling and storage of materials.

2. SPECIAL PROJECT PROCEDURES

.1 The CONTRACTOR shall provide a 24 hour emergency phone number and the name of a person to be contacted in case of any complaints from residents related to the Contractor's work. If the Contractor does not readily respond to the complaint and the customer complaints to the Town, a Town crew will respond and the Contractor will be billed by the Town for the emergency service provided to the customer.

.2 The CONTRACTOR shall not damage trees, plants and shrubs during the course of the Contract except where noted on the drawings. Any damage to trees shall be made good to the original condition or replaced with new trees to the satisfaction of the OWNER.

.3 The cost to temporarily remove, relocate or support any or all utility ducts and lines, and power poles necessitated for the installation of the lift station and gravity trunks will be considered incidental to the Contract and no extra payment will be made unless otherwise shown on drawings or approved by the OWNER.

.4 Excess excavated materials and other wastes shall be disposed off the site at CONTRACTOR'S own expense.

.5 The CONTRACTOR must provide and maintain all required barriers, detour signs, flagpersons, and other precautions to protect the public against accident or injury, and to ensure no passage by unauthorized vehicles. Barricades and signs must meet the requirements of the Manual of Uniform Control Devices as distributed by Transportation Association of Canada, as well as Alberta Transportation Guidelines.

.6 The CONTRACTOR is responsible to provide any crossing agreements, license of occupations, or permits required by regulatory stakeholders, that are not already provided by the Owner. The CONTRACTOR must account for the procurement of these authorizations in their schedule and budget.

.7 The CONTRACTOR is responsible to obtain all Building Schedules, and pay all costs associated with this, in a timely manner to allow issuances of the Building Permit prior to starting the work on-site.

.8 The Contractor is responsible to provide pre-construction photographs and videos of the entire site(s) and all driveways and private property that may be impacted by construction.

3. CONSTRUCTION SPECIFICATIONS

.1 All work and materials for the civil surfacing and underground components must conform to the City of Red Deer Construction Specifications manual unless otherwise specified.

4. PRE-MOBILIZATION REQUIREMENTS

The following items / documents are required prior to the CONTRACTOR mobilization to site. Note that various submittals may take 2 or 3 reviews, and 1-2 weeks is to be allowed for each review, therefore quick action is required immediately upon Notice of Award. No schedule delay or costs will be accepted for delayed mobilization.

.1 Notice of Construction.

.2 Notices to residents delivered.

.3 All Permits will be required by the Town of Blackfalds prior to mobilization and they will require the necessary fees to be paid by the Contractor. The permits include but not limited to the following:

- Temporary Building Permit
- Building Permit
- Utility Installation and Street Occupation Permit
- Haul Permit

.4 The ECO Plan, strictly following the ECO Plan Framework approved by the ENGINEER and OWNER.

.5 Safety Manual, Site Specific Emergency Response Plan and Site Specific Health and Safety Plan approved by the ENGINEER and OWNER.

.6 Traffic Accommodation Strategy approved by the ENGINEER and OWNER.

.7 LOC Agreement

5. WATER TABLE

.1 Historically the ground water levels in the west area have been recorded as above average. Therefore, it is probable that extensive dewatering will be required in some areas for the duration of this project. Refer to Appendix A for Geotechnical log information. Placement of filter fabric and washed rock and possible dewatering will be required.

.2 Check with the soils report and the soils ENGINEER for amounts of ground water which may require pumping.

.3 If conditions are discovered by the CONTRACTOR that varies from those indicated in the documents, notify the ENGINEER.

6. PUBLIC LIAISON

.1 Five working days minimum prior to work commencing on a road the CONTRACTOR shall be responsible for notifying all businesses and residents in writing that work will be commencing on this roadway. Alternate access to businesses and residences shall be provided wherever possible and as determined by the Town of Blackfalds.

7. WARRANTY AND MAINTENANCE

.1 The warranty and maintenance period for all work in this contract is two years from the Construction Completion Certificate. If different the two year warranty noted in this section takes precedence over the warranty noted in the technical specification sections.

8. ENVIRONMENTAL MANAGEMENT

.1 Erosion and Sediment Control

.1 The CONTRACTOR is responsible for all erosion and sediment control for the duration of this project and will be considered incidental to the contract. This includes such items as silt fencing along Alberta Transportation's ditch and storm pond, and interim paving salt and water control to catch basins.

.2 Dust and Noise Control

.1 The CONTRACTOR is responsible for all dust and noise control for the duration of this project and will be considered incidental to the contract.

9. SPECIALIST SITE REVIEWS

.1 Safety – at minimum monthly site reviews are to be performed by the CONTRACTORS qualified safety representative, and a report is to be submitted on a bi-weekly basis. This person is defined as being responsible for the CONTRACTORS safety program. A brief report is to be submitted following each site review.

.2 Environment – at minimum bi-weekly site reviews for every month that civil site work, forcemain work, or road work is being performed, are to be performed by the CONTRACTORS qualified environmental representative, and a report is to be submitted on a bi-weekly basis. This person is defined as being qualified to prepare an ECO Plan document as required by the latest version of the ECO Plan Framework. A brief report is to be submitted following each site review.

.3 These site reviews are considered incidental and no separate payment will be made.

10. CONSTRUCTION STAGING

.1 A construction staging plan is required to be submitted by the CONTRACTOR to the ENGINEER for review and approval prior to commencing the WORK.

.2 Protect existing driveways and provide continuous access to existing adjacent property unless previously arranged with landowners in writing and submitted to ENGINEER for review before disturbance.

11. UTILITY COORDINATION

i. The Contractor shall be responsible for the location and protection of all existing utilities and appurtenances, including but not limited to, signs, power poles, street lights, pad mount transformers, telephone pedestals, legal survey control monuments, buried utility conductors, buried shallow utility lines and buried water, sanitary, and storm sewer mains and services.

ii. Extreme caution is to be exercised at all times, and damage is to be reported and repaired immediately. The costs associated with protection of and repair of all utilities shall be borne by the Contractor.

iii. The Contractor shall be required to contact all the various authorities controlling or owning the referred to infrastructure and services, and satisfy itself as to the location of same. If it is necessary to relocate the services because of the construction, the Contractor will negotiate with the authority concerned, with regards to costs, payment and timing but this will not relieve the Contractor of responsibility of damage caused thereto as referred to above.

iv. The Contractor shall provide sufficient notice of the requirement for relocation to the owner of the utility services which may require relocation because of the construction and notification to the Engineer. Existing utility services as shown on the Contract drawings are plotted according to available information but are not necessarily accurate or complete.

END OF SECTION 01030

1. General

.1 Although the specifications set forth the work of various trades under separate Divisions, it is not intended that the work of that trade is limited to or includes all work set forth in that particular Division. The CONTRACTOR shall delegate the extent of THE WORK to be done by the various trades and shall coordinate execution of THE WORK by all trades.

.2 Although the specifications are separated into titled Divisions, neither the ENGINEER nor the OWNER will be an arbitrator to establish limits of any agreements between the CONTRACTOR and his SUBCONTRACTORS.

2. Traffic Accommodation (TAS)

It is the intent of the Town of Blackfalds to have construction proceed quickly with due consideration to the Town's overall traffic flows and patterns. The successful bidder will be required to prepare a Traffic Accommodation Strategy for work at the existing intersection of Womacks Road and Leung Road at the east project limit, which will be permitted to be periodically closed in stages during construction.

Traffic will be required to be safely detoured during the closure of the road. The TAS must be prepared by a qualified individual, trained and knowledgeable of Alberta Transportation (AT) Standards and Guidelines.

The CONTRACTOR is responsible for all costs associated with detouring traffic and pedestrians, including providing flag people, signage, and maintaining signage during the duration of the construction or in stoppages due to weather. These costs shall be included in the contract lump sum unit price for Traffic Accommodation, Detouring and Signage.

Traffic Accommodation includes the following requirements:

- The CONTRACTOR shall submit a Traffic Accommodation Strategy to the ENGINEER to AT standards for approval. The CONTRACTOR shall be solely responsible for maintaining construction signage and barricades on the road under construction for the duration of construction.

- No work may begin on the WORK until the Traffic Accommodation Strategy has been approved by the ENGINEER.

- The cost of preparing, submitting the Traffic Accommodation Strategy and setting up and maintaining construction signage shall be included in the contract lump sum unit price for Traffic Accommodation, Detouring and Signage.

The typical plans and drawings for this Contract are published in the following documents:

Drawings indicating typical minimum requirements for traffic accommodation and construction zone temporary signing are included in the following Alberta Transportation Department manuals:

- Traffic Accommodation in Work Zones, 2nd Edition; and
- Traffic Accommodation in Urban Work Zones, 1st Edition.

It may be necessary for the CONTRACTOR to modify these drawings and/or develop new drawings to address non-typical situations when using the Traffic Accommodation Strategy in accordance specification 7.1, Temporary Construction Signing.

- Typical drawings indicating requirements for pavement markings are included in the Department manual entitled, Alberta Highway Pavement Marking Guide, 2nd Edition, issued March 2003.
- Typical drawings indicating requirements for permanent highway signage are included in the Department manual entitled “Typical Signage Drawings”
- Typical drawings indicating requirements for barriers are included in the Department manual entitled “Typical Barrier Drawings”
- All other typical plans and drawings are included in the Department manual entitled “CB6 Standard Highway Construction Drawings”

Any typical drawings not found in these manuals including any updates issued prior to the publishing of the new editions of the manuals will be included in the contract documents.

No numbered highway or single access points to a residence or business may be closed to traffic during construction. For roads that are closed, alternative access to businesses and residences must be ensured and approved by the ENGINEER prior to construction commencing.

3. Mechanical and Electrical Coordination

.1 The CONTRACTOR shall examine the electrical, mechanical, structural and architectural drawings before beginning THE WORK and report to the ENGINEER any discrepancies or interferences.

.2 Electrical and mechanical system layouts shown on the drawings may be diagrammatic and locations of outlets, fittings and equipment are approximate. Exact routing of conduits, wiring, pipes and tables shall be determined and coordinated by the CONTRACTOR to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.

.3 Obtain the Engineer's approval for locations of outlets, fittings and equipment.

4. Cutting and Patching

.1 The CONTRACTOR shall do all cutting, fitting, or patching of THE WORK that may be required to make its several parts come together properly and fit it to receive or be received by work of OTHER CONTRACTORS shown in, or reasonably implied by, the CONTRACT DOCUMENTS.

.2 Any cost caused by cutting and patching due to ill-timed work shall be borne by the CONTRACTOR.

.3 The CONTRACTOR shall not endanger any adjacent property or portion of THE WORK by cutting, digging or any other method, and shall be responsible for any damages caused by him.

.4 Where new work connects with existing work, and where existing work is altered, cut and patch as required.

.5 Coordinate THE WORK to minimize the amount of cutting and patching required.

.6 Do no cutting that may impair the strength of structures. Obtain the ENGINEER'S approval before cutting, boring or sleeving load-bearing members.

.7 Make cuts clean and smooth and make patches equivalent to new work.

.8 Provide openings, holes and sleeves as required for process mechanical, building mechanical, electrical and all other components of THE WORK. Provide openings in pre-cast work and cast-in-place work.

.9 Drill or field cut smaller openings or holes and cast openings larger than 100 mm diameter.

5. Concealment

.1 Conceal pipes, ducts, conduits within walls and ceilings of finished areas, as required by the CONTRACT DOCUMENTS.

END OF SECTION 01040

1. General

.1 The Laws and Regulations of the province of Alberta shall govern.

.2 If the National Building Code of Canada applies to the WORK, the standards of the WORK shall conform to or exceed the minimum standards of the National Building Code of Canada.

.3 In the event of a dispute resolution by arbitration, the arbitration shall be governed by the Alberta Arbitration Act.

.4 The CONTRACTOR shall ensure compliance on his part and on the part of all of his SUBCONTRACTORS with the Alberta Occupational Health and Safety Act and Regulations thereunder.

For purposes of this CONTRACT, the CONTRACTOR shall be the PRIME CONTRACTOR within the context of the Alberta Occupational Health and Safety Act and the Regulations thereunder.

.5 The attention of the CONTRACTOR is drawn to the requirements of the Alberta Builders' Lien Act and Regulations thereunder.

.6 In the case of a CONTRACT which falls under the requirements of the Alberta Public Works Act, the Alberta Public Works Act shall apply.

.7 With respect to requirements for preserving historic resources, the Alberta Historical Resources Act and Regulations thereunder shall be complied with.

Any item of suspected paleontological, historical or archaeological significance shall remain the property of the OWNER, shall be preserved and recovered within the requirements of the Alberta Historical Resources Act. Notify the ENGINEER whenever any item of paleontological, archaeological or historical value is discovered and suspend operations on the WORK immediately until the ENGINEER issues instructions and authorizes that the WORK may proceed.

The OWNER may instruct the ENGINEER to issue a CHANGE ORDER if, in the opinion of the ENGINEER, the CONTRACTOR is unduly delayed or is required to perform extra work by reason of the discovery and preservation of any paleontological, archaeological or historical resource. The ENGINEER will, in the first instance, make a determination of the validity of a claim for delay and an estimate of the time of delay, and of the validity of the CONTRACTOR'S claim for additional payment and an estimate of the amount of the additional payment.

.8 All other Alberta Laws and Regulations shall apply as appropriate and the CONTRACTOR shall comply with the requirements thereof as though they had been specifically named in these specifications.

2. Burning

.1 Restrictions of federal, provincial and municipal authorities shall be complied with, and permits shall be obtained by the CONTRACTOR.

3. Regulations, Standards and Codes

.1 Codes, Standards and Regulations are specified in other sections of the specifications and the WORK shall be done in accordance with those Codes, Standards and Regulations where applicable.

END OF SECTION 01060

1. Abbreviations - Specifications, Methods, Standards

.1 General

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ARCA	Alberta Roofing Contractors Association
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers Associations
AWS	American Welding Society
BCLMA	B.C. Lumber Manufacturer's Association
CAN	National Standard of Canada
CCA	Canadian Construction Association
CISC	Canadian Institute of Steel Construction
CITC	Canadian Institute of Timber Construction
CPCI	Canadian Prestressed Concrete Institute
CRCA	Canadian Roofing Contractors Association
CSA	Canadian Standards Association
CWB	Canadian Welding Bureau
ISO	International Organization for Standardization
NBC	National Building Code
PCI	Prestressed Concrete Institute
PMBC	Plywood Manufacturer's Association
SJI	Steel Joist Institute
SSPC	Steel Structures Painting Council
WCB	Worker's Compensation Board

.2 Utilities

API	American Petroleum Institute
AWWA	American Water Works Association
CGA	Canadian Gas Association
CGSB	Canadian General Standards Board
CSPI	Corrugated Steel Pipe Institute
IAO	Insurer's Advisory Organization
RTAC	Roads and Transportation Association of Canada
ULC	Underwriters Laboratories of Canada
USA	United States of America Standards (ASA)

.3 Mechanical

AFBMA	Anti Friction Bearing Manufacturer's Association
AGMA	American Gear Manufacturer's Association
AMCA	Air Moving and Conditioning Association

ANSI	American National Standards Institute
ACR	Air Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating Refrigerating and Air Conditioning Engineers
NFPA	National Fire Protection Association
SAE	Society of Automotive Engineers

.4 Electrical

AIEE	American Institute of Electrical Engineers
CEC	Canadian Electrical Code
EEMAC	Electrical and Electronic Manufacturers Association of Canada
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
IES	Illuminating Engineers Society
IPCEA	Insulated Power Cable Engineer's Association
LEMA	Lighting Equipment Manufacturer's Association
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NESC	National Electrical Safety Code

.5 Use of Abbreviations

These abbreviations refer to Specifications, Methods and Standards issued by the respective Association, and the abbreviations are used in the specifications.

Alphanumeric designations following the abbreviations denote the specification, method, or standard.

2. Abbreviations - Metric

.1 General

The specifications are metric and metric usage is based upon SI units in accordance with CSA Standard CAN/CSA-Z234.1 Canadian Metric Practice Guide. In this specification SI units are abbreviated in accordance with the Metric Units and Abbreviations below.

.2 Linear Measure

Metre	m
Millimetre	mm
Kilometre	km
micrometre	micro-m

.3 Area

Square metre	m^2
Square millimetre	mm^2
Hectare	ha

.4 Volume

Cubic metre	m^3
Litre	L

.5 Mass and Density

Kilogram	kg
Gram	g
Tonne	t
Kilogram per metre	kg/m
Gram per metre	g/m
Kilogram per square metre	kg/m^2
Gram per square metre	g/m^2
Kilogram per cubic metre	kg/m^3

.6 Temperature

Degree Celcius	°C

.7 Force, Pressure, Stress

Newton	N
Kilonewton	kN
Pascal	Pa
Kilopascal	kPa
Megapascal	MPa

.8 Velocity, Rate of Flow

Metre per second	m/s
Metre per hour	m/h
Kilometre per hour	km/h
Litre per second	L/s
Cubic metre per second	m^3/s

.9 Power, Energy, Heat, Work

Watt	W
Kilowatt	kW
Kilowatt hour	kWh
Joule	J

.10 Electricity

Ampere	A
Volt	V

END OF SECTION 01070

1. General

.1 All systems shall be installed and identified in accordance with the specified identification systems.

2. Electrical

.1 Electrical conductors shall be identified by Colour Code as specified in Division 16 Electrical.

.2 Buried conduits shall be identified in accordance with local codes and as specified in Division 16 Electrical.

.3 Nameplates shall be provided for electrical panels and equipment and are specified in Division 16.

3. Mechanical

.1 Mechanical and process equipment shall be labelled in accordance with Divisions 11 and 15 Specifications. Piping shall be colour coded as specified below.

.2 Painting specifications in Section 09900 shall apply.

.3 Unless otherwise specified, piping and fittings for water supplies and sewerage systems shall be painted in accordance with the following Colour Code. The entire length of the pipe shall be painted in the basic colour, and bands shall be painted at 10 metre intervals or whenever a pipe enters or leaves a room. Individual bands shall be 25 mm wide with a 25 mm space between bands.

Pipe	Colour
Raw or unfinished water	Dark Green
Clarified water	Dark Green with one Black Band
Filtered water	Dark Green with two Black Bands
Filtered and Chlorinated (Potable Water)	Blue
Chemical Feed Lines	
- Coagulant	Pink with one Black Band
- pH Control	Pink with two Black Bands
- Taste and Odor	Pink with three Black Bands
- Fluoride	Pink with one Green Band
- Chlorine and water	Pink with one Yellow Band
- Chlorine Gas	Yellow
Plumbing (Waste)	Brown
Raw Sewage	Brown
Primary Settled Sewage Effluent	Brown with one White Band
Secondary Settled Sewage Effluent	Gray

Chlorinated Effluent	Gray
Sludge Lines	
- Raw Sewage	Black
- Primary Sludge	Black with one White Band
- Secondary Sludge	Black with two White Bands
- Digested Sludge	Black with three White Bands
- Digested Liquor	Black with one Brown Band
Natural Gas	Orange
Digester Gas	Orange with one Black Band
Electrical	Purple
Compressed Air	White
Heating	Silver
Fire Protection	Red

END OF SECTION 01080

1. Use of Alternatives

.1 If the CONTRACTOR elects to supply and/or install an alternative material to that specified or shown on the drawings, the CONTRACTOR shall be responsible for making all consequent adjustments, at his own cost, to make the alternative fit into THE WORK as specified, and these consequent costs shall be deemed to be included in the price bid for the alternate.

.2 All alternatives must be submitted to the ENGINEER for approval.

END OF SECTION 01100

1. General

.1 Payments will be made on the basis of the lump sum prices bid and the unit prices bid in the Tender, and in accordance with Article 18 of the General Conditions.

.2 The prices bid for various items of work, unless specifically noted otherwise, shall include the supply of all labour, PLANT, MATERIAL and PRODUCT equipment necessary to construct THE WORK in accordance with the specifications.

.3 The prices bid for supply and installation shall be full compensation for supplying, hauling, installing, cleaning, testing, and placing in service together with all other work subsidiary and incidental thereto for which separate payment is not provided elsewhere.

.4 The method of measurement of the quantities for payment and the basis for payment will be in accordance with the following items of this section. All measurement will be done by the ENGINEER using generally accepted field survey methods. Stationing interval for volume calculations shall not exceed 20m.

.5 Where the Tender shows separate items for supply and installation, the unit prices or lump sum prices bid for supply shall include supplying, delivering, loading, unloading and all allowances for handling, storage, breakage and waste. Payment will be made only for MATERIAL actually installed in THE WORK.

Progress Payment for supply-only items shall be made only for MATERIAL and PRODUCT on the WORKSITE and in the CONTRACTOR'S care, and shall then become the Property of the OWNER.

.6 Other materials on site, whether existing structures, vegetation, topsoil, gravel, sand or other excavated or piled materials, are the property of the OWNER or of the owner of the land on which THE WORK is located. Only those materials specifically noted in the specification or on drawings as belonging to the CONTRACTOR shall become the CONTRACTOR'S property.

.7 Where there are excess excavated materials, unsuitable materials excavated or materials of any kind that are excavated but not used in THE WORK, such materials are not the property of the CONTRACTOR unless authorized in writing by the ENGINEER or specified to be disposed of by the CONTRACTOR.

.8 Upon Total Completion of THE WORK, the CONTRACTOR shall credit the OWNER for MATERIAL paid for as supplied on the WORKSITE, but not incorporated in THE WORK, and remove the surplus MATERIAL from the WORKSITE.

.9 Tender items may include several topics under Measurement and Payment.

2. Incidental Work

.1 The following work will be considered incidental work and separate payment will not be made.

a) Wastewater control and disposal.
b) Disposal of excavation material off the site, to site located by the Contractor.
c) Detailed Environmental Protection Plan as specified and detailed in Section 01060 of the Contract Documents.
d) Traffic Accommodation as specified and detailed in Section 01030 of the Contract Documents.
e) Locating and temporarily removing, relocating or protecting existing utilities, and supporting power poles and structures.
f) Obtaining all permits and approvals including affected property owners.
g) Temporary removal and replacement of existing fences, traffic signs and structures not specified in the tender to the original condition.
h) Maintaining existing services in operation and access to all businesses affected.
i) All quality control tests of any / all products supplied to complete the work.
j) Replacement of any lost or damaged Owner-supplied materials under the Contractor's care.
k) Replacement of unsuitable material
l) Restoration of any existing facilities damaged or disturbed during construction.
m) Coordination with utility authorities and the owners as required.
n) Coordination with McKay Ranch Developer
o) Coordination with the Town of Blackfalds and other Contractors working in the area.
p) Contractor will be responsible for all re-tests required including supply of water and other materials and equipment as required for the project.
q) Contractor is responsible for coordinating with the Town of Blackfalds Public Works department for the moving and reinstallation of existing signs. Contractor is responsible for all temporary signage.
r) Any other incidental work related to the performance of the Contract for which separate payment is not specified.

3. Lump Sum Contracts

.1 Payments will be made on the basis of the following:

a) Lump Sum items in the Schedule of Prices in the Tender Forms.

b) Changes in THE WORK for items not covered by tender prices, in accordance with Article 16 - CHANGES IN THE WORK of the General Conditions.

c) For each Lump Sum item in the Schedule of Prices, the CONTRACTOR will provide breakdown prices. The ENGINEER will, in cooperation with the CONTRACTOR, estimate the percentage of the item completed at the end of the payment period for the breakdown prices supplied by the CONTRACTOR and accepted by the ENGINEER.

4. General

4.1 Mobilization and Demobilization

a) Mobilization and demobilization shall include the CONTRACTOR'S costs of mobilization at the beginning of the project; and the costs of demobilization at the end of the project.

b) Included in mobilization are such items as bonding, insurance, permits, moving personnel, materials and equipment to the site, setting up temporary facilities, construction offices, and all preparation for performing THE WORK.

c) Included in demobilization are preparation and submission of operation and maintenance manuals, submission of record drawings, removal of all personnel, materials and equipment; and cleanup of the site and THE WORK.

d) The lump sum price bid for this work shall be relative to the costs involved but shall not exceed ten percent of the Tender Price.

e) Payment will be made as follows, as approved by the ENGINEER:

i) 60% of the lump sum bid will be included in the first progress payment certificate;

ii) 40% of the lump sum bid will be included in the final progress payment certificate.

The ENGINEER may at his discretion recommend partial payment if mobilization or demobilization is not complete.

With respect to Division 1 General Requirements, payment will be made as specified for demobilization and mobilization. The costs of other items specified under General Requirements shall be considered as incidental to THE WORK; and separate payment will not be made for any other items of General Requirements.

.2 Environmental Construction Operations (ECO) Plan

The price includes preparation, implementation, maintenance, removal and of the

Environmental considerations for Construction Document, per the Alberta Transportation ECO Plan guidelines (latest edition). Preparation, implementation, maintenance and removal of the Erosion and Sediment Control (ESC) plan. Refer to Section 1060 Regulatory Requirements, and any other requirements stated for environmental protection in the specification or drawings.

Payment: Lump Sum as a percentage of work completed as approved by the ENGINEER.

4.2 Division 2 – Civil Works

.1 Lift Station Excavation and Backfill

Lift Station Excavation and Backfill should include site work for common excavation for lift station structure. The work shall include common excavation including cut, fill, and backfill, as well as temporary or permanent stockpiling, coordination with Town forces, coordination with adjacent contractors, disposal of all materials regardless of their nature for the construction of the structure, backfill around structure, compaction, testing, protection of existing roads/utilities/structures.

.2 Deep Utilities (Water and Sanitary) shall include excavation, of all materials regardless of their nature, backfill, compaction, soils testing, dewatering as required, protection of existing utilities/structure(s), coordination and installation of new utilities (water, sanitary and culverts), erosion control, hydrants, maintenance during construction, yard piping, and all related work to complete the site work as detailed on the drawings and specified in the Contract documents.

Payment: Lump Sum

Measurement: Percentage of Work Completed Determined by The Engineer

.3 Shallow Utilities (Power, Gas, Communications) shall include excavation, of all materials regardless of their nature, backfill, compaction, soils testing, dewatering as required, protection of existing utilities/structure(s), coordination and installation of new utilities (including telephone, gas, power), erosion control, maintenance during construction, and all related work to complete the site work as detailed on the drawings and specified in the Contract documents.

Payment: Lump Sum

Measurement: Percentage of Work Completed Determined by The Engineer

.4 Site Grading, Landscaping and Surface Work shall include stripping, grading, export and or Import, temporary or permanent stockpiling, of all materials regardless of their nature, backfill, compaction, soils testing, dewatering as required, protection of existing utilities/structure(s), erosion control, all concrete

slabs, bollards, maintenance during construction, site restoration, gravelling, asphalt pavements, concrete surfacing, landscaping, fencing, gates, and all related work to complete the site work as detailed on the drawings and specified in the Contract documents.

Payment: Lump Sum

Measurement: Percentage of Work Completed Determined by The Engineer

.5 450mm Plug Valve (Deletable Item)

450mm Plug Valve shall include supply, installation and adjustment to final grade of valve.

Payment: Unit price bid per valve installed

Measurement: Work Completed

.6 Dewatering

Provide all Work required to mobilization, set-up, install, operate, monitor, take down and demobilization a dewatering system for the lift station based on the expected conditions outlined in the geotechnical report and in Section 02240 – Dewatering. This item is to include all Work (materials and labour) for 24/7 operation of the dewatering pumps, hoses, excavated sumps, and all related equipment. The daily rate will be paid only for days in operation and is to include all mobilization, set-up, take down and demobilization costs. The Contractor shall make their own investigations into site conditions to confirm site conditions and construction methodology prior to undertaking Dewatering & Temporary Shoring Work.

Payment: Days of well point dewatering in operation.

Measurement: Days of well point dewatering in operation (not including mob, set-up, take down and demob).

4.3 Divisions 3-16

Each Lump Sum price as broken down in the tender forms shall include demolish, dispose of the existing components, supply and installation of all materials and equipment to construct that component of the work under each division for complete functioning products.

For each Lump Sum item in the Schedule of Prices, the ENGINEER will, in cooperation with the CONTRACTOR, estimate the percentage of the item completed at the end of the payment period.

4.4 Commissioning and start up

Commissioning and start up shall include final leakage and pressure testing of all components as a complete operating system, cleaning, trouble shooting, adjusting, training of Town operators, commissioning, placing into operation and operating the system for a one week period without problems, submission of draft and final operation and maintenance manuals, and all related work as detailed on the drawings and specified in the Contract documents. The bid for the Commissioning and start up line item is to be a minimum of 20% of the Mobilization and Demobilization bid line item.

Payment: Lump Sum

Measurement: Percentage of Work Completed Determined by The Engineer

4.5 Prime Cost (PC) Sums

Portions of THE WORK done under Prime Cost Sum shall be paid for by unit prices in the schedule of Unit Prices for Provisional Work or in the Supplementary Tender Forms, or on the basis of the CONTRACTOR's cost plus percentage fee in accordance with General Condition 17.3 or both, as stipulated in the tender.

REFER TO SECTION 01021 CASH ALLOWANCE FOR FURTHER DETAILS ON PRIME COST ITEMS.

.1 Survey

Payment: Prime Cost Sum

Measurement: Payment will be made as defined in a percentage of work completed as approved by the ENGINEER.

.2 Material Testing

Payment: Prime Cost Sum

Measurement: Payment will be made as defined in a percentage of work completed as approved by the ENGINEER.

.3 Coordination and Payment for Permanent Power and Gas Connection

Payment: Prime Cost Sum

Measurement: Payment will be made as defined in a percentage of work completed as approved by the ENGINEER.

.4 Programming

Payment: Prime Cost Sum

Measurement: Payment will be made as defined in a percentage of work completed as approved by the ENGINEER.

END OF SECTION 01150

1. Preconstruction Meeting

.1 Preconstruction meetings will be arranged by the ENGINEER after the Acceptance of the TENDER.

.2 Meetings will be held at the ENGINEER'S office or at an alternate location at or near the site.

.3 The agenda for the Preconstruction Meeting shall include, but is not limited to, the following:

a) Confirm the SUPERINTENDENT, CONTRACTOR'S PROJECT MANAGER, and the ENGINEER'S Resident personnel on the WORKSITE.

b) Establish WORKSITE protocols for communication, reporting, inspection, etc.

c) Clear up any ambiguities or questions of interpretation known at that time.

d) CONTRACTOR shall present its detailed WORK SCHEDULE.

e) Occupational Health and Safety relationships and responsibilities.

f) Discuss other responsibilities of the OWNER, the CONTRACTOR, and the ENGINEER. Review General Conditions 5 to 11, inclusive.

2. Progress Meetings

.1 Progress meetings will be held on a regular bi-weekly basis or more frequently if requested by the ENGINEER.

.2 Accommodation for progress meetings shall be provided by the CONTRACTOR at or near the site.

.3 The ENGINEER will give to all parties advance notice of meeting dates, times and locations.

.4 The CONTRACTOR shall have in attendance the SUPERINTENDENT, the CONTRACTOR'S Project Manager and representatives of the SUBCONTRACTORS if requested by the ENGINEER.

.5 The ENGINEER will have the ENGINEER'S Project Manager or the Resident Engineer, or both, in attendance.

.6 The OWNER may have a representative in attendance.

.7 Occupational Health and Safety incidents, records and procedures shall be part of the agenda for every progress meeting.

.8 Minutes will be taken by the ENGINEER and copies will be distributed to all attendees.

END OF SECTION 01200

1. General

.1 Submittals are required in accordance with the provisions of this section, to determine whether the specified MATERIAL and PRODUCT are furnished and installed in accordance with design intent as expressed in the CONTRACT DOCUMENTS.

.2 Individual submittals as required are detailed in other sections of the specifications.

.3 Until submissions are reviewed, work involving relevant PRODUCT or MATERIAL may not proceed.

.4 Where the phrase "or approved equivalent alternative" occurs in the CONTRACT DOCUMENTS, do not assume that MATERIAL, PRODUCT or methods will be accepted as equal by the ENGINEER unless the item has been specifically accepted for THE WORK by the ENGINEER in writing.

2. Identification of Submittals

.1 Identify each submittal and resubmittal by showing at least the following information:

a) Name, address and telephone number of the submitter, and a name of an individual for contact.

b) Drawing number and specification number to which the submittal applies.

c) Whether an original submittal or resubmittal.

d) Confirmation of prior review by the CONTRACTOR.

e) Date of submittal or resubmittal.

f) Authorized signature of the Submitter.

3. Coordination of Submittals

.1 Prior to submittal for the ENGINEER'S review, coordinate all material:

a) Determine and verify field dimensions and conditions and conformance with specifications, including MATERIAL, catalogue numbers, type numbers and similar data.

b) Coordinate requirements between trades.

c) Coordinate with requirements under laws, regulations, etc.

d) Secure required approvals of public agencies, inspection agencies and standards agencies and show proof of approvals acquisition.

e) Indicate any deviations from the intent of design as expressed in the CONTRACT DOCUMENTS and request specific review of these deviations.

4. Timing of Submittals

.1 Make submittals far enough in advance to allow adequate time for coordination, ENGINEER'S review, revisions and resubmittals, and for supply and delivery in time for the scheduled installation in THE WORK.

.2 Allow at least ten calendar days for the ENGINEER'S review after receipt of submittals. The Engineer will make every effort to review the submittals in a timely and expedient manner.

.3 Costs due to delays in making submittals shall be borne solely by the CONTRACTOR.

END OF SECTION 01300

1. Construction Schedule

.1 Upon award of the CONTRACT and prior to commencement of THE WORK, the CONTRACTOR shall submit for approval to the ENGINEER a construction schedule in critical path method format showing all the principal phases of the work. No Progress Payment Claim shall be certified until an acceptable Construction Schedule has been received by the ENGINEER.

.2 The Construction Schedule shall be updated monthly against actual progress of THE WORK by the CONTRACTOR.

.3 If, in the opinion of the ENGINEER, any Construction Schedule is inadequate as a control tool or if it does not show THE WORK being fully completed by the CONTRACT Completion Date, the ENGINEER may reject it and the CONTRACTOR shall provide a Construction Schedule and work program that is acceptable to the ENGINEER.

END OF SECTION 01310

1. Requirements for Shop Drawings and Product Data

.1 The CONTRACTOR shall arrange for the preparation of clearly identified shop drawings and submit shop drawings as follows:

a) One digital combined .pdf file: Copy with transmittal and review stamp submitted by email to the Engineer project manager or designated person plus one printed copy to be retained by the Engineer plus the number of copies required by the CONTRACTOR.

b) Shop drawings will be returned to the CONTRACTOR digitally by email only.

The Contractor shall provide clearly identified Product Data and submit two prints to be retained by the Engineer plus the number of copies required by the Contractor.

Product Data shall include but not be limited to:

i) Product assembly drawings

ii) Materials list

iii) Principal dimensions

iv) Parts and components details

v) Letters of compliance with recognized standards where required

vi) Operation data

vii) Operation curves

viii) Operation manuals where specified

ix) Product Name and Model Number

.2 Shop drawings for components required to be submitted include, but are not limited to:

- Pile Shop Drawing
- Pile Installation Data
- Aluminum Hatches
- Davit Drawings
- Door and Hardware
- Plug Valve
- Bell X Hub Adaptors for HDPE Road Crossings
- Valve Box

- Wet Well
- Wood Truss’s
- Butterfly Valve
- Hydrants
- Wet well Cast in Spool
- Grade beam & Main Floor Rebar
- Masonry, Housekeeping Pad, Pipe Support, and Apron
- Mechanical Shop Drawings
- Pumps
- Building Exterior Colors
- Metal Colour
- Sanitary DD Couplers
- Sanitary Service Saddle Tees
- Mono Rail & Chain Hoist
- Control Panel
- Door Switches, Strobes Lights and Horns
- Air Proving Switch,
- Level Transmitter, Flow Meter,
- Gas Detection System
- Distribution and Lighting Package
- Sink, Faucet, Water Heater
- Unit Heater
- Radio Path Study
- Foundation Inspection Report
- Generator
- RTD's, IPAQ, Limatherm Display
- Scada Shop Drawings
- Oxygen Sensor
- MCC, VFD,
- Smoke Sensor
- Harmonic Filter
- O&M Binder Proof

.3 Shop drawings shall be accurately drawn to a scale sufficiently large to show all pertinent features of the item, and its method of connection to THE WORK and shall have sufficient space for the CONTRACTOR'S stamp and the ENGINEER'S stamp.

.4 Shop drawings shall be in accordance with the International System of Units (S.I.) metric units.

.5 Prior to submission to the ENGINEER the CONTRACTOR shall review all shop drawings. By this review, the CONTRACTOR represents that he has determined and verified all field measurements, field construction criteria, materials, catalogue numbers and similar data or will do so, and that he has checked and coordinated each shop drawing with the requirements of THE WORK and of the

CONTRACT DOCUMENTS. The CONTRACTOR'S review of each shop drawing shall be indicated by stamp, with the date and signature of a responsible person.

.6 The CONTRACTOR shall submit shop drawings to the ENGINEER for his review with reasonable promptness and in orderly sequence so as to cause no delay in THE WORK or in the work of OTHER CONTRACTORS. If either the CONTRACTOR or the ENGINEER so requests they shall jointly prepare a schedule fixing the dates for submission and return of shop drawings.

.7 At the time of submission the CONTRACTOR shall notify the ENGINEER in writing of any deviations in the shop drawings from the requirements of the CONTRACT DOCUMENTS.

.8 The ENGINEER will review and return shop drawings in accordance with a schedule agreed upon, or otherwise with reasonable promptness. The ENGINEER'S review shall be for conformity to the design concept and for general arrangement only and such review shall not relieve the CONTRACTOR of responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of the CONTRACT DOCUMENTS. A specific deviation on the shop drawings from the design concept requested by the CONTRACTOR may be approved or rejected in writing by the ENGINEER.

.9 The CONTRACTOR shall make any changes in shop drawings which the ENGINEER may require consistent with the CONTRACT DOCUMENTS and resubmit unless otherwise directed by the ENGINEER. When resubmitting, the CONTRACTOR shall notify the ENGINEER in writing of any revisions made by the CONTRACTOR other than those requested by the ENGINEER, in his previous review.

.10 Each reviewed shop drawing will be stamped by the ENGINEER with the following form of stamp:

REVIEWED	( )
REVIEWED AS MODIFIED	( )
REVISE AND RESUBMIT	( )
NOT REVIEWED	( )

This review by the ENGINEER is for the sole purpose of ascertaining conformance with the general design concept. This review shall not constitute approval of the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor submitting same. Review by the ENGINEER shall not relieve the Contractor of his responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication

processes or to techniques of construction, for installation, and for co-ordination of the work of all sub-trades.

ENGINEER
By:
Date:

2. Design by the Contractor

.1 When the CONTRACTOR is responsible for engineering design of portions of THE WORK, this shall be clearly and specifically indicated in the drawings or in the specifications of the CONTRACT DOCUMENTS.

.2 Where the CONTRACTOR is required, either by law or regulation or by the CONTRACT to provide engineering design, he shall use the services of a Professional Engineer registered in the area in which THE WORK is to be performed, and he shall submit Shop Drawings bearing the Seal and Signature of that Registered Professional Engineer.

END OF SECTION 01340

1. Records During Construction

.1 The CONTRACTOR shall keep one complete set of all construction drawings on the WORKSITE.

.2 On the WORKSITE set of CONTRACT Drawings, the CONTRACTOR shall record any changes that are made during the actual construction of THE WORK. The purpose of recording these changes is to provide drawings of record at the end of THE WORK. The CONTRACTOR shall be responsible for the adequacy and the reliability of the information recorded on the drawings of record.

.3 At the completion of the construction period, the CONTRACTOR shall turn over the set of construction drawings which have been marked up with changes during the course of THE WORK to the ENGINEER to permit the ENGINEER to prepare Drawings of Record for THE WORK.

.4 As-built redline markup drawings are to be submitted as one consolidated set for each separate schedule.

.5 95% complete as-built drawings are required to be submitted and accepted prior to issuing Substantial Completion for each separate schedule.

2. Recording Actual Site Conditions

.1 Record information on set of black line opaque drawings.

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

.3 Contract Drawings and shop drawings: mark each item to record actual construction, including but not limited to:

a) Measured depths of elements of foundation in relation to finish first floor datum.

b) Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

c) Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.

d) Field changes of dimension and detail.

e) Changes made by change orders.

f) Details not on original Contract Drawings.

g) References to related shop drawings and modifications.

h) Changes made by Addenda.

END OF SECTION 01390

1. General

.1 The CONTRACTOR is totally responsible for the quality of MATERIAL and PRODUCT which he provides and for THE WORK.

.2 The CONTRACTOR is responsible for quality control and shall perform such inspections and tests as are necessary to ensure that THE WORK conforms to the requirements of the CONTRACT DOCUMENTS.

.3 During the progress of THE WORK, a sufficient number of tests shall be performed by the CONTRACTOR to determine that MATERIAL, PRODUCT and installation meet the specified requirements.

.4 The CONTRACTOR shall perform as many inspections and tests as are necessary to ensure that THE WORK conforms to the requirements of the CONTRACT DOCUMENTS.

.5 Testing shall be in accordance with pertinent codes and regulations, and with selected standards of the American Society for Testing and Materials (ASTM) and Canadian Standards Association (CSA).

2. Quality Control Testing by the Contractor

.1 The CONTRACTOR shall retain the services of an independent testing agency under supervision of a registered professional engineer, and pay the cost of testing services for quality control including, but not limited to, the following:

a) Sieve analysis of sands and aggregates to be supplied to THE WORK.

b) Aggregates and mix designs for asphaltic concrete.

c) Aggregates and mix design for Portland Cement concrete.

d) Standard Proctor Density curves for backfill materials.

e) Standard Proctor Density curves for approved borrow materials.

f) Compaction control tests for backfill and embankment material.

g) Any product testing that is required and is specified under various sections of the specifications.

.2 The CONTRACTOR shall promptly process and distribute all required copies of test reports and test information and related instructions to all of his SUBCONTRACTORS and Suppliers to ensure that all necessary retesting and replacement of construction can proceed without delay.

.3 The CONTRACTOR shall promptly provide the ENGINEER with copies of all test results.

3. Quality Assurance Testing by the Owner

.1 The OWNER may retain and pay for the services of an independent testing agency for testing for quality assurance, for the OWNER'S purposes.

.2 The OWNER'S testing agency and the ENGINEER may inspect and test MATERIAL, PRODUCT and THE WORK for conformance with the requirements of the CONTRACT DOCUMENTS; however, they do not undertake to check the quality of THE WORK on behalf of the CONTRACTOR nor to provide quality control.

.3 Inspections and tests by the OWNER'S testing agency and by the ENGINEER do not relieve the CONTRACTOR of his responsibility to supply MATERIAL and PRODUCT and to perform THE WORK in accordance with the requirements of the CONTRACT DOCUMENTS.

.4 The ENGINEER, at his discretion, may order or perform any additional inspections and tests for purposes of his own or for purposes of the OWNER.

.5 The CONTRACTOR shall coordinate with the ENGINEER the scheduling of testing and inspection by the OWNER'S testing agencies or by the ENGINEER, to enable testing to be done as necessary, without delay, and the CONTRACTOR shall notify the ENGINEER sufficiently in advance of operations to allow for such inspection and tests by the ENGINEER'S or the OWNER'S testing agency.

4. Code Compliance Testing

.1 Inspections and tests required by codes or ordinances, or by a plan approval authority, shall be the responsibility of and shall be paid for by the CONTRACTOR.

.2 Copies of reports resulting from such inspections shall be submitted in a timely manner by the CONTRACTOR to the OWNER.

5. Retesting

.1 When tests on PRODUCT, MATERIAL or completed portions of THE WORK carried out by the CONTRACTOR or the CONTRACTOR'S testing agency or by the OWNER’S testing agency yield results not meeting the requirements of the CONTRACT DOCUMENTS, the CONTRACTOR, in addition to carrying out remedial work or replacement of the PRODUCT or MATERIAL shall provide for retesting of the remedied work and the replacement PRODUCT and MATERIAL. Retesting, including retesting by the OWNER’S testing agency, shall be at the CONTRACTOR'S expense.

.2 In every case where the CONTRACTOR has submitted test results which fail to meet the requirements of the CONTRACT DOCUMENTS, the CONTRACTOR shall submit within a practical and reasonable time results of a retest showing that the results are in accordance with the requirements of the CONTRACT DOCUMENTS.

.3 If the CONTRACTOR fails or refuses to do remedial work or replace unacceptable MATERIAL or PRODUCT, the ENGINEER may refuse to certify payment and the OWNER may refuse to make payment, in addition to any other remedies the OWNER may have.

END OF SECTION 01400

1. Temporary Utilities

1.1 Natural Gas, Gasoline and Other Fuels

.1 Provide and pay all costs for natural gas, gasoline and other fuels required for the performance of THE WORK, in accordance with governing regulations and ordinances, and the CONTRACT DOCUMENTS.

.2 Furnish and install all necessary temporary piping and upon completion of THE WORK remove all such temporary piping.

1.2 Water

.1 Provide and pay all costs for all water required for the performance of THE WORK, in accordance with governing regulations and ordinances, and the CONTRACT DOCUMENTS.

.2 Furnish and install all necessary temporary piping and upon completion of THE WORK remove all such temporary piping.

1.3 Electricity And Lighting

.1 Provide and pay all costs for electricity and artificial lighting required for the performance of THE WORK, in accordance with governing regulations and ordinances, and the CONTRACT DOCUMENTS.

.2 Furnish and install all necessary temporary wiring, distribution boxes, panels, etc., and upon completion of THE WORK, remove all such temporary installations.

1.4 Telephone

.1 Provide, maintain and pay all costs for a telephone for the CONTRACTOR'S use.

.2 A telephone is not required for the ENGINEER'S use on this project.

1.5 Sanitary Facilities

.1 Furnish and install all required temporary toilet buildings with sanitary toilets for use of all workmen; comply with all minimum requirements of the Health Department or other public agency having jurisdiction; maintain in a sanitary condition at all times.

1.6 Fire Protection

.1 Provide and pay all costs for adequate fire protection of THE WORK and adjacent property.

.2 Furnish and install temporary extinguishers, hydrants and other equipment, and upon completion of THE WORK remove all such temporary equipment.

2. Construction Aids

2.1 Temporary Excavation

.1 The CONTRACTOR is responsible for the means and methods of making temporary excavations in order to install components of THE WORK.

2.2 Access Roads

.1 Construct temporary access roads as necessary to perform THE WORK, and maintain temporary access roads until construction is over or until permanent access is established.

.2 Locations and drainage facilities for temporary access roads are subject to the approval of the ENGINEER.

.3 No direct payment will be made to the CONTRACTOR for construction of temporary access roads.

3. Protection

.1 Remove trees, fences and other structures from the site of THE WORK, as necessary to perform THE WORK.

.2 Remove only those items that must be removed, or are clearly shown on the drawings to be removed.

.3 Protect all remaining trees, plants, fences and other items from damage during construction.

4. Existing Utilities and Structures

.1 Existing utilities and structures include pipes, culverts, ditches or other items which are a part of an existing sewerage, drainage or water system; or which are a part of a gas, electrical, telephone, television, telecommunications or other utility system. Also included are sidewalks, curbs, gutters, swales, poles, fences or any other structures encountered during construction.

.2 The CONTRACTOR shall be responsible for location, protection, removal or replacement of existing utilities and structures, or for repair of any damage which may occur during construction.

.3 Existing utilities and structures may be shown on the drawings, or described in the specifications. Such information is shown for design purposes and the existence, location and detail given is information that is obtained during the design period and is not necessarily complete, correct or current.

.4 Unless specifically detailed elsewhere in these documents, the CONTRACTOR shall pay all costs and be responsible for establishing locations and state of use of all existing utilities that may affect THE WORK. The CONTRACTOR shall make satisfactory arrangements with the utilities companies involved for the location, protection and inspection of existing utilities.

.5 Notice in writing shall be given by the CONTRACTOR to the utilities companies at least 48 hours before work commences in the vicinity of existing utilities.

.6 The CONTRACTOR shall pay all the costs involved in protection of utilities, inspection of utilities, and all costs due to delays because of existing utilities and structures.

.7 The CONTRACTOR shall provide for the uninterrupted flow of all water courses, sewers and drains encountered during THE WORK.

.8 Access shall be maintained to all existing structures such as valves, hydrants, meter chambers and control structures at all times during construction.

.9 If interruption of service provided by an existing utility is necessary, the planned shut-down shall be approved by the owners of the utilities. Requests for shut-down shall be made by the CONTRACTOR in writing at least 48 hours in advance.

.10 The CONTRACTOR shall notify all customers or make arrangements with the utility company to notify all customers 24 hours in advance of a shut-down.

.11 Unless otherwise specified the CONTRACTOR shall make arrangements for relocation of existing utilities that the ENGINEER requests to be relocated; and the actual relocation shall be constructed by the OWNER of the utility. The CONTRACTOR will be reimbursed the invoiced cost of the relocation. No extra payment is permitted for delays, or standby time.

5. Temporary Controls

5.1 Noise Controls

.1 Perform THE WORK in conformity with all municipal by-laws with respect to noise, hours of work, night work and holiday work. Night work or holiday work requires the written permission of the ENGINEER.

5.2 Dust Control

.1 Perform THE WORK in a manner that will not produce an objectionable amount of dust. Dust control measures shall be paid for by the CONTRACTOR.

5.3 Pollution Control

.1 Perform THE WORK in conformance with the applicable sections of the Provincial Regulations with respect to air and water pollution control requirements.

5.4 Disposal Of Wastes

.1 Burying of rubbish and waste on site is not permitted.

.2 Disposal of waste or volatile materials into waterways, storm or sanitary sewers is not permitted.

.3 Pumping or draining water containing silt in suspension into waterways, sewers or drainage systems is prohibited.

.4 Abide by requirements of Statute, Bylaw and Regulations respecting disposal of wastes.

.5 Obtain required Permits for waste disposal.

6. Contractor's Field Office

.1 Furnish and install a field office building adequate in size and accommodation for all CONTRACTOR'S offices, superintendent's office.

.2 A dedicated bi-weekly construction meeting area is to be provided in the contractor’s office and is to be kept clean for all site meetings.

i) The meeting space is to accommodate up to 10 people throughout the entire construction period, including 10 chairs and 2 -3 large tables with access all around the tables.

ii) The trailer is to be heated adequately (20 deg C).

7. Engineer's Field Office

.1 Provide a separate standalone field office building for the sole use of the ENGINEER, not in the same trailer as the CONTRACTOR's.

.2 Locate the field office within the CONTRACTOR'S working area.

.3 Submit details of the office, its contents and its proposed location to the ENGINEER and obtain the ENGINEER'S approval.

.4 Provide all weather vehicle access and parking space for two vehicles for ENGINEER'S use. Gravel office access and parking to keep free of mud.

.5 Provide power and heating fuel for ENGINEER'S office for the duration of THE WORK to adequately heat the space to 20 deg C.

.6 The ENGINEER'S field office shall be in accordance with the following:

a) windproof, weatherproof and insulated
b) minimum floor area 15 m^2
c) thermostatically controlled heat
d) ventilated adequately by exhaust fan, screen door or window
e) brightly illuminated for office work
f) window area at least 1 m^2
g) window screen and shade
h) screen door and lockable exterior door
i) minimum 3 electrical receptacles

.7 The ENGINEER'S field office shall contain:

a) two, 2 meter long plan tables
b) one office desk-minimum 1500 x 600
c) three chairs
d) minimum 42" widescreen TV with HDMI port for laptop connection
e) Microwave, new coffee maker, Culligan water cooler, garbage can
f) high speed internet access

END OF SECTION 01500

1. Quality

.1 MATERIAL and PRODUCT supplied and installed shall be new.

.2 MATERIAL and PRODUCT supplied shall conform to these specifications and to specified standards.

.3 Workmanship shall be the best quality, executed by workmen experienced and skilled in their respective trades.

.4 Ensure full cooperation among all trades and coordination of THE WORK with continuous supervision.

.5 Use PRODUCT for which replacement parts and service are readily available.

.6 Use PRODUCT of one manufacturer for PRODUCT of the same type or classification. Do not mix different manufacturer's PRODUCT in THE WORK or in parts of THE WORK.

2. Manufacturer's Instructions

.1 Unless otherwise specified, comply with the MANUFACTURER'S/SUPPLIER'S instructions for MATERIAL or PRODUCT and installation methods.

.2 Notify the ENGINEER in writing of any conflict between these CONTRACT specifications and the instructions of the MANUFACTURER/SUPPLIER.

3. Fastenings

.1 Provide metal fastenings and accessories in the same texture, colour and finish as the base metal in which they occur. Prevent electrolytic action between dissimilar metals. Use non-corrosive fasteners, anchors and spacers for securing exterior work, or work that may be located in a corrosive atmosphere.

.2 Space anchors within limits of load bearing or shear capacity and ensure that they provide positive permanent anchorage.

.3 Space fastening evenly and lay out neatly.

4. Delivery and Storage

.1 Deliver, store and maintain packaged MATERIAL and PRODUCT with manufacturer's seals and labels intact.

.2 Prevent damage and soiling of MATERIAL and PRODUCT.

.3 Store MATERIAL and PRODUCT in accordance with instructions of the MANUFACTURER/SUPPLIER.

.4 Provide suitable areas or buildings where storage is weatherproof, if dry areas are recommended by the MANUFACTURER/SUPPLIER.

.5 PRODUCT shall have name plates displaying PRODUCT data and serial numbers.

.6 Comply with Work Place Hazardous Materials Information Systems requirements.

END OF SECTION 01600

1. General

.1 The CONTRACTOR shall provide, commission and turn over to the ENGINEER a complete operating lift station, gravity sewer system.

.2 Testing and commissioning shall normally proceed in three steps:

a) Test all individual items and items forming sub-systems, ready for operation.

b) Commission THE WORK of this CONTRACT entirely.

c) Turn over THE WORK to the OWNER.

.3 Testing and commissioning shall be performed by the CONTRACTOR, in the presence of the ENGINEER.

.4 Testing shall be performed in two phases:

a) Static Testing, and

b) Dynamic Testing.

.5 Refer to Division 11,13, 15 and Division 16 for additional Testing and Commissioning requirements specific to other disciplines and coordinate with CONTRACTOR subtrades for any and all support required to complete the requirements herein.

2. Preparation – Pre-Startup

.1 Commissioning and Training Plan: Establish a written detailed procedure and schedule and submit to the ENGINEER for review as follows:

a) The first submission a minimum of four (4) months prior to the anticipated commissioning date. Allow 2 weeks for review.

b) The second submission a minimum of two (2) months prior to the anticipated commissioning date. Allow 2 weeks for review.

c) The third submission a minimum of two (2) weeks prior to commission to allow for distribution to all parties.

i) The Consultant will submit a power point format Functional Testing document that is to be used to supplement the commissioning process, however this document is not to take the place of the commissioning plan.

d) Should the following submission dates not be met, the ENGINEER may delay the commissioning activities at the Contractors cost.

.2 Follow the procedure and schedule unless otherwise agreed.

.3 Inspect all MATERIAL and PRODUCT to ensure that THE WORK is complete, that MATERIAL and PRODUCT are in place and secure, and that the recommendations of the MANUFACTURER/SUPPLIER have been complied with for lubrication, cooling fluids and all other requirements.

.4 Inspect and clean all pipe, vessels and equipment, and all electrical connections.

.5 Submit fully completed and verified Commissioning / Readiness Forms A through E inclusive a minimum of two (2) weeks prior to the programmers arriving on-site for programming.

a) It is recommended that the CONTRACTOR preform a thorough check of all items required in the readiness forms to ensure they are fully complete and deficiency free.

b) Should the work not be complete after sign-off of the forms, standby labour charges of fixed rate $1,200 per day, travel charges including hotels and meals at a fixed rate of $300 per day, and flight charges at cost for the programmer will apply and be charged directly from the ENGINEER to the CONTRACTOR.

.6 Allow three (3) weeks for the ENGINEERS programming and testing of the facility prior to Commissioning / Functional Testing with the Owner.

3. Personnel

.1 Provide competent, experienced, factory trained technical personnel to prepae the commissioning and training plan, supervise the installation, inspection, testing and commissioning of PRODUCT supplied and installed under this CONTRACT.

.2 The CONTRACTOR shall provide and pay for all such personnel, regardless of the length of time required to commission THE WORK.

.3 The CONTRACTOR is to provide a detailed resume of the proposed commissioning lead.

a) The commissioning lead must have experience commissioning a minimum of two sanitary lift stations with a wet well / dry well set-up similar to this lift station. If the CONTRACTOR doesn’t employ personnel that meet the requirements, they are required to contract out the services as incidental to the contract and no separate payment will be made.

4. Testing Individual Equipment – Pre-Commissioning

.1 Every individual item of equipment shall be tested by itself and in combination with related items to ensure that the item and the subsystem are in perfect operating condition, comply with specified requirements and are ready for operation.

.2 All testing, checking, calibration, adjustments, making of connections, setting, lubrication and other requirements shall be carried out and a brief report submitted to the ENGINEER for each item tested individually.

.3 Other sections of the specifications may contain specific testing, cleaning, disinfecting, balancing and operation requirements which are to be followed in conjunction with this Section.

.4 Inspection and testing shall include, but shall not be limited to:

a) soundness - without damaged parts,

b) completeness in all details as specified,

c) correctness of setting, alignment and arrangements of parts,

d) adequacy and correctness of packing, sealing and lubrication.

.5 Pre-Commissioning of the facility is to take place two (2) weeks prior to the final commissioning / functional testing with the Owner to allow for deficiency correction as needed.

.6 The pre-commissioning is to follow the Commissioning and Functional Testing Plan, testing all equipment for functionality.

.7 Pre-Commissioning activities shall be completed as follows:

a) Initial Dry Run with the CONTRACTOR and Trades on-site and deficiencies are to be noted and corrected before the next run.

b) Second Dry Run with the CONTRACTOR, Trades and ENGINEER on-site and deficiencies are to be noted and corrected before the next run.

c) The pre-commissioning runs are to take place until they are completed with all equipment without any deficiencies. Only at this time is the Final Commissioning with the Owner to be scheduled and then completed.

The manufacturer representatives for the primary equipment (pumps, generator, HVAC, Grinder) are to be on-site for the pre-commissioning.

5. Final Commissioning / Functional Testing and Training

.1 Commissioning shall include the Functional Testing and Training with the Owners representative on-site and will be required to accommodate two (2) Operations shifts – Shift 1 on a Tuesday and Shift 2 on a Wednesday.

a) All trades and key equipment suppliers (pumps, generator and grinder) are to be on-site for this training.

.2 During the Commissioning period the CONTRACTOR shall appoint the pre-approved qualified commissioning lead to run the commissioning group of CONTRACTOR'S personnel, SUBCONTRACTOR'S and MANUFACTURER'S / SUPPLIER'S representatives.

.3 Operation of any part of an existing system that is not part of THE WORK shall be performed by the OWNER only.

.4 The ENGINEER may order changes in procedure, operation methods or may take whatever actions are necessary to ensure correct commissioning.

.5 During the commissioning period, the CONTRACTOR shall demonstrate that the operation of the facility as a whole, as well as all components, is correct and in accordance with the CONTRACT requirements.

.6 All components shall be demonstrated over the entire range of operation specified, including variations in flow, pressures, speeds and controls. All malfunctions, alarms, safety devices, interlocks, and annunciation shall be demonstrated by simulation of malfunctions as necessary.

.7 During the commissioning period, the manufacturers reps, trades or qualified and experienced CONTRACTOR personnel are to run through the maintenance procedures of all equipment.

.8 Commissioning shall also include the CONTRACTOR'S operation of the facilities as a complete system for 14 calendar days, followed by the OWNER'S staff operating the facilities under the guidance of the CONTRACTOR for 7 calendar days. These are minimum times based upon demonstration of satisfactory operation.

a) During the initial commissioning period, only the CONTRACTOR shall operate the systems installed in this CONTRACT, and the OWNER'S personnel shall observe and receive operation instructions.

b) During the second period of the commissioning the OWNER'S personnel will operate the facility under the guidance and supervision of the CONTRACTOR. At the end of the commissioning period the OWNER will assume responsibility for operation of the facility pending satisfactory operations of THE WORK items.

.9 If the commissioning is completed with deficiencies that impact the safe and automated operation of the facility, including any outstanding alarm deficiencies, the commissioning is to take place again with the CONTRACTOR, Trades, ENGINEER and OWNER on-site.

END OF SECTION 01650

1. Cleanup

.1 Maintain the working area in a clean and orderly manner as THE WORK progresses, and upon completion of construction, remove all waste materials, and all temporary facilities from the site.

.2 Haul surplus or salvage materials that are the property of the OWNER to the OWNER'S storage site.

.3 Remove surplus or salvaged materials belonging to the CONTRACTOR from the site.

.4 Clean haul routes.

.5 Vacuum clean interior building areas when ready for painting, and continue vacuuming as needed.

.6 Remove grease, dust, dirt, stains, labels, finger prints and other foreign materials from sight on exposed interior and exterior finished surfaces, including glass and other polished surfaces.

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

.8 Broom clean paved surfaces, rake clean other surfaces of ground.

.9 Remove debris and surplus materials from roof areas and accessible concealed spaces.

.10 Remove snow and ice from access to the building.

2. Record Documents

.1 As specified in other sections of the specifications, the CONTRACTOR may be required to prepare and record drawings, to provide survey notes, to supply test results or other documents. Such information shall be turned over to the ENGINEER; as soon as start-up is complete, and before the Construction Completion Certificate is issued.

.2 Record documents shall be neat, legible and accurate.

3. Operation Manuals

.1 Submit the following copies:

a) One (1) digital and editable PDF copy, in keyword searchable format and with an interactive Table of Contents (Bookmark Feature).

b) Three (3) hard copies in extension type catalogue binders bound with heavy weight bright red fabric, hot stamped in silver lettering front and spine.

.1 A 100% complete digital Operation and Maintenance Manuals that have been prepared in strict accordance with the requirements this Section and submitted and reviewed at least twice for the lift station are required to achieve Substantial Completion. The Contractor is to submit early enough to allow 2 weeks for each review.

.2 Operation and maintenance manuals are specified in general in this section, with regard to numbers of binders, preparation, marking, general arrangement, format and general contents. Detailed requirements for mechanical, process equipment, electrical work and other items may be specified in other sections of the specifications, however the general format shall be in accordance with this section.

.3 The binder template is to be submitted as a shop drawing for review and acceptance prior to ordering the binders.

.4 Four (4) months prior to commissioning activities, provide 1 comprehensive draft digital copy of the O&M manual to the ENGINEER for review. This will be reviewed and returned and the Contractor is to then provide a second draft for review two (2) months prior to commissioning for a second review. The contractor is to then update the O&M manual and provide 1 comprehensive draft digital copy of the O&M manual on a laptop or tablet for reference on site during the facility commissioning.

a) Should the following O&M submission dates not be met, the ENGINEER may delay the commissioning activities at the Contractors cost.

.5 Provide the services of qualified and experienced personnel to prepare manuals.

.6 Prepare sets of manuals for various divisions using identical bindings, and the same indexing system and format for all manuals.

.7 Provide 215 x 280 mm extension type catalogue binders bound with heavy weight bright red fabric, hot stamped in silver lettering front and spine. Acropress, Cerlox or similar light weight or special hole binders are not acceptable.

.8 Letter each binder as follows:

<u>Front Face</u>

a) Full identification of title of project
b) Prime consultant - full identification title
c) Sub consultant - full identification title
d) CONTRACTOR - full identification title
e) Sub-contractors - full identification title

Spine
a) Full identification of title of project
b) Copy number

.9 Arrange each individual binder as follows, using coloured divider tabs which shall be laminated mylar plastic and which shall be coloured according to section of the manual.

Each division of the manual ie. mechanical, electrical, process equipment etc. shall be a complete manual and shall in general be in the following format with the divider tabs as noted.

General Information is for the entire project, is to include the information for all disciplines, and is to be only in the front of the first binder.

Title Page

i) Project Name

ii) Owner, Consultant and Contractor Company Contact Information

iii) Index of all divider tabs

Tab 1.0 – General Information

1.1 Owner, Consultant, Contractor and Sub-Contractors Contact Information – Company and Program Manager

1.2 Description and Operations of Systems

1.3 Maintenance & Lubrication Chart

This chart is to be done in excel and is to have the daily, weekly, monthly, quarterly and annually columns for all maintenance activities. The chart shall include all maintenance items for all equipment and not simply reference the shop drawings for the equipment.

1.4 List of suppliers and addresses of same

1.5 List of drawings

Tab 2.0 – Certifications, Permits, Warranties

2.1 Permits

2.2 A,B,C Schedules

2.4 Commissioning Documentation (start-up reports, functional testing document, training sign off sheets, manufacturer site inspections, air balancing report, pressure testing charts and results, etc.) with the documents broken out as separate sub-tabs.

2.5 Substantial Completion Certificate

2.6 Construction Completion Certificate

2.7 Functional Acceptance Certification

2.3 Geotechnical Report

Tab 3.0 Process Control Narrative

3.1 Process Control Narrative (updated after commissioning)

Tab 4.0 Manufacturers Data

4.1 Shop drawings, separated out for each discipline as 4.1, 4.2, 4.3 etc. with sub-tabs for each individual shop drawing.

Tab 5.0 Contract Administration

5.1 RFI's, Clarifications, Field Orders, Change Orders, etc. as separate tabs.

.10 Provide preventive maintenance program if specified in applicable sections.

.11 Provide, in addition to mechanical, electrical equipment details:
- a) Maintenance data for finished surfaces
- b) Copies of hardware schedules
- c) Guarantees, warranties and bonds showing names and addresses of manufacturer and guarantee commencement and expiry date
- d) Valve lists giving numbers, types, service and location.
- e) Certificates and inspection reports by the manufacturers and their representatives.

.12 Provide a turnover package of all digital information including but not limited to:
- a) Automation software including proof of purchase or license information.
- b) Automation programs for equipment including specialized packaged equipment in editable format

END OF SECTION 01700

DIVISION 2 SITEWORK

PART 1 GENERAL

1.1 Description

.1 This section specifies the requirements for the dewatering operations necessary to stabilize excavation and prevent sloughing conditions for the Lift Station Schedules.

.2 Dewatering operations will consist of one or a combination of:

a) Conventional sump and pump systems

b) Well point systems or

c) Alternate method approved by the ENGINEER.

1.2 Related Sections

.1 Trenching - Section 02221.

.2 Excavating and Backfilling - Section 02325

.3 Underground Piping – Section 02650

.4 Pressure Pipe – Section 02713

.5 Horizontal Directional Drilling – Section 02716

1.3 Submittals

.1 Submit shop drawings and details of the proposed dewatering system to the ENGINEER, in accordance with Division 1.

1.4 Sedimentation & Erosion Control Measures

.1 Comply with all requirements and regulations of the Federal Department of Fisheries and Oceans and of Alberta Environment and all other applicable regulations, with regards to sedimentation and erosion control measures. Provide the ENGINEER with a sediment and erosion control plan and report prior to commencement of construction.

.2 Construct, regularly inspect, maintain and repair as necessary, such facilities until such time that the risk of silt and/or deleterious materials entering the storm sewer drainage system for the construction phase has passed.

.3 All decant must be contained in a matter that will ensure that no sediment will enter the stormwater system.

.4 All saw cutting slurry must be contained in a matter that will ensure that none of the materials enter the stormwater system, in accordance with the following:

a) Minimize the amount of water used to cool and lubricate the saw, so as to minimize the amount of slurry generated.

b) Use anti-freeze only if necessary, Use the minimum amount required to prevent water from freezing.

c) Cover manholes to prevent slurry from entering them.

d) Cover/block catch basins to prevent slurry from entering them.

e) Direct saw cutting slurry into an excavation, rather than allowing it to migrate to the catch basin.

f) Contain saw cutting slurry in the immediate work area wherever possible, not allowing it to run across the road and to a catch basins so as to minimize the amount of clean-up after cutting is completed. Containment may be achieved using socks and/or absorbent material.

g) Clean up contained slurry or slurry remaining on the road. Place an absorbent material on the surry and clean up as a solid either manually or by calling a street sweeper; pay all costs for street sweeper). Alternatively, collect as a slurry using an appropriate sized vacuum. (Eg. Vacuum sweeper or Vactor Unit for large amounts of wet/dry vacuum cleaner for small amounts.).

h) Use a sway with a built-in slurry containment system.

i) Dispose of solid clean up material as regular garbage.

j) Dispose of liquid clean-up material appropriately.

1.5 Site Conditions

.1 A geotechnical investigation has been carried out by the OWNER. The CONTRACTOR will be deemed to have examined these reports before submitting a bid.

.2 Check with the soils report and the soils ENGINEER for amounts of ground water which may require pumping.

.3 If conditions are discovered by the CONTRACTOR that varies from those indicated in the documents, notify the ENGINEER.

.4 High groundwater is anticipated at the site, and the excavation is over 10 meters deep with limited room on-site. This will make for challenging conditions during the excavation and the geotechnical report and supplemental memo from November 2021 are to be referenced and the geotechnical engineer Parkland Geotechnical to be contacted for any questions and to gain additional information.

.5 The bid item **"Dewatering"** is provided to include all work required to complete the work and no separate payment will be made for challenging or unexpected sub-surface conditions or groundwater.

.6 Groundwater Levels:

a) The actual groundwater levels at the time of construction may differ from those recorded on the test hole logs. It is recommended that water levels be read again prior to construction, and this cost is considered incidental to the contract.

PART 2 PRODUCTS

1.6 Materials

.1 Equipment: provide sufficient pumps, pipes, hoses and equipment necessary to complete all dewatering and to maintain the excavated surfaces and areas free of water from any source – groundwater or surface water.

.2 The 4" (100mm dia.) pumps are to be trash pumps capable of pumping dirty silty water and are to be of sufficient head for the excavation depth and discharge hose.

PART 3 EXECUTION

1.7 Dewatering

.1 Provide temporary drainage and pumping facilities to maintain excavations and site free of all water from whatever source to the approval of the authority having jurisdiction.

.2 The pumps are to be run 24 hours a day to avoid water in the excavation in the morning causing schedule delays. Sufficient monitoring is required to maintain 24 hour per day dewatering operations and is considered incidental.

.3 Notify the Construction Manager and the ENGINEER's Site Representative immediately of pump breakdowns or other interruptions in the dewatering operations which would be detrimental to construction operations.

.4 Keep excavations free of water and protect open excavations against flooding and damage due to surface run-off, while work is in progress.

.5 Provide for surface drainage during the period of construction in a manner to avoid creating a nuisance to adjacent areas.

.6 Handle discharged water in strict accordance with all applicable environmental regulations and to the satisfaction of the Authority Having Jurisdiction. Dispose of water in a manner not detrimental to public and private property, or any portion of work completed or under construction.

.7 Bear all costs for remedial work, and/or the cost to remove saturated material and install additional material to replace saturated material resulting from the failure to carry out the recommended dewatering techniques.

1.8 Cleaning

.1 Upon completion of WORK, remove pumps, hoses, piping and all other items associated with dewatering.

END OF SECTION 02240

PART 1 GENERAL

1.1 Scope of Work

1.1.1 Work includes but is not necessarily limited to the following items.

1.1.2 Excavation of common material as required to construct structures at design locations and elevations.

1.1.3 Excavation for footings, foundation walls, base slabs, sumps, and other structures and for ditches or swales as shown on the drawings.

1.1.4 Dewatering of excavations.

1.1.5 Disposal of unsuitable or surplus excavated material.

1.1.6 Backfilling around structures and construction of embankments to the extent and limits shown on the drawings.

1.1.7 Compaction requirements for backfill and embankments.

1.1.8 Final grading to the elevations and limits shown on the drawings.

1.1.9 Subbase and base requirements for slabs-on-grade.

1.1.10 Excavate, slope, trim and fill slopes to grades shown on drawings.

1.1.11 Post warning and traffic signs; supply and place barricades.

1.1.12 Protective hoarding.

1.2 Reference Standards

1.2.1 All standards to be latest issue at time of tender.

1.2.2 The National Building Code – 2023 Alberta Edition.

1.2.3 ASTM C117 “Test Method for Materials Finer than 75 µm Sieve in Mineral Aggregates by Washing”.

1.2.4 ASTM C136 “Test Method for Sieve Analysis of Fine and Coarse Aggregates”.

1.2.5 ASTM D698, “Test Methods for Laboratory Compaction Characteristics of Soil using Standard Effort (600 kN•m/m3)”.

1.2.6 ASTM D2922, “Test Methods for Density of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depths)”.

1.2.7 The Workers' Compensation Act, Safety Regulations Governing Building Construction and Demolition (Alberta Building Code).

1.2.8 Safety regulations Governing General Accident Prevention (Alberta Building Code).

1.3 Regulations

1.3.1 Abide by the current bylaws and regulations of the province and/or municipality in which the Work is located, and abide by the current laws and regulations with regard to public safety.

1.3.2 The regulations of the Minister of Labour, Occupational Health and Safety Act, the Workers' Compensation Board and other applicable acts administered by the authority having jurisdiction of the province or territory apply to the Work of this section.

1.4 Definitions

1.4.1 Rock Excavation

.1 Rock is either single boulders, pieces of concrete or masonry with a volume in excess of 1.0 m^3, or any material that cannot be broken by a hydraulic excavator classified as a "Group 17" or greater model in the 2011 ARHCA Equipment Rental Rates Guide & Membership Roster, and equipped with a single tooth ripper, or material which requires for its breakup and removal, drilling and blasting or breaking up with a power operated hand tool.

.2 No soft or disintegrated rock which can be removed with a hand pick; no material which can be ripped by a hydraulic excavator classified as a "Group 17" model or greater in the 2011 ARHCA Equipment Rental Rates Guide & Membership Roster; no loose or previously blasted rock or broken stone and no rock exterior to the minimum limits for measurement allowed, which may fall into the excavation will be measured or allowed.

.3 Frozen material is not classified as rock.

1.4.2 Common excavation

.1 Excavation of materials of whatever nature, which are not excavation of materials with the exception of surface gravel, pavement or rock, is classified as common excavation.

.2 Topsoil: material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.

1.5 Geotechnical Report

1.5.1 Refer to the Geotechnical Investigation – McKay Ranch Lift Station, Blackfalds, Alberta – February 2017, and updated report – November 25, 2021 as included in Appendix A of the contract documents.

1.6 Visit and Examine Site

1.6.1 Visit and examine the site and become familiar with all features, characteristics and existing conditions affecting the Work.

1.6.2 Examine the site to determine the conditions under which the Work is to be done and the amount and type of materials and debris to be excavated.

1.7 Changed Conditions

1.7.1 If the condition of the site sub-surface or of services and utilities are significantly different when work is commenced, relative to the conditions at time of examination prior to bidding, immediately inform the Engineer.

1.8 Existing Structures, Services and Utilities

1.8.1 Confirm and establish the locations and extents of all underground services and utilities in the work area prior to commencement of excavation work. Clearly mark such locations to prevent disturbance or damage.

1.9 Protection

1.9.1 Protect benchmarks, existing structures, services and utilities, both above and below ground, including roads and paving which will or may be damaged by excavation work.

1.9.2 Conform to good construction practice with regard to safety, and comply with the current requirements of the responsible regulatory agencies, such as the Workers' Compensation Board of Alberta and Occupational Health and Safety Act.

1.9.3 Drain away from the site and ensure that water from the site does not discharge into utility lines adjacent to the excavated site to prevent drained water from re-entering the site.

1.9.4 Direct discharge water from dewatering pumps to only those allowable locations as directed by the Engineer so that damage does not occur to the site and adjacent properties. Do not discharge water, containing silt into sewer or storm lines. Notify the Engineer if silts are observed in drainage water.

1.9.5 Protect localized excavations by shoring, bracing, sheet piling, underpinning or by other methods as required to prevent failure of the excavations and injury to personnel.

1.9.6 Protect bottom of excavations and the soil around and beneath footings from frost, rain, snow, standing water and drying, or other deterioration.

1.9.7 Protect all foundations, base slabs, and bearing levels from frost penetration during construction, and extend protection until start-up and commissioning.

1.10 Safety

1.10.1 Carry out excavation and backfill work in accordance with the Alberta Building Code and current Occupational Health and Safety Act construction safety regulations.

1.11 Submittals

1.11.1 Submit a 25 kg sample of each type of imported backfill material specified, for analysis by a testing laboratory. For coarse gravely soil or coarse crushed stone, submit a 75 kg sample of each.

1.11.2 Ship samples prepaid or deliver in tightly closed containers to testing laboratory designated by the Engineer at least one week prior to commencing work.

1.11.3 Costs for analysis are to be paid by the Owner, as part of the Cash Allowance Section 01021 Item 1.4.2.

1.12 Inspection and Testing

1.12.1 Notify the Engineer and testing firm 24 hours prior to commencing backfill work or placing foundations.

1.12.2 Inspection and testing to be done by a testing firm retained and paid for by the Owner and approved by the Engineer in accordance with Section 01400 - Quality Control of these specifications.

1.12.3 Compaction control tests are to be performed in accordance with ASTM D698 for Standard Proctor Density.

1.12.4 The testing firm will prepare the necessary Standard Proctor Density curves and will take as many field tests as are required to properly ascertain compaction of fill. Frequency of testing will be approximately as follows.

1.12.5 One test for each layer of fill for each 30 m of trench for trenches and for grade beams, foundation walls inside the structure areas.

1.12.6 One test for each layer of fill placed for each 30 m of perimeter of all interior pad footings, sumps and pits.

1.12.7 One test per layer of fill placed per 250 m^2 under all foundations, and base slabs within the structure areas.

1.12.8 One test per layer of fill per 500 m^2 for site fill outside the structure area.

1.12.9 The frequency of testing may be reduced at the discretion of the testing agency if compaction procedures prove to be satisfactory.

1.12.10 Assist testing firm by providing the following services:

1.12.11 Secure and deliver to the testing firm, without cost, representative samples of the materials proposed for use that require testing as per this specification.

1.12.12 Provide casual labour as necessary to obtain and handle samples at the site.

1.12.13 The testing firm is to review all backfill material to ensure it is in conformance with the Specifications.

1.12.14 Testing firm is to inspect and verify, in writing, bearing pressures and soil conditions prior to placement of any foundation concrete, granular bases, base slabs, slabs and pavements.

1.12.15 Remove and replace or re-work materials not conforming to the Specifications and drawings as represented by the test results. Re-test the replaced or re-worked materials. The cost of re-testing is to be borne by the Contractor.

1.12.16 Inspection and testing firm to submit to the Engineer a final report certifying that all material requirements, compaction and allowable bearing pressures have been achieved and are in accordance with the contract documents. This report to be submitted under the seal and signature of a professional geotechnical engineer registered in the Province or Territory where the Work is to commence.

1.13 Disposal

1.13.1 All materials on site, whether stockpiled, stored or excavated, are the property of the Owner, and the Owner reserves the right to keep any part or all of the material.

1.13.2 The Contractor shall dispose of debris, waste, unsuitable material, rock or excess material in accordance with the Contract Specifications.

1.13.3 Obtain approval from the disposal sites applicable authorities. Perform disposal in accordance with all applicable regulations and laws. Pay all costs for disposal.

PART 2 PRODUCTS

2.1 Fill and Backfill Materials

2.1.1 Use a single consistent source for the duration of the work for each type of fill material used.

2.1.2 Pit run or crushed gravel: Uniformly graded 75 mm clean, hard, durable coarse gravel free from shale, clay, friable material, organic matter, soluble sulphate concentrations and other deleterious substances graded within the following limits when tested to ASTM C117 and ASTM C136 and approved for intended use by the geotechnical engineer.

Sieve Size (mm)	% Passing by Weight
75	100
50	85 - 100
25	30 - 70
5	25 - 60
0.080	>5

2.1.3 Common Excavation Material

2.1.4 All native material which must be excavated to complete the installations and construction as shown on the drawings, except for topsoil.

2.1.5 Lean mix concrete: 10 MPa at 28 days with maximum slump of 100 mm.

PART 3 EXECUTION

3.1 Preparation

3.1.1 Remove obstructions, ice and snow from surfaces to be excavated within the limits indicated.

3.1.2 Establish building and structure lines and levels. Designate and identify datum elevation.

3.1.3 Erect batter boards as required and securely anchor.

3.1.4 Rough grade to working levels by excavation or backfill from existing grades as required.

3.1.5 Provide sufficient site preparation and grading to ensure that site conditions are adequate to support construction equipment and operations.

3.1.6 Maintain benchmarks, monuments and other reference points and re-establish if disturbed or destroyed at no additional cost to the Owner.

3.2 Stockpiling

3.2.1 Stockpile excavated material within the designated contract boundary for later use as common backfill material.

3.2.2 Protect backfill materials from contamination.

3.3 Services and Utilities

3.3.1 Prior to commencement of final excavation work, establish location and extent of all underground services and utilities occurring in work area.

3.3.2 Protect services and utilities uncovered by excavation.

3.4 Excavation

3.4.1 Excavate to working levels, and maintain clearance around foundations to allow for foundation forming.

3.4.2 Remove obstructions and rock encountered during excavations as required to achieve design foundation and pipe elevations.

3.4.3 Excavate for sump pits, trenches and depressions using appropriate machine methods. Rock excavation may require additional efforts, but blasting is not permitted.

3.4.4 Remove unsuitable material from trench bottom to extent and depth directed by the Engineer.

3.4.5 For deep trench excavation (greater than 2 m), unless otherwise authorized by the Engineer in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation.

3.4.6 Excavate final 200 mm for footings and base slabs by appropriate machine methods to avoid over-excavation.

3.4.7 Excavations are not to encroach on 1 vertical to 1 horizontal splay at bearing from the bottom and edge of any foundation.

3.4.8 Bear all footings and base slabs totally on native sand or till notwithstanding the elevations indicated on the drawings. Bearing pressures to be verified by the geotechnical engineer prior to placing concrete including areas protected with a mat of lean mix concrete.

3.4.9 Where required, excavate to 300 mm below structural slabs to allow for a minimum 300 mm thick drainage layer, compacted to 100% Standard Proctor Maximum Dry Density (SPMDD) as directed by the geotechnical engineer.

3.4.10 For other structures, excavate to 75 mm below the structural slabs, footings, and slabs on grade to allow for a 75 mm thick mat of lean mix concrete as directed by the geotechnical engineer.

3.4.11 Proof-roll all structural subgrades with suitable equipment to detect soft spots under inspection of the geotechnical engineer, and upgrade as directed by the geotechnical engineer.

3.4.12 Excavate and remove rocks over 150 mm in size within 200 mm under structures.

3.4.13 Do not use blasting for excavation, break and remove all rock, sandstone and mudstone by mechanical methods.

3.4.14 Remove all organic material from the structure areas.

3.4.15 Notify the Engineer of any sub-surface conditions that are not as shown on the drawings or in the specifications. Discontinue work in the area until the Engineer provides notification to resume work.

3.5 Backfilling

3.5.1 Do not commence backfilling operations until structures have been inspected and approved by the Engineer in writing.

.1 Ensure all below grade work is completed, inspected and approved prior to commencing backfilling.

.2 Do not use frozen material as backfill material.

.3 Backfill any over-excavations with lean mix concrete fill.

.4 Backfill all process pipes, which are located beneath structural floors, with lean mix concrete. Use crushed gravel for bedding and backfill in the pipe zone for all other process pipes.

.5 Ensure areas to be backfilled are free from debris, snow, ice and water. Do not backfill against frozen ground.

.6 Backfill to bring the site to finished grades using approved common excavated material.

.7 Use approved common excavated material for all other fills except as noted in clauses 3.5.4 and 3.5.5 above.

.8 Unless noted otherwise, place 75 mm of lean concrete immediately below structural slabs.

.9 Place and compact 150 mm of crushed gravel immediately below slabs on grade, sidewalks and exterior concrete pads.

.10 Ensure there is adequate lateral support, as determined by the Engineer, for walls against which backfill is to be placed.

.11 Waterproofing on walls to be protected from damage due to backfilling.

.12 Do not backfill around or over cast-in-place concrete within 24 hours after placing.

.13 Backfill equally against grade beams and underground walls on both sides of all structures to equalize soil pressures.

.14 Place material by hand under, around and over installations until 300 mm of cover is provided. Dumping material directly on installations will not be permitted.

.15 Do not backfill against any liquid retaining structure until all necessary leakage tests have been completed and watertightness criteria has been approved.

3.6 Compaction

.1 Compact all native sub-grades to 98% of Standard Proctor maximum dry density prior to placing fill material.

.2 Compact common fill to bring site to grades: Place common fill in lifts appropriate for the size and type of compaction equipment used to a maximum lift thickness before compaction of 300 mm and compact to a minimum of 98% of Standard Proctor maximum dry density.

.3 Compaction around structures: Place approved material in lifts not exceeding 150 mm, and compact with approved compaction equipment to a minimum of 98% Standard Proctor maximum dry density.

.4 After excavation, the subgrade shall be proof-rolled prior to placement of base course gravel or concrete mud slab.

.5 As required, place an approximate 300 mm thick layer of free draining crushed gravel layer under the base slab. Mechanically compact entire crushed gravel bearing area with vibrating compactor equipment to 100% Standard Proctor maximum dry density.

.6 Provide 75 mm concrete mud slab under all other structural slabs, footings.

.7 Place an approximate 150 mm thick layer of crushed gravel subbase under slab on grades, apron slabs and outdoor concrete pads. Mechanically compact entire crushed gravel bearing area with vibrating compactor equipment to 98% Standard Proctor maximum dry density.

.8 Use only hand-operated power tampers and vibrators for compaction within 1000 mm of walls, grade beams and in the immediate vicinity of any concrete work, pipes, ducts and other underground conduits.

3.7 Shoring/Bracing/Underpinning

.1 Provide all localized shoring, bracing, sheet piling and underpinning required to prevent damage to excavations and injury to personnel.

.2 Comply with all applicable rules and regulations of authorities having jurisdiction.

.3 Protect localized excavations, adjacent structures, services and utilities against cave-ins, shear failure, slides, undermining, erosion and settlement. Erect shoring, cribbing, bracing, sheet piling, planking or underpinning as necessary to provide such protection. Ensure such work does not interfere with operations, and place independent of any footings.

.4 Assume full responsibility for any failure, collapse or movement of shoring, bracing, sheet piling or underpinning, collapse of earth banks, trenches or other excavations.

3.8 Restoration

.1 Upon completion of work, remove surplus materials and debris, trim slopes, and correct defects noted by Engineer.

.2 Clean and reinstate areas affected by work as directed by Engineer.

END OF SECTION 02325

PART 1 GENERAL

1.1 Scope of Work

1.1.1 The Scope of Work shall include design, supply, and installation of all piles, pile caps, and pile extensions.

1.2 Related Sections

1.2.1	Submittals	Section 01300
1.2.2	Quality Control	Section 01400
1.2.3	Concrete Forming and Accessories	Section 03100
1.2.4	Concrete Reinforcing	Section 03200
1.2.5	Cast-In-place Concrete	Section 03300

1.3 Reference Standards

1.3.1 Perform pile foundation work in accordance with the following standards, except where specified otherwise. All standards to be latest issue at time of tender. Provide one copy on site of the first four two standards listed below.

1.3.2 The National Building Code – 2019 Alberta Edition.

1.3.3 Canadian Standards Association (CSA International)

.1 CAN/CSA-G30.18-M92 (R2002), "Billet Steel Bars for Concrete Reinforcement".

.2 CAN/CSA-G40.21-04, "Structural Quality Steels".

.3 CAN/CSA-A3000, "Cementitious Material".

.4 CSA-A283-00, "Qualification Code for Concrete Testing Laboratories" (including Supplement No. 1 - 1987).

.5 CSA W59-03, "Welded Steel Construction (Metal Arc Welding)".

1.3.4 American Society for Testing and Materials International (ASTM)

.1 ASTM A252-98 (2002), "Standard Specification for Welded and Seamless Steel Pipe Piles".

.2 ASTM A252, "Welded and Seamless Steel Pipe Piles".

.3 ASTM D1143-81 (1994) e1, “Test Method for Piles Under Static Axial Compressive Load”.

1.4 Regulations

1.4.1 Abide by the current bylaws and regulations of the province and/or municipality in which the work is located, and abide by the current laws and regulations with regard to public safety.

1.4.2 The regulations of the Minister of Labour, Occupational Health and Safety Act, the Workers' Compensation Board and other applicable acts administered by the authority having jurisdiction of the province apply to the work of this section.

1.5 Geotechnical Report

1.5.1 Refer to the geotechnical report and associated supplements which are included in these specifications.

1.5.2 Ensure the requirements of the geotechnical report and associated supplements are read and understood prior to commencing with work.

1.6 Existing Structures, Services and Utilities

1.6.1 Confirm and establish the locations and extents of all underground structures, services and utilities in the work area prior to commencement of piling work by notifying the applicable owners, authorities or agencies. Clearly mark such locations to prevent disturbance or damage.

1.6.2 Arrange and pay for disconnecting, removing, and capping services and utilities within area of piling work. Disconnect and stub off as required by the authority having jurisdiction.

1.6.3 Place markers to indicate location of disconnected services and utilities. Identify utility and service lines and capping locations on as-built drawings.

1.7 Protection

1.7.1 Protect all underground structures, services and utilities and ensure they are not damaged by piling operations. Repair any damage done to existing structures, services and utilities at no additional cost to the contract. Services indicated on the drawings are in accordance with available records. The Contractor is responsible for verifying all locations in the field.

1.7.2 The Contractor is to undertake a thorough inspection of existing structures and facilities and document any existing damage. The Contractor will be responsible for repairs of any damage caused by piling operations.

1.8 Safety

1.8.1 Carry out piling work in accordance with the current Occupational Health and Safety Act construction safety regulations.

1.9 Qualifications

1.9.1 Engage a professional structural engineer registered in the Province of Alberta, fully qualified and experienced in the design of pile foundations to be responsible for the design of proposed piles and for the supervision of their installation.

1.9.2 The organization undertaking to weld under this section, if required, is to be fully approved by the Canadian Welding Bureau (CWB) under the requirements of CSA W47.1, Division 1 or 2.1 only. Division 3 qualifications are not sufficient.

1.10 Design

1.10.1 Design steel driven piles in accordance to design parameters outlined in the geotechnical report.

1.10.2 Retain a professional engineer, registered in Alberta, complying with the requirements of the Building Code and the Contract Documents, to take responsibility for:

.1 Mix design.

.2 Pile design.

.3 Installation.

.4 Certification of as-built load carrying capacity.

1.10.3 Design pile caps and grade beams in accordance with CSA A23.3 and specifications sections 03100, 03200, and 03300.

1.10.4 Submit design criteria to the Engineer for review.

1.11 Alternates

1.11.1 Alternates will be considered only after closing of tender and will only be discussed with the successful Contractor on the base bid.

1.11.2 Alternates will be subject to:

.1 A thorough review and unqualified acceptance by the geotechnical engineer retained by the Owner.

.2 Evidence that a significant saving will be realized by the Owner.

1.11.3 Contractors will be responsible for additional cost of design checking, re-design, and re-drawing to accommodate the proposed alternate.

1.11.4 Alternates will be judged on the basis of at least vibration and sound transmission to adjacent properties.

1.12 Submittals

1.12.1 Submittals are to be in accordance with Division 1 and in a form sufficiently complete to satisfy any authority having jurisdiction.

1.12.2 Prior to commencing the work, the Contractor's engineer is to submit documentation showing evidence of registration in the Province of Alberta as well as qualifications and experience. The Contractor's engineer is to further acknowledge in writing that he or she has reviewed the specifications and drawings and is aware that he or she is to inspect the fabrication and installation of the work and certify the work at completion.

1.12.3 Submit in writing evidence of qualifications for welding under CWB.

1.12.4 When requested, submit copies of mill test reports properly correlated to the materials used for piling indicating yield and carbon content analysis.

1.13 Shop Drawings

1.13.1 Submit shop drawings in accordance with Division 1 of these specifications.

1.13.2 Clearly indicate the following information:

.1 Pile layout, schedule of installation and placing sequence.

.2 Type of pile, sizes and details.

.3 Load capacity of each pile.

.4 Grade and details of steel and/or reinforcing used.

.5 Elevation of pile bases.

.6 Elevation of top of pile.

.7 Pile cap sizes and details.

.8 Type of cement, air content, slump and concrete strength.

1.13.3 Prepare shop drawings of piles under the seal and signature of the Contractor's professional engineer responsible for this design.

1.13.4 Review of the shop drawings by the Engineer is intended to assist the Contractor and does not relieve the Contractor of responsibility for the completeness and accuracy of the work and its conformance with the contract drawings and specifications.

1.14 Quality Control

1.14.1 The Contractor's professional engineer responsible for this work is to inspect the installation of all piles on behalf of the Contractor in accordance with APEGA "Responsibilities for Engineering Services for Building Projects" dated April 2001.

1.15 Inspection

1.15.1 Full time pile inspection of piling operations will be carried out by an independent geotechnical firm retained by the Contractor and approved by the Engineer in accordance with Section 01400 of these specifications.

1.15.2 Inspection firm is to submit to the Consultant a final report summarizing their inspection and Contractor's degree of compliance with the contract documents and reviewed shop drawings, including any remedial requirements that may have been required during the course of work. This report is to be submitted under the seal and signature of a professional geotechnical engineer registered in the Province of Alberta.

1.15.3 Notify the Contractor's Engineer and inspection and testing firm five (5) business days in advance of starting piling work on site.

1.16 Field Records and Drawings

1.16.1 Maintain accurate records of all piles installed. Records are to include the following:

.1 Locations of piles.

.2 Sequence of placing.

.3 Final base and head elevations.

.4 Sizes and lengths of piles.

.5 Condition of base material.

.6 Date and time of placing piles.

.7 Driving force of each hammer blow.

.8 Identification of piles requiring drilling.

.9 Details of unusual occurrences.

.10 Inspector's name.

1.16.2 Submit three (3) copies of all field records and drawings to the Consultant.

PART 2 PRODUCTS

2.1 Structural Steel

2.1.1 Steel H piles: To CAN/CSA-G40.21, Type W - weldable steel, minimum yield strength of 300 MPa.

2.1.2 Steel pipe piles: To CAN/CSA-G40.21, Type W - weldable steel, minimum yield strength of 300 MPa.

2.1.3 Pile reinforcement caps or shoes: To CAN/CSA-G40.21, Type W - weldable steel, minimum yield strength of 400 MPa.

2.1.4 Cast steel pile driving points: Pruyn Point 75600 by Associated Pile and Fitting Corp. or approved equal.

2.1.5 Welding to conform to the requirements of CSA W59. Do not splice materials without the written approval of the Engineer. Where granted, provide a complete non-destructive examination by a certified inspection and testing firm approved by the Engineer. Show all approved splices on the shop drawings.

2.2 Concrete Materials

2.2.1 Conform to the requirements noted under Concrete Materials in Section 03300 of these specifications and as noted herein.

2.2.2 Cement: To CAN/CSA-A3000 and as per the contract drawings.

2.3 Reinforcement

2.3.1 Reinforcing steel: To CAN/CSA-G30.18, Grade 400 deformed billet steel bars.

2.3.2 Reinforcing steel: To CAN/CSA-G30.18, Grade 400W special low alloy deformed billet steel for welded bars with equivalent carbon content not exceeding 0.5.

2.4 Concrete Mixes

2.4.1 Conform to the requirements noted under Concrete Mixes in Section 03300 of these specifications.

PART 3 EXECUTION

3.1 Preparation

3.1.1 Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by drilled concrete piling operations.

3.2 Installation

3.2.1 Notify the Consultant and inspection and testing firm 24 hours prior to any installations on site.

3.2.2 Ensure site conditions are adequate to support piling equipment and to allow proper performance of pile operations.

3.2.3 Ensure piling equipment is adequate for soil conditions.

3.2.4 Do not use piling methods that could cause damage to nearby or existing structures.

3.2.5 Install piles where indicated on drawings.

3.2.6 Ensure pile shafts are installed vertically and that bases are founded in bearing material indicated in the geotechnical report.

3.2.7 Cast steel driving points shall be installed to protect the pile tips. Protect the heads of all piles while they are being driven by means of steel caps or some other method of reinforcement, if required. Ensure full bearings of piles for proper distribution of hammer blow. Do not damage piles during driving operations.

3.2.8 Hold pile securely and accurately in position while driving. At all times, deliver hammer blows in direct axis of the piles.

3.2.9 Arrange for and allow inspection of pile installation before and while piles are driven.

3.2.10 Drive piles until refusal, as defined by the geotechnical engineer, has been attained, satisfactory to provide the required pile load capacities. Prior to final set, drive piles sufficiently to break or prevent development of freeze. Avoid damaging piles by overdriving when the point of refusal has been reached.

3.2.11 Discontinue piling operations and immediately notify the Engineer in the event that unusual soil conditions are encountered such that pile load capacities cannot be obtained.

3.3 Drilling

3.3.1 Predrilling may be acceptable to facilitate driving only if it has been satisfactorily demonstrated to the Engineer that piling cannot be completed in the regular manner.

3.3.2 Predrill shafts such that the hole diameters are not more than 25 mm larger than the tip dimension. Drill only through the strata obstructing the driving. Stop drilling where hard material extends below the desired penetration level, and set the pile finally by normal driving methods. Do not leave any unfilled shafts overnight.

3.4 Tolerances

3.4.1 Do not deviate from centre of true location more than 50 mm.

3.4.2 Do not deviate from specified head elevations more than 25 mm.

3.4.3 Top of pile elevations shall be within 50 mm of that shown on the Drawings.

3.4.4 Piles shall not exceed 2.0% out of plumb over the pile length.

3.5 Non-Conforming Piles

3.5.1 Non-conforming piles are piles that are placed out of position or are damaged and/or piles not conforming to size, length and material specifications.

3.5.2 Provide additional piles or supplement piles with additional pile caps or grade beams to meet specified requirements as directed by the Engineer at no additional cost to the contract.

3.6 Certification

3.6.1 Certify at completion of work all piles installed by the piling contractor under the seal and signature of the Contractor's professional engineer responsible for this work.

3.6.2 Certify that all piles are capable of developing the capacities specified in the contract specifications and on the drawings.

3.6.3 Certify that all piles are installed in accordance with the contract documents and the reviewed shop drawings.

3.7 Survey Verification

3.7.1 Submit a survey of all pile locations with respect to grid lines. Survey to be carried out by an independent legal surveyor registered in the Province of Alberta.

3.7.2 Each building unit is to be surveyed, and the survey drawings are to be submitted to the Engineer for review prior to construction of formwork of foundation walls and/or grade beams.

3.7.3 The cost of this survey is to be the responsibility of the Contractor.

END OF SECTION 02465

DIVISION 3 CONCRETE

PART 1 GENERAL

1.1 Scope of Work

1.1.1 Include all concrete forms required for concrete placement.

1.2 Work Installed but Supplied under Other Sections

1.2.1 Install materials specified to be supplied under other sections of these specifications. Materials include but are not limited to:

.1 Fabricated components, anchor bolts, bearing plates, sleeves and other inserts to be built into forms.

1.2.2 Ensure installation is to the satisfaction of other sections and of the Engineer prior to placing concrete.

1.3 Reference Standards

1.3.1 Perform concrete forms work in accordance with the following standards, except where specified otherwise. All standards to be latest issue at time of tender. Provide one copy on site of the first two standards listed below.

.1 The National Building Code – 2023 Alberta Edition.

.2 CSA-A23.1, “Concrete Materials and Methods of Concrete Construction”.

.3 CSA-A23.3, “Design of Concrete Structures”.

.4 CSA-A23.4, “Precast Concrete - Materials and Construction”.

.5 BS 8007: “British Standard Code of Practice for Design of Concrete Structures for Retaining Aqueous Liquids”.

.6 ACI 350R, “Environmental Engineering Concrete Structures”.

.7 American Society for Testing and Materials (ASTM) where noted.

.8 Provincial safety standards where applicable.

1.4 Regulations

1.4.1 Abide by the current bylaws and regulations of the province and/or municipality in which the work is located, and abide by the current laws and regulations with regard to public safety.

1.4.2 The codes and regulations of the Minister of Labour, Occupational Health and Safety Act, the Workers’ Compensation Board and other applicable acts administered by the authority having jurisdiction in the Province of Alberta apply to the work of this section.

1.5 Safety

1.5.1 Conform to good construction practice with regard to safety.

1.5.2 Carry out concrete forms work in accordance with the Alberta Building Code.

1.6 Qualifications

1.6.1 Engage a professional structural engineer registered in the Province of Alberta, fully qualified and experienced in the design of formwork and shoring, to be responsible for the design of formwork, scaffolding, shoring, re-shoring and all other components required for formwork erection.

1.7 Submittals

1.7.1 Submit all proposed joint details, locations and construction procedures. Include waterstop, crack inducer, reglet, sealant and joint filler products as required.

1.7.2 Submit responses to all site review reports stating that all reported defects and deficiency items were corrected or stating what action was taken.

1.8 Shop Drawings

1.8.1 Submit shop drawings of formwork, shoring and re-shoring in accordance with Section 01330 under the seal and signature of a professional structural engineer registered in the Province of Alberta.

1.8.2 Clearly indicate materials, sizes, grades, methods of construction, arrangement of joints, ties, shores, falsework, dimensions, spacings, schedule of erection, rate and sequence of concrete placement, stripping requirements and design parameters.

1.8.3 Clearly indicate all pertinent dimensioning, location of reglets and reveals and tie patterns.

1.8.4 Where complicated forms are required, indicate construction methods and materials proposed to achieve clean, smooth or straight concrete lines and smooth even surfaces free from bugholes, honeycombs and cold joints.

1.9 Delivery, Storage and Handling

1.9.1 Deliver all materials to the site in bundles easily identified and properly marked.

1.9.2 Store and handle all form material on site in a manner to prevent damage and contamination.

1.10 Quality Control

1.10.1 The Contractor’s professional engineer responsible for the design of formwork is to inspect the fabrication and erection of formwork in accordance with APEGGA, “Responsibilities for Engineering Services for Building Projects”.

1.10.2 The Contractor is not to assign the responsibility of coordination of forming and placing other required material. Ensure a full-time qualified superintendent representing the Contractor is in attendance to inspect and check all phases of this work.

PART 2 PRODUCTS

2.1 Formwork Materials

2.1.1 Plywood: Wood forms are not considered to be watertight and non-absorptive unless coated or scaled to prevent moisture absorption.

.1 Douglas fir conforming to CSA-O121 or softwood conforming to CSA-O151 as required to resist design loads imposed upon the forming system. Regular grade select tight face. Sound, undamaged sheets with clean, true finish.

.2 Exposed finished concrete (including painted or epoxy-coated concrete): Use medium density overlaid one side. Material to CSA-O121, smooth surface, undamaged sheets with clean, true edges. Re-use no more than five times. Allow Engineer to inspect before each use.

2.1.2 Lumber: Fir or spruce species, #2 Grade or better, conforming to CSA-O141 and to the design requirements of CSA-O86.1 to resist applied loads required of the forming system.

2.1.3 Anchorage devices (including nails, bolts, spikes and lag screws): Sized to ensure all formwork loadings are adequately resisted. Nails, spikes and staples conforming to CSA-B111 galvanized or phosphatized.

2.1.4 Steel forms: Minimum thickness 1.6 mm, well matched, tight fitting and adequately stiffened to support weight of concrete without deflection.

2.1.5 Circular structures to have circular forms and not to be segmented straight sections.

2.1.6 Form ties for concrete below grade which is neither liquid retaining or dry areas below grade to be waterproofed.

.1 Snap off metal ties with metal form spacers, fixed or adjustable length to resist all forces that will break off 40 mm below the surface and permit a flush finish.

2.1.7 Form ties for all interior concrete with unexposed finishes or concrete covered by an applied architectural finish:

.1 Snap off metal ties to resist all forces that will break off approximately 15 mm below the surface and permit a flush finish.

2.1.8 Form ties for all exposed concrete including painted and/or epoxy-coated concrete as indicated in the room finish schedule:

.1 Snap off metal ties with 25 mm length cone to resist all forces to permit a recessed finish. Pattern to be symmetrical acceptable to the Engineer.

2.1.9 Form ties for all liquid retaining structures; tanks and channels, and for dry areas below grade where surfaces are to be waterproofed.

.1 Snap off metal ties with metal form spacers, fixed or adjustable length to resist all forces that will break off 40 mm below the surface and leave 25 mm cone.

.2 Removable form ties that leave through-holes in the water retaining structure are not permitted.

2.1.10 Form Tie Hole Sealant: Non-Shrink Grout for interior exposed concrete or Cementitious Waterproofing for liquid retaining structures and dry areas below grade where surfaces are to be waterproofed.

2.1.11 Form Release Agent: Colourless, non-staining, non-volatile type. For exposed concrete finishes, use low viscosity agent to eliminate bugholes.

2.1.12 Fillets for Chamfered Corners: Minimum 12 mm x 12 mm wood.

2.1.13 Void Form: Closed celled expanded polystyrene complete with void spaces specifically designed to allow frost heave and swelling of soil under concrete without inducing uplift on the concrete. Structurally sufficient to support weight of wet concrete. Use 100 mm thick void form.

2.1.14 Structural Slab on Grade Void Form Protection: Provide plywood or hard board as required over void form to protect the void form from crushing under construction activities and reinforcement chairing.

2.1.15 Void Protection: Wood preserved pressure treated plywood, 12 mm thick by 250 mm high each side of void form to protect void space.

2.1.16 Joint Filler: Use asphalt impregnated fibreboard. Sizes indicated on the drawings.

PART 3 EXECUTION

3.1 General

3.1.1 Perform concrete formwork and falsework in accordance with requirements of CSA-A23.1 unless indicated otherwise on the drawings.

3.2 Formwork Erection

3.2.1 Verify lines, levels and centres before proceeding with formwork. Ensure that dimensions agree with drawings.

3.2.2 Ensure that supplied equipment, hardware, and items to be cast-in will fit concrete dimensions.

3.2.3 Construct formwork, shoring and bracing accurately to meet design and code requirements so that resultant finished concrete conforms to shapes, lines, levels and dimensions indicated on drawings.

3.2.4 Provide bracing to ensure stability of formwork as a whole. Prop or strengthen all previously constructed elements liable to be overstressed by construction loads.

3.2.5 Arrange and assemble formwork so as to permit easy dismantling and stripping so that concrete is not damaged during its removal.

3.2.6 Align joints and make watertight to prevent leakage of mortar and disfigured appearance of concrete. Keep form joints to a minimum. Obtain approval of Engineer for location of form joints in exposed work.

3.2.7 Chamfer external corners and edges of beams, columns and walls 12 mm when exposed or as noted.

3.2.8 Construct formwork to maintain concrete tolerances in accordance with CSA-A23.1, Clause 10 unless closer tolerances are required for special conditions. Refer to drawings for special concrete tolerances.

3.2.9 Camber beams: 0.2% of span unless otherwise noted.

3.2.10 Camber slabs: 0.1% of span for all spans over 3 m.

3.2.11 Apply form release agent on formwork in accordance with manufacturer's recommendations. Apply prior to placing reinforcing steel, anchoring devices and embedded parts. Do not apply form release agent where concrete surfaces are to receive special finishes or applied coverings which are affected by agent. Soak inside surfaces of untreated forms with clean water and keep moist prior to placing concrete.

3.2.12 Do not re-use formwork with surface defects that will impair the appearance of finished concrete. Do not patch formwork. Meet the requirements of Part 2 of this section when re-using formwork.

3.2.13 Obtain approval of Engineer for use of earth forms when not shown on drawings. When using earth forms, hand-trim sides and bottoms and remove loose dirt prior to placing concrete. Increase concrete cover as required to 75 mm minimum.

3.2.14 Provide sufficient space below grade beams and walls for void form and void protection. Place void form prior to reinforcement to ensure specified concrete cover.

3.2.15 Separate slabs on grade from vertical surfaces with 6 mm or 12 mm thick joint filler where indicated on drawings. Extend joint filler from bottom of slab to within space required for joint sealant at finished slab surface.

3.2.16 Form construction joints as indicated on the drawings.

3.2.17 Form construction joints in accordance with CSA-A23.1 at locations indicated on the drawings or with the written approval of the Engineer as follows:

.1 At centre of span of suspended slabs, beams and joists.

.2 In walls directly over centroid of pile or pile cap if applicable.

.3 In grade beams at midspan.

.4 In walls and columns immediately above and below floor construction joints.

3.2.18 Construction joints at centre of span of non-watertight suspended slabs, beams and joists to be adequately doweled and keyed. Maximum concrete placement length for structural slabs to be 35 m unless otherwise indicated. Refer to drawings for construction joint locations and details.

3.2.19 Construction joint spacing in non-watertight walls and grade beams maximum 12 m or as indicated on drawings.

3.2.20 Construction joint spacing in slabs on grade maximum 24 m or as indicated on drawings.

3.2.21 Construction joints spacing in all base slabs maximum 22.5m or as indicated on drawings.

3.2.22 Construction joint spacing in walls of liquid retaining structures or dry areas below grade that are to be watertight are not to exceed 7.5 m and are to be approved prior to construction.

3.2.23 Proposed construction joint locations and details to be approved by the Engineer.

3.2.24 Roughen surface of construction joints to sound concrete, dampen surface, apply cementitious waterproofing and bonding system prior to placing fresh concrete. Procedures specified in Section 03300.

3.2.25 Provide continuous waterstop at all construction joints in liquid retaining structures and dry area below grade structures with high ground water level to 600 mm above the water level and not less than the locations noted on the drawings.

3.3 Forming of Exposed Concrete

3.3.1 The intent of this section is to ensure the formwork is of a high quality to result in exposed concrete surfaces free of unsightly cold joints, blemishes, bugholes, honeycombing and cracking. Acceptable symmetrical joint patterns are mandatory.

3.3.2 Formwork to be in accordance with CSA-A23.1, Clause 27.

3.3.3 Allow Engineer to inspect and approve each section of formwork prior to placing reinforcement.

3.3.4 Control joint and placement break spacings outlined on structural drawings are maximum allowable.

3.3.5 All horizontal and vertical joints are to result in a satisfactory symmetrical pattern approved in advance of forming by the Engineer.

3.3.6 All reglets in walls and railings to also extend over top of the wall or railing.

3.3.7 Caulk or otherwise seal all form joints including corners to prevent bleeding of fines.

3.3.8 Provide reglets to forms at all vertical placement breaks and as indicated or detailed. Caulk reglet formwork to prevent bleeding of fines from concrete.

3.3.9 Replace damaged forms and forms with poor surfaces with new material as directed by the Engineer.

3.3.10 Chamfer all exposed edges and corners.

3.4 Void Form

3.4.1 Ensure void form is in place and not damaged prior to placing concrete (top void form protection is required to protect the void form from construction activities).

3.4.2 Install top void form protection for structural slabs on grade.

3.5 Inserts/Embedded Parts/Openings

3.5.1 Provide formed openings where required for pipes, conduits, sleeves and other work to be embedded in and passing through concrete members.

3.5.2 Refer to architectural, mechanical, electrical, instrumentation and process drawings for sleeves and openings required through structural components. These are not to reduce the structural capacity. Locations and sizes not shown on the structural drawings are to be approved in writing by the Engineer prior to construction.

3.5.3 Maximum size of conduit in structural slabs is 1/5 of solid portion of the slab thickness, and where more than two are adjacent to each other, they are to be spaced 100 mm apart. Conduit is to be placed in the middle third of the slab unless otherwise specified or approved in writing by the Engineer.

3.5.4 Provide recesses in top of foundation walls at all doors and openings to allow slab to bear on walls.

3.5.5 Accurately locate and set in place items that are to be cast directly in concrete.

3.5.6 Coordinate work of other sections and cooperate with the trade involved in forming and/or setting openings, slots, recesses, chases, sleeves, bolts, anchors and other inserts. Do not perform work unless specifically indicated on drawings or approved prior to installation.

3.5.7 Do not place anchor bolts, sleeves and inserts into freshly placed concrete. Tie firmly into place prior to placing concrete.

3.5.8 Install all concrete accessories in accordance with drawings and manufacturer's recommendations, straight, level and plumb. Ensure adequate support to prevent movement during concrete placement.

3.5.9 Ensure all waterstops are continuous and properly installed and sealed watertight.

3.5.10 Ensure all waterstop are securely fastened to prevent folding during concrete placement.

3.5.11 Ensure all openings for pipes or sleeves through liquid retaining structures properly address watertight requirements.

3.6 Cleaning Forms

3.6.1 Clean forms as erection proceeds to remove foreign matter. Remove cuttings, shavings and debris from within forms. Flush completely with water or compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

3.6.2 During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out completed forms unless formwork and concrete construction proceed within a heated enclosure. Use compressed air or other means to remove foreign matter.

3.6.3 Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain. Close temporary ports or openings with tight-fitting panels, flush with inside of forms, neatly fitted so that joints will not be apparent in exposed concrete surfaces.

3.7 Form Removal

3.7.1 Comply with CSA-S269.1 for dismantling all falsework.

3.7.2 Do not remove forms, shores and bracing until concrete has gained sufficient strength to carry its own weight, construction loads and the design loads that are liable to be imposed upon it.

3.7.3 Remove forms not directly supporting weight of concrete as soon as stripping operations will not damage concrete but not before a minimum of three days from final concrete placement to prevent rapid loss of moisture from concrete. Earlier removal may be allowed provided acceptable curing is maintained.

3.7.4 Arrange forms to allow removal without removal of principal shores where these are required to remain in place.

3.7.5 Retain shores and forms under structural members for a minimum of 14 days or until the concrete has attained 75% of the required 28 day strength, whichever occurs later.

3.7.6 Verify strength by field cylinders or insert type tests in accordance with ASTM C900-T.

3.7.7 Remove formwork progressively and in accordance with code requirements so that no shock loads or unbalanced loads are imposed on structure.

3.7.8 Loosen forms carefully. Do not damage concrete by wedging pry bars, hammers or tools against concrete surfaces.

3.7.9 Re-shore structural members as required for design or construction conditions. Construction is to be re-shored to carry all future anticipated construction loading unless otherwise approved in writing by the Engineer.

3.8 Certification

3.8.1 At the completion of formwork and shoring, certify all formwork components have been fabricated and erected by the Contractor under the seal and signature of the Contractor's professional engineer responsible for this work.

3.8.2 Certify that all formwork, shoring and components are capable of supporting all the construction loads and forces required to complete the cast-in-place concrete work.

3.8.3 Certify that all formwork, shoring and components are fabricated and erected in accordance with the reviewed shop drawings.

END OF SECTION

PART 1 GENERAL

1.1 Scope of Work

1.1.1 Include all reinforcement required, for but not necessarily limited to the following areas: Concrete Tanks, Floors Slabs and Slab-on-Grade.

1.2 Work Installed but Supplied under Other Sections

1.2.1 Install materials specified to be supplied under other sections of these specifications.

1.2.2 Ensure installation is to the satisfaction of sections concerned and of the Engineer prior to placing concrete.

1.3 Reference Standards

1.3.1 Perform concrete reinforcement work in accordance with the following standards, except where specified otherwise. All standards to be latest issue at time of tender. Provide one copy on site of the first two standards listed below.

.1 The National Building Code – 2023 Alberta Edition.

.2 CSA-A23.1, “Concrete Materials and Methods of Concrete Construction”.

.3 CSA-A23.3, “Design of Concrete Structures”.

.4 CSA-A23.4, “Precast Concrete - Materials and Construction”.

.5 ACI 350R “Environmental Engineering Concrete Structures”.

.6 BS 8007: “British Standard Code of Practice for Design of Concrete Structures for Retaining Aqueous Liquids”.

.7 American Society for Testing and Materials (ASTM) where noted.

.8 American Concrete Institute Detailing Manual (ACI 315) where noted.

.9 Concrete Reinforcing Steel Institute (CRSI) where noted.

.10 Reinforcing Steel Institute of Canada (RISC), “Manual of Standard Practice, Metric Supplement” where noted.

.11 Provincial safety standards where applicable.

1.4 Regulations

1.4.1 Abide by the current bylaws and regulations of the province and/or municipality in which the work is located, and abide by the current laws and regulations with regard to public safety.

1.4.2 The codes and regulations of the Minister of Labour, Occupational Health and Safety Act, the Workers' Compensation Board and other applicable acts administered by the authority having jurisdiction in the Province of Alberta apply to the work of this section.

1.5 Safety

1.5.1 Conform to good construction practice with regard to safety.

1.5.2 Carry out concrete reinforcement work in accordance with the Alberta Building Code.

1.6 Submittals

1.6.1 Submit mill certificates for reinforcing steel upon request.

1.6.2 Submit results of ladle analysis of all reinforcement to be spliced by welding, and submit manufacturer's information and test reports for mechanical splices of all reinforcement to be mechanically spliced.

1.6.3 Submit responses to all site review reports stating that all reported defects and deficiency items were corrected or stating what action was taken.

1.7 Shop Drawings

1.7.1 Submit shop drawings of reinforcing steel in accordance with Section 01330.

1.7.2 Clearly indicate bar sizes, bending and cut lengths, spacings, locations and quantities of reinforcing steel and wire fabric. Submit bending and cutting schedules and supporting and spacing devices.

1.7.3 Use large scale details for areas of congested reinforcement.

1.7.4 Support and placing details of reinforcing to ACI 315 and RISC.

1.8 Delivery, Storage and Handling

1.8.1 Deliver all materials to the site in bundles easily identified and properly marked.

1.8.2 Store and handle all material on site in a manner to prevent damage and contamination.

1.8.3 Do not straighten or re-bend any reinforcement.

1.8.4 Do not use any reinforcement that has been kinked or bent on site.

1.9 Quality Control

1.9.1 The Contractor is not to assign the responsibility of coordination of placing reinforcing steel and placing other required material. Ensure a full-time qualified superintendent

representing the Contractor is in attendance to inspect and check all phases of this work.

1.10 Inspection and Testing of Reinforcement

1.10.1 The Contractor is to ensure concrete reinforcement is tested by a qualified testing firm.

1.10.2 An independent testing firm may be retained and paid for by The Town and approved by the Engineer in accordance with Section 01452 of these specifications if requested by the Engineer.

1.10.3 The independent testing firm will only provide the minimum testing as required by The Town and does not relieve the Contractor of his responsibility to test all reinforcements to ensure concrete reinforcement work conforms to the requirements of the Contract Documents.

1.10.4 Provide casual labour to the testing firm's field personnel for the purpose of obtaining and handling sample materials. Provide free access to all portions of the work, and cooperate with the testing firm.

1.10.5 Provide samples of reinforcement as delivered to the site for testing if requested.

1.10.6 The Contractor is to inspect and test all concrete reinforcement work to ensure compliance with the Contract Document.

1.10.7 The Contractor's testing firm is to submit to the Engineer certified test results within two days.

PART 2 PRODUCTS

2.1 Reinforcing Materials

2.1.1 Reinforcing steel: To CAN/CSA-G30.18, 400 MPa yield grade deformed billet steel bars.

2.1.2 Reinforcing steel: To CAN/CSA-G30.18, 400W MPa yield grade special low alloy deformed billet steel for welding. The equivalent carbon content is not to exceed 0.5. Grade 400W is to be used where bars are bent and where bars are galvanized to CAN/CSA-G164 as detailed.

2.1.3 Welded steel wire fabric: To CSA-G30.5, flat sheets.

2.1.4 Chairs, bolsters, bar supports, spacers: Adequate strength for support of reinforcing. Metal pipe, stone or wood are not acceptable.

.1 Where concrete is exposed to view, exposed to elements or where rust is possible use plastic or non-corrosive material, or precast concrete made from concrete of equal strength and durability to concrete being placed. Chairs used

are not to result in voids or unacceptable appearance in exposed concrete surfaces.

.2 For liquid-retaining structures and dry areas below grade use precast concrete made from concrete of equal strength and durability to concrete being placed. Chairs used are not to result in voids or unacceptable appearance.

2.1.5 Slab on grade chairs and bar supports: Precast concrete of correct height. Metal pipe, stone or wood are not acceptable.

2.1.6 Tie wire: Minimum 1.6 mm annealed type or patented system approved by the Engineer.

2.1.7 Mechanical splices at locations where reinforcing cannot be lap spliced for compression as for full tension.

2.2 Fabrication of Concrete Reinforcement

2.2.1 Fabricate reinforcement hooks, bends, laps and similar details to CSA-A23.1, ACI Detailing Manual 315 and Metric Supplement of the Reinforcing Steel Institute of Canada (RISC) Manual of Standard Practice and in accordance with the drawings and specifications and the reviewed shop drawings.

2.2.2 Verify dimensions of existing work prior to commencing fabrication.

2.2.3 Verify all drawing dimensions and conditions prior to commencing fabrication.

2.2.4 Bend all reinforcement cold unless otherwise approved by the Engineer.

2.2.5 Provide column and wall dowels from foundations and base slabs using same reinforcing as in columns and walls unless noted otherwise on the drawings.

2.2.6 Provide all additional support bars as required to support all main reinforcement indicated.

2.2.7 Provide stirrup support bars sized to match stirrup size in hooks or corners of beam stirrups unless noted otherwise on drawings.

2.2.8 Provide 10M “U” spacers at 3 m on centre horizontally and 1.5 m on centre vertically to hold wall reinforcing mats in position.

2.2.9 Provide mesh over electrical conduit, ductwork or piping buried in slabs with strips of 102 x 102 x MW13.3 x MW13.3 welded wire fabric 300 mm each side. If principal slab reinforcement is placed above conduit, then place strips under conduit. Position of reinforcing steel takes precedence over conduit, ductwork or piping.

2.2.10 Locate reinforcing splices not indicated on drawings at points of minimum stress. Location of splices is to be approved by the Engineer.

2.2.11 Refer to structural drawings for minimum splices. Splice lengths as indicated on the drawings.

2.2.12 Weld reinforcement where indicated and only by an organization certified under the requirements of CSA-W186. Do not weld reinforcing at any location without written approval of the Engineer.

2.2.13 Test all welded reinforcement splices unless noted.

2.2.14 Provide minimum reinforcing to slabs on grade unless otherwise noted: 100 mm slabs: 305 x 305 x MW66.7 x MW66.7 “step through” mesh. 125 mm and 150 mm thick slabs: 305 x 305 x MW100 x MW100 “step through” mesh. An alternative using tied reinforcing steel providing the equivalent reinforcing value will be considered if approved in writing by the Engineer.

2.2.15 Lap adjacent sheets of welded steel wire fabric to provide an overlap of at least one cross wire spacing plus 50 mm.

PART 3 EXECUTION

3.1 General

3.1.1 Perform concrete reinforcement work in accordance with requirements of CSA-A23.1 unless indicated otherwise on the drawings.

3.2 Placing Reinforcing Steel

3.2.1 Place reinforcing steel in accordance with CSA-A23.1, Clause 12.

3.2.2 Place reinforcement within a tolerance of ±6 mm for slab steel and ±12 mm for other steel. Bends and end of bars to be within 50 mm of specified location. Adequately support and secure reinforcement to prevent movement within the allowable tolerances before and during placing of concrete.

3.2.3 Place and secure all reinforcement in its correct position prior to placing any concrete. Do not adjust or place reinforcement in freshly placed concrete.

3.2.4 Reinforce around openings as noted on structural drawings.

3.2.5 Supply and place all necessary support accessories, whether specifically detailed or not, to ensure proper placement of reinforcing steel.

3.2.6 Use non-corrosive or non-stain supports for reinforcing when concrete is exposed.

3.2.7 Support slab on grade, structural slab, foundation and base slab reinforcement at 900 mm maximum on centre.

3.2.8 Supply bar support chairs for top reinforcing bars in sufficient quantity to not exceed 900 mm average spacing in each direction.

3.2.9 Supply chairs to support temperature reinforcing or mesh to maintain minimum covers specified.

3.2.10 Ensure supports are such that they are not forced into the supporting formwork or soil and do not break or collapse from the weight of reinforcement and other construction loads.

3.2.11 Supply horizontal reinforcing spacers in walls to ensure reinforcing does not move during placement.

3.2.12 Support reinforcement laterally in pairs on opposite faces of walls, columns and beams.

3.2.13 Provide minimum concrete cover to reinforcing steel as indicated on the drawings.

3.2.14 Do not re-bend or straighten reinforcing steel after initial fabrication unless so indicated on the drawings.

3.2.15 Ensure reinforcing is clean, free of loose scale, dirt, oil, rust and other foreign coatings.

3.2.16 Place reinforcement for interior and exterior slabs on grade as indicated on drawings. Place and support uniformly above centre line of the slab, and have a minimum concrete cover of 50 mm.

3.2.17 Place reinforcing for slab on grade on precast concrete chairs or other approved supports at correct height.

3.2.18 Obtain written approval from the Engineer prior to cutting of reinforcing to accommodate openings, or embedded items or to accommodate precast concrete, structural steel or timber connections. Allow for additional splice material which may be required to reinforce these cut bars as directed by the Engineer.

END OF SECTION

PART 1 GENERAL

1.1 Scope of Work

1.1.1 Include all concrete required for but not necessarily limited to the following areas: Concrete Tanks, Floors Slabs and Slab-on-Grade.

1.2 Work Installed but Supplied under Other Sections

1.2.1 Install materials specified to be supplied under other sections of these specifications. Materials include but are not limited to:

.1 Fabricated components, anchor bolts, bearing plates, sleeves and other inserts to be built into concrete.

1.2.2 Ensure installation is to the satisfaction of sections concerned and of the Engineer prior to placing concrete.

1.3 Reference Standards

1.3.1 Perform cast-in-place concrete work in accordance with the following standards, except where specified otherwise. All standards to be latest issue at time of tender. Provide one copy on site of the first two standards listed below.

.1 The National Building Code – 2023 Alberta Edition.

.2 CSA-A23.1, “Concrete Materials and Methods of Concrete Construction”.

.3 CSA-A23.2, “Methods of Test for Concrete”.

.4 CSA-A23.3, “Design of Concrete Structures”.

.5 CSA-A23.4, “Precast Concrete - Materials and Construction”.

.6 CAN/CSA-A3000, “Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004, and A3005).”

.7 BS 8007, “British Standard Code of Practice for Design of Concrete Structures for Retaining Aqueous Liquids”.

.8 ACI 350R, “Environmental Engineering Concrete Structures”.

.9 American Society for Testing and Materials (ASTM) where noted.

.10 Provincial safety standards where applicable.

1.4 Regulations

1.4.1 Abide by the current bylaws and regulations of the province and/or municipality in which the work is located, and abide by the current laws and regulations with regard to public safety.

1.4.2 The codes and regulations of the Minister of Labour, Occupational Health and Safety Act, the Workers' Compensation Board and other applicable acts administered by the authority having jurisdiction in the Province of Alberta apply to the work of this section.

1.5 Safety

1.5.1 Conform to good construction practice with regard to safety.

1.5.2 Carry out cast-in-place concrete work in accordance with the Alberta Building Code.

1.6 Submittals

1.6.1 Submit information on the quality of all proposed concrete making materials and the proposed mix designs for all concrete and grout mix types to the Engineer for approval two weeks prior to their initial use.

1.6.2 Submit data to confirm compatibility of all proposed admixtures with the proposed Portland Cements and supplementary cementing materials.

1.6.3 Submit data sheets for all proposed pre-mixed grouts to the Engineer for review.

1.6.4 Submit samples of fine and coarse aggregate and all admixtures proposed for concrete mixes to the testing firm's laboratory if requested by the Engineer.

1.6.5 Submit all proposed saw cut and joint details, locations and construction procedures. Include waterstop, crack inducer, reglet, sealant and joint filler products as required.

1.6.6 Submit all proposed curing procedures and product data sheets.

1.6.7 Submit proposed methods of protection of concrete when air temperatures are expected to be above 25°C or below 5°C.

1.6.8 Submit proposed procedures for applying separate bonded topping.

1.6.9 Submit details of the proposed bonding system for bonded topping and construction joints.

1.6.10 Changes in concrete mix proportions or source of materials are subject to submission of information on new proposed materials and approval of the Engineer.

1.6.11 Submit responses to all site review reports stating that all reported defects and deficiency items were corrected or stating what action was taken.

1.7 Quality Control

1.7.1 The Contractor is not to assign the responsibility of coordination of placing required material and placing concrete. Ensure a full-time qualified superintendent representing the Contractor is in attendance to inspect and check all phases of this work.

1.8 Inspection and Testing of Concrete

1.8.1 The Contractor is to ensure all concrete is tested by a testing firm certified in accordance with CSA-A283.

1.8.2 An independent testing firm will be retained and paid for by The Town and approved by the Engineer in accordance with Section 01452 of these specifications.

1.8.3 The independent testing firm will only provide the minimum testing as required by The Town and does not relieve the Contractor of his responsibility to test all concrete to ensure concrete work conforms to the requirements of the Contract Documents.

1.8.4 Provide casual labour and appropriate onsite facility to the independent testing firm's field personnel for the purpose of obtaining and handling sample materials. Provide free access to all portions of the work, and cooperate with the independent testing firm.

1.8.5 Advise testing firm 24 hours in advance of concrete placement.

1.8.6 The Contractor is to provide properly designed temperature-controlled storage boxes for test cylinders, as specified in CSA-A23.2-3C, for a period of at least 24 hours and further protection from adverse weather and mishandling until removed from the site. The Contractor is to provide a max-min thermometer for each storage box. Storage of test cylinders in a portable building that will be used by the Contractor's personnel or the Engineer during the first 24 hour storage period will not be permitted. Storage facilities are to be provided, installed, checked and approved by the Engineer before any concrete may be placed.

1.8.7 The Contractor is to secure sufficient 3 and 7-day field cured/laboratory cured test cylinders for testing of concrete to ensure quality control and sufficient strength for application of construction loads and stripping. Cost for these additional tests to be borne by the Contractor.

1.8.8 The Contractor is to inspect and test all cast-in-place concrete work to ensure compliance with the Contract Documents.

1.8.9 The independent testing firm will review information on all concrete making materials and all mix designs submitted and confirm in writing that all mix designs are consistent with the specified concrete strength and durability requirements.

1.8.10 Testing firms are to conduct all tests in accordance with CSA-A23.2.

1.8.11 Samples of concrete to be taken as close to the point of final deposit in the form as possible, at end of pipe when pumping is used.

1.8.12 Sampling of concrete for acceptability tests will be done at the discharge pipe of the concrete pump. The Contractor is to provide a suitable testing station in a location suitable to the Engineer and convenient to the point of sampling. The testing station will be required to be moved from time to time during placement.

1.8.13 Testing firms are to take a minimum of three (3) test cylinders for a strength test.

1.8.14 The independent testing firm will take at least one (1) strength test for each 50 m^3 of concrete, or portion thereof, for each type of concrete placed and not less than one (1) test for each type of concrete placed in any one day.

1.8.15 Testing firms are to moist cure and test one (1) cylinder in 7 days and to moist cure and test the remaining two (2) cylinders in 28 days.

1.8.16 Contractor is to take at least one additional test cylinder during cold weather concreting and cure on job site under same conditions as the concrete it represents.

1.8.17 Testing firms are to take at least one slump test and one air content test for each set of test cylinders taken.

1.8.18 The independent testing firm is to take one slump test and one air test for every third load of concrete placed for liquid retaining structures.

1.8.19 The independent testing firm is to conduct an air void analysis of hardened in-place concrete to determine the spacing factor ($\overline{L}$) of the air void system for Type A1 and A2 concrete.

1.8.20 The Contractor is to obtain an air void analysis of hardened in-place concrete whenever there is a change in the mix design or method of placing concrete.

1.8.21 Testing firms are to report results of tests immediately to the Contractor and the Engineer. The Contractor is responsible for ensuring that the concrete meets the requirements of the specifications. Report adverse test results to the Engineer immediately.

1.8.22 The independent testing firm is not authorized to revoke, relax, enlarge or release any requirements of the specification, nor to approve or disapprove any portion of the work.

1.8.23 Testing firms are to advise placing crew superintendent to halt placing of non-compliant concrete immediately, and thereafter request Contractor to reject the non-compliant concrete. The execution, or lack of execution, of this request is to be recorded.

1.8.24 Testing firms are to submit to the Engineer and Contractor certified copies of test results. Include the following information with the results within two days:

.1 Name of the project.

.2 Date of sampling.

.3 Mix design, specified strength, slump and air content.

.4 Name of supplier, truck and ticket number.

.5 Time batched and time placed.

.6 Identification of sampling and testing technician.

.7 Cement type and admixtures used.

.8 Exact location in the structure of the concrete sampled.

.9 Ambient air and concrete temperatures.

.10 Nominal aggregate size.

.11 Water added and personnel authorizing additional water.

1.8.25 The Contractor's testing firm and the independent testing firm are to submit to the Engineer final reports stating whether all concrete and grout is in accordance with the contract documents. Submit these reports under the seal and signature of a professional engineer registered in the Province of Alberta.

1.8.26 Reject and do not place concrete with slumps greater than maximum specified, air content outside of the specified range and concrete over 2 hours from batch time.

1.9 Aggregate Tests

1.9.1 The Contractor is to conduct tests on and submit the results of each source of proposed aggregates to confirm that the aggregates satisfies all the requirements of CSA-A23.1.

.1 Alkali Aggregate Resistivity (AAR).

- Alberta aggregates are known to be at least moderately reactive with respect to AAR.

- All concrete mix designs are to be prepared to take into account AAR durability as per guidelines in CSA-A23.2 method 27A.

1.9.2 For the proposed aggregates for concrete mix Type A and Type B, the Contractor is to conduct and submit the results of the following aggregate tests, in addition to the tests identified above for each source of aggregates to be used:

.1 Resistance to degradation of small size coarse aggregate by abrasion and impact in the Los Angeles Machine as per CSA-A23.2. The abrasion loss is not to exceed 30%.

.2 Petrographic examination of aggregates for concrete as per Ministry of Transport of Ontario (MTO) Specification LS616 for fine aggregate and LS609 for coarse aggregate.

- Petrographic evaluation of aggregate samples is to be conducted by an experienced concrete petrographer employed by a CSA certified concrete testing laboratory with the results certified by a professional geologist, geological engineer, or professional engineer.

- The weighted petrographic number is to be between 100 and 125, and the ironstone content is not to exceed 0.8%.

1.9.3 If the fine aggregate consists of a blend from more than one source, the fine aggregate sieve analysis is to show the gradation of the blended fine aggregates. Similarly, in the case of blended coarse aggregates, the coarse aggregate sieve analysis is to indicate the gradation of the blended coarse aggregates.

1.9.4 All aggregate tests are to be conducted by an approved independent third party laboratory certified in accordance with CSA-A283 to Category II. Following completion of all tests, the laboratory is to declare that the aggregate is fully acceptable for the intended use and that it will provide good long-term performance. All test results and evaluations are to bear the seal of a professional engineer registered in the Province of Alberta.

1.9.5 Aside from the potential expansivity test, the analyses of the aggregates are to be current. Sampling and testing are to be done not more than 90 days prior to concrete production unless otherwise approved by the Engineer. Additional analyses of more recent sampling are to be provided periodically if so directed.

1.9.6 All costs associated with these specified aggregate tests are to be borne by the Contractor.

1.10 Inspection and Testing of Grout

1.10.1 The Contractor is to ensure all grout is tested by a testing firm certified in accordance with CSA-A283.

1.10.2 An independent testing firm will be retained and paid for by The Town and approved by the Engineer in accordance with Section 01452 of these specifications.

1.10.3 The independent testing firm will only provide the minimum testing as required by The Town and does not relieve the Contractor of his responsibility to test all grout to ensure grout work conforms to the requirements of the Contract Documents.

1.10.4 The independent testing firm will test one set of cubes with a minimum of six (6) cubes for each day's production on all types of grout used in accordance with ASTM C109.

1.11 Inspection and Testing of Topping or Benching Bond

1.11.1 The Contractor is to ensure the tensile bond between topping and substrate is tested by a certified testing firm.

1.11.2 An independent testing firm will be retained and paid for by The Town and approved by the Engineer in accordance with Section 01452 of these specifications.

1.11.3 The independent testing firm will only provide the minimum testing as required by The Town and does not relieve the Contractor of his responsibility to test all bond strength to ensure bond strength conforms to the requirements of the Contract Documents.

1.11.4 Test bond strength in accordance with CSA Test Method A23.2-6B.

1.11.5 The independent testing firm will test bond strength at a frequency of one test for each 200 m^2 or less of area.

1.12 Acceptability

1.12.1 Failure to comply with the requirements of these specifications will result in the structure being considered potentially deficient.

1.12.2 Strength evaluation tests and analysis:

.1 The Engineer may order an independent testing firm to obtain cores, x-rays or similar non-destructive tests where evidence points to a potentially deficient structure.

.2 The Engineer may order a load test and/or analysis, as defined by CSA-A23.3, if the non-destructive tests are impractical or inconclusive.

1.12.3 Pay all costs for the evaluation tests and additional engineering analysis required:

.1 To demonstrate the adequacy of a structure that does not meet the requirements of these specifications or the drawings.

.2 For a structure that has been placed before formwork and reinforcing have been made available for review by the Engineer.

1.12.4 Reinforce by additional construction or replace as directed by the Engineer at Contractor's expense concrete that is judged inadequate by structural analysis or by results of load tests.

1.12.5 Revise mix design proportions as required for the remainder of the work.

1.12.6 The Engineer may order further additional testing to the above at any time even though the required tests indicate that the strength requirements have been met. In this instance, The Town will pay for those tests that meet the specified requirements, and the Contractor will pay for those that do not.

1.12.7 Concrete in place not meeting air content or slump specifications as tested is to be replaced or protected by remedial measures to the satisfaction of the Engineer at no cost to The Town.

PART 2 PRODUCTS

2.1 Cementing Materials

2.1.1 Portland cement: to CSA-A3001 Type GU normal Portland cement, Type HS high sulphate resistant. The cement is not to contain a total sodium oxide equivalent in excess of 0.6% by mass.

2.2 Supplementary Cementing Material

2.2.1 Fly ash is to be a Type F or Type CI pozzolan and is to meet the requirements identified in CSA-A3001.

2.3 Aggregates

2.3.1 For all concrete mix types, the fine aggregates are to conform to the requirements identified in CSA-A23.1 for the specified exposure class.

2.3.2 For all concrete mix types, the coarse aggregates are to conform to the requirements identified in CSA-A23.1 for the specified exposure class. The aggregates are to meet the Group 1 gradation requirements listed in CSA-A23.1.

2.3.3 The source of the aggregates and the method of manufacture or production, including the type of equipment used, is not to be altered for the duration of the project following the acceptance of the aggregates unless a new source is approved and accepted by the Engineer as per requirements of this section.

2.4 Water

2.4.1 Water for use in concrete production and curing is to be clean and free from injurious amounts of oil, acid, alkali, soluble chlorides, organic matter, sediment or any other deleterious substances as per CSA-A23.1.

2.5 Admixtures

2.5.1 Air-entraining admixtures are to conform to the requirements of ASTM C260. The admixture is to be of uniform consistency and quality within each container and from shipment to shipment.

2.5.2 Water-reducing admixtures are to conform to the requirements of ASTM C494, Type A or D. The admixture is to be of uniform consistency and quality within each container and from shipment to shipment.

2.5.3 Superplasticizers, if approved by the Engineer, (high-range water reducers) are to conform to the requirements of ASTM C494, Type F or G.

2.5.4 Waterproofing admixture: Kryton's KIM-HS or approved equal.

2.6 Concrete Mixes

2.6.1 Design all concrete mixes and pay for all costs associated with the development of the mix designs. Ensure the mix designs provide adequate protection against AAR deterioration as per provisions of CSA A23.2 Method 27A.

2.6.2 Supply concrete in accordance with CSA-A23.1, Clause 16, Table 13, Alternative 1, except that the additional requirements of this specification are also to apply.

2.6.3 Use only such materials or blends of materials that will result in a uniform colour of exposed surfaces.

2.6.4 Design concrete mixes that will be placed by concrete pump for pumping.

2.6.5 In the event that slump and/or air content are outside the specified tolerance range as determined by the inspection and testing firm appointed by The Town, the Engineer may, at his sole discretion, accept a proposal for one adjustment of the deficient condition as an alternate to rejection.

2.6.6 In the case of concrete mixes with superplasticiers, the Contractor will be allowed to adjust only the quantities of superplasticizers and air entrainment agent. Addition of water to the batch will not be permitted. In no case will approved batch adjustment relieve the Contractor of responsibility for the eventual durability, strength and acceptability of the concrete concerned. The Engineer reserves the right to reject any batch in the event of confirmed unacceptability and to require immediate removal of any concrete from this batch that has already been placed in the structure.

2.6.7 For the mass concrete mixes used in structural sections, with thickness greater than 500 mm:

.1 The temperature of the mix is to be maintained below 18°C maximum temperature by including ice or liquid nitrogen to the mix at the plant, as approved by the Engineer and as supervised by the Contractor's testing firm, taking care to maintain the design water/cementing materials ratio.

.2 The maximum placement concrete temperature of 18°C is specified to ensure that the peak concrete temperatures do not exceed 50°C during curing and that the temperature gradients do not exceed 20°C total and temperature rise or drop do not exceed a maximum heating and cooling rate of 2°C/hour.

.3 Mass concrete is to satisfy the requirements of CSA A23.1 Table 18.

.4 The maximum placement temperature can be increased to 25°C provided the above temperature requirements are met.

2.6.8 Supply concrete in accordance with CSA-A23.1 with properties as specified in the Concrete Mix Table in the Contract Drawings General Notes.

2.6.9 Water-soluble chloride ion content in exposure class C-1 concrete before exposure is not to exceed 0.06% by mass of cementing material.

2.6.10 Aggregate size specified is the maximum nominal size.

2.6.11 Cement: Use Type GU for all concrete except pre-cast concrete wet well and concrete benching.

2.6.12 Minimum cement content:

.1 350 kg/m^3 for watertight or liquid-retaining structures.

.2 335 kg/m^3 for all concrete subjected to deicing salts and freeze thaw exposure.

2.6.13 Fly Ash:

.1 Concrete mixes with greater than 25% fly ash are not recommended for flatwork requiring a steel trowel finish or flatwork exposed to deicing salts and freeze-thaw.

.2 Concrete mixes with greater than 30% fly ash to be designed with a substantial reduction in water.

2.6.14 Slump: No slumps outside the range of maximum or minimum will be permitted without written permission of the Engineer.

2.6.15 Air Content: All mix types with exposure classifications to be air-entrained in accordance with the above table and CSA-A23.1.

2.6.16 Use a water-reducing agent in all concrete.

2.6.17 Do not change concrete mix proportions or source material for concrete without written approval of the Engineer.

2.6.18 Use only non-chloride based accelerating admixtures in cold weather only when approved by the Engineer. If approved, the use of admixtures will not relax cold weather placement requirements.

2.6.19 Do not use calcium chloride or admixtures containing calcium chloride in any concrete.

2.6.20 Use set-retarding admixtures during hot weather with written approval of the Engineer to prevent cold joints in concrete.

2.6.21 Use all admixtures in strict accordance with the manufacturer’s recommendations.

2.6.22 Do not use non-specified admixtures unless approved in writing by the Engineer. Where superplasticizers are thus approved, ensure mix designs are correctly adjusted for placement, strength, durability and air content requirements.

2.6.23 Documentation indicating the compatibility of the water reducing admixture, the air entraining admixture, the superplasticizing admixture (if any) and the Portland cement and the supplementary cementing materials is to be submitted with the mix design for review by the Engineer.

2.6.24 Add waterproofing admixture to all walls and bottom slabs in all liquid retaining structures as indicated on drawing. For Kryton's KIM-HS use 2% weight of cementitious material.

2.7 Storage and Handling of Materials

2.7.1 Cement and supplementary cementing materials proposed are to be stored in a suitable weather-tight building that will protect these materials from dampness. All cementing materials to be free from lumps at all times during use in the work. All cementing materials stored for a length of time resulting in the hardening or formation of lumps not to be used in the work.

2.7.2 All aggregates are to be handled so as to prevent segregation and to obtain uniformity of materials. The separated aggregates and the aggregates secured from different sources are to be piled in separate stockpiles. The site of the stockpiles is to be cleaned of all foreign materials and is to be reasonably level and firm. If the aggregates are placed directly on the ground, material is not to be removed from the stockpile within 150 mm of the ground level. This material is to remain undisturbed to avoid contaminating the aggregate with the ground material.

2.8 Grout Mixes

2.8.1 Epoxy grout: Non-shrink, high strength compound consisting of epoxy resins, hardeners and non-metallic aggregate for exterior use. Pre-mixed in strict accordance with the manufacturer's instructions to obtain a minimum compressive strength of 50 MPa in 28 days.

2.8.2 Dry pack grout: Non-shrink compound consisting of non-metallic aggregate and water. Mixed with sufficient water for the mixture to make a sound, solid pack and capable of developing compressive strength of 35 MPa at 28 days.

2.8.3 Non-shrink grout: Pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents. Pre-mixed in strict accordance with manufacturer's instructions to obtain a minimum compressive strength of 16 MPa in 24 hours and 50 MPa in 28 days. Acceptable non-shrink grouts:

.1 Masterflow 713 Grout.

.2 Master Builders Set Non-Shrink Grout.

.3 Sika Grout 212.

.4 CPD Non-Shrink Grout.

.5 Sonogrout.

2.9 Concrete Curing

2.9.1 Liquid membrane-forming curing compound: To ASTM C309. Must be compatible with dustproofing and hardening agents, floor hardeners and any sealers or waterproofing used.

2.9.2 Membrane Curing Compound - Sealtight 1220, white pigmented curing compound by Meadows.

2.9.3 Monomolecular Film – Confilm by Master Builders Technologies. Use mixture of one part Confilm to five parts water.

2.10 Hardeners

2.10.1 Non-metallic Surface Hardener: To provide a high strength; high impact, abrasion and slip resistant finish, for medium duty traffic conditions. Pre-mixed for a dry shake application using Portland cement and mineral aggregates with a MOH hardness of not less than 7 to produce a minimum compressive strength of 50 MPa. Colour to be concrete grey. Acceptable non-metallic hardeners:

.1 Sika Durag Premium

.2 Target Synthetic Floor Hardener

2.10.2 Use non-metallic surface hardener for top surface of all floor slabs of Service Areas and Lower Levels.

2.10.3 Apply hardener where indicated in the Room Finish Schedule. Do not use where epoxy flooring is indicated in the schedules.

2.10.4 Apply surface hardeners in strict accordance with the manufacturer's recommendations and cure concrete as specified herein.

2.10.5 Do not use surface hardeners on concrete with air entrainment contents greater than 3%.

2.10.6 Follow the manufacturer's recommendations when using surface hardeners on concrete containing fly ash or slag.

2.11 Sealers:

2.11.1 Silane Floor Sealer: Cappar Capseal U, Masterseal SL silane sealers containing a minimum of 40% solids by weight. Use on exterior exposed slabs.

2.12 Sandblasting

2.12.1 Sandblast sand: Fine granular material, hard, strong durable mineral particles conforming to CSA-A179.

2.12.2 Sandblast equipment: Capable of delivering 5.6 m^3 of free air at 0.69 MPa pressure, complete with filters, hoses and nozzles that can be regulated to ensure an even finish as approved by the Engineer.

2.13 Waterproofing

2.13.1 Cementitious waterproofing: Refer to Section 07160.

PART 3 EXECUTION

3.1 General

3.1.1 Perform cast-in-place concrete work in accordance with requirements of CSA-A23.1 unless indicated otherwise on the drawings.

3.2 Placing Concrete

3.2.1 Notify Engineer and independent testing firm a minimum of 24 hours prior to commencement of any concrete placement. Allow time for corrective work for areas of unusual formwork and congested reinforcement.

3.2.2 Notify independent inspection and testing firm's geotechnical engineer to inspect and verify all soil conditions and bearing pressures of all foundations prior to placing concrete for mudslabs or foundations.

3.2.3 Do not place concrete against frozen ground, frozen concrete or frosted forms.

3.2.4 Place concrete in accordance with CSA-A23.1 and as specified herein.

3.2.5 In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and set solidly with non-shrink grout or as specified on the drawings. The holes for the inserts are to be thoroughly cleaned.

3.2.6 Ensure all hardware and all other items to be cast into concrete are placed securely and will not cause undue hardship in placing concrete.

3.2.7 Ensure all waterstops are securely fastened to concrete or securely wired to reinforcing to prevent misalignment, folding or movement during concrete placement. Maintaining the integrity and correct position of waterstops is critical to the performance of the structure.

3.2.8 When placing concrete by pumping, grout or mortar used to lubricate the pump is to be wasted and not allowed to be placed into forms.

3.2.9 Placing Concrete at Expansion Joints:

.1 Ensure joints are properly dimensioned and prepared as indicated on drawings.

3.2.10 Placing Concrete at Construction Joints:

.1 Ensure joints are properly dimensioned and prepared as indicated on drawings, in accordance with A23.1 Clause 23.4 and as specified herein.

.2 Previously placed concrete surfaces are to be roughened to hard sound concrete and cleaned as soon as possible after placing concrete or stripping forms and properly cured. Do not use acid to clean substrate.

.3 After reinforcement and accessories are in place and prior to placing final forms, soak existing concrete surface for 12 hours or sufficiently long to obtain a saturated condition.

.4 Immediately prior to placing concrete remove excess water from existing concrete to obtain a saturated surface-dry condition and immediately apply cementitious waterproofing as per Section 07135.[1]

.5 For vertical joints of slabs; immediately scrub in the approved grout bonding system to the existing concrete surface as per CSA A23.1 and before the grout stiffens place concrete. Do not use plain latex as the bonding system.

.6 Vertical construction joints of walls can be constructed without the grout bonding system, however, the cementitious waterproofing is to be used.

.7 For horizontal walls: immediately place final forms followed by placing a thin cushion of structurally compatible grout, as per CSA A23.1, and then immediately followed by concrete placement.

3.2.11 Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints and other critical items are not disturbed during concrete placement.

3.2.12 Revise, re-seat and correct improperly positioned reinforcing hardware and other embedded items immediately before concrete placement.

3.2.13 Ensure specified concrete cover around reinforcing is maintained.

3.2.14 Do not place concrete older than 2 hours from batch time.

3.2.15 Do not add water after batching unless in strict accordance with CSA-A23.1, Clause 18.4.3 and such that concrete conforms with the specified mix design parameters.

3.2.16 Place concrete and screed in accordance with the lines and levels indicated on the drawings. Note special finish concrete tolerances indicated on the drawings.

3.2.17 Place concrete in approximate horizontal layers such that each lift can be vibrated into the previous lift.

3.2.18 Maximum vertical free fall of concrete is not to exceed 1200 mm in unexposed work or 800 mm in exposed work or in liquid retaining structures. Confine concrete with a suitable vertical drop pipe to prevent segregation.

3.2.19 Place concrete directly into its final position in forms. Do not spread concrete with vibrators.

3.2.20 Compact concrete thoroughly by mechanical vibrators. Ensure concrete is worked around reinforcement, embedded items and into all areas and corners of forms.

3.2.21 Use internal vibrators in all sections that are sufficiently large, and supplement with external type in the event that satisfactory surfaces can not be obtained.

3.2.22 Check and re-adjust formwork to required lines and levels during placement of concrete.

3.2.23 Place concrete as a continuous operation, stopping only at construction joints.

3.2.24 Allow a minimum of three days between adjacent concrete placements.

3.2.25 Place concrete in liquid-retaining structures with extreme care and extra effort.

3.2.26 Consolidate and screed floors and slabs on grade level in accordance with CSA-A23.1, Clause 22, maintaining surface flatness as required for final floor finish. Pitch to drains 20 mm per meter nominal or as indicated on the drawings.

3.2.27 Place building slabs on grade as one continuous placement between construction joints indicated on drawings. Sawcut control joints for each placement by sawing a continuous minimum 25 mm deep slot, and at least 1/3 of the slab thickness at maximum 4.5 m centres each way unless otherwise indicated on the drawings. Sawcut as soon as the concrete has sufficiently hardened to prevent ravelling of the edges, but in no case later than 24 hours after the concrete has been placed.

3.2.28 Use cold weather concreting methods in accordance with CSA-A23.1, Clause 21 when the mean daily temperature falls below 5°C, and use hot weather methods when the mean temperature rises above 25°C.

3.2.29 Maintain accurate records of concrete placement. Record date, location of placement, quantity, air temperature and test samples taken. Make records available on request.

3.3 Placing of Exposed Concrete Walls

3.3.1 Limit length of concrete placement to prevent cold joints.

3.3.2 Do not place concrete from one end for full height of placement.

3.3.3 Use sufficient vibration equipment and methods to ensure dense, smooth concrete lines and surfaces free from bugholes, honeycombs and cold joints.

3.3.4 Ensure vibrator penetrates each layer of fresh concrete to prevent stratification.

3.3.5 In hot weather, use set retarding agents to prevent cold joints with permission of the Engineer.

3.4 Separate Concrete Toppings and Benching

3.4.1 Prepare surface of previously-placed concrete substrate in accordance with CSA-A23.1 to create a roughened surface for adequate bond, except do not use acid for surface preparation of the substrate. Remove any loosened or delaminated concrete.

3.4.2 Remove all dust from the prepared surface by first using water then vacuuming after the surface is dry.

3.4.3 Contact the Engineer for inspection of the prepared surface immediately prior to application of the bonding system.

3.4.4 Thoroughly saturate the concrete substrate with clean water for a minimum of 12 hours, and allow to surface-dry. Remove any standing water after saturation period.

3.4.5 Apply the approved bonding system to the substrate in accordance with the provisions of CSA-A23.1. Do not use latex in the bonding system.

3.4.6 Place concrete topping or benching to required lines and levels indicated on drawings to a tolerance of +5 mm to -0 mm. Place within timing per bonding agent's manufacturer's instructions. Refer to drawing for special concrete tolerances.

3.4.7 Start placement of topping at centre and work to outside in 300mm sections at a time.

3.4.8 Use the secondary clarifier mechanism as a template to set the top of the topping elevation.

3.4.9 Finish and moist-cure topping or benching as specified in other clauses. Any joints in the substrate are to be matched in the topping.

3.4.10 The tensile bond strength between topping and substrate is to be minimum 0.9 MPa at 28 days as tested in accordance with CSA Test Method A23.2-6B.

3.5 Finishing Flatwork

3.5.1 Finish flatwork in accordance with timing and procedures outlined in CSA-A23.1.

3.5.2 Flatness and levelness to be in accordance with CSA-A23.1, Table 19, Class A for liquid retaining structures. Refer to drawings for special concrete tolerances.

3.5.3 Scratch finish: For all concrete slabs to receive a bonded topping or benching, final finish surface to produce 5 mm deep, closely spaced grooves to a true plane not exceeding a 10 mm gap under a three metre straight edge placed in any direction.

3.5.4 Float Finish: For all concrete slabs to receive insulation board, waterproof membrane, or cementitious waterproofing, final finish surface with a power float to a true plane not exceeding a 10 mm gap under a three metre straight edge placed in any direction.

3.5.5 Steel Trowel: For all concrete floor slabs to be left exposed, final finish surface with a power trowel to a true plane not exceeding a 5 mm gap under a three metre straight edge placed in any direction.

3.5.6 Concrete slabs in liquid retaining structures including topping and benching with air entrainment: Float finish followed by hand steel trowel to a true plane not exceeding 5 or 10 mm gap under a three meter straight edge placed in any direction. Do not overwork surface to prevent scaling. Do not power float or power trowel. Do not commence finishing until all bleed water has evaporated.

3.5.7 Concrete slabs to be used for vehicle and pedestrian traffic: Rough finish surface by floating manually to the specified slope, ensuring positive slope into all drains. Do not overwork surface to prevent scaling. Do not power float or power trowel. Finish surface to a medium broom finish. Do not commence finishing until all bleed water has evaporated.

3.5.8 Broomed Finish: For all exterior concrete slabs to have non-slip surfaces, final finish surface after trowelling with fine broom finish.

3.5.9 Repair all surfaces with unacceptable finishes or excessive variation by grinding and/or filling as approved by the Engineer at Contractor's expense.

3.5.10 Floor Hardeners: Apply in strict accordance with the manufacturer's recommendations to surface of all slabs.

3.6 Curing and Protection

3.6.1 Moist cure and protect concrete in general accordance with CSA-A23.1, Clause 21, and as stated in this specification. Curing is to begin immediately after the completion of the placing and finishing operation. Curing process is to provide the moisture and temperature conditions for a period necessary to develop strength, durability and other required properties. The minimum curing requirements for the concrete are stated in the clauses that follow.

3.6.2 Basic Curing, Type 1: Moist cure at a minimum temperature of 10°C for three (3) days or for the time required to obtain 40% of the specified 28 days strength.

3.6.3 Additional Curing, Type 2: Moist cure at a minimum temperature of 10°C for a total seven (7) days or for the time required to obtain 70% of the specified 28 day strength.

3.6.4 Extended Curing, Type 3: Continuously moist cure (concrete surfaces not allowed to dry) at a minimum temperature of 10°C for a minimum total of ten (10) days. All formed structures requiring the extended curing are to be kept in forms for a minimum of three (3) days. After removal of forms, curing for the remaining seven (7) days is to consist of a combination of the acceptable extended curing methods.

3.6.5 Protect concrete from sudden temperature changes as noted in CSA-A23.1.

3.6.6 Liquid retaining structures to be moist cured for a minimum of 10 days. Loosen wooden forms to allow water to run down inside.

3.6.7 Acceptable Basic or Additional curing methods: Curing Types 1 and 2:

.1 Ponding or continuous sprinkling.

.2 Absorptive mat or fabric kept continuously wet.

.3 Curing compounds approved by the Engineer for type and rate of application.

.4 Waterproof paper or plastic film.

.5 Non-absorptive and watertight forms left in contact with concrete. Wood forms are not considered watertight unless coated or sealed to prevent moisture absorption.

.6 Other moisture-retaining method approved by the Engineer.

3.6.8 Acceptable Extended curing methods: Curing Type 3

.1 Ponding or continuous sprinkling.

.2 Absorptive mat or fabric kept continuously wet.

.3 Non-absorptive and watertight forms left in contact with concrete. Wood forms are not considered watertight unless coated or sealed to prevent moisture absorption.

.4 Other moisture-retaining method approved by the Engineer.

.5 Membrane curing compound, Sealtight 1220, applied within one (1) hour of form removal or discontinuing of other approved curing method, at a rate of four (4) sq. m/litre.

3.6.9 Where curing compounds are approved, apply in two applications at right angles to each other.

3.6.10 Do not use curing compounds on concrete surfaces to receive topping, hardener, sealer or other type of bonded finish unless approved by the Engineer. Confirm that the coatings and curing compound are compatible.

3.6.11 Protect freshly placed and consolidated concrete against damage or defacement from curing methods or adverse weather conditions.

3.6.12 Exterior concrete to be properly cured and protected and allowed to air dry for 30 days prior to application of de-icing chemicals.

3.6.13 Exposed concrete walking surfaces not to receive an integral hardener: Coat with curing compound of type that provides permanent seal.

3.6.14 During hot weather, curing process begins immediately after finishing. Use continuous water applications or absorptive mats.

3.6.15 No concreting is to be allowed until all materials required for the curing and protection phase are on site and ready for use.

3.7 Defective Concrete

3.7.1 Immediately after removing forms, all concrete surfaces are to be inspected. Report any imperfect joints, voids, stone pockets and other defective areas to the Engineer at once and repair before the concrete is thoroughly dry. Defective areas are to be chipped away to a depth of not less than 25 mm past the defective concrete with the edges perpendicular to the surface. The area to be repaired and a space at least 150 mm wide entirely surrounding it are to be wet to a saturated surface-dry condition to prevent absorption of water from the repair material.

3.7.2 The repair is to be made of the same material and of the same proportions as used for the concrete, except that the coarse aggregate is to be omitted, and cement added to match the colour of the surrounding concrete. The amount of mixing water is to be as little as consistent with the requirements for handling and placing. The mortar is to be re-tempered without the addition of water by allowing it to stand for a period of one hour, during which time it is to be mixed with a trowel to prevent setting.

3.7.3 The repair material is to be thoroughly compacted into place and screeded off to leave the repair slightly higher than the surrounding surface. It is then to be left undisturbed for a period of one to two hours to permit initial shrinkage before being finally finished. The repair is then to be finished to match the adjoining surface and cured to the requirements noted in this specification.

3.7.4 Watertight structures with honeycombing or embedded debris are not acceptable. Remove and replace concrete between construction joints.

3.7.5 Report any shapes and lines outside the specified tolerances and repair or correct as directed by the Engineer.

3.8 Finishing Formed Surfaces

3.8.1 Finish concrete in accordance with CSA-A23.1. Ensure all concrete finishes are uniform.

3.8.2 Rough-Form Finish: Concrete surfaces not exposed to view including walls of liquid-retaining structures below grade. Seal tie holes with non-shrink grout or where concrete is to be watertight with cementitious waterproofing, repair defects and remove fins exceeding 5 mm.

3.8.3 Smooth-Form Finish: Horizontal concrete surfaces exposed to view including ceilings and soffits. Surfaces to be smooth, hard and uniform texture free from raised grain, torn surfaces, worn edges, patches, dents or other defects impairing the texture. Seal tie holes with non-shrink grout or where concrete is to be watertight with cementitious waterproofing, repair defects and remove all fins.

3.8.4 Sack-Rubbed Finish: Concrete surfaces exposed to view unless sandblasted including tunnel, pumphouses, service areas, and stairs and all vertical exposed surfaces including tanks, exteriors and interiors to 300 mm below grade and liquid levels. Seal tie holes with non-shrink grout or where concrete is to be watertight cementitious waterproofing, repair defects and remove all fins. Rub saturated surface with premixed mortar using clean burlap pads in strict accordance with CSA-A23.1 by an experienced person to fill all surface voids for a smooth, even, uniform finish.

3.8.5 Do not parge.

3.8.6 Waterproofed Surfaces Form Finish: Concrete surfaces to be waterproofed. Surfaces to have an open capillary system prepared in accordance with Section 07160. Surfaces to be free from raised grain, torn surfaces, worn edges, patches, dents or other defects impairing the application or effectiveness of the waterproofing. Seal tie holes with cementitious waterproofing, repair defects as recommended by the manufacturer of waterproofing and remove all fins.

3.9 Surfacing and Finishing

3.9.1 Surface finishes are to be classified as follows:

.1 Class 1: Ordinary surface finish.

.2 Class 2: Sack rubbed finish.

.3 Class 3: Floated surface finish.

.4 Class 4: Trowel finish.

.5 Class 5: Broomed finish.

.6 Class 6: Sandblast finish.

3.9.2 All formed surfaces are to receive as a minimum a Class 1 finish. Other finishes are to be as indicated in the specifications.

3.9.3 Class 1 - Ordinary surface finish:

.1 Immediately following the removal of forms, all fins and irregular projections are to be removed from all surfaces except from those that are not to be exposed. On all surfaces, the cavities produced by form ties and all other holes, honeycomb spots, broken corners or edges and other defects are to be thoroughly cleaned, and after having been kept saturated with water for a period of not less than three hours, it is to be carefully pointed and trued with mortar of cement and fine aggregate mixed in the portions used in the grade of concrete being finished. Mortar used in pointing is not to be more than one hour old. The mortar patches are to be cured as specified under “Curing”. All construction and expansion joints in the completed work are to be left carefully tooled and free from all mortar and concrete. The joint filler is to be left exposed for its full length and with clean and true edges.

.2 The resulting surfaces are to be true and uniform. All surfaces that cannot be repaired to the satisfaction of the Engineer are to be rubbed as specified for Class 2 – Sack rubbed finish.

3.9.4 Class 2 – Sack rubbed finish: Required for exposed surfaces unless sandblasted:

.1 After removal of forms, the rubbing of concrete is to be started as soon as conditions permit. Immediately before starting this work, the concrete is to be kept thoroughly saturated with water for a minimum period of three (3) hours. Sufficient time is to have elapsed before the wetting down to allow the mortar used in pointing of defects to thoroughly set. Surfaces to be finished are to be rubbed with a medium coarse carborundum stone using a small amount of mortar on its face. The mortar used is to be composed of cement and fine sand fixed in the proportion used in the concrete being finished. Rubbing is to be continued until all of the form marks, projections and irregularities have been removed, all voids have been filled and a uniform surface has been obtained. The paste produced by this rubbing is to be left in place at this time.

.2 After concrete above the surfaces being treated has been cast, the final finish is to be obtained by rubbing with a fine carborundum stone and water. This rubbing is to be continued until the entire surface is of a smooth texture and uniform colour.

.3 After the final rubbing is completed and the surface has dried, it is to be rubbed with burlap to remove loose powder and left fee from all unsound patches, paste, powder and objectionable marks.

3.9.5 Class 3 - Floated surface finish: Required for all unexposed top surfaces.

.1 After the concrete has been compacted, the surface is to be carefully rodded and struck off with a strike board to conform to the cross-section and grade shown on the drawings. Proper allowance is to be made for camber if required. The strike board can be operated longitudinally or transversely and is to be moved forward with a combined longitudinal and transverse motion, the manipulation being such that neither end is raised from the side forms during the process. A slight excess of concrete is to be kept in front of the cutting edge at all times.

.2 After striking off and consolidating, the surface is to be made uniform by longitudinal or transverse floating or both.

.3 After floating has been completed and the excess water removed, but while the concrete is still plastic, the surface is to be tested for trueness with a straight edge. Any depression found is to be immediately filled with fresh mixed concrete, struck off, consolidated and refinished. High areas are to be cut down and refinished. The final surface is to conform to the required grade and contour such that the deviation is not greater than 6 mm under a 3 m straight edge.

3.9.6 Class 4 - Trowel finish: Required for all exposed top surfaces that are not to receive a broomed finish.

.1 After the concrete has been deposited in place, it is to be compacted and the surface struck off by means of a strike board. The surface is to be made uniform, dense and free from voids by wood trowel floating. When the concrete has hardened sufficiently, the surface is not to vary by more than 3 mm under a 3 m straight edge.

.2 It is then to be trowelled to a smooth, dense finish using a steel trowel.

3.9.7 Class 5 - Broomed finish: Required for sidewalk and walkway surfaces and approach slabs.

.1 After the concrete has been deposited in place, it is to be compacted and the surface struck off by means of a strike board. The surface is to be made uniform, dense and free from voids by wood trowel floating. When the concrete has hardened sufficiently, the surface is not to vary by more than 3 mm under a 3 m straight edge.

.2 When the concrete has hardened sufficiently, the surface is to be given a broomed finish. The strokes of the broom are to be square across the slab with adjacent strokes slightly overlapped so as to produce regular corrugations not over 3 mm in depth.

.3 Sidewalk surfaces are to be laid out in blocks with an approved grooving tool as shown on the drawings or as directed by the Engineer. An edging tool is to be used along all edges of the sidewalks.

3.9.8 Class 6 - Sandblast finish: Required to roughen construction joints, to prepare and clean surfaces to receive waterproofing or sealers or finish exposed surfaces as indicated on the drawings.

.1 A medium sandblast finish for exposed finished surfaces. This finish is intended to give a uniform texture to the concrete but not to expose the coarse aggregate.

.2 Prior to applying a sandblast finish, prepare test panels on concrete that is to be backfilled or not exposed. No sandblasting is to be done until such time as the test panels meet with the satisfaction of the Engineer as to texture and conformity.

3.10 Grout

3.10.1 Mix to flowable consistency, and apply in accordance with manufacturer's instructions.

3.10.2 Install epoxy grout in all exterior handrail, davit and equipment base plates during erection.

3.10.3 Install dry pack grout as required under column and beam base plates.

3.10.4 Install non-shrink grout as required under columns, beams and equipment pads, and for doweling to existing concrete.

3.11 Sealers

3.11.1 Silane sealer: To be applied by an approved applicator competent in application of sealers in strict accordance with the manufacturer's recommendations and directions. Apply Capseal U at a rate of 284 ml/m^2 and Masterseal SL at a rate of 222 ml/m^2.

3.12 Joint Sealants

3.12.1 Refer to Section 07920 for Joint Sealants.

3.12.2 Seal base of all form tie holes in exposed concrete surfaces using non-shrink grout or cementitious waterproofing.

3.12.3 Place cementitious waterproofing in below-grade and liquid retaining structure wall construction joint reglets.

3.13 Sandblasting

3.13.1 Conform to the requirements of the Portland Cement Association for sandblasting of concrete surfaces.

3.13.2 Use only competent and qualified workers experienced in sandblasting techniques with adequate plant and equipment.

3.13.3 Protect from damage all surfaces not scheduled for sandblast finish. Make good any damaged surfaces to the satisfaction of the Engineer.

3.13.4 Hoard around work area and prevent air-borne products from contaminating or damaging new construction or other existing work.

3.13.5 Apply the sandblast finish to a designated area of concrete surface. Match the approved sample panel. This sample area is to be done in the presence of the Engineer, and the approval is to be given prior to the continuance of the work. The entire sandblasted surface is to match this approved sample area.

3.13.6 Schedule sandblasting operations with placement of concrete so that the most economical procedures can be used and the desired finish attained with minimum interference with other trades.

3.14 External Fastening and Coring

3.14.1 Do not core concrete without prior written approval of the Engineer.

3.14.2 Do not drill inserts or drive power actuated fasteners into structural concrete without prior written approval of the Engineer.

3.15 Carbon Monoxide Producing Equipment

3.15.1 Do not place concrete for floor slabs if carbon monoxide producing equipment has been in operation in the building or temporary enclosure during the 12 hours preceding the start of concreting.

3.15.2 Provide positive ventilation during the 12 hours preceding the start of concreting.

3.15.3 Do not operate carbon monoxide producing equipment in the building or temporary enclosure during or within 24 hours after completing the finishing of any floor slab section. If necessary, provide adequate provisions to exhaust all carbon monoxide outside the enclosure.

3.16 Testing of Watertightness of Concrete Structures

3.16.1 Do not proceed with the watertightness test until the concrete structure is completed and the concrete has attained the specified 28 day strengths.

3.16.2 Do not backfill around structures or apply gasproofing membranes, damproofing, membrane waterproofing, masonry, veneers or joint sealants until leakage and gas tests have been successfully completed.

3.16.3 Provide clean potable water to fill tanks. Do not use high pressure effluent water to fill tanks.

3.16.4 Non-potable Planttreated effluent water at ambient pressure can be used in place of potable water if potable water is not readily available, refer to Section 01510.

3.16.5 If effluent water is used, be responsible for cleaning the liquid retaining structure of all silts and dirt and where leaks are to be repaired clean the repair area thoroughly prior to proceeding with repair work.

3.16.6 Monitor inlets and outlets for leakage and under drain discharges for increases in flow during filling operations.

3.16.7 Fill all structures to contain liquid with clean potable or effluent water where accepted. Fill tanks and channels only to design level elevations and in sequences as directed by the Engineer.

3.16.8 Leave for 96 hours prior to testing for leakage.

3.16.9 Measure any loss of water or leakage during the next 24 hour period.

3.16.10 The Engineer will calculate allowances for evaporation from open tanks on the basis of field conditions during testing.

3.16.11 Where permissible, an allowable leakage is to be measured as a drop in the water elevation over the 24 hour period and will be determined based on actual service intended for the structure being tested. The allowable leakage for the respective structure is to be in accordance with the table following.

3.16.12 Maximum allowable leakage for the various structures is tabulated as follows:

Item	Maximum Allowable Leakage in a 24 Hour Period
Liquid retaining structures such as tank walls and base slabs subject to external high groundwater	Nil
Liquid retaining structures such as tank walls	0.1% of Liquid Volume

3.16.13 No leakage or sweating whatsoever of the structure forming drywell will be permitted.

3.16.14 Empty structure, examine, locate and repair all defects and leaks at Contractor's expense.

3.16.15 Plug and make completely watertight all visible leaks in items requiring nil leakage at Contractor's expense.

3.16.16 Remedy all leaks in excess of maximum specified at Contractor's expense. Re-test structure at Contractor's expense after repairing until leakage is less than maximum specified.

3.16.17 Place sealants after all requirements for watertightness have been met as noted on the drawings.

3.16.18 Watertightness testing schedule:

.1 Perform tests on individual tanks to ensure that all walls including interior walls and slabs are subjected to liquid on one side only to confirm watertightness of each wall or slab.

.2 Schedule and perform tests such that all individual tanks, chambers, and channels are tested for watertightness.

3.16.19 Test and ensure watertightness for all concrete structures designed to hold water; channels, chambers, wet wells and tanks, including the following:

.1 Secondary Clarifiers;

.2 All channels, tanks and chambers constructed or modified during construction;

3.17 Cleaning

3.17.1 Repair, remove and clean all drips and smears resulting from the work of this section on exposed, finished surfaces or surfaces to be subsequently finished.

3.17.2 Hose down sandblasted surfaces. Brush thoroughly with a stiff broom to remove all dust and loose particles.

END OF SECTION

CONCRETE FINISHING

PART 1 GENERAL

1.1 References

1.1.1 American Concrete Institute (ACI):

.1 ACI 117/117M-10 (R2015), ACI Manual of Practice: Specifications for Tolerances for Concrete Construction and Materials, (ACI 117-10) and Commentary.

.2 ACI 301-16, Specification for Structural Concrete.

.3 ACI 302.1R-15, ACI Manual of Practice: Guide for Floor and Slab Construction.

1.1.2 American Society for Testing and Materials International (ASTM)

.1 ASTM C881/C881M-15, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete

.2 ASTM C979/C979M-16, Standard Specification for Pigments for Integrally Colored Concrete

1.1.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-25.20-95, Surface Sealer for Floors.

1.1.4 Canadian Standards Association (CSA)

.1 CSA-A23.1- 05/A23.2-14, Concrete Materials and Methods of Concrete Construction/Testing Methods and Standard Practices for Concrete, Includes Update No. 1 (2015).

1.1.5 International Concrete Repair Institute (ICRI)

.1 ICRI 310.2R-2013, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings and Polymer Overlays and Concrete Repair – Guide Only

1.1.6 South Coast Air Quality Management District (SCAQMD), California State

.1 SCAQMD Rule 1113-16, Architectural Coatings.

1.1.7 Standards

.1 As applicable

1.2 Action Submittals / Informational Submittals

1.2.1 Submit product data in accordance with Division1 General Requirements.

.1 Submit manufacturer's printed product literature, specifications and data sheet for each product specified.

.2 Submit WHMIS MSDS - Material Safety Data Sheets. WHMIS MSDS acceptable to Labour Canada and Health and Welfare Canada for concrete floor treatment materials. Indicate VOC content.

.3 Include application instructions for concrete floor treatments.

1.2.2 Submit closeout data in accordance with Division1 General Requirements.

.1 Provide manufacturer's printed recommendations for general maintenance, including cleaning instructions and submit a complete list of floor care products that will be required for on-going maintenance.

1.3 Quality Assurance

1.3.1 Performance Requirements

.1 Product quality and quality of work in accordance with Division1 General Requirements.

.2 Submit written declaration that components used are compatible and will not adversely affect finished flooring products and their installation adhesives.

1.4 Waste Management And Disposal

1.4.1 Separate and recycle waste materials in accordance with Division1 General Requirements.

1.5 Environmental Requirements

1.5.1 Temporary lighting:

.1 Minimum 1200 W light source, placed 2.5 m above floor surface, for each 40 sq m of floor being treated.

1.5.2 Electrical power:

.1 Provide sufficient electrical power to operate equipment normally used during construction.

1.5.3 Work area:

.1 Make the work area water tight protected against rain and detrimental weather conditions.

1.5.4 Temperature:

.1 Maintain ambient temperature of not less than 10 degree C from 7 days before installation to at least 48 hours after completion of work and maintain relative humidity not higher than 40% during same period.

1.5.5 Moisture:

.1 Ensure concrete substrate is within moisture limits prescribed by flooring manufacturer.

1.5.6 Safety:

.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.

1.5.7 Ventilation:

.1 Arrange for ventilation system to be operated during installation of concrete floor treatment materials by use of approved portable supply and exhaust fans.

.2 Ventilate enclosed spaces in accordance with Section Division1 General Requirements.

.3 Provide continuous ventilation during and after coating application.

PART 2 PRODUCTS

2.1 Materials

2.1.1 Patching and Flash Patching Materials: Cementitious based, polymer modified, fine aggregate, single component, rapid curing, early strength floor patching compounds having high adhesion with manufacturer's recommended primer and surface profile; for application in thicknesses to a minimum of 4 mm to 25 mm, and as follows:

.1 Acceptable Materials:

.1 GenPatch, Custom Building Products

.2 NXT Patch, Laticrete

.3 Planitop 18 ES, MAPEI Inc.

.4 SD-P, Ardex

.5 SikaQuick 1000, Sika

.6 Sealtight Meadow-Crete H, W.R. Meadows

.7 Approved Equivalent

2.2 Crack Repair Materials

2.2.1 Crack repair and filler: two-component, nonshrink, 100% solids, moisture-insensitive, VOC free, and meeting the requirements of ASTM C881.

.1 Basis-of-Design:

.1 Planibond EBA, MAPEI Canada Inc.

.2 Approved Equivalent

2.3 Hardeners

2.3.1 Type: 1, Sodium silicate, permanent penetrating sealer and hardener

.1 Liquid applied, water based, chemically reactive.

.2 Non-toxic, non-flammable, and anti-dusting have low or no VOC.

.3 Colour: as selected by the Owner/Owner's Representative.

.4 Acceptable Materials:

.1 Ashford Formula, Curecrete

.2 Euco Diamond Hard, Euclid Chemical Company

.3 Mapecrete Hard SB, Mapei Inc.

.4 Pentra-Hard, Dayton Superior Corporation

.5 Seal Hard, L&M Construction Company

.6 Sealtight Liqui-Hard, W.R. Meadows

.7 Sikafloor 3S, Sika Canada

.8 Approved Equivalent

2.3.2 Water: potable.

2.4 Sealing Compounds

2.4.1 Surface sealer: to CAN/CGSB-25.20, Type 1 - solvent-based.

.1 Surface sealers manufactured or formulated with aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, hexavelant chromium and their compounds are not acceptable.

.2 Surface sealer shall be compatible with the hardener and shall be manufactured by hardener manufacturer.

.3 Surface sealer shall have less than 100g/l of VOC in accordance with SCAQMD Rule #1113.

2.5 Chemical-Resistant Coatings

2.5.1 Chemical resistant coating as specified herein, as indicated on drawings and as required.

.1 Product by Sika or approved equivalent, chemical resistant, compatible and suitable for the project.

.1 Primer: Sikagard WDE Primer applied @ 10 mils w.f.t

.2 First coat: Sikagard CRV 20 applied @ 15 mils w.f.t.

.3 Second coat: Sikagard CRV 20 applied @ 15 mils w.f.t.

.2 For vertical surfaces, three coats of Sikagard CRV 20 @ 10 mils w.f.t. per coat as recommended by the manufacturer.

2.6 Mixes

2.6.1 Mixing, ratios and application in accordance with manufacturers instructions.

PART 3 EXECUTION

3.1 Examination

3.1.1 Prepare floor surface in accordance with CSA A23.1.

3.1.2 Verify that slab surfaces are ready to receive work and elevations are as instructed by manufacturer.

3.2 Repairs

3.2.1 Inspect surfaces for defects immediately after removal of forms. Repair or patch defects within 48 hours of removal of forms with cure repairs same as new concrete with Owner/Owner’s Representative permission.

3.2.2 Defective Areas: where patches are allowed, repair and patch areas to match surrounding areas in texture and colour.

3.3 Application: General

3.3.1 After floor treatment is dry, seal control joints and joints at junction with vertical surfaces with sealant.

3.3.2 Apply floor treatment in accordance with Sealer manufacturer's written instructions.

3.3.3 Clean overspray. Clean sealant from adjacent surfaces.

CONCRETE FINISHING

3.3.4 Cure concrete in accordance with manufacturers recommended procedures.

3.4 Application: Liquid Applied Floor Hardener

3.4.1 Apply liquid floor hardener in accordance with manufacturer's written instructions after initial floating.

3.4.2 Cure concrete in accordance with manufacturer’s recommended instructions.

3.4.3 Apply hardener to horizontal and vertical exposed concrete to remain unfinished.

3.5 Protection

3.5.1 Protect finished installation in accordance with manufacturer's instructions.

3.6 Maintenance

3.6.1 Provide training to Owners representative based on written manufacturers instructions as indicated in Division1 General Requirements.

END OF SECTION

PART 1 GENERAL

1.1 Description

1.1.1 This section applies to the design of precast concrete structures including the lift station wet well.

1.2 Related Work Specified in Other Sections

.1 Conform to the requirements noted under Section 03300 and as noted herein.

.2 Submittals and Shop Drawings Section 01300

.3 Quality Control Section 01400

.4 Concrete Formwork Section 03100

.5 Concrete Reinforcement Section 03200

.6 Cast-in-Place Concrete Section 03300

1.3 Reference Standards

1.3.1 Perform cast-in-place concrete work in accordance with the standards listed in Section 03300 and as noted herein, except where specified otherwise. All standards to be latest issue at time of tender. Provide one copy on site of the standards listed below.

.1 CSA-A23.4, “Precast Concrete Materials and Construction”.

.2 CAN/CSA-G40.21, “Structural Quality Steels”.

.3 CAN/CSA-S16, “Limit States Design of Steel Structures”.

1.4 Qualifications

1.4.1 The organization undertaking to manufacture and erect under this section is to be fully qualified and certified by the CSA under the requirements of:

.1 CSA Certificate of Qualification - Precast Concrete Program, to manufacture precast concrete to CSA Standard A23.4 in the categories specifically required for this project.

.2 CSA-W47.1, Division 1 and 2.1 only.

.3 CSA-W186.

.4 Weld Inspection: The organization undertaking to perform weld inspection under this section is to be fully approved by the Canadian Welding Bureau under the requirements of CSA-W178.1.

1.4.2 Engage a professional structural engineer registered in the Province of Alberta, fully qualified and experienced in the design of precast concrete, to be responsible for the design of this precast concrete.

1.4.3 Perform precast concrete work in accordance with the requirements of CSA-A23.4 unless indicated otherwise herein.

1.5 Design

1.5.1 Design precast concrete products in accordance with the current Alberta Building Code, under the direct supervision of a professional engineer registered in the Province of Alberta, fully experienced in the design of precast concrete products.

1.5.2 Design products and supports to withstand their own weight for stripping, handling and erection to prevent any cracking or damage.

1.5.3 Design products to withstand all forces and design loads due to wind, temperature, earthquake, live and dead loads.

1.5.4 Design products to be completely sealed and watertight.

1.5.5 Design precast concrete products based on soil conditions and ground water conditions, for information refer to geotechnical report.

1.6 Tolerances

1.6.1 Conform to the requirements of CSA-A23.4, Clause 10.

1.7 Quality Control

1.7.1 The Contractor's professional engineer responsible for the design of precast concrete is to inspect the fabrication and erection of these items in accordance with APEGGA, "A Guideline - Responsibility for Structural Design on General Engineering and Building Projects" dated December 1987.

1.7.2 Provide the Engineer with certified copies of quality control tests related to this project as specified in CSA-A23.4.

1.8 Inspection and Testing of Concrete, Reinforcement and Grout

1.8.1 Test in accordance with Section 03300.

1.9 Submittals

1.9.1 Prior to commencing the work, the manufacturer's engineer is to submit documentation showing evidence of registration in the province, plus qualifications and experience. The manufacturer's engineer is to further acknowledge in writing that he or she has reviewed the specifications and drawings and is aware that he or she is to inspect the fabrication and installation of the work and certify the work at completion.

1.9.2 Submit copies of all design calculations, if requested, to the Engineer for review.

1.9.3 Submit in writing evidence of qualification for precast concrete work under the CSA and for welding under the CWB.

1.9.4 Submit evidence of ability to weld reinforcing steel in accordance with CSA-W186.

1.9.5 Submit methods of handling and erecting precast concrete products.

1.9.6 Submit all erection proposals to the Engineer for review prior to commencing work.

1.10 Shop Drawings

1.10.1 Submit shop drawings in accordance with Section 03300 and as noted herein.

1.10.2 Submit shop drawings of concrete products, reinforcing steel, connection details and formwork in accordance with Section 01300 and CSA-A23.4.

1.10.3 Clearly indicate product locations, fabrication details, unit identification marks, connection details, dimensions, relationship to adjacent elements, lifting and erection devices, sleeves and openings.

1.10.4 Clearly indicate erection details, sequence of erection and grouting methods.

1.10.5 Clearly indicate formed and unformed surfaces and the extent of all specified finishes.

1.10.6 Clearly indicate product weights and concrete strengths required for design.

1.10.7 Clearly indicate loads used for design.

1.10.8 Prepare shop drawings of all components and products designed by the manufacturer under the seal and signature of the manufacturer's professional structural engineer.

1.10.9 Submit shop drawings of temporary bearings and temporary bracing signed and sealed by a professional engineer registered in the province of Alberta.

1.10.10 Review of the shop drawings by the Engineer is intended to assist the manufacturer and does not relieve the manufacturer of his or her responsibility for the completeness and accuracy of his or her work and its conformance with the contract drawings and specifications.

1.11 Warranty

1.11.1 The manufacturer hereby warrants that the precast structural products will not spall or show visible evidence of cracking in accordance with parameters outlined in the General Conditions of these specifications for five years.

1.12 Protection

1.12.1 Protect members from damage caused by field erection and welding operations. Provide non-combustible shields during these operations.

1.13 Handling, Storage and Transportation

1.13.1 Handling, storage and transportation to be in accordance with Section 03300 and as noted herein.

1.13.2 Conform to the requirements of CSA-A23.4.

1.13.3 Deliver all materials to the plant or site in bundles easily identified and properly marked.

1.13.4 Store and handle all material in the plant or on site in a manner to prevent damage and contamination.

1.13.5 Handle all precast concrete products in a position consistent with their shape and design. Do all lifting and supporting only from approved lifting and supporting points.

1.13.6 Ensure lifting or handling devices are capable of supporting the product in all positions anticipated during manufacture, storage, transportation and erection. Maintain capacity of lifting devices sufficient to resist all forces with a safety factor of four or greater.

1.13.7 Blocking and lateral support during storage and transportation are to be clean, non-staining and are not to prevent uniform curing of exposed surfaces. Provide temporary lateral support to prevent bowing and warping.

1.13.8 Protect edges of products to prevent staining, chipping or spalling of concrete.

1.13.9 Clearly mark products with date of production and final position in the structure.

1.13.10 Do not transport member to the site before the concrete has reached the design strength. Use only competent and qualified workers trained to handle and erect precast concrete members.

1.14 Rejection

1.14.1 Failure to meet the requirements of these specifications will be due cause for rejection of the product. Excessive honeycombing, distortion or warping of products, cracking, improper placement of connection plates, improper grouting or other evidence of inferior workmanship will be cause for rejection of the products.

1.14.2 Minor surface cavities or irregularities which, if satisfactorily repaired, will not constitute cause for rejection. Repairs are not to be made until the Engineer has inspected the extent of the irregularity and has determined whether or not the product will be rejected.

1.14.3 Final acceptance of the product will not be made until they have been installed in the structure. Products accepted tentatively at the manufacturing plant but that are damaged in transit or erection are to be replaced by the manufacturer at his own expense.

PART 2 PRODUCTS

2.1 Concrete Materials

.1 Refer to Section 03300.

PART 3 EXECUTION

3.1 Fabricating and Installing Hardware, Inserts and Embedded Parts

.1 Fabricate and install hardware, inserts and embedded plates as per Section 03300 and as noted herein.

.2 Fabricate all required connecting devices, anchors, bolts, plates, steel shapes and inserts to precast concrete products to carry design loads in accordance with CAN/CSA-S16.1.

.3 Welding to conform to the requirements of CSA-W59.

.4 Locate hoisting devices and temporary support connections so that they can be closed off and sealed watertight after erection.

.5 After fabrication, shop prime anchors, bolts, plates, steel shapes and inserts, except surfaces in contact with concrete, and touch up primer on anchors after welding.

.6 Galvanize anchors, steel inserts and reinforcement after fabrication, and touch up anchors with zinc-rich primer after welding.

3.2 Storage of Materials

.1 Store materials in accordance with CSA-A23.4, Clause 9.

3.3 Manufacture

.1 Manufacture products in accordance with CSA-A23.4. Formwork to Clause 11, reinforcement to Clause 12 and hardware to Clause 13.

.2 Mark each precast product to correspond to identification mark on shop drawings for location.

.3 Mark each precast product with date cast.

.4 Markings to be on part of product which will not be exposed.

3.4 Erection

.1 Erect precast concrete in accordance with CSA-A23.4, Clause 32.

.2 Measure the position of all supports for the precast products before erecting, and immediately advise the Engineer of any discrepancies in the dimensions. Erection of any product will be taken as an acceptance that work by others has been completed correctly.

.3 At least seven days before starting work, inform the Engineer fully as to the proposed methods of handling and installation and the amount and character of equipment to be used. In no case is the erector relieved of the responsibility for the safety of his methods or equipment or from carrying out the work in full accordance with the drawings and specifications.

.4 Install and fasten precast prestressed concrete products in the structure in conformity with the details shown on the shop drawings. The placing tolerances are to be ±6 mm from the position shown on the drawings.

.5 Employ a professional engineer registered in the Province of Alberta to design all temporary bracing and support systems for use in supporting precast products during the erection stage as may be required. Maintain temporary bracing in place until final support is provided.

.6 Design temporary support bends to permit vertical adjustment to ensure proper alignment of precast segments.

.7 Set precast products straight, level and square.

.8 Non-cumulative erection tolerances to be in accordance with CSA-A23.4, Clause 10.

.9 Adjust differential camber between precast products to within tolerance before final connection is made.

.10 Set products dry, without mortar, attaining specified joint dimension with lead or plastic spacers.

.11 Fasten precast concrete products securely in place as indicated on shop drawings.

.12 Tighten bolted connections with equal indicated torque.

.13 Secure bolts with lockwashers or tack weld nut to bolt.

.14 Weld connections and supports in accordance with CSA-W59.

.15 Install precast concrete closures between stems of flanged products.

.16 Level differential elevation of horizontal joints with grout to slope not more than 1 in 12.

.17 Clean field welds with wire brush, and touch up with shop primer and primer galvanized finish with zinc-rich primer.

.18 Apply two coats of dampproofing compound to bottom and sides of precast wet well.

3.5 Damage to Substructure

.1 Protect substructure carefully during erection of the temporary bracing of precast elements. All concrete surfaces and corners liable to damage are to be protected with wood blocking, sacking or other means to prevent damage and chipping of concrete due to wire ropes, swing loads or other activities. Repair any such damage to the satisfaction of the Engineer.

3.6 Cleaning, Patching and Repairs

.1 Clean, patch and repair precast concrete in accordance with CSA-A23.4, Clause 30 and as recommended by the manufacturer.

.2 Approval by the Engineer is required for all cleaning, patching and repairing methods.

.3 Clean soiled precast concrete surfaces by approved means.

.4 Patch all holes left by lift hooks, hold-down devices and other temporary inserts and all damaged surfaces and corners with perfectly matching finishes of the base compound.

.5 Repair all structural defects or damages that are not rejected by the Engineer.

3.7 Testing of Watertightness of Concrete Structures

.1 Test for watertightness as noted in Section 03300 and as noted herein.

3.8 Site Clean-Up

.1 Remove from the site all falsework, rejected materials and debris caused by erection of precast concrete.

3.9 Certification

.1 Certify at the completion of work, under the seal and signature of the manufacturer's professional engineer responsible for this work, that all connections and components designed by the manufacturer are capable of supporting the loads and forces indicated in the contract specifications and on the contract drawings and that all connections and components are fabricated and installed in accordance with the reviewed shop drawings.

END OF SECTION 03420

MORTAR

PART 1 GENERAL

1.1 Section Includes

1.1.1 Section includes, but is not limited to:

.1 Mortar for all masonry work.

1.2 Related Sections

1.2.1 Unit Masonry: Section 04200

1.3 Reference Standards

1.3.1 Standards referenced throughout this Section shall be the latest standard at time of tender.

1.3.2 ASTM Standards:

.1 ASTM C5: Standard Specification for Quicklime for Structural Purposes.

.2 ASTM C144: Standard Specification for Aggregate for Masonry Mortar.

.3 ASTM C207: Standard Specification for Hydrated Lime for Masonry Purposes.

.4 ASTM C270: Standard Specification for Mortar for Unit Masonry.

.5 ASTM C780: Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.

.6 ASTM C952: Standard Test Method for Bond Strength of Mortar to Masonry Units.

.7 ASTM C1072: Standard Test Method for Measurement of Masonry Flexural Bond Strength.

.8 ASTM C1329/C1329M: Standard Specification for Mortar Cement.

.9 ASTM C1357: Standard Specification for Evaluating Masonry bond Strength.

.10 ASTM C1384: Standard Specification for Admixtures for Masonry Mortars.

.11 ASTM C1714/C1714M: Standard Specification for Preblended Dry Mortar Mix for Unit Masonry.

1.3.3 CSA Standards:

.1 CSA-A3000: Cementitious Materials Compendium.

.2 CSA A179: Mortar and Grout for Unit Masonry.

1.4 Samples

1.4.1 Submit duplicate 100 mm long x 10 mm wide samples of coloured mortar to the Engineer for review, in accordance with Division 1.

1.4.2 Submit samples in quantity and size in accordance with CSA A179M.

1.5 Test Reports

1.5.1 Submit three (3) sets of test results to show that properties are appropriate to particular mortar mix.

1.6 Allowable Tolerances

1.6.1 If the mortar fails to meet the 7 day compressive strength requirements, but meets the 28 day compressive strength requirement, it is to be accepted. If the mortar fails to meet the 7 day compressive strength requirement, but its strength at 7 days exceeds two thirds of the value required for the 7 day strength, the SubContractor may elect to continue work at his own risk whilst awaiting the results of the 28 day tests, or to take down the work affected.

1.7 Quality Assurance

1.7.1 Perform all work of this Section in accordance with the requirements of CSA A179.

1.8 Alternatives

1.8.1 Obtain Engineer’s acceptance before changing manufacturer's brands or sources of supply of mortar materials during entire contract or other methods of mixing mortar specified elsewhere in this specification.

PART 2 PRODUCTS

2.1 Materials

2.1.1 Mortar: to CSA A179.

2.1.2 Portland Cement: Conforming to the requirements of CSA-A3000; normal-symbol GU type; colour to be grey.

2.1.3 Aggregates: Standard masonry type, graded and controlled and conforming to the requirements of CSA A179, passing a 1.18 mm sieve. Aggregates are to be clean and dry, protected against dampness, freezing and foreign matter. Modified gradation acceptable only if acceptable to the Engineer.

2.1.4 Hydrated Lime: type N lime to ASTM C207.

2.1.5 Water: Potable, clean and free from injurious amounts of oil, alkali, organic matter or other deleterious material.

2.1.6 Mortar for Brick: bulk mortar low sulphate alkali free, containing not more than 0.25% coal and lignite and containing 0.5% barium carbonate. Colour of mortar to be standard grey unless noted otherwise - refer to architectural drawings.

2.1.7 Anti-freeze compounds: do not use any anti-freeze liquid, salts or other substances to lower the freezing point of the mortar.

2.2 Mortar Types

2.2.1 For all concrete block masonry: Type S site mixed mortar based on proportion specification, producing not less than 12.4 MPa at 28 days. Use lime mix, not masonry cement mix.

2.2.2 Mortar for brickwork: Type N bulk mortar based on property specification, producing not less than 5.2 MPa at 28 days. Use lime mix, not masonry cement.

2.2.3 For all exposed masonry, provide mortar that does not produce efflorescence.

PART 3 EXECUTION

3.1 Mortar Mixing

3.1.1 Mix mortar in accordance with to CSA A179.

3.1.2 Provide gauging equipment and ensure that shovel count is accurate.

3.1.3 For site mixed mortar, use mechanical mixer of one sack minimum capacity for large batches, mechanically mixing for not less than three minutes and not more than five minutes. Hand mixing may be used for small batches.

3.1.4 Mix mortar to achieve a minimum 28 day compressive strengths as specified in item 2.2 of this Section.

3.1.5 Thoroughly mix ingredients in quantities needed for immediate use.

3.1.6 Adjust consistency of mortar by adding maximum amount of water consistent with workability to provide maximum tensile bond strength. Air content in mortar to be kept to minimum.

3.1.7 Mix mortar to an initial flow of 100% to 115%, having a flow after suction of not less than 70%.

3.1.8 For masonry work which has an upward facing horizontal exposure outdoors, air entrain mortar to provide 4 to 6% air content.

3.1.9 At temperatures over 10°C, use all mortar within 2 hours of mixing; discard all mortar not used within 2 hours of mixing. At temperatures under 10°C, use all mortar within 2 ½ hours of mixing; discard all mortar not used within 2 ½ hours of mixing.

3.1.10 Mortar may be retempered within 2 hours of mixing to replace water lost by evaporation. Do not retemper mortar after 2 hours of mixing.

3.1.11 Apply mortar as specified in Section 04200.

3.2 Testing of Mortar

3.2.1 Testing of masonry materials will be carried out as specified in Division 1 by the SubContractor's independent testing agency.

3.2.2 Cooperate with and submit sample to laboratory of mix and water proposed to be used on the project for testing to ensure that the mortar will not produce efflorescence. Do not begin masonry work until proposed mortar mix tests are accepted by the Engineer.

3.2.3 For mortars based on property specifications, tests will be required from representative batch mixes of mortar, one sample tested for water retention, three 50 mm cubes tested for every 100 m^2 of masonry in area, crushing at 7 and 28 days or as otherwise outlined in CSA A179 for type of mortar specified.

3.2.4 For mortars based on proportion specifications, tests will be required from representative batch mixes of mortar to ensure that materials ratios are in accordance with CSA A179 for type of mortar specified.

END OF SECTION

MASONRY

PART 1 GENERAL

1.1 Section Includes

1.1.1 Section includes, but is not limited to:

.1 Supply and installation of all concrete blocks including special blocks.

.2 Truss type horizontal wire reinforcing.

.3 Through wall flashings to masonry.

.4 Cleaning of all masonry.

.5 Interior concrete block partitions.

.6 Concrete fill in all bond courses, core fills, bearing and lintels.

.7 Installation of re-bars in horizontal and vertical core fills.

.8 Cutting and patching of work in this Section to accommodate work of other trades.

.9 Installation of anchors, bolts, hangers, and connections into masonry work, supplied under other Sections as required for work of other trades.

.10 Lateral support at non-load bearing wall tops.

.11 Concrete infill to masonry.

1.2 Related Sections

1.2.1	Mortar:	Section 04100
1.2.2	Miscellaneous Metals:	Section 05500
1.2.3	Board Insulation:	Section 07212
1.2.4	Air/Vapour Barrier:	Section 07270
1.2.5	Metal flashings:	Section 07600
1.2.6	Sealant work:	Section 07900
1.2.7	Hollow Metal Doors & Frames:	Section 08100
1.2.8	Painting:	Section 09900

1.3 Reference Standards

1.3.1 Work of this Section shall comply with NBC-AE 4.3.2 (National Building Code - Alberta Edition). Structure classified as Post-Disaster as per Table 4.1.2.1, with Importance Category IE = 1.5 applied to all applicable loads. Seismic and climatic data sourced from NBC Appendix C with adjustments for post-disaster performance level. Comply with CSA A23.3-19 and CSA S16-19 for ductile detailing and robustness.

1.3.2 Standards referenced throughout this Section shall be the latest standard at time of tender.

1.3.3 ASTM Standards:

.1 ASTM A82/A82M: Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.

.2 ASTM A123/A123M: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.3 ASTM A1011/A1011M: Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

.4 ASTM C90: Standard Specification for Load-bearing Concrete Masonry Units.

.5 ASTM C129: Standard Specification for Non-load-bearing Concrete Masonry Units.

1.3.4 CSA Standards:

.1 CAN/CSA-A23.1/A23.2: Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.

.2 CSA A165 Series: CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).

.3 CSA A179: Mortar and Grout for Unit Masonry.

.4 CSA-A370: Connectors for Masonry.

.5 CSA-A371: Masonry Construction for Buildings.

.6 CSA-A3000-13: Cementitious Materials Compendium.

.7 CSA S304.1: Design of Masonry Structures.

.8 CAN/CSA-G30.18: Billet-Steel Bars for Concrete Reinforcement.

1.4 Copy of Standards at Site

1.4.1 Provide a copy of the following standards in the field office, during masonry work:

.1 CSA A179.

.2 CSA-A371.

1.5 Submittals

1.5.1 Refer to Division 1.

1.5.2 Samples: provide duplicate samples of masonry units, and related accessories.

1.5.3 Submit Product Data for each type of masonry unit and accessory used, indicating compliance with the requirements of this Section.

1.5.4 Obtain Engineer's acceptance before ordering materials.

1.5.5 Shop drawings: submit shop drawings for structural reinforced masonry, reinforced masonry lintels. Indicate installation details for full wall assembly including ties and shelf angles, air/vapour barriers, through wall flashings, metal flashings, sealants, insulation and the like.

1.6 Product Delivery/Storage and Handling

1.6.1 Store cementitious materials in accordance with the requirement of CSA A179. Store aggregates in accordance with the requirements of CAN/CSA-A23.1.

1.6.2 Deliver and store blocks on site on pallets. If this cannot be done, stack units carefully and neatly on high ground and on solid planks to avoid chipping. Store well away from roads and parking areas. If not used immediately after delivery, cover with tarpaulins, or a 0.15 mm thick polyethylene adequately weighted or anchored down. Keep blocks clean and dry, protecting them from concrete, mortar and other work and materials which could stain it.

1.6.3 Protect masonry materials from damage during all phases or delivery, storage and handling.

1.6.4 Replace exposed units which become stained or chipped and materials which are affected by inadequate protection.

1.6.5 Do not stack materials to exceed structural design loads of new and existing structure.

1.7 Protection

1.7.1 Cover top of completed and partially completed walls, not enclosed or sheltered, with waterproof coverings at end of working day. Drape cover and extend 600 mm down both sides. Tie securely in position to prevent lifting under high winds.

1.7.2 Maintain protective boards at exposed external corners which may be damaged by construction activities. Provide such protection without damaging complete work.

1.7.3 Provide protection to the work of others from possible damage resulting from the work of this Section.

1.7.4 Protect all installed masonry from damage and staining. Cover immediate ground area.

1.7.5 Protect adjacent surfaces and work during cleaning of masonry.

1.8 Environmental Conditions

1.8.1 When temperature drops below 5°C, perform masonry in a heated enclosure, to maintain air temperature above 5°C.

1.8.2 Heat units if necessary so that temperature of units at time of laying is minimum 5°C.

1.8.3 During warm weather protect freshly laid masonry from drying too rapidly, by means of water fog spray, and protection from direct sunshine.

1.9 Winter Construction

1.9.1 For masonry work which will be done below 5°C: maintain temperatures as close as possible for successive mortar batches; ensure that mortar temperature never exceeds 50°C (to avoid flash set); use dry masonry units, lay masonry on unfrozen surfaces free from snow or ice; use windbreaks during laying of masonry not protected by enclosures when wind exceeds 25 km/h; provide a high-low registering thermometer where directed on site.

1.9.2 When the air temperature will fall below 5°C over a 24 hour period but not below 0°C, conduct masonry work as for normal temperature except as follows:

.1 Heat water and sand to produce mortar temperatures between 5°C and 50°C.

.2 Protect entire constructed masonry by enclosing within weather proof membrane for 48 hours for Type S mortar, 72 hours for Type N mortar.

1.9.3 When the air temperature will fall below 0°C over a 24 hour period, but not below -4°C, conduct masonry work as for normal temperatures except as follows:

.1 Heat water and sand to produce temperatures between 5°C and 50°C, and maintain temperature of mortar on boards above 0°C.

.2 Protect entire constructed masonry by enclosing within weatherproof membrane for 48 hours for Type S mortar, 72 hours for Type N mortar.

1.9.4 When the air temperature will remain below -4°C, conduct laying of masonry in enclosures heated to maintain air temperature above 0°C. Perform masonry work as for normal temperatures except as follows:

.1 Heat water and sand to produce mortar temperatures between 5°C and 50°C.

.2 Heat units if necessary so that temperature of units at time of laying is minimum 0°C.

.3 Maintain enclosure in position for 48 hours for Type S mortar, 72 hours for Types N mortar and maintain air temperature within enclosure at minimum 0°C.

1.10 Wind Bracing and Shoring

1.10.1 The masonry Subcontractor is responsible for supplying and installing adequate bracing to walls during construction.

1.10.2 Submit the design drawings of wind bracing and shoring to the Engineer under the seal of a Professional Structural Engineer registered in the Province of Alberta and engaged by the masonry Subcontractor, for acceptance prior to start of construction.

1.11 Site Meetings

1.11.1 Before commencement of work on site, arrange a site meeting to be attended by the Construction Manager’s Superintendent, the Subcontractor's Representative, the Subcontractor's Foreman for this project and the Engineer's Site Representative. Specifications and details will be reviewed, including:

.1 Masonry supplier.

.2 Mortar Testing.

.3 Provision for structural deflection at wall tops.

.4 Appearance design for exposed block lintels.

.5 Reinforcement - corners, wall intersections.

.6 Interior crack control measures.

.7 Vertical alignment of cores to be filled with concrete.

.8 Interfaces with work of other trades.

1.12 Quality Guidelines

1.12.1 Use qualified, experienced journeymen masons for cutting and placing of masonry units and to personally direct the execution of all phases of masonry work, including site mortar mixes.

1.12.2 Before proceeding with the Work, verify all unit, modular, and system requirements.

PART 2 PRODUCTS

2.1 Product Selection

2.1.1 Basis-of-Design: Materials and colours listed in drawings form the Basis-of-Design materials for this project. Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

2.1.2 Materials and products supplied by subcontractor shall match the approved samples, in all aspects, including but not limited to form, texture, size, shape, aesthetics, performance and technical specification.

2.2 Concrete Masonry Materials

2.2.1 Concrete Masonry: lightweight aggregate block conforming to CSA A165 Series and all subsequent revisions. Use smooth faced concrete blocks of metric modular size as indicated on the drawings.

2.2.2 Facet Designation:

.1 Non-load bearing units exposed to view: Hollow concrete blocks to have a facet designation H/15/C/M. Solid concrete block to have facet designation S/15/C/M.

.2 Non-load bearing units unexposed to view: Hollow concrete blocks to have a facet designation H/15/C/O. Solid concrete block to have facet designation S/15/C/O.

.3 For exposed load bearing concrete block and for block to exterior back-up walls: Hollow concrete blocks to have a facet designation H/15/B/M. Solid concrete block to have facet designation S/15/B/M.

.4 For unexposed load bearing concrete block and for block to exterior back-up walls): Hollow concrete blocks to have a facet designation H/15/B/O. Solid concrete block to have facet designation S/15/B/O.

2.2.3 Method of curing: Autoclave or low pressure steam curing is acceptable, provided that masonry units comply with linear shrinkage and moisture content requirements of CSA A165 Series for type M units at time of delivery to site. Notwithstanding the foregoing, age all units before delivery to site as follows:

.1 Autoclaved Units: minimum seven (7) days.

.2 Low pressure steam Cured Units: minimum twenty-eight (28) days.

2.2.4 Ensure all blocks are free from cracks, splits, laminations, or other defects which may impair the strength and durability. Ensure face of concrete masonry units are of uniform smooth texture, free from spalled or broken edges.

2.2.5 Use special blocks for jambs, lintels, bond beams, sash blocks, base blocks and other special blocks as required. Provide corner blocks to all visible openings, wall ends, block wall door jambs and other openings. Outside corner blocks to have same finish on exposed ends and on outside face.

2.3 Reinforcement

2.3.1 Horizontal Reinforcing: conforming to CSA-A370, of width 50 mm less than the block thickness with minimum 3.66 mm diameter side and cross rods for non-load bearing partitions and 4.76 mm diameter side and cross rods for load bearing partitions and exterior backup walls, galvanized and conforming to ASTM A82/A82M; Dur-O-Wall truss or ladur design as manufactured by Hohmann & Barnard or preapproved product. Provide prefabricated tee-shaped and 90° corner configurations for use at wall intersections and corners.

2.4 Anchors and Ties

2.4.1 Galvanizing: where masonry connectors are galvanized, galvanizing is to be in accordance with CAN/CSA-A370 and ASTM A123/A123M, to 401 g/m^2/side.

2.4.2 Masonry Connectors: all masonry connectors to conform to CSA-A370. Provide proof of masonry connectors meeting CSA-A370, prior to supplying connectors for this project.

2.4.3 Column Adjustable Tie: CAT-tie system consisting of AB clip manufactured of 1.5 mm thick (16 gauge) sheet steel conforming to ASTM A1011/A1011M, with hot dipped galvanized finish, complete with Vee tie of 4.76 mm diameter wire conforming to ASTM A82/A82M with hot dipped galvanized finish or stainless steel, lengths to suit application; as manufactured by Fero or preapproved product.

2.4.4 Screws to ties: stainless steel, type and size as recommended and engineered by the tie manufacturer and of sufficient size and holding capacity to withstand all superimposed loading. Submit holding capacities of screws and evidence that the screws will support all superimposed loading, signed and sealed by a Structural Engineer Registered in the Province of Alberta.

2.5 Accessories

2.5.1 Wall Plugs: 0.556 mm thick galvanized steel plugs.

2.5.2 Rubber control joint: rubber, vinyl or neoprene, solid, custom formed control joint. Cross shape. 'Titewall', manufactured by Blok-Lok, distributed by Steels or preapproved product.

2.5.3 Mortar Net: Premanufactured drainage system, recycled polyester/polystyrene mesh, thickness to suit cavity, one of the following:

.1 Mortar Net as supplied by Steels Industrial Products Ltd.

.2 Mortar Break as manufactured by Advanced Building Products Inc.

.3 Other Preapproved Product.

2.5.4 Rubber asphalt caulking: heavy bodied cutback sealing compound of rubber and asphalt with selected fillers and solvents.

2.5.5 Metal angle support at non-load bearing block partition heads: refer to Section 05 50 00 and the drawings.

2.5.6 Fire safing insulation: rock wool or mineral fibre, one of the following materials:

.1 "Firebarrier" distributed by A/D Distributors.

.2 'Firestop' distributed by Alberta Spray-On.

.3 Fibrex Safing Insulation as manufactured by Fibrex Insulation Inc.

.4 Roxul 07840 Safe as manufactured by Roxul.

.5 Other preapproved product.

2.5.7 Reinforcing steel: deformed steel bars to CAN/CSA-G30.18-09. Unless otherwise indicated, 10M bars to be grade 300 (40 ksi), and 15M and larger bars to be grade 400 (60 ksi).

2.5.8 Concrete for core fills and Lintels: Conforming to CAN/CSA-A23.1, 20 MPa, 175 mm slump, 12 mm maximum aggregate.

2.6 Flashings

2.6.1 Through-wall flashing: self adhered membrane, one of the following:

.1 Bakor Blueskin TWF Flashing

.2 Grace Perm-A-Barrier Wall Flashing.

.3 Soprema Sopreseal Stick 130.

.4 CCW-705 TWF as manufactured by Carlisle Coatings and Waterproofing Incorporated.

.5 Other preapproved product.

2.6.2 Flashing primer: as recommended by flashing manufacturer.

2.6.3 Metal Flashing to masonry construction: type and colour as specified in Section 07600.

PART 3 EXECUTION

3.1 Examination

3.1.1 Examine work of other Sections upon which Work of this Section is dependent. Should discrepancies be found which affect the proper performance of the Work of this Section do not commence work until such discrepancies have been resolved.

3.1.2 Ensure that all materials delivered to the site are certified in accordance with the specifications. Non-certified materials will be rejected. Remove rejected materials from the site.

3.2 Installation

3.2.1 Install items not covered under this Section in accordance with CSA-A371.

3.2.2 Establish all lines, levels, coursing and ensure co-ordination with other trades. Obtain any built-in items prior to start of work.

3.3 Preparation

3.3.1 Establish all lines, levels and coursing, protect from disturbances.

3.3.2 Coordinate all work of this Section with other trades such as cutting and fitting around other work.

3.3.3 Ensure that all items built-in are ready to receive the work of this Section.

3.3.4 Install dowels in concrete work to match reinforcing or reinforced core fills.

3.4 Workmanship

3.4.1 Install masonry with exposed faces having straight arises and be free from stains, chips and cracks. Do not use chipped, cracked or deformed units in exposed work. Replace damaged masonry units in exposed work.

3.4.2 Select and blend coloured masonry units to produce a uniform consistent appearance. Cull out all non-typical coloured units and do not use in visible locations.

3.4.3 Place all nailing blocks, anchor bolts, ties, flashing, structural bearing plates and other miscellaneous items for doors and windows, accurately as the Work proceeds.

3.4.4 Lay work from face side, true to line and level.

3.4.5 Buttering corners of units, throwing mortar droppings into joints and veneer wall air space, deep or excessive furrowing of bed joints, will not be permitted. Do not shift or tap units after mortar has taken initial set. Where adjustment must be made after mortar has started to set, remove mortar and replace with fresh supply. Do not allow mortar droppings to impair veneer wall air space and impede drainage through weep holes at base of wall or through wall flashings. Clean out as directed by the Engineer.

3.4.6 Where stop-off is necessary in horizontal runs of masonry, back one unit in every course, do not tooth.

3.4.7 Erect adjoining or intersecting walls with no wall more than 1200 mm above the other at any time.

3.4.8 Where fresh masonry abuts partially or fully set masonry, clean exposed surface and dampen existing surface for best possible bond.

3.4.9 Where masonry abuts columns or adjacent existing concrete walls, use CAT ties mechanically fastened at a maximum of 400 mm o.c.

3.4.10 Isolate masonry from vertical structural framing members, fill void with compressible filler.

3.4.11 Extend all masonry partitions to underside of slab, deck or structural member above, unless indicated otherwise.

3.4.12 Remove excess mortar and projections. Take care to prevent breaking masonry corners.

3.5 Placing of Block Units

3.5.1 Lay the work from face side to line and level. Accurately space courses. Keep the bond plumb throughout. Install corners and reveals plumb and true. Form uniform size joints. Check work regularly.

3.5.2 Lay interior block walls according to architectural drawings.

3.5.3 Use full mortar bedding for all masonry construction unless noted otherwise.

3.5.4 Lay block with webs to align over each other with thick end of webs up. Leave no cells open in exposed work.

3.5.5 Minimize cutting block. Cut exposed block with high speed power driven abrasive cutting disc or diamond cutting wheel for flush-mounted electrical outlets, grilles, pipes, conduit, leaving 3 mm in maximum clearance.

3.5.6 Dampen without saturating all masonry units immediately before installation. Do not saturate units. Consult manufacturer for length of time and climatic conditions for dampening masonry units.

3.5.7 Avoid racking and toothing where possible, except where specifically noted.

3.5.8 Mortar fill hollow metal door and window frames built in to masonry.

3.5.9 Where new masonry joins masonry that has set, clean and lightly wet the surface of the set masonry. Remove loose masonry and mortar.

3.5.10 Use special shaped units where indicated or where required.

3.6 Tolerances

3.6.1 Tolerances: to CSA A371, and as specified in this Section. If there is a discrepancy between the tolerances specified in this Section and those specified in CSA A371, the more stringent tolerance will govern.

3.6.2 Variation from Mean Plane: 3 mm when measured with a 3 m straight edge.

3.6.3 Variation from the Plumb: 3 mm on any vertical line up to 3 m high. Tolerances are not cumulative and not be more than 12 mm up to 45 m high.

3.6.4 Variation in the Sizes of Wall Openings: 6 mm maximum.

3.6.5 Variation from Grade Levels Stated: 6 mm.

3.6.6 Variation of Building Lines from Plane: In any bay or 6000 mm - maximum 12 mm. In 12,000 mm or more - 19 mm.

3.7 Mortar Joints

3.7.1 Tooling: When mortar is "thumb-print" hard, tool exposed block joints to a dense smooth surface, to form concave joints. Tool exposed joints to form concave joints. For unexposed work, strike joints flush. At base blocks which are to receive integral epoxy base, strike vertical joints flush to height of top of base; tool joint in base block above integral epoxy base height to a concave joint.

3.7.2 Use sufficient force to press mortar tight against masonry units on both sides of joint. Remove excess material and burrs. Tool exposed joints to a uniform depth. Slushing of mortar into joints is not permitted.

3.7.3 Masonry courses to be of uniform height and both vertical and horizontal joints to be of equal and uniform thickness.

3.7.4 Course units to bring wall to the required elevations using even horizontal joints.

3.8 Building In

3.8.1 Build in frames, steel lintels, sleeves, anchor bolts, anchors, nailing strips and other items to be built into masonry.

3.8.2 Bed anchors of frames in mortar and completely fill frame voids with mortar as wall is erected. To exterior walls, fill voids with foam-in-place insulation as specified in Section 07214.

3.8.3 Build in access panels supplied by Mechanical and Electrical Contractor in locations directed by them. Install plumb and square.

3.8.4 Be responsible for protection and maintenance of built-in items supplied by others.

3.9 Block Reinforcement and Anchors

3.9.1 Install all reinforcing steel in accordance with CSA A371 and as specified herein.

3.9.2 Build block reinforcement continuously into masonry bed joints at 400 mm o.c. vertically (every second block joint).

3.9.3 Place cross rods or additional ties not more than 100 mm from any end, such as a door opening, window opening, or vertical joint.

3.9.4 Place horizontal reinforcing in first and second mortar joints above and below openings. Extend 600 mm past openings.

3.9.5 Place horizontal reinforcing in first and second mortar joints below tops of walls.

3.9.6 Install additional reinforcement if so indicated on drawings.

3.9.7 Lap joints of reinforcement 150 mm minimum.

3.9.8 Do not extend reinforcement through control joints.

3.9.9 Use pre-formed or continuous formed corner reinforcement.

3.9.10 At masonry walls abutting or passing concrete, install anchors at 400 mm o.c. vertically.

3.10 Bond Beams

3.10.1 Form full length bond beams (tie beams) to the top of all concrete block walls and elsewhere as indicated. Unless otherwise indicated, form with bond beam block units, 200 mm high. Fill with concrete and reinforce as specified herein unless otherwise noted.

3.10.2 Reinforcement: use two 15M bars unless otherwise indicated. Continue reinforcement around corners. (Bend bars, or use 600 x 600 mm corner bars). Lap bars 300 mm minimum.

3.10.3 Form bond beam under bearing to all block bearing walls.

3.11 Vertical Core-fill

3.11.1 Concrete fill cores of concrete blocks, where indicated. Concrete-fill all cores at parapets; trowel tops smooth and flush with top of block, to provide solid backing for air/vapour barrier membrane.

3.11.2 Provide one 20M continuous in each vertical concrete core fill unless noted otherwise.

3.11.3 Where core fill and reinforcement is indicated, the cores must be in acceptable vertical alignment. Obtain Engineer's acceptance prior to construction.

3.11.4 Use full mortar bedding of the cross webs of the cores to be filled, when webs are in line vertically.

3.11.5 Fill cores in lifts of 1.2 m maximum. If a lift of more than 1.2 m is accepted provide clean-out openings. If cores contain reinforcement, do any core filling which is more than 2.4 m in height in 1.2 m maximum lifts, unless accepted otherwise.

3.11.6 Provide clean-outs at the bottom of each lift for all cells being filled. The inside of these cells are to be free of all debris or obstructions. Clean-outs not permitted where both faces of wall are visible.

3.11.7 Consolidate the core fill during placing by vibration or puddling. Repeat after excess moisture has been absorbed, while fill is still plastic.

3.11.8 Fix reinforcement rigidly in position in centre of cores or with 19 mm cover to sides and face of bars. Splice vertical reinforcement minimum 600 mm unless indicated otherwise.

3.11.9 Secure vertical reinforcement in position at top and bottom, and at intervals of 200 diameters of the steel.

3.11.10 Stop concrete fill 50 mm below top surface of lift wherever filling is stopped for more than one hour.

3.11.11 Unless specifically indicated otherwise, provide 1-20M vertical reinforcing at the following locations:

.1 At ends of walls, including where walls butt into dissimilar walls or columns.

.2 At each side of openings, including under each end of lintels, extending minimum 200 mm beyond opening.

.3 All corners under plates requiring bearing.

.4 At each side of control joints.

.5 At 800 mm oc along the length of all non-load bearing walls.

.6 All fixings for fixtures and other work built into and fixed to block work, including brackets, bearers, bolts and inserts.

.7 Support all horizontal concrete filled cores with expanded metal or other acceptable grout stop in bed joints below.

.8 All other cells containing reinforcing bars.

3.11.12 Refer to Structural Drawings for reinforcing for load bearing concrete block walls and exterior concrete block backup walls.

3.12 Reinforced Lintels

3.12.1 Form concrete block lintels over openings using lintel blocks. Provide lintels with a minimum bearing equal to their depth on walls at ends, where not otherwise detailed. Support rigidly during construction. Fill with concrete.

3.12.2 Refer to structural drawings for reinforcement sizes and placement.

3.13 Mortar Fill for Anchors and Ties

3.13.1 Where dovetail anchors, or dovetail wire ties, or welded anchors are required to tie masonry walls to concrete, fill cores solid with mortar so that ties and anchors are fully bedded.

3.14 Through-Wall Flashing

3.14.1 Install where indicated.

3.14.2 Install over all door and window heads to exterior walls, support angles, and concrete ledges and at transitions of masonry to other assemblies.

3.14.3 At openings, extend flashing 200 mm beyond jambs.

3.14.4 Apply continuous membrane flashing over all ledger angles or supporting sills, extending flashing up behind air/vapour barrier, and up vertical surface minimum 200 mm. Coordinate installation of flashing with installation of air/vapour barrier specified in Section 07270, so that air/vapour barrier weather laps over membrane flashing to provide a weather tight installation and to maintain continuity of the air/vapour barrier. Extend flashing horizontally over ledger angle or supporting sill, stopping maximum 10 mm from horizontal leg of ledger angle or supporting sill.

3.14.5 Use a manufacturer's approved primer to locations where flashing is to be adhered.

3.14.6 Where through-wall flashing occurs adjacent to roof flashing, leave a continuous 200 mm wide strip hanging out from joint to act as roof membrane counter flashing.

3.14.7 Lap and fully adhere all joints and cuts. Use an approved primer. Add adhered 'patches' at cuts at changes of direction, or lap separate pieces. Use mastic sealant were reverse lapping cannot be avoided.

3.14.8 At locations where flashing will not be covered or built in within two weeks, temporarily secure the flashings which are to hang out as counter-flashings.

3.14.9 Install metal flashing as detailed on the drawings, break formed to shapes as specified in Section 07 60 00. Continuously overlap metal flashing with membrane flashing minimum 50 mm and seal membrane flashing to metal flashing. Ensure that membrane flashing is not visible in the completed construction.

3.15 Control Joints (Exterior)

3.15.1 Where joints are not indicated on the drawings, obtain joint layout from the Engineer.

3.15.2 Stop control joint at bond beams (tie beams). Stop horizontal reinforcement at control joints.

3.15.3 Form exposed joints free of mortar.

3.15.4 Form joints to same width as regular jointing.

3.16 Installation of Metal Support Angles

3.16.1 Install lateral support at top of concrete block walls as indicated on the drawings. Refer to the Structural drawings.

3.16.2 Allow 25 mm live load deflection space between top of non-load bearing block and structure above, or as indicated on drawings.

3.16.3 To non rated walls, install 'fire safing insulation' in deflection space.

3.17 Cutting and Fitting

3.17.1 Fit and cut chases for piping, conduits, ducts, and sleeves. Install grounds, blocking, inserts, and the like, as required.

3.17.2 Cut, fit, drill, patch and make good for other trades.

3.17.3 Cut and fit block around structural framing leaving 25 mm space all around. Fill space with fire safing insulation.

3.17.4 Obtain Engineer's acceptance before cutting any part which may impair appearance or strength of the work.

3.18 Provisions for Other Trades

3.18.1 Provide openings in masonry walls where required or indicated.

3.18.2 Locate chases and openings, and neatly finish to required sizes.

3.18.3 Where masonry encloses conduit or piping, do not cover any pipe or conduit chases or enclosures until advised that work has been inspected and tested.

3.19 Masonry Cleaning

3.19.1 Clean and wash surfaces using masonry manufacturer's approved non-acid cleaning solution of type which will not harm constructed masonry. Use only fibre brushes in cleaning operations. Clean a trial test area and obtain approval from the Engineer before proceeding.

3.19.2 Where block is to be painted, prepare suitable surface.

3.20 Cleaning Up

3.20.1 Remove mortar droppings, broken units, and debris resulting from the work of this Section, from the site, as work proceeds.

3.20.2 Remove excess mortar and smears that remain, using wood paddles or scrapers. Leave interior areas broom clean.

3.20.3 Point or replace defective mortar to match adjacent work.

END OF SECTION

STRUCTURAL METAL STUD FRAMING

PART 1 GENERAL

1.1 Summary

1.1.1 Design wall framing system to resist wind loads and building loads in accordance with Division1 General Requirements including, but not limited to, the following components:

.1 Studs subjected to lateral loads.

.2 Top and bottom tracks.

.3 Bridging and bracing.

.4 Top and bottom track connections to main structure, including fabrications to accommodate main structure deflections; top of wall anchor allowing for dead load deflections during construction and live load deflections after construction.

.5 Head, sill and jamb members at wall openings.

.6 Framing component connections.

1.2 Related Sections

1.2.1 Division1 General Requirements

1.2.2 Section 05500 - Metal Fabrications

1.2.3 Section 06100 - Rough Carpentry

1.2.4 Section 08100 - Metal Doors and Frames

1.2.5 Section 09260 - Gypsum Board Assemblies

1.3 References

1.3.1 American Society of Mechanical Engineers International (ASME):

.1 ASME B18 Series Codes and Standards as referenced for specific screws, nuts, bolts and other fasteners.

1.3.2 American Society for Testing and Materials (ASTM):

.1 ASTM A307-04, Carbon Steel Bolts and Studs

.2 ASTM A325-04b Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

.3 ASTM A653/A653M-04a, Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process

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1.3.3 Canadian General Standards Board (CGSB):

.1 CAN/CGSB 1.181-99, Ready-Mixed Organic Zinc-Rich Coating

.2 CAN/CGSB 7.1-98, Lightweight Steel Wall Framing Components

1.3.4 Canadian Sheet Steel Building Institute (CSSBI):

.1 CSSBI 50M-1987, Lightweight Steel Framing Manual

.2 CSSBI 51M-91, Lightweight Steel Framing Design Manual

.3 CSSBI S5-2000, Guide Specification for Wind Bearing Steel Studs

.4 CSSBI S6-2000, Guide Specification for Lightweight Steel Framing

1.3.5 Canadian Standards Association (CSA):

.1 CSA S16-01, Limit States Design of Steel Structures

.2 CSA S136-01, Cold Formed Steel Structural Members

.3 CSA S304.1-04, Design of Masonry Structures

.4 CSA W47.1-03, Certification of Companies for Fusion Welding of Steel Structures

1.3.6 CSA W59-03, Welded Steel Construction (Metal Arc Welding)

1.4 Definitions

1.4.1 **Minimum Uncoated Steel Thickness:** Minimum uncoated thickness of lightweight steel framing shall be not less than 95% of the thickness used in the design for the framing system:

.1 Lesser thicknesses may be permitted at bends arising from the cold forming process.

.2 Metal thicknesses listed in this section are minimum uncoated steel thickness; exclusive of any subsequent coatings or treatments.

1.4.2 **Delegated Design Professional Engineer:** The professional engineer hired or contracted to the fabricator or manufacturer to design specialty elements, produce delegated design submittals and shop drawings to meet the requirements of the Project; who is registered in the province of the Work; and coordinate with Division 01.

1.4.3 **Letters of Commitment and Compliance:** Documents prepared by the delegated design professional engineer as recommended by APEGGA's Responsibilities for Engineering Services for Building Projects, April 2001, Appendix G-2.

STRUCTURAL METAL STUD FRAMING

1.5 Quality Assurance

1.5.1 Retain a professional engineer, registered in the province of the Work, to design fabrication and erection of the Work of this Section in accordance with applicable Building Code and Contract Documents requirements including, but not limited to, the following:

.1 Seal and signature to shop drawings and design submittals.

.2 Field review of installed components.

.3 Completion of Letters or Commitment and Compliance specified in Division1 General Requirements.

1.5.2 Welding shall be performed by company certified by the Canadian Welding Bureau to CSA W47.1 for the type of work being performed; welding shall conform to CSA W59.

1.5.3 Clearly mark steel thickness exclusive of coating by embossing, stamping with indelible ink or by colour coding.

1.6 Delegated Design Requirements

1.6.1 Perform design, fabrication and erection of the work of this Section based on Limit States Design principles using factored loads and resistances, determined in accordance with CAN/CSA S136.

1.6.2 Conform to the requirements of indicated fire resistance ratings.

1.6.3 Design wall framing system capable of withstanding design loads within limits and under design loads indicated on Drawings, and as follows:

.1 Dead Loads: Weights of materials and construction.

.2 Wind Loads: as indicated in National Building Code (latest Alberta Edition).

.3 Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 70°C.

.4 Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure upward and downward movement of 25 mm; or larger gap as may be required to accommodate structural movement.

.5 Design deflection detail so that free floating vertical members are restrained from horizontal movement by means of continuous bridging, nested or boxed tracks, or sliding or flexible web connections.

.6 Maximum allowable deflection under q10 sustained wind loading shall be as follows:

.1 Behind stone veneer – stud deflection limited to L/720.

.2 Behind metal cladding – stud deflection limited to L/360.

.7 Allow for movement of the structure; design lightweight steel framing end connections to accommodate floor and roof deflections such that studs are not loaded axially; limit free play and movement in connections perpendicular to the plane of framing to ±0.50 mm relative to the building structure.

.8 Design connections between light steel framing members using bolts, welding or sheet metal screws.

.9 Design bridging to prevent member rotation and member translation perpendicular to the minor axis, and as follows:

.1 Design for secondary stress effects due to torsion between lines of bridging.

.2 Collateral contribution of sheathing materials may be used to help restrain member rotation and translation perpendicular to the minor axis for wind bearing studs. Design exterior wall framing to accommodate horizontal deflection without allowing for collateral contribution of sheathing materials.

.3 Design bridging at 1530 mm (5’-0”) centres maximum, closer spacing may be required by design to satisfy structural requirements; spaced at even intervals over the span of the member.

1.6.4 Stud, sill and top track sizes and thicknesses, and fastening details indicated in this Section and on the Drawings shall be considered as minimums only, spacing indicated as maximum permissible, except where changes are required to meet design criteria, and as follows:

.1 Design head, sill and jamb members to frame openings larger than 100 mm in any dimension.

.2 Design components or assemblies to accommodate specified tolerances of the structure.

.3 Sill and Top Tracks:

.1 Double track system, outer track flanges with depth to suit vertical deflection and width of studs.

.2 Sill tracks, minimum 33 mm deep flanges and width of studs.

.4 Movement Connection Clips: Purpose made clip designed to allow structural member vertical movement and to transfer wind suction or pressure to structural frame.

.5 Structural Metal Stud framing is a delegated design item, 400mm OC spacing is acceptable provided trade supplied specialty engineer allows for proposed spacing with stud size as indicated in the drawings with appropriate guage in selection of the metal stud design.

.6 Maximum spacing for top and bottom track connections to the structure shall not exceed 812 mm centres.

.7 Minimum design thickness for wall framing members shall be as follows:

.1 64 mm: 0.84 mm

.2 92 mm: 0.84 mm

.3 101 mm: 0.84 mm

.4 140 mm: 0.84 mm

.5 152 mm: 0.84 mm

.6 184 mm: 0.91 mm

.7 203 mm: 1.12 mm

.8 Minimum thickness for walls supporting masonry veneer shall be 1.22 mm regardless of minimum thickness indicated above, or thicker as required to suit design conditions.

.8 Bridging Channel: 1.22 mm minimum.

.9 Clip Angles: 1.52 mm minimum.

1.7 Submittals

1.7.1 Submit items requested in this section in accordance with Division1 General Requirements.

1.7.2 Submit shop drawings clearly indicating all construction details including connections and anchor requirements. Indicate type, size and spacing of fastening devices. Indicate design loads.

1.7.3 Submit product data for mechanical fasteners, indicating sizes, shear, and pull over loading capacity where applicable. Provide data indicating thickness and type of corrosion protection coating.

1.7.4 Submittals shall bear the seal of a professional engineer registered in the Province of the Work.

1.7.5 Submit delegated design professional engineer's design notes and calculations upon request of the Consultant.

1.7.6 Submit Letter of Commitment, signed and sealed by the professional engineer required by the Work of this Section in compliance with Division1 General Requirements; professional engineer shall define applicable responsibilities in the completed Letter of Commitment and Letter of Compliance in compliance with the intent of the Building Code. Submit in conjunction with Shop drawings.

1.7.7 Submit evidence of welder qualifications specified in this Section.

1.7.8 Prior to declaration of Substantial Performance, submit Trade Contractor’s design engineer to certify substantial compliance with the system design by submitting a Letter of Compliance, signed and sealed by the retained professional engineer required by the Work of this Section in compliance with Division1 General Requirements.

1.8 Delivery, Storage, and Handling

1.8.1 Store materials flat, blocked off the ground in a manner to prevent kinking or permanent set.

1.8.2 Bent, kinked or twisted studs and track will be rejected.

1.9 Coordination

1.9.1 Coordinate work of this Section with work of other sections that may have items supported by or built into wind load bearing metal stud systems, which may include, but not limited to: doors, windows, architectural woodwork, pre-manufactured casework, plumbing fixtures, and electrical fixtures and panels.

PART 2 PRODUCTS

2.1 Product Selection

2.1.1 Basis-of-Design: Materials and colours listed in drawings form the Basis-of-Design materials for this project. Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

STRUCTURAL METAL STUD FRAMING

2.1.2 Materials and products supplied by subcontractor shall match the approved samples, in all aspects, including but not limited to form, texture, size, shape, aesthetics, performance and technical specification.

2.1.3 MONOPLY FRAMING

.1 System Description: Continuous exterior insulation installed over Monoply framing system to provide a thermally efficient exterior wall assembly.

.2 Insulation Type: Rigid board insulation suitable for exterior wall applications (mineral wool or rigid foam as required).

.3 Thermal Performance:

.1 Continuous insulation uninterrupted by framing members

.2 Minimum R-value as required by energy code

.4 Moisture Performance:

.1 Water-resistant and vapor-permeable as required for wall assembly

.2 Integrated with weather-resistive barrier, flashing, and drainage plane

.5 Fire Performance:

.1 Insulation and assembly to comply with applicable fire-resistance and flame-spread requirements

.6 Attachment: Mechanically fastened or adhered per manufacturer’s recommendations and Monoply framing requirements.

.7 Compatibility: Materials compatible with adjacent air barrier, cladding support systems, and exterior finishes.

.8 Durability:

.1 Resistant to moisture, mold, and deterioration

.2 Suitable for exterior exposure during construction

.9 Installation: Installed in accordance with manufacturer’s instructions, applicable codes, and approved shop drawings.

.10 Warranty: Standard manufacturer and installer warranties.

2.2 Materials

2.2.1 Wind Bearing Steel Framing Members and Accessories:

.1 Steel conforming to CAN/CSA S136 and shall be identified as to specification, type grade and mechanical properties; metal core thickness and spacing determined by delegated design professional engineer, hot

dipped galvanized steel; roll formed with knurled flanges, and cut-outs for services and bracing.

.2 Galvanizing conforming to ASTM A653/A653M to a minimum of ASTM Z275 for masonry veneer assemblies; the Consultant may accept other coatings meeting or exceeding the corrosion protection listed upon written request to the Consultant.

.3 Colour Coding: In accordance with Lightweight Steel Framing Manual, published by Canadian Sheet Steel Building Institute.

2.2.2 Fasteners and Welds:

.1 Welding materials conforming to CSA W59; electrodes minimum 480 MPa tensile strength.

.2 Bolts and nuts conforming to ASTM A307 or ASTM A325, with washers and hot-dip galvanized finish.

.3 Metal to Metal: Sheet metal screws conforming to ASME 18, with minimum 0.008 mm thick galvanized coating and #8 Ø; self-drilling, self-threading, case hardened type; hex, pan, and low-profile head profile type to suit application; length sufficient to penetrate not less than 3 fully exposed threads beyond joined materials.

.4 Metal to Concrete: Hilti drilled insert, minimum 8 mm Ø; **do not use Powder Actuated Fasteners**.

.5 Metal to Structural Steel: Secure track to structural steel over 8 mm thickness with Hilti DX fastening system with ENH2-21L15MX nails.

.6 Drilled Inserts: Steel, cadmium plated or hot-dip galvanized, sizes as indicated on drawings.

2.2.3 Touch-up Paint: Zinc-rich, to CAN/CGSB 1.181M.

2.2.4 Moisture Barrier: Insulating moisture resistant 6 mm thick foam strip x width of framing member, length as required.

.1 Acceptable material:

.1 Ethafoam 222 as manufactured by The Dow Chemical Company, Telephone: (604) 270-2130, (403) 543-3366, (888) 808-8055, (800) 268-4840 or (800) 361-8448.

.2 Thermal Insulation: ASTM C 665, Type I, un-faced mineral-fibre blankets produced by combining glass or slag fibres with thermosetting resins.

STRUCTURAL METAL STUD FRAMING

PART 3 EXECUTION

3.1 Inspection and Preparation

3.1.1 Confirm that flashings and waterproof membranes provided by other Sections are properly installed to divert moisture to exterior.

3.1.2 Confirm that door and window frames are placed and securely braced in proper location.

3.2 Erection – General

3.2.1 Fabrication and erection shall conform to the reviewed shop drawings; modifications required to accommodate on-site conditions, other than minor dimensional changes shall be submitted delegated design professional engineer and reviewed with the Consultant for acceptance prior to proceeding with work.

3.2.2 Provide continuous top and bottom tracks.

3.2.3 Align exterior wall partition tracks at floor and underside of deck, isolate track from direct contact with concrete using moisture barrier.

3.2.4 Cut bottom of studs square and set with full contact in bottom track; screw-fasten both flanges to sill track.

3.2.5 Place studs vertically at not more than 50 mm from abutting walls, and at each side of openings and corners; position studs in tracks at floor and ceiling, unless noted otherwise.

3.2.6 Cross-brace steel studs as required to provide rigid installation to delegated design engineer's instructions; attach studs to lower ceiling track using specified fasteners.

3.2.7 Cut members using saw or shear; flame cutting is not permitted.

3.2.8 Provide minimum of three studs at corners; insulate exterior components not accessible from interior using mineral fibre insulation:

.1 Place insulation equal to that specified for the field area of assemblies into non-accessible areas such as jamb and header assemblies, corners and wall to roof transitions.

.2 Keep insulation dry after installation. Do not compress insulation.

3.2.9 Provide cross-studs secured to studs, and additional framing as required for support of fixtures mounted to walls.

3.2.10 Erection tolerances shall be as follows:

STRUCTURAL METAL STUD FRAMING

.1 Erect metal studding to tolerance of ± 3 mm, non-cumulative from design spacing. Spacing in any case shall not exceed the requirements of the finishing materials.

.2 Out-of-plumb shall not exceed 1/500 of the member length.

.3 Out-of-straight (camber or sweep) shall not exceed 1/1000 of the member length.

.4 Track camber shall not exceed 1/1000 of member length.

.5 Studs shall seat into top and bottom tracks; gap between the end of the stud and the web of the track shall not exceed 4 mm for lightweight steel framing.

.6 Distance from centreline of last un-reinforced cut-out to end of framing member shall not be less than 305 mm.

3.2.11 Coordinate simultaneous erection of studs with installation of service lines; align web openings when erecting studs.

3.2.12 Coordinate erection of studs with installation of door/window frames and special supports or anchors for Work specified in other Sections.

3.2.13 Provide two studs extending from floor to ceiling at each side of openings wider than stud centres specified; secure studs together using sheet metal and screw fasteners.

3.2.14 Erect track at head of door openings and sills of sidelight/window openings to accommodate intermediate studs; secure track to studs at each end install intermediate studs above and below openings in same manner and spacing as wall studs.

3.2.15 Install steel studs or furring channel between studs for attaching electrical and other boxes.

3.2.16 Perform welding in accordance with CSA W59; for material less than 3 mm thick, the effective throats of welds shall not be less than the thickness of the thinnest connect part:

.1 Mechanically fasten all members having a thickness of 0.91 mm and less; weld or mechanically fasten members having thicknesses of 1.22 mm and greater.

3.2.17 After erection, refinish damaged finishes, welds, fastener heads and nuts with zinc-rich paint, in accordance with paint manufacturer's instructions

STRUCTURAL METAL STUD FRAMING

3.3 Fixture Attachment and Access Panels

3.3.1 Install all attachments within steel stud partitions for fixtures being hung from or anchored to such partitions.

3.3.2 Install access doors to electrical or mechanical fixtures supplied under respective Sections.

3.3.3 Rigidly secure frames to furring or framing systems.

3.4 Inspection and Certification

3.4.1 The installation of the exterior steel stud walls shall be inspected periodically by the professional engineer responsible for the component selection and connection designs for conformance to the shop drawings and design intent in accordance with Division1 General Requirements.

3.4.2 Copies of inspection reports shall be forwarded to Owner, Consultant, and the Trade Contractor responsible for the Work and the Contractor.

3.4.3 Prior to declaration of Substantial Performance, delegated design professional engineer shall submit a Letter of Compliance, signed and sealed in accordance with Division1 General Requirements.

END OF SECTION

MISCELLANEOUS METAL

PART 1 GENERAL

1.1 Scope of Work

1.1.1 Include all miscellaneous metal required for but not necessarily limited to the Effluent Filtration Facility and Filtered Effluent Pump Station.

1.2 Work Supplied but Installed Under Other Sections

1.2.1 Supply the following materials specified to be installed under other Sections of the Specifications:

.1 Anchor bolts, bearing plates, sleeves, restraining straps and other inserts to be built into concrete and masonry elements and required for anchorage and support of fabricated steel components.

.2 Fabricated steel components to be built into concrete or masonry unless specified elsewhere.

1.2.2 Supply instructions and templates as required for accurate setting of inserts and components.

1.3 Reference Standards

1.3.1 Perform miscellaneous metal work in accordance with the following standards, except where specified otherwise. All standards to be latest issue at time of Work Package issue.

1.3.2 Provide one copy on site of the first two standards listed below.

.1 ABC, “National Building Code - Alberta Edition”.

.2 CSA-G40.20, “General Requirements for Rolled or Welded Structural Quality Steels”.

.3 CSA-G40.21, “Structural Quality Steels”.

.4 ASTM A123M, “Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products ”

.5 CAN/CSA-S16.1, “Limit States Design of Steel Structures”.

.6 CSA-W47.1, “Certification of Companies for Fusion Welding of Steel Structures”.

.7 CSA-W59, “Welded Steel Construction (Metal Arc Welding)”.

.8 CSA-W59.3, “Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.

.9 CSA-W178.1, “Certification of Welding Inspection Organizations”.

.10 CSA-W178.2, “Certification of Welding Inspectors”.

.11 CSA-W186, “Welding of Reinforcing Bars in Reinforced Concrete Construction”.

.12 ASTM A108, “Specification for Standard Quality Cold Finished Carbon Steel Bars”.

.13 ASTM A193, “Specification for Alloy-Steel and Stainless Steel Bolting Material for High-Temperature Service.

.14 ASTM A194, “Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both”.

.15 ASTM A307, “Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength”.

.16 ASTM A325, “Standard Specification for Structural Bolts, Steel, Heat Treated, 830 MPa ksi Minimum Tensile Strength”.

.17 ASTM A449, “Standard Specification for Quenched and Tempered Steel Bolts and Studs”.

.18 CISC/CPMA 1-73a, “Structural Steel One-Coat Paint”.

.19 CISC/CPMA 2-75, “Structural Steel Primer”.

.20 CAN/CGSB-1.40, “Anticorrosive Structural Steel Alkyd Primer”.

.21 CAN/CGSB-1.71, “Inorganic Zinc Coating”.

.22 CAN/CGSB-1.181, “Ready-Mixed Organic Zinc-Rich Coating”.

.23 SSPC SP2, “Hand Tool Cleaning”.

.24 SSPC SP5, “White Metal Blast Cleaning”.

.25 SSPC SP6, “Commercial Blast Cleaning”.

.26 SSPC SP7, “Brush-Off Blast Cleaning”.

1.4 Regulations

1.4.1 Abide by the current bylaws and regulations of the province and/or municipality in which the Work is located, and abide by the current laws and regulations with regard to public safety.

1.4.2 The codes and regulations of the Minister of Labour, Occupational Health and Safety Act, the Workers’ Compensation Board and other applicable acts administered by the authority having jurisdiction in the Province of Alberta apply to the Work of this section.

1.5 Safety

1.5.1 Conform to good construction practice with regard to safety.

1.5.2 Carry out miscellaneous metal work in accordance with the National Building Code - Alberta Edition, Occupational Health and Safety Regulations Act, and construction safety regulations.

1.6 Qualifications

1.6.1 The organization undertaking to weld under this section is to be fully approved by the Canadian Welding Bureau under the requirements of CSA-W47.1, “Certification of Companies for Fusion Welding of Steel Structures”, Division 1 or 2.1 only, or CSA Standard W55.3, “Resistance Welding Qualification Code for Fabricators of Structural Members”, or both, as applicable.

1.6.2 Welding of steel is to be as per CSA-W59. Welding of aluminum to be as per CSA-W59.2.

1.6.3 Welding Inspection: The organization undertaking to perform weld inspection under this section is to be fully approved by the Canadian Welding Bureau under the requirement of CSA-W178.

1.6.4 Engage a professional structural engineer registered in the Province of Alberta, fully qualified and experienced in the design of structural steel, connections and welded components to be responsible for the design of specified steel components, connections and welded components.

1.7 Design

1.7.1 Design components and connections in accordance with the ABC and CAN/CSA-S16 to resist all loads indicated on the drawing or as specified.

1.7.2 Connections:

.1 Connection Design: to CAN/CSA-S16 to resist all loads and forces shown on the Drawings and as noted below.

.2 Provide bolted or welded connections, unless shown otherwise on Drawings.

.3 Use high strength bolts, except that A307 bolts may be used for connections of roof purlins, bridging, girths and trimmer beams not connecting to columns, unless otherwise noted on Drawings.

.4 Use slip resistant friction–type connections for bolted joints designed to resist reversible forces, impact loads, seismic or wind loads, crane loads, tension loads and oversized and slotted holes not designed for movement.

1.7.3 Beam Connections:

.1 Design components and connections in accordance with CAN/CSA-S16 to resist all loads and forces shown on the Drawings and as noted below.

.2 Design connections for wide flange beams, channel sections and horizontal hollow structural steel sections for a minimum force equal to 67% of the shear capacity of the web of the section with a minimum connection length of one-half the depth of the section.

.3 Provide flexible beam connections for unrestrained members in accordance with CSA S16, unless shown otherwise on Drawings.

.4 Select connections, wherever possible, from standard designs tabulated in current edition of CISC Handbook of Steel Construction, except that length of beam web angles are not to be less than half the depth of beam, and single angles are not to be used for beams deeper than 600mm.

.5 Provide direct connections to flanges of spandrel beams for interior and exterior perimeter beams to restrain twisting but maintain flexibility in primary plane of bending.

1.7.4 Bracing and stability systems shown on structural drawings are for stability of the completed structure and are not to be assumed as adequate for various stages of construction.

1.7.5 Verification of design capacities by calculation to be made available.

1.8 Submittals

1.8.1 Submit in writing evidence of qualification for welding under CWB.

1.8.2 Submit evidence of ability to weld reinforcing steel in accordance with CSA-W186.

1.8.3 Submit design calculations sealed and signed by a professional structural engineer registered in the Province of Alberta.

1.8.4 Prior to commencing work, the Subcontractor's engineer is to submit documentation showing evidence of registration in the province, plus qualifications and experience. The Subcontractor's engineer is to further acknowledge in writing that he has reviewed the Specifications and Drawings and is aware that he is to inspect the fabrication and installation of Work and certify the work at completion.

1.9 Shop Drawings

1.9.1 Submit Shop Drawings in accordance with Section 01330.

1.9.2 Clearly indicate materials, components, core thicknesses, finishes, dimensions, connections, joints, method of anchorage, number of anchors, supports, reinforcement, fabrication and installation details and accessories.

1.9.3 Clearly show all shop and erection details including cuts, copes, holes and threaded fasteners.

1.9.4 Clearly show all welds, both shop and field, by the currently recommended symbols of the Canadian Welding Bureau.

1.9.5 Prepare Shop Drawings of all connections and components designed by the fabricator under the seal and signature of the Subcontractor's professional structural engineer responsible for this design.

1.10 Quality Control

1.10.1 The Subcontractor's professional engineer responsible for the design of connections and other components is to inspect the fabrication and erection of these components in accordance with APEGA "Responsibilities for Engineering Services for and Building Projects.

1.11 Inspection and Testing

1.11.1 The Construction Manager is to ensure materials and workmanship are inspected and tested by an independent inspection and testing firm certified in accordance with CSA-W178.1.

1.11.2 An inspection and testing firm may also be retained and paid for by The City in accordance with Section 01452 of these Specifications.

1.11.3 The City's inspection and testing firm will only provide the minimum inspection and testing as required by The City and does not relieve the Construction Manager of his responsibility to inspect and test materials and workmanship to ensure miscellaneous metals work conforms to the requirements of the Specifications and the Drawings.

1.11.4 Provide casual labour and access for inspection to all places where work is being done or stockpiled.

1.11.5 The independent inspection and testing firm will test 1 in 10 welds. Testing of welds to include visual examination of all welding procedures at the plant and in the field, plus magnetic particle, x-ray or other means deemed necessary by the testing agency to permit certification of welds.

1.11.6 The independent inspection and testing firm will inspect all bolts for all snug-tightened high-strength bolted connections.

1.11.7 The independent inspection and testing firm will test all Nelson Studs.

1.11.8 The independent inspection and testing firm will inspect surface preparation and cleaning for painted and galvanized steel.

1.11.9 The independent inspection and testing firm will inspect and verify one coat paint, primer, zinc coat and galvanizing thickness.

1.11.10 The Construction Manager is to inspect and test all miscellaneous metal work to ensure compliance with the Specifications and the Drawings.

1.11.11 The Engineer may request additional testing of welds and bolts to ascertain the full amount of defects if the tests noted above indicate excessive deficiencies. Additional costs for extra testing to be borne by the Construction Manager at no additional cost to The City.

1.11.12 Construction Manager to pay for all costs for re-testing and re-inspection as a result of defective workmanship at no additional cost to The City.

1.11.13 Construction Manager to pay for all costs of repairs to correct defective work at no additional cost to The City.

1.11.14 The Construction Manager's independent inspection and testing firm and The City's inspection and testing firm are to submit to the Engineer final reports certifying all welds and connections, including confirmation that required repairs have been completed. These reports to be submitted under the seal and signature of a professional structural engineer registered in the Province of Alberta.

1.11.15 Notify Engineer and inspection and testing firm 24 hours prior to commencement of shop work for all testing and inspection.

1.12 Acceptability

1.12.1 Failure to comply with the requirements of these specifications will result in the structure being considered potentially deficient.

1.12.2 Additional testing, inspection and evaluation may be required where evidence points to a potentially deficient structure.

1.12.3 Pay all costs for additional testing, inspection and analysis required to demonstrate the adequacy of a structure that does not meet the requirements of the Specifications and the Drawings at no additional cost to The City.

1.12.4 Reinforce by additional construction or replace as directed by the Engineer at no additional cost to The City all structure or material judged inadequate by structural analysis or by testing and inspection.

1.12.5 The Engineer may order further testing, inspection and analysis at any time. In this instance, The City will pay for those tests, inspections or analysis that meet the specified requirements, and the Construction Manager will pay for those that do not with no additional cost to The City.

1.13 Handling

1.13.1 Use all means necessary to protect fabrications before, during and after installation.

1.13.2 In the event of damage, immediately make all repairs and replacements necessary to the approval of the Engineer at no additional cost to The City.

PART 2 PRODUCTS

2.1 Materials/Components

2.1.1 Structural steel members and plates: To CSA-G40.21 of Type W weldable steel. Minimum yield strength 350 MPa for hollow structural steel members, wide flange sections, channel sections and angles with legs 80 mm or greater; 300 MPa for plates.

2.1.2 Structural steel angles with 80 mm legs or less: To CSA-G40.21 of Type W weldable steel. Minimum yield strength 300 MPa.

2.1.3 Embedded plates with shear stud connections: Headed concrete anchors conforming to ASTM A108.

2.1.4 Bolts and required nuts and washers: High strength type recommended for structural steel joints to ASTM A325, medium-carbon steel. Nuts for galvanized bolts to be A563 Grade DH or A194 Grade 2H.

2.1.5 Anchor bolts: Stainless Steel: ASTM F593, AISI Type 316 unless otherwise indicated on the drawings. ASTM F1554 Grade 55 where indicated on the drawings.

2.1.6 Welding materials as per CSA-W59.

2.1.7 Stainless steel: To ASTM A167 and ASTM A276, Type 316L as indicated on the drawings.

2.1.8 Nut dimensions as per ASA B182 for heavy semi-finished hexagon nuts.

2.1.9 For fastenings in stainless steel use stainless steel Type 316 ELC ASTM A167.

2.1.10 All fasteners submerged in water or sewage: Stainless steel Type 316 ELC ASTM A167.

2.1.11 Drilled adhesive anchors refer to Section 03150.

2.1.12 One-coat paint where no further painting is specified: Conform to CISC/CPMA 1.73a, “Structural Steel One-Coat Paint”.

2.1.13 Primer where further painting is specified: Conform to CISC/CPMA 2-75, “Structural Steel Primer”.

2.1.14 Primer: to CAN/CGSB-1.40 for interior locations, to CAN/CGSB-1.181 (zinc-rich) to exterior locations. Use shop primer compatible with primers and paints specified in Section 09900 – Painting.

2.1.15 Shop and field studs to be Nelson headed type anchors with fluxed ends or approved equivalent. Sizes as detailed on drawings.

2.1.16 Shop galvanizing: Hot dipped galvanizing with a minimum coating of 900 g/m^2 to ASTM A123.

2.1.17 Hatch covers material: Refer to standard details drawing.

2.2 Corrosion Protection

2.2.1 Conform to Section 09900.

2.2.2 Use stainless steel, aluminum or galvanized steel where indicated on drawings.

2.3 Safety Chains

2.3.1 Removable 5 mm proof chain 13 mm x 29 mm c/c oval shaped type 316 SS stainless steel links, snaphooks and eye unless noted otherwise.

2.4 Steel Ledge Angle and Lintels

2.4.1 Fabricate and install steel ledger angles and lintels as detailed on the Drawings and reviewed Shop Drawings, complete with anchors or bolts, as indicated.

2.4.2 Fabricate and install steel ledger angles and lintels to withstand all superimposed loading.

2.4.3 Install level and true to line.

2.5 Steel Framing Around Openings

2.5.1 Fabricate steel plate and bent plate framing around openings, including around windows, doors louvers and the like, as detailed on the Drawings and reviewed Shop Drawings.

2.5.2 Coordinate installation of steel framing with air/vapour barriers specified in Section 07270 – Air/Vapour Barriers, to maintain continuity of the air seal around openings and between steel plate and bent plate framing.

2.5.3 Coordinate installation of steel framing with doors, windows, louvers and the like, to ensure openings are correctly sized. Coordinate installation of Foam-In-Place Insulation with Section 07214 – Foam-In-Place Insulation.

2.5.4 Install steel plate and bent plate framing to support doors, windows, louvers and the like, and to withstand all superimposed loading.

2.6 Bent Sheet Metal Framing

2.6.1 Fabricate and install 0.762 mm base metal thickness, Z275 galvanized sheet metal, continuous “C” channel framing to parapets on roof, and to ends of hollow core slabs as detailed on the Drawings and reviewed Shop Drawings.

2.6.2 Install “C” channel to roof parapets after roofing air/vapour barrier has been installed. Coordinate with installation of roofing air/vapour barrier.

2.6.3 Fabricate in minimum 2440 mm lengths. Butt joints together so that sections are flush and even with each other to provide a smooth flat surface to accept membranes, plywood and finishes.

2.6.4 Mechanically fasten channels to hollow core slabs with drilled anchors, of type to suit installation, with 2 anchors (one at each side of bottom leg of channel) at maximum 400 mm o.c., and to withstand all superimposed loading.

2.6.5 Mechanically fasten “C” channel to face of hollow core slab ends and edges, to provide a smooth flat surface, ready to receive membrane and finishes.

2.7 Anchor Bolts, Lag Screws, Etc.

2.7.1 Provide anchor bolts, bolts, bolt washers and nuts, lag screws, expansion shields, toggles, straps, sleeves, brackets, etc., where required and where indicated.

MISCELLANEOUS METAL

2.8 Bollards

2.8.1 Fabricate and install bollards to locations indicated, using extra heavy wall galvanized steel pipe, 219 mm OD, minimum 1200 mm above ground and minimum 900 mm into ground.

2.8.2 Set into minimum 600 mm diameter concrete piers, extending 1200 mm into the ground, unless detailed otherwise.

2.8.3 Set steel pipe bollards in concrete and fill with concrete plumb and true to line; round off tops of concrete in pipe and slope concrete at top of concrete piers, away from pipe.

2.9 Steel Railing

2.9.1 Railings: This term shall include guardrail systems, handrail systems, platform railing systems, ramp-rail systems, and stair-rail systems. Railings may be comprised of a framework of vertical, horizontal, or inclined members, grillwork or panels, accessories, or combination thereof.

2.9.2 Design's Qualification: Calculations and shop drawings required for Contractor design must be signed and stamped by a Professional Engineer registered in the Province of Alberta.

2.9.3 Design railing and anchorage in accordance with National Building Code - Alberta Edition and National Building Code.

2.9.4 Shop drawings for railing shall bear the seal and signature of a Professional Engineer registered in the Province of Alberta.

2.9.5 Material:

.1 Pipe Railing:

.1 Painted or hot dip galvanized as noted on drawings carbon steel, ASTM A53.

.2 Minimum Outside Diameter: 42.2 mm

.3 Bar railing refer to Architectural Drawings.

.2 Perforated Metal panels and screens as indicated on Architectural drawings.

.3 Accessories, including railing components, flanges and wall brackets shall conform to the following:

.1 Wall Brackets:

.1 Malleable iron, round top, and painted or hot dip galvanized as noted on drawings.

.2 Manufacturer and Products:

.1 The Wagner Companies; No 1765.

.2 Julius Blum & Co., Inc.; No. 1382.

.2 Rail Terminals (including Wall Returns):

.3 Round, painted steel, welded to rail, with two 5/16-inch holes for ¼-inch fasteners.

.4 Manufacturer: The Wagner Companies.

.3 Toe boards

.1 ASTM A36 steel, painted or hot dip galvanized as noted on drawings.

.2 Provide slotted holes for expansion and contraction where required. Fasten with stainless steel fasteners.

.4 Fasteners

.1 Bolts and nuts for bolting to railing to interior metal beams: Painted ASTM A325 bolts.

.2 Concrete anchors: Stainless steel

2.9.6 Fabricate all steel railing as detailed, including, but not limited to design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings and anchorage, but not less than needed to withstand indicated design loads. Accurately and uniform fabricate all components. Fabricate all railings to National Building Code - Alberta Edition requirements and to ANSI/NAAMM AMP 521-00.

2.9.7 For all railing, grind all weld smooth. Remove all sharp edges and burrs. All welds must be ground smooth and flush with adjacent surfaces. Fill welded areas and grind markings and sand smooth. Ensure welded areas, cut locations and all other fabricated surfaces are undetectable from adjacent architectural quality steel and match the accepted mock-up. Ensure that all bends are smooth and uniform to radii indicated.

.1 Cope components at connections to provide close fit, or using fittings designed for this purpose.

.2 Weld all around at connections, including at fittings.

.3 Form changes in direction of railings by radius bends of radius indicated.

2.9.8 Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required, maintain cross section of members throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

2.9.9 Provide expansion joints in railings as required and as indicated on the accepted shop drawings. Ensure that expansion joints are flush. Provide expansion joints at maximum intervals of 16.5 meters on center and at structural movement joints. Locate joints within 305mm of posts.

2.9.10 Provide wall brackets, end closures, flanges, miscellaneous fittings and anchors for interconnecting components and for attaching to other work.

.1 Furnish inserts and other anchorage devices for connecting to concrete work.

.2 Connect posts to stair framing by direct welding, unless otherwise indicated.

2.9.11 Conceal exposed ends of railing members with prefabricated end fittings.

2.9.12 Where wall-mounted handrails are indicated, provide handrails and brackets as detailed. Provide wall returns at wall mounted handrails, unless otherwise indicated.

.1 Close ends of returns unless clearance between end of rail and wall is 6 mm or less.

2.9.13 Provide filler made from steel plate, or other suitably crush resistant material, where required to transfer wall bracket loads through wall finishes to structural supports.

.1 Size fillers to suit wall finish thickness and to produce adequate bearing area to prevent bracket rotation.

2.9.14 Toe boards: Provide at railings, except where 102 millimeter or higher concrete curbs are installed, at gates, or on stairways unless shown otherwise.

2.9.15 Verify all dimensions on site prior to shop fabrication.

2.9.16 Fabricate railing square, plumb, straight and true with all joints neatly and accurately aligned.

2.9.17 Provide all base plates with minimum 6 millimeters diameter drain hole.

2.9.18 Fabricate railing system to meet all code requirements, including 300 millimeters continuous horizontal extension at top and bottom of stair railings.

2.9.19 Shop/Factory Finishing: After fabrication paint steel components other than stainless steel components as specified in Section 09900 Painting.

2.9.20 All railing components that specified on the drawings as galvanized, to be hot dip galvanized after fabrication/welding.

2.10 Steel Grating

2.10.1 Design:

.1 Design metal grating to support loads indicated on drawings but not less than 4.8 kPa (100 psf) or 4.5 kN (1000 lbs) concentrate loads apply to mid span.

.2 Grating deflection shall not exceed L/180.

2.10.2 Product:

.1 Borden Metal Products (Canada) Ltd. AMICO.

.2 Grating for all application shall be hot-dip galvanized.

2.10.3 Installation:

.1 Anchor grating to supporting members with clips and bolts with spring as indicated or at 300 mm c/c minimum.

.2 Grating supporting equipment shall be weld to supporting members with 5 mm fillet welds, at 300 mm c/c 50 mm long.

2.11 Embedded Plates:

Fabricate steel plates with Nelson studs to be embedded into concrete to sizes indicated on drawings, hot-dip galvanized after fabrication.

2.12 Fixing Angles

2.12.1 Fabricate fixing angles where indicated and as detailed on the Drawings.

2.12.2 Material:

.1 Galvanized Steel: Carbon steel, ASTM A123/A123M, commercial grade, hot-dip galvanized after fabrication.

2.13 Steel Protective Angle

2.13.1 Fabricate steel angles cast-in concrete to configuration indicated.

2.13.2 Use Nelson Stud anchors of minimum 12 mm diameter by 150 mm length at 400 mm o.c.

2.13.3 Hot-dip galvanize after fabrication.

2.14 Stairs and Ships Ladder

2.14.1 Design's Qualification: Calculations and shop drawings required for Contractor design must be signed and stamped by a Professional Engineer registered in the Province of Alberta.

2.14.2 Design stairs in accordance with National Building Code - Alberta Edition and National Building Code and for additional requirements specified. Minimum live load shall be 4.8 kPa.

2.14.3 Shop drawings for stairs and support members shall bear the seal and signature with a Professional Engineer registered in the Province of Alberta.

2.14.4 Material:

.1 Exterior Galvanized Steel: Carbon steel, CSA G40.20/21 – 300W/350W, hot-dip galvanized after fabrication.

2.14.5 Minimum Thickness:

.1 Steel: 6 mm, unless shown otherwise on Drawings.

2.14.6 Fabricate stairs as detailed on drawings and install using A325 high strength galvanized bolts for galvanized steel and stainless steel anchor bolts for aluminum structure.

2.14.7 Design the tread sections to limit deflection to 1/180th of the span under a concentrated load of 1.0 kN at the centre.

2.14.8 For steel railing requirements, refer to 2.10.

2.15 Concrete Filled Steel Pan Stairs

2.15.1 Fabricate stairs with closed riser steel pan construction as indicated on drawings.

2.15.2 Provide angles for fastening to channel stringers, where applied finish is indicated for underside of stairs and landings.

2.15.3 Form wall and outer stringers as indicated on Structural Drawings.

2.15.4 Extend stringers around mid landing for steel base.

2.15.5 Close ends of stringers where exposed.

2.15.6 Finish exit stairs in accordance with NAAMM AMP 510, commercial class.

2.16 Platforms

2.16.1 Design's Qualification: Calculations and shop drawings required for Contractor design must be signed and stamped by a Professional Engineer registered in the Province of Alberta.

2.16.2 Design Criteria:

.1 Comply with the requirements of National Building Code - Alberta Edition and NBC whichever is more stringent.

.2 Open grating.

.3 Uniform Service Load: 4.8 kPa minimum or equipment weight as indicated on drawings.

.4 Maximum Deflection: 6 mm or L/240.

.5 Do not use existing building framing as part of lateral load resisting system.

.6 Design platforms to accommodate openings for piping, ducting, and electrical services as shown on drawings.

2.16.3 Design and provide other items such as grating, checkered floor plate, stairs, railing, bolts, welds, anchors, etc. in compliance with the requirements of this section.

2.16.4 Field measure areas around equipment prior to fabrication. Design platforms and grating so that gaps around perimeter of equipment do not exceed 75 mm clearance.

2.16.5 Material:

.1 Steel Galvanized: Carbon steel, CSA G40.2021 – 300W, hot-dip galvanized after fabrication- for stair landing.

.2 Aluminum for platform at DPH 2 and 3 as per section 05140.

2.17 Radon Pit

2.17.1 Refer to Drawings for Radon pit details which are to be fabricated, supplied and installed under this Section.

2.17.2 Fabricate all metal fabrication items or miscellaneous metal items required to complete Radon pit work as indicated on Drawings.

2.18 Hatch Covers

2.18.1 Hatches are to be equipped with lift assistance device for one-hand door operation and automatic hold-open device.

.1 All hatch covers and handles should be gas-tight.

2.18.2 Fabricate floor plates on sanitary and process sumps with the following features:

.1 Hinged

.2 Hold open assembly

.3 3 mm full face neoprene border gasket secured in place with a suitable adhesive

.4 Countersunk stainless steel screws to fasten plate down.

2.18.3 Minimum Thickness: 10 mm for Aluminum, unless shown otherwise in Drawings.

2.18.4 Pre-Engineered Aluminum Hatch Cover: Designed by supplier for loads indicated on the drawings or a minimum live load not less than 4.8 kN/m^2 or a point load of 9.0 kN, whichever will produce to greater stresses, with a maximum deflection not exceeding 1/300 of the span or 6 mm. Acceptable products: Bilco Type J-AL and Type JD-AL, and U.S.F. Fabrications Inc. Type TPS and TPD.

2.18.5 Locate hatch covers where indicated on the Drawings.

2.18.6 Provide diamond pattern cover.

2.18.7 Hatches to open 90^o and lock automatically in that position.

MISCELLANEOUS METAL

2.19 Miscellaneous Framing

2.19.1 Refer to Drawings for miscellaneous metal items and embedded plates which are to be fabricated, supplied and installed under this Section.

2.19.2 Fabricate all other metal fabrication items or miscellaneous metal items required to complete the project.

2.20 Fabrication

2.20.1 Notify Engineer and inspection and testing firm a minimum of 24 hours prior to fabrication to allow for inspection.

2.20.2 Fabricate miscellaneous metals in accordance with CAN/CSA-S16, the Drawings, Specifications and the reviewed Shop Drawings.

2.20.3 Verify dimensions of existing work prior to commencing fabrication.

2.20.4 Verify all drawing dimensions and conditions prior to commencing fabrication.

2.20.5 Welding to conform to the requirements of CSA-W59. Do not splice materials without the written approval of the Engineer. Where granted, provide a complete non-destructive examination by a certified inspection and testing firm; method and firm to be approved by the Engineer. Pay for all inspection and testing at no additional cost to The City. Show all approved splices on the Shop Drawings

2.20.6 No cutting or provision for holes except as on approved Shop Drawings.

2.20.7 Bolted connections to be “friction type” connections.

2.20.8 Shop installed shear studs to be installed in strict conformance with requirements of CSA-W59.

2.20.9 Tolerances of all miscellaneous metal to be maintained strictly in accordance with CAN/CSA-S16.

2.20.10 Grind all welds smooth and grind all groove welds flush on exposed structural steel.

2.20.11 Do not place any holes or openings in structural steel members without the approval of the Engineer. Where approval is granted, provide reinforcing plates around all openings to maintain design strength.

2.20.12 Weld reinforcement where indicated. Weld in accordance with applicable requirements of CSA-W186. Do not weld reinforcing at any location without written approval of the Engineer.

2.20.13 Weld all anchors required to restrain concrete masonry walls.

2.20.14 Weld shear stud connectors in strict accordance with manufacturer’s instructions by electrical resistance only.

2.20.15 Galvanize all structural steel components noted or specified to ASTM A123.

2.20.16 Apply one coat of paint or primer where required.

2.20.17 Provide two coats of alkali resistant bituminous paint to all aluminum in contact with or imbedded in concrete mortar or grout.

2.21 Surface Preparation

2.21.1 Thoroughly clean and suitably pretreat steel prior to finishing.

2.21.2 Remove loose mill scale, rust, oil, grease, dirt and other foreign matter using SSPC-SP No. 6, Commercial Blast Cleaning, followed by SSPC – SP No. 1, solvent cleaning. Shop prime all commercial blast cleaned surfaces immediately after cleaning operations.

2.21.3 Grind and sand all sharp projections smooth.

2.22 Finishes

2.22.1 Shop paint items, all miscellaneous metal items with the exception of those which are to be galvanized or special coating.

2.22.2 Do prime painting to CSA-S16. Ensure shop primers are compatible with paint finishes and special coatings.

2.22.3 Use primer as prepared by manufacturer without thinning or adding admixtures. Paint on dry surfaces, free from rust, scale of grease. Do not paint when temperature is lower than 7°C.

2.22.4 After fabrication, clean, remove rust, mill scale, grease or extraneous material. Unless specified otherwise, apply to all items, in shop, a full smooth coat of primer (see materials). Work paint into corners and open spaces.

2.22.5 Apply two (2) coats of primer to parts inaccessible after assembly.

2.22.6 Apply one (1) coat of primer to steel surfaces except where encased in concrete. Leave these surfaces clean and uncoated.

2.22.7 Touch-up burnt or scratched surfaces. Touch-up bare or worn areas on site after installation, and apply field painting also to field-installed bolts, welds, screws, etc.

2.22.8 Make good corrosive protection after welding where burnt by welding operations and where removed to facilitate welding operations, using two (2) coats of zinc-rich touch-up primer conforming to CAN/CGSB-1.181.

2.22.9 Back prime with bituminous paint all aluminum surfaces in contact with concrete or or dissimilar metals.

2.22.10 Provide hot dipped galvanized finish at all exterior metal fabrications and elsewhere indicated.

PART 3 EXECUTION

3.1 Surface Conditions

3.1.1 Prior to installation of the Work of this section, carefully inspect the installed Work of all other trades and verify that all such Work is complete to the point where this installation may properly commence.

3.1.2 Verify that metal may be fabricated and erected in strict accordance with the original design, the approved Shop Drawings and the referenced standards.

3.1.3 In the event of a discrepancy, immediately notify the Engineer.

3.1.4 Do not proceed with fabrication or installation in areas of discrepancy until all such discrepancies have been fully resolved.

MISCELLANEOUS METAL

3.2 Erection

3.2.1 Erect in accordance with approved drawings. Erect true and plumb. Use temporary bracing where necessary to take care of all loads to which the structure may be subject, including erection equipment and operation of same. Leave such bracing in place as long as required for safety.

3.2.2 Use bolts for field connections except where welded field connections called for on drawings.

3.2.3 Tolerance of all structural steel to be maintained strictly in accordance with CAN/CSA-S16.

3.3 Certification

3.3.1 Certify at the completion of work, under the seal and signature of the Subcontractor's professional engineer responsible for this Work, that all connections and components designed by the Subcontractor are capable of supporting the loads and forces indicated in the Specifications and on the Drawings and that all connections and components are fabricated and installed in accordance with the reviewed Shop Drawings.

END OF SECTION

ROUGH CARPENTRY

PART 1 GENERAL

1.1 Section Includes

1.1.1 Section includes, but is not limited to:

.1 Miscellaneous wood blocking for roofing and flashings.

.2 Miscellaneous blocking and strapping where required.

.3 Preservative treatment of wood members.

.4 Bracing and support for masonry.

1.2 Related Sections

1.2.1	Exterior Steel Stud Systems:	Section 05400
1.2.2	Modified Bituminous Roofing:	Section 07525
1.2.3	Metal Flashing:	Section 07600

1.3 References

1.3.1 Standards referenced throughout this Section shall be the latest standard at time of tender.

1.3.2 ASTM Standards:

.1 ASTM A307: Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.2 ASTM A653/A653M: Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealled) by the Hot-Dip Process.

.3 ASTM D1761: Standard Test Methods for Mechanical Fasteners in Wood.

.4 ASTM D5582: Standard Test Method for Determining Formaldehyde Levels from Wood Products using Desiccator.

.5 ASTM F1667: Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.

.6 ASTM F2403: Standard Specification for Inch Series Machine Screws, Carbon Steel, 60 000 psi Tensile Strength.

1.3.3 CSA Standards:

.1 CAN/CSA O80-Series: Wood Preservation.

.2 CSA O121: Douglas Fir Plywood.

.3 CAN/CSA O141: Softwood Lumber.

.4 CSA O151: Canadian Softwood Plywood.

.5 CAN/CSA-O325: Construction Sheathing.

1.3.4 NLGA Standard Grading Rules for Canadian Lumber.

ROUGH CARPENTRY

1.4 Quality Assurance

1.4.1 Provide all lumber bearing the grading stamp of an agency certified by the Canadian Lumber Standards Administration Board.

1.4.2 Supply lumber and panel components marked with a recognized, visible grade stamp.

1.5 Product Handling

1.5.1 Protect materials from weather while in transit and on job site.

1.5.2 Store materials on site to prevent deterioration or loss or impairment of structural or other essential properties. Store materials on raised supports. Avoid rapid changes in moisture content. Provide adequate air circulation and ventilation.

1.5.3 Store, protect, handle and install prefabricated structural elements in accordance with manufacturer's instructions. Pay particular attention to requirements for stacking, lifting, bracing, cutting, notching, and special fastening requirements.

1.5.4 Cover materials with tarpaulins or polyethylene sheets to prevent moisture absorption and impairment of structural or aesthetic properties.

1.5.5 Do not store seasoned materials in wet or damp areas.

1.5.6 Damaged material will be rejected and must be removed from site.

PART 2 PRODUCTS

2.1 Materials

2.1.1 Lumber for blocking and strapping: S-P-F species, construction grade.

2.1.2 Moisture content of dimension lumber: Dimension lumber to meet dry service conditions with a maximum moisture content of 15% (fifteen percent) at the time of installation of the surfacing material.

2.1.3 Sheathing plywood: Douglas Fir or Canadian softwood, sheathing grade, to CSA O121 or O151; 19 mm or 16mm thick unless indicated otherwise.

2.1.4 Nails, spikes and staples: to ASTM F1667, galvanized for exterior work and preservative treated lumber. To locations where ACQ pressure treated lumber is used, use corrosion resistant type fasteners which are specially manufactured for use with ACQ pressure treated lumber.

2.1.5 Screw fasteners into metal framing: stainless steel or ceramic coated galvanized steel, self drilling screws of lengths to suit application. Ensure fasteners are compatible with ACQ pressure treated wood and plywood where applicable.

2.1.6 Rough Hardware and proprietary fasteners: bolts, nuts, toggle bolts, expansion shields, washers, lag bolts, pins, screws (hot dip) galvanized to ASTM A123/A123M where exposed to corrosive conditions, and lead or inorganic fibre plugs; recommended for purpose by manufacturer. To locations where ACQ pressure treated lumber is used, use corrosion resistant type fasteners which are specially manufactured for use with ACQ pressure treated lumber.

2.1.7 Wood preservative: to CSA O80, alkaline copper quaternary (ACQ) content, no chromium or arsenic allowed.

2.2 Miscellaneous Materials

2.2.1 Nails: To CSA B111, Galvanized for all work.

2.2.2 Bolt, nut, washer screw and pin type fasteners: Hot dipped galvanized finish to CSA G164-M92.

2.2.3 Building paper: Wall sheathing paper conforming to CAN/CGSB-51.32 (30 minute paper).

2.2.4 Surface applied wood preservative: copper napthanate base or pentachlorophene, prepared in accordance with CSA O80.15-M, green in colour.

2.3 Pressure Preservative Treated Wood

2.3.1 In accordance with CAN/CSA 080, CSA 080.15-M using ACA or CCA water borne preservative treatment.

2.4 Treated Materials

2.4.1 Panel materials: Pressure Preservative Treated Wood in accordance with CAN/CSA 080 .

PART 3 EXECUTION

3.1 Workmanship

3.1.1 Produce joints which are tight, true and well nailed, with members assembled in accordance with the Drawings and with pertinent codes and regulations.

3.1.2 Select individual pieces so that knots and obvious defects will not interfere with placing of bolts, or proper nailing, and will allow making of proper connections.

3.1.3 Cut out and discard defects which render a piece of wood unable to serve its intended function.

3.1.4 Lumber may be rejected by the Engineer, whether or not it has been installed, for excess warp, twist, bow, crook, mildew, fungus, our mould, as well as for improper cutting and fitting.

3.1.5 Do not shim any framing components.

3.1.6 Sequence work to minimize use of temporary HVAC to dry out building and to control humidity.

3.2 Preservative Treatment

3.2.1 Pressure preservative treat wood in the following locations:

.1 Wood in or on exterior walls.

.2 Wood in contact with the ground.

.3 Where indicated on the drawings.

.4 Note: ensure that pressure treated surfaces are suitable to accept asphalt based products such as roof membranes, air/vapour barrier membranes and the like, without deteriorating or damaging the membranes. Coordinate with Sections 07270 and 07525.

3.2.2 Treat components in accordance with CSA-O80-08 series, and as follows:

ROUGH CARPENTRY

.1 CSA-O80 using ACQ water borne preservative treatment to S-P-F materials.

3.2.3 Following water borne preservative treatment, dry material to maximum moisture content of 19%.

3.2.4 Treatment for site sawn ends and edges: two brushed coats, or three-minute immersion.

3.2.5 Treat individually all cuts or holes made after general treatment, before installation of items.

3.3 Fire Retardant Treated Wood

3.3.1 Fire retardant treated wood: pressure treated to CSA-O80-Series, to provide flame spread rating and smoke developed rating to meet all National Building Code - Alberta Edition requirements, and to the satisfaction of the Authority Having Jurisdiction.

.1 To interior locations:"Dricon" Fire Retardant Treated Wood as manufactured by a licensed producer of Kopper Building Products Ltd., or preapproved product.

.2 To exterior locations: “FRX” as manufactured Chemco Inc., P.O. Box 875, Ferndale, WA, 98248; telephone (360) 366-3500., or preapproved product.

3.3.2 Fire retardant treat all wood members where required by Code and to the satisfaction of the Authority Having Jurisdiction.

3.4 Self-Adhesive Vapour Permeable Air Barrier

3.4.1 Premium self-adhesive vapour permeable, weather-resistive air barrier membrane composed of four layered polyolefin structures with a silicon release liner on the underside. Air barrier c/w air gap beads as indicated on Drawings.

3.5 Fastening & Attachment Methods/Devices

3.5.1 Unless otherwise required, fastening methods to conform to Section 9.23 Residential Standards (Table 23A and 23B) and Part 4 of the National Building Code - Alberta Edition. Minimize splitting by staggering nails in the direction of the grain and by keeping them well away from edges.

3.5.2 Adequately mechanically fasten all wood products used in connection with roofing.

3.5.3 Only use galvanized nails where nailing is an approved method of attachment, except where ACQ treated wood is used, use specified nails.

3.5.4 When fastening wood products to brick, concrete, concrete block and similar cementitious/masonry material, use only lag bolts or hilti "Hit" type fastening system. Use hilti "hit" when fastening to brick and block and lag bolts for fastening to concrete at 450 mm o.c. each way. In no case use lag bolt less than 10 mm diameter. Hilti "HPS" and other types of fasteners are not approved for fastening wood, blocking, and the like.

3.5.5 When fastening wood products to metal decks, use only Ucan "tek screws" in a size and quantity pattern to be determined by the Engineer, but in no case to less than a 300 mm o.c. each way.

ROUGH CARPENTRY

3.6 Miscellaneous Blocking, Bucks, and Plates

3.6.1 Provide blocking and plates for roofing and related sheet metal work according to indicated details. Provide wood curbs around roof penetrations, unless metal is indicated.

3.6.2 Place members true to lines and levels and secure rigidly in place.

3.6.3 Notch wood blocking attached to metal studs as required to accommodate stud flange returns, so that blocking will be flush with stud faces.

3.6.4 Install plywood blocking where indicated.

3.6.5 All blocking in fire rated assemblies is to conform to National Building Code - Alberta Edition requirements.

3.6.6 Install other blocking where indicated.

3.7 Larsen Trusses

3.7.1 Comply with section 01350 Delegated Design Submittal Procedures for delegated engineering, wind uplift, and design requirements. Refer to Architectural drawings and details for design intent.

3.8 Wall Sheathing

3.8.1 To back side of parapets and the like, apply wall sheathing horizontally to studs using specified screw fasteners at 150 mm o/c along edges and 300 mm o/c in the middle of the sheet. Support all edges of wall sheathing with blocking.

3.9 Carpentry in Connection with Roofing

3.9.1 Curb all roof penetrations (except drains). Construct wood curbs for roof mounted equipment and anchors, and for roof penetrations (except drains). Curb heights measured from highest point of roof adjacent to curb to be:

200 mm for plumbing vents.
250 mm for all other curbs.

3.9.2 Mechanically fasten plywood facing to parapets, and walls at roof-wall junctions.

3.9.3 Attach curbs, control joint boxes, blocking and framing directly to structure.

3.9.4 Install continuous 250 mm wide plywood sheathing below parapet walls at roof/parapet locations on steel deck. Ensure that plywood is the same thickness as adjacent gypsum board on metal decking at roofs.

3.10 Miscellaneous

3.10.1 Install bracing to masonry during construction. Install support for masonry lintels.

3.11 Telephone and Electrical Equipment Backboards

3.11.1 Provide backboards for mounting telephone and electrical equipment as indicated. Use 19 mm thick Canadian Softwood Plywood/S1S or Douglas Fir Plywood/G1S. Treat with intumescent paint or use pressure fire retardant plywood.

END OF SECTION

PART 1 GENERAL

1.1 Related Requirements

1.1.1 Section 02210 – Grading

1.1.2 Section 02260 – Soil Anchors

1.1.3 Section 02325 – Excavating and Backfilling for Structures

1.1.4 Section 03300 – Cast-in-Place Concrete

1.1.5 Section 07215 – Air and Vapour Barrier Membrane

1.2 References

1.2.1 American Society for Testing and Materials (ASTM):

.1 ASTM D146 - Standard Test Methods for Sampling and Testing Bitumen-Saturated Felts and Fabrics Used in Roofing and Waterproofing.

.2 ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers -Tension.

.3 ASTM D570 - Standard Test Method for Water Absorption of Plastics.

.4 ASTM E96 (Method B) - Standard Test Methods for Water Vapor Transmission of Materials.

.5 ASTM C836 - Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course.

.6 ASTM C836 - Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course.

.7 ASTM D882: Standard Test Method for Tensile Properties of Thin Plastic Sheeting.

.8 ASTM D903: Standard Test Method for Peel or Stripping Strength of Adhesive Bonds.

.9 ASTM D1970 - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.

.10 ASTM D5385: Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes.

.11 ASTM E154: Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.

.12 ASTM F2130: Standard Test Method for Measuring Repellency, Retention, and Penetration of Liquid Pesticide Formulation Through Protective Clothing Materials.

1.3 Administrative Requirements

1.3.1 General Contractor to carry price for 3 site reviews for manufacturer's representative to visit the site. Contact manufacturer's representative for amount for each location, depending on location of project. Basis-of-Design: WR Meadows, contact info: Adam Develter 403.604.5760

1.3.2 Convene pre-installation meeting one week prior to beginning waterproofing Work, with waterproofing contractor's representative, Engineer, Consultant, and Contractor in accordance with Division 01. Notification of meetings must be sent out minimum 2 weeks prior to meeting date. Meeting agenda:

.1 Verify project requirements.

.2 Co-ordination with other building subtrades.

.3 Review installation procedures, including:

.1 Substrate requirements for Project acceptance (curing of concrete surface, for release agents, temperature).

.2 Waterproofing installation.

.3 Phasing and sequencing requirements.

.4 Termination, flashing, expansion joint, and penetration requirements.

.5 Review inspection, testing, and quality control procedures.

.6 Manufacturer's warranty requirements.

1.4 Submittals

1.4.1 Submit product data in accordance with Division 01:

.1 Submit duplicate 300 x 300 mm samples of sheet membrane material and protection board.

.2 Submit certified copies of test data from recognized independent testing laboratory confirming performance properties of waterproofing membrane.

1.4.2 Manufacturer's Certificate: certify that products meet or exceed specified requirements.

1.4.3 Test and Evaluation Reports: submit laboratory test reports certifying compliance of bitumen and membrane with specification requirements.

1.4.4 Manufacturer's Installation Instructions: indicate special precautions required for seaming the membrane.

1.4.5 Reports: indicate procedures followed including ambient temperatures during application.

1.4.6 Alternate product: alternate products MUST be reviewed by Consultant during bid period.

1.5 Quality Assurance

1.5.1 Preconstruction meeting: Convene on site one week prior to commencing work of this section, in accordance with Division 01, meeting with the manufacturer's technical representative, general contractor and site engineer to review installation procedures.

1.5.2 Qualifications: Provide proof of qualifications:

.1 Membrane: applied by applicator trained and approved by manufacturer for application of its products. Provide written evidence of endorsement from manufacturer upon request.

.2 Applicators: minimum 5 years proven experience.

.3 Manufacturer's representative responsibilities:

.1 Inspect substrate prior to commencement of work, periodically during application of membrane and upon completion of work to ensure compliance with the contract documents and manufacturer's published guidelines.

.2 Provide written copies of such inspection reports.

.3 Provide technical assistance to applicator and assist where required in correct installation of membrane.

.4 On direction from the Consultant, evaluate the continuity and integrity of the in-place waterproofing installation through flood test procedures, using an independent testing agency engaged by the Consultant and paid for by the Owner.

1.5.3 Provide proper equipment, manpower and supervision at jobsite to install the membrane in compliance with the project plans and specifications.

1.5.4 Mock-up:

.1 Construct mock-up 5 m minimum, of elastomeric membrane waterproofing including one lap joint, one inside corner and one outside corner and under slab installation. Mock-up may be part of finished work.

.2 Allow 72 h for inspection of mock-up by Consultant before proceeding with waterproofing work.

1.6 Delivery, Storage, And Handling

1.6.1 Delivery and Acceptance Requirements: Deliver materials to job site in original unopened packages, clearly marked with manufacturer's name, material brand name and description of contents.

1.6.2 Storage and Handling Requirements: Protect membrane materials before, during and after installation in accordance with manufacturer’s requirements for weight, temperature, heat and flame, and humidity; store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by membrane manufacturer.

1.7 Field Conditions

1.7.1 Ambient Conditions

.1 Do not install waterproofing when temperature remains below -18 degrees C for torch application, or to manufacturers' recommendations for mop application.

.2 Minimum temperature for solvent-based adhesive is -5 degrees C.

1.7.2 Install waterproofing on substrate, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture into waterproofing system.

1.8 Environmental Requirements (Underslab and blindside waterproofing)

1.8.1 Product not intended for uses subject to abuse or permanent exposure to the elements.

1.8.2 Apply membrane when conditions are dry and rain is not imminent.

1.8.3 Ensure concrete is poured within 60 days of membrane application.

PART 2 PRODUCTS

2.1 Manufacturers

2.1.1 Acceptable manufacturers: Subject to compliance with requirements of this Section, products by the following manufacturers are acceptable.

.1 W.R. Meadows.

.2 Soprema

.3 WR Grace Construction Materials

.4 Permaquik

.5 Henry

2.2 Vertical Cold Applied Waterproofing

2.2.1 Waterproofing Membrane: Rolled, Self-Adhering Waterproofing Membrane: Polymeric waterproofing membrane protected by release paper on cross-laminated polyethylene carrier film with exposed polymeric membrane strips on both sides protected by pull-off release strips.

.1 Waterproofing membrane shall have the following properties as determined by laboratory testing:

.1 Color: Black

.2 Compliance: AREMA Specification Chapter 29 - Waterproofing.

.3 Thickness: Carrier Film: 4 mils. + Polymeric Membrane: 56 mils.

.4 Tensile Strength, ASTM D412, Die C:

.1 Carrier Film: 5,900 psi (40.71 MPa) minimum.

.2 Polymeric Membrane: 460 psi (3.23 MPa) minimum.

.5 Elongation, ASTM D412, Die C: Polymeric Membrane: 971 % minimum.

.6 Peel Adhesion, ASTM D903: 11.8 lbf/in. (2068 N/m).

.7 Lap Adhesion, ASTM D1876: 8.62 lbf/in. (1508 N/m)

.8 Water Vapor Permeability, ASTM E96, Method B: 0.036 perms.

.9 Water Absorption, ASTM D570: 0.1 percent, 72 hours maximum.

.10 Resistance to Hydrostatic Head: Equivalent to 230.9 feet (70.3 m) of water.

.11 Puncture Resistance, ASTM E154: 48.2 lbf (214.6 N).

.12 Exposure to Fungi, Soil Test: Pass, 16 weeks.

.2 Basis-of-Design: Mel-Rol by W.R. Meadows. Use Low Temperature materials when installing in temperatures below freezing.

.3 Acceptable Alternates:

.1 Colphene 3000 as manufactured by Soprema Inc.

.2 Bituthene 3000 as manufactured by W.R. Grace Construction Materials Ltd.

.3 Permaquik PQ 7100.

.4 Mel-Rol as manufactured by W.R. Meadows Inc.

.5 Henry WP200

2.3 Blindside / Underslab Membrane Waterproofing

2.3.1 Blindside Waterproofing Membrane: 73 mil (1.85mm) thick, composite sheet membrane comprised of an elastomeric membrane bonded to a seven-ply plasmatic matrix and a non-woven geotextile fabric.

.1 Performance Based Spec: Blindside waterproofing membrane shall have the following properties as determined by laboratory testing:

.1 Membrane Thickness: 73 mil (1.85 mm)

.2 Low Temperature Flexibility, ASTM D1970: Pass

.3 Resistance to Hydrostatic Head, ASTM D5385-93: 230’ (70 m)

.4 Elongation, ASTM D412-06: >400%

.5 Tensile Strength (film), ASTM D882: 9,200 psi (63.4 MPa)

.6 Crack Cycling, ASTM C836: Pass

.7 Puncture Resistance, ASTM E154: >210 lb. (>934 N)

.8 Peel Adhesion to Concrete, ASTM D903: 10 lb/in (1,754 N/m)

.9 Moisture Vapor Transmission, ASTM E96 (Method B): 0.0011 perms

.10 Resistance to Penetration by Termites, Texas A&M Method, Percentage of Penetration: 0.0%

.11 Resistance to Penetration by Pesticides, ASTM F2130, Percentage of Penetration: 0.0%

.12 Resistance to Fungi in Soil, GSA-PBS 07115 – 16 weeks: No Effect

.2 Basis-of-Design: PRECON Blindside/Underslab Waterproofing Membrane by W.R. MEADOWS.

.3 Acceptable Alternate: Bithuthene Preprufe 300 waterproofing membrane by WR Grace Construction Materials Ltd.

2.4 Accessories – cold applied waterproofing

2.4.1 Surface Conditioner:

.1 Temperatures Above 40oF (4oC): Mel-Prime Water Base Primer.

.2 Temperatures Above 0oF (-18oC): Mel-Prime VOC Compliant Solvent Base Primer or Standard Solvent Base Primer.

2.4.2 Flashing and Fillets: MEL-ROL LIQUID MEMBRANE.

2.4.3 Pointing Mastic: POINTING MASTIC.

2.4.4 Termination Bar: TERMINATION BAR.

2.4.5 Corner Tape: DETAIL STRIP.

2.4.6 Waterproofing Protection Course: PROTECTION COURSE

2.5 Accessories – blindside / underslab

2.5.1 Liquid Membrane for Fastener Details: MEL-ROL 2 COMPONENT LIQUID MEMBRANE by W. R. MEADOWS.

2.5.2 Liquid Membrane for Overlap Detail: HYDRALASTIC 836 by W. R. MEADOWS.

2.5.3 Detail Fabric for Terminations: DETAIL FABRIC by W. R. MEADOWS.

2.5.4 Detail Tape Adhesive: MEL-PRIME by W. R. MEADOWS.

2.5.5 Provide accessories as required for complete installation as recommended by waterproofing manufacture.

2.5.6 Protection Board (for all horizontal underslab installations): premanufactured protection board as recommended by the membrane manufacturer for installation under slabs.

2.5.7 Protection Board (for all vertical applications): 25 mm thick expanded polystyrene foam board or other premanufactured protection board as recommended by the membrane manufacturer.

2.5.8 Protection board adhesive: fast drying, rubber based cement, Bituthene PBA-3000 or as recommended by the membrane manufacturer. Note: protection board adhesive is to be compatible with protection board and with membrane.

2.5.9 Liquid Membrane: two component, high performance polyurethane sealant, 100% solids in content, as manufactured by the membrane manufacturer.

PART 3 EXECUTION

3.1 Examination And Preparation Of Surfaces – Cold Applied Waterproofing

3.1.1 Examine surfaces to receive membrane. Notify Consultant if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected.

3.1.2 Protect adjacent surfaces not designated to receive waterproofing.

3.1.3 Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions.

3.1.4 Do not apply waterproofing to surfaces unacceptable to manufacturer.

3.1.5 Concrete surfaces must be clean, relatively smooth, and free of standing water.

3.1.6 Patch all holes and voids and smooth out any surface misalignments.

3.1.7 Apply surface conditioner to surfaces that will be covered within one working day according to manufacturer’s recommended coverage rates.

3.1.8 Install corner tape on all inside and outside corners, including the footing.

3.1.9 Apply a 230 mm strip of self-adhering membrane over construction, control and expansion joints and over cracks greater than 1.6 mm wide.

3.1.10 Seal all terminations with pointing mastic.

3.2 Application – Cold Applied Waterproofing

3.2.1 Apply waterproofing membrane system in accordance with manufacturer's instructions.

3.2.2 Ensure accessory materials are compatible with membrane and approved by membrane manufacturer.

3.2.3 Remove release paper on edge and position the membrane.

3.2.4 Pull balance of release paper off, running the roll vertically over the top of the corner tape at the footing.

3.2.5 Immediately hand-rub the membrane firmly to the surface, removing any bubbles or wrinkles, then pressure roll the complete surface to assure positive adhesion.

3.2.6 Overlap all seams and stagger end laps at least 2 ½” (63.5 mm).

3.2.7 Seal all terminations with pointing mastic.

3.2.8 Inspect membrane before covering and repair as necessary. Cover tears and inadequate overlaps with membrane. Seal edges of patches with pointing mastic.

3.3 Protection – Cold Applied Waterproofing

3.3.1 Protect membrane with application of waterproofing protection course, drainage board, or other approved material.

3.3.2 Backfill immediately using care to avoid damaging waterproofing membrane system.

3.4 Examination and Preparation of Blindside / underslab waterproofing

3.4.1 Examine surfaces to receive membrane. Notify architect if surfaces are not acceptable. Do not begin surface preparation or installation until unacceptable conditions have been corrected.

3.4.2 Inspect all surfaces for any conditions detrimental to the proper completion of the work.

3.4.3 Ensures surfaces are structurally sound.

3.4.4 Remove debris or any other foreign material that could damage the membrane.

3.5 Installation - Blindside Waterproofing

3.5.1 Mechanically fasten membrane across the top lagging at 12” (300 mm) on centre, 12 mm from the top, with fasteners approved by the manufacturer.

3.5.2 Ensure the fabric side of the membrane is facing the interior side of the form to receive the concrete.

3.5.3 Apply two-component liquid membrane over the areas where the fasteners have been attached and carry over the top edge.

3.5.4 Remove release paper on 150 mm selvedge edge and overlap edges of additional sheet. Roll press into place.

3.5.5 For end-to-end overlap, overlap membrane 150 mm.

3.5.6 Apply liquid detail membrane in this area to be lapped and roll press membrane into this liquid detail membrane.

3.5.7 Apply liquid detail membrane at terminations of membrane, 310 mm wide centered over the termination.

3.5.8 Embed detail fabric into this wet liquid detail membrane centered over the termination, 6” (152.4 mm) on each side of lap edge, and roll press into place.

3.5.9 Apply additional liquid detail membrane on all terminations of detail fabric.

3.5.10 Inspect membrane prior to pouring of concrete for any punctures or damage.

3.5.11 Repair damaged areas as directed by the manufacturer.

3.6 Installation – Underslab Waterproofing

3.6.1 Prepare subgrade prior to membrane application according to ACI 302.1R.17.

3.6.2 Ensure the fabric side of the membrane is facing up.

3.6.3 Remove release paper on 150 mm selvedge edge and overlap edges of additional sheet. Roll press into place.

3.6.4 For end-to-end overlap, overlap membrane 152.4 mm.

3.6.5 Apply liquid detail membrane in this area to be lapped and roll press membrane into this liquid detail membrane.

3.6.6 Apply liquid detail membrane at terminations of membrane, 310 mm wide centered over the termination.

3.6.7 Embed detail fabric into this wet liquid detail membrane centered over the termination, 150 mm on each side of lap edge, and roll press into place.

3.6.8 Apply additional liquid detail membrane on all terminations of detail fabric.

3.6.9 Inspect membrane prior to pouring of concrete for any punctures or damage.

3.6.10 Repair damaged areas as directed by the manufacturer.

3.7 Protection – Blindside / Underslab Waterproofing

3.7.1 Ensure membrane is not damaged prior to concrete pour.

3.7.2 Ensure concrete is poured within 60 days of membrane application.

END OF SECTION 07150

BOARD INSULATION

PART 1 GENERAL

1.1 Section Includes

1.1.1 Section includes, but is not limited to:

.1 Semi-rigid insulation.

.2 Perimeter foundation Insulation

.3 Fire Safing Insulation.

1.2 Related Sections

1.2.1 Air/Vapour Barriers: Section 07270

1.2.2 Sealants: Section 07920

1.3 Referenced Standards

1.3.1 Comply with the latest edition of the following statutes, codes and standards and all amendments thereto.

1.3.2 ASTM Standards:

.1 ASTM C553: Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.

.2 ASTM C578: Standards Specification for Rigid, Cellular Polystyrene Thermal Insulation.

.3 ASTM C612: Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

.4 ASTM C665: Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

.5 ASTM C1320: Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction.

.6 CGA Standards:

.7 CAN/CGA-B149.1: Natural Gas and Propane Installation Code Handbook.

.8 CAN/CGA-B149.2: Propane Storage and Handling Code.

1.3.3 ULC Standards:

.1 CAN/ULC-S101: Standard Methods of Fire Endurance Tests of Building Construction and Materials.

.2 CAN/ULC-S102: Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.3 CAN/ULC-S114: Standard Method of Test for Determination of Non-Combustibility in Building Materials.

.4 CAN/ULC-S115: Standard Method of Fire tests for Firestop Systems.

.5 CAN/ULC-S604: Standard for Factory-Built Type A Chimneys.

.6 CAN/ULC S701: Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.7 CAN/ULC-S702: Standard for Mineral Thermal Fibre Insulation for Buildings.

.8 CAN/ULC-S702.2: Mineral Fibre Thermal Installation for Building, Part 2: Application Guidelines.

.9 CAN/ULC-S704: Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

1.4 Product Handling

1.4.1 Deliver all insulation materials to the site suitably protected with the manufacturer's seals and labels intact, and store neatly in dry locations, on raised platforms, protected from damage by weather, and construction activity.

1.4.2 Prior to and during installation, take all precautions and handle with due care all insulation materials to prevent breakage, tearing or indentations of the surface and the like.

1.4.3 Replace insulation materials damaged or installed in such a manner as may be detrimental to designed performance of the material.

1.4.4 Prevent exposure of polystyrene insulation to direct sunlight.

1.5 Certification

1.5.1 Ensure polystyrene insulation is tested, certified and labelled for conformance with CAN/ULC S701-11, Thermal Insulation, Polystyrene, Boards and Pipe Covering, in accordance with CGSB, ULC, or other certification program accredited by Standards Council of Canada.

1.6 Quality Assurance

1.6.1 Perform work of this Section using a company which specializes in the type of building insulation work required for this Project, with a minimum of 5 years of documented successful experience, using skilled workers throughly experienced in the necessary crafts.

1.6.2 Use Manufacturer specializing in manufacturing the type of building insulation specified in this Section with a minimum of 5 years of documented successful experience, and having the facilities capable of meeting all requirements of the Contract Documents as a single-source responsibility and warranty.

1.6.3 Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.

1.6.4 Fire-Test-Response Characteristics: provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by ULC or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspection agency.

.1 Test Reports: Submit copies of fire test reports from ULC of product and assembly indicating conformance to:

.1 CAN/ULC-S101 for fire resistance rating.

.2 CAN/ULC-S102 for surface burning characteristics.

.3 CAN/ULC-S114 for non-combustibility.

1.6.5 The Engineer will periodically review air/vapour barrier and insulation material installations, prior to application of covering materials. Construction Manager must keep the Engineer aware of the installation schedule and be prepared to remove insulation materials to allow for spot verification of air/vapour barrier installation where the Engineer was not on site at time of installation.

1.7 Sequencing and Scheduling

1.7.1 Schedule application of insulation to follow immediately after installation of air/vapour barrier and to proceed concurrently with it.

PART 2 PRODUCTS

2.1 Insulation Types

2.1.1 Perimeter Insulation: Rigid polystyrene insulation: conforming to ULC S701, CFC and HCFC free, without ozone depletion potential greater than zero; thickness and RSI values as indicated on the drawings, ship lapped edges generally, shiplap edges generally, square edges where insulation butts into adjacent materials or is installed between framing members, types as follows:

.1 Perimeter Foundation Insulation: extruded polystyrene insulation type 4, compressive strength of 240 kPa (30 p.s.i.), Acceptable materials:

.1 Dow Styrofoam SM.

.2 Owens-Corning Formular C-300.

.3 Other preapproved product.

2.1.2 Extruded Polystyrene Insulation (XPS), CAN/ULC-S701 Type 3; cellular type, conforming to the following:

.1 Compressive Strength: 170 kPa.

.2 Thermal Resistance per 25.4 mm: RSI of 0.88.

.3 Board Thickness: As indicated.

.4 Water Absorption: 0.7% by volume maximum.

.5 Board Edges: Long edge, Shiplap or T&G; Short edge.

.6 Acceptable Materials/Products: DuPont, "Styrofoam CAVITYMATE" for brick cavity walls and "Styrofoam CAVITYMATE SC" for steel stud cavity walls, or approved alternative.

2.1.3 Concrete-Faced Extruded Polystyrene Insulation (XPS), CAN/ULC-S701 Type 4; cellular type, conforming to the following:

.1 Compressive Strength: 210 kPa.

.2 Thermal Resistance per 25.4 mm: RSI of 0.88.

.3 Board Thickness: as indicated.

.4 Water Absorption: 0.7% by volume maximum.

.5 Board Edges: Long edge, Shiplap or T&G; Short edge.

.6 Facing: 8 mm latex modified concrete on one face.

.7 Acceptable Materials/Products: Tech-Crete, "CFI Wall Panels" or approved alternative.

2.1.4 Low Water Absorption meeting ASHRAE 90.1 - 1999 for ground contact: Extruded Polystyrene Insulation (XPS), CAN/ULC-S701 Type 4; cellular type, conforming to the following:

.1 Compressive Strength: 172 kPa minimum.

.2 Thermal Resistance per 25.4 mm: RSI of 0.828 minimum.

.3 Board Thickness: As indicated.

.4 Water Absorption: 0.3% by volume maximum.

.5 Board Edges: Long edge, Shiplap or T&G; Short edge.

.6 Acceptable Materials/Products: Owens Corning Foamular 250, DuPont Styrofoam Brand Perimate.

2.1.5 High Load/Low Water Absorption meeting ASHRAE 90.1 for ground contact: Extruded Polystyrene Insulation (XPS), CAN/ULC-S701 Type 4; cellular type, conforming to the following:

.1 Compressive Strength: 415 kPa (60 psi).

.2 Thermal Resistance per 25.4 mm: RSI of 0.88.

.3 Board Thickness: As indicated.

.4 Water Absorption: 0.55% by volume maximum.

.5 Board Edges: Square.

.6 Acceptable Materials/Products: Styrofoam Highload 60.

2.1.6 Mineral fibre board (MFB) Noncombustible to CAN/ULC-S702, Type 1, conforming to the following:

.1 Density: To ASTM C612.

.1 Outer layer: 100 kg/m³.

.2 Inner layer 60 kg/m³.

.2 Thermal Resistance per 25.4 mm: RSI of 0.76 overall RSI value 3.52.

.3 Thickness: indicated.

.4 Surface Burning Characteristics: To CAN/ULC S102

.1 Flame spread: 0

.2 Smoke developed: 5.

.5 Moisture absorption: 1% maximum to ASTM C1104/C1104M.

.6 Acceptable Materials/Products: ROCKWOOL CavityRock, or approved substitution.

2.1.7 Mineral fibre board: (MFB) To CAN/ULC-S702, Type 1, conforming to the following:

.1 Density: 72 kg/m³ (4.5 lbs/ft3)

.2 Thermal Resistance per 25.4 mm: RSI of 0.74 overall RSI value 3.52.

.3 Thickness: indicated.

.4 CAN/ULC S102: flame spread - 0, smoke developed - 0.

.5 Moisture absorption: 0.03% to ASTM C 1104.

.6 Acceptable Materials: ROCKWOOL ComfortBatt

2.1.8 Low Density Insulation: Expanded polystyrene (EPS) to CAN/ULC-S701, Type 2.

.1 Compressive strength: 110 kPA.

.2 Size: 48” x 48” blocks, tapered slope 1:100, or as indicated.

.3 Edges: square.

.4 Acceptable material: Mansonville Plastics, Korolite EPS, PlastiSpan HD by Plasti-Fab, or approved substitution.

2.1.9 Insulation for roof: Polyisocanurate core, glass fiber faced to CAN/ULC C-S704, thickness as indicated. Aged RSI value of 1.0325/25mm thickness (R5.9/in.)

.1 Board Density: 32 kg/cu m.

.2 Thermal Conductivity: KSI factor of 0.62 as determined by ASTM C177.

.3 Flat, 1220mm x 1220mm x 127mm.

.4 Square edge.

.5 Minimum insulating value RSI 5.28 (R30) at roof drains sumps.

.6 Acceptable Materials: Acceptable material: Mansonville, Soprema, Firestone or approved substitution.

2.1.10 Wood Fiber Insulation:
Insulation Type: Wood fiber board insulation, with a dense, high-performance core suitable for applications. The insulation shall be composed of natural wood fibers, treated for moisture resistance and thermal stability.

.1 Board Density: 180–220 kg/cu m (depending on manufacturer specifications), providing excellent compressive strength while maintaining a light overall weight.

.2 Thermal Performance:

.1 RSI Value: 1.15 RSI per 25mm thickness (R6.5/inch).

.2 Thermal Conductivity: value of 0.045 W/m·K (ASTM C518).

.3 Physical Dimensions:

.1 Board Size: as indicated on Drawings. 1200mm x 2400mm (standard board size for applications).

.2 Thickness: as indicated on Drawings.

.4 Moisture Resistance:

.1 Water Vapor Diffusion Resistance Factor (μ): 5–10.

.5 Minimum Insulating Value:

.1 RSI 5.28 (R30) at roof drain sumps, as required by standard roofing practices for high-performance insulation zones.

.6 Acceptable Materials:

.1 Approved Manufacturers: Gutex, Steico, Udi, or other certified wood fiber insulation manufacturers as per project requirements.

.7 Fire Resistance:

.1 Fire Class: Euroclass C-s3,d2 or better.

2.1.11 Environmental Considerations:

.1 Sustainability: Made from renewable wood fibers, the material offers a low carbon footprint and is fully recyclable at the end of its life cycle

2.2 Fasteners

2.2.1 Screwed fasteners: 6.4 mm diameter, drilled self tapping galvanized or stainless steel "tapcon" screw anchors complete with PVC or galvanized steel discs approximately 38 mm diameter. Screws to be long enough to penetrate through insulation, air/vapour barrier and gypsum sheathing and into steel studs or into concrete or concrete block minimum 32 mm, to securely anchor system into place and to withstand all super-imposed loads.

2.3 Accessories

2.3.1 Insulation Adhesive for perimeter foundation insulation: conforming to CGSB 71-GP-24M, Type 1, Class A, adhesive must not contain solvents and must be compatible with membrane and insulation.

2.3.2 Insulation fasteners:

.1 For metal: self-tapping sheet metal screws, plated/coated for corrosion protection, of length to penetrate minimum 20 mm through stud.

2.3.3 For concrete/solid masonry:

.1 Plastic expansion anchor with integral large head purposed made for attaching insulation boards. Acceptable material: Hilti IDP Insulation Anchor.

.2 Impaling clip of galvanized steel with washer retainer, mechanically fastened to surface to receive board insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.

2.3.4 Nailing discs: flat caps, minimum 25 mm diameter, minimum 0.4 mm (26 gauge) thick, sheet metal or fibre, formed to prevent dishing. Bell or cup shapes not acceptable.

2.3.5 Insulation adhesive (for polystyrene): to CGSB 71-GP-24, Type II.

2.3.6 Concrete-faced Insulation Fasteners: Galvanized steel mounting clips as recommended by insulation manufacturer.

.1 Refer to Drawings for fastening details and trims.

PART 3 EXECUTION

3.1 Workmanship

3.1.1 Install insulation to maintain continuous and complete thermal protection for building spaces and elements.

3.1.2 Ensure all surfaces which are to receive insulation are clean, free from deleterious matter and are sufficiently level to allow the proper installation of insulation.

3.1.3 Install insulation boards horizontally. Offset vertical joints minimum 300 mm.

3.1.4 Install tightly against dry substrate. Provide continuity of thermal protection to building elements and spaces.

3.1.5 Cut and trim insulation to fit spaces around corners and penetrations. Take care to prevent cutting sheet membrane air/vapour barrier. Cut and fit insulation tight around all cladding anchors and supports, against mechanical, electrical and other items which protrude through the plane of insulation.

3.1.6 Butt edges and ends tight. Deform board edges as required to maintain tight butt joints at insulation fasteners and other penetrations located at board joints.

3.1.7 Press insulation tightly in place so that it abutts the air/vapour barrier membrane.

3.1.8 Butt ends and edges of boards tightly together to form a complete thermal barrier.

3.1.9 Use insulation free from broken or chipped edges.

3.1.10 Follow the instructions for use of materials of insulation and accessory manufacturers.

3.1.11 Use largest possible dimensions to reduce the number of joints.

3.1.12 Ensure that joints in insulation do not occur directly over joints in back-up such as between different materials and at deflection joints. Offset insulation joints from deflection joints in backup minimum 300 mm.

3.1.13 Fill all spaces 3 mm or greater, between boards and between boards and adjacent materials, with foam-in-place insulation.

3.1.14 Where the flame spread rating of cavity wall insulation exceeds 25, provide blocking in cavities to meet all National Building Code - Alberta Edition requirements.

3.1.15 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures, and minimum 50 mm from sidewalls of CAN/ULC-S604 type A chimneys and CAN/CGA-B149.1 and CAN/CGA-B149.2 type B and L vents. Fill spaces adjacent to heat emitting devices with fire safing insulation.

3.2 Installation of Fasteners

3.2.1 To cavity wall locations, coordinate installation fastening with brick ties specified in Section 04200. Supplement brick ties fastenings with mechanical fasteners to ensure that each board in held in place with minimum 6 fastener (brick ties or combination of brick ties and mechanical fasteners). Ensure fasteners are installed into metal studs or solid backing. Do not anchor to gypsum sheathing only.

3.2.2 Where insulation is installed over bentonite clay waterproofing, using screw-on type fasteners using minimum 6 fasteners per board and not less than 75 mm from all ends and edges.

3.2.3 Provide minimum of 2 fasteners per cut section and no pieces of insulation smaller than 300 mm^2.

3.3 Installation/Perimeter Foundation

3.3.1 Secure polystyrene insulation to perimeter of foundation walls by adhering it with adhesive in accordance with manufacturer's recommendations and specifications. Place 600 mm wide insulation board horizontally. Extend insulation down to bottom of grade beams or as otherwise indicated on the Drawings. Ensure adhesive is compatible with modified bituminous waterproofing. Where insulation is applied over bentonite clay waterproofing, install with mechanical fasteners as specified in item 3.2.2 of this Section.

3.3.2 Stagger all vertical joints on insulation except free ends or line of expansion/control joints.

3.3.3 Lay out insulation so that ends overlap minimum 100 mm and maximum of 150 mm over line of expansion/contraction joints. Leave overlapping ends of insulation unbonded over line of these joints, allowing insulation to move freely with foundation.

3.3.4 Install board to prevent displacement. Protect insulation during backfill operations to prevent damage. Ensure complete coverage in insulation with backfill materials.

3.4 Protection

3.4.1 Protect installed insulation and air/vapour barriers from damage due to harmful weather exposure, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

3.5 Cleaning

3.5.1 Promptly as work proceeds, and on completion, clean up and remove from premises all rubbish and surplus materials resulting from work of this Section, leaving areas in clean condition.

END OF SECTION

BATT INSULATION

PART 1 GENERAL

1.1 Section Includes

1.1.1 Section includes, but is not limited to:

.1 Fibrous Batt insulation.

.2 Fire Safing Insulation.

.3 Wood Fiber Insulation.

1.2 Related Sections

1.2.1	Exterior Steel Stud Systems:	Section 05400
1.2.2	Board Insulation:	Section 07212
1.2.3	Foam-in-place insulation:	Section 07214
1.2.4	Air Vapour Barrier:	Section 07270
1.2.5	Modified Bituminous Roofing:	Section 07525

1.3 Referenced Standards

1.3.1 Comply with the latest edition of the following statutes, codes and standards and all amendments thereto.

1.3.2 ASTM Standards:

.1 ASTM C553: Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.

.2 ASTM C612: Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

.3 ASTM C665: Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

.4 ASTM C1320: Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction.

1.3.3 CGA Standards:

.1 CAN/CGA-B149.1: Natural Gas and Propane Installation Code Handbook.

.2 CAN/CGA-B149.2: Propane Storage and Handling Code.

1.3.4 ULC Standards:

.1 CAN/ULC-S101: Standard Methods of Fire Endurance Tests of Building Construction and Materials.

.2 CAN/ULC-S102: Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.3 CAN/ULC-S114: Standard Method of Test for Determination of Non-Combustibility in Building Materials.

.4 CAN/ULC-S115: Standard Method of Fire tests for Firestop Systems.

.5 CAN/ULC-S604: Standard for Factory-Built Type A Chimneys.

.6 CAN/ULC-S702: Standard for Mineral Thermal Fibre Insulation for Buildings.

.7 CAN/ULC-S702.2: Mineral Fibre Thermal Installation for Building, Part 2: Application Guidelines.

1.4 Environmental Requirements

1.4.1 Install insulation adhesives in accordance with manufacturer's instruction.

1.5 Product Handling

1.5.1 Deliver all insulation materials to the site suitably protected with the manufacturer's seals and labels intact, and store in dry locations, off ground, protected from damage by weather, and construction activity. Protect from damage and disfiguration.

1.5.2 Prior to and during installation, take all precautions and handle with due care all insulation materials to prevent tearing and the like.

1.5.3 Replace insulation materials damaged or installed in such a manner as may be detrimental to designed performance of the material in the opinion of the Engineer.

1.6 Quality Assurance

1.6.1 Perform work of this Section using a company which specializes in the type of building insulation work required for this Project, with a minimum of 5 years of documented successful experience, using skilled workers throughly experienced in the necessary crafts.

1.6.2 Use Manufacturer specializing in manufacturing the type of building insulation specified in this Section with a minimum of 5 years of documented successful experience, and having the facilities capable of meeting all requirements of the Contract Documents as a single-source responsibility and warranty.

1.6.3 Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.

1.6.4 Fire-Test-Response Characteristics: provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by ULC or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspection agency.

.1 Test Reports: Submit copies of fire test reports from ULC of product and assembly indicating conformance to:

.1 CAN/ULC-S101 for fire resistance rating.

.2 CAN/ULC-S102 for surface burning characteristics.

.3 CAN/ULC-S114 for non-combustibility.

1.6.5 The Engineer will periodically review air/vapour barrier and insulation material installations, prior to application of covering materials. Construction Manager must keep the Engineer aware of the installation schedule.

PART 2 PRODUCTS

2.1 Materials

2.1.1 Fibrous Mineral Wool Thermal Insulation: non-combustible, stone wool batt insulation to CAN/ULC 702 and as follows:

.1 Type: one.

.2 Fire performance:

.1 Combustion Characteristics: non combustible in accordance with CAN/ULC S114.

.2 Surface Burning Characteristics: To CAN/ULC S102.

.1 Flame spread: 0.

.2 Smoke developed: 0.

.3 Density: 32 kg/m3 to ASTM C167.

.4 Thermal Resistance: nominal RSI of 0.71/25 mm.

.5 Thickness: as required to fill insulated spaces.

.6 Acceptable Materials:

.1 Thermafiber UltraBatt, Owens-Corning Canada LP.

.2 ComfortBatt, Rockwool Inc.

BATT INSULATION

2.1.2 Fibrous Mineral Wool Insulation: Un-faced, preformed mineral slag fibrous insulation in accordance with CAN/ULC 702 and as follows:

.1 Type: 1VB.

.2 Thermal Resistance: nominal RSI of 0.74/25 mm.

.3 Combustion Characteristics: non-combustible in accordance with CAN/ULC S114.

.4 Flamespread: 0 in accordance with CAN/ULC S102.

.5 Density: 96 kg/m3.

.6 Thickness: as indicated on Drawings.

.7 Basis-of-Design Materials:

.1 Roxul Safe 65, Rockwool Inc.

.8 Thickness: as indicated on drawings and to match stud thickness.

2.1.3 Wood Fiber Insulation:

.1 Insulation Type: Wood fiber board insulation, designed for applications. The core shall be made from compressed, untreated wood fibers that provide both thermal and acoustic insulation.

.2 Board Density: 160–200 kg/cu m.

.3 Thermal Performance:

.1 RSI Value: 0.85 RSI per 25mm thickness (R4.8/inch).

.2 Thermal Conductivity: value of 0.045 W/m·K (measured according to ASTM C518).

.4 Physical Dimensions:

.1 Board Size: as indicated on Drawings 600mm x 1200mm or 1200mm x 2400mm panels.

.2 Thickness: as indicated on Drawings.

.5 Moisture Resistance:

.1 Water Vapor Diffusion Resistance Factor (μ): 5–10, allowing for breathability and moisture management.

.6 Minimum Insulating Value:

.1 RSI 2.8 (R15).

.7 Acceptable Materials:

.1 Gutex, Steico, Udi, or other certified manufacturers producing high-quality wood fiber insulation.

.8 Fire Resistance:

.1 Fire Class: Euroclass C-s3,d2 or better.

.9 Sustainability: Made from renewable wood fibers, with a low environmental impact in both production and end-of-life disposal.

2.1.4 Fire safing insulation: rock wool or mineral fibre, conforming to ASTM C612, one of the following materials:

.1 'Firebarrier' distributed by A/D Distributors.

.2 'Firestop' distributed by Alberta Spray-On.

.3 Roxul 07840 Safe as manufactured by Roxul.

.4 Other preapproved product.

PART 3 EXECUTION

3.1 Workmanship

3.1.1 Install insulation after building substrate materials are dry.

3.1.2 Install insulation to maintain continuous and complete thermal protection for building spaces and elements.

3.1.3 Ensure all surfaces which are to receive insulation are clean, free from deleterious matter and are sufficiently level to allow the proper installation of insulation.

3.1.4 Neatly and accurately cut and trim insulation to fit spaces. Butt edges and ends tight. Leave no gaps or voids.

3.1.5 Install batt insulation in accordance with ASTM C1320 and CAN/ULC-S702.2. Follow the manufacturer's instructions for use of insulation and accessories.

3.1.6 Fit insulation closely around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation. Do not squeeze insulation at edges.

3.1.7 Do not compress insulation to fit into spaces. Fluff to retain the full insulating value.

3.1.8 Where applicable, keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures, and minimum 50 mm from sidewalls of CAN/ULC-S604 type A chimneys and CAN/CGA-B149.1 and CAN/CGA-B149.2 type B and L vents. Fill spaces adjacent to heat emitting devices with fire-safing insulation.

BATT INSULATION

3.2 Installation/Batt Insulation

3.2.1 Install batt insulation tight between framing members to exterior locations such as to parapet walls.

3.2.2 Install between framing members to completely fill furred area and to maintain continuity and complete thermal protection to interior spaces. Cut insulation as required.

3.2.3 Use batts sized for the spacing of the framing. Full size for steel stud framing.

3.2.4 Install insulation so as to be in full contact with cladding.

3.3 Installation/Fire Safing Insulation

3.3.1 Install fire safing insulation around hot penetrations through the exterior envelope. Fire safing insulation to masonry construction is specified under Section 04200.

3.3.2 Completely fill voids with fire safing insulation.

3.4 Protection

3.4.1 Protected installed insulation, air/vapour barriers from damage due to harmful weather exposure, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

3.5 Cleaning

3.5.1 Promptly as work proceeds, and on completion, clean up and remove from premises all rubbish and surplus materials resulting from work of this Section, leaving areas in clean condition.

END OF SECTION

FOAM IN PLACE INSULATION

PART 1 GENERAL

1.1 Section Includes

1.1.1 Section includes, but is not limited to:

.1 Foam-in-place insulation to exterior hollow metal door and window frames and louvres.

.2 Foam-in-place insulation around all protrusions through exterior envelope.

1.2 Related Sections

1.2.1 Hollow Metal Doors and Frames: Section 08100

1.3 Source Quality Control

1.3.1 Submit test reports in accordance with Division 1, verifying properties of foam-in-place insulation meet or exceed the requirements of this specification.

1.4 Environmental Requirements

1.4.1 Apply foam-in-place insulation only when substrate and ambient temperatures are within the prescribed limits.

1.4.2 Ensure that the temperature is maintained throughout the curing period.

1.4.3 The use of insulation products manufactured with CFCs and HCFCs as blowing agents is prohibited.

1.5 Protection

1.5.1 Provide temporary enclosures to prevent spray and noxious vapour from contaminating air beyond application area.

1.5.2 Protect workers as recommended by insulation manufacturer.

1.5.3 Protect adjacent surfaces and equipment from damage by over spray, fall-out, and dusting of insulation materials in accordance with Alberta Human Resources & Employment.

1.5.4 Dispose of waste foam daily in location designated by Engineer and decontaminate empty drums in accordance with foam manufacturer's instructions.

PART 2 PRODUCTS

2.1 Materials

2.1.1 The use of insulation products manufactured with CFCs or HCFCs as blowing agents is prohibited.

2.1.2 Insulation: one or two component rigid urethane foam, closed cell, one of with the following acceptable manufacturers:

.1 Froth Pak as manufactured by Dow Chemical Co.

.2 "EnerFoam" as manufactured by Dow Chemical Co.

.3 “Versi-Foam as manufactured by RHH Foam Systems Inc.

.4 CF812 as manufactured by Hilti Corporation.

.5 “Handi-Seal Window & Door Sealant” as manufactured by Fomo Products Inc.

.6 Other preapproved product.

PART 3 EXECUTION

3.1 Surface Preparation/Existing Conditions

3.1.1 Clean spaces which are to receive insulation, of dirt, dust, grease, loose material or other foreign matter which may inhibit adhesion.

3.1.2 Provide sufficient ventilation during and until insulation has cured, to ensure safe working conditions. Introduce fresh air and exhaust air continuously during the 24 hour period after application to maintain non-toxic, unpolluted, safe working conditions.

3.1.3 Prior to application, slightly moisten surfaces to which foam in place insulation is being applied, to accelerate curing.

3.1.4 Temporarily brace door frames as may be required to prevent possible bowing of frames due to over expansion of the foam-in-place insulation. Take all precautions required to ensure that windows are not bowed out, putting undue stress on doors to restrict operation of doors.

3.2 Installation/General

3.2.1 Where foam-in-place insulation is used to maintain continuity of thermal barrier, and is installed in conjunction with vapour retarder membrane around frames including metal and aluminum frames or protrusions, ensure that the foam-in-place insulation is installed on the exterior side of the self adhered air/vapour barrier membrane.

3.3 Installation/Around Hollow Metal Door and Window Frames and Louvres

3.3.1 Fill hollow metal door and window frames and louvres 75% full with foam-in-place insulation after self adhered membrane strip is attached but prior to installation of frames. Fill the remainder of the frame after installation, through the gap between the frame and the wall construction.

3.3.2 Fill gap after the self adhered air/vapour barrier membrane tie-in has been placed. Fill between frame and insulation to ensure a complete seal and to maintain continuity of the air/vapour barrier.

3.4 Installation/ Around Protrusions Through Air Seal

3.4.1 Install foam-in-place insulation around all protrusions including mechanical and electrical protrusions, and elsewhere as required to achieve and maintain continuity of thermal barrier around such protrusions.

3.5 Clean-Up

3.5.1 Cut back excess foam-in-place insulation once cured, flush with surrounding surfaces, or recess back for application of sealant as specified in Section 07900.

.1 Upon completion of foam-in-place insulation work, clean adjacent surfaces of over spray and dusting to the satisfaction of the Engineer.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

1.1.1 Section 07212 – Board Insulation

1.1.2 Section 07620 – Sheet Metal Flashing and Trim

1.1.3 Section 07900 – Sealants

1.1.4 Section 08110 – Steel Doors and Frames

1.1.5 Section 09250 – Gypsum Board Assemblies

1.2 References

1.2.1 ASTM Standards:

.1 B 117: Method of Salt Spray (Fog) testing

.2 C 150: Specification for Portland Cement

.3 C 1177: Specification for Glass Mat Gypsum for Use as Sheathing

.4 C 1325: Specification for Non-Asbestos Fiber-Mat Reinforced Cement Substrate Sheets

.5 C1396:Standard Specification for Gypsum Board

.6 D 968: Test for Abrasion Resistance of Organic Coatings by Falling Abrasive

.7 D 1037: Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials

.8 D 1784: Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

.9 E 84: Test Method for Surface Burning Characteristics of Building Material

.10 E 119: Method for Fire Tests of Building Construction and Materials

.11 E 228: Test Method for Linear Thermal Expansion of Solid Materials With a Push-Rod Dilatometer

.12 E 283: Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

.13 E 330: Test Method for Structural Performance of Windows, Curtain Walls, and Doors by Uniform Static air Pressure Difference

.14 E 331: Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference

.15 E 2178: Standard Test Method for Air Permeance of Building Materials

.16 G 153: Practice for Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials

.17 G 154: Practice for Operating Light and Water Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Non-metallic materials

1.2.2 National Fire Protection Association:

.1 NFPA 268: Standard Test Method for Determining Ignitability of Exterior Wall Assemblies Using a Radiant Heat Energy Source

.2 NFPA 285: Standard Method of Test for the Evaluation of Flammability Characteristics of Exterior, Nonload-bearing Wall Assemblies Containing Combustible Components Using the Intermediate-scale, Multistory Test Apparatus

1.2.3 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

.1 Handbook of Fundamentals

1.3 Design Requirements

1.3.1 L/360 maximum allowable deflection. Space metal framing 16 inches (406 mm) on center maximum. Provide horizontal and vertical framing where needed for continuous support and attachment of cement board perimeter.

1.3.2 Verify conformance of wall assembly wind load resistance with project design pressure requirements.

1.3.3 Prevent water infiltration into or behind the cement board stucco system (refer to Sto Tech Hotline Nos. 0403-BSc, *Critical Detail Checklist for Wall Assemblies,* and 0603-BSc, *Moisture Control Principles for Design and Construction of Wall Assemblies*).

1.3.4 Provide expansion joints at floor lines, dissimilar materials, where framing material changes, changes in building height, shape or structural system, and at expansion joints in the framing or building. Provide control joints at intervals of 25 ft (7.6m) maximum in each direction with length/width ratio not to exceed 2-1/2:1. Maximum allowable area without a control joint is 625 ft^2 (58 m^2). When using dark color finishes (lightness value less than 50) the allowable control joint interval/area is reduced to 16 ft/256 ft^2 (4.68 m/23.5 m^2)

1.3.5 Select colors with a lightness value of 30 or more. Refer to Sto Color Chart.

1.3.6 When adding foam trim features use foam plastic in compliance with the applicable code. Refer to IBC Chapter 26 and Sto ICC ES Evaluation Report No 1720. Reinforce all foam trim with base coat and reinforcing mesh. Comply with thickness and slope limitations for foam trim. Refer to Sto Details.

1.3.7 Where fire rated wall construction is required, start with an existing hourly rated assembly. The addition of the StoQuik Silver II System to an existing hourly fire-resistive wall assembly will not detract from the rating. Also see ICC ES Legacy Report Nos. 578 and 5371 for proprietary assemblies.

1.3.8 Not intended for use below grade. Maintain minimum 4 inches (102mm) above earth grade and 2 inches (51mm) above pavement. Increase distance above grade for snow regions.

1.3.9 Do not use as a parapet coping or for other non-vertical weather exposed surfaces

1.4 Submittals

1.4.1 Submit product data in accordance with Division 01:

.1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Provide two copies of WHMIS MSDS - Material Safety Data Sheets in accordance with WHMIS acceptable to Labour Canada, and Health and Welfare Canada.

1.5 Quality Assurance

1.5.1 Manufacturer requirements:

.1 System manufacturer for a minimum of twenty five (25) years.

.2 Manufacturing facilities ISO 9001:2000 Certified Quality System.

1.5.2 Contractor requirements:

.1 Licensed, insured and engaged in application of portland cement stucco, EIFS or DEFS for a minimum of three (3) years.

.2 Knowledgeable in the proper use and handling of Sto materials and possessing a certificate of completion for the on-line Sto applicator test.

.3 Employ skilled mechanics who are experienced and knowledgeable in EIFS, DEFS or portland cement stucco application and familiar with the requirements of the specified work.

.4 Successful completion of minimum of three (3) projects of similar size and complexity to the specified project.

.5 Provide the proper equipment, manpower and supervision on the job site to install the system in compliance with Sto's published specifications and details and the project plans and specifications.

1.5.3 Cement board manufacturer requirements:

.1 Recognized by Sto as capable of producing ASTM C 1325 compliant cement board to meet system requirements.

.2 Cement board shall be listed in an ICC evaluation report.

1.5.4 Mock-up Testing (for projects of sufficient size or complexity):

.1 Construct full-scale mock-up of typical stucco/window wall assembly with specified tools and materials and test air and water infiltration and structural performance in accordance with ASTM E 283, E 331 and E 330 respectively, through independent laboratory. Mock-up shall comply with requirements of project specifications. Where mock-up is tested at job site maintain approved mock-up at site as reference standard. If tested off-site accurately record construction detailing and sequencing of approved mock-up for replication during construction.

1.5.5 Inspections:

.1 Provide independent third party inspection where required by code or contract documents.

.2 Conduct inspections in accordance with code requirements and contract documents.

1.6 Delivery, Storage and Handling

1.6.1 Deliver all materials in their original sealed containers bearing manufacturer's name and identification of product.

1.6.2 Protect coatings (pail products) from freezing and temperatures in excess of 90°F (32° C). Store away from direct sunlight.

1.6.3 Protect portland cement based materials (bag products) from moisture and humidity. Store under cover and off the ground in a dry location.

1.6.4 Store cement board materials inside and protected from damage by the elements. Protect ends, edges, and faces of cement boards from damage

1.7 Project / Site Conditions

1.7.1 Maintain ambient and surface temperatures above 40°F (4°C) during application and for 24 hours after set of base coat and finish materials.

1.7.2 Provide supplementary heat for installation in temperatures less than 40°F (4°C) such that temperatures are maintained as in 1.08A. Prevent concentration of heat on the uncured waterproofing/air barrier, base coat and finish coat and vent fumes and other products of combustion to the outside to prevent contact with the waterproofing/air barrier, base coat and finish coat

1.7.3 Provide protection of surrounding areas and adjacent surfaces from application of materials.

1.8 Coordination / Scheduling

1.8.1 For load bearing stud wall assemblies, commence the cement board system installation after completion of all floor, roof construction and other construction that imposes dead loads on the walls to prevent excessive deflection (and potential cracking) of the cement board system.

1.8.2 Sequence interior work such as drywall installation prior to cement board system installation to prevent stud distortion (and potential cracking) of the cement board system.

1.8.3 Provide site grading such that the cement board stucco terminates above earth grade minimum 4 inches (102 mm) and above finished grade (pavers/sidewalk) minimum 2 inches (51 mm). Provide increased clearance above grade for snow regions.

1.8.4 Provide protection of rough openings before installing windows, doors, and other penetrations through the wall and provide sill flashing. Coordinate installation of water-resistive barrier with window and door installation to provide weather proofing of the structure and to prevent moisture infiltration and excess air infiltration.

1.8.5 Install window and door head flashing immediately after windows and doors are installed.

1.8.6 Install diverter flashings wherever water can enter the wall assembly to direct water to the exterior.

1.8.7 Install copings and sealant immediately after installation of the cement board stucco system and when finish coatings are dry.

1.8.8 Attach penetrations through the cement board stucco system to structural support and provide watertight seal at penetrations.

1.9 Warranty

1.9.1 Provide manufacturer's 10 year limited materials and moisture protection warranty.

PART 2 PRODUCTS

2.1 Manufacturers

2.1.1 Sto Corp.—StoQuik™ Silver II System: primer (if used), meshes, base coat and finish coat as furnished by Sto Corp.

2.1.2 Plastic Components, Inc.— Accessories as furnished by Plastic Components, Inc., 9051 NW 97th Terrace, Miami, Florida 33178 (800-327-7077).

2.1.3 National Gypsum Company, Inc.-Permabase® Brand Cement Board as furnished by National Gypsum Company, Inc. 2001 Rexford Road, Charlotte, NC 28211 (704-365-7300).

2.2 Cement Board

2.2.1 Minimum 5/8 inch (16 mm) thick PermaBase® Brand Cement Board complying with ASTM C 1325

2.3 Z-Shaped Furring:

2.3.1 Comply with ASTM C 645.

2.3.2 With slotted or nonslotted web, face flange of 32 mm, wall attachment flange of 22 mm, minimum uncoated-metal thickness of 0.018 inch (0.45 mm), and depth required to fit insulation thickness indicated.

2.4 Mechanical Fasteners *(supplied by others)*

2.4.1 Appropriate non-corroding fasteners, depending on the type framing or substrate:

.1 Steel Framing—minimum # 8 Type S-12 wafer head fully threaded corrosion resistant screws with minimum 3/8 inch (10 mm) penetration into studs.

2.5 Base Coat

2.5.1 Waterproof Base Coat:

.1 Sto Flexyl—two component fiber reinforced acrylic based waterproof base coat mixed with Portland cement (for use as a waterproof base coat to waterproof foundations, parapets, splash areas, trim and other projecting architectural features).

2.6 Reinforcing Mesh

2.6.1 Standard Mesh:

.1 Sto Mesh--nominal 4.5 oz./yd2 (153 g/m2), symmetrical, interlaced open-weave glass fiber fabric made with alkaline resistant coating for compatibility with Sto materials (achieves Standard Impact Classification when used with foam trim).

2.6.2 Specialty Meshes:

.1 Sto Guard™ Mesh- nominal 4.2 oz/sq. yd. (142 g/m2), self-adhesive, flexible, symmetrical, interlaced glass fiber fabric, with alkaline resistant coating for compatibility with Sto materials (used to reinforce cement board joints, corners of openings and accessory flanges).

.2 Sto Detail Mesh--nominal 4.2 oz/yd2 (143 g/m2), flexible, symmetrical, interlaced glass fiber fabric, with alkaline resistant coating for compatibility with Sto materials (used for foam shape backwrapping, aesthetic detailing, and as an alternative to Sto Guard™ Mesh reinforcement).

.3 Sto Corner Mat--nominal 7.7 oz./yd2 (261 g/m2), pre-creased, heavy-duty, open-weave woven glass fiber fabric with alkaline resistant coating for compatibility with Sto materials (used for maximum impact protection at inside and outside corners).

2.7 Primer

2.7.1 Sto Primer— Any Sto acrylic based tintable primer.

2.8 Finish Coat

2.8.1 Sto Finish—Any Sto acrylic or silicone enhanced acrylic based textured wall coating.

2.9 Accessories

2.9.1 Starter Track— Vent Screen TRAC® a rigid PVC (polyvinyl chloride) plastic track with double row of drainage holes, Part No. VST-75 as furnished by Plastic Components, Inc.

2.9.2 Surface Mounted “L” Bead— a rigid PVC (polyvinyl chloride) surface mounted “L” shaped bead for terminations, openings, etc, Part No. 2221-50 as furnished by Plastic Components, Inc.

2.9.3 Casing Bead—CB Casing Bead, a rigid PVC (polyvinyl chloride) plastic accessory for sheathing termination points Part No. CB-75-16 as furnished by Plastic Components, Inc.

2.9.4 Corner Bead—Corner Bead a rigid PVC (polyvinyl chloride) plastic accessory for smooth transitions at exterior corners, Part No. 2209 as furnished by Plastic Components, Inc.

2.9.5 Control Joint—Control Joint a rigid PVC (polyvinyl chloride) plastic accessory for designed control joints, Part No. 220027-16 as furnished by Plastic Components, Inc.

2.9.6 Furring Strips—Strip-Lath®, a rust proof, and self-furring, damage-resistant, ULTRA-LATH® strips of plastic lath for allowing drainage of incidental moisture to the exterior. Part Nos. PDM3 or PDM4 as furnished by Plastic Components, Inc.

2.10 Job Mixed Ingredients

2.10.1 Water—clean and potable.

2.10.2 Portland cement – ASTM C 150, Type I, Type II or Type I-II

2.11 **Foam Trim and Build-Outs**

2.11.1 Adhesive:

.1 Sto Primer Adhesive-B

.2 Sto BTS® Plus

.3 Sto BTS Xtra

2.11.2 Insulation Board:

.1 Sto EPS Insulation Board--nominal 1.0 lb/ft3 (16 kg/m3) Expanded Polystyrene (EPS) Insulation Board in compliance with ASTM C 2430.

2.11.3 Reinforcing Mesh:

.1 Sto Mesh

.2 Sto Detail Mesh

2.11.4 Base Coats:

.1 Sto Primer Adhesive-B

.2 Sto BTS® Plus

.3 Sto BTS Xtra

.4 Sto Flexyl (for use as a waterproof base coat on splash areas, trim and other projecting architectural features).

2.12 Mixing

2.12.1 Sto Primer Adhesive-B--Mix automatically using Sto's continuous mixer, or mix manually by adding one 50 lbs. (23 kg) bag of Sto Primer/Adhesive-B to 5-6.5 quarts (4.7-6.2 L) of clean, potable water in a clean mixing pail. Mix with a clean, rust-free electric drill and paddle. Allow to set approximately five minutes, adjust mix if necessary by adding up to 12 fl. oz. (0.35 L) of water per bag, and remix to a uniform consistency. Avoid retempering after mixing of product. Do not exceed maximum amount of water in mix ratio.

2.12.2 Sto BTS® Plus—mix ratio with water: 6-8 quarts (5.7-7.6 L) of water per 60 pound (27.3 kg) bag of Sto BTS® Plus. Pour water into a clean mixing pail. Add Sto BTS® Plus, mix to a uniform consistency with clean, rust-free electric drill and paddle. Allow to set for approximately 5 minutes, then remix. Adjust mix if necessary with additional Sto BTS® Plus or water and remix to a uniform trowel consistency. Avoid retempering. Keep mix ratio consistent.

2.12.3 Sto BTS® Xtra—mix ratio with water: 4.75-5 quarts (4.5-4.7 L) of clean water per 38 pound (17.2 kg) bag of Sto BTS® Xtra. Mix automatically using StoSilo, Sto's Continuous Mixer or mix manually by pouring water into a clean mixing pail. Add Sto BTS® Xtra, mix to a uniform consistency, using a low speed electric drill mixer, and allow to set for approximately 5 minutes. Adjust mix if necessary with additional Sto BTS® Xtra or water (maximum 16 fl. oz./0.5 L) and remix to a uniform consistency.

2.12.4 Sto Flexyl--mix ratio with portland cement: 1:1 ratio by weight. Pour Sto Flexyl into a clean mixing pail. Add portland cement, mix to a uniform consistency and allow to set for approximately five minutes. Adjust mix if necessary with additional Sto Flexyl and remix to a uniform trowel consistency. Avoid retempering. Do not add water. Keep mix ratio consistent.

2.12.5 Sto Primer--mix with a clean, rust-free high speed mixer to a uniform consistency.

2.12.6 Sto Finish --mix with a clean, rust-free high speed mixer to a uniform consistency. A small amount of water may be added to adjust workability. Limit addition of water to amount needed to achieve the finish texture.

2.12.7 Mix only as much material as can readily be used.

2.12.8 Do not use anti-freeze compounds or other additives.

PART 3 EXECUTION

3.1 **Acceptable Installers**

3.1.1 Pre-qualify under Quality Assurance requirements of this specification.

3.2 Sheathing Installation

3.2.1 Comply with applicable code for installation of wood and gypsum-based sheathings.

3.3 Water-Resistive Barrier Installation

3.3.1 Comply with applicable code. Typically attach asphalt saturated felt horizontally to framing with minimum number of fasteners needed to keep in place, lap shingle style with minimum 2 inch (51mm) horizontal laps, and minimum 6 inch (152mm) vertical laps. Prevent tears or breaks in the continuity of the water-resistive barrier. Lap over flashing, starter track, and other accessories for drainage to exterior.

3.4 **Examination**

3.4.1 Inspect framed wall assembly for:

.1 Attachment of sheathing and installation of water-resistive barrier in compliance with the applicable code.

.2 Damage or deterioration of sheathing; damage, breaks or tears in the water-resistive barrier.

.3 Presence of flashing at decks, sills, roof/wall intersections and other areas requiring flashing.

.4 Straightness and trueness of wall assembly to receive the cement board stucco system.

3.4.2 Report deviations from the requirements of project specifications or other conditions that might adversely affect the cement board stucco installation to the General Contractor.

3.5 Installation of Cement Board Stucco System

3.5.1 Starter Track and Back Mount Casing Beads:

.1 Strike a level line at the base of the wall to mark where the top of the starter track terminates.

.2 Attach the starter track even with the line onto the structure a maximum of 16 inches (406 mm) on center with the proper fastener: Type S-12 corrosion resistant screws for steel framing with minimum 3/8 inch (9 mm) penetration, and galvanized or zinc coated nails for wood framing with minimum 3/4 inch (19 mm) penetration. Blocking installed between the studs may be necessary to secure the track flat against the wall surface. For solid sheathing attach directly into sheathing at 12 inches (305 mm) on center maximum.

.3 Butt sections of starter track together. Miter cut outside corners and abut. Snip front flange of one inside corner piece (to allow the cement board to be seated inside of track) and abut.

.4 Install Starter Track at other cement board system terminations as designated on detail drawings: above windows and doors, at floor lines, above roof along dormers or gable end walls, and beneath window sills with concealed flashing.

.5 Install casing beads similarly at cement board termination points—window and door jambs and other through wall penetrations, unless using surface mount accessories for these areas.

3.5.2 Installation of Cement Board:

.1 Install cement board horizontally or vertically but perpendicular to the direction of the supporting sheathing. Insert bottom edge of board into the starter track, and then attach the board through the sheathing to the studs with approved fasteners spaced 8 inches (203mm) on center at the perimeter and in the field of the board. Similarly install cement board in to back mount accessories at termination points.

.2 Install cement board with ends and edges closely butted but not forced together.. “L” cut boards around openings such as windows, doors, etc.

.3 Stagger cement board joints by 16 inches (406mm) minimum from sheathing joints. Do not create planes of weakness by allowing cement board joints to coincide with sheathing joints.

.4 Provide for expansion and control joints in cement board layout.

3.5.3 Surface Mounted Accessories:

.1 Install surface mount “L” beads at stucco terminations—doors, windows, and other through wall penetrations. Use only casing bead/accessory with weeps at heads of doors, windows, etc.

.2 Install two piece expansion joints (or back to back “L” beads) at floor lines, dissimilar materials, where framing material changes, changes in building height, shape or structural system, and at expansion joints in the framing or building. Abut horizontal into vertical joint accessories.

.3 Install one piece control joints at intervals of 25 ft (7.6 m) maximum in each direction with length/width ratio not to exceed 2-1/2:1. Maximum allowable area without a control joint is 625 ft2 (58m2). When using dark color finishes (lightness value less that 50) the allowable control joint interval/area is reduced to 16 ft/256ft2 (4.8 m/23.5 m2). Abut horizontal into vertical joint accessories.

.4 Install corner bead at outside corners.

.5 Install full accessory pieces where possible and avoid small pieces.

3.5.4 Joint Reinforcement, Diagonal Corner Reinforcement of Openings, and Reinforcement of Surface Mount Accessories:

.1 Center minimum 4 inch (102 mm) wide self-adhesive mesh over board joints. Overlap mesh seams minimum 2-1/2 inches (64mm).

.2 Apply minimum 9x12 inch (225x300 mm) diagonal strips of self-adhesive mesh at corners of windows, doors, and all penetrations through the system.

.3 Apply minimum 4 inch (102 mm) wide self-adhesive mesh over perforated flange of surface mount accessories. Overlap mesh seams minimum 2-1/2 inches (64 mm).

.4 Skim coat self-adhesive mesh with base coat, feather along edges, and allow to dry.

3.5.5 Foam Trim and Build-Outs:

.1 Where foam build-outs terminate at a dissimilar material such as a window, door or other non-cement board stucco system surfaces, backwrap the foam build-out by installing detail mesh onto the terminating edge of the cement board. Embed the mesh in the foam adhesive. Allow the mesh to dangle until the backwrapping procedure is completed (see section 3.05 E.4).

.2 Install foam build-outs directly over cement board with foam adhesive. Apply adhesive with the appropriate size notched trowel to the back of the insulation board and immediately place build-out in the proper location on the wall. Press firmly into place.

.3 As soon as the foam build-out is firmly attached rasp the entire surface smooth.

.4 Complete the backwrapping procedure by applying the foam base coat to the exposed edges of the foam build-out and minimum 2-1/2 inches (64 mm) onto the face. Pull the backwrap mesh around the foam build-out and fully embed it into the foam base coat. Use a corner trowel for neat straight corners.

.5 Apply the foam base coat to the foam build-out and approximately 3 inches (76 mm) onto the adjacent cement board surfaces to an approximate thickness of 1/8 inch (3 mm). Immediately embed the reinforcing mesh in the wet base coat. Trowel from the center to the edges of the mesh to avoid wrinkles and remove excess base coat. Overlap mesh seams minimum 2-1/2 inches (64 mm). Overlap mesh onto adjacent cement board wall surfaces minimum 2-1/2 inches (64 mm) at terminations of the foam build-out and feather onto the cement board wall surface.

3.5.6 Base Coat and Reinforcing Mesh Application:

.1 Apply base coat over the cement board, including areas with self-adhesive or detail mesh and areas of unreinforced foam trim/build-outs, with a stainless steel trowel to a uniform thickness of approximately 1/8 inch (3 mm). Work horizontally or vertically in strips of 40 inches (1016mm), and immediately embed the mesh into the wet base coat by troweling from the center to the edge of the mesh. Overlap mesh not less than 2-½ inches (64 mm) at mesh seams and fully overlap self-adhesive or detail mesh (and backwrap reinforcing mesh along foam trim/build-outs if these surfaces have not yet been reinforced with base coat/mesh). Feather seams and edges. Double wrap all inside and outside corners with minimum 2-½ inch (64 mm) overlap in each direction where mesh is used in lieu of an accessory. (Alternate corner treatment with mesh: embed corner mat in base coat, allow to dry, and then overlap up to corner with standard reinforcing mesh embedded in base coat). Avoid wrinkles in the mesh. The mesh must be fully embedded so that no mesh color shows through the base coat when it is dry. Re-skim with additional base coat if mesh color is visible or if necessary to correct planar irregularities in the wall surface. Allow base coat to thoroughly dry before applying primer or finish.

.2 Sloped Surfaces: for foam trim, reveals, aesthetic bands, cornice profiles, sills or other architectural features that project beyond the vertical wall plane more than 2 inches (51 mm) apply waterproof base coat with a stainless steel trowel to the weather exposed sloped surface and minimum four inches (100 mm) above and below it. Embed standard mesh or detail mesh in the waterproof base coat and overlap mesh seams a minimum of 2-½ inches (65 mm). Allow base coat to thoroughly dry before applying primer or finish.

3.5.7 Primer Application

.1 Apply primer evenly with brush, roller or proper spray equipment over the clean, dry base coat and allow to dry thoroughly before applying finish.

3.5.8 Finish Coat Application:

.1 Apply finish directly over the base coat (or primed base coat) when dry. Apply finish by spraying or troweling with a stainless steel trowel, depending on the finish specified. Follow these general rules for application of finish:

.1 Avoid application in direct sunlight.

.2 Apply finish in a continuous application, and work to an architectural break in the wall.

.3 Weather conditions affect application and drying time. Hot or dry conditions limit working time and accelerate drying. Adjustments in the scheduling of work may be required to achieve desired results; cool or damp conditions extend working time and retard drying and may require added measures of protection against wind, dust, dirt, rain and freezing. Adjust work schedule and provide protection.

.4 Float "R" (rilled texture) finishes with a plastic trowel to achieve their rilled texture.

.5 Do not install separate batches of finish side-by-side.

.6 Do not apply finish into or over sealant joints. Apply finish to outside face of wall only.

.7 Do not apply finish over irregular or unprepared surfaces, or surfaces not in compliance with the requirements of the project specifications.

3.6 *Z*-Furring Members:

3.6.1 Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with *Z*-furring members spaced 600 mm o.c.

3.6.2 Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 600 mm o.c.

3.6.3 At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 300 mm from corner and cut insulation to fit.

3.6.4 "Installation Tolerance" Paragraph below is based on recommendation in GA-216 for wood framing and in ASTM C 840 for metal framing.

3.6.5 Installation Tolerance: Install each framing member so fastening surfaces vary not more than 3 mm from the plane formed by faces of adjacent framing

3.7 Protection

3.7.1 Provide protection of installed materials from water infiltration into or behind them.

3.7.2 Provide protection of installed materials from dust, dirt, precipitation, freezing and continuous high humidity until they are fully dry.

END OF SECTION 07240

UNDER SLAB SHEET VAPOUR BARRIER

PART 1 GENERAL

1.1 Section Includes

1.1.1 Section includes, but is not limited to:

.1 Sheet vapour barrier under slabs on grade.

1.2 Related Sections

1.2.1 Cast-In-Place Concrete: Section 03300

1.2.2 Bentonite Clay Waterproofing: Section 07170

1.3 Referenced Standards

1.3.1 Comply with the latest edition of the following statutes, codes and standards and all amendments thereto.

1.3.2 ASTM:

.1 ASTM E1745: Standard Specification for Water Vapor Barriers Used in Contact with Soil or Granular Fill under Concrete Slabs.

1.3.3 CGSB Standards:

.1 CAN/CGSB-51.33: Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction.

1.4 Submittals

1.4.1 Submit Product Data in accordance with Division 1.

1.4.2 Submit Product Data sheets for under slab sheet vapour barrier. Include:

.1 Product characteristics.

.2 Performance criteria.

.3 Limitations.

1.4.3 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence and cleaning procedures.

1.5 Job Mock-up

1.5.1 Prior to commencement of installation of under slab sheet vapour barrier, install a minimum of 10 m^2 mock-up of the under slab sheet vapour barrier, including at least 1 sealed joint and one termination at adjacent foundation wall/footing.

1.5.2 Upon completion of the mock-up, notify the Engineer to review the mock-up. Make adjustments to the mock-up as requested by the Engineer.

1.5.3 When accepted the mock-up will become the standard for the project, and any installation of under slab sheet vapour barrier which is not to the standard, will be rejected and replaced to match the accepted mock-up.

1.5.4 The accepted mock-up may be incorporated into the work.

UNDER SLAB SHEET VAPOUR BARRIER

1.6 Product Handling

1.6.1 Deliver all under slab sheet vapour barrier materials to the site suitably protected with the manufacturer's seals and labels intact, and store in dry locations protected from damage by weather, and construction activity. Manufacturer's labels to indicate the following:

.1 Manufacturer or trade name.

.2 Compliance with ASTM/CGSB standard.

.3 Material type, thickness, roll width and area.

1.6.2 Prior to and during installation, take all precautions and handle with due care all under slab sheet vapour barrier materials to prevent breakage, puncture, tearing and the like. Protect materials from direct exposure to sunlight.

1.6.3 Replace under slab sheet vapour barrier materials damaged or installed in such a manner as may be detrimental to designed performance of the material in the opinion of the Engineer.

1.7 Quality Assurance

1.7.1 Periodic reviews by the Engineer of under slab sheet vapour barrier materials and installations - prior to application of covering materials - are MANDATORY. There will be no exceptions.

PART 2 PRODUCTS

2.1 Sheet Materials

2.1.1 Under Slab Sheet Vapour Barrier: conforming to ASTM E1745, Class A, underslab vapour barrier, manufactured using a blend of virgin polyolefins; 0.38 mm thickness; one of the following:

.1 Stego Wrap Vapour Barrier, 0.38 mm thickness, as manufactured by Stego Industries, LLC.

.2 Perminator 0.38 mm thickness as manufactured by W.R. Meadows.

.3 Other preapproved product.

2.2 Accessories

2.2.1 Joint sealing tape: as recommended by the underslab sheet vapour barrier manufacturer.

2.2.2 Termination bars: as recommended by the manufacturer.

PART 3 EXECUTION

3.1 Installation/Under Slab Sheet Vapour Barrier

3.1.1 Install under slab sheet vapour barrier below all slabs on grade. Cover entire area with sheet vapour barrier. Install directly over bentonite clay waterproofing.

UNDER SLAB SHEET VAPOUR BARRIER

3.1.2 Lap joints minimum 150 mm and continuously seal with tape. Wrap under slab sheet vapour barrier up adjacent walls and vertical surfaces, minimum 100 mm. Where recommended by the manufacturer, install termination bars to attached vapour barrier to vertical surfaces, in strict accordance with manufacturer's recommendations.

3.1.3 Protect under slab sheet vapour barrier during concrete installation and take care not to damage or displace under slab sheet vapour barrier.

3.2 Cleaning

3.2.1 Promptly as work proceeds, and on completion, clean up and remove from premises all rubbish and surplus materials resulting from work of this Section, leaving areas in clean condition.

END OF SECTION

AIR VAPOUR BARRIER

PART 1 GENERAL

1.1 Section Includes

1.1.1 Section includes, but is not limited to:

.1 Air/vapour barrier membrane.

.2 Air Barrier System (Self-Adhering, Vapour Permeable)

.3 Sheet metal support for membrane.

.4 Materials and installation methods supplementing other air seal materials and assemblies.

.5 Air seal materials to bridge and seal openings and penetrations through the plane of the air/vapour barrier.

1.2 Related Sections

1.2.1	Unit Masonry:	Section 04200
1.2.2	Exterior Steel Stud Assemblies:	Section 05400
1.2.3	Board Insulation:	Section 07212
1.2.4	Bentonite Clay Waterproofing:	Section 07170
1.2.5	Modified Bituminous Roofing:	Section 07525
1.2.6	Hot Rubberized Asphalt Waterproofing:	Section 07560
1.2.7	Sealants:	Section 07900

1.3 Reference Standards

1.3.1 Comply with the latest edition of the following statutes, codes and standards and all amendments thereto.

1.3.2 ASTM Standards:

.1 ASTM E330/E330M: Standard for testing the Structural Performance of exterior Windows, Curtain Walls, and doors by Uniform Static Air pressure Difference.

.2 ASTM E2178: Standard test method for air permeance of building materials.

.3 ASTM E96: Water vapor transmission of materials (to ensure high VP).

.4 ASTM D1970: Self-adhered sheet materials used as waterproofing.

.5 ASTM E331: Water penetration test of exterior windows, skylights, doors, and curtain walls.

.6 ASTM D3330: Peel adhesion of pressure-sensitive tapes.

.7 ASTM D1000: Pressure-sensitive adhesive tapes (for adhesion strength).

.8 ASTM E783: Standard Test Method for Field Measurements of Air Leakage Through Installed Exterior Windows and Doors.

.9 ASTM E1186: Standard Practices for Air Leakage Site Detection in Building Envelope and Air Retarder Systems.

.10 ASTM E2357: Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.

1.3.3 Canadian Construction Materials Centre CCMC Technical Guide 07273 Air Barrier Materials.

1.3.4 CGSB Standards:

.1 CAN/CGSB-51.33: Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction.

1.4 Definitions

1.4.1 The air/vapour barrier for the purpose of these specifications, is a membrane which performs three functions, air barrier, moisture barrier and vapour retarder as defined below.

1.4.2 The definition of the vapour retarder for the purpose of these specifications is a continuous membrane including joints of membrane to adjacent construction and to itself which retards the passage of moisture as it diffuses through the assembly of materials in the wall.

1.4.3 The definition of the air barrier for the purpose of these specifications is a continuous membrane including joints of membrane to adjacent construction and to itself, which stops outside air from entering the building through the walls or roof, and inside air from exfiltration through the building envelope to the outside.

1.5 Performance Requirements

1.5.1 Be responsible for establishing that sealing work as indicated and specified is carried out correctly and in accordance with the overall intent of this Section.

1.5.2 The air/vapour barrier must be continuous through the building envelope. The air/vapour barrier membrane of the wall must be continuous with the air/vapour barrier of the roof and adjacent insulated composite metal panels.

1.5.3 The air/vapour barrier must be adhered with some fastening at perimeter connection details, to the supporting structure to resist a peak wind load, and sustained stack effect or pressurization from ventilation equipment; it must be sufficiently rigid to resist displacement.

.1 The materials and configuration of the air/vapour barrier assembly must resist the highest expected air pressure load, inward or outward, without rupturing or detaching from the support.

.2 The assembly must not creep away from the substrate or part at a joint under sustained pressure difference.

.3 The deflection of the air/vapour barrier materials between supports must be minimized to prevent the displacement of other materials.

.4 The air/vapour barrier system (mean area plus joints) must be virtually air-impermeable.

.5 A combined air/vapour barrier system must meet the requirements of the air barrier, moisture barrier and vapour retarder functions.

.1 Use galvanized sheet steel as a substrate to support the air/vapour barrier membranes as necessary. Do not allow the galvanized material to interfere with the perimeter edge seals of the air barrier membranes.

.2 The air/vapour barrier installation must be designed and installed to accommodate building movement without rupture.

1.5.4 Building sealing comprises of the following:

.1 Prevention of entry of air and water into interior building spaces.

.2 Prevention of air leakage from inside of the building.

.3 Control of water vapour migration.

1.5.5 Prevent interior air leakage through gaps in air/vapour barrier membrane which cause condensation or frost accumulation.

1.5.6 Where air/vapour barriers are specified or indicated, ensure that no gaps, openings, or cracks are left. Seal all cracks, gaps, and the like, to satisfaction of the Engineer.

1.5.7 The method for prevention of air leakage is indicated or specified. Ensure that the work is carried out fully and correctly.

1.5.8 The air/vapour barrier must be installed by a manufacturer's approved installer having a minimum of 2 years documented experience in the installation of the product on similar projects. The manufacturer must submit a written declaration that the air/vapour barrier installation including connection to other vapour retarders, air barrier and membranes is done in accordance with the manufacturer's specifications and recommendations to achieve a complete air/vapour barrier.

1.5.9 Unless specifically noted otherwise, use only one type of self adhered air/vapour barrier throughout the project. Notwithstanding any trade scope definitions, install all air/vapour barrier specified in this Section, using only one installer for all work of this project.

1.6 Quality Assurance

1.6.1 Submit document stating the applicator of the air/vapour barrier membranes specified in this Section is authorized by the manufacturer as suitable for the execution of the Work.

1.6.2 Perform Work in accordance with manufacturer's written instructions and this specification.

1.6.3 Maintain one copy of manufacturer's written instructions on site.

1.6.4 Allow access to Work site by the air/vapour barrier membrane manufacturer's representatives.

1.6.5 Single-Source Responsibility:

.1 Obtain air/vapour barrier materials from a single manufacturer regularly engaged in manufacturing the product. Source all components from one manufacturer, including air/vapour barrier membrane, air barrier sealants, primers, mastics, flashings and adhesives.

.2 Provide products which comply with all federal, provincial, and local regulations controlling use of volatile organic compounds (VOCs).

1.7 Submittals

1.7.1 Submit Product Data in accordance with Division 1.

1.7.2 Provide Product Data on material characteristics, performance, criteria, limitations, and all other information necessary to completely describe air/vapour barrier installation.

1.7.3 Provide manufacturer's installation instructions indicating preparation, installation requirements and techniques, product storage and handling criteria and special installation requirements as indicated on the drawings and specified herein. Provide manufacturer's written acceptance of the selected transition membrane sheets, with regards to compatibility and adhesion.

1.8 Pre-installation Conference

1.8.1 Before commencement of air/vapour barrier work, arrange a pre-installation conference to be attended by the Construction Manager’s Superintendent, representatives of the Subcontractor and suppliers of the air/vapour barrier membrane, the adjoining membranes which lap with the air/vapour barrier membrane and the insulated composite metal panel installer. Arrange this meeting only when the representative of the Engineer can attend. Methods of operation, and trade responsibility will be resolved.

1.9 Inspection

1.9.1 Do not cover any portion of the air/vapour barrier installation, including foam-in-place insulation, until it has been reviewed and accepted by the Engineer. Reviews of the air/vapour barrier membrane installation, before application of covering materials, is MANDATORY. There will be no exceptions.

1.9.2 Remove cladding to access the defect area using same trade who initially installed cladding. Repair defect or gap in air/vapour barrier and reinstall cladding using original installer.

1.10 Environmental Requirements

1.10.1 Do not install solvent curing or vapour release materials in enclosed spaces without ventilation.

1.10.2 Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation. For exterior surface temperatures between 0°C and -10°C, use winter grade membranes only. Where exterior surface temperatures are colder than minus 10°C, provide heating and hoarding to maintain surface temperatures above 0°C.

1.10.3 Apply air/vapour barrier only when substrate is dry and free of moisture or frost.

1.10.4 In cold weather, at temperatures below those recommended by the manufacturer for installation of the air/vapour barrier, provide all necessary heating and hoarding to maintain temperatures within the range recommended by the manufacturer for installation of the air/vapour barrier. Install hoarding to protect from rain, snow and the like. Use winter grade materials as required to suit exterior conditions.

1.11 Coordination

1.11.1 Coordinate the installation of sheet air/vapour barrier with other parts of the work to achieve an air tight building envelope.

1.11.2 Ensure that air/vapour barrier materials used at junctions between different parts of the Work are compatible with each other and with other adjacent materials such as foam-in-place insulation around windows and protrusions.

1.12 Sequencing

1.12.1 Sequence work to permit installation of materials in conjunction with related materials and seals.

1.12.2 Do not leave exposed incomplete installation of transition membranes. Do not leave release film exposed to the environmental conditions. Coordinate and sequence all work to prevent damages to incomplete membrane installation.

1.13 Product Delivery, Storage, and Handling

1.13.1 Deliver sheet air/vapour barrier materials in factory-wrapped rolls with labels indicating manufacturer and trade name and material type, thickness, roll width and area.

1.13.2 Protect materials from direct exposure to sunlight and physical damage.

1.13.3 Protect materials from weather by use of raised platforms and waterproof covering. Do not double stack pallets on the job site.

1.13.4 Protect materials from temperatures in excess of 32°C.

1.13.5 Store mastic and liquid materials in dry area, away from high heat, open flames and sparks.

1.14 Warranty

1.14.1 The manufacturer shall provide a minimum 10-year warranty for the air barrier system, covering defects in materials and performance.

PART 2 PRODUCTS

2.1 Materials

2.1.1 Air/Vapour barrier membrane (self-adhering type): As indicated on Drawings.

.1 Grace Co. 'Perma-A-Barrier'.

.2 Soprema Sopraseal Stick 1100.

.3 Blue Skin "SA" as manufactured by Henry Company. (**WINTER GRADE ONLY**)

.4 CCW-705 as manufactured by Carlisle Coatings and Waterproofing Incorporated.

.5 Other preapproved product.

.6 Note that only one type is to be used throughout the project.

2.1.2 Air Barrier System (Self-Adhering, Vapour Permeable): As indicated on Drawings.

.1 Provide a self-adhering Vapour Permeable Air Barrier (VP) with an integral air gap and rainscreen mesh, such as HydroGap SA by Benjamin Obdyke or Rainscreen SA by VaproShield or equivalent. The membrane shall consist of a high-performance film that combines moisture control, air barrier, and vapor permeability.

.2 Vapor Permeability: The air barrier membrane shall exhibit a vapor permeance rating greater than 10 perms when tested in accordance with ASTM E96.

.3 Water Resistance: The membrane shall meet the water resistance requirements of ASTM D1970, with resistance to wind-driven rain of up to 140 mph.

.4 Adhesion: The membrane shall adhere securely to typical substrates, with a minimum peel strength of 1.5 lbf/in per ASTM D3330.

.5 UV Exposure: The membrane shall resist UV degradation for a minimum of 180 days prior to the installation of the exterior cladding.

2.1.3 Sheet Air/Vapour Barrier Membrane at movement joints: movement joint membrane as recommended by the air/vapour barrier membrane manufacturer.

2.2 Miscellaneous Materials

2.2.1 Liquid Membrane: one component elastomeric bituminous trowel or spray applied membrane; Air-Bloc 32 as manufactured by Henry Company, or preapproved product; having the following characteristics:

.1 Air permeability: 0.0006/s m^2 @ 75 Pa.

.2 Water vapour permeance: 5.0g/Pa.m^2.s. (0.08 perms).

.3 Elongation: 500% to ASTM D412.

.4 Liquid membrane must be compatible with air/vapour barrier membrane.

2.2.2 Rubber asphalt sealant: Conforming to CAN/CGSB-37.29-M89.

2.2.3 Mastic caulking: black asphalt caulking compound meeting CAN/CGSB-37.5-M89, and compatible with the membrane.

2.2.4 Primer: bituminous primer, as recommended by the membrane manufacturer.

2.2.5 Sheet metal membrane support: Z275 designation galvanized sheet metal commercial quality conforming to ASTM A653/A653M, 0.91 mm (20 gauge) thickness.

2.2.6 Battens: channels formed of 1.2 mm base metal thickness, Z275 designation galvanized sheet steel, commercial quality conforming to ASTM A653/A653M, 19 mm wide with 9.5 mm legs.

2.2.7 Mechanical Fasteners: galvanized flat head screws, of type and size suitable for securing metal battens to substrate.

2.3 Fabrication

2.3.1 Brake form sheet metal to permit installation using self tapping, self-drilling screws or drilled anchors.

2.3.2 Make provisions in air/vapour barrier design to accommodate movement resulting from thermal change and from structural deflection. Provide sheet metal membrane support to bridge all gaps in excess of 12 mm.

2.3.3 Supply and install sheet metal membrane support to all locations where no other substrate occurs to support the membrane, including at all locations of through wall membrane flashing at cavities where gaps exceed 12 mm. Form return flanges or provide suitable angles, and fasten to adjacent substrates to prevent deflection movement.

2.3.4 Form 13 mm hem on sheet metal edges overlapped with air/vapour barrier membrane and membrane flashing.

2.3.5 Brake form sheet metal backing able to accommodate movement with continuous “V” groove to allow for expansion and contraction.

2.3.6 Cut, fit trim and form metal air/vapour barrier supports as required to accommodate conflicting framing connections.

2.3.7 Cut back all 90 degree corners to a 45 degree to prevent puncturing of air/vapour barrier materials with sharp edged corners.

PART 3 EXECUTION

3.1 Examination

3.1.1 Verify that surface and conditions are ready to accept the Work of this Section. Notify the Engineer of unacceptable conditions. Do not start work until unacceptable conditions have been rectified.

AIR VAPOUR BARRIER

3.2 Preparation

3.2.1 Remove loose or foreign matter which might impair adhesion of materials.

3.2.2 Clean and prime substrate surfaces to receive materials in accordance with manufacturer's instructions.

3.3 Installation/Membrane

3.3.1 Install materials in accordance with manufacturer's instructions.

3.3.2 Prime all surfaces receiving air/vapour barrier, using primer recommended by membrane manufacturer. Prime all surfaces receiving self-adhered membrane or strips.

3.3.3 Before installing membrane to substrate in final position, allow the membrane to relax. Position membrane without stretching.

3.3.4 Install self-adhered membrane to manufacturer's directions. Apply a bead of sealant along edge of lower leaf of lap, if temperature or other conditions prevent satisfactory seal to the poly sheet surface.

3.3.5 Apply heavy pressure to membrane at top and bottom terminations of each sheet, using roller as recommended by the manufacturer, to assure positive adhesion at the edge. Apply pressure over entire area, using small roller.

3.3.6 All side laps to be minimum 65 mm and all end laps to be 150 mm minimum.

3.3.7 Carefully plan the installation in advance to avoid excessive layering of the membrane at laps and change in direction bends that will compromise the proper installation of later materials and components. Offset laps so as not to thicken membrane.

3.3.8 Completely adhere the entire membrane to the substrate after application of primer, and roll with a weighted roller, in accordance with the manufacturer's instructions. Install membrane to achieve smooth wrinkle free surfaces, completely bonded to the substrate, without air entrapment.

3.3.9 Ensure complete coverage of (and adhesion to) all substrates to receive air/vapour barrier membrane, including all wall protrusions. Ensure co-operation of other trades to obtain continuity of the membrane.

3.3.10 Where applicable, install membrane prior to installation of masonry ties and the like. Where membrane is installed after ties and the like, are in place, notch membrane around ties and seal penetrations using a combination of membrane patches and rubber asphalt sealant.

3.3.11 Apply membrane so the horizontal joints overlap with the upper sheet over the lower sheet, shingle style. Use mastic sealant where reverse lapping cannot be avoided.

3.3.12 Inspect membrane thoroughly before covering and immediately make any corrections or modifications required. Misaligned or inadequately lapped seams, punctures, fishmouths or other damage must be repaired with patch of membrane extending minimum 150 mm in all directions from edge of damaged area. Seal all edges of the patch with mastic. Slit fishmouths prior to repair with a membrane patch.

3.3.13 Where membrane is not otherwise mechanically held in place, fasten membrane to the substrate with vertical battens spaced 600 mm maximum centres. Place additional battens adjacent to openings, edges, and corners. Install battens and mechanical fasteners where the membrane bond width to substrate is less than 50 mm. Ensure batten occur in locations that will not be exposed in the final assemblies.

3.3.14 Fasten battens through the membrane and into concrete block backup at 300 mm centres, with the legs facing out. Bend up ends of battens and file smooth so that thermal movement will not cause end of batten to dig into membrane. Use battens in lengths not exceeding 1200 mm, and leave 25 mm gaps between ends of battens on the same alignment.

3.3.15 Dress the membrane around corners. At all inside and outside corners, use 300 mm wide reinforcing piece of membrane strip, centred on corner, prior to installation of membrane. Cut, lap, and weld double return corners and other complicated changes of direction.

3.3.16 Provide membrane continuity strips at deflection joints, and where gaps are wider than 12 mm but less than 38 mm, using factory cut strips from same manufacturer as wall membrane.

3.3.17 Apply liquid membrane to difficult areas which do not allow for easy installation of sheet membrane. Apply liquid membrane by trowel or spray to a minimum wet thickness of 3 mm as recommended by the Manufacturer. Exercise care to ensure full contact of coating around all protrusions.

3.3.18 Apply insulation specified in Section 07212, in a timely manner, especially in cold weather, to minimize condensation at sheathing to membrane surfaces.

3.3.19 At all movement joints, install air/vapour barrier specified for movement joints, in strict accordance with manufacturer's recommendations, to accommodate all movement and to maintain continuity of the air/vapour barrier. Use minimum 300 mm wide strip of movement joint membrane and overlap adjacent air/vapour barrier and adjacent materials where applicable, minimum 150 mm and completely and continuously seal in place to maintain continuity of the air/vapour barrier.

3.4 Installation/Metal Air/Vapour Barrier Back-up

3.4.1 Prior to installation, apply a heavy protective coating of alkali resistant bituminous paint or zinc chromate primer, to concealed surfaces of galvanized sheet steel, which come in direct contact with steel, dissimilar metals, concrete and masonry.

3.4.2 Supply and install sheet metal membrane support to all locations where no other substrate occurs to support the membrane, where gaps exceed 12 mm. Form return flanges or provide suitable angles, and fasten to adjacent substrates to prevent deflection movement.

3.4.3 Provide membrane supports for all gaps in the substrate or between components, larger than 12 mm, or as otherwise recommended by the membrane manufacturer.

3.4.4 Provide metal backing at junctions between different substrates as indicated.

3.4.5 Overlap metal back-up with adjoining substrates and securely attach with fasteners appropriate for the substrate encountered. Where metal back-up is used to span deflection joints or areas where movement is anticipated between dissimilar materials, fasten metal on one side only to allow for movement. Provide continuity of air/vapour barrier with adjacent air/vapour barrier systems.

3.4.6 Gun apply a continuous 6 mm bead of sealant at all joints and junctions with adjacent construction. Liberally butter screws fastenings with sealant. Attach sheet metal membrane supports with screws at 300 mm o.c.

3.4.7 Cut back all sheet metal corners, and ensure that the sheet metal supports do not interfere with the perimeter edge seals of the air/vapour barrier membranes.

3.5 Perimeters

3.5.1 At perimeters, overlap roofing, waterproofing, and the like, seal air/vapour barrier membrane to adjacent membranes. Overlap end joints minimum 150 mm and seal together to achieve a complete air seal.

3.5.2 Cut corners are to prevent curling back of membrane and to prevent water migration through horizontal end laps at termination edges.

3.5.3 Ensure that a complete seal is obtained at overlap situations, and that the work is carried out in accordance with the agreements with other trades, made at the site meeting referred to in Part 1.

3.5.4 Position lap seal over firm bearing.

3.5.5 Extend air/vapour barrier membrane under parapet framing to tie wall air/vapour barrier to roof air/vapour barrier. Coordinate sequencing with Steel Stud parapet framing specified in Section 05410. Coordinate overlapping of roofing air/vapour barrier membrane over air/vapour barrier membrane of this Section, minimum 150 mm and completely and continuously seal in place to maintain continuity of the air/vapour barrier.

3.5.6 Coordinate installation of through wall flashing specified in Section 04200 with air/vapour barrier of this Section, to ensure a water tight installation and to maintain continuity of the air/vapour barrier. Sequence membrane flashing installation with air/vapour barrier installation, so that air/vapour barrier membrane overlaps top edge of membrane flashing, minimum 50 mm and is completely and continuously sealed in place to maintain air/vapour barrier and to shed water in cavity to the exterior through the weeping vents. Coordinate with Section 04200.

3.5.7 At heads of door and window frames and louvre frames, apply self adhered air/vapour barrier membrane strip, minimum 300 mm wide unless indicated otherwise, and sealed to adjacent frame as specified below. Then install metal flashing as detailed; coordinate with Section 07600; ensure top edge of wall leg of flashing is not less than 75 mm below top edge of air/vapour barrier tie-in strip. After metal flashing is installed, extend wall air/vapour barrier over air/vapour barrier membrane tie in strip and metal flashing down to bottom of vertical leg of metal flashing and completely and continuously seal in place to maintain continuity of the air/vapour barrier.

3.5.8 At junctions between air/vapour barrier and hollow metal door and window frames and louvres, apply a 300 mm wide strip of membrane, sealed to the inside of the frame, prior to application of foam in place insulation. Do not remove release on unadhered portion of strip until the door and window frame and louvre is in place and the adjacent air/vapour barrier membrane is in place and ready to be sealed. Seal to adjacent membranes to achieve a continuous and complete air/vapour barrier.

3.5.9 Extend air/vapour barrier membrane down to overlap adjacent hot rubberized asphalt waterproofing minimum 150 mm and completely and continuously seal in place.

3.5.10 Inspect air/vapour barrier for continuity. Pay particular attention to change in direction bends, such as at windows head, sill and jamb intersections. Repair tears, punctures, rips, with pieces of membrane.

3.6 Gap Sealing

3.6.1 At all locations where non-moving gap and joints does not exceed 12 mm, and joints are not otherwise sealed, install 'Rubber Asphalt Sealant', or other approved sealing method which is compatible with the membrane.

3.6.2 At all moving joints and at all gaps which exceed 12 mm, use sheet metal backing as specified in this Section, to bridge gaps and then apply air/vapour barrier membrane to sheet metal backing and seal in place to maintain continuity of the air/vapour barrier.

3.6.3 Supply and apply joint filler, expanding foam and rubber asphalt sealant as noted or required, where not specified in other Sections of the specification.

3.6.4 Supervise the sealing work described in other Sections.

3.6.5 Report to the Engineer any aspects of the work requiring clarification or explanation.

3.7 Self-adhered vapour permeable air barrier membrane Installation Requirements:

3.7.1 Ensure that the air barrier is installed according to the manufacturer’s instructions. The surface must be clean, dry, and free from debris.

3.7.2 Overlap seams of the membrane by a minimum of 2 inches and adhere with manufacturer-specified adhesives.

3.7.3 Install the integral air gap with the membrane as specified. Ensure proper drainage and airflow as per the manufacturer’s recommendations.

3.7.4 Install rainscreen mesh over the membrane, maintaining proper airflow behind the cladding as part of the drainage system.

3.8 Sealing Around Protrusions

3.8.1 Coordinate the installation of air/vapour barrier membranes with the installation of foam-in-place insulation around hollow metal door and window frames, louvre frames and protrusions through the exterior air/vapour barrier membrane to ensure a complete and continuous thermal barrier. Refer to Section 07214. Ensure that air/vapour barrier membrane specified in this Section is compatible with foam-in-place insulation and adjoining materials.

3.9 Protection of Finished Work

3.9.1 Do not permit adjacent work to damage work of this Section.

3.9.2 Do not leave air/vapour barrier membrane and liquid membrane exposed to sunlight longer than recommended by the manufacturer.

END OF SECTION

STANDING SEAM METAL ROOF AND WALL PANELS

PART 1 GENERAL

1.1 Description

1.1.1 Furnish and install standing seam metal roofing and wall panels, clips, fasteners, flashing, closures, insulation and related accessories required for a complete system as indicated on the contract documents.

1.2 Related Work

1.2.1 Sealants Section 07900

1.3 Reference Latest Editions of Publications and Standards

1.3.1 Building Design Codes – Uplift, Live and Dead Loads

.1 ASCE 7 (current edition unless specified elsewhere) Minimum Loads for Buildings and Other Structures

1.3.2 Reference Standards

.1 American Iron and Steel Institute (AISI), Specification for the Design of Cold-Formed Steel Structural Members (2017).

.2 Aluminum Association Design Manual.

.3 American Society for Testing and Materials (ASTM) (Current Edition).

.1 ASTM E1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding by Uniform Static Air Pressure Difference.

.2 ASTM E1680 - Standard Test Method for Rate of Air Leakage through Exterior Metal Roof Panel Systems.

.3 ASTM E1646 - Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.

.4 ASTM E2140 - Standard Test Method for Water Penetration of Metal Panel Roof Systems by Static Water Pressure Head.

.5 ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

.6 ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.7 ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

.8 ASTM A792 - Standard Specification for Steel Sheet, 55 percent Aluminum-Zinc Alloy-Coated by the Hot- Dip Process.

.9 ASTM B69 - Standard Specification for Rolled Zinc.

.10 ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.11 ASTM B221 - Standard Specification for Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

.12 ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction.

.4 Underwriters Laboratory, USA (UL LLC).

.5 UL 580 - Tests for Uplift Resistance of Roof Assemblies.

.6 FM Global (FM): FM 4471 - Approval Standard for Class 1 Panel Roofs.

.7 Florida Building Code - current edition, product approvals.

.8 MCA Metal Roof Installation Manual.

1.4 Quality Assurance

1.4.1 Manufacturer’s Qualifications:

.1 Prior to bidding the manufacturer shall have had at least (10) ten years experience in architectural and industrial systems.

1.4.2 Installer Qualifications:

.1 Prior to bidding the installer shall have a minimum of (5) years experience of installation with structural field-formed concealed clip systems.

.2 Manufacturer must train and certify the installer so as to provide a single source responsibility for this portion of the work.

1.4.3 Source Limitation: Obtain components for system from or approved by system manufacturer.

1.4.4 Sheet Metal Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

1.4.5 Preinstallation Conference: Conduct conference at Project site. Comply with requirements in Division 01. Review methods and procedures related to system including, but not limited to, the following:

.1 Meet with the Architect, General Contractor, Construction Manager, Engineer, Authority's insurer if applicable; testing and inspecting agency representative; Installer; system manufacturer's representative; deck Installer; and installers whose work interfaces with or affects roofing, including installers of accessories and mounted equipment.

.2 Review methods and procedures related to installation, including manufacturer's written instructions.

.3 Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

.4 Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.

.5 Review structural loading limitations of roof deck during and after roofing.

.6 Review base flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that will affect system.

.7 Review governing regulations and requirements for insurance and certificates if applicable.

.8 Review temporary protection requirements for system during and after installation.

.9 Review observation and repair procedures after installation.

1.5 Submittals

1.5.1 Provide the following:

.1 Submit the following Test Reports certified by an independent testing laboratory or an independent professional engineer to verify that the proposed system will meet the performance requirements of this specification.

.1 ASTM E1592 Structural Performance Test Results.

.2 Halter/Clip Fastener Pull-Out Tests and Calculations.

.3 UL 90 Classification Test Data.

.4 Concentrated Load Test Results.

.5 Air Infiltration ASTM E1680 and Water Penetration ASTM E1646 Test Results

.6 100,000 Clip Cycling Test Results.

.7 ASTM E2140 Water Penetration Test Results.

STANDING SEAM METAL ROOF AND WALL PANELS

1.5.2 With the Proposal: Qualification and/or exceptions to the drawings and specifications.

1.5.3 Prior to Fabrication:

.1 Shop Drawings: Submit complete shop drawings, catalog cuts, calculations with all details, plans, wall elevations and field installation notes clearly indicated. Drawings must be approved before fabrication can begin.

.1 Show fabrication and installation layouts of sheet metal roofing and wall cladding, including plans, elevations, and keyed references to termination points. Distinguish between shop- and field-assembled work.

.2 Include the following:

.1 Details for forming sheet metal roofing, wall cladding, including seams, thicknesses and dimensions.

.2 Details for joining and securing sheet metal roofing, including layout of fasteners, clips, and other attachments. Include pattern of seams.

.3 Details of termination points and assemblies, including fixed points.

.4 Details of expansion joints, including showing direction of expansion and contraction.

.5 Details of penetrations.

.6 Details at connection to rainscreen, if applicable.

.7 Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counter flashings.

.8 Details of special conditions.

.9 Details of connections to adjoining work.

.10 Details of the following accessory items, at a scale of not less than 1-1/2 inches per 12 inches

.11 Roof tie-offs.

.12 Flashing and trim.

.13 Roof curbs.

.14 Snow guards.

1.5.4 Performance Requirements: (Delegated Design) Submit structural design calculations and test reports certified by a registered professional structural engineer licensed to verify load carrying capacities and thermal movement allowance of the panel system.

1.5.5 Furnish certified laboratory test reports showing that the proposed system has been tested and conforms to applicable provisions specified herein.

1.5.6 Samples and descriptive date:

.1 Roof panel: Full panel width, 12 inches long.

.2 Wall Panel: Full panel width.

.3 System Clips/Halters: Two Required.

.4 Fasteners: Two of each type to be used with a statement identifying the intended use of each.

.5 Closure: One metal and one neoprene

.6 Insulation: 12 inch square sample of specified thickness.

.7 Sealants: One sample of each type and statement identifying the intended use of each.

.8 Snow guards.

1.5.7 Qualifications Data: For installer and manufacturer.

1.5.8 Maintenance Data: For system to include in maintenance manuals.

1.5.9 Inspection Report: Sample copy of system manufacturer’s inspection report of completed installation.

1.6 Warranty

1.6.1 Manufacturer’s Warranty: Standard performance warranty provided by the manufacturer to warrant all panels, flashings, sealants, fasteners, and accessories against defective materials and/or workmanship for a period of two (2) years. Manufacturer’s standard warranty must accompany submittal package.

1.6.2 Manufacturer’s Weather-tight Warranty: Standard performance warranty provided by the manufacturer to warrant all panels, flashings, sealants, fasteners, and accessories against defective materials and/or workmanship for a period of twenty (20) years. Manufacturer’s joint-liability Weather-Tightness standard warranty must accompany submittal package.

.1 Manufacturer will require review and approval of shop drawings for all warranty projects.

.2 Inspections required by panel system manufacturer technical representative.

1.6.3 Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal roofing and cladding that shows evidence of deterioration of factory- applied finishes within specified warranty period. This is a pass-through warranty from the paint coating manufacturer.

1.6.4 Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

.1 Color fading more than 5 Hunter units when tested according to ASTM D 2244.

.2 Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.

.3 Cracking, checking, peeling, or failure of paint to adhere to bare metal.

1.6.5 Finish Warranty Period: Twenty (20) years from date of Substantial Completion.

1.7 Delivery, Storage and Handling

1.7.1 Cover prefinished components to protect surface finishes and insulation core from damage and deterioration.

1.7.2 Store components off the ground to prevent twisting, bending or delamination. Slope to shed moisture.

PART 2 PRODUCTS

2.1 Acceptable Manufacturers

.1 Basis of Design: BEMO or equivalent.

.1 Metal strapping: delegated design.

.2 Profile: BEMO 65/400

.3 Panel Width: 400mm (15.75”) as indicated on Drawings.

.4 Seam Height: 65 mm (2.55”) minimum

.5 Shape: as indicated on Drawings

.6 Texture: as indicated on Drawings

.7 Anti-capillary Groove: Integrated into all panels

.8 Joint Type: Mechanically Seamed Bulb with Factory Applied Seam Sealant

.9 Requests to use alternate systems must be submitted in writing to the project designer at least ten (10) days prior to the bid date. Performance requirements, certified statements, samples, sample warranties and descriptive date must accompany the request for substitution.

.10 Manufacturers listed in this section are prequalified manufacturers. Substitution of manufacturers product for those specified will not be allowed at any time during the bidding or construction phases of this project.

.11 Being listed as a prequalified manufacturer does not release the manufacturer from providing complete and acceptable performance data as indicated in this specification.

2.2 Performance Requirements

2.2.1 General: Provide complete sheet metal roofing and cladding system, including, but not limited to, custom-fabricated metal roof and wall panels, sub-framing, clips, anchors and fasteners, sheet metal flashing and drainage components related to sheet metal roofing, fascia panels, trim, cleats, underlayment, insulation, coverboard, rain screen overlay, snow guards, fall protection, lightning protection, penetrations, and accessories as indicated and as required for a weathertight installation.

2.2.2 The standing seam system shall be designed to safely resist the positive and negative loads as required for the location and type of project designed.

2.2.3 Structural-uniform uplift load capacity of the panel system shall be determined in accordance with the principles of ASTM E1592, “Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference” as follows:

.1 The Factor of Safety on the test results shall be 1.65 for the panel and clip/halter ultimate loads with no increase for wind.

.2 The Factor of Safety for fasteners shall be 3.0 for single fastener in each connection, 2.25 for 2 or more fasteners in each connection and 4.0 in masonry.

.3 Design uplift capacity for condition of gage, span or loading other than those tested may be determined by interpolation of test results.

.4 Deflection shall be l/180 for positive loading.

2.2.4 Wind Loads: As indicated on Drawings.

2.2.5 Snow Loads: As indicated on Drawings.

2.2.6 Water penetration of the panel assembly at 20 psf pressure for 15 minutes shall have “no uncontrollable leakage” when tested in accordance with ASTM E1646.

2.2.7 Air infiltration of panel assembly at 20 psf pressure shall be no more than 0.02 cfm/sf of panel when tested in accordance with ASTM E1680.

2.2.8 Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E 2140.

2.2.9 The panel system shall have a U.L. Class 90 rating.

2.2.10 Cycle Thermal Test: Provide metal panel assemblies that have been tested a minimum 100,000 cycles of 1” movement using 10 lbs positive load at 5’-0” spans with no signs of wear through the panel clip. Any clip attachment that causes any direct wear on the panel itself will not be approved or allowed on this project.

STANDING SEAM METAL ROOF AND WALL PANELS

2.2.11 Concentrated Load Performance: Provide metal panel system that withstand a concentrated load of 300 lbs (136 kg) applied to a 4 sq. in. (2580 sq. mm) at mid-span and center of the panel halfway between supports without causing deformation, buckling or side lap separation.

2.2.12 FMG Listing: Comply with FMG 4471. Provide metal panel assembly listed in FMG's "Approval Guide."

.1 Fire and Windstorm Classification: Class 1A-120.

.2 Hail Resistance: SH.

2.2.13 Panels are to be fabricated full length with absolutely no end lap conditions allowed unless approved otherwise in writing by the architect.

2.2.14 The manufacturing equipment must be owned and operated by the manufacturer who must also train and certify the installer and take complete responsibility for the entire work scope.

2.2.15 Fire Performance for Assembly: Meet requirements of ASTM E108, Class A.

2.2.16 Fasten the panels to the structure through the use of concealed halters/clips which are designed to allow for up to and including a full 3-3/4" of panel movement without impeding the performance of the panel.

2.2.17 Curved panels either concave, convex or both are to be manufactured in one continuous panel length and curved without crimping or distorting the standing seam legs of the panels. Mechanical curving equipment must be owned and operated by the manufacturer.

2.2.18 Removable for replacement. Panels shall be designed to allow for replacement of individual panels without removing adjacent panels using manufacturer's un-seaming tool.

2.2.19 Roll Forming Equipment to have a minimum of 12 hardened tooling roll forming stations with a profiled post shear. Pre-shearing and portable roll forming equipment is strictly prohibited.

2.2.20 Panels that are Installer roll formed, coil supplier roll formed, private label roll formed or toll formed panels will not be accepted.

2.2.21 Thermal Movements: Provide sheet metal that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, distortion and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

.1 Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2.22 Energy Performance: Provide system with Solar Reflectance Index (SRI) minimum 78 for roof slopes of 2:12 or less and 29 for roof slopes greater than 2:12 when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency.

2.3 Materials

2.3.1 Metal panels shall be Structural Standing Seam Metal System as manufactured BEMO or equivalent and installed by trained and certified contractors or approved equal.

.1 Fabricate metal panels from a minimum of:

.1 Aluminum: .040” thick aluminum alloy 3004-H14 (or 3105-H34) conforming to ASTM B209.

.2 Zinc Coated (Galvanized) Steel: .0296” (22 gage) G-90 Galvanized steel conforming to ASTM A653 structural quality Grade 33.

.3 Weather Steel.0356” (20 gage) conforming to ASTM A606 weathering steel.

.4 Zinc: 0.8 mm, 1.0 mm or 1.25 mm architectural titanium zinc alloy mill finish or pre-patina, whose base is electrolytic high grade with a 99.995% Zn degree of purity and alloying additives of 0.08% to 1.0% copper and 0.07% to 12% titanium, .001% to .015% aluminum conforming to ASTM B69 Architectural Rolled Zinc, Type 1 and Type 2.

2.3.2 Concealed Clips

.1 Fasten standing seam to structure with specially designed and tested clips manufactured exclusively for the system.

.2 Clips/halters must be designed to allow the materials free movement in either direction parallel to the standing leg of the panel.

.3 Clips must be designed to allow for a minimum of 5/8” air space under the pan of the panels and the substrate materials.

2.3.3 Exposed Coil Coated Finish

.1 Fluoropolymer Two-Coat System: Nominal 1.0 mil total dry film thickness consisting of a 0.2-mil primer with a 0.8-mil 70 percent PVDF fluoropolymer color coat, AAMA 620 and 621.

.2 Color copper penny as indicated on Drawings.

.3 Interior Surface: Manufacturer's standard two coat system consisting of a nominal 0.2 mil primer and nominal 0.3 ml acrylic or polyester backer finish for a nominal 0.5 mil total dry film thickness.

.4 The backside of the panels to have an additional EPA approved 0.2 mil Clear Coat.

2.4 Underlayment Materials

2.4.1 Basis of Design: BEMO-HT Ice and Water Shield or equivalent.

2.4.2 Self-Adhering, High-Temperature Sheet: 40 mils thick minimum, consisting of a white face sheet comprised of a Tri-laminate woven HDPE. In accordance with ASTM D412 Die C - Ultimate elongation MD/XD (%) – 88/55 and Tensile Strength minimum of MD/XD (%) – 11200/13100 (1624/1900psi). Membrane must be proven to not "flow" at 250F. Material is able to be left exposed for up to 180 days.

2.4.3 Basis of Design: BEMO-Shield Plus HT Water, Air, and Vapor Shield for Roofs and Walls or equivalent.

.1 Self-Adhering, High Temperature Sheet: 10.2 mils thick, consisting of a non-asphaltic high strength polypropylene.

.2 UV Exposure Period: 12 months

.3 Roll Dimensions/Coverage: 60" x 100' / 500 ft^2

2.5 Snow Guards

2.5.1 Basis of Design: BEMO Snow Stopper System as manufactured by BEMO or equivalent.

2.5.2 The snow guard system as indicated on drawings shall designed, engineered, supplied, and warranted by the SSMR panel manufacturer. The snow retention system will not be allowed to penetrate the standing seam metal system. All attachments to the roof and wall shall be made to the standing seam and not hinder the thermal movement of the panels.

2.5.3 Type: Fence type with non-penetrating clamp attached directly to the standing seam. All components to be aluminum or stainless steel.

.1 Components:

.1 Clamps manufactured from 6061 T6 mill finish aluminum.

.2 Snow Stop Fence manufactured from 6061 T6 mill finish aluminum.

.3 Stainless steel bolt, lock nut and washer

.4 Finish: Two or Three-coat spray applied high performance fluoropolymer extrusion coating to match color of SSMR panel.

2.5.4 The Snow Retention System will perform to the following:

.1 The ultimate connection load of the seam clamp shall be min. 1700 LBS. parallel (longitudinal) to the standing seam system.

.2 All snow load requirements shall be derived from the "Roof Snow Load Study" performed by RWDI if applicable.

2.5.5 Snow Guard system components shall be sourced by the metal roofing panel manufacturer and include signed and sealed shop drawings and calculations by a licensed Professional Engineer to substantiate all structural design and performance requirements in accordance with the contract documents and applicable building codes

2.6 Sub-Framing Materials

2.6.1 Standard stainless steel clip fastener system as indicated on Drawings and recommended by the manufacturer.

2.7 Lightning Protection

2.7.1 Lightning Protection: roof manufacturer's standard design as indicated on Drawings and recommended by the manufacturer.

2.8 Accessories

2.8.1 Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

.1 Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

.2 Joint Sealant: Manufacturer's standard or recommended liquid and preformed sealers and tapes and as follows:

.1 Factory-Applied Seam Sealant: Manufacturer's continuously applied standard hot-melt type.

.2 Concealed Joint Sealant: Non-curing butyl, AAMA 809.2.

.3 Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311

2.8.2 Sheet Metal Accessories: Provide components required for a complete sheet metal assembly including trim, copings, fasciae, corner units, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of sheet metal, unless otherwise indicated.

.1 Closures: Provide closures at eaves and ridges, fabricated of same metal as sheet metal. Ridge, headwall, hip, etc. shall use a combination foam and metal closure.

.2 Panel Clips: Minimum 18ga galvanized steel hook and stainless-steel base panel clips designed to withstand negative-load requirements.

.3 Cleats: For mechanically seaming into joints and formed from the following materials:

.1 Aluminum Roofing: 0.0250-inch- thick stainless steel or as required by the SSMR panel manufacturer.

2.8.3 Flashing and Trim: Formed from same material and with same finish as sheet metal roofing unless specified otherwise elsewhere. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.

.1 Pipe and Penetration Flashing: Premolded, flashing sleeve or pipe collar with flexible metal ring bonded to sloped base. Intended to provide weatherproof seal and to isolate pipe movement from vibration and expansion/contraction.

2.8.4 Roof Curbs: Fully welded or wet sealed and riveted or as required by the manufacturer for weathertightness warranty. Curb backpan, sidepan, apron flashing and counter flashing shall be fabricated from same material and finish as sheet metal roofing, minimum thickness matching the sheet metal roofing; with bottom of skirt profiled to match roof panel profiles; with weatherproof top box and integral full-length cricket (or manufacturer standard). Fabricate curb sub framing of nominal 0.062-inch-thick, angle-, C-, or Z-shaped galvanized steel or stainless-steel sheet. Fabricate curb and sub framing to withstand indicated loads of size and height indicated. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

.1 Factory insulate curbs with 1-inch- thick, rigid insulation.

.2 Factory install wood nailers at tops of curbs.

.3 Fabricate curb units with water diverter or cricket and with height tapered to match slope to level tops of units or as required by the manufacturer.

.4 Curb base flashing shall be a minimum eight (8) inches above the horizontal roof surface.

.5 Curbs must be installed to accommodate panel thermal movement with a 1” minimum clearance.

2.9 Miscellaneous Materials

2.9.1 General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for a complete system and as recommended by fabricator for sheet metal. Provide accessories made of the same or compatible materials as the items to which they are applied.

2.9.2 Fasteners: Self-tapping screws, self drilling screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads. Use the same metal or a metal compatible with the item fastened. At any location where dissimilar metals are to be fastened, provide stainless steel fasteners.

.1 Concealed Fasteners: Corrosion resistant steel fasteners (zinc plated, stainless steel or equal) designed to meet structural loading requirements. Provide #14 as a minimum fastener size.

.2 Exposed Fasteners: Heads matching color of sheet metal by means of plastic caps or factory-applied coating.

.3 Fasteners for Flashing and Trim: 300 series stainless steel self-drilling screws with hex washer head and bonded washer.

.4 Blind Fasteners: 300 series stainless steel rivets or aluminum.

PART 3 EXECUTION

3.1 Preparation

3.1.1 Obtain all dimensions from job site.

3.1.2 Ensure all structural support is aligned and condition is acceptable.

3.1.3 Provide additional structural framing, as required to conform with Performance Requirements.

3.2 Inspection

3.2.1 The manufacturer/installer shall examine the building to verify that the structure is ready for installation.

3.2.2 Manufacturer/installer cannot proceed until all structural supports and/or substrates are satisfactorily installed in accordance with the drawings, specifications and applicable industry standards.

3.2.3 The manufacturer's Technical Field Representative shall conduct periodic inspections of the work in progress as described herein and shall furnish written documentation of all such inspections. The frequency of the inspections shall be as required by the manufacturer with a minimum of two inspections.

3.3 Installation

3.3.1 The manufacturer must train and certify the installer.

3.3.2 All attachments shall allow for thermal expansion and contraction of the materials.

3.3.3 Install all panels in one continuous unbroken length for any length of 350' or less.

3.3.4 Panels are to be mechanically seamed after installation in the field.

3.4 Damaged Material and Cleaning

3.4.1 Replace any materials or components that are damaged beyond repair prior to completion.

3.4.2 Each area will be wiped down as it is completed.

END OF SECTION

METAL FLASHING

PART 1 GENERAL

1.1 Section Includes

1.1.1 Section includes, but is not limited to:

.1 Metal flashings to roofs, where indicated.

.2 Formed metal expansion joint upstands, parapet tops, and upstand around roofing.

.3 Downspouts and splashpads.

.4 Flashing to protrusions through roofing.

.5 Caulking to flashing.

.6 Flashing to brick veneer and to exterior walls and elsewhere as indicated.

1.2 Related Sections

1.2.1	Unit Masonry:	Section 04200
1.2.2	Modified Bituminous Roofing:	Section 07525
1.2.3	Sealants:	Section 07900
1.2.4	Hollow Metal Doors & Frames:	Section 08100

1.3 Reference Standards

1.3.1 Comply with the latest edition of the following statutes, codes and standards and all amendments thereto.

1.3.2 ARCA: Alberta Roofing Contractors Association Manual.

1.3.3 ASTM Standards:

.1 ASTM A653/A653M: Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 ASTM A924/A924M: Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.

1.3.4 CGSB Standards:

.1 CAN/CGSB-19.13: Sealing Compound, One Component, Elastomeric, Chemical Curing.

.2 CAN/CGSB-19.24: Multi-Component, Chemical Curing Sealing Compound.

1.3.5 Sheet Metal and Air Conditioning Contractors National Association Inc. (SMACNA) "Architectural Sheet Metal Manual".

1.4 Submittals

1.4.1 Submit shop drawings, Product Data and samples in accordance with Division 1.

1.4.2 Submit duplicate full size samples of each joint and profile when requested by the Engineer. Include fasteners, cleats, clips, closures and other attachments.

1.4.3 Submit duplicate samples, 100 mm square of each type of metal flashing to be used, at least 2 weeks prior to the installation of metal work.

1.4.4 Submit samples of trim, including fasteners and other exposed accessories.

1.4.5 Submit shop drawings for flashing detail acceptance, before commencement of work of this type.

1.4.6 Clearly indicate bending, folding, jointing, fastening installation details and materials, thickness, weight and finishes. Indicate profiles, shapes, seams and dimensions. Provide details of expansion joint covers.

1.5 Performance Requirements

1.5.1 Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking and fastener disengagement.

1.5.2 Install metal flashings on all surfaces such as roof edges, sleepers, parapets and cap type, wall junctions, roof dividers, curbs, roof control joints, through roof penetrations and the like, and as otherwise are required to provide flashing type protection to details. Unless otherwise directed extend all flashings down and onto the horizontal portion of the roof. Additionally install counter and base flashings unless otherwise directed by the Engineer.

1.5.3 Sheet metal flashings are intended to protect the roof membrane from accelerated deteriorating effects of the elements, and to limit mechanical damage of the membrane, and are not intended to protect the work from direct migration of moisture. Ensure that the roofing system membrane terminations are fully water tight, without reliance on covering flashing.

1.5.4 Fasten and install roof edge flashing and copings capable of all resisting according to recommendations of FMG Loss Prevention Data Sheet 1-49, for wind conditions as outlined in the National Building Code - Alberta Edition for the Lac St. Anne County Area.

1.5.5 Provide sheet metal flashing and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects:

.1 Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements.

.2 Base engineering calculations on surface temperatures of materials due to both solar heat gain and nightime sky heat loss.

.3 Temperature change (range): 67°C ambient; 100°C material surfaces.

1.5.6 Provide sheet metal flashing and trim to create a rain screen assembly to the completed air/vapour and roofing membrane termination details.

1.5.7 Call for inspection by roofing inspector, of completed roofing work prior to the installation of any metal flashings. Provide other flashing inspections, such as at start-up and periodic inspections, by the roofing inspector at frequencies recommended by ARCA.

1.5.8 Coordinate installation of flashing work of this Section with flashing work of other Sections which ties into this work. Coat surfaces of different metals such as aluminum and galvanized steel which are in contact to each other, with bituminous paint to prevent electrolysis.

METAL FLASHING

1.6 Qualifications

1.6.1 Use only competent and qualified tradesmen to execute the work of this Section, using adequate plant and equipment.

1.7 Sample Installation

1.7.1 Perform a sample installation of flashing, with at least one corner and two joints, for acceptance, before proceeding further. Perform sample installation work in conformance with submitted samples and shop drawings as per submittal requirements specified in item 1.4 of this Section.

1.8 Delivery/Storage

1.8.1 Store off ground and under cover in a dry, well ventilated enclosure.

1.8.2 Stack pre-formed material in a manner to prevent twisting, bending and rubbing.

1.8.3 Provide protection for galvanized or pre-coated surfaces.

1.8.4 Prevent contact of dissimilar metals during storage. Protect from acids, flux, and other corrosive materials and elements.

1.9 Protection

1.9.1 Exercise care when working on roof surfaces to avoid damage to roofing.

1.10 Warranty

1.10.1 Refer to Roofing Section for Warranty which includes work of this Section. Provide warranty to The City, agreeing to repair or replace specified materials or Work that has failed within the warranty period. Failures include, but are not limited to the following:

.1 Rain Screen function.

.2 Flashing displacement, blow off, ripping and tearing.

.3 Oil-canning.

.4 Material incompatibility with other materials.

.5 Deterioration or corrosion of finishes.

.6 Defective workmanship or objectionable appearance resulting from defective or non-conforming materials.

1.11 Special Reviews

1.11.1 Items subject to special reviews are as follows:

.1 Inspect all flexible roof flashing before metal flashing is applied. Includes curbs for mechanical items.

.2 Review caulking locations, applicator, and sealant before any caulking work is done.

PART 2 PRODUCTS

2.1 Materials

2.1.1 Metal flashing: 0.61 mm thick base metal, commercial quality sheet steel to ASTM A653/A653M with Z275 designation zinc coating to ASTM A924/A924M, prepainted with baked enamel, to CSSBI Technical Bulletin No. 20M, Baycoat Perspectra Series coating or Vicwest Weather-X series coating, colour to match adjacent metal cladding.

2.1.2 Downspouts: Fabricated from same as metal flashing.

2.1.3 Flashing Underlayment: High temperature type where membrane is installed directly under flashings, and compatible with roofing membrane:

.1 Grace “Ultra”

.2 Henry Blueskin "PE200HT" (WINTER GRADE ONLY)

.3 Soprema Lastobond Pro-HT-S (for high temperature application)

.4 Other preapproved product.

2.1.4 Flashing underlayment primer: as specified in Section 07270 for air/vapour barrier membrane.

2.1.5 Cleats: of same material as sheet metal, not less than 50 mm wide, sized to suite application or as detailed.

2.1.6 Flashing nails: #12 hot dipped galvanized, annular ringed. For fastening to wood.

2.1.7 Flashing screws: 300 series stainless steel, non-corrosive self-tapping, pan head. For fastening to metal.

2.1.8 Fasteners: 'pop' rivets or sheet metal screws of length and thickness suitable for metal flashing application.

2.1.9 Plastic cement: to CAN/CGSB-37.5.

2.1.10 Lap Cement: CAN/CGSB-37.4.

2.1.11 Bituminous Paint: alkali resistant bituminous paint.

2.1.12 Sealant: type 1 as specified in Section 07900.

2.1.13 Recessed Reglets: Preformed 0.61 mm galvanized steel channel with face and ends covered with plastic tape.

2.1.14 Splashpads: Precast concrete type, minimum strength 20 MPa; 2% air entrainment.

METAL FLASHING

2.2 Fabrication/Flashings

2.2.1 Generally, form all flashing in connection with aluminum curtain wall, windows and entrances using aluminum flashing, and use prefinished steel flashing to all other locations.

2.2.2 Fabricate metal flashing and other sheet metal work to applicable ARCA and SMACNA specifications and according to details from 0.61 mm (24 gauge) thick material.

2.2.3 Form all flashing components in 2400 mm maximum length generally, and at 1500 mm lengths at parapet wall caps, unless acceptance of intermediate fastening is obtained, and accepted sample installation.

2.2.4 Form sections square, true and accurate to size, free from distortions and other defects detrimental to appearance or performance.

2.2.5 Form metal rake and eave edge flashings shall be by roofing manufacturer and shall be of same colour.

2.2.6 Curb metal flashings, flashing and counterflashing for penetrations, cap-flashings, copings and fascias, sheet steel roof drain sleeves, air-stops, air-fire stop below control joint box, and the like, from 0.61 mm (24 gauge) prefinished steel to exposed locations.

2.2.7 Overbrake rake and eave flashings slightly so that when installed, fascia flashings are sprung tightly to fascia boards or wall fascia panels.

2.2.8 Construct flashing joints to allow for flashing movement, using flat "S" lock seams. Maintain minimum of 25 mm lap on all joints. Maintain anchor projection of the "S" lock to 25 mm. At inside and outside corners, mitre the joint, and use upstanding seams, 25 mm minimum height and 25 mm minimum lap. Use standing seams only on top flashing; side laps to be “S” locked in conjunction with standing seams.

2.2.9 All counter flashings over 450 mm high must be cross-broken in 1520 mm lengths to insure it is backed firmly against its backing during windy conditions.

2.2.10 Form flashings over 600 mm wide in standing seam construction in 600 mm widths.

2.2.11 Maintain 1:5 minimum slope on horizontal surfaces of all flashings, parapets and control joints.

2.2.12 Hem all exposed edges of flashings on underside 12 mm.

2.2.13 Fabricate cap flashing to have a drip leg, minimum 106 mm high unless detailed otherwise.

2.2.14 Fabricate cap flashings to lap 100 mm over base flashings.

2.2.15 Fit flashings together so that one end of each section is free to move in the joint.

2.2.16 Do not set base flashing screws lower than 200 mm from top of the roof membrane, unless otherwise directed.

2.2.17 Properly flash around all projections through deck.

2.2.18 Install flashings free of buckle and warp due to installation methods or dimensional changes due to 100°C temperature range.

2.2.19 Brake form sections to profiles indicated. Lap metal in runs and at corners and securely screw pieces together and seal with sealant.

PART 3 EXECUTION

3.1 Examination of Surfaces

3.1.1 Examine all surfaces to receive flashings.

3.1.2 Notify the Engineer of surfaces which are considered unacceptable to receive the work of this Section.

3.1.3 Commencement of flashing work will imply unconditional acceptance of surfaces and substrate to which flashing is to be affixed.

3.2 Workmanship

3.2.1 Form sections true and accurate to size, free from distortion and other defects detrimental to appearance and performance.

3.3 Installation/Flashings

3.3.1 Install flashings not later than seven days after installation of the membrane on any particular section of the roof.

3.3.2 Perform work of this Section using competent mechanics experienced in this type of work. Make adequate provision for expansion and contraction. Install flashing in lengths not exceeding 2400 mm generally, and 1500 mm lengths at parapet wall caps, and fabricate to allow for 5 mm expansion between sections.

3.3.3 Install sheet metal work according to drawings, reviewed shop drawings, and to ARCA and SMACNA recommended practice.

3.3.4 Locate and install recessed reglets where applicable. Install level and true to line, free of waves and imperfections, Install flashing into reglets and completely and continuously seal in place to provide a waterproof installation.

3.3.5 Seal flashing into reglet with bond breaker and sealant compound. Bond sealant on two surfaces only.

3.3.6 Use S-lock joints unless otherwise accepted by the Engineer. Cap and lock seams, exposed edges folded back 13 mm mitre and caulk corners. Use slip seams for vertical seams.

3.3.7 Use concealed fastenings unless otherwise accepted by the Engineer.

3.3.8 Install self adhered membrane under all cap flashings. Adhere in place and lap joints 100 mm. Where indicated, adhere top edge continuously to wall surface, so any water running down the wall surface which leaks around the caulked flashing will flow over the underlay and onto the roof surface. Ensure membrane is compatible with roofing membrane. Note: this is in addition to the roofing membranes specified in Section 07 52 00.

3.3.9 Fasten flashings of 1200 mm length and shorter through the extended "S" locks. Fasten flashings over 1200 mm length through the extended "S" locks and at the mid-length with a 150 mm long, 0.792 mm thick (22 gauge) thick galvanized steel clip.

3.3.10 Fasten flashings at maximum 600 mm oc.

3.3.11 Fit flashings together so that one end of each section is free to move in the joint. Do not use any caulking or other sealant at joints.

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3.3.12 Do not caulk between top of flashing and adjacent exterior finishing materials above flashing, so that moisture can escape through space between flashing and adjacent materials above.

3.3.13 Lap, cap or counter flashings with base flashing, minimum 100 mm.

3.3.14 Where possible, do not set base flashing screws lower than 200 mm from top of the roof membrane.

3.3.15 Join all prefinished steel components stainless steel screws.

3.3.16 Do not apply sealant to S-lock joints or exposed joints. Use sealant at other joints only with prior acceptance of Engineer.

3.3.17 Back paint sheet metal with bituminous paint on surfaces in contact with concrete, masonry, other cementitious materials, or dissimilar metal, including aluminum flashing.

3.3.18 For reglet detail seal flashing into reglet with ethafoam bond breaker and caulking sealant. Caulk reglets using specified caulking. Reglet depth to be at least 38 mm and height to be sufficient to fit metal and uncompressed bond breaker.

3.3.19 Provide continuous hook strips or inserts where flashings built into vertical or horizontal surfaces. Wedge flashings in reglets in masonry or concrete with lead wedges and caulk. Install continuous hook strips with 190 mm splayed drip fascias, copings, and at tops of parapets to receive flashings, secured at not over 450 mm o.c.

3.3.20 At parapets, install flashings to top of coping and lock over hook strip at the exterior bottom of coping. Dress flashings over top of coping, and on the roof side locked to a base flashing crimped out over the roof edge at roof level and finished with a hemmed edge. Form expansion joint in coping flashing at approximately 7600 mm o.c., or as otherwise indicated on the drawings. Where different metals are in contact, coat the surfaces in contact to prevent electrolysis.

3.3.21 Install cap and base flashings where roofing abuts parapets, walls, and other vertical surfaces, in lengths not exceeding 2400 mm. Secure cap flashings not less than 300 mm above finished roofing. Lock base flashing to cap flashing and crimp out on to roof level and finish with a hemmed edge.

3.3.22 Properly flash around all projections through roofing, including vents, stacks, mechanical equipment, louvres, and the like, which is not otherwise flashed, to form a watertight installation.

3.3.23 Screw sheet metal fabrications to substrate, rigid and secure.

3.3.24 Install metal flashings at intersections of roofing with walls, and service penetrations.

3.3.25 Coordinate installation of wall flashings, with air/vapour barrier membrane specified in Section 07270, to ensure that flashing extending minimum 100 mm up the wall behind the wall cladding and the air/vapour barrier is lapped over and sealed to flashing to maintain continuity of the air/vapour barrier and to ensure that moisture within the cavity is drained to the exterior.

3.3.26 Install prefinished flashings to all other locations, including at brick veneer, over hollow metal door and window heads and elsewhere as detailed or as otherwise required. Coordinate installation of metal flashing with air/vapour barrier installation at heads of doors, windows and the like, as specified in Section 07270.

3.4 Installation Downspouts

3.4.1 Install downspouts as recommended by the Alberta Roofing Contractors Association.

3.4.2 Anchor downspouts securely using galvanized steel straps.

3.4.3 Fabricate downspouts, 100 mm x 150 mm unless indicated otherwise. Install ells and tees as required, and secure downspouts to wall with 0.61 mm base metal thickness prefinished galvanized steel straps at 1200 mm oc, minimum 3 straps per downspout.

3.5 Installation/Splashpads

3.5.1 Install one (1) precast concrete splashpad at the end of each downspout. Slope away from the building.

3.6 Sealing

3.6.1 Perform all caulking using trained mechanics skilled in the use of materials used.

3.6.2 Caulk all locations as specified, and as required to meet reference standards, consistent with the contract documents. Use caulking type specified.

3.6.3 Match colour of caulking to surfaces to be applied to. Obtain Engineer's direction if colour match unobtainable.

3.6.4 Thoroughly clean and prime all surfaces to receive caulking, following manufacturers recommendations.

3.6.5 Call for inspection of the reglet detail prior to caulking.

3.7 Clean Up

3.7.1 Remove all metal scraps and cuttings from roof upon completion of flashing work. Leave roof area in a clean tidy condition acceptable to the Engineer.

3.7.2 Remove temporary protective coverings and strippable films.

3.7.3 Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair, by finish touch-up or similar minor repair procedures.

END OF SECTION

PART 1 GENERAL

1.1 General Requirements

1.1.1 The General Conditions of Contract, Division 01 General Requirements and all Addenda thereto form an integral part of and must be read in conjunction with the requirements of this Section.

1.1.2 Cooperate and coordinate with the requirements of other units of work specified in other Sections.

1.2 Section Includes

1.2.1 Section includes, but is not limited to:

.1 Prefinished Steel Gutters.
.2 Prefinished Steel Downspouts.
.3 Precast concrete Splash pads.

1.3 Related Sections

1.3.1 Section 07613 - Standing Seam Metal Roofing

1.3.2 Section 07620 – Sheet Metal Flashing and trim

1.4 Reference Standards

1.4.1 American Society for Testing and Materials (ASTM):

.1 ASTM A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

1.4.2 SMACNA - Architectural Sheet Metal Manual.

1.4.3 ARCA (Alberta Roofing Contractor's Association) - Roofing Manual.

1.5 Qualifications

1.5.1 Employ a qualified applicator to execute work of this Section, equipped to properly form the specified gutter sections continuously from roll stock at the site.

1.6 Shop Drawings

1.6.1 Submit shop drawings in accordance with Division 1.

1.6.2 Clearly indicate bending, folds, jointing, fastening, end caps, profiles, and installation details.

1.7 Samples

1.7.1 Submit duplicate 100 mm x 100 mm samples of metal material indicating colour to be used for this project.

1.8 Delivery and Storage

1.8.1 Store off ground and under cover in a dry, well ventilated enclosure.

1.8.2 Stack pre-formed material in manner to prevent twisting, bending and rubbing.

1.8.3 Provide protection for galvanized prefinished surfaces.

1.8.4 Prevent contact of dissimilar metals during storage. Protect from acids, flux, and other corrosive materials and elements.

1.9 Examination of Surfaces

1.9.1 Examine all surfaces to receive gutter and downspouts.

1.9.2 Notify the Engineer of surfaces which are considered unacceptable to receive the work of this Section.

1.9.3 Commencement of gutter and downspout work implies unconditional acceptance of surfaces and substrate to which gutters and downspouts are attached.

PART 2 PRODUCTS

2.1 Materials

2.1.1 Prefinished sheet metal (for fascias, flashings and alignment splines for fascias): grade A commercial quality galvanized steel conforming to ASTM A653 with Z275 zinc coating in accordance with ASTM A653; factory prefinished on exposed side with modified silicone polyester coating of special colour selected by Consultant; factory pre-coated on non-exposed side with lightly pigmented modified silicone polyester; of minimum 0.76 mm (22 gauge) base metal thickness.

2.1.2 Sheet Metal (for eave edge gutters, alignment splines for gutters and transition sections for gutters): Grade A commercial quality galvanized steel conforming to ASTM A653 with Z275 coating in accordance with ASTM A653; minimum 1.78 mm (0.074”) (14 gauge) base metal thickness.

2.1.3 Sheet Metal (for gutter thrust bars): same quality of galvanized steel specified for gutters but in minimum 2.52 mm (0.104”) (12 gauge) base metal thickness.

2.1.4 Sheet Metal downspouts: of same quality and type of galvanized sheet steel specified for fascias and flashings except without coloured coating.

2.1.5 Bituminous Coating: filled, cut-back asphalt of type recommended for roof coating; conforming to CAN/CGSB-37.8.

2.1.6 Sealant: type and quality specified in Section 07 92 00. Sealants are acceptable in non-visible locations only.

2.1.7 Fasteners: corrosion resistant steel; self-drilling, self-tapping type; of lengths to penetrate through back-up by 13mm (1/2"); of size and strength to provide adequate securement of components; complete with soft neoprene washers where used to secure gutters and gutter lining in place; of finish to match metal surfaces in exposed locations.

2.1.8 Splashpads: Precast concrete splashpad from 24 Mpa concrete, 310 mm (12 ¼") wide x 75 mm (3") deep x 610 mm (24") long, to CAN/CSA A23.1.

2.2 Fabrication Of Eave Edge Fascias

2.2.1 Fabricate eave edge fascias to profiles detailed, in maximum 2400mm (8'-0") lengths.

2.2.2 Fascias are to have joints that are flush butt type, including joints at inside and outside corners. All joints, including inside and outside corners are to be backed with alignment splines which have a face width of 150mm (6").

2.2.3 Alignment splines for inside and outside corners are to be fabricated as one piece for each location. Consultant will allow alignment splines for corners to be fabricated of galvanized sheet stock with shop applied enamel finish to match fascias.

2.2.4 Alignment splines are to follow the profile of fascias and be capable of being installed before fascias are installed. The exposed surfaces of alignment splines are to have a finish and colour to match fascias.

2.2.5 Form all edges slightly radiuses, adequate enough to prevent damage to prefinished coatings.

2.2.6 Fabricate fascias complete with matching closure pieces for locations where fascias terminate at gable ends.

2.2.7 Fabricate shapes free of distortion, ripples, dents, buckling and other visible non-repairable surface damage.

2.3 Fabrication Of Eave Edge Gutters

2.3.1 Fabricate eave edge gutters to profiles detailed, min. 100 mm x 100 mm, in maximum 2400 mm (8'-0") lengths; minimum 1830 mm (6'-0") lengths. Joints in gutters must correspond with joints in eave edge fascias. Do not rivet sections together.

2.3.2 Fabricate all corners as one piece with joints mitred and welded watertight. No rivets.

2.3.3 Fabricate gutters with ends closed off, with caps welded in place watertight.

2.3.4 Form spill-outs as detailed, welded in place watertight.

2.3.5 At expansion joints, gutters are to be end capped and separated by 25mm (1"). End caps are to be welded in place watertight.

2.3.6 Fabricate gutter sections with flush butt joints. All joints are to be backed with alignment splines which are to have a face width of 65 mm (2 ½").

2.3.7 Alignment splines are to be full welded to one side of each gutter section so that when gutters are installed each and every joint will be backed with an alignment spline.

2.3.8 Alignment splines are to be lapped 25 mm (1") over the gutter sections to which they are to be welded.

2.3.9 Thrust bars are to be 25 mm (1") wide and be spaced at maximum 600 mm (24") on centre, and not more than 100 mm from each end of each gutter section.

2.3.10 Fabricate shapes free of distortion, ripples, dents, and other visible non-repairable surface damage. Grind all welds smooth and flush with adjacent surfaces.

2.3.11 Fabricate gutter spill-out profile 75 mm wide x 50 mm high (3" wide x 2" wide) to match existing.

2.3.12 All gutter sections, including thrust bars, are to be finished in shop before delivery to site. All surfaces are to be cleaned, degreased and provided with a two- (2) coat thermosetting epoxy resin powder finish of colour and sheen selected by Consultant. Powder finish must be applied by an approved applicator.

2.4 Fabrication Of Metal Flashings

2.4.1 Fabricate metal flashings and lead flashings for roof changes. Form sections in minimum 2400 mm (8'-0") lengths.; minimum 1830 mm (6'-0") unless approved by Consultant.

2.4.2 Fabricate flashings with flat lap joints. Provide minimum 180 degree turned down hemmed edges.

2.4.3 Fabricate all required sections required to interlock with metal fascias at eave edges.

2.4.4 Fabricate metal flashings with straight uniform edges, and free of distortion, ripples, and dents, buckling and other visible non-repairable surface damages.

2.5 Fabrication Of Downspouts

2.5.1 Form sections in maximum sizes with all joints S-locked and sealed watertight.

2.5.2 Form downspouts minimum 100 mm x 75 mm (4" x 3") in size unless otherwise detailed.

2.6 Fabrication

2.6.1 Form eavestroughs and down spouts from 0.6 mm base metal thickness prefinished galvanized steel of colour to match metal roofing. Form eavestrough of 100 mm widths using continuous rolling process.

PART 3 EXECUTION

3.1 Workmanship

3.1.1 Form sections true and accurate to size, free from distortion and other defects detrimental to appearance and performance.

3.2 Installation

3.2.1 Eave Edge Fascias

.1 Install fascias well secured and rigid in place and with all sections in-line with each other. All anchorage's must penetrate back up Z-bars and channels.

.2 Install back-up alignment splines independent of fascias in a manner to allow fascias to expand and contract at joints.

.3 Maintain 10 mm (3/8") wide joints between fascia sections to allow for expansion and contraction.

.4 Install alignment splines across expansion joints and maintaining 25-mm (1") wide joints between fascia sections. Install to allow for movement at expansion joints.

.5 Co-ordinate the installation of rigid insulation within/behind fascias.

.6 Install closure pieces at locations where fascias terminate at gable ends. Install watertight.

.7 Interlock fascias with metal flashings at roof changes. Provide watertight junctions acceptable to the Consultant.

3.2.2 Metal Flashings

.1 Install metal flashings well secured in place and in a manner to allow expansion and contraction at joints. Weatherlap all joints.

.2 All exposed fasteners must be neatly arranged in manner acceptable to Consultant. All fasteners must penetrate back up Z-bars and channels.

3.2.3 Eave Edge Gutters

.1 Install eave edge gutters well secured in place and rigid, and with all sections in-line with each other. All joints must correspond with joints in metal fascias. All anchorage's must penetrate back up Z-bars and channels.

.2 Maintain 10-mm (3/8") wide joints between gutter sections to allow for expansion and contraction. Seal lapped edges as work progresses. Clean all visible traces of sealant at lapped joints as work progresses.

.3 Keep gutter sections 25 mm (1") apart at expansion joints.

.4 Install thrust bars at maximum 600 mm (24”) on centre, not more than 100 mm (4”) from each end of each gutter section.

.5 Use only anchorage’s which have soft neoprene washers.

3.2.4 Gutter Liner

.1 Install gutter liner as detailed using fasteners with soft neoprene washers. Prior to installation, back-paint all metal surfaces that will be in contact with structural steel members. Use bituminous type paint material.

.2 Flash and seal gutter-liner to downspouts. Make all connections watertight and in manner acceptable to Consultant.

3.2.5 Downspouts

.1 Secure downspouts to structural steel columns using 0.76-mm (0.029”) (22 gauge) thick galvanized steel straps at 600 mm (24”) on centre. Secure straps to steel columns using corrosion resistant screws.

.2 Install splash pans as indicated.

3.2.6 Bituminous Coating

.1 Apply two (2) coats of asphalt bitumen on all inside surfaces of steel gutters. Allow the first coat to dry prior to installing the second coat.

3.2.7 Splashpads

.1 Install precast concrete splashpads as indicated, below each down spout.

3.3 Cleaning

3.3.1 Proceed in accordance with Division 01.

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

3.3.3 Leave work areas clean, free from grease, finger marks and stains.

END OF SECTION 07712

ROOF ACCESSORIES

PART 1 GENERAL

1.1 Summary

1.1.1 Roof accessories and appurtenances mounted on the roof system.

1.1.2 Roof guards including:

- .1 Fixed roof guardrails.
- .2 Non-penetrating guardrail systems (counter-weighted).
- .3 Collapsible/maintenance-only guardrail systems.

1.1.3 Associated flashings, bases, fasteners, and attachments.

1.1.4 Coordination with roofing and waterproofing systems.

1.2 References

1.2.1 OSHA 29 CFR 1910.29 – Fall Protection Systems.

1.2.2 OSHA 29 CFR 1926.502 – Fall Protection Requirements for Construction.

1.2.3 ANSI/ASSP Z359.1 – Fall Protection Code.

1.2.4 ASTM A123 – Zinc Coatings on Iron and Steel Products.

1.2.5 ASTM A153 – Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

1.2.6 ASTM B117 – Standard Practice for Salt Spray Exposure (Corrosion Testing).

1.3 Submittals

1.3.1 Submittals: Provide following submittals before starting any work of this Section:

- .1 Product Data:
  - .1 Manufacturer’s data sheets for guardrail systems and roof accessories.
  - .2 Load and performance ratings.
- .2 Shop Drawings:
  - .1 Layout of guardrail locations.
  - .2 Anchorage, supports, base plates, counterweights, and transitions.
  - .3 Interface details with roof membrane.
- .3 Samples:
  - .1 Finish samples for exposed metal components.
- .4 Closeout Submittals:
  - .1 Operation and maintenance instructions.
  - .2 Warranty documentation.

1.4 Quality Assurance

1.4.1 Installer Qualifications:

.1 Minimum 3 years of experience installing roof safety and accessory systems.

1.4.2 Regulatory Requirements:

.1 Guardrail systems shall comply with OSHA requirements for fall protection:

.1 Guardrail height: 42 in ± 3 in.

.2 Strength: Must withstand 200 lb force applied in any outward/downward direction.

1.5 Warranty

1.5.1 Manufacturer's standard warranty: minimum 1 year against manufacturing defects.

1.5.2 Installer warranty: minimum 1 year for workmanship.

1.5.3 Coordinate with roof membrane manufacturer to maintain roofing warranty.

PART 2 PRODUCTS

2.1 Manufacturers

2.1.1 Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include; but are not limited to, the following:

.1 Kee Safety.

.2 BlueWater Manufacturing.

.3 Miller / Honeywell.

.4 SafetyRail

.5 or approved equivalent.

2.2 Materials

2.2.1 Guardrail System Components:

.1 Material:

.1 Structural aluminum or galvanized steel.

.2 For steel components: Hot-dip galvanized per ASTM A123 / A153.

2.2.2 Railings:

.1 1¼–1½ in OD tubing minimum.

2.2.3 Base Assemblies:

.1 Penetrating or non-penetrating (counterweighted type).

2.2.4 Fasteners:

.1 Stainless steel for exterior use.

2.2.5 Finish:

.1 Galvanized, anodized aluminum, or powder-coated.

2.2.6 Performance Requirements:

.1 Guardrail assembly must withstand:

.1 200 lb at top rail without permanent deformation.

.2 Toe boards provided when required by code.

.3 Non-penetrating systems must be stable under wind loads per local code.

2.3 Roof Accessory Flashings

2.3.1 Fabricated from 24-ga minimum sheet metal or manufacturer's standard.

2.3.2 Provide membrane-compatible flashing kits for penetrating guardrails.

2.3.3 Ensure watertight integration with roof system.

PART 3 EXECUTION

3.1 Examination

3.1.1 Verify roof substrate is complete, stable, and ready for installation.

3.1.2 Coordinate with roofing contractor before penetrating roof surfaces.

3.2 Installation

3.2.1 Install guardrails in accordance with manufacturer's instructions.

3.2.2 Ensure proper spacing, alignment, and anchorage.

3.2.3 Coordinate flashing with roofing installer to maintain waterproofing.

3.2.4 Provide temporary protection of roof during installation.

3.3 Field Quality Control

3.3.1 Inspect completed installations for structural stability and compliance.

3.3.2 Perform load testing if required by Owner.

3.4 Cleaning And Protection

3.4.1 Remove debris from roof and clean accessible metal surfaces.

3.4.2 Protect installed guardrail systems until project completion.

3.5 Closeout

3.5.1 Submit final O&M documentation.

3.5.2 Train Owner's personnel if guardrails include collapsible or removable components.

ROOF ACCESSORIES

END OF SECTION

PART 1 GENERAL

1.1 Summary

1.1.1 Provide floor hatches and guard rail system in accordance with Contract Documents.

1.2 Submittals

1.2.1 Submittals: Provide following submittals before starting any work of this Section:

.1 Product Data: Submit product data for hatches including construction, hardware and finishes.

.2 Shop Drawings: Submit shop drawings indicating size and description of components, materials, attachment, description of frame and finish, and construction details.

1.3 Storage and Protection

1.3.1 Deliver the units to the jobsite, store and handle in original packages, in an undamaged condition, with the manufacturer's seals and labels intact.

1.3.2 Store in waterproof and weather proof shelter, ensure prevention from damage in any form.

1.3.3 Damaged units shall be rejected.

PART 2 PRODUCTS

2.1 Materials

2.1.1 Floor Hatches

.1 Material: 1/4" (6mm) aluminum cover and extruded aluminum frame

.2 Cover: Diamond-pattern tread plate reinforced for 7.2 kPa loading. Designed for installation in off street locations where the door is not subjected to high density, fast moving traffic.

.3 Frame: Extruded aluminum channel frame with bend down anchor tabs around the perimeter. A 1-1/2" (38mm) drain coupling is welded under the frame for a pipe connection to a dry well or disposal system.

.4 Hinges: Heavy forged Type 316 stainless steel hinges with 1/4" (6 mm) type 316 stainless steel hinge pins.

.5 Latch: Type 316 stainless steel slam lock with fixed interior handle and removable exterior turn/lift handle. Latch release is protected by a flush, gasketed, removable screw plug.

.6 Lift Assistance: Compression spring operators enclosed in telescopic tubes. Automatic hold-open arm with release handle automatically locks cover(s) in the open position.

.7 Finish: Mill Finish aluminum with a bituminous coating applied to the exterior of the frame

.8 Hardware: Type 316 stainless steel throughout.

2.1.2 Fall Protection Grating:

.1 Grating panels constructed of aluminum with a powder coat paint finish, safety yellow color.

.2 Panels designed to meet the requirements of OSHA standard 29 CFR 1910.23 and equipped with hold open device to lock the grating panels in open position.

.3 Hold open device and hardware: Type 316 stainless steel.

.4 Manufacturer shall provide a twenty-five year warranty against defects in material and workmanship.

2.2 Fabrication

2.2.1 Fabricate components free of twists, bends, or visual distortion and insulated.

2.2.2 Fabricate flashings to collect and lead off accumulated condensation.

PART 3 EXECUTION

3.1 Examination

3.1.1 Inspect the work of others and notify the Engineer of all adverse conditions or discrepancies which may affect the work of this section. Commencement of work shall imply acceptance of all surface conditions and work of others.

3.2 Coordination

3.2.1 Coordinate the work of this Section with the work of all other trades to ensure a continuous erection procedure.

3.2.2 Confirm all opening dimensions.

3.2.3 Provide all parts to be embedded and required templates for proper installation prior to pouring of surrounding concrete.

3.3 Installation

3.3.1 Units shall be installed in accordance with manufacturer's installation details and recommendations.

END OF SECTION 07830

FIRESTOPPING

PART 1 GENERAL

1.1 Summary

1.1.1 Provide labelled firestopping to all openings in fire rated walls, floors and ceilings and slab edges to maintain the integrity of the fire rating of the assembly. Include new construction, new openings in existing structure and where rating is required between new construction and existing building.

1.1.2 During the course of construction, where unprotected openings are discovered in existing fire rated walls, floors, and ceilings install firestopping material to maintain the integrity of the fire rating of the assembly.

1.1.3 Seal the perimeter of all fire rated and non-rated fire partitions with labelled sealant where gypsum board, concrete block or other rated construction does not meet the structure to allow for movement, expansion and contraction.

1.1.4 Apply firestopping to all locations as noted on the drawings.

1.2 References

1.2.1 Underwriter's Laboratories of Canada CAN/ULC S115– “Standard Method of Fire Tests of Firestop Systems”.

1.3 Installer Qualifications

1.3.1 Installer Qualifications: have been regularly engaged in installation of firestopping materials for the last five (5) years minimum. Provide proof of qualifications upon request from the Engineer.

1.3.2 Installer Qualifications: have received training from at least one manufacturer in installation of all types of firestopping materials. Provide proof of such training, refer to Submittals below.

1.4 Quality Assurance

1.4.1 Provide on-site inspection during the initial installation of firestopping materials by firestopping material manufacturer’s trained technical representative. Review site conditions, firestopping materials for compliance with “best before” date and storage conditions as well as substrate preparation and installation compliance with manufacturer’s installation instructions and with requirements for labelled assemblies. Provide additional training for subcontractor’s employees as required.

1.5 Performance Requirements

1.5.1 Firestopping: provide a rating, when tested to ULC S115, for a rating period applicable to the fire separation.

1.5.2 Provide F, FT and combination rated assemblies as required by Building Code for each application.

1.5.3 Firestopping used to fill voids in floors having openings 100 mm in diameter or larger, and which are accessible design in accordance with floor design loading.

1.6 Submittals

1.6.1 Submit product data to the Engineer. Submit product data within one week of notification of Contract award.

1.6.2 Submit manufacturer's product data for materials and systems. Include detail drawings of each typical firestopping installation and manufacturer's printed instructions for installation/construction of each type of firestopping assembly. Copies are required for submission to the Building Permit application submission.

1.6.3 Indicate conformance with requirements of this Section, including approval certification information of an agency acceptable to the Authority having Jurisdiction for each assembly.

1.6.4 For those applications for which no ULC or cUL tested system is available through a manufacturer, provide a “manufacturer’s engineering judgment” assembly derived from similar application and assembly. Submit manufacturer’ engineering judgments to the Authority having Jurisdiction for approval prior to installation.

1.7 Coordination and Sequencing

1.7.1 Coordinate the work of this Section with construction of fire separations and penetrations through fire separations.

1.7.2 Ensure penetrations have been completed prior to installing firestopping.

PART 2 PRODUCTS

2.1 Acceptable Manufacturers

2.1.1 Products and systems, complying with these specifications, from the following manufacturers are acceptable:

.1 3M Company

.2 Hilti

.3 AD Fire Protection Systems

.4 Tremco

2.2 Systems and Materials

2.2.1 Certify firestopping systems by an agency acceptable to the Authority having Jurisdiction.

2.2.2 Firestopping materials, in addition to complying with the requirements above include:

.1 Be compatible with substrates,

.2 Allow for movement caused by thermal cycles,

.3 Prevent the transmission of vibrations from pipe, conduit or duct to structure and structure to pipe, conduit or duct.

2.2.3 Ensure products are compatible and from same manufacturer when more than one product is required for an assembly.

2.2.4 Firestopping sealants and coatings: silicone based, guaranteed not to re-emulsify if subject to wetting or standing water, acrylic based coatings and sealants are not acceptable.

2.2.5 Provided that all other specified requirements can be met, use any of the following products, either singly or in combination:

.1 Elastomeric sealant.

.2 Elastomeric coating.

.3 Mineral fibre.

.4 Rated Mortar.

.5 Intumescent putty.

.6 Firestop putty pads, similar to Hilti “CP 617".

.7 Poured in place silicone foam.

.8 Manufactured collars for plastic pipe and conduits through walls.

.9 Concrete floor slab cast-in fire-stop pipe collars, similar to Hilti “CP 680”

.10 Multi cable transit system.

.11 Any other product which meets all other specified requirements.

2.2.6 Primer: as recommended by firestopping manufacturer for applicable substrate.

2.2.7 Smoke sealing assemblies: certified by an agency acceptable to the Authority having Jurisdiction, installed to locations noted and for wall-metal deck locations consist of mineral wool and sealant in a labelled assembly.

PART 3 EXECUTION

3.1 Verification of Conditions

3.1.1 Examine condition of voids to be filled to ensure suitability for firestop systems.

3.1.2 Verify installation of service penetrations and adjacent construction has been completed.

3.2 Preparation

3.2.1 Prepare substrates and surfaces to a clean, dry, and frost free condition, ready to receive firestopping.

3.2.2 Prime all substrates and surfaces to manufacturer's recommendations.

3.2.3 Mask adjacent surfaces to prevent over-spray or fouling.

3.3 Installation

3.3.1 Provide certified firestopping systems meeting specified performance requirements wherever the continuity of a fire separation is interrupted by mechanical, electrical or other service penetrations, or by any building construction openings, gaps or discontinuities.

3.3.2 Install firestopping systems in strict conformance with tested systems.

3.3.3 In locations for which there are no applicable tested firestopping assemblies, install approved “manufacturer’s engineering judgement” assembly.

3.3.4 Where applicable, neatly tool or trowel firestopping surfaces remaining exposed and make flush with surrounding exposed surfaces.

3.3.5 Where two outlet boxes must be located on opposite sides of a fire rated partition within the same stud cavity apply firestop putty pad to back of each outlet box.

3.3.6 Seal the perimeter of all fire rated and non-rated fire partitions with labelled sealant where gypsum board, concrete block or other rated construction does not meet the structure to allow for movement, expansion and contraction. To the perimeter of all fire rated partitions, apply full depth of void, labelled, rated sealant.

3.3.7 Install smoke sealing systems to locations noted using approved assemblies.

END OF SECTION

SEALANTS

PART 1 GENERAL

1.1 Section Includes

1.1.1 Section includes, but is not limited to:

.1 Preparing sealant substrate surfaces.

.2 Placement of joint fillers, backing and sealants.

1.2 Related Sections

1.2.1	Unit Masonry:	Section 04200
1.2.2	Metal Flashing:	Section 07600
1.2.3	Hollow Metal Doors & Frames:	Section 08100

1.3 Reference Standards

1.3.1 Comply with the latest edition of the following statutes, codes and standards and all amendments thereto.

1.3.2 ASTM Standards:

.1 ASTM C603: Standard Test Method for Extrusion Rate and Application Life of elastomeric Sealants.

.2 ASTM C919: Standard Practice for Use of Sealants in Acoustical Applications.

.3 ASTM C920: Standard Specification for Elastomeric Joint Sealants.

.4 ASTM C1193: Standard Guide for Use of Joint Sealants.

.5 ASTM C1518: Standard Specification for Precured Elastomeric Silicone Joint Sealant.

1.3.3 CGSB Standards:

.1 CAN/CGSB-19.13: Sealing Compound, One Component, Elastomeric, Chemical Curing.

.2 CAN/CGSB-19.17: One Component, Acrylic Emulsion Base Sealing Compound.

.3 CAN/CGSB-19.24: Multi-Component, Chemical Curing Sealing Compound.

1.4 Qualifications

1.4.1 Perform Caulking using parties recognized for ability in the trade, having at least five (5) years proven satisfactory experience, to carry out the work and supervise skilled mechanics thoroughly trained and competent in the use of caulking and sealing materials using pressure operated equipment.

1.4.2 Perform Work in accordance with the sealant manufacturer's requirements for preparation of surfaces and materials installation instructions.

1.5 Submittals

1.5.1 Submit product data in accordance with Division 1.

1.5.2 Submit duplicate copies of manufacturer's product literature for each type of sealant material specified.

1.5.3 Submit a certified statement attesting that all areas and surfaces were satisfactorily prepared to receive sealants as per manufacturer's instructions and requirements.

1.6 Protection

1.6.1 If sealant can be damaged before it has cured sufficiently, provide adequate protection. If damaged, remove sealant and renew the application.

1.7 Delivery/Storage

1.7.1 Deliver all materials and store in original wrappings and containers with manufacturer's seals and labels intact, and as recommended by the manufacturer of the sealant.

1.7.2 Maintain containers and labels in undamaged condition.

1.8 Environmental Conditions

1.8.1 Do not work at temperatures greater or less than those recommended by the manufacturer.

1.8.2 Maintain air temperature range of 4°C to 27°C in areas to receive sealants, 24 hours before, during application, and until sealants have cured.

1.8.3 Should it become necessary to apply sealants at temperatures below or above this range, advise the Engineer and consult sealant manufacturer and follow the latter's recommendations.

1.8.4 Protect all work against damage and disfigurations and work of other trades against soiling and damage arising out of this work. Upon completion, replace and repair all defective work.

1.8.5 Examine substrate materials, joint voids, and note temperature/humidity conditions. Report unacceptable conditions to the Engineer.

1.8.6 Commencement of work implies acceptance of conditions.

1.9 Safety Requirements

1.9.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of material safety data sheets acceptable to Labour Canada and Alberta Occupational Health and Safety.

1.9.2 Ventilate area of work as using acceptable portable supply and exhaust fans.

1.10 Compatibility

1.10.1 Ensure that all materials used are compatible.

1.10.2 Declaration of Materials Compatibility: Submit written declaration stating that sealant materials are compatible with adjacent materials and substrates, and are acceptable to the sealant manufacturer. Include a list of materials, suppliers and manufacturers.

1.11 Guarantee

1.11.1 Provide a written guarantee endorsed and issued in the name of The City stating that all sealant and caulking work is guaranteed against leakage, cracking and deterioration, shrinkage, loss of cohesion, loss of adhesion, staining of adjacent surfaces, integral staining or failure to provide intended seal; for a period of five (5) years from date of Construction Completion Certificate and that any defects will be replaced including related materials and damage to the building due to sealant failure, at no cost to The City.

PART 2 PRODUCTS

2.1 General

2.1.1 Sealants: nationally recognized brands suitable for intended application, with acceptable low level emissions as follows:

.1 Total VOC concentration less than 250 g/L.

.2 Formaldehyde: must be less than 1 part per billion (1 PPB).

.3 4 Phenycyclohexane (4-PCH): must be less than 1 part per billion (1-PPB).

2.2 Materials

2.2.1 Note: all sealants to have matte finish; high gloss finish will not be acceptable.

2.2.2 Sealant Type 1: one component silicone sealant to CAN/CGSB-19.13-M87, type 2, Class 25, shore A hardness of 25 - 30, non sag, neutral curing, one of the following:

.1 Dow Corning 795.

.2 SCS2000 Silpruf as manufactured by GE.

.3 Spectrum 2 as manufactured by Tremco.

.4 Other preapproved product.

2.2.3 Sealant type 2 (horizontal joint sealant): multi component, chemical curing, self levelling, polyurethane sealant, conforming to CAN/CGSB-19.24-M90, type 1, Class B, and U.S Federal Specification TT-S-00227E, and ASTM C920, type M, Grade P, Class 25, One of the following:

.1 Tremco "THC-900".

.2 Sikaflex 2C/SL.

.3 Sonolastic SL, by BASF.

.4 Iso-flex 880 GB.

.5 Other preapproved product.

2.2.4 Sealant type 3: one component paintable silicone rubber sealant conforming to CAN/CGSB-19.13-M87, Dow Corning 499 or preapproved product.

2.2.5 Joint Cleaner: Non-corrosive solvent recommended by sealant manufacturer for applicable substrate materials.

2.2.6 Primer: Non-staining type recommended by sealant manufacturer.

2.2.7 Joint Filler: Round closed cell, non-staining, non-absorbent foam, extruded polyethylene shore hardness 20, tensile strength 138-207 KPa oversized 30-50%. For backup to large joints, cavities or voids, use fibreglass wool.

2.2.8 Bond Breaker: Pressure sensitive polyethylene or PVC tape, not bondable to sealant.

2.3 Colours

2.3.1 Colours: to match adjacent material, as selected by the Engineer.

PART 3 EXECUTION

3.1 Preparation

3.1.1 Surface Cleaning: Clean all surfaces required to be caulked, removing all loose particles, dust, oil, wax, protective coatings, mould release agents, and the like, using brush, solvents, or acid etching methods.

3.1.2 Primer Application: Prior to application of primer where required, test primers for possible yellowing, discolouration, and dirt pick-up when applied over face of porous substrates.

3.1.3 Following testing apply primers to joints following manufacturer's recommendations.

3.1.4 When tests indicate discolouration, dirt pick-up and the like on surfaces, take special precautions when applying, by masking surfaces not required to be primed.

3.1.5 Ensure that the sealant manufacturer's representative reviews site conditions, joint design and installers qualifications. Report unsatisfactory conditions to the Engineer. Ensure that sealants are compatible with adjoining materials.

3.1.6 Ensure that the sealant manufacturer's representative checks container labels, random inspect preparation of substrate materials and random test installed work.

3.2 Application - General

3.2.1 Use sealant Type 1 for exterior caulking except where indicated otherwise.

3.2.2 Apply substrate foam bead or backer rod to within 10 mm of face of joint.

3.2.3 Ensure all surfaces are clean. Caulk only when surface temperature is between 4°C and 26°C.

3.2.4 Apply sealant in accordance with manufacturer's instructions.

3.2.5 Use pressure gun fitted with suitable nozzle.

3.2.6 Ensure finished surfaces of sealant are smooth and free from ridges, wrinkles, or foreign matter.

3.2.7 Prime joints when recommended by manufacturer. Use a brush that will reach all parts of the joints.

3.2.8 Wire brush loose surfaces (such as masonry).

3.2.9 Caulk interior joints using sealant type 3, before final coat of paint is applied to adjacent work.

3.2.10 Ensure bead is solid, filling entire space between sides and bedding material, and exerting sufficient pressure on sides to obtain maximum bond, by allowing sealant to bulge out in advance of nozzle.

SEALANTS

3.3 Application of Sealants

3.3.1 Apply sealants in accordance with manufacturer's directions, using a pressure air gun with proper size nozzle. Use sufficient pressure to fill voids and joints solid. Superficial pointing with skin bead is not acceptable.

3.3.2 Apply sealant type 1 to exterior at joints between dissimilar materials, control joints, around exterior louvres, around exterior door and window installations,, to flashings and between flashings and adjacent materials, and to all other exterior joints to render areas of application weather tight. Caulk both inside and outside of perimeter of openings such as doors.

3.3.3 Do not apply sealant between metal flashing and an adjacent material on the top side, so as to prevent moisture drainage out of wall or window assembly.

3.3.4 Use Sealant type 3 to all other joints to interior such as between dissimilar materials around door frames and between drywall and concrete block. Apply sealant prior to painting or special coatings. Allow sealant to cure properly prior to paint application.

3.3.5 Apply traffic Grade sealant type 2 around openings and joints in floor slabs, including sawcuts, and where slabs abut foundation walls to provide a continuous watertight joint.

3.3.6 Apply sealant type 1 to all locations required to be bedded in caulking compound where not exposed to view, such as below thresholds, bedding where called for, in joints and elsewhere as required.

3.3.7 Joint Design: Fill all spaces that are deeper than width of joint, with approved backup material. Ensure that the backup material fills the joint out to a dimension that is equal to the width of the joint, but in no case less than half the width of the joint.

3.3.8 Sealant Application: Gun apply sealants through a nozzle opening of such shape and diameter that the full bead of sealant is gunned into the joint, filling the joint completely; to the approval of the Engineer.

3.3.9 A superficial or skin bead in joints will not be acceptable and is to be corrected to manufacturer’s recommended joint profile at no additional cost to The City.

3.3.10 Tool all beads immediately after application to ensure firm, full contact with the inner faces of the joint. Strike off excess material with tooling stick or knife.

3.3.11 Upon completion ensure caulking surfaces are smooth, even, free from ridges, wrinkles, air pockets, and embedded foreign matter.

3.3.12 Joint Finishes: Finish joints in flush surfaces; fill joints full in internal angles, except as otherwise detailed. Use wet tool as required. Avoid the use of face fillet (or angle bead) joints. Tool joints to match masonry. CONVEX JOINTS WILL BE REJECTED.

3.3.13 Where sharp, exact bead lines are desired, use masking tape. When taping, avoid touching cleaned and primed areas to which sealant is to be applied. Remove masking tape immediately after bead is placed and tooled, to avoid damage to developing surface skin.

3.3.14 Completely fill void with compound into which they are installed. Remove excess immediately following installation. Void depth to be 12 mm maximum and 6 mm minimum.

SEALANTS

3.4 Bond Breaker

3.4.1 Use foam bead as specified, to limit depth of sealant and to act as bond breaker at back of joint (adhesion is to be prevented at back of joint).

3.4.2 Where depth of joint does not permit the use of foam bead, apply tape to the back of the joint to act as bond breaker.

3.5 Cleaning

3.5.1 Promptly as work proceeds remove all excess material or smears from surfaces beyond joint or surface to be caulked, using solvents as recommended by the manufacturer's representative. If sealant or caulking has set up, employ mechanical removal.

3.5.2 During application, maintain areas of work in clean condition daily removing from the premises and site all rubbish and surplus material.

3.5.3 Clean immediately soiled non-porous materials.

3.5.4 On porous surfaces, remove any excess sealant as recommended by manufacturer.

END OF SECTION

HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 Section Includes

1.1.1 Section includes, but is not limited to:

.1 Hollow metal doors (steel).

.2 Hollow metal door and window frames (steel).

.3 Steel reinforcing within hollow metal frames.

1.2 Related Sections

1.2.1	Unit Masonry: including mortar fill to frames in masonry walls	Section 04200
1.2.2	Door Hardware:	Section 08700
1.2.3	Glazing:	Section 08800

1.3 Reference Standards

1.3.1 Comply with the latest edition of the following statutes, codes and standards and all amendments thereto.

1.3.2 American Society for Testing and Materials (ASTM International):

.1 ASTM A568/A568: Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold Rolled, General Requirements.

.2 ASTM A653/A653M: Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

1.3.3 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-1.181: Ready-Mixed Organic Zinc-Rich Coating.

1.3.4 Canadian Standards Association (CSA International):

.1 CAN/CSA-G40.20: General Requirements for Rolled or Welded Structural Quality Steel.

.2 CAN/CSA-G40.21: Structural Quality Steels.

.3 CSA W59-13: Welded Steel Construction (Metal Arc Welding) (Metric Version).

1.3.5 Canadian Steel Door Manufacturers' Association, (CSDMA):

.1 Recommended Dimensional Standards.

.2 Recommended Selection and Usage Guide - Section 08 11 00.

.3 CSDMA Recommended Specifications for Commercial Steel Door and Frame Products - Section 08 11 00.

.4 CSDMA Fire Labelling Guide.

1.3.6 Underwriters' Laboratories of Canada (ULC):

.1 CAN/ULC-S701: Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.4 Defining Opening Sizes

1.4.1 Width: measure widths of openings from inside to inside of frame jamb rabbets. (Referred to as "frame rabbet width" or "nominal door width").

1.4.2 Height: measure heights of openings from the finished floor (exclusive of floor coverings) to the head rabbet of the frame. (Referred to as "frame rabbet height" or "nominal door height").

1.4.3 Door Sizes: size doors so as to fit the above openings and allow a 3 mm nominal clearance at jambs and head of frame. Provide a clearance of 19 mm maximum between the bottom of the door and the finished floor (exclusive of floor coverings).

1.4.4 Tolerances: manufacture doors and frame product and install in accordance with the CSDMA's, "Recommended Dimensional Standards for Commercial Steel Doors and Frames".

1.5 Quality Assurance

1.5.1 Perform work of this Section using a company that specializes in the type of steel door and frame work required for this Project, with a minimum of five (5) years of documented successful experience using skilled workers thoroughly experienced in the necessary crafts.

1.5.2 Use manufacturer specializing in the manufacturing of the type of steel doors and frames specified in this Section, with a minimum of five (5) years of documented successful experience, and have the facilities capable of meeting all requirements of the Contract Documents as a single-source responsibility and warranty. The manufacturer must be a member in good standing of the Canadian Steel Door and Frame Manufacturer’s Association.

1.5.3 Use installers trained and approved by the door and frame manufacturer.

1.5.4 Obtain all steel doors and frames through one source from a single manufacturer.

1.5.5 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

1.5.6 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.5.7 Provide listing and labelling requirements for glazing materials in fire rated doors and frames, in accordance with NFPA 80.

1.5.8 Pre-installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

HOLLOW METAL DOORS AND FRAMES

1.6 Submittals

1.6.1 Submit shop drawings and product data in accordance with Division 1.

1.6.2 Fully describe and locate all items being furnished and include large scale details of principle construction features. Show dimensions in metric units.

1.6.3 Indicate each type of door, frame, steel, core and material thickness, mortises, glazed openings, reinforcements, anchorages, locations of exposed fasteners, and arrangement of hardware. Show the top edge fillers to exterior doors. Show reinforcement for hardware.

1.6.4 Indicate all door hardware mounting heights and locations. DO NOT PROCEED WITH PREPARATION OF DOORS FOR HARDWARE UNTIL HARDWARE MOUNTING HEIGHTS AND LOCATIONS HAVE BEEN CONFIRMED BY THE ENGINEER.

1.6.5 Maintain the numbering and identification system used on the drawings and schedules.

1.6.6 Provide coordination drawings of each opening, including door and frame drawing to scale and coordinating hardware:

.1 Indicate elevations of each door design type, showing dimensions, locations of door hardware, and preparations for power, signal, and electrified and pneumatic control systems.

.2 Fully cooperate with finish hardware supplier during preparation of shop drawings and execution of shop drawings.

1.6.7 Provide a 300 mm x 300 mm corner section of door representing the specified construction of the steel doors and frames to be used on this Project.

.1 Doors: indicate vertical edge, top and internal construction; and hinge and other door hardware reinforcement. Include glazing stops, with stops applied to show corner joint.

.2 Frames: indicate welded corner joint at head and jamb; and hinge mortise and reinforcement. Include glazing stops applied to show corner joint.

1.7 Coordination

1.7.1 Coordinate installation of anchorages for steel door and window frames.

1.7.2 Furnish setting drawings, templates and directions for installing anchorages, including sleeves, anchor bolts, and items with integral anchors, that are to be embedded in masonry.

1.7.3 Coordinate with hardware trade to ensure the proper preparation and fabrication of doors and frames. Coordinate where holes and grommets are required in framing system to accommodate cabling.

1.7.4 Deliver such items to Project site in time for installation.

1.8 Warranty

1.8.1 Provide manufacturer's standard Two (2) year warranty commencing upon the date of Construction Completion Certificate, against defects in material and workmanship.

PART 2 PRODUCTS

2.1 General

2.1.1 Use silicone/plastic shims to all exterior hollow metal frames.

2.2 Door Construction Option

2.2.1 All and only steel doors and frame products manufactured by the Canadian Steel Door and Frame Manufacturer's Association members are eligible for use on this project. Knock-down frames are not acceptable and will be rejected.

2.3 Hollow Metal Doors

2.3.1 Standard types with flush faces; of sizes indicated on Drawings and Schedules.

2.3.2 Face material: Commercial grade steel to ASTM A653/A653M, CS, Type B, hot dipped galvanized, ZF075 coating designation, commercially known as "Colourbond", "Satincoat", or "Galvanneal". For doors in exterior walls, use coating designation Z275 (fully galvanized).

2.3.3 Primers: rust inhibitive touch up only, as recommended by the door manufacturer.

2.3.4 Filler: metallic paste filler as recommended by the manufacturer.

2.4 Thickness of Materials

2.4.1

Component	Thickness in mm.
Frames	
- Standard Duty	1.6 mm
Doors	
- Honeycomb core construction:	
Face Sheets	1.2 mm
- Exterior doors:	
Face Sheets	1.6 mm
- Top and bottom Channels	
Interior Doors:	1.2 mm
Exterior Doors:	1.6 mm

2.4.2 All other components: in accordance with SDI, Specification for Commercial Steel Doors and Frames, Thickness of Steel for Component Parts, commercial grade steel to ASTM A653M, minimum base steel thickness to be in accordance with SDI - Thickness of Steel for Component Parts, unless specified otherwise.

2.5 Hollow Metal Door Components

2.5.1 Insulated Core Doors: minimum 1.6 mm (16 gauge) thick surface sheets and top and bottom end channels. Cores filled with polystyrene insulation material laminated under pressure to surface sheets.

2.5.2 Honeycomb Core Doors: minimum 1.2 mm (18 gauge) thick surface sheets. Cores filled with honeycomb material laminated under pressure to surface sheets.

2.5.3 Cores (Honeycomb): structural small cell (24.5 mm max.) kraft paper "honeycomb". Weight 36.3 kg per ream minimum density, 16.5 kg/m^3 minimum (1.03 pcf), sanded to the required thickness.

2.5.4 Cores (Polystyrene): Rigid extruded, fire retardant, closed cell board, density 16 to 32 kg/m^3, thermal value RSI 1.0 minimum.

2.5.5 Glass Stops: Anemostat “LoPro” or KNC “Steelite” or Shanahan’s Apex glass moulding metal vision frame, size to suit glass openings indicated on the drawings. For glazed exterior doors, ensure glass stops will accommodate sealed unit glazing, or use channel as specified for glazing to hollow metal doors and ensure channel is of sufficient width to accommodate sealed unit glazing.

2.5.6 Provide tight-fitting rigid PVC extruded flush closure caps conforming to CGSB 41-GP-19Ma, at top edge of exterior doors.

2.5.7 Door Reinforcement for Hardware:

.1 Locks: minimum 1.6 mm (16 gauge) thick steel.

.2 Butts:

.1 Top hinge: minimum 3.5 mm thick steel high frequency hinge bracket as manufactured by Shanahan's or preapproved product.

.2 All other hinges: minimum 2.7 mm thick steel, minimum 200 mm long.

.3 Door closers: minimum 2.5 mm (12 gauge) thick steel.

.4 Door holders: minimum 2.5 mm thick steel.

2.5.8 Adhesives: for honeycomb cores and steel components, use heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement. For polystyrene cores use heat resistant, epoxy resin based, low viscosity contact cement.

2.6 Hollow Metal Doors - Fabrication

2.6.1 Fabricate hollow metal doors in accordance with requirements of "Canadian Manufacturing Standards for Steel Doors and Frames" produced by the Canadian Steel Door and Frame Manufacturers' Association, and as indicated on drawings.

2.6.2 Fabricate swing type, flush steel doors with glazed openings as indicated on the door schedule on the Drawings.

2.6.3 Door thickness: 45 mm unless indicated otherwise.

2.6.4 For interior doors, fully weld longitudinal edges. Weld, fill and sand and grind seams and edges flush and smooth. Fully weld top and bottom edges.

2.6.5 For doors in exterior walls, stitch weld longitudinal edges using tack welds at 150 mm oc. Weld, fill and sand and grind seams and edges flush and smooth. Factory caulk edges between stitch welds.

2.6.6 Shop prime face and backside of all welds where accessible.

2.6.7 Ensure spot welding does not leave marks on exposed faces. Fill spot weld marks on door faces with filler as specified. Sand smooth, leaving spot weld marks invisible and producing a uniform surface. Doors with spot weld marks on exposed faces will be rejected.

2.6.8 Reinforce and prepare doors to receive hardware. Blank, reinforce, drill and tap for mortise, templated hardware.

2.6.9 Cut out areas to receive glass as indicated. Install glazing stops in accordance with manufacturers' directions to provide a tamperproof installation. Fixed stops to be on secure side of door. Coordinate glazing with Section 08800.

2.6.10 Factory prepare holes 12.7 mm diameter and larger, except mounting and through-bolt holes, prepared at site at time of hardware installation. Factory prepare holes less than 12.7 mm diameter only when required for function of the device (for knob, lever, cylinder, thumb or turn pieces) or when these holes overlap function holes.

2.6.11 If doors with surface depressions are accepted, fill with metallic paste filler and sand to a smooth uniform finish and to render patched areas undetectable after painting.

2.6.12 Touch up areas where galvanized coating has been removed due to sanding or handling. Use zinc chromate primer CAN/CGSB-1.132-M90.

2.6.13 Install conduit in doors as required for electronic hardware such as electric hinges and strikes. Conduit to be of type and sizes as recommended by the electronic hardware supplier. Coordinate conduit locations with hardware locations.

2.7 Honeycomb and Insulated Core Construction

2.7.1 Form each face of exterior doors from a sheet of 1.6 mm thick steel with polystyrene core laminated under pressure to face sheets.

2.7.2 Form each face sheet of interior doors from a sheet of 1.2 mm thick steel with honeycomb core laminated under pressure to face sheets.

2.8 Hollow Metal Door Frames

2.8.1 Type: Standard types with welded corners.

2.8.2 Size: as shown on Drawings/Schedule. Where indicated, throat size to suit wall construction for wrap around frames in stud walls.

HOLLOW METAL DOORS AND FRAMES

2.8.3 Material: Commercial grade steel to ASTM A653/A653M, CS, Type B, hot dipped galvanized, ZF075 coating designation, commercially known as "Colourbond", "Satincoat", or "Galvanneal". For frames in exterior walls, use coating designation Z275 (fully galvanized).

2.9 Frame Components

2.9.1 Frames: minimum 1.6 mm (16 gauge) thick.

2.9.2 Glass Stops: minimum 0.9 mm thick; channel shaped; 16 mm high profile; flush screw applied. For exterior frames, ensure glass stops will accommodate sealed unit glazing.

2.9.3 Floor Anchors, channel spreaders and wall anchors. Sheet steel to the following minimum core thicknesses:

.1	Jamb floor anchors	1.6 mm
.2	Jamb spreaders	0.9 mm
.3	Masonry strap type	1.2 mm
.4	Wire type anchors	NOT ACCEPTABLE

.5 Use ULC approved types for labelled frames.

2.9.4 Jamb Anchors: manufacturer's standard type recommended for applicable installation; of suitable design and capable of securely and rigidly anchoring frames in place.

2.9.5 Mortar Guard Boxes: minimum 0.8 mm thick; welded in place. Note: provide to all door frames, including in masonry and steel stud applications.

2.9.6 Reinforcement for Hardware: steel to the following minimum thickness:

.1 Strikes: minimum 1.5 mm thick steel.

.2 Butts:

.1 Top hinge: minimum 3.5 mm thick steel high frequency hinge bracket assembly as manufactured by Shanahan's or preapproved product.

.2 All other hinges: minimum 2.7 mm thick steel, minimum 200 mm long.

.3 Door closers: minimum 2.5 mm thick steel.

.4 Door holders: minimum 2.5 mm thick steel.

2.9.7 Door Bumpers: manufacturer's standard resilient single stud rubber/neoprene type; removable for replacement. Mask bumpers for painting.

2.9.8 Thermally broken frames: hollow metal frames incorporating thermal spline consisting of rigid PVC extrusion conforming to CGSB 41-GP-19Ma, eliminating through-metal contact. Frames must meet or exceed CAN/CGSB-82.5-M88 standards.

HOLLOW METAL DOORS AND FRAMES

2.10 Fabrication/Frames

2.10.1 Fabricate hollow metal frames in accordance with requirements of "Canadian Manufacturing Standards for Steel Doors and Frames" produced by the Canadian Steel Door and Frames Manufacturer's Association and as indicated on drawings.

2.10.2 Fabricate fire rated hollow metal door frames in accordance with the label authority requirements. Place metal labels where visible when installed, rivetted to frames; stick on labels are not acceptable. Refer to door schedule for fire-rating requirements.

2.10.3 Fabricate exterior frames of 1.6 mm base thickness steel welded type construction thermally broken except where fire rated exterior frames occur. Fabricate interior frames and exterior fire rated frames of 1.6 mm base thickness steel welded type construction.

2.10.4 Accurately mitre or mechanically joint frames and securely welded on the inside of the profile. Grind welded corners to a flat plane, grind all welds to a smooth, uniform finish. Fill any exposed gaps with metallic paste filler and sand to a smooth uniform finish.

2.10.5 All welding must conform to CSA W59.

2.10.6 Reinforce frames wider than 1200 mm with 2.5 mm thick formed steel channels welded in place, flush with top of frames.

2.10.7 Blank, reinforce, drill and tap for mortised, templated hardware.

2.10.8 Protect mortised cutouts with steel guard boxes.

2.10.9 Reinforce and prepare door frames to receive hardware. Provide junction box where electric hinge is required. In mortar-filled frames, adhere a piece of spruce wood 12 mm thick to the closer reinforcement to facilitate tapping of screw holes.

2.10.10 Provide for appropriate anchorage to floor and wall construction. Securely attach to jambs. Locate each wall anchor immediately above or below each hinge reinforcement on the hinge jamb and directly opposite on the strike jamb. For rebate opening heights up to 1520 mm provide two (2) anchors and an additional anchor for each additional 760 mm of height or fraction thereof.

2.10.11 Securely attach floor anchors to the inside of each jamb profile.

2.10.12 Place minimum of 3 bumpers on single door frames. Space equally along strike jambs.

2.10.13 Place minimum of 2 bumpers on double door frames. Place on frame heads.

2.10.14 When frames with surface depressions or holes are accepted by the Engineer, fill with metallic paste filler and grind to a smooth finish.

2.10.15 Weld in two (2) temporary jamb spreaders per frame to maintain proper alignment during shipping and installing.

2.10.16 Touch up areas where galvanized coating has been removed due to sanding or handling, inside and outside of frames, whether exposed or not. Use primer as noted for doors.

2.11 Hollow Metal Window Frames

2.11.1 Fabricate hollow metal window frames to profiles indicated, as for door frames. Provide screwed glass stops. Use tamper proof screws.

2.11.2 Provide thermally broken frames to all exterior window frames.

2.11.3 Accurately cope and securely weld butt joints of mullions and sills.

PART 3 EXECUTION

3.1 Site Storage and Protection

3.1.1 Thoroughly inspect all materials upon receipt and immediately report in writing to the supplier all discrepancies, deficiencies and damages.

3.1.2 Note on the carrier's bill of lading all damage incurred during shipment and report immediately to the supplier in writing.

3.1.3 Properly store materials on planks, out of water and completely covered to protect from damage and weather.

3.1.4 Remove wrappings or coverings from doors upon receipt at site. Properly store doors in vertical position spaced by blocking to permit air circulation.

3.1.5 Store frames vertically in a dry location, off ground and prevent damage and weathering.

3.2 Installation/Frames

3.2.1 Set frames as indicated, rigid, plumb, square, true to line and level and at proper elevation and place without distortion.

3.2.2 In masonry walls, limit of acceptable frame distortion 1.5 mm of plumb measured on face of frame. Maximum twist corner to corner 3.0 mm.

3.2.3 Brace solidly in position while being built in. Remove temporary steel shipping jamb spreaders. Grind frame smooth where metal spreader was removed. Install wood spreaders at third points of frame rebate height to maintain width until adjacent wall work is completed. Remove wood spreaders after frames have been built in.

3.2.4 Locate and anchor frames in alignment with other work.

3.2.5 Install anchors at 750 mm o.c. maximum in walls, unless noted otherwise.

3.2.6 Securely anchor frames to retain position and clearance during construction of walls or partitions.

3.2.7 Install mortar in hollow metal frames to interior masonry walls.

3.2.8 Provide vertical support at centre for head to frames over 1200 mm wide.

3.2.9 Fill exterior frames with foam-in-place insulation as specified in Section 07214. Coordinate with installation of air/vapour barrier specified in Section 07270. After foam-in-place insulation has been installed and cured, apply sealant specified in Section 07900, around entire perimeter of door frames, between frames and adjacent construction.

3.2.10 Make allowance for deflection to ensure structural loads are not transmitted to frames.

3.2.11 Where field jointing, use countersunk metal screws. Joints to be filled and ground smooth.

3.2.12 Drill and tap for surface applied hardware.

3.2.13 Remove all hardware before painting commences and replace upon completion of painting or original condition without damage to adjacent finished surfaces. All hardware is to be removed and reinstalled by the original hardware installer, who will store hardware until required for reinstallation.

3.2.14 Coordinate the installation of glazing with Section 08800.

3.3 Installation/Doors

3.3.1 Install doors and hardware in accordance with templates and hardware manufacturer's instructions. Install square into openings, with correct edge spaces. Refer to Section 08700 for hardware installation requirements.

3.3.2 Provide even margins between doors and jambs and doors and flooring and thresholds as follows:

.1 Hinge side: 3 mm.

.2 Latch side and head: 3 mm.

.3 Flooring: maximum 19 mm.

3.3.3 Coordinate the installation of glazing with Section 08800.

3.3.4 Adjust operable parts for correct function.

3.4 Adjust and Clean

3.4.1 Remove rust, sand abrasive areas and apply touch-up factory primer prior to application of field applied finish coat. Touch up galvanized surfaces with zinc-rich primer prior to application of finish paint.

3.4.2 Clean, sand, fill and apply touch up primer on exposed surfaces where zinc coating or factory applied primer has been damaged during handling or installation.

3.4.3 Clean all door frames after installation, removing all foreign matter.

HOLLOW METAL DOORS AND FRAMES

END OF SECTION

DOOR HARDWARE

PART 1 GENERAL

1.1 Section Includes

1.1.1 Section includes, but is not limited to:

.1 Door hardware: including butts, locks, handles, closers, door stops, electric strikes, kickplates, push plates, and panic hardware.

.2 Weatherstripping.

.3 Thresholds.

.4 Door security accessories.

1.2 Related Sections

1.2.1 Hollow Metal Doors and Frames: Section 08100

1.3 Quality Control

1.3.1 Supplier: A recognized builders Hardware Supplier who has been furnishing hardware in the project's vicinity for a period of not less than five (5) years, and who is or has in employment an Architectural Hardware Consultant (AHC) who holds a current certification seal of the Door and Hardware Institute. Submit all documents bearing the seal of the hardware consultant. Ensure the hardware consultant is available for on site consultation as required. Ensure that the supplier has adequate equipment, maintenance and advisory facilities in order to serve and keep pace with contract obligations and responsibilities.

1.4 References

1.4.1 Comply with the latest edition of the following statutes, codes and standards and all amendments thereto.

1.4.2 ANSI / BHMA:

.1 ANSI/BHMA A156.1 - Butts and Hinges.

.2 ANSI/BHMA A156.2 - Bored and Preassembled Latches.

.3 ANSI/BHMA A156.3 - Exit Devices.

.4 ANSI/BHMA A156.4 - Door Controls - Closers.

.5 ANSI/BHMA A156.5 - Auxiliary Locks.

.6 ANSI/BHMA A156.6 - Architectural Door Trim.

.7 ANSI/BHMA A156.7 - Template Hinge Dimensions.

.8 ANSI/BHMA A156.8 - Door controls - Overhead Holders.

.9 ANSI/BHMA A156.13 - Mortise Locks and Latches.

.10 ANSI/BHMA A156.15 - Closer/Holder/Release Devices.

.11 ANSI/BHMA A156.16 - Auxiliary Hardware.

.12 ANSI/BHMA A156.18 - Materials and Finishes.

.13 ANSI/BHMA A156.21 - Thresholds.

.14 ANSI/BHMA A156.22 - Door Gasketing Systems.

.15 ANSI/BMHA A156.23 - Electromagnetic Locks.

.16 ANSI/BHMA A156.25 - Electrified Locking Devices.

.17 ANSI/BHMA A156.28 - Master Keying Systems.

.18 ANSI/BHMA A156.29 - Exit Locks, Exit Locks with Exit Alarms, Exit Alarms, Alarms for Exit Devices.

.19 ANSI/BHMA A156.30 - High Security Cylinders.

.20 ANSI/BHMA A156.31 - Electric Strikes and Frame Mounted Actuators.

.21 ANSI/NFPA 101 - Life Safety Code.

.22 ANSI/NFPA 105 - Smoke and Draft Control Door Assemblies.

.23 Recommended Locations for Architectural Hardware - Standard Steel Door & Frames.

.24 Door & Hardware Institute Sequence Format for Hardware Schedule -.

1.5 Submittals

1.5.1 Submit hardware schedule in accordance with Division 1, in vertical format prepared in accordance with Door & Hardware Institute Sequence and format - (current edition) recommendations.

1.5.2 Coordinate reviewed shop drawings from affected trades, as soon as possible after award of hardware contract.

1.5.3 Submit template information to all manufacturers who have door hardware applied to their products.

1.5.4 Prepare and submit a complete detailed hardware schedule. Provide one (1) electronic copy in PDF format and two (2) hard copies. Incorporate addenda items and any Engineer accepted changes into detailed hardware list.

1.5.5 Schedule and detail each floor separately. On doors of different sizes or where hinges, closers, or locks are different, use a separate heading. Do not combine labelled openings with non-labelled openings.

1.5.6 Clearly indicate hardware proposed, including make, model, material, function, finish, quantities and location in project, and all other pertinent information.

1.5.7 Provide manufacturer's printed literature for each piece of hardware listed in the hardware schedule, with technical information and a picture of each item.

1.5.8 If requested, supply a sample of each hardware item as required, to be retained by Engineer for comparison with hardware furnished. Replace any deviation from hardware schedule with scheduled hardware. The Engineer will deliver the accepted samples to the project site to be stored. Samples will remain there until delivery of hardware to the project site is complete, when they will be incorporated in the work.

1.5.9 Mark samples plainly giving hardware number used in the hardware list, the manufacturer's name, numbers, types and sizes.

1.5.10 Furnish confirmation of hardware compliance to ANSI/NFPA80, ANSI/NFPA101 and the National Building Code - Alberta Edition by the supplier prior to installation.

1.5.11 Furnish three (3) copies of a keying schedule and bitting list in accordance with Part 2 of this Section.

1.5.12 After installation, turn over to The City, one (1) copy of representative templates, instruction sheets, hardware schedule, and keying schedule for permanent record.

1.5.13 Submit shop drawings of each type of door indicating mounting heights and locations of each piece of hardware. DO NOT PREPARE DOORS TO RECEIVE HARDWARE UNTIL MOUNTING HEIGHTS AND HARDWARE LOCATIONS HAVE BEEN CONFIRMED BY THE ENGINEER.

1.6 Delivery

1.6.1 Co-ordinate the delivery of hardware so as to avoid any delay in the work.

1.6.2 Deliver and store hardware material in original undamaged containers with manufacturer's labels and seals intact, except permanent cylinder and keys.

1.6.3 Neatly package hardware items in substantial and secure boxes, properly labelled and readily identifiable for individual locations and use.

1.6.4 Include all items of securement and fastening, such as screws, bolts, nuts, brackets, and the like. Use Phillips head type screws except where specifically required otherwise.

1.6.5 Protect knobs, handles, push plates and pulls with adhesive release paper of type easily removable without marring finish. Do not remove protective coating until completion of project.

1.6.6 Mark cylinders for all locks with specific door number as per door schedule.

1.6.7 Packaging to include the following with each item of hardware:

.1 Screws, bolts and fastenings necessary for installation.

.2 Installation instructions.

.3 Special tools required for installation.

.4 Keying for locksets tagged and plainly marked with change number, door designation and all other identifying information as required, mounted on key board.

1.7 Storage

1.7.1 Provide one specific room for storing hardware as received. Provide the room with adequate security.

1.7.2 Store in a clean dry room with lockable man door and adequate shelving to permit organization so item numbers are readily visible. Maintain ambient room temperature between 0°C and 50°C.

1.8 Coordination

1.8.1 Before furnishing any hardware, check all drawings and specifications for hardware requirements, verifying door swings, check all shop drawings with frame and door lists and advise Engineer in writing of discrepancies noted.

1.8.2 Deliver templates required for shop fabrication to fabricator of hollow metal doors and frames in ample time so as not to impede the progress of the work.

1.8.3 Ensure early delivery of all hardware required.

1.9 Maintenance

1.9.1 Provide the following for The City's maintenance staff:

.1 One set wrenches for door closers and locksets. The hardware installer must turn over all wrenches and installation instructions to the Construction Manager, who, in turn will turn such wrenches and instructions to The City upon completion.

.2 Manufacturer's installation instructions for door closers and locksets.

.3 Manufacturer's instructions in regard to proper care of hardware including lubrication of locksets.

1.9.2 Brief the building maintenance staff regarding the proper care of hardware such as lubrication of locksets, adjustments of door closers, cleaning and general maintenance.

1.9.3 Provide maintenance data for each piece of hardware, for incorporation into the maintenance manuals specified in Division 1.

1.10 Warranty

1.10.1 Provide a ten (10) year warranty period for door closers and a three (3) year warranty period for panic devices. Provide copies of manufacturer's warranties for door closers and panic devices.

1.10.2 All warranties to commence upon the date of Construction Completion Certificate.

1.11 Delivery of Master Keys

1.11.1 Deliver keys by hand to The City.

1.11.2 Send the masterkeys directly to The City's representative by registered mail.

PART 2 PRODUCTS

2.1 Product Selection

2.1.1 Basis-of-Design: Materials and colours listed in drawings form the Basis-of-Design materials for this project. Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

2.1.2 Materials and products supplied by subcontractor shall match the approved samples, in all aspects, including but not limited to form, texture, size, shape, aesthetics, performance and technical specification.

2.1.3 Basis of Design: As indicated on Drawings.

2.2 Materials

2.2.1 Provide materials and finishes as specified in the Hardware Schedule indicated on the drawings. The schedule uses manufacturer's product reference numbers. Base bids on the specified material unless Engineer's acceptance is obtained prior to bid closing.

DOOR HARDWARE

2.2.2 Supply all products in a given category, from the same manufacturer.

2.3 Keying and Keys

2.3.1 Furnish all locksets with two (2) cut keys. Factory masterkey and construction masterkey all cylinders. Furnish ten (10) construction masterkeys to Construction Manager. Furnish six (6) masterkeys for each group and three (3) grand master keys.

2.3.2 Consult with the Engineer and The City and secure written acceptance of complete keying layout prior to placing lock order.

2.3.3 Stamp all keys "DO NOT COPY".

2.3.4 Identify permanent keys with tags.

2.4 Materials and Finishes

2.4.1 Provide materials and finishes as listed in hardware schedule at the end of this Section.

2.5 Fasteners

2.5.1 Where pull scheduled on one side of door and push plate on opposite side, supply fastening devices and install so pull can be secured through door from reverse side.

2.5.2 Provide ferrous or non-ferrous fasteners matching the product being supplied.

2.6 Packaging, Templates and Quantities

2.6.1 Package hardware with all necessary screws and fittings, and clearly label as to intended location and use.

2.6.2 Furnish templates and all necessary information for the proper installation of the hardware to metal doors and frames.

.1 General Notes

2.6.3 Co-ordinate electric hold-open closers with Electrical Contractor.

2.6.4 Where butt hinges are required to swing 180 degrees, furnish butts of sufficient throw to clear trim as required.

2.6.5 Construction and master key cylinders to building system.

2.6.6 Fasten all kickplates with flush flat headed stainless steel screws. All kick plates to have bevelled edges.

2.6.7 Provide nickel-silver keys.

2.7 Access Control handles:

2.7.1 Concealed Panic Handles: Panic device shall be 1-1/4” (32 mm) diameter

2.7.2 CRL-Blumcraft PA100 or PA110 with interior operating panic handle in combination with exterior fixed pull handles designated by letters. Panic mechanism shall be concealed within the brass or stainless-steel tubing and the security latch bolt is retracted by pushing the interior ‘L’ shaped crash bar. Entrance from exterior by a keyed cylinder. Dogging shall be standard and conveniently located with a built-in dogging pin that keeps the security latch bolt in the retracted position and the crash bar fixed.

2.7.3 Vertical Rod Device: Panic device shall be ultra-narrow crash bar.

.1 CRL-Blumcraft PA300 Series with interior operating ultra-narrow crash bar that securely attaches to a vertical 1-1/4” diameter handle in combination with exterior fixed pull handles designated by letters. Panic mechanism shall be concealed within the stainless-steel tubing and ultra-narrow crash bar. The security latch bolt is retracted by pushing the ultra-narrow crash bar. Entrance from exterior by keyed cylinder. Dogging shall be standard and conveniently located with a built-in dogging pin that keeps the security latch bolt in the retracted position and the crash bar fixed.

2.7.4 California 5lb Panic Handles: Panic device shall be 1-1/4” (32 mm) diameter

.1 CRL-Blumcraft PAC100 Series with interior operating panic handle in combination with exterior fixed pull handles designated by letters. Panic mechanism shall be concealed within the brass or stainless-steel tubing and the security latch bolt is retracted by pushing the interior ‘L’ shaped crash bar. Entrance from exterior by a keyed cylinder. Dogging shall be standard and conveniently located with a built-in dogging pin that keeps the security latch bolt in the retracted position and the crash bar fixed.

.2 Shall meet the following: CBC 11B-404.2.7 and ADA 404.2.7

2.7.5 Balance Door Panic Handles: Panic device shall be 1-1/4” (32 mm) diameter

.1 CRL-Blumcraft BP100 Series with interior operating panic handle in combination with exterior fixed pull handles designated by letters. Panic mechanism shall be concealed within the brass or stainless-steel tubing and the security latch bolt is retracted by pushing the interior ‘L’ shaped crash bar. Entrance from exterior by a keyed cylinder.

.2 Dogging shall be standard and conveniently located with a built-in dogging pin that keeps the security latch bolt in the retracted position and the crash bar fixed.

.3 Meets building code requirements for Balance Doors when code states that the push pad shall not extend more than one-half the width of the door.

2.7.6 Designer Panic Handles: Panic device shall be 1-1/4” D-Shaped

.1 CRL-Blumcraft DP100 Series with interior operating panic handle in combination with exterior fixed pull handles designated by letters. Panic mechanism shall be concealed within the brass or stainless-steel tubing and the security latch bolt is retracted by pushing the interior ‘L’ shaped crash bar. Entrance from exterior by a keyed cylinder.

.2 Dogging shall be standard and conveniently located with a built-in dogging pin that keeps the security latch bolt in the retracted position and the crash bar fixed.

2.7.7 CRL 316 Matte Black 2-3/8" x 1" Point Supported Standoff Base and Domed Cap.

.1 Finish/Color: Matte Black

.2 Material 316 Stainless Steel

.3 Width 2 in. (51 mm)

PART 3 EXECUTION

3.1 Inspection

DOOR HARDWARE

3.1.1 Verify that frames have been installed plumb and within tolerances as set out in DHI Document "Installation of Commercial Steel Doors and Steel Frames".

3.1.2 Examine doors and frames, with installer present, for compliance with requirements for installation tolerances, labelled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

3.1.3 Do not proceed with installation in areas of discrepancy until all discrepancies have been fully resolved in writing.

3.1.4 Verify that rough-in for power, wiring conduit and boxes for any electrical hardware are provided and properly in place to receive hardware. Verify actual locations of wiring connections before electrified door hardware installation.

3.1.5 Test electronic door closer products in conjunction with fire alarm test to ensure correct operation.

3.1.6 Verify all hardware, check all shop drawings with frame and door list for proper sizing.

3.1.7 Prior to installation, ensure that doors and frames are properly prepared and reinforced to received finish hardware. Ensure doors are properly matched to frames for which they are scheduled.

3.1.8 Ensure cutouts in frames, or other built-in assembles to receive hardware are clean and free of mortar, concrete, plaster, or other foreign material.

3.1.9 Ensure that door frames and finished floor are sufficiently plumb, and level to permit proper engagement and operation of hardware.

3.1.10 Preparation:

.1 Steel Doors and Frames: Comply with DHI A115 series.

3.1.11 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Installation

3.2.1 Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required in accordance with governing regulations:

.1 Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."

3.2.2 Coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way.

3.2.3 Install, fit, adjust, and clean each item of hardware to manufacturer's directions. Install and adjust hardware to operate freely. Protect from damage.

3.2.4 Ensure all locksets, latchsets and deadlocks are of the correct hand before installation to ensure that the cylinder is in the correct position.

3.2.5 Ensure all exit devices are of the correct hand and the device cam adjusted for proper outside trim function prior to installation.

3.2.6 Do not install surface mounted items until finishes have been completed on substrates involved, and as follows:

.1 Set units level, plumb, and true to line and location.

.2 Adjust and reinforce attachment substrates as necessary for proper installation and operation.

.3 Drill and countersink units that are not factory prepared for anchorage fasteners.

.4 Space fasteners and anchors according to industry standards.

3.2.7 Install hardware using proper fasteners for materials encountered.

3.2.8 Install hardware using carpenters skilled in the application of commercial grade hardware.

3.2.9 Co-ordinate requirements for power and alarm wiring to hold open/release devices with the electrical Subcontractor. Confirm and coordinate all electrical hardware with access Control Systems supplier.

3.2.10 Install hardware to degree of opening as listed in the hardware schedule.

3.2.11 Key Control System: Place keys on markers and hooks in key control system cabinet, as determined by final keying schedule.

3.2.12 Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings, or in equipment room; verify location with Engineer, and as follows:

.1 Configuration: Provide one power supply for each door opening.

3.2.13 Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant in accordance with requirements specified in Section 07900 - Sealants.

3.3 Inspection of Installation

3.3.1 After installation, have the hardware supplier inspect the hardware and certify in writing to Construction Manager (copy to the Engineer) whether or not all hardware items are in accordance with specification requirements, all pertinent codes and regulations, and are installed and functioning properly.

3.4 Adjusting

3.4.1 Ensure key cylinders are properly installed in correct locations in accordance with approved keying schedule and that keys work properly.

3.4.2 Ensure all screws are fully set, secure and flush.

3.4.3 Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and in accordance with referenced accessibility requirements:

.1 Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.

.2 Door Closers: Adjust sweep period so that, from an open position of 70_, the door will take at least 3 seconds to move to a point 76 mm (3”) from the latch, measured to the leading edge of the door.

.3 Key Cylinders: Ensure cylinders are properly installed in correct locations in accordance with approved keying schedule and that keys work correctly.

3.4.4 Six Month Adjustment: Approximately six months after date of Construction Completion Certificate, perform the following:

.1 Examine and readjust each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.

.2 Consult with and instruct The City's personnel on recommended maintenance procedures.

.3 Replace door hardware items that have deteriorated or failed due to faulty design, materials, or installation of door hardware units.

3.5 Cleaning And Protection

3.5.1 Clean adjacent surfaces soiled by door hardware installation.

3.5.2 Clean operating items as necessary to restore proper function and finish.

3.5.3 Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Construction Completion Certificate.

3.6 Hardware Schedule

3.6.1 Refer to Drawings.

END OF SECTION

PART 1 GENERAL

1.1 Section Includes

1.1.1 Section includes, but is not limited to:

.1 Fixed, extruded aluminum louvres with insect screens.

1.2 Reference Standards

1.2.1 Comply with the latest edition of the following statutes, codes and standards and all amendments thereto.

1.2.2 Air Movement and Control Association (AMCA):

.1 AMCA 500-L, Laboratory methods of Testing Louvres for Rating

.2 AMCA 501, Application Manual for Air Louvres

1.2.3 NAAMM's "Metal Finishes Manual for Architectural and Metal Products"

1.2.4 SMACNA's "Architectural Sheet Metal Manual"

1.3 Submittals

1.3.1 Submit shop drawings and product data in accordance with Division 1.

1.3.2 Product Data: Submit for Consultant's action. Furnish manufacturer's literature, specifications and installation instructions describing the general properties of each material and accessory to be used in the Work.

.1 Furnish technical data describing the quality and performance of each material component or system to be used in the Work, e.g., the louver air performance and water penetration ratings or other such primary characteristics as required by the Drawings or Specifications.

1.3.3 Shop Drawings: Submit for Consultant's action. Furnish shop drawings for the fabrication and installation of the Work. Prepare details at not less than 1:5 minimum scale. Show typical details of the conditions for every member, joint, anchorage and support in the system.

1.3.4 Closeout Submittals: Submit for Owner's documentation.

1.4 Quality Assurance

1.4.1 Contractor's Quality Control Responsibilities: Contractor is solely responsible for quality control of the Work.

1.4.2 Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances and regulations of National, Provincial and Municipal authorities having jurisdiction. Obtain necessary approvals from all such authorities.

1.4.3 Obtain louvres and vents from a single source and manufacturer they are of same type, design, or factory applied colour finish.

1.4.4 Perform welding for structural quality joins using procedures and personnel having certifications specific to the work of this Section in accordance with CSA W47.2 and W59.2.

1.4.5 Construct flashings in accordance with recommendations in SMACNA Architectural Sheet Metal Manual for fabrication, construction details, and installation procedures.

1.4.6 Follow NAAMM's recommendations for applying and designating finishes; finish louvres after assembly.

1.5 Project / Site Conditions

1.5.1 Field Measurements: Verify dimensions of supporting structure at the project site by accurate field measurements so that louvers are accurately designed, fabricated and fitted to the structure. Tolerances for supporting structure are specified in other Sections. Notify Contractor in writing, of any dimensions found to be different than shown, including specified tolerances. Use Contractor’s bench marks as basis of measurements.

1.6 Warranty

1.6.1 Factory Finish Warranty: Submit for the City’s documentation. Furnish manufacturer’s 5 year written warranty, warranting that the factory−applied finishes will not develop excessive fading or excessive non−uniformity of colour or shade, and will not crack, peel, pit, corrode, or otherwise fail as a result of defects in materials or workmanship within the following defined limits. Upon notification of such defects, within the warranty period, make necessary repairs or replacement at the convenience of the City.

.1 “Excessive Fading”: A change in appearance which is perceptible and objectionable as determined by the Consultant when visually compared with the original color range standards.

.2 “Excessive Non−Uniformity”: Non−uniform fading during the warranty period to the extent that adjacent panels have a colour difference greater than the original acceptable range of color.

.3 “Will Not Pit or Otherwise Corrode”: No pitting or other type of corrosion, discernible from a distance of 3000mm, resulting from the natural elements in the atmosphere at the project site.

PART 2 PRODUCTS

2.1 Materials

2.1.1 Basis-of-Design: Construction Specialties Group RS-7315.

2.1.2 Heads, sills, jambs and mullions to be one-piece structural aluminum members with integral caulking slot and retaining beads. Architectural Line Drainable Sightproof Storm Resistant Fixed-Blade designed to collect and drain water to exterior at sill by means of multiple gutters in blades and channels in jambs and mullions Louvers: supplied with 101.6mm high by full depth sill flashings formed from minimum 1.27mm thick aluminum. Sill flashings to have welded side panels.

2.1.3 AMCA Performance: 1220mm x 1220mm unit shall conform to the following:

.1 Free Area: 0.75 sq.m.

.2 Intake Pressure drop at 900 fpm free area velocity (274 m/min): 7.93 mm in H2O

.3 Exhaust pressure drop at 900 fpm area velocity (274 m/min): 10 mm in H2O.

2.1.4 Wind Driven Rain Performance: AMCA certified and licensed to bear the AMCA seal. The louver test was based on a 1.00m x 1.00 m core area. Unit tested at a rainfall rate of 75mm/hr and with a wind directed to the face of the louver at a velocity 13 m/s. The test data shall show the water penetration effectiveness rating at each corresponding ventilation rate.

Core Ventilation Rate (m/s):	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5
Core Ventilation Rate (ft/min):	0	132	196	283	375	468	587	673
Free Area Velocity (ft/min):	0	264	392	567	751	937	1175	1347
Rating Effectiveness:	A	A	A	A	B	C	D	D
Effectiveness Ratio (%):			100	99.8	97	92.1	72.9	57.4
Effectiveness Rating:	A = 1 to 0.99		B = 0.989 to 0.95		C = 0.949 to 0.80		D = 0.80 to 0	

2.2 Fabrication

2.2.1 Assemble louvres in factory to minimize field splicing and assembly.

2.2.2 Disassemble units as necessary for shipping and handling limitations.

2.2.3 Clearly mark units for reassembly and coordinated installation.

2.2.4 Fabricate vertical assemblies to permit field bolted assembly with close fitting, reinforced joints in jambs and mullions where height of louvre units exceeds fabrication and handling limitations, and as follows:

.1 Continuous Vertical Assemblies: Fabricate units without interrupting blade spacing pattern unless horizontal mullions are indicated.

1.1.1 Maintain equal louvre blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

1.1.2 Fabricate frames; including integral sills, to fit in openings with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

1.1.3 Include supports, anchorages, and accessories required for complete assembly.

1.1.4 Provide vertical mullions of type and at spacing indicated, but not more than recommended by manufacturer, 1800 mm o/c, whichever is less, and as follows:

.2 Exposed Mullions:

1.1.5 Provide units with exposed mullions of same width and depth as louvre frame.

1.1.6 Provide interlocking split mullions designed to permit expansion and contraction where length of louvre exceeds fabrication and handling limitations.

2.2.5 Exterior Corners: Prefabricated corner units with mitred and welded blades and with semi-recessed mullions at corners.

2.2.6 Provide sub-sills made of same material as louvres or extended sills for recessed louvres.

2.2.7 Join frame members to each other and to fixed louvre blades with fillet welds concealed from view or size of louvre assembly makes bolted connections between frame members necessary.

2.3 Finishes

2.3.1 Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

2.3.2 High Performance Organic Finish:

.1 3 Coat PVDF Coating: AA-C12 Chemical Finish, cleaned with inhibited chemicals; C40 Chemical Finish, conversion coating; R1x Organic Coating, manufacturer's standard 3 coat, thermo-cured system consisting of specially formulated inhibitive primer, fluoropolymer colour coat, and clear fluoropolymer topcoat, with both colour coat and clear topcoat containing not less than 70% PVDF resin by weight; prepare, pre-treat, and apply coating to exposed metal surfaces in accordance with AAMA 2605 and with coating and resin manufacturers' written instructions.

.2 Colour: Refer to Drawings.

PART 3 EXECUTION

3.1 Site Storage and Protection

3.1.1 General: Deliver and store materials in manufacturer’s original packaging with labels to show name, brand, type, and grade. Store materials in protected dry location off-ground in accordance with manufacturer’s instructions. Do not open packaging nor remove labels until time for installation.

3.1.2 Removable Protective Coverings: Provide finished panels and accessories with manufacturer's recommended temporary protective covering. Maintain covering on materials until installation. Covering shall not to affect factory finish coating nor leave residue or other deleterious matter on surface.

3.2 Installation

3.2.1 Locate and place louvres level and plumb at indicated alignment with adjacent work.

3.2.2 Use concealed anchorages where possible; provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weather tight connection.

3.2.3 Form closely fitted joints with exposed connections accurately located and secured.

3.2.4 Provide perimeter reveals and openings of uniform width for sealants and joint fillers.

3.2.5 Repair finishes damaged by cutting, welding, soldering, and grinding, and as follows:

.1 Restore finishes so no evidence remains of corrective work.

.2 Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

3.2.6 Protect galvanized and nonferrous metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces.

3.2.7 Install concealed gaskets, flashings, joint fillers, and insulation as louvre installation progresses where weather tight louvre joints are required, refer to Section 07920 for sealants applied during louvre installation.

3.3 Adjust and Clean

3.3.1 Clean exposed surfaces of louvres that are not protected by temporary covering, to remove fingerprints and soil during construction period; do not let soil accumulate until final cleaning.

3.3.2 Clean exposed surfaces with water and a mild soap or detergent not harmful to finishes, and thoroughly rinse surfaces and dry before final inspection.

3.3.3 Restore louvres damaged during installation and construction so no evidence remains of corrective work; remove damaged units and replace with new units where results of restoration are unsuccessful, as determined by Consultant.

3.3.4 Touch up minor abrasions in finishes with compatible air dried coating matching colour and gloss of factory applied finish coating.

END OF SECTION

NON-STRUCTURAL METAL FRAMING

PART 1 GENERAL

1.1 Related Requirements

1.1.1 Section 09260 - Gypsum Board Assemblies.

1.2 References

1.2.1 American Society for Testing and Materials International, (ASTM).

.1 ASTM A653/A653M-17, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

.2 ASTM C645 14e1, Standard Specification for Nonstructural Steel Framing Members.

.3 ASTM C754 17, Standard Specification for Installation of Steel Framing Members to Receive Screw Attached Gypsum Panel Products.

1.2.2 CSSBI LSF Technical Bulletin Volume 7, Number 1 Maximum Height Tables for Interior Non-Load bearing Partitions

1.2.3 Environmental Choice Program (ECP).

.1 CCD-047-05, Architectural Surface Coatings.

.2 CCD-048-06, Surface Coatings - Recycled Water-borne.

1.3 Administrative Requirements

1.3.1 Convene pre-installation meetings one week prior to beginning work of this Section in accordance with Division 1 General Requirements to:

.1 Verify project requirements.

.2 Review installation conditions.

.3 Co-ordinate with other building subtrades.

.4 Review manufacturer's instructions.

1.4 Quality Assurance

1.4.1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

1.4.2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.5 Waste Management and Disposal

1.5.1 Separate and recycle waste materials in accordance with Division 1 General Requirements.

NON-STRUCTURAL METAL FRAMING

PART 2 PRODUCTS

2.1 Materials

2.1.1 Non-load bearing channel stud framing: to ASTM C645, stud sizes as indicated on Drawings, roll formed from 0.45 mm thickness hot dipped galvanized steel sheet, for screw attachment of gypsum board. Use 0.75 mm heavy weight framing to support fire rated door frames. Knock-out service holes at 460 mm centres.

2.1.2 Runners: Width, gauge and galvanizing to match steel studs, and as follows:

.1 Double Runner Deflection Track: Outside runner using 50 mm flanges; inner runner 33 mm; maintaining 25 mm minimum deflection space.

.2 Slotted Deflection Track for Fire Separations: Premanufactured slotted top runner with 63 mm down standing legs and having 6 mm wide x 38 mm high slots spaced at 25 mm O/C along length of runner; tested and certified for use in fire rated wall construction:

.1 Acceptable materials:

.1 Brady Construction Innovations, SliptrackSystems

.2 Dietrich Metal Framing, SLP-TRK

.2 Base Runner: Bottom track with 33 mm upstanding legs.

2.1.3 Metal channel stiffener: sizes as required, 1.4 mm thick cold rolled steel, coated with rust inhibitive coating.

2.1.4 Acoustical sealant: to Section 07925.

2.1.5 Insulating strip: rubberized, moisture resistant 3 mm thick cork or foam strip, 12 mm wide, with self sticking adhesive on one face, lengths as required.

2.1.6 Fasteners for Metal Framing: Type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

2.1.7 Curving tracks: Commercial steel sheet with ASTM A653, Z180, hot dip galvanized zinc coating, complete with flexible sliding straps to allow for curvature indicated on drawings; width to suit framing, and as follows:

.1 Width: 92 mm

.2 Minimum base metal thickness: 0.75 mm.

.3 Acceptable materials:

.1 Flex-C Trac

2.1.8 Metal channel stiffener: sizes as required, 1.4 mm thick cold rolled steel, coated with rust inhibitive coating.

NON-STRUCTURAL METAL FRAMING

PART 3 EXECUTION

3.1 Erection

3.1.1 Align partition tracks at floor and ceiling and secure at 600 mm on centre maximum.

3.1.2 Install damp proof course under stud shoe tracks of partitions on slabs on grade.

3.1.3 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.

3.1.4 Erect metal studding to tolerance of 1:1000.

3.1.5 Attach studs to bottom track using screws, crimp method, or pop rivets.

3.1.6 Co-ordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.

3.1.7 Co-ordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other Sections.

3.1.8 Provide two studs extending from floor to ceiling at each side of openings wider than stud centres specified. Secure studs together, 50 mm apart using column clips or other approved means of fastening placed alongside frame anchor clips.

3.1.9 Install heavy gauge (1.52 mm thick) single jamb studs at openings.

3.1.10 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.

3.1.11 Frame openings and around built in equipment, cabinets, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.

3.1.12 Provide 40 mm stud or furring channel 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.

3.1.13 Install steel studs or furring channel between studs for attaching electrical and other boxes.

3.1.14 Extend partitions to ceiling height except where noted otherwise on drawings.

3.1.15 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs. Use 50 mm leg ceiling tracks. Use double track slip joint as indicated.

3.1.16 Install continuous insulating strips to isolate studs from uninsulated surfaces.

3.1.17 Install two continuous beads of acoustical sealant or continuous insulating strip under studs and tracks around perimeter of sound control partitions.

NON-STRUCTURAL METAL FRAMING

3.2 Cleaning

3.2.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

3.3 Steel Stud Height Schedule

Maximum Stud Height (mm) based on lateral pressure of 240 Pa with deflection limit of L/240

Stud Spacing O.C.	300	400	600	300	400	600
Stud Depth (mm)	0.45 mm Steel Design Thickness			0.80 mm Steel Design Thickness		
64	3630	3430	3230	4240	3910	3530
92	4670	4370	4090	5440	5000	4500
102	5000	4670	4320	6070	5590	5000
152	6730	6020	5110	8150	7470	6580

Based upon tests with 13mm gypsum board both sides with screw fasteners spaced at 300 mm o.c. Heights also apply to greater gypsum board thickness and multiple gypsum board layers.

END OF SECTION

GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 Related Requirements

1.1.1 Section 06100 – Rough Carpentry

1.1.2 Section 07845 – Firestopping and Smokeseals

1.1.3 Section 07925 – Sealants

1.1.4 Section 09110 – Non-Structural Metal Framing

1.1.5 Section 09905 – Painting

1.2 References

1.2.1 Aluminum Association (AA)

.1 AA DAF-45-2003(R2009), Designation System for Aluminum Finishes.

1.2.2 American Society for Testing and Materials International, (ASTM)

.1 ASTM A653/A653M-17, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

.2 ASTM C475/C475M-17, Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.

.3 ASTM C514-04(2014), Specification for Nails for the Application of Gypsum Board.

.4 ASTM C635/C365M-17, Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings

.5 ASTM C645-18, Standard Specification for Nonstructural Steel Framing Members

.6 ASTM C840-18, Specification for Application and Finishing of Gypsum Board.

.7 ASTM C954-18, Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.

.8 ASTM C1002-18, Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

.9 ASTM C1047-14a, Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.

.10 ASTM C1178/C1178M-18, Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel.

.11 ASTM C1396/C1396M-17, Standard Specification for Gypsum Board.

.12 ASTM D3273-16, Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber

.13 ASTM D5420-16, Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact)

.14 ASTM E90-09(2016), Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

.15 ASTM F1267-18, Standard Specification for Metal, Expanded, Steel

1.2.3 Association of the Wall and Ceilings Industries International (AWCI)

1.2.4 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-71.25-M88, Adhesive, for Bonding Drywall to Wood Framing and Metal Studs.

1.2.5 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S102-10, Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC S114-05, Standard Method of Test for Determination of Non-Combustibility in Building Materials

.3 CAN/ULC S702.1:2014-AMD1, Standard for Mineral Fibre Thermal Insulation for Buildings, Part 1: Material Specification

1.3 Action Submittals / Informational Submittals

1.3.1 Submit product data in accordance with Division 1 General Requirements:

.1 Submit manufacturer's printed product literature, specifications and data sheet for each product specified.

1.4 Delivery, Storage, and Handling

1.4.1 Deliver materials in original packages, containers or bundles bearing manufacturers brand name and identification.

1.4.2 Store materials inside, level, under cover. Keep dry. Protect from weather, other elements and damage from construction operations and other causes.

1.4.3 Handle gypsum boards to prevent damage to edges, ends or surfaces. Protect metal accessories and trim from being bent or damaged.

1.5 Site Conditions

1.5.1 Environmental

.1 Maintain temperature minimum 10 degrees C, maximum 21 degrees 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.

1.6 Waste Management and Disposal

1.6.1 Separate and recycle waste materials in accordance with Division 1 General Requirements.

PART 2 PRODUCTS

2.1 Manufacturers

2.1.1 Acceptable Manufacturers:

.1 CertainTeed Gypsum Canada Inc.

.2 CGC Inc.

.3 Georgia-Pacific Canada, Inc.

2.2 Gypsum Materials

2.2.1 Standard board: to ASTM C1396/C1396M and as follows:

.1 Type: regular and fire resistant.

.2 Size: 1220 mm x maximum practical length.

.3 Thickness: as indicated on Drawings.

.4 Ends: square cut.

.5 Edges: tapered

.6 Acceptable materials:

.1 Wallboard (Type X), CertainTeed.

.2 Sheetrock (Firecode), CGC Inc.

.3 Toughrock Gypsum Wallboard (Fireguard), Georgia-Pacific Canada, Inc.

2.2.2 Sag Resistant Gypsum Board: to ASTM C1396/C1396M and as follows:

.1 Type: regular and fire resistant.

.2 Thickness: as indicated on Drawings.

.3 Acceptable materials:

.1 CD Ceiling Board, Georgia-Pacific Canada, Inc.

.2 Interior Ceiling Board, CertainTeed.

.3 Sheetrock Interior Ceiling Board, CGC Inc.

2.2.3 Mould resistant board: to ASTM C1396/C1396M and as follows:

.1 Type: regular and fire resistant.

.2 Size: 1220 mm x maximum practical length.

.3 Thickness: as indicated on Drawings.

.4 Acceptable materials:

.1 M2Tech Moisture & Mould Resistant Gypsum Board, CertainTeed.

.2 Sheetrock Mold Tough, CGC Inc.

.3 ToughRock Mold-Guard, Georgia-Pacific Canada, Inc.

.4 Quietrock ES-MR, Pabco Gypsum

2.3 Framing Materials

2.3.1 Studs and Tracks: as indicated in Section 09110.

2.3.2 Shaft Wall Framing System: to ASTM C645 manufacturer's standard shaft wall steel framing system having ASTM A653M, Z180, hot-dip galvanized zinc coating; minimum steel thickness of 0.46 mm thick or heavier as required by detailed design required for indicated spans; including head and bottom rails, channels, trim and accessories required for a complete installation:

.1 Acceptable materials:

.1 C-H Stud Framing System, CGC Inc.

.2 C-T Stud Framing System, Georgia-Pacific Canada, Inc.

.3 C-H, C-T, Series IV – I Studs, CertainTeed.

2.3.3 Metal furring runners, hangers, tie wires, inserts, anchors.

2.3.4 Drywall furring channels: 0.75 mm core thickness galvanized steel channels for screw attachment of gypsum board.

2.3.5 Resilient clips: 0.5 mm base steel thickness galvanized steel for resilient attachment of gypsum board.

2.4 Insulation Materials

2.4.1 Mineral Fiber Insulation for Fire and Smoke Rated Assemblies: Un-faced preformed GreenGuard™ or formaldehyde free binder fibrous insulation meeting the requirements of ULC S702; having maximum flame spread and smoke developed of 20/20 in accordance with CAN/ULC S102 and being non-combustible in accordance with CAN/ULC S114 and as follows:

.1 Type: 1.

.2 Width: to friction fit in stud spaces.

.3 Thickness: to fill a minimum of 90% of the cavity thickness.

.4 STC Ratings: as indicated on Drawings.

.5 Acceptable materials:

.1 Johns Manville, MinWool Sound Attenuation Fire Batts

.2 Owens-Corning Canada Inc., Sound Attenuation Fire Batts.

.3 Rockwool Inc., AFB Acoustical Fire Batt.

2.4.2 Mineral Fiber Acoustical Insulation for Non-rated Assemblies: Un-faced, preformed GreenGuard™ or formaldehyde free binder fibrous insulation meeting the requirements of ASTM C423, ASTM E90, ASTM E413 and ULC S702 and as follows:

.1 Type: 1.

.2 Width: to friction fit in stud spaces.

.3 Thickness: to fill a minimum of 90% of the cavity thickness.

.4 STC Ratings: as indicated on Drawings

.5 Acceptable materials:

.1 CertainTeed, NoiseReducer, Sound Control Fibre Glass Batts.

.2 Johns Manville, Sound Shield Glass Fibre Batts.

.3 Owen-Corning Canada LP., Thermafiber UltraBatt

2.5 Ceiling / Wall Access Doors

2.5.1 Architectural, flush mounting access panels for gypsum board installation, thickness and fire rating to match wall assembly, manufacturer's standard sizes selected to suit access requirements, complete with extruded aluminum frame, concealed hinge and a removable door panel, air tight gasket and screwdriver slot latch mechanism. Confirm proposed location and number of access doors with Consultant prior to installation.

.1 Basis-of-Design: Bauco Products Incorporated, Bauco Plus.

.2 Acceptable Manufacturers:

.1 Access Panel Solutions

.2 Acudor Products, Inc.

.3 Chicago Metallic/Rockfon Corporation

.4 Nystrom Building Products Co.

2.6 Finishes

2.6.1 Paint: in accordance with Section 09905 – Painting.

GYPSUM BOARD ASSEMBLIES

2.7 Accessories

2.7.1 Nails: to ASTM C514.

2.7.2 Steel drill screws: to ASTM C1002.

2.7.3 Stud adhesive: to CAN/CGSB-71.25.

2.7.4 Laminating compound: as recommended by manufacturer, asbestos-free.

2.7.5 Casing beads, corner beads, control joints and edge trim: to ASTM C1047, ABS, 0.5 mm base thickness, perforated flanges, one piece length per location.

2.7.6 Shadow mould: 35 mm high, snap-on trim, of 0.6 mm base steel thickness galvanized sheet pre-finished in satin enamel, white colour.

2.7.7 Strippable Edge Trim: Extruded PVC with pre-masked L-shaped tape on trim with tear away protective serrated strip for removal after compound and paint is applied, for use at areas where gypsum butts aluminum frames and where gypsum butts concrete or concrete block.

2.7.8 Sealants: in accordance with Section 07925 - Sealants.

2.7.9 Acoustic sealant: in accordance with Section 07925 – Sealants.

2.7.10 Firestopping: refer to Section 07845 for firestopping and smokeseals for project as required for all new and existing surfaces, penetrations, irregular connections, and locations as described in Section 07845.

2.7.11 Joint Treatment Materials: Provide joint compound and accessory materials in accordance with ASTM C475 and as follows:

.1 Joint Tape:

.1 Interior Gypsum Board: Paper.

.2 Interior Mould Resistant Gypsum Board: Fibreglass mesh tape.

.2 Joint Compound for Interior Gypsum Board: Vinyl based, non-asbestos, low dusting type compatible with other compounds applied on previous or for successive coats, and as follows:

.1 Pre-filling: Setting type taping compound.

.2 Embedding and First Coat: Drying type compound.

.3 Fill Coat: Drying type compound.

.4 Finish Coat: Drying type, sandable topping compound.

.5 Skim Coat: Drying type, sandable topping compound.

.6 Acceptable Materials:

.1 CertainTeed Dust Away

.2 CGC Dust Control

.3 Joint Compound for Interior Mould Resistant Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

.1 Pre-filling: Setting type joint compound.

.2 Embedding and First Coat: Setting type joint compound.

.3 Fill Coat: Setting type, sandable topping compound.

.4 Skim Coat: Setting type joint compound, sandable topping compound.

PART 3 EXECUTION

3.1 Erection

3.1.1 Do application and finishing of gypsum board in accordance with ASTM C840 except where specified otherwise.

3.1.2 Do application of gypsum sheathing in accordance with ASTM C1280.

3.1.3 Erect hangers and runner channels for suspended gypsum board ceilings in accordance with ASTM C840 except where specified otherwise.

3.1.4 Support light fixtures by providing additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.

3.1.5 Install work level to tolerance of 1:1200.

3.1.6 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, grilles.

3.1.7 Install 19 x 64 mm furring channels parallel to, and at exact locations of steel stud partition header track.

3.1.8 Furr gypsum board faced vertical bulkheads within and at termination of ceilings.

3.1.9 Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.

3.1.10 Install wall furring for gypsum board wall finishes in accordance with ASTM C840, except where specified otherwise.

3.1.11 Furr openings and around built-in equipment, cabinets, access panels, on four sides. Extend furring into reveals. Check clearances with equipment suppliers.

3.1.12 Furr duct shafts, beams, columns, pipes and exposed services where indicated.

3.1.13 Erect drywall resilient furring transversely across studs and joists spaced maximum 600 mm on centre and not more than 150 mm from ceiling/wall juncture. Secure to each support with 25 mm drywall screw.

3.1.14 Install 150 mm continuous strip of 12.7 mm gypsum board along base of partitions where resilient furring installed.

GYPSUM BOARD ASSEMBLIES

3.2 Application

3.2.1 Do not apply gypsum board until bucks, anchors, blocking, sound attenuation, electrical and mechanical work are approved.

3.2.2 Apply single or double layer gypsum board to metal furring or framing using screw fasteners for first layer, laminating adhesive for second layer. Maximum spacing of screws 300 mm on centre.

.1 Single-Layer Application:

.1 Apply gypsum board on ceilings prior to application of walls in accordance with ASTM C840.

.2 Apply gypsum board vertically or horizontally, providing sheet lengths that will minimize end joints.

.2 Double-Layer Application:

.1 Install gypsum board for base layer and exposed gypsum board for face layer.

.2 Apply base layer to ceilings prior to base layer application on walls; apply face layers in same sequence. Offset joints between layers at least 250 mm.

.3 Apply base layers at right angles to supports unless otherwise indicated.

.4 Apply base layer on walls and face layers vertically with joints of base layer over supports and face layer joints offset at least 250 mm with base layer joints.

3.2.3 Apply mould-resistant gypsum board where wall tiles to be applied. Apply mould-resistant sealant to edges, ends, cut-outs which expose gypsum core and to fastener heads. Do not apply joint treatment on areas to receive tile finish.

3.2.4 Apply 12 mm diameter bead of acoustic sealant continuously around periphery of each face of partitioning to seal gypsum board/structure junction where partitions abut fixed building components. Seal full perimeter of cut-outs around electrical boxes, ducts, in partitions where perimeter sealed with acoustic sealant.

3.2.5 Install ceiling boards in direction that will minimize number of end-butt joints. Stagger end joints at least 250 mm.

3.2.6 Install gypsum board on walls vertically to avoid end-butt joints. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs, except where local codes or fire-rated assemblies require vertical application.

3.2.7 Install gypsum board with face side out.

3.2.8 Do not install damaged or damp boards.

3.2.9 Locate edge or end joints over supports. Stagger vertical joints over different studs on opposite sides of wall.

GYPSUM BOARD ASSEMBLIES

3.3 Installation

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

3.3.2 Install casing beads around perimeter of suspended ceilings.

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

3.3.4 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.

3.3.5 Install shadow mould at gypsum board/ceiling juncture as indicated. Minimize joints; use corner pieces and splicers.

3.3.6 Construct control joints of preformed units or two back-to-back casing beads set in gypsum board facing and supported independently on both sides of joint.

3.3.7 Provide continuous polyethylene dust barrier behind and across control joints.

3.3.8 Locate control joints where indicated and at changes in substrate construction at approximate 10 m spacing on long corridor runs at approximate 15 m spacing on ceilings.

3.3.9 Install control joints straight and true.

3.3.10 Construct expansion joints at building expansion and construction joints. Provide continuous dust barrier.

3.3.11 Install expansion joint straight and true.

3.3.12 Splice corners and intersections together and secure to each member with 3 screws.

3.3.13 Install access doors to electrical and mechanical fixtures specified in respective sections.

.1 Rigidly secure frames to furring or framing systems.

3.3.14 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.

3.3.15 Gypsum Board Finish: finish gypsum board walls and ceilings to following levels in accordance with Association of the Wall and Ceiling Industries (AWCI) International Recommended Specification on Levels of Gypsum Board Finish:

.1 Levels of finish:

.1 Level 0: No taping, finishing or accessories required for areas of temporary construction.

GYPSUM BOARD ASSEMBLIES

.2 Level 1: Embed tape for joints and interior angles in joint compound. Surfaces to be free of excess joint compound; tool marks and ridges are acceptable and for plenum areas above ceilings, in attics or in concealed spaces.

.3 Level 2: Embed tape for joints and interior angles in joint compound and apply one separate coat of joint compound over joints, angles, fastener heads and accessories; surfaces free of excess joint compound; tool marks and ridges are acceptable and when gypsum is used as a substrate for tile.

.4 Level 3: Embed tape for joints and interior angles in joint compound and apply two separate coats of joint compound over joints, angles, fastener heads and accessories; surfaces smooth and free of tool marks and ridges and where areas are to receive a heavy coating of textured material.

.5 Level 4: Embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; surfaces smooth and free of tool marks and ridges and where light textures or wall coverings are to be applied.

.6 Level 5: Embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; apply a thin skim coat of joint compound to entire surface; surfaces smooth and free of tool marks and ridges. Use this level of finish to minimize joint photographing, in long corridors, and where severe lighting occurs.

3.3.16 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.

3.3.17 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.

3.3.18 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.

3.3.19 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.

3.3.20 Mix joint compound slightly thinner than for joint taping.

3.3.21 Apply thin coat to entire surface using trowel or drywall broadknife to fill surface texture differences, variations or tool marks.

3.3.22 Allow skim coat to dry completely.

3.3.23 Remove ridges by light sanding or wiping with damp cloth.

3.3.24 Provide protection that ensures gypsum drywall work will remain without damage or deterioration at time of substantial completion.

GYPSUM BOARD ASSEMBLIES

END OF SECTION

EPOXY FLOORING

PART 1 GENERAL

1.1 Section Includes

1.1.1 Section includes, but is not limited to:

.1 Epoxy flooring, cove bases and accessories, including epoxy flooring to precast concrete stairs and landings.

1.2 Related Sections

1.2.1 Concrete Work: Division 3

1.3 Reference Standards

1.3.1 Comply with the latest edition of the following statutes, codes and standards and all amendments thereto.

1.3.2 ASTM Standards:

.1 ASTM C413: Standard Test Method for Absorption of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacings and Polymer Concretes.

.2 ASTM C531: Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.

.3 ASTM C579: Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings and Polymer Concretes.

.4 ASTM D523: Standard Test Method for Specular Gloss.

.5 ASTM D580/D580M: Standard Specification for Greige Woven Glass Tapes and Webbings.

.6 ASTM D635: Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.

.7 ASTM D638: Standard Test Method for Tensile Properties of Plastics.

.8 ASTM D695: Standard Test Method for Compressive Properties of Rigid Plastics.

.9 ASTM D790: Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

.10 ASTM D1864/D1864M: Standard Test Method for Moisture in Mineral Aggregate Used on Built-Up Roofs.

.11 ASTM D2047: Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine.

.12 ASTM D2240: Standard Test Method for Rubber Property - Durometer Hardness.

.13 ASTM D4060: Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.

.14 ASTM D4226: Standard Test Methods for Impact Resistance of Rigid Poly(Vinyl Chloride) (PVC) Building Products.

.15 ASTM D4258: Standard Practice for Surface Cleaning Concrete for Coating.

.16 ASTM D4259: Standard Practice for Abrading Concrete.

.17 ASTM D4260: Standard Practice for Acid Etching Concrete.

.18 ASTM D4262: Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces.

.19 ASTM D4263: Standard Test Method for Indicating Moisture in Concrete by Plastic Sheet.

.20 ASTM D4541: Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

.21 ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials.

1.4 Submittals

1.4.1 Submit product data and samples in accordance with Division 1.

1.4.2 Product Data: Submit manufacturer's technical data, installation instructions and general recommendations for each type of flooring material required.

1.4.3 Submit duplicate 300 x 300 mm sample of epoxy flooring applied to Concrete. Submit additional samples until Engineer’s acceptance is obtained. Make changes in aggregate mix as required to secure correct colour and texture. Label sample(s) with Project name and number, applicator, names of material and manufacturer, colour, gloss, texture and aggregate mix proportion.

1.5 Job Mockup

1.5.1 Construct a 5 m^2 mockup in a location as directed by the Engineer. Do not proceed until the mockup has been accepted by the Engineer. If accepted, the mockup may be incorporated into the work. If it is not accepted, remove and install another 5 m^2 mockup and do not proceed until mockup has been accepted by the Engineer.

.1 Maintenance

1.5.2 Provide maintenance data for epoxy enamel flooring for incorporation into maintenance manual as specified in Division 1.

1.5.3 Provide specific instructions for maintenance, preservation and cleaning. Provide adequate warning of maintenance materials or practices which may be detrimental to flooring.

1.6 Quality Assurance

1.6.1 Installer Qualifications: Trained and approved by the manufacturer and having a minimum five years’ experience in the installation of the work described in this Section and can show evidence of satisfactory completion of projects of similar size, scope and type with a record of successful in-service performance. If requested, provide letter of certification from manufacturer stating that installer is certified applicator of its products, and is familiar with proper procedures and installation requirements required by the manufacturer.

.1 Qualifications include having the necessary experience, staff, and training to install manufacturer's products. Manufacturer's willingness to sell its products to installers does not in itself confer qualification on installer.

1.6.2 Maintenance Seminars: Engage a factory authorized service representative to train The City's maintenance personnel on proper maintenance procedures.

1.6.3 Pre-Installation Meeting: Prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section. Advise the Engineer of the date and time of the meeting.

1.6.4 Manufacturer's Site Inspection: Have the manufacturer's technical representative inspect the Work at suitable intervals during application and at conclusion of the work of this Section, to ensure the Work is correctly installed. When requested, submit manufacturer's inspection reports and verification that the work of this Section is correctly installed.

1.6.5 Testing of Concrete Floors: Test floors that have been cured for minimum 28 days, and after preparation for Product installation is complete and patching or levelling compound is fully cured. Conduct testing simultaneously on floors free of sealer, curing compounds, oil, grease and other agents detrimental to the test and Product performance. Locate test sites to cover representative installation areas. Do not proceed with work when the test results do not conform to the specified allowable.

.1 Cohesive Strength: Minimum 1.45 MPa by tensile load as tested to CSA A23.2-6B. Do one test for every 9 sq.m. or fraction thereof.

.2 Moisture Vapour Transmission: ASTM D4263 plastic sheet method, no visible condensation or vapour allowed. Do one test for every 4.5 sq.m. or fraction thereof.

.3 Surface Moisture Content: Maximum 4% or as otherwise recommended by the epoxy flooring manufacturer, tested by moisture meter. Do one test for every 4.5 sq.m. or fraction thereof.

.4 Surface and Ambient Temperature: Minimum 16°C.

1.6.6 Apply epoxy flooring in accordance with the most recent installation instructions of the manufacturer.

1.7 Environmental Requirements

1.7.1 Maximum moisture content of substrate: 4% or as otherwise recommended by the epoxy flooring manufacturer.

1.7.2 Temperature: maintain minimum temperature of substrate in accordance with manufacturer’s recommendations prior to, during and after installation or until cured unless otherwise required by the flooring manufacturer. Minimum temperature of air during and for 48 hours after coating is applied 16°C. Maximum ambient and surface temperatures not to exceed 29°C, for time periods as specified for minimum temperatures.

.1 Alkali: Ensure negative alkalinity of substrate before application of coating.

1.7.3 Alkali: Ensure negative alkalinity of substrate before application of coating.

1.7.4 Ventilation: provide continuous ventilation during and after coating application to control dangerous vapour build-up, odours and fumes.

1.7.5 Post and enforce "No smoking or open flame" signs until flooring has cured. Eliminate all spark producing devices (furnaces, all pilot lights, spark-producing switches and the like) in or near the work area.

1.7.6 Provide uniform and sufficient lighting in areas of installation.

1.7.7 Do not begin flooring installation until all other work which would cause damage, dirt dust or interruption of normal installation pace has been completed.

1.8 Delivery, Storage and Handling

1.8.1 Deliver and store materials undamaged, in original containers, with manufacturer's seals and labels intact.

1.8.2 Handle and store materials in accordance with manufacturer's printed directions.

1.8.3 Designate a room for storage of flooring materials and equipment. Keep room dry, neat and clean at all times, under lock and key, and surrounding surfaces protected from damage. Keep material temperatures between 16°C and 29°C.

1.8.4 Store flammable materials in safe, approved containers to eliminate fire hazards and remove from Site at end of each work shift.

1.8.5 Do not use materials that has been stored for period of time exceeding maximum recommended shelf life of materials.

1.9 Protection

1.9.1 Protect adjacent surfaces from damage resulting from work of this Section. If necessary, cover or mask adjacent surfaces to those receiving flooring including fixtures and equipment. Make good any damage so caused, to the satisfaction of the Engineer.

1.9.2 Replace materials soiled during application, and from which soil cannot be completely removed, at no extra cost.

1.9.3 Ensure that spark-proof electrical equipment is used in areas where inflammable materials are being applied. Prevent use of open flames or equipment that may cause sparks.

1.9.4 Keep all traffic out of all areas receiving flooring until it has been completed and cured.

1.9.5 Apply temporary protection until floor is fully cured.

1.10 Warranty

1.10.1 Provide a two (2) year warranty commencing on the date of Construction Completion Certificate, against defects in material and workmanship.

PART 2 PRODUCTS

2.1 Product Selection

2.1.1 Basis-of-Design: Materials and colours listed in drawings form the Basis-of-Design materials for this project. Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

2.1.2 Materials and products supplied by subcontractor shall match the approved samples, in all aspects, including but not limited to form, texture, size, shape, aesthetics, performance and technical specification.

2.2 Materials

2.2.1 Epoxy Flooring: two component, solid colour, high solids, silicone free, moderate thixotropic viscosity, epoxy flooring, chemical resistant. Provide flooring with slip resistance to meet all National Building Code - Alberta Edition requirements. Colours as selected by the design consultant from the manufacturer's standard range and as noted in the interior finish schedule. Acceptable Material:

Sikafloor 261^{CA} Thixo Lite as manufactured by Sika Canada Inc.
Other preapproved product.

2.2.2 Primer: primer as recommended by manufacturer for types of surface to be primed.

2.2.3 Subfloor Filler: Compatible to floor coating and as recommended by coating manufacturer.

2.2.4 Joint and crack sealant: as specified in Section 07900.

2.2.5 Surface cleaner: as recommended by the manufacturer.

PART 3 EXECUTION

3.1 Inspection

3.1.1 Ensure concrete floors conform to manufacturer's requirements.

3.1.2 Ensure that items penetrating coating are placed before application of coating.

3.1.3 Ensure that all surfaces are clean and dry.

3.1.4 Ensure under slab sheet vapour retarder is installed under the slab as specified in Section 07261.

3.2 Preparation of Surfaces

3.2.1 Protect adjacent surfaces and equipment from damage by over spray, fall-out and dusting.

3.2.2 Ensure surfaces are clean, sound and dry; in all cases requiring some form of preparation. Prepare substrates in accordance with manufacturer's printed instructions.

3.2.3 Remove any dust, laitance, grease, oil, dirt, curing agents, impregnations, wax, foreign matters, coatings and detritus from the surface by appropriate mechanical means, in order to achieve a profile equivalent to ICRI-CSP 3-4.

3.2.4 The compressive strength of the concrete substrate must be at least 25 MPa (3625 psi) at 28 days and at least 1.5 MPa (218 psi) in tension at the time of application of primer.

3.2.5 Effectively remove concrete laitance by steel shot blasting, grit blasting or method approved by manufacturer.

3.2.6 Prefill and repair surface irregularities, holes, cracks and other defects in accordance with manufacturer's recommendations. Level subfloor with filler.

3.2.7 Clean subfloor free of laitance, oil, grease, curing and sealing compounds, hardeners, chemical additives and other foreign matter detrimental to flooring application.

3.2.8 Blow clean control joints, sawcuts and cracks with compressed air and grout with material compatible with floor coating materials.

3.2.9 Ensure that masonry backing surfaces for cove bases are free of voids and irregularities. Fill recessed joints with recommended epoxy plaster.

3.2.10 Before commencement of application of flooring, ensure that concrete floors are acceptable in accordance with manufacturer's recommendations.

3.2.11 Commencement of work implies acceptance of surfaces and working conditions.

3.3 Mixing

3.3.1 Pre-mix each component separately. Empty component B in the correct mix ratio to component A.

3.3.2 Mix the combined components for at least 3 minutes, using a low-speed drill (300 - 450 rpm) to minimize entrapping air. Use an Exomixer type mixing paddle (recommended model) suited to the volume of the mixing container.

3.3.3 During the mixing operation, scrape down the sides and bottom of the container with a flat or straight edge trowel at least once to ensure complete mixing. When completely mixed, prime coat (regular B component) and thixo lite wear coat (special Thixo Lite B component) must be uniform in colour and consistency. Mix only that quantity which can be used within its pot life.

3.4 Application/Epoxy Flooring

3.4.1 Primer: Apply primer over prepared substrate, at manufacturer's recommended spreading rate with timing of application co-ordinated with subsequent application of topping mix to ensure optimum adhesion between flooring materials and substrate. Prime entire surface with recommended primer. Applly prime cost to uniform coverage without puddling.

3.4.2 Ensure that floors have been prepared in accordance with manufacturer's instructions prior to application of epoxy flooring.

3.4.3 Apply epoxy flooring at ambient temperatures and humidity range as recommended by the manufacturer.

3.4.4 Apply epoxy flooring immediately after mixing.

3.4.5 Once prime coat is tack-free, apply thixo lite wear coat using a squeegee or roller and backroll to achieve even coverage. Finish with texture roller to achieve a slip resistant finish to meet all National Building Code - Alberta Edition 2006 requirements. Broadcast silica sand into top coat as required to achieve a slip resistant surface.

3.4.6 Apply epoxy flooring in strict accordance manufacturer's printed directions to a dry film thickness between 20 and 24 mils, with integral cove bases, uninterrupted except at sawn joints or other types of joints required, free of laps, pin holes, voids, crawls, skips or other marks or irregularities are visible, and to provide uniform appearance.

3.4.7 Install cove and base including top cap in accordance with manufacturer's instructions. Ensure top of base is level, and true to line.

3.4.8 Work coating into corners and other restricted areas, up and over bases, and into recesses in floors to ensure full coverage.

3.4.9 Make clean true junctions with no visible overlap between adjoining applications of coatings.

3.4.10 Provide reinforcing at wall/floor intersections if necessary to prevent cracking at corners.

3.4.11 Finish flooring uniformly, free from surface imperfections, and to match the accepted sample in the Engineer's office.

3.4.12 Allow proper cure time for each installation procedure.

3.4.13 Apply flooring up adjoining walls 200 mm to form base to flooring. Top of base to be level, true, and even.

3.4.14 Flash pipes, conduits and other penetrations to manufacturer's standards.

3.4.15 Coat house keeping pads prior to installation of equipment.

3.5 Adjustment and Clean-Up

3.5.1 Upon completion of work of this Section clean area up of debris, remove flooring material from adjacent surfaces where splattered and leave area in clean, tidy condition acceptable to the Engineer.

3.5.2 Touch up and refinish minor defects in work. Refinish entire coated surface areas where finish is damaged or otherwise unacceptable.

3.5.3 Remove promptly as work progresses spilled or splattered coating materials from adjacent surfaces. Clean floors on completion of Work. Do not mar surfaces while removing splatters.

3.5.4 Protect completed work from traffic for at least one week to allow proper curing of floor finish. Protect work from any trades using area after completion of installation.

END OF SECTION

PAINTING

PART 1 GENERAL

1.1 Section Includes

1.1.1 Section includes, but is not limited to:

.1 On-site painting work.

1.2 Related Sections

1.2.1	Unit masonry:	Section 04200
1.2.2	Structural Steel, Steel Deck, steel joists and metal fabrications	Division 5
1.2.3	Hollow Metal Doors & Frames:	Section 08100
1.2.4	Pipe and equipment coding and identification:	Division 15

1.3 Reference Standards

1.3.1 The Master Painters Institute (MPI) - Architectural Painting Specification Manual (current edition).

1.4 Qualifications

1.4.1 The Subcontractor performing the work of this Section must have a minimum of five (5) year experience as a recognized independent Contractor specializing in this work whose work has resulted in applications with a record of successful in-service performance and must be a member of the Master Painters and Decorator's Association (MPDA). Refer to www.paintinfo.com.

1.4.2 Employ journeymen painters and non-journeymen to the requirements of the MPI.

1.5 Quality Assurance

1.5.1 Acceptable manufacturer's, materials, workmanship and all items affecting the work of this Section is to be in accordance with the specifications in the first instance and The Master Painters Institute "Architectural Painting Specification Manual" current edition.

1.5.2 On a continuous basis, conduct detailed and thorough inspections of the work being performed and ensure that the work conforms to the specifications. Any inspections performed by the Engineer or his representatives is not intended to substitute for the Construction Manager's responsibilities under the contract documents.

1.6 Samples

1.6.1 Provide paint samples, in duplicate, on 216 mm x 279 mm x 3 mm thick hardboard, of each colour and sheen for acceptance.

1.6.2 Identify each sample as to manufacturer, finish, formula, colour name and number and sheen name and gloss units.

1.6.3 After acceptance, the samples will become the standard for work throughout the project.

1.7 Material Schedules

1.7.1 Before ordering, submit to the Engineer, a schedule of all paint types, showing brands and quality identification of material to be used.

1.7.2 Paint Schedule requirements:

.1 Ensure the Paint Schedule is endorsed by the paint manufacturers as being the best quality of the applicable paint types.

.2 Submit Schedule to Engineer for review.

.3 Keep a copy of the approved Schedule at the project site.

1.7.3 On completion, submit two (2) copies of a list of painting materials used on the project, referenced to the Colour Schedule and containing listing of suppliers and paint numbers.

1.8 Product Handling

1.8.1 Deliver paint materials to the job site in sealed original labelled containers bearing manufacturer's name, brand name, type of paint, colour designation and instructions for mixing and reducing, W.H.M.I.S material safety data sheet. Ensure that the manufacturer's labels and seals are intact and the specification number and lot number are clearly shown on the label.

1.8.2 Protect materials subject to damage by low temperatures.

1.8.3 Store paint materials at a minimum ambient temperature of 10°C.

1.8.4 Provide adequate storage facilities. Store paint materials and equipment on the job in a well-ventilated and heated single designated area. Perform mixing and preparation work in this area. Provide a CO2 fire extinguisher of 8 kg minimum capacity in the area.

1.8.5 Take all necessary precautionary measures to prevent fire hazards and spontaneous combustion. Place cotton waste, cloths and materials which may constitute a fire hazard, in closed metal containers and removed from the site at the end of each work day.

1.8.6 Where toxic materials, and both toxic and explosive solvents are used, take appropriate precautions.

1.8.7 In the event of materials damaged by the elements, improper handling, or other causes, such materials will be rejected and replaced at no extra cost to The City.

1.9 Equipment

1.9.1 Use paint application equipment, brush, roller or spray of a type and quality best suiting the work and keep clean and in a workable condition.

1.9.2 When using spray equipment, use only 'airless spray guns' for spray application. Take all necessary precautions to prevent accidental application to adjacent surfaces which are not to receive paint, or which are to receive different colour, sheen or type of paint.

1.10 Protection

1.10.1 Provide adequate protection for all surfaces from paint and damage. Place covers before painting commences and remain until completed.

1.10.2 Furnish sufficient drop cloths, shields and protective equipment to prevent spray or droppings from fouling surfaces not being painted and in particular surfaces within storage and preparation areas.

1.10.3 Protect walls where hoisting is necessary. Keep equipment away from building air intakes.

1.10.4 Provide adequate protection from finished and partially completed building finishes and equipment during the performance of Work. Provide all necessary screens, covers, hoarding, and the like, as may be required. Be responsible for all damages incurred due to improper or lack of protection.

1.10.5 Protect items such as sprinkler heads, smoke detectors and all factory finished items such as panels, existing equipment, gauges and instruments.

1.10.6 Make good all damage as a result of inadequate or unsuitable protection.

1.10.7 Post 'wet paint' signs where work is in process of drying.

1.10.8 Post 'no smoking' signs where volatile materials are being used or stored.

1.11 Environment and Surface Conditions

1.11.1 Maintain a uniform ambient temperature and provide adequate and continuous ventilation and sufficient heating facilities, during paint application and for at least 24 hours after completion of work in each area.

1.11.2 Broom clean area before painting is started.

1.11.3 Do not apply exterior paint during rainy, foggy or moist weather. Avoid painting surfaces while they are exposed directly to the hot summer sun.

1.11.4 Do not apply paint at temperatures lower than 10°C, or under dusty or other unsuitable conditions.

1.11.5 Ensure that surface conditions and moisture content are as recommended by the MPI Architectural Painting Manual, except as otherwise noted herein.

1.11.6 Measure moisture content of surfaces using an electronic "Moisture Meter". Do not apply finishes unless the moisture content of surfaces are below the following maximum values:

.1 Masonry, Concrete block and Concrete: 12%

.2 Interior located wood (equipment back boards): 15%

1.11.7 Provide a minimum lighting level of 270 Lux. on the surfaces to be finished.

1.11.8 Allow an "out gassing" period at the end of the project of minimum 3 days before The City's move in.

1.12 Additional Materials

1.12.1 Provide a list of manufacturers, types, gloss levels, and colour formula for each type of paint used on this project. Incorporate into maintenance manuals as specified in Division 1.

1.12.2 Leave on the premises at location designated by The City, a minimum of 2% extra (in any case not less than 4 litres) of all colours and paint and finish types scheduled. Provide in 4 litre or one gallon containers.

1.12.3 Tightly seal containers and clearly label for identification.

PART 2 PRODUCTS

2.1 Product Selection

2.1.1 Basis-of-Design: Materials and colours listed in drawings form the Basis-of-Design materials for this project. Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

2.1.2 Materials and products supplied by subcontractor shall match the approved samples, in all aspects, including but not limited to form, texture, size, shape, aesthetics, performance and technical specification.

2.2 Paint Materials

2.2.1 Paints, enamel, fillers and related painting materials must meet or exceed the CGSB specifications noted, and be the manufacturer's top line quality of the paint type. Paint types and manufacturers are to be as listed in the MPI Architectural Painting Specification Manual - for each paint system specified unless indicated otherwise.

2.2.2 Use ready-mixed paints unless otherwise specified, except any coating in paste or powder form, or field-catalyzed, field-mix in accordance with the directions of its manufacturer. Fully grind pigments and maintain a soft paste consistency, in the vehicle during storage, capable of being readily and uniform dispersed readily and uniformly by paddle to a complete homogeneous mixture.

2.2.3 Ensure paints have good flowing and brushing properties and dry or cure free of streaks or sags, to yield the desired and specified finish.

2.2.4 Provide the highest quality product for paint materials such as linseed-oil, shellac, turpentine, and the like, and any of the materials not specifically mentioned herein but required for good quality work with the finish specified.

2.2.5 Use same brand of paint for primer, intermediate and finish coats.

2.3 Environmental Notation

2.3.1 Incorporate the MPI Environmental Notation System (ENS) for this project. The ENS system addresses indoor air quality with environmentally preferred products from a g/L of VOC's contributed standpoint plus a duty cycle perspective. The E ratings noted below are to be the total of the "E" range number s and the applicable bonus points. Levels of acceptance as defined by MPI:

.1 E1: highest level of VOC's.

.1 E2: second lowest level of VOC's.

.2 E3: lowest level of VOC's acceptable.

2.3.2 For interior painting, remain within E1 or E2 emission levels.

2.4 Final Colours

2.4.1 Selection: Paint colours and other finishes will be selected by the Engineer.

2.5 Gloss/Sheen Ratings

2.5.1 The sheen rating of the applied paint defines the paint gloss, in accordance with the following values:

Gloss Level Category	**Units @ 60º**	**Units @ 85º**
G1 - matte finish	0 to 5	max. 10
G2 - velvet finish	0 to 10	10 to 35
G3 - eggshell finish	10 to 25	10 to 35
G4 - satin finish	20 to 35	min. 35
G5 - semi-gloss finish	35 to 70	
G6 - gloss finish	70 to 85	
G7 - high gloss finish	> 85	

2.5.2 Provide gloss level ratings of painted surfaces as specified for each painting system in this Section.

PART 3 EXECUTION

3.1 Surface Conditions

3.1.1 Thoroughly examine surfaces scheduled to be painted or finished and report defects which could adversely affect the work of this Section to the Construction Manager and Engineer in writing, for correction, before applying prime coat. Do not proceed with work of this Section until defects have been corrected and the Engineer has given instruction to proceed.

3.1.2 The commencement of painting and finishing work implies unconditional acceptance of surfaces to receive work of these specifications.

3.1.3 Ensure surfaces are clean, dry and protected from dampness and be smooth, even and true to plane.

3.1.4 Ensure that surfaces are free of any material which will adversely affect adhesion or appearance of applied coatings and other work of this Section.

3.1.5 Be responsible for the condition of surfaces or for correcting defects and deficiencies in surfaces which may adversely affect work of this Section.

3.1.6 Apply the prime coat after surface preparation has been completed, to prevent contamination of substrate.

3.1.7 After application of prime coat, re-examine surfaces for defects which may then have become apparent. Report defects to the Engineer and Contractor for correction.

3.2 Preparation

3.2.1 Prepare new surface in accordance with the Master Painters Institute (MPI) "Architectural Painting Specification Manual", current edition.

3.2.2 Remove electrical plates, surface hardware, fixtures, fittings and fastenings, and the like, prior to painting operations, unless approved by the Engineer in writing.

3.2.3 Properly prepare each surface in order to obtain correct and sufficient adhesion of next coat of material.

3.2.4 Mildew removal: scrub with solution of T.S.P. and bleach, rinse with clear water and allow surface to dry completely.

3.2.5 Remove dirt, oil, grease and sand as necessary to provide adhesion key, and when asphalt, creosote or bituminous surfaces required paint finish.

3.2.6 Remove contamination from wall surfaces and prime to show defects, if any. Carry on with paint coating after defects have been remedied.

3.2.7 Masonry: remove loose mortar, scale powder and foreign matter. Remove oil and grease with a solution of T.S.P, rinse well and allow to thoroughly dry. Fill holes which are too large to be filled by block filler as required to produce a uniform texture.

3.2.8 Steel and iron surfaces: where heavy coatings of scale or rust are evident, remove by wire brushing, sandblasting or power tool clean or any other necessary method. Ensure all steel surfaces are satisfactory before paint finishing.

3.2.9 Unprimed Steel: clean by washing with solvent and ensure weld joints, bolts and nuts are properly cleaned. Prime surfaces to indicate defects, if any. Commence with painting immediately after defects have been remedied.

3.2.10 Primed metal: remove dirt and grease by cleaning with solvent. Feather shoulders of uneven primer to prevent edges from telegraphing through finish coats. Touch up of damaged shop coating and touch up patches inconspicuous. Prime all bare steel surfaces.

3.2.11 Galvanized metal: clean with detergent and solvent to etch surface, as a spray, product #25 as per the MPI manual.

3.2.12 Canvas & Cotton Insulated Coverings (for pipe insulation and the like): remove dirt, grease and oil.

3.3 Mixing/Tinting

3.3.1 Job mix or job tint only when approved.

3.3.2 Thin only in accordance with manufacturer's directions and specifications, using manufacturer's recommended thinning agents.

3.3.3 Ensure tinting colours are as recommended by manufacturer for the specific type of paint.

3.3.4 Tint all primers and undercoats to approximate shade of the selected finish coat.

3.4 Priming and Backpriming

3.4.1 Prime top and bottom edges of metal doors with enamel undercoat, prior to application of finish coat.

3.4.2 At all site weld connections, brush apply all coats of paint. Blend colour and finish into spray applied finishes to ensure uniform final appearance.

3.4.3 Touch up damaged surfaces of item which have been shop primed under other Sections.

3.4.4 If shop applied primers do not comply with the quality or type of primer specified herein, field prime with applicable primer.

3.5 Application

3.5.1 Refer to SSPC-PA-1 and to the Master Painting Contractors Architectural Painting Specification Manual, as a general reference for application techniques, requirements and precautions.

3.5.2 Finishes specified are intended to cover surfaces satisfactorily when applied in accordance with the manufacturer's recommendations. Re-paint surfaces to achieve hiding of substrate and uniform finish.

3.5.3 Mix materials thoroughly before application and apply evenly, free from sags, and other defects. Perform cutting-in neatly.

3.5.4 Lightly sandpaper each coat before the next coat is applied. After the prime coat is applied, fill holes and sand smooth when dry.

3.5.5 Tint each coat slightly darker than the preceding coat, unless otherwise approved by the Engineer.

3.5.6 Ensure that finish work is uniform in sheen, colour and texture and free from roller or brush hair, with no indication of base coat visibility. Do not exceed sleeve NAP of 10 mm on metal doors. Telegraphing through of the base colours is not acceptable and will be considered a deficiency.

3.5.7 Clean droppings and over-spray as work progresses.

3.5.8 Use brush application on doors and metal surfaces, unless otherwise directed. On other surfaces, roller work is acceptable, but if this does not prove to give satisfactory results, repaint rejected surfaces with brush at no additional cost to The City.

3.5.9 Apply each coat at the proper consistency in accordance with the manufacturer's directions.

3.5.10 Each coat of finish should be dry and hard before a following coat is applied unless the manufacturer's directions state otherwise. Allow each coat of finish to dry 24 hours before a following coat is applied unless directed otherwise by the Engineer.

3.5.11 Finish a whole panel, door or frame and the like, rather than spot painting of facing off where a portion of the finish has been damaged or is unsatisfactory.

3.5.12 Paint top and bottom edges of metal doors to match faces.

3.5.13 Completely paint items such as doors, frames, and the like (e.g. Both sides of door and total frame).

3.6 Mechanical and Electrical Items

3.6.1 Refer to mechanical and electrical Sections with respect to painting and finishing requirements.

3.6.2 Remove grilles, covers and access panels for mechanical and electrical.

3.6.3 Finish paint primed equipment.

3.6.4 Do not paint heating and ventilation units with factory finish or stainless steel finish. Apply two coats of machinery enamel to units with prime coat finish.

3.6.5 Paint fire hose cabinets and convectors. Paint pipes, ducts, and conduit where exposed. Do not paint flexible ducts, connectors or isolators.

3.6.6 Paint pipe coding bands, where pipes are concealed, in accordance with CGSB 24-GP-3 "Identification and Classification of Piping Systems".

3.6.7 Replace identification markings on mechanical and electrical equipment when painted over or spattered.

3.6.8 Paint all surfaces of mechanical and electrical items occurring in finished areas, including non-ferrous metal. Colour and texture to match adjacent surfaces. Paint identification bands at least once where pipe or conduit enters and leaves each space. Paint inside of fire hose cabinets.

3.7 Paint Types

3.7.1 Apply paint types to interior surfaces as indicated in the Finish Schedule.

3.7.2 Apply paint types to exterior surfaces as indicated in the Exterior Paint Schedule in this Section.

3.8 Painting Schedule

3.8.1 Apply paint as follows in accordance with the manufacturer's recommendations and Master Painters Institute Architectural Specification Manual and the paint manufacturer.

3.8.2 Exterior Surfaces:

.1 Galvanized Steel: EXT 5.3B - Premium Grade

- .1 1st Coat- Cementitious Primer
- .2 2nd Coat- Exterior Alkyd G5 Gloss Level
- .3 3rd Coat- Exterior Alkyd G5 Gloss Level

3.8.3 Interior Surfaces:

.1 Concrete Block: INT 4.2K - Premium Grade

- .1 1st Coat- Latex Block Filler
- .2 2nd Coat- W.B. Light Industrial Coating G5 Gloss Level
- .3 3rd Coat- W.B. Light Industrial Coating G5 Gloss Level

.2 Steel: INT 5.1E - Premium Grade

- .1 1st Coat- Alkyd Metal Primer
- .2 2nd Coat- Interior Alkyd Enamel G5 Gloss Level
- .3 3rd Coat- Interior Alkyd Enamel G5 Gloss Level

.3 Galvanized Steel: INT 5.3C - Premium Grade

.1 1st Coat- Cementitious Primer

.2 2nd Coat- Alkyd Enamel G5 Gloss Level

.3 3rd Coat- Alkyd Enamel G5 Gloss Level

.4 Electrical Backboards: INT 6.4P - Pigmented - Premium Grade

.1 1st Coat- Shellac or Correct Sealer

.2 2nd Coat- Clear Intumescent Coating

.3 3rd Coat- Clear Intumescent Coating

.4 4th Coat- Clear Intumescent Coating

.5 Canvas & Cotton Insulation Covers: INT 10.1A - Premium Grade

.1 1st Coat- Latex Primer Sealer

.2 2nd Coat- Latex G3 Gloss Level

.3 3rd Coat- Latex G3 Gloss Level

3.9 Extent of Paint Application

3.9.1 Exterior:

.1 Paint metalwork (ferrous and galvanized), and other surfaces normally requiring painting. Ferrous metals are specified to have shop-applied zinc-rich primer.

.2 Paint exterior hollow metal doors and frames.

.3 Paint all other exposed not otherwise finished.

3.9.2 Interior:

.1 Paint all interior hollow metal doors and frames. Paint all exposed exterior metal fabrications, structural steel, steel joists and underside of steel deck. Paint all interior concrete block which is not receiving special coating.

.2 Refer to Section 09961 for special wall and ceiling coatings where indicated.

.3 Paint all surfaces not otherwise finished, in exposed locations throughout the project.

3.10 Cleaning

3.10.1 Remove paint marks and spatterings, as work proceeds and on completion.

3.10.2 During the progress of the work keep the premises free from any unnecessary accumulation of tools, equipment, surplus materials and debris.

3.10.3 Upon completion of work leave premises neat and clean, to the satisfaction of the Engineer.

3.11 Room Finish Schedule

3.11.1 Provide room finishes in accordance with, but not limited to the schedule provided on the Drawings.

END OF SECTION

MISCELLANOUS SPECIALTIES

PART 1 GENERAL

1.1 Summary

1.1.1 The contractor shall examine all drawings and specifications to ascertain the scope of the work, including all drawings of the consulting engineers.

1.1.2 This Section includes the following:

.1 Furnish labour and materials to complete miscellaneous specialties work indicated on drawings and specified herein.

1.2 Submittals

1.2.1 Submit product data, samples, shop drawings in accordance with Division 1 General Requirements.

1.2.2 Submittals

.1 As applicable

1.2.3 Materials: Applicable to their respective divisions.

1.2.4 All exterior finishes to match adjacent finishes in colour, texture, and appearance unless otherwise noted.

1.2.5 Provide samples for consultant review prior to installation.

1.2.6 All components to be supplied and installed by qualified trades.

1.3 Delivery, Storage, and Handling

1.3.1 Protect during delivery, storage, and handling to comply with manufacturer’s direction and as required to prevent damage.

1.4 Warranty

1.4.1 For all specified products of this Section, Manufacturer/Supplier to provide a minimum 1-year warranty against manufacturers defects, commencing from the date of Substantial completion of the Work.

PART 2 PRODUCTS

2.1 Product Selection

2.1.1 Basis-of-Design: Materials and colours listed in drawings form the Basis-of-Design materials for this project. Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

MISCELLANOUS SPECIALTIES

2.1.2 Materials and products supplied by subcontractor shall match the approved samples, in all aspects, including but not limited to form, texture, size, shape, aesthetics, performance and technical specification.

2.2 Materials

2.2.1 The manufacture (s) mentioned should be used to form the Basis of Design only. The subcontractor can submit equivalent or better proposals for final approval during construction in accordance with Division 1.

2.3 FRP Wall Protection

2.3.1 Provide fiberglass reinforced plastic (FRP) wall panels with high-impact resistance, moisture resistance, and smooth, non-porous surface suitable for service and utility areas. Panels shall be resistant to staining, chemicals, and routine cleaning. Install complete with manufacturer-recommended trims, fasteners, and adhesives to provide a durable, hygienic, and easily maintainable wall protection system.

2.3.2 Basis of design: Glasbord FRP panels, Pearl Gray 48, or approved equivalent.

2.4 Attic hatch

2.4.1 Provide ceiling-mounted attic access hatch as indicated on Drawings to allow maintenance access to attic or ceiling space above Pump Room 102. Hatch shall be insulated where located in insulated ceilings and shall maintain the ceiling's fire rating and air barrier where applicable. Provide frame, hinged access panel, and secure latch system suitable for frequent maintenance access.

2.4.2 Access hatch shall be durable, corrosion-resistant, and sized appropriately for maintenance access. Installation shall ensure tight fit within ceiling assembly and maintain surrounding ceiling finishes.

2.5 Metal Wall Cladding

2.5.1 Basis of design: Bellara Metal Plank Series – Plank 135

2.5.2 Manufacturer: Vicwest

2.5.3 Color: Warm Rosewood

2.5.4 Pre-finished galvanized steel plank siding, concealed fastener system.

2.5.5 Minimum 24 ga (as indicated on Drawings).

2.5.6 Designed to meet applicable wind load requirements.

2.5.7 Non-combustible steel substrate.

2.5.8 Installed as ventilated rainscreen over WRB and continuous insulation.

2.5.9 Provide manufacturer's trims, flashings, and accessories.

MISCELLANOUS SPECIALTIES

2.6 Manufactured Stone Veneer

2.6.1 Basis of design: Black Tusk Random Ledge

2.6.2 Manufacturer: IXL Building Products

2.6.3 Color: Black Tusk

2.6.4 Lightweight manufactured stone veneer, Random Ledge profile.

2.6.5 Freeze-thaw resistant; suitable for exterior applications.

2.6.6 Installed as adhered veneer over code-compliant WRB and drainage plane.

2.6.7 Corrosion-resistant lath, mortar, flashings, and weeps per manufacturer.

2.6.8 Designed to accommodate structural movement and moisture drainage.

2.7 Prefinished Metal Snow Guards

2.7.1 Material: Prefinished metal compatible with roofing system.

2.7.2 product: 3M™ DBI-SALA® Standing Seam Roof Anchor

2.7.3 Model/Part Number: 2190073

2.7.4 OSHA Compliance 29 CFR 1910.140, 1926.502

2.7.5 Maximum Working Load 420 lb (190 kg)

2.7.6 Material Corrosion-resistant aluminum & steel

2.7.7 Mounting Clamp-on, non-penetrating

2.7.8 Roof Compatibility Standing seam (flat/sloped)

2.7.9 Seam Spacing Compatibility 12", 24", 30", 32", 36"

2.7.10 Weight ~27.7 lb (12.6 kg)

2.7.11 Installation:

.1 Installed per manufacturer’s spacing and attachment requirements.

.2 Integrated with roofing system without penetrations where possible.

2.7.12 Standards: Engineered system suitable for Canadian snow load requirements.

2.8 Premanufactured Concrete Splash Pads

2.8.1 Material: Precast concrete.

2.8.2 Finish: Smooth or broom finish suitable for exterior exposure.

2.8.3 Dimensions: Sized to receive full discharge from downspouts.

2.8.4 Performance Requirements:

.1 Designed to prevent soil erosion and foundation splashback.

.2 Frost-resistant and suitable for freeze-thaw conditions.

2.8.5 Installation:

.1 Installed level on compacted base.

.2 Positioned to direct water away from building foundation.

2.8.6 Standards: CSA-approved concrete products for exterior use.

PART 3 EXECUTION

3.1 Installation

3.1.1 Install miscellaneous manufactured specialties according to supplier/manufacturer's written directions, using recommended fasteners and techniques for proper installation.

3.2 Cleaning and Protection

3.2.1 Clean surfaces upon completing installation to remove dust, dirt, adhesives, and other foreign materials according to manufacturer's written instructions.

END OF SECTION

DIVISION 11 PROCESS MECHANICAL

PART 1 GENERAL

1.1 Description

1.1.1 This section specifies general clauses applicable to the supply and installation of all process mechanical systems.

1.1.2 The process mechanical systems include all of the systems handling process fluid and those directly related to the process system.

1.1.3 The Work under this section shall include the supply, installation, testing and start-up of the Process Mechanical Material and Products to provide a complete and workable installation in accordance with the drawings and specifications, and all applicable codes, standards and ordinances. Any work and/or other necessary materials that are not specifically mentioned in the specifications or shown on the drawings, but are necessary to be completed the installation shall be furnished by the Contractor as if specifically mentioned herein and detailed.

1.2 Related Work

1.2.1 Refer to Division 16 for Electrical work related to Process Mechanical work.

1.2.2 Refer to Division 13 for Controls and Instruments related to Process Mechanical work.

1.2.3 Refer to Division 15 for Building Services Mechanical Systems.

1.2.4 All Sections Division 1 - are an integral part of this specification and shall be read in conjunction herewith.

1.2.5 The process mechanical drawings do not show structural details and any information involving accurate measurements of buildings. Refer to architectural and structural drawings as well as all other divisions of this specification.

1.2.6 Piping and mechanical work shall be painted in accordance with the painting specifications in Division 9 and in accordance with this specification with regard to pipe identification.

1.3 Permits, Certificates, Fees

1.3.1 The Contractor shall give all notices, obtain all permits and pay all fees so that the work specified herein may be carried out.

1.3.2 The Contractor shall make all necessary arrangements with Utilities Companies for services and meters as required, and pay for all the costs involved.

1.3.3 Refer to Division 1, Section 01060 - Regulatory Requirements.

1.4 Codes and Standards

1.4.1 The Alberta Environment Standards and Guidelines for Municipal Water Supply, Wastewater and Storm Drainage Facilities (2006), shall apply to the work of this Section.

1.4.2 Welding shall conform to the ANSI/ASME Power Piping Code and the ASME Boiler and Pressure Vessel Code.

1.4.3 Welders shall be qualified and licensed in Alberta, and welder qualifications shall be in accordance with CAN3-Z183-M86.

1.4.4 Welding safety requirements shall be in accordance with CAN/CSA-W117.2-M87 - Code for Safety in Welding and Cutting.

1.4.5 Work shall be performed in accordance with the Regulations of the Occupational Health and Safety Act.

1.4.6 Installation shall be in accordance with the National Building Code and all regulations and codes of the Province, Territory or Municipality in which the work is located.

PART 2 PRODUCTS

2.1 Approved Alternatives

2.1.1 Approval of alternative equipment shall be in accordance with Instructions to Tenderers.

2.1.2 All equipment shown on the drawings and specified is the recommended equipment and is to be used unless permission for an approved equivalent alternative is obtained.

2.2 Product Delivery, Storage, Handling

2.2.1 All materials and equipment shall be delivered, handled and stored subject to the provisions contained herein and according to the manufacturer's recommendations.

2.2.2 Provide temporary storage facilities and heated storage where required for sensitive items such as motors.

2.2.3 All equipment, including pumps and motors, shall not be placed in temporary or final locations in the new structures before a date approved by the Engineer. The date of delivery into the structure shall be commensurate with the construction progress and the suitability, with respect to temperature, humidity, etc. of the building.

2.2.4 Take precautions to maintain equipment in good condition and to avoid corrosion or other damages which may affect the equipment's performance. Provide temporary coatings as required to prevent corrosion.

2.2.5 Leave factory covers in place and prevent entry of foreign materials into working parts of equipment.

2.2.6 Protect all members and bearings with plastic covers.

2.2.7 Grease all shafts and sheaves to prevent corrosion.

2.2.8 The Contractor shall recognize the time interval required for complete construction before the structure is suitable for equipment installation. If equipment is manufactured before it is required at the site, the Contractor shall provide suitable heated dry storage space for the equipment, to the approval of the Engineer. All equipment and motors shall be rotated at least weekly during the storage period, and after installation, until the equipment is placed in normal use.

2.2.9 All material damaged or otherwise harmfully affected during delivering; storage, handling or installation shall be replaced by the Contractor at his own expense.

2.2.10 The Owner or the Owner’s representative will inspect and approve all materials before installation.

2.3 Equipment Supports, Anchors, Bases

2.3.1 The Contractor shall provide all structural work required for foundation and support of units, foundation bolts, sleeves, washers, nuts, shims and templates to locate bolts.

2.3.2 Anchor bolts shall be set in concrete with one end of the bolt hooked as detailed; or sleeved anchor bolts as detailed may be set in concrete. Expansion type bolts drilled into concrete may not be used in lieu of anchor bolts.

2.3.3 Provide a minimum of 25 mm non-metallic grout between bedplates and concrete foundation, fill voids, finish and remove wedges after grout is set. Grout shall be Embeco or approved equivalent alternative, non metallic type.

2.3.4 Where grouting is required for bedplates and equipment bases on concrete foundation; the surface of the concrete foundation shall be roughened to provide a bond.

2.3.5 All bases shall be finished to match the floor.

PART 3 EXECUTION

3.1 Installation

3.1.1 Follow the recommended installation details and procedures for all equipment as found in the supplier's technical data, supplemented by the shop drawings, the drawings, the specifications and the directions of the Engineer. The equipment installation shall be by qualified Millwright.

3.1.2 Install mechanical work in advance of concrete pouring as necessary.

3.1.3 For equipment or material of the same type or classification install only products of one manufacturer.

3.1.4 Install all equipment with adequate access for inspection and servicing.

3.1.5 Employ only skilled tradesmen properly licensed by the Province or Territory, for all work requiring tradesmen with special skill.

3.1.6 Motors shall be aligned, shimmed and coupled to fit shafts, to the tolerances given by the manufacturer.

3.1.7 Set the equipment in place and install pipes, fittings, valves and other items. Make final adjustments in alignment and elevation before securely fastening equipment and other items in place.

3.1.8 Control alignment so that excess forces are not imposed on equipment when piping connections are tightened.

3.1.9 Do not tighten pipes until grout is set.

3.1.10 Tighten so that there is no excessive stresses set up in flanges.

3.2 Vibration Isolation

3.2.1 Balance rotating equipment statically and dynamically for minimum vibration and low operating noise level.

3.2.2 Provide flexible connectors to pipes for all equipment supported by vibration isolators.

3.2.3 Provide flammable proofed flexible connectors between fans, heaters, equipment and ducts.

3.2.4 Equipment installed by the Contractor shall operates smoothly without excessive wear, adjustment and attention. Vibration shall not exceed the manufacturer's specified limits for individual products. Vibrations in pumps shall be within acceptable field vibration limits as outlined in the Standards of the Hydraulics Institute.

3.3 Guards

3.3.1 Provide the vibration free guards for all exposed drives and rotating parts to meet safety requirements.

3.3.2 Provide means to permit lubrication, use of test instruments, and the movements of motors to adjust belt tension.

3.4 Minor Deviations

3.4.1 The Contractor shall allow for additional material such as pipes, and ducts for modifications that may be required to correct minor conflicts or deviations.

3.5 Primary Measuring Elements

3.5.1 Install all primary elements specified in Division 13 - Controls and Instrumentation.

3.6 Shop Drawings

3.6.1 Shop drawings shall be submitted in accordance with Section 01300 - Division 1, and in accordance with the requirements of the various sections of Divisions 11.

3.6.2 The Contractor shall submit shop drawings and data for all products, components and control systems provided under Divisions 11, all sections.

3.6.3 The contractor shall submit with equipment shop drawing spool drawings on all major piping runs. Provide specific details of the valve actuator positions for maintenance and operation. This information shall be included with each valve shop drawing.

3.7 Operation And Maintenance Manuals

3.7.1 Submit operation and maintenance manuals in accordance with Section 01700 - Division 1, and in accordance with the requirements of Division 11, all sections.

3.7.2 Operation and Maintenance Manuals Specific to Process Mechanical shall include and be arranged as follows:

Tab 1.1 Lists of Process Drawings

Tab 1.2 Description of Systems: Provide a complete description of each mechanical system within the building. Include an explanation of each component comprising the system and a description of how each component interfaces with others within the system. Indicate the location of mode of energization, switches and controls and sequence of operation.

At the end of each system list the manufacturer, type, designation and location of each mechanical component.

Tab 1.3 Operation Division: Provide a comprehensive explanation of operation for each mechanical component. Include start up procedures, remote set point adjustments, condition indicators, alarms, how the mechanical component interfaces with other components, control sequences, operational changes for summer and winter operation, and how to accomplish changeover, and safeguards to check if equipment goes off line.

Tab1.4 Maintenance and Lubrication Division: Provide a preventive maintenance schedule for each of the major components to include daily, weekly, monthly, semi-annual, and yearly checks and tasks. Include this information as a separate preventive maintenance schedule. Provide lubrication information and instructions which will explain the various bearings and lubrication procedures.

Tab 1.5 List of Equipment Suppliers and Contractors: Provide a complete list of equipment suppliers and contractors, including address and telephone number, separate from that which is indicated in "Tab 1.2".

Tab 2.0, 2.1, etc. Certification: Include copy of test data, hydrostatic or air tests performed on piping systems, equipment alignment certificates, copy of valve tag identification and pipe colour code.

Tab 3.0, 3.1, etc. Manufacturer's Shop Drawings and Maintenance Bulletins: Include materials as received in compliance with clause "Shop Drawings".

3.7.3 Provide two complete manuals including system description two weeks prior to startup. These are for Owner's and Engineer's review.

3.7.4 Upon completion of performance tests and debugging, provide corrected system description and correct differences in manuals noted by Owner and Engineer.

3.7.5 Individual check sheets shall be prepared for all mechanical equipment. Each check sheet will contain specified design, shop drawing and actual on site information as follows:

- designation
- location
- manufacturer
- model number
- serial number
- voltage
- current
- phase
- power
- peak load performance
- control set points
- safety limit set points
- equipment interlocked by controls

- control sequence

3.8 Manufacturer's Representative

3.8.1 Refer to Division 1 General Requirements, Section 01700 and to other sections of Division 11 with regard to start up and check out services by the manufacturers of equipment.

3.9 Painting

3.9.1 Piping and valves shall be painted in accordance with paint specifications in Division 9.

3.9.2 All unpainted equipment and appurtenances shall be given shop prime paint suitable for field painting as specified in Division 9.

3.9.3 Hangers, supports and fabricated equipment shall be primed and painted as specified in Division 9.

3.9.4 Equipment having a finished shop coat shall be touched up.

3.9.5 Do not paint over nameplates.

3.10 Identification Of Equipment

3.10.1 Provide a manufacturer's nameplate on each piece of equipment.

3.10.2 Provide system nameplates on each piece of mechanical equipment as follows:

.1 Minimum size 75 mm x 35 mm x 2.5 mm thick laminated plastic with black face and white centre. Letters to be 6 mm high.

3.10.3 Identify each piece of equipment by type and number.

3.11 Identification Of Piping

3.11.1 All piping shall be colourful coded in accordance with the code shown in Section 01080 - Identification Systems, and Division 9.

3.11.2 Colours will be primary colours, numbered in accordance with CGSB Standard Paint Colours.

3.11.3 The entire length of each pipe will be painted in the basic colour, with bands to indicate the specific fluid, and an arrow to indicate flow direction.

3.11.4 Bands shall be 25 mm wide.

3.11.5 Use standard plastic colour bands and marker tags on small piping.

3.11.6 Direction arrows shall be black 150 mm x 25 mm.

3.11.7 Arrows shall be painted at each branch and termination point.

3.11.8 Locate markers from usual operating areas and identify piping runs at least once in each room and where piping enters or leaves a room.

3.12 Valve Directories

3.12.1 Tag all valves and floor stands to the corresponding valve number.

3.12.2 Tags shall be 20 mm brass, lamacoid, metal photo or aluminum tags with black numbers, secured to the valve stem with a key chain.

3.12.3 Prepare a schematic diagram of the various piping systems in the building and on each diagram show the valve number and the purpose of the valve. Frame one copy of each under glass for wall mounting as directed.

3.12.4 All branch and main valves shall be consecutively numbered and identified on the schematic and on the list.

3.12.5 Tag automatic controls, instruments and relays and key to control shop drawing identification numbers. Tag all equipment excluding pipes and ducts.

3.13 Electric Starting Switch Identification

3.13.1 Identify electric starting switches, remote push button stations and equipment supplied under this division with lamacoid plates having 6 mm minimum letter size. Identification to state equipment controlled.

3.14 Cleanup And Disinfection

3.14.1 All piping and equipment shall be thoroughly cleaned of dirt, cuttings, and other foreign substances.

3.14.2 Disconnect, clean and reconnect whenever necessary for purposes of locating and removing obstructions.

3.14.3 Flush and chlorinate all potable water systems as specified in plumbing codes and where applicable, in accordance with AWWA standards for Disinfection of Facilities.

3.15 Lubrication

3.15.1 For all equipment furnish all lubricants used during testing and trial runs.

3.15.2 .2 For equipment supplied by the Contractor, furnish lubricants in sufficient quantity 12 months operation by the Owner.

3.15.3 Identify lubricants furnished by brand, grade and item of equipment for which it is intended.

3.15.4 Operate, drain and flush out bearings and refill with a new change of oil before completion.

3.16 Drawings Of Record

3.16.1 Refer to Division 1, Section 01390 - Drawings of Record.

3.16.2 Drawings of Record are required for process mechanical revisions.

3.16.3 The Contractor shall maintain, at the site, a separate set of process mechanical drawings on which he shall record all changes and deviations from the original plans and specifications.

3.17 Motors

3.17.1 Motors supplied for Process Mechanical Equipment shall be suitable for hard, continuous service according to EEMAC and CSA Standards, and shall operate free of vibration.

3.17.2 Motors shall be drip proof open type, TEFC or explosion proof as required for the service indicated. Under full load the motor temperature rise shall not exceed 40°C for open types and 50°C for enclosed types.

3.18 Cutting And Patching

3.18.1 Refer to Division 1, Section 01040 - Coordination which shall apply to the work of this section.

3.18.2 The Contractor shall locate and provide holes and sleeves for all process mechanical work in accordance with the drawings and specifications, and in accordance with Section 01040.

3.19 Temporary Use

3.19.1 Refer to Section 01500 - Construction Facilities regarding temporary use of process mechanical piping and/or equipment.

END OF SECTION 11100

PART 1 GENERAL

1.1 Description

1.1.1 Installation, including the supply of anchor bolts, and testing of equipment supplied by others and supplied under other sections in Division 11.

1.2 Definitions

1.2.1 Testing: In this Division, testing is defined as the operation of a specific item of equipment under actual and/or simulated conditions for the purpose of ensuring the equipment satisfies its basic design criteria. Contractor will conduct testing and be responsible for all materials, labour, power and equipment required to conduct the tests. The Equipment Manufacturer is to provide technical assistance to the Contractor for the installation, testing, start-up and commissioning of the equipment supplied. Refer to Section 01650.

1.2.2 Commissioning: In this Division, commissioning is defined as the operation of equipment systems under actual and/or simulated conditions for the purpose of ensuring the system performs its intended functions. Refer to Section 01650.

1.3 Shop Drawings

1.3.1 Check all the shop drawings relative to the equipment and materials, dimensions, measurements, size of members, type of materials, controls, list of equipment being supplied, names of manufacturers, and other details to affirm that they are correct and conform to the requirements and intent of the Contract.

1.3.2 Where the shop drawings are submitted with coordination information missing, such as dimensions of structures, the Engineer will return the submission as soon as practicable marked “Revise & Resubmit.”

PART 2 PRODUCTS

2.1 Equipment Schedule

2.1.1 Unless indicated or specified otherwise, supply and install all equipment listed on the equipment specification sheets, or shown on the drawings.

2.1.2 Incorporate all ancillary devices in the installation including those providing for cooling water, seal water, lubricant supply, process drains, electrical connection, and instrumentation and control requirements.

2.2 Mounting Requirements

2.2.1 Provide all supports, anchorage, and mounting of all equipment in accordance with the manufacturer's recommendations, the Alberta Building Code, and industry standard requirements, unless otherwise specified.

2.2.2 Design and provide all elements required to resist the calculated forces or required by the element manufacturer.

2.2.3 Design anchorage for all equipment bases, supports, and foundations in accordance with ABC. For seismic loads, design for horizontal acceleration at 0.05g, applied at the centre of gravity of the element.

2.2.4 For rotating equipment, where specified for the specific item of equipment, submit design notes and calculations for anchorage, signed and sealed by a Professional Engineer.

2.3 Anchor Bolts

2.3.1 Design all equipment anchorage to withstand operating stresses and seismic loads. Provide design calculations and design summary, stamped by a Professional Engineer in the Province of Alberta.

2.3.2 Rotating Equipment above 15 kW

.1 Use Grade B8C or Grade B8M anchor bolts, to ASTM A193, with a yield strength in excess of 550 MPa. Place a stainless steel washer (AISC 316) at the base of the bolt and tack weld to provide sufficient pull-out resistance.

.2 Place a corrugated polyethylene sleeve over the upper 30 to 50 percent of the bolt length when casting in place to prevent the ingress of concrete.

2.3.3 Rotating Equipment below 15 kW: use adhesive anchors of 316 Stainless Steel

2.3.4 Epoxy Grout: 100 percent solids, non sag, insensitive to moisture, vibration resistant, corrosion resistant.

2.3.5 Provide nuts and washers of the same material and of equal or greater strength than bolts. Use tapered washers where the mating surface is not square with the nut.

2.3.6 Where stainless steel anchor bolts are required, double nut all connections or use nylon locking nuts.

PART 3 EXECUTION

3.1 Coordination

3.1.1 Coordinate the work specified under this Section with the work of other Sections.

3.1.2 Coordinate the placement of equipment bases and housekeeping pads with Division 3.

3.1.3 Coordinate the routing of ancillary piping with Division 11 and Division 15.

3.1.4 Coordinate the routing of electrical and control wiring and conduit with Division 16.

3.2 Preparation

3.2.1 Before commencing installation of the work, inspect and take field measurements and ensure that work conducted previously in the area is not prejudicial to the proper installation of the works.

3.2.2 Refer to the equipment specifications, specification sheets, and Shop Drawings to determine the form in which equipment is to be shipped and the extent of field assembly required.

3.2.3 Dimensions shown on the Contract Documents for equipment bases, piping connections, etc., are approximate and must be adjusted by the Contractor to suit the exact dimensions of the equipment provided for each application. Arrange any necessary modifications to piping connections, pipework, or other ancillaries at no cost and after acceptance by the Engineer.

3.2.4 Schedule manufacturer's representative site visits for the times and periods specified in other sections. Cooperate in his supervision of the installation and start-up. Follow all reasonable instructions of the manufacturer's representative. Should the Contractor require the manufacturer's representative to attend for longer or more frequent periods he shall arrange this, at his own expense, with the manufacturer.

3.3 Installation of Equipment

3.3.1 Install all equipment specified in other sections, detailed on the equipment specification sheets, or shown on the drawings.

3.3.2 Supply and install all necessary shims, gaskets, etc., required to complete the installation.

3.3.3 Provide all necessary lifting and loading equipment and all tools required to complete the installation.

3.3.4 Comply with the specific requirements for installation noted in other sections of this specification and with the instructions of the Manufacturer. Where there is a conflict in these requirements, identify the conflict to the Engineer and proceed as directed.

3.4 Equipment Bases and Anchorage

3.4.1 For rotating equipment above 15 kW and for equipment requiring structural anchoring, set anchor bolts in advance. For other equipment, drill anchor bolt locations after concrete pour. Use machine base templates where shown.

3.4.2 Cast in place anchor bolts:

.1 After concrete pour, cut off top of sleeve flush with concrete.

.2 After adjustment of anchor bolts to suit equipment, fill void with epoxy grout.

3.4.3 Adhesive anchor bolts

.1 Drill anchor bolts after concrete has poured. Ensure hole is sufficiently sized to accept epoxy grout.

.2 Place anchor bolt in prepared hole and apply grout as per manufacturer's directions.

3.4.4 Place equipment bases on shims to appropriate height to ensure level installation.

3.4.5 Prepare base plate grout as specified in Division 3 and provide full contact with the equipment bases unless otherwise recommended by the equipment manufacturer and accepted by the Engineer. Neatly bevel, form or trim the grout.

3.4.6 Where equipment is supplied with a plate steel base, use a pour grade, non-shrink, non-metallic grout as specified in the structural concrete specifications to fill the entire void under the base.

3.5 Alignment

3.5.1 Set and align all rotating equipment in accordance with the more stringent requirements of either the manufacturer's requirements or the following:

.1 Level base, use machinists level on all machined bases.

.2 Align couplings to satisfy the following criteria:

Coupling Speed	Allowable Angular Misalignment	Allowable Parallel Misalignment
Under 100 rpm, below 50 hp	4'00"	0.25 mm
Under 100 rpm, 50 hp and above	3'00"	0.12 mm

100 to 600 rpm	2’00”	0.12 mm
600 to 1800 rpm	1’00”	0.10 mm
1800 to 3600 rpm	0’35”	0.05 mm

.3 Check for soft foot, maximum permissible 0.002 mm.

3.5.2 Where equipment undergoes a substantial differential temperature rise (30°C between driver and driven unit), provide precision benchmarks in foundation and on equipment and perform alignment at operating temperatures.

3.5.3 Demonstrate to The Owner, Engineer, and Manufacturer’s Representative the final alignment.

3.6 Lubricants

3.6.1 Extend any inaccessible lubrication points and lubricant drains to convenient locations.

3.6.2 Remove storage lubricant and provide the initial fill of new lubricants for the equipment. Lubricant grade to be as recommended by the Manufacturer.

3.7 Vibration Survey

3.7.1 Qualified personnel to conduct a vibration survey under normal operating conditions for all equipment with a motor size exceeding 37 kW and for smaller units where specified.

3.7.2 Use a calibrated vibration sensor, accepted by the Engineer, and capable of measuring unfiltered vibration velocities and peak to peak amplitudes. Select a sensor capable of measuring velocities at a precision of 0.1 mm/s and an accuracy of plus or minus 0.2 mm/s.

3.7.3 Monitor vibration in all three dimensions at the head and tail end of both the driver and driven units, at intermediate bearing points, and at other critical locations which may be identified by the Engineer.

3.7.4 Record the vibration velocities for each item of rotating equipment and submit a report to the Engineer detailing the findings. Include a description of the measuring equipment, identification of equipment on which vibration monitoring was completed, description of conditions under which the test was conducted, and a listing of all of the collected data.

3.7.5 Unless specified otherwise, use unfiltered velocities as the vibration criteria. Unfiltered velocities less than 5 mm/sec shall be considered acceptable. Undertake corrective action where unfiltered velocities exceed 5 mm/sec.

3.8 Quality Assurance Forms

3.8.1 Test all process equipment to ensure the equipment operates in accordance with the basic design criteria listed in the specification sections or equipment specification sheets. Complete the series of forms that attest to the proper installation and functioning of the equipment. Refer to Section 01650 for the Forms.

END OF SECTION 11101

1. Description

.1 This section refers to testing of process mechanical piping and equipment.

.2 Testing of underground piping shall be in accordance with Section 02713, Pressure Pipe.

2. Related Work

.1 Quality Control - Section 01400

.2 Commissioning - Section 01650

3. General Testing

.1 Test all equipment and material where required by contract specification or authority having jurisdiction to demonstrate its proper operation. All tests shall be witnessed by the Engineer.

.2 Provide all equipment, materials and labour for tests and pay all expenses for conducting same. All instruments shall be tested by an approved laboratory and test results and certificates showing degree of accuracy shall be furnished to the Engineer. If permanent gauges, thermometers, etc. are used for tests these shall not be installed until just prior to the tests to avoid possible changes in calibration.

.3 Should tests indicate defective work or performance at variance with specified requirements, make all changes immediately to correct the defects.

.4 The Contractor shall be in charge of the work during tests. He/she shall assume responsibility for damages in the event of injury to the personnel, building or equipment and shall bear all costs for liability, repairs and restoration.

.5 Perform tests as specified and upon completion of mechanical installation, provide certification of tests with detailed data as required. Itemize each test as to time performed and personnel responsible. Obtain certificates of approval, acceptance and compliance with rules and regulations from authorities having jurisdiction. Include these certificates in the Operation and Maintenance manuals. This work will not be considered complete until such certificates have been delivered to the Engineer.

4. Pressure and Leakage Testing

.1 Hydraulic tests shall be carried out for a period of 8 hours and pressure maintained with no appreciable pressure drop. Where leakage occurs, repairs shall be made and the entire system shall be retested.

a) Process piping shall be tested at normal operating pressure plus 300 kPa or 1030 kPa water pressure, whichever is greater, measured at the low point in the system or as specified otherwise.

.2 Lines which will be normally open-ended on completion of the work shall be initially plugged for testing purposes.

.3 Air shall not be used a test medium for systems not using air.

.4 Leaks in screwed fittings shall be corrected by remaking joints; leaks in welded joints shall be cut out and rewelded; leaks in copper lines shall be corrected by remaking joints. Caulking will not be permitted.

.5 Leaks in valves shall be rectified as required to meet valve specifications.

.6 Test air lines with compressed air. Maintain a pressure of 70 kPa for a period of 24 hours. Pressure drop shall not exceed 3.5 kPa in 24 hours, after allowance for temperature changes.

5. Performance Testing

.1 After the mechanical installations are completed and pressure tested, conduct performance tests to demonstrate that the equipment and systems actually meet the specified requirements.

.2 Lubricate all bearings, adjust and/or replace and set all direct drives and "V" belt drives for proper alignment and tension; calibrate and adjust all thermostats, thermometers, linkage and dampers; operate and test all motors and speed switches for correct wiring, sequences, check all heaters in motor starters; replace and clean all filters, flush out lines and equipment, remove and clean all strainers; fill all water systems and purge all air; clean fan wheels, heating and cooling coils; fasten all loose and rattling pieces of equipment. Equipment and other apparatus must operate quietly and develop specified capacities; control valves must operate freely.

.3 Operating tests shall be made on all systems and items of equipment. For testing, vary conditions to simulate operating conditions to test start up, operation sequence, normal shutdown, safety shutdown and all automatic and manual functions.

.4 Furnish written test reports to the Engineer noting the tests made and any adjustments made.

6. Welding Testing

.1 Shop fabrication welding tests shall be performed by an independent testing agency paid for by the Contractor. Submit test results to the Engineer.

END OF SECTION 11102

PART 1 GENERAL

1.1 Description

1.1.1 This section specifies the general requirements for supply and installation of all process mechanical piping systems and is supplemented by other specific details shown or specified in the respective piping system section.

1.2 Related Work

.1 Painting - Section 09900

.2 Pressure Pipe - Section 02713

.3 Process Mechanical, all other sections - Division 11

.4 Controls and Instrumentation - Division 13

.5 Building Mechanical - Division 15

.6 Electrical - Division 16

.7 Conform to General Requirements - Division 1

PART 2 PRODUCTS

2.1 Pipe for Buried And Non-Buried Service

2.1.1 Stainless Steel

- ASTM A240-860 Type 316
- Minimum Wall Thickness: 1.98 mm up to 150mm diameter
- Schedule 10s for pipe above 150mm diameter
- Operating pressure rating: 1035 kPa
- Vacuum rating: 100kPa
- Longitudinally welded by Tungsten Inert Gas (TIG) or Metal Inert Gas (MIT) method
- Ends prepared for welding or to suit connections as shown on drawings
- Provide flanges where required to connect to valves and equipment and at 12 m maximum spacing on straight runs

2.1.2 Polyvinyl Chloride Pipe/ HDPE

- Pressure pipe to AWWA-C900 (max. 300 mm dia.)
- Water transmission pipe to AWWA-C905 (350 to 900 mm dia.)
- Rubber gasket joint to ASTM-D3139
- UV resistance for outdoor use

2.2 Pipe Fittings

2.2.1 Steel Welding Fittings

- Includes elbows, tees, caps, reducers and other welding fittings as shown on drawings
- To ASTM A234M-86 seamless or seam welded
- Standard weight
- Physical properties to match pipe
- Dimensions to ANSI B16.9-86
- Lined and coated to match pipe

2.2.2 Steel - Threaded

- ANSI B16.3-85 - standard malleable
- Pressure rate to match pipe
- Lined and coated to match pipe
- Standard straight thread ANSI B1.20.1-83

2.2.3 PVC

- For pressure service to CAN3-B137.3-M86
- For non-pressure service to CAN/CSA-181.2-M87
- Schedule 80 for all pressure fittings
- Solvent joint fittings to match pipe
- To AWWA C111-85 - rubber gasket type where required
- Flanges, reducing bushings and other fittings to be compatible with line pipe material

2.3 Flanges

2.3.1 Flanges for use in cold water service with steel pipe shall be welding neck or slip-on type as shown on the drawings.

2.3.2 Slip-on flanges shall be in accordance with ANSI/AWWA C207-86.

2.3.3 Slip-on flanges to be Class D for pressures as follows:

- Pipe size 100 to 300 — 1200 kPa
- Pipe size greater than 300 — 1035 kPa

2.3.4 Slip-on flanges to be Class E for pressures up to 1900 kPa and Class F to 2070 kPa

2.3.5 Slip-on flanges shall be flat faced.

2.3.6 Welding neck flanges shall be steel to ASTM A181-M85, Grade 60, fabricated to ANSI B16.5, rated for 1035 kPa, or 2070 kPa as shown on the drawings.

2.3.7 Use flat face flanges to connect to cast iron flanges, and raised face flanges to connect to raised face flanges.

2.3.8 Flange class shall be plainly marked on all flanges.

2.3.9 Supply and install ANSI B16.5 flange isolation kits for Stainless steel flanges to connect to other metal flanges

2.4 Bolts and Nuts

2.4.1 Bolts and nuts shall be to ANSI/AWWA C207-86.

2.4.2 Bolts and nuts shall be stainless steel 316.

2.4.3 Size and length to match flanges and valves.

2.5 Flange Gaskets

2.5.1 For flanges, 1.6 mm cloth inserted rubber SBR, Garlock Style 22 or approved alternate for temperatures below 100°C.

2.5.2 Use flat ring gaskets with raised face flanges.

2.5.3 For flanges in air piping use 1.6 mm neoprene, Garlock 7797 gasket or approved alternate.

2.5.4 Use full faced gaskets with flat face flanges.

2.6 Victaulic Couplings

2.6.1 Victaulic couplings shall be used for jointing standard steel pipe.

2.6.2 Victaulic couplings shall be in accordance with the recommendations of the Victaulic Company of Canada.

2.6.3 For rigid connections (indicated as VC in drawings) in water piping use:

.1 - Victaulic Zero - Flex Style 07.

2.6.4 For flexible couplings (indicated as FVC) allowing for expansion, contraction and deflection use:

.1 -Victaulic 71 Standard Couplings for maximum working pressures to 3450 kPa.

.2 -Victaulic 77 Standard Couplings for maximum working pressures in accordance with manufacturer's recommendations.

2.6.5 Coupling gaskets - Grade E-EDPM for water from -34°C to +110°C.

2.6.6 Bolts and nuts - stainless steel Type 316.

2.6.7 Coupling Materials

- Ductile Iron to ASTM A536 for normal conditions.

2.7 Victaulic Grooves

2.7.1 Standard Steel Pipe - cut grooves to coupling manufacturer's standards.

2.7.2 Light Wall Steel Pipe - roll grooves to coupling manufacturer’s standards or use Vic-ring ends.

2.7.3 Cast Iron and Ductile Iron Pipe - radius cut groove either rigid or flexible type groove, as required.

2.7.4 Stainless Steel Pipe - roll grooves to coupling manufacturer’s standards.

2.8 Victaulic Fittings (Grooved Ends)

2.8.1 Steel to ASTM A106 Grade B - segmentally welded.

2.9 Victaulic Flanges

2.9.1 Use Victaulic Flange Style 741 for pipe diameters 300 mm and smaller.

2.9.2 Use Victaulic Flange Style 742 for pipe diameters 350 mm and larger.

2.10 Sleeve Type Couplings

2.10.1 Use steel couplings, standard shop coated, with Dresser or Robar or approved alternative nuts and bolts, and plain grade 27 gaskets.

2.10.2 Couplings to be Dresser Style 38 or Robar 1408 or approved alternative, standard length, standard weight.

2.10.3 Transition couplings to be Dresser Style 162 or approved alternative.

2.10.4 For underground service use couplers with followers and middle rings fully coated with Dresser Al-Clad or approved alternative, and installed with stainless steel harness, nuts, bolts and rings packed with protective Denso Past and coated with Denso tape.

2.10.5 Joint harness details shall be in accordance with AWWA Steel Pipe Manual M11.

2.10.6 Design of joint harness shall be based on an operating pressure of 1035 kPa unless otherwise noted.

2.10.7 Harness nuts and bolts to be hot stainless steel.

2.11 FLANGED ADAPTERS

2.11.1 Dresser Style 127 or 128 to suit the type of pipe, or approved alternative.

2.11.2 Plain Grade 27 gasket.

2.11.3 Standard shop coating.

2.12 WELDING OUTLETS

2.12.1 Fabricate to the requirements of ANSI B16.9-86, ANSI B16.11-80 and ANSI B31.1-83.

2.12.2 Welded outlets include weldolets, sockolets and thredolets.

2.13 PIPE SLEEVES

2.13.1 Pipe sleeves shall be of standard weight steel pipe and shall be, unless detailed otherwise, one size larger than the penetrating pipe for 100 mm and larger pipe, and two sizes larger for pipe smaller than 100 mm.

2.13.2 Pipe sleeves shall have a 50 mm by 10 mm thick steel ring continuously welded all around the middle of the pipe length.

2.13.3 Special sleeves shall be as shown on the drawings.

2.14 SUPPORTS AND HANGERS - GENERAL

2.14.1 Hangers and supports shall conform to ANSI Code for Pressure Piping B31.1.0-86.

2.14.2 Materials, design and manufacture for Pipe Hangers and Support shall be in accordance with ANSI/MSS SP-58.

2.14.3 All supports, hangers, guides, sway braces, restraints, dampeners, bolts, washers and nuts are stainless steel 316.

2.14.4 Hangers and supports shall be sized to suit the pipe sizes as shown on drawings and as recommended by the manufacturer.

2.15 Pipe Supports

2.15.1 Wall supports - use Grinnell Fig. 194, Fig. 195, or Fig. 199 welded steel brackets hot dipped galvanized, or as shown on the drawings.

2.15.2 Floor Supports - use concrete supports as detailed on drawings.

2.15.3 Pipe saddle supports - use Grinnell Fig. 264 adjustable pipe saddle support complete with riser pipe and floor flange.

2.15.4 Strap supports - use Grinnell Fig. 262 for 100 mm and smaller pipe. Provide straps for larger pipe as detailed on drawings.

2.15.5 Wall supports for copper tubing up to 50 mm diameter shall be Grinnell tube strap or approved alternate.

2.16 Pipe Hangers

2.16.1 For non-insulated steel pipe of 150 mm and smaller use Grinnell Figure CT97C coated adjustable pipe ring complete with hanger rod and expansion case or insert for mounting on concrete surface.

2.16.2 For non-insulated steel pipes to 600 mm use Grinnell Fig. 260 adjustable clevis galvanized.

2.16.3 For copper tubing use Grinnell CT99C.

2.16.4 For concrete inserts use Grinnell Fig. 152, Fig. 117 and Fig. 285 to suit service conditions and pipe size.

2.16.5 For ceiling flanges, use Grinnell Fig. 153.

2.16.6 Hanger rods shall be machine threaded both ends, and shall be hot dipped galvanized after fabrication.

2.16.7 Spring hangers shall be Grinnell Fig. 80-V or 81-H constant support spring hangers.

2.16.8 Any part of a hanger or other pipe support in direct contact with stainless steel shall be nylon coated with NCA-1477 nylon thermoplastic 0.5 mm thick or shall be of 304 stainless steel. Provide felt paper between pipe and concrete pipe supports to prevent bonding.

2.17 Pressure Gauge – Sewage service

- Working pressure 200 kPa, range 0~750kPa
- 12 mm connections
- Stainless steel gear
- Bronze bourdon tube
- Adjustable pointer
- Liquid silicone filled
- Flanged diaphragm seal
- Steel bottom housing
- Teflon diaphragm
- 12 mm connections
- 6 mm flushing connection
- Gauge and diaphragm seal assembly, silicone filled, one unit
- Isolating valve 50 mm flanged and with Buna N seat; non-rising stem, stainless steel shaft
- Diaphragm seal – Type 100 Ashcroft 303 TS or approved alternatives
- Gauge - Ashcroft Model 45 or approved alternatives.

PART 3 EXECUTION

3.1 NUTS AND BOLTS

3.1.1 Install nuts and bolts so that bolts have a minimum of two exposed threads projecting after tightening; with a maximum of 8 threads projecting.

3.2 INSTALLATION OF PIPE AND FITTINGS

3.2.1 Prior to commencing piping work, examine route for conflicts and notify the Engineer of any conflicts. Obtain approval of the Engineer for any relocations.

3.2.2 Install to piping lines and elevations shown. Minimize spacing between pipes for future piping requirement

3.2.3 Install all piping parallel to building walls.

3.2.4 Determine exact location of each pipe in the field with respect to adjacent and interconnecting piping and equipment.

3.2.5 Install all piping systems in accordance with the ANSI code for pressure piping, B31.1-83.

3.2.6 Provide flanged joints intermittently in all welded piping systems to facilitate removal of every section of the piping systems by two men and without cutting any pipe or joint.

3.2.7 Provide unions intermittently in all screwed piping systems to facilitate removal of valves and every section of the piping system without cutting any pipe or joint.

3.2.8 Provide temporary bracing and supports to adequately support pipes and fittings during installation.

3.2.9 Where the required piping is not shown on drawings or is shown diagramatically, the pipes shall be installed in such a way as to conserve head room and interfere as little as possible with the spaces through which they pass.

3.2.10 Maintain grade on all draining pipes. Horizontal water piping shall be run with a grade of 2% to drain.

3.2.11 Where piping is to connect to equipment, dimensions shown on the Drawings are based on catalogue information of first named supplier. Provide flexible couplings in form of victaulic couplings at pump/shredder inlet and outlet connections to facilitate equipment installation/removal.

3.2.12 Modify work to suit final dimensions shown on shop drawings for equipment.

3.2.13 Ascertain the correct equipment dimensions before ordering piping closure lengths and fittings. Review of Drawings by the Engineer will not relieve the Contractor of his obligation in this respect.

3.3 JOINTING PIPES - GENERAL

3.3.1 Clean pipes inside and outside before assembly. Remove welding slag.

3.3.2 Ream pipes and tubes.

3.3.3 Make screwed joints using approved compound or teflon tape applied to male threads. Use thread tape on P.V.C. pipe.

3.3.4 Connect pipes to equipment as shown or specified, without springing the pipes.

3.3.5 Provide complete isolation of dissimilar metals. Do not connect copper to any ferrous metal.

3.3.6 Use standard fittings for direction changes.

3.3.7 Follow the recommendations of the manufacturer for jointing pipes, installing couplings and fittings.

3.4 WELDING STEEL PIPE JOINTS

3.4.1 Jointing of steel pipe by field welding, shall be in accordance with the current CSA Standard Z183 - M86.

3.4.2 Each operator shall be currently qualified for the P number covering the material on which he will be engaged as prescribed in the Welding Qualification Code, latest revision. Each operator certificate of qualification and experience record shall be on file at the site, and shall be made available to the Engineer on request.

3.4.3 Prior to the start of production welding, a detailed procedure specification shall be established and qualified in accordance with CSA-Z183 - M86, by the Contractor to demonstrate that welds have suitable mechanical properties and soundness.

3.4.4 Welders shall qualify by demonstrating ability to produce acceptable welds using the qualified welding procedure. CSA Standard Z183 - M86 shall apply to this section.

3.4.5 The Engineer reserves the right to specifically test, at no cost to the Owner, the qualification of individual welders employed by the Contractor.

3.4.6 Welding equipment shall be of a size and type suitable for the work and shall be maintained in such a condition as to ensure acceptable welds, continuity of operation and safety of personnel.

3.4.7 Filler metals shall be approved by the Canadian Welding Bureau and shall conform to CSA Standard W 48.1 - 1980 or CSA Standard W48.3 - M1982.

3.4.8 All welding shall be done by the shielded metal-arc welding process. Three beads or more shall be required and the size and type of rods used shall be suitable for the pipe being welded.

3.4.9 Any welder who does not perform satisfactorily in the Engineer's test shall be removed from the job at no cost to the Owner.

3.4.10 Welded pipe joints shall be single-V butt joint, using a root gap of 1.6 mm. Welds shall be full penetration welds. Care shall be exercised to keep the interior pipe lining free from damage during welding. Longitudinal weld seams shall be on opposite sides of the pipe at the joint. Welding shall not be carried on when weather conditions, in the opinion of Engineer, are unsatisfactory and would impair the quality of the welds.

3.4.11 Quality of full penetration welds and partial penetration welds shall be determined by testing in conformance with CSA Standard Z183 - M86.

3.4.12 The minimum distance between the edges to adjacent circumferential welds shall be 50 mm. If this requirement cannot be satisfied, stress relieving of the welds must be undertaken.

3.4.13 The Engineer shall have the right to inspect all welds by non-destructive means or by removing welds and testing by mechanical means. Prepare sections for destructive testing in accordance with CSA Standard Z183 - M86.

3.4.14 Repair damage to linings, and reline joints after welding is complete. Reline joints using materials and procedures recommended by the supplier of the lining material.

3.4.15 For further details on welding steel pipe joints refer to Section 02710, Pressure Pipe.

3.5 RUBBER GASKET JOINTS

3.5.1 Make rubber gaskets joints in ductile iron pipe, PVC pipe or other pipes in accordance with the manufacturer's instructions. Use appropriate tools to pull joints, to field cut joints and to prepare pipes for joining. After assembly check the gasket position.

3.6 FLANGED JOINTS

3.6.1 Fit flanged joints so that gaskets are bearing uniformly, and joints are even. Apply an anti-seize compound to bolt threads, and tighten bolts evenly.

3.7 VICTAULIC JOINTS

3.7.1 Grooves shall be rigid style, made in accordance with the coupling manufacturer's recommendations.

3.8 OLDER JOINTS

3.8.1 Clean and flux solder pipe joint ends and fittings, and fully sweat at each joint. Use 50/50 tin/lead solder and use 95/5 tin/antimony solder on hot water lines.

3.9 VALVES AND OPERATORS

3.9.1 Install all valves and operators in strict accordance with manufacturer's shop drawings and instructions.

3.9.2 Valve floor stand and operators shall be oriented as shown on the drawings.

3.9.3 Install extension stems, stem supports and other accessories as required and as shown on drawings for the connection of valve operators to floor stand units.

3.9.4 If pipe sleeves through concrete slabs for floor stands are not in vertical line with gear operators other than as shown on the drawings, provide universal joints on the extension operating stem for the correction of alignment.

3.10 EXPANSION PIECES

3.10.1 Install piping to permit free movement of piping caused by thermal expansion and contraction except where it is anchored.

3.10.2 Install Victaulic couplings on flexible radius grooved cast iron pipe wherever pipe crosses structural expansion joints and install flexible Victaulic couplings wherever steel pipe crosses structural expansion joints.

3.10.3 Provide for expansion and contraction by installing suitable expansion pieces as is necessary or where indicated.

3.10.4 Provide expansion pieces having ratings equivalent to the test pressures specified for the particular piping system and wetted surfaces of material similar to that of the piping system.

3.10.5 Provide anchors and guides where necessary to direct expansion into expansion pieces.

3.11 NSTALLATION OF SUPPORTS AND HANGERS

3.11.1 Support all piping after alignment and before tightening joints.

3.11.2 Do not move pipe after tightening joints.

3.11.3 Provide all hangers, supports, anchor bolts, washers and nuts to support pipes at the lines and elevations indicated and/or as detailed on the drawings.

3.11.4 Provide inserts in concrete, concrete piers and anchor bolts as required. Provide reinforcing bars in concrete for inserts carrying pipe over 100 mm in diameter.

3.11.5 Bolt base flanges to the floors or to concrete.

3.11.6 Provide all necessary sway braces, dampeners, flexible hoses, and restraints to eliminate all movements of piping due to vibration. Install additional braces and anchors as necessary to eliminate vibrations.

3.11.7 Provide hangers, supports, anchors, guides, dampeners, flexible hoses, restraints and sway braces that will cope with the loads and thrust forces from all directions so that all pipe joints will function and thrust is not transferred to the equipment to which the pipe is connected.

3.11.8 Maximum hanger spacing and minimum rod size shall be in accordance with the following:

Pipe Size	Rod Size	Maximum Spacing Steel	Maximum Spacing P.V.C.

up to 25 mm	10 mm	1200 mm	1200 mm
25 - 50 mm	10 mm	1800 mm	1800 mm
65 - 90 mm	12 mm	2400 mm	2100 mm
100 - 125 mm	16 mm	2400 mm	2100 mm
150 mm	20 mm	3600 mm	2400 mm
200 - 300 mm	22 mm	5500 mm	2400 mm
350 and up	25 mm	6500 mm	2800 mm

3.11.9 Install sufficient hangers and supports to provide an adequate safety factor as outlined in ANS1 B31.1 - 1986.

3.11.10 Drilling into concrete, and using expansion type inserts will be permitted only on approval of the Engineer.

3.12 PIPES THROUGH FLOORS AND WALLS

3.12.1 Provide standard steel pipe sleeves where pipes pass through floors and walls.

3.12.2 Install sleeves flush at walls and projecting at floors as detailed or 50 mm above floor surfaces and flush with bottom.

3.12.3 Provide continuously welded rings on pipes passing through walls below grade or where walls are watertight. The thrust/seepage rings shall be as detailed on the drawings.

3.12.4 Remove coating from pipes to be cast in concrete to permit a good bond.

3.12.5 Where electrical insulation from concrete rebar is required use link seals with pipe sleeves where shown on drawings.

3.12.6 For stainless steel pipe passing through concrete use stainless steel sleeves. Coat surfaces of stainless steel in contact with concrete, with bitumastic.

3.12.7 There shall be no direct contact between structural steel and stainless steel.

3.12.8 Seal space between sleeves and pipes with non-hardening mastic -Daraseal-A or approved alternative.

3.13 CLEANING

3.13.1 Clean all pipes, fittings and miscellaneous items after installation.

3.13.2 Remove all materials from pipes, whatever their origin, by flushing with water, blowing with air and dismantling and manually cleaning.

3.13.3 Prevent entrance of foreign materials from pipes to equipment or pumps.

3.13.4 Pickle stainless steel lines, and wash to remove stains. Pickle all welds and brush with stainless steel brushes; then wash with hot water.

3.14 SHOP FINISHES

3.14.1 Shop priming of the equipment shall be as specified in Section 09900.

3.15 FIELD PAINTING

3.15.1 Field painting shall be in accordance with Section 09900 - Painting.

END OF SECTION 11150

PART 1 GENERAL

1.1 Description

1.1.1 This section specifies the supply and installation of all process valves including, but not limited to, plug, ball, air release, drain and pressure relief applicable to the process piping system.

1.1.2 Conform to Division 1 - General Requirements and Division 9 - Finishes.

1.1.3 Valves shall be tested in accordance with Section 11102 - Testing.

1.2 Submittals

1.2.1 The Contractor shall submit shop drawings and product data as follows:

.1 Assembly drawings and material list.

.2 Details of all parts and principal dimensions.

.3 Submit installation manuals before shipment of any equipment.

.4 Submit operation and maintenance manuals 30 days prior to start up.

1.3 Suppliers

1.3.1 All valves and operators of the same type shall be provided by one manufacturer.

PART 2 PRODUCTS

2.1 Plug Valve

2.1.1 Plug Valve 50 to 300 mm

- Flanged ends plug valve
- Full round port eccentric plug
- ANSI Class 125
- Cast Iron ASTM A126B body and cover
- Epoxy lined and coated
- One piece Cast Iron Plug with nitrile rubber coated
- With grit-guard packing and bearings
- Rated to 175 PSI Pressure
- Lever operator for less than 100 mm diameter valves.
- Worm Gear Operator and handwheel for 100mm diameter valves and larger.

- Valve to be Valmatic Series 5800R up to 300 mm size or approved alternative

2.2 Sanitary Combination Air Valve 50mm

- Cast Iron ASTM A126 Class B Body
- Epoxy lined and coated
- 316 Stainless steel orifice, float and linkage mechanism
- Pressure rating 1,000 kPa
- Threaded ends
- Valve to be Valmatic or ARI sewage combination air valve or approved alternative

2.3 Ball Valve (50 mm and Smaller)

- Regular port
- 1000 kPa maximum working pressure
- Brass body
- Stainless steel ball and stem
- Teflon seats and seals
- Threaded ends
- Lever operated
- Flow-Tek or approved alternative

2.4 Check Valve

- Rubber flapper check valve
- ANSI Class 150 flanged
- Ductile iron body and cover
- Epoxy lined or rubber lined and coated
- Replaceable NBR and steel reinforced N disc
- Cover mounted position indicator to identify the flapper position
- Pressure rating 1,725 kPa
- Stainless Steel bolting
- Suitable for raw sewage flow application
- APCO Rubber Flapper Swing Check or approved alternative

2.5 Hand Valve Operators

2.5.1 Provide hand wheel operators for plug valves, ball valves unless operators are specified.

2.5.2 Provide operator floor stands as shown on the drawings.

2.6 Manual Gear Operators

2.6.1 Manual gear operators shall be sized for the operating rim pull of 80 N at maximum working pressure differential across the valve.

2.6.2 Provide hand lever operator for valves 100 mm and smaller.

2.6.3 Provide geared type actuator complete with valve position indicator for valves 150 mm and larger. Handwheel operator shall be provided unless otherwise specified.

2.7 Extension Stem Operator

2.7.1 Provide extension stem, stem guides, 50 mm square AWWA operating nut where shown on the drawings.

2.7.2 Valve extension stem shall be Type 316 stainless steel with stainless steel wall brackets as required for complete installation. The stems shall withstand the maximum operator torques with a safety factor of 1.5.

2.7.3 Buried service actuators shall be packed with grease and sealed for temporary submergence to 6 m of water.

2.8 Floor Stand Operators (Manual)

2.8.1 Floor stand operators shall be of the enclosed gear pedestal type with side mounted cranks and shall be sized for the allowable maximum torques for the specified operating pressure across the valve.

2.8.2 Gear ratios shall be selected so that the force exerted on the rim of the crank shall not exceed 180 N. Operator shall be capable of withstanding a force of up to 900 N on the rim without damage. Valve position indicators shall be supplied.

2.8.3 The lift mechanism shall be complete with floor stand, ball thrust bearings, grease fittings, bronze nuts, mounting pedestal and accessories as required.

2.8.4 The operator shall be adaptable to a power wrench operation by replacing the crank with an adapter socket.

2.8.5 Standard pedestal floorstand shall be used unless otherwise specified. Provide offset pedestal floorstand where shown on the drawings.

2.8.6 Provide rising stem floorstand for sluice gates and non-rising stem floorstand for valves.

2.8.7 Provide clear plastic stem cover over the rising stem complete with markings for valve position indication.

2.9 Shop Finishes

2.9.1 All unfinished iron and steel work on the valves shall be thoroughly cleaned and painted with approved shop coat, refer to Section 09900 - Painting. All finished parts shall be coated with heavy grease or a mixture of white lead and tallow to prevent corrosion during shipment and installation. Bronze work shall be left bright.

2.10 Field Painting

2.10.1 All exposed surfaces of valves shall be painted after installation, refer to Section 09900 - Painting.

PART 3 EXECUTION

3.1 Valves and Operators

3.1.1 Install all valves and operators in strict accordance with manufacturer's shop drawings and instructions.

3.1.2 Valve floor stands and operators shall be oriented as shown on the drawings.

3.1.3 Install extension stems, stem supports and other accessories as required and as shown on drawings for the connection of valve operators to floor stand units.

3.1.4 If pipe sleeves through concrete slab for floor stands are not in vertical line with gear operators other than as shown on the drawings, provide universal joints on the extension operating stem for the correction of alignment.

END OF SECTION 11160

PART 1 GENERAL

1.1 Description

1.1.1 The work consists of the supply, delivery, installation supervision and commissioning of two (2) vertical submersible, wet-pit wastewater sewage pumps in the lift station, complete with integral motors, power/monitoring cables, discharge connections with anchor frames, stainless steel lifting chain, guide rails and holders, and minicase as specified herein and as shown on the drawings.

1.2 Submittals

Submit the information as follows:

a) Pump

i) General outline drawings showing clearly all general and essential dimensions.

ii) Descriptions and specifications of various component parts as follows:

- Pump shaft
- Mechanical construction of the impeller and details of assembly
- Mechanical seals

iii) Characteristics curves showing efficiency (%) head (m), power requirements (HP), and required net positive suction head (m) versus capacity (L/s) for maximum speed.

iv) Pump data as required in the following list:

- Pump curve Reference No.
- Pump impeller diameter (mm)
- Rated capacity (L/s)
- Rated head (m)
- Rated speed (rpm)
- Rated power requirement (kW)
- Discharge flange size (mm)
- Maximum solids size (mm)
- Motor power output (KW)
- Approximate total mass (kg) of pump

b) Motors

i) Type, manufacturer and general description.
ii) General outline drawings showing clearly all general and essential dimensions.
iii) Efficiency and power factor.
iv) Approximate total mass (kg) of motor.
v) Maximum noise level (dbA).

Submit the following drawings:

a) General layout of each pump unit, drive shaft, extension, universal joint and motor with anchor bolts locations, casing position and direction of rotation.

b) Cross-sectional details of each pump and pump seal with complete materials list.

c) Dimensional layout of discharge elbow.

d) Dimensional drawings of motors.

Submit installation manuals before shipment of any equipment.

Submit as part of the bound, indexed manual for all equipment, the installation, operation and maintenance manuals and certified performance pump curves corrected to the actual running rpm in the field, 30 days prior to startup.

PART 2 PRODUCTS

2.1 **Pumps**

General

a) Supply two (2) vertical submersible wastewater pumps for installation in the McKay Ranch Lift Station;

b) The pumps shall be as manufactured by Xylem or Approved Alternatives

Service Conditions

c) The pumps shall be designed for pumping raw sanitary sewage and storm water inflow and infiltration flows from wastewater collection system.

d) The following service conditions which apply to the two (2) lifting pumps shall be equaled or surpassed:

Equipment No.:	RSP-001/002
Type:	Centrifugal
Fluid:	Sanitary Wastewater
Total Dynamic Head:	15 m
Design Flow:	90 l/s (each pump)
Static Head:	13.5 m
Motor:	35 hp
Speed:	1200 RPM
Drive:	VFD Drive
Impeller:	314 mm

Xylem Flygt Model NP 3202 MT 643 or approved alternative.

The above service conditions are defined for the pumps to be installed in this contract. In the future, larger pumps designed for 140 l/s, 19 meter TDH, e.g. Xylem Flygt 3202 MT 640 60HP pumps, will be installed. Hence the process mechanical components, e.g. the discharges, lifting guiderails, chains, and the pump bases should be sized and constructed for the future larger pumps.

Approvals

Each pump shall be tested and approved in accordance with national and international standards (IEC34-1, HI, CSA)

The pump/motor unit shall be also approved by CSA for service in Class 1, Division II, Groups A, B, C or D hazardous locations.

Wet-pit Pump Design

The pumps shall be automatically and firmly connected to the discharge connection, guided by no less than two guide bars extending from top of the station to the discharge connection. There shall be no need for personnel to enter the wetwell. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal-to-metal, watertight contact. No portion of the pump shall bear directly on the sump floor.

Hydraulic End Design

The impeller(s) shall be of semi open multi vane, back-swept, non-clog design. The impeller vanes shall be self-cleaned upon each rotation and shall keep the vane clear of debris, maintaining an unobstructed pumping. The impeller(s) shall have heavily back swept leading edges with a specific angle distribution enabling the capability of handling solids, fibrous materials, heavy sludge and other matter found in waste water. The design of the impeller shall prevent builds up at the leading edge. Impellers shall be locked to the shaft and be easy to fasten and to

remove. The clearance between the pump housing/insert ring and the impeller shall be adjustable.

The leading edges shall be induction hardened to a depth of 4-5 mm. The hardness shall have a minimum of 45 HRC. The impeller and pump housing shall be of grey iron EN1561-GJL-250 or ASTM-A48-No35B. Pump volute(s) shall be single-piece non-concentric design with smooth passages large enough to pass any solids that may enter the impeller. The volute shall have a mating flange machined and be prepared for a flush valve.

Motor Shaft Design

Pump and motor shaft shall be the same unit. The pump shaft is an extension of the motor shaft. Couplings shall not be acceptable. The shaft material shall be AISI type 431Stainless steel. The use of Stainless steel sleeves will not be considered equal to Stainless steel shafts.

The Outer Design

The outer design shall be maintenance optimized. The pump(s) shall be easy to clean when serviced.

Mechanical Seals

Each pump shall be provided with a plug-in seal unit consisting of two independent working mechanical face seals and a propeller that also circulates the coolant in the cooling system. The springs shall be positioned so they always are protected from the pump media. The seals shall operate in conjunction with a liquid reservoir that continuously lubricates and cools the seal faces. Both seals shall comprise one stationary and one mechanical driven rotating ring. Each seal interface shall be held in contact by its own spring system. The seals shall not depend on direction of rotating for sealing. The seal cavity for the outer seal shall be equipped with means for wear reduction such as spiral grooves for particle removal.

Cable Entry Seal

Each pump shall be provided with a plug-in seal unit consisting of two independent working mechanical face seals and a propeller that also circulates the coolant in the cooling system. The springs shall be positioned so they always are protected from the pump media. The seals shall operate in conjunction with a liquid reservoir that continuously lubricates and cools the seal faces. Both seals shall comprise one stationary and one mechanical driven rotating ring. Each seal interface shall be held in contact by its own spring system. The seals shall not depend on direction of rotating for sealing. The seal cavity for the outer seal shall be equipped with means for wear reduction such as spiral grooves for particle removal.

Cooling System

The Pump(s) shall be provided with an integral closed-loop cooling system with or without cooling jacket. The internal system shall be driven by a propeller integrated in the plug-in seal.

The coolant shall consist of a non-poisonous and an environment friendly media such as Monopropylene-Glycol.

The main cooling area shall be the seal housing cover. There shall be a flow diffuser by the seal housing cover and an inner cooling jacket around the stator housing which creates a narrow gap. The narrow gap shall ensure high coolant velocity and turbulent flow, which transports heat more efficiently than laminant low velocity flow.

Bearings

The pump volute shall be a single piece grey cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified. The volute shall have integral spiral-shaped, sharp-edged groove(s) that is cast into the suction cover. The spiral groove(s) shall provide the sharp edge(s) across which each impeller vane leading edge shall cross during rotation so to remain unobstructed. The internal volute bottom shall provide effective sealing between the multi-vane semi-open impeller and the volute.

Paint Standard

The exterior of the pump, including all metal surfaces coming into contact with the pumpage shall be protected by a factory-applied spray coating of acrylic dispersion zinc phosphate primer and finished with a polyester, epoxidized resin paint. Prior to the final paint finish being applied, the pump components shall be primed and washed. The components shall then be assembled and washed a second time before the final topcoat is applied. The finish paint or top-coat shall be Flygt Duasolid , applied externally to a minimum dry film thickness of not less than 100µm(microns). The film thickness shall be consistent with ISO 2808, method no.6.

Protection

Each pump motor stator shall incorporate three thermal switches, one per stator phase winding and be connected in series, to monitor the temperature of the motor. Should the thermal switches open, the motor shall stop and activate an alarm. A float switch shall be installed in the seal leakage chamber and will activate if leakage into the chamber reaches 50% chamber capacity, signalling the need to schedule an inspection.

The thermal switches and float switch shall be connected to a Mini CAS control and status monitoring unit. The Mini CAS unit shall be designed to be mounted in the pump control panel.

Bearings

- Support Bearings

Motors with range 7.5 kW to 11kW should be supplied with a support bearing with at least a single row ball bearing.

For the range 13kW to 70kW the support bearing shall consist of a double row angular contact ball bearing.

- Main Bearing

The main bearing shall consist of a double row angular contact ball bearing.

Both support and main bearings shall be sealed with two metal shields (bearing designation with suffix "2Z") and shall be delivered ready greased from the bearing supplier.

The design life time shall be at least 50,000 hours (L10aah).

2.2 **Motors**

The pump motor shall be a squirrel cage induction motor, shell type design, housed in an air filled, watertight chamber. The stator windings and stator leads shall be insulated with moisture resistant Class H insulation rated for 180°C. The stator shall be trickle impregnated with Class H varnish. The motor shall be designed for continuous duty handling pumped media of 40°C and capable of up to 15 evenly spaced starts per hour. Thermal switches set to open at 140°C and close at a minimum of 70°C, shall be embedded in the stator lead coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel.

The motor and pump shall be designed and assembled by the same manufacturer. The motor shall be designed for operation up to 40°C ambient temp. with a temperature rise not to exceed 80°C. A motor performance chart shall be provided showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on starting and no-load characteristics. The motor and the cable shall be capable of continuous submergence under water without loss of watertight integrity according to protection class IP 68 (20 m). The rated power shall be adequate so that the pump is not over-loading throughout the entire indicated pump performance curve.

2.3 **Spare Parts**

Contractor to provide three sets of Mechanical Seals/o-ring repair kit for each pump in the lift station.

PART 3 EXECUTION

3.1 Supervision

1.1.2 A supervision period shall be allowed for the Supplier's representatives to thoroughly check the final installation, supervise startup, finalize on-site adjustments and coordinate the field supervision by other suppliers within his area of responsibility. At a later date, it will be necessary to instruct the operating personnel in proper operating and maintenance procedure Owner's.

1.1.3 Allow two (2) trips to the site with a total of two (2) working days on site. The date and duration of each trip shall be subject to the approval of the Engineer.

3.2 Shop Testing

1.1.4 The pumps shall be tested in accordance with the standards of the Hydraulic Institute. The minimum extent of testing shall be as follows:

- The pumps shall be tested for airborne sound, in the factory of the manufacturer. Certified performance curves shall be provided.
- All pump casings shall be hydrostatically pressure tested to 1035 kPa.

3.3 Site Testing

1.1.5 Each pump shall be subjected to a mechanical site test by a qualified technical representative of the pump manufacturer. The test shall include:

- Visual check of completeness of installation and condition of equipment, including all components and auxiliaries.

END OF SECTION 11205

DIVISION 13 SPECIAL CONSTRUCTION

PART 1 GENERAL

1.1 Related Work

1.1.1 Division 13 & 16 - General Electrical Provisions

1.1.2 Division 1 - General Requirements

1.2 Definitions

1.2.1 Supply - supply material only; installation by others.

1.2.2 Install - install and assist in commissioning of materials supplied by other trades, vendors or OWNER.

1.2.3 Provide - supply, install and commission material supplied in the work of this division.

1.2.4 EtherNet/IP - Industrial communications protocol managed by ODVA which utilizes TCP, UDP, and IP over Ethernet to deliver CIP.

1.3 General Requirements

1.3.1 The Scope of Work includes the installation and commissioning of all instrumentation required for discharge flow control, auxiliary processes, building monitoring, and pump control for the lift station. Instrumentation shall be terminated to a site PLC control panel that shall be fabricated for installation in the electrical room. PLC programming shall not be included in the CONTRACTOR's Scope of Work, but support in commissioning the facility is included.

1.3.2 The CONTRACTOR shall be responsible for providing a fully functional control system.

1.3.3 PLC and HMI programming shall be performed by others.

1.3.4 Spare requirements within this CONTRACT for Division 13 shall be as per Section 13115 - Instrumentation Spare Parts and Maintenance Materials

PART 2 PRODUCT

2.1 Setting Out of Work

2.1.1 Where equipment is combined with the work of other trades, supply equipment to be built-in or measurements to allow necessary openings to be left so as not to hold up THE WORK.

2.1.2 Make reference to electrical, mechanical, structural, process and architectural drawings when setting out THE WORK. Consult with respective Divisions in setting out locations for conduit runs, instrumentation boards, panel assemblies, etc., so that conflicts are avoided and symmetrical even spacing is maintained.

2.1.3 Layouts shown for facility are for estimating purposes only. Coordinate installation of conduit, outlets and equipment with final equipment layout.

2.1.4 Where instrumentation equipment is in close proximity, said items are to be lined up horizontally unless otherwise called for by the ENGINEER.

2.2 General

2.2.1 Purchase all components required for the fabrication of process control panel(s) as detailed in the design drawings and control panel specifications.

2.2.2 Procure all specified process devices and instrumentation as indicated in the instrumentation specifications.

2.2.3 Supply all other required equipment and cables to meet the intent of this specification.

2.3 Excavation and Backfilling

2.3.1 Provide all excavation, sand leveling and bedding for electrical installation. Level all trenches for underground conduit and duct banks with a 75 mm layer of sand. Conduits not encased in concrete shall be laid on sand bed then covered by a second 150 mm layer of compacted sand. Steel conduit not encased in concrete shall be painted with two coats of asphaltum paint after assembly. Remainder of backfill, removal and disposal of surplus excavated material shall be the responsibility of the CONTRACTOR. Refer to Division 2 of the General Specifications.

PART 3 EXECUTION

3.1 Mechanical and Process Equipment Wiring - Control

3.1.1 Provide all labour and materials required to complete the controls wiring for pumping, plumbing, heating and ventilating equipment as called for in these specifications and/or shown on the drawings.

3.2 Instrumentation and Controls Wiring - Control

3.2.1 Provide all labour and materials required to complete the controls wiring for the instrumentation and electrical equipment (for example, the generator) as called for in these specifications and/or shown on the drawings.

3.2.2 The CONTRACTOR shall supply, fabricate and install the PLC control panel as per the control panels and programmable logic controller specifications and drawings.

3.3 Tagging

3.3.1 All cables are to be tagged according to the standards in this specification.

3.4 Scope

3.4.1 The work under this CONTRACT generally consists of supply, installation and putting into operation the electrical systems as indicated on the drawings and specified herein and the work as outlined below.

3.4.2 All material supplied and installed under this CONTRACT shall be suitable for a heated, ventilated environment, and it shall have a minimum life expectancy of 18 years. In case the material specified does not comply with this requirement, CONTRACTOR shall submit an alternate material and price as an add-on to the base bid price.

3.4.3 All concrete work, unless specified elsewhere, shall be done by Division 3 but the support steel system necessary for electrical equipment, conduit, cables and devices shall be part of the CONTRACTOR's scope.

3.4.4 The CONTRACTOR shall review and understand the design and construction for the installation of electrical equipment and conduit for distribution pumps, instrumentation, PLC control system, and H&V power.

3.4.5 The CONTRACTOR is responsible for the testing and commissioning of the entire installations under this contract. During system commissioning a representative of both the ENGINEER and the System Operator shall be present.

3.4.6 The CONTRACTOR shall be responsible for completing an organized and documented plan for equipment and instrumentation procurement and commissioning procedures.

3.4.7 The CONTRACTOR shall conduct a site visit to examine the WORKSITE and become familiar with all features and characteristics affecting THE WORK.

3.4.8 The CONTRACTOR shall be responsible for maintaining accurate as-built markups for all drawings provided as part of the design basis.

3.4.9 THE WORK shall be performed in accordance with the attached drawings and specification and shall include but not be limited to the following:

.1 THE WORK for McKay Ranch Lift Station

END OF SECTION 13110

PART 1 GENERAL

1.1 General Instruction

1.1.1 Provide a complete inventory of instrumentation spare parts and maintenance materials as specified.

1.1.2 Provide all special tools required for normal maintenance in a heavy gauge, corrosion resistant metal box complete with lock and keys.

1.1.3 Provide wall mounted metal cabinet with adjustable shelving and hinged locking door to house all spare parts associated with controls systems.

PART 2 PRODUCT

2.1 Spare Parts and Maintenance Materials Schedule

2.1.1 Control Panels:

.1 Two (2) plug-in control relays of each type used complete with base.

.2 Twenty (20) fuses of each size and type used.

.3 Two (2) indicating lights of each type and colour used.

.4 Two (2) fuse holders of each type used.

.5 One (1) push button of each type used.

.6 One (1) selector switch of each type used.

.7 One (1) spare control panel lighting lamp.

.8 One (1) spare 24 V(dc) power supply.

.9 One (1) spare PLC power supply.

.10 One (1) spare PLC processor.

.11 One (1) spare PLC controller digital input card.

.12 One (1) spare PLC controller digital output card.

.13 One (1) spare PLC controller analog input card.

.14 One (1) spare PLC controller analog output card.

.15 One (1) spare control panel DIN rail mount breaker for each size.

.16 Twenty (20) spare terminal blocks, end brackets, and end plates of each type.

.17 One (1) spare control panel 120 V(ac) surge protection device (SPD).

.18 One (1) spare 16-port Ethernet Switch.

.19 One (1) spare Zelio Logic Relay controller.

.20 One (1) spare intrinsically safe barrier interface for each type used.

.21 Two (2) spare CAT-6 Ethernet cables, 5 meters in length.

2.1.2 See Section 13330 and Section 13331 for spare instrument requirements.

2.1.3 Should conflicts arise between spare part quantities, the larger quantity of the conflicting item shall be provided.

PART 3 EXECUTION

3.1 NOT APPLICABLE

END OF SECTION 13115

PART 1 GENERAL

1.1 **Related Work**

1.1.1 Section 13140 - SCADA Software

1.2 General

1.2.1 The items outlined within this specification are required to be provided by the CONTRACTOR for connection into the new site control system and existing SCADA system.

1.3 **SCADA Hardware General Requirements**

1.3.1 A Human Machine Interface (HMI) will be installed in the control panel at the lift station for local Supervisory Control and Data Acquisition (SCADA).

1.3.2 A ProTalk Cv3 alarm dialout system shall be integrated into the cellular network for alarm callouts, as per detailed drawings.

PART 2 PRODUCT

2.1 Human Machine Interface (HMI)

2.1.1 Local HMI shall be installed within local control panel, as per the detailed drawings.

2.1.2 HMI shall have, at a minimum, two (2) USB ports; one (1) RS-232 serial port; one (1) RS-485 serial port; two (2) Ethernet ports; 16 GB RAM; 18 inch display touchscreen.

2.1.3 HMI shall be powered by 24 V(dc).

2.1.4 HMI shall be provided with one (1) license of Ignition Edge Panel for local HMI

2.1.5 HMI shall be manufactured by Teguar or approved equivalent.

2.2 Alarm Dialer System

2.2.1 A ProTalk Cv3 Alarm Auto Dialer, model B1277, shall be connected to the cellular network as per the detailed drawings.

2.2.2 CONTRACTOR shall provide SIM cards as required. Coordinate with OWNER for preferred service provider.

2.2.3 Relay outputs from PLC shall terminate at ProTalk inputs as per detailed drawings.

2.2.4 CONTRACTOR is responsible for the configuration and testing of the alarm dialer system.

2.2.5 Coordinate with OWNER for specific alarms to be generated.

PART 3 EXECUTION

3.1 General

3.1.1 The CONTRACTOR shall be responsible for purchase and delivery of HMI and PLC hardware to the INTEGRATIONS CONTRACTOR immediately upon award of the CONTRACT, following the corresponding shop drawing reviews, such that the schedule for development of the SCADA and PLC programs is not affected. PLC hardware shall include the PLC processor and PLC power supply.

3.1.2 CONTRACTOR shall install HMI and alarm dialer in control panel as per the detailed drawings.

END OF SECTION

PART 1 GENERAL

1.1 **Related Work**

1.1.1 Section 13130 - SCADA Hardware

1.1.2 Section 13320 - Programmable Logic Controller

1.2 **SCADA Software General Requirements**

1.2.1 SCADA programming shall be performed by others.

1.2.2 All software shall be registered to the OWNER.

1.2.3 All software outlined herein shall be purchased by the CONTRACTOR.

PART 2 PRODUCT

2.1 Alarm Dialer Software

2.1.1 CONTRACTOR shall purchase and supply all alarm dialer programming and configuration software for the alarm dialer as required.

2.2 PLC and Controllers Software

2.2.1 The CONTRACTOR shall provide the necessary programming software package for the PLC processor, registered to the OWNER, defined herein and shown in the drawings. Refer to Section 13320 - Programmable Logic Controller for details.

2.2.2 The CONTRACTOR shall provide the necessary programming software package for the Zelio logic controller. Refer to Section 13320 - Programmable Logic Controller for details.

PART 3 EXECUTION

3.1 General

3.1.1 The implementation of these services shall be provided for the intended functional requirements.

3.1.2 If applicable, the CONTRACTOR shall be responsible for purchase and delivery of HMI and PLC software to the ENGINEER immediately upon award of the CONTRACT, following the corresponding shop drawing reviews, such that the schedule for development of the SCADA and PLC programs is not affected.

END OF SECTION 13140

PART 1 GENERAL

1.1 Related Work

1.1.1 Section 16010 - General Electrical Provisions

1.1.2 Division 1 - General Requirements

1.2 Definitions

1.2.1 Supply - supply material only; installation by others.

1.2.2 Install - install and assist in commissioning of materials supplied by other trades, vendors or OWNER.

1.2.3 Provide - supply, install and commission material supplied in the work of this division.

1.2.4 EtherNet/IP - Industrial communications protocol managed by ODVA which utilizes TCP, UDP, and IP over Ethernet to deliver CIP.

1.2.5 Lift Station - Mckay Ranch Lift Station

1.3 General Testing and Commissioning Requirements

1.3.1 The CONTRACTOR, with the support of the ENGINEER, shall demonstrate that the control system, remote station interface, communications, and all other relevant components of the new facility are operational and meet the specification requirements.

1.3.2 The CONTRACTOR is required to provide the ENGINEER and OWNER's personnel with detailed commissioning and testing schedules. Test schedules shall include a detailed description of the test to be performed along with proposed start and end dates.

1.3.3 All testing shall be thoroughly documented utilizing Microsoft Excel spreadsheets, or similar, to document all test parameters and results and shall provide a sign off field for the CONTRACTOR, the ENGINEER, and the OWNER REPRESENTATIVE.

1.3.4 The complete testing process shall follow this sequence:

.1 ENGINEER/CONTRACTOR commissioning and loop checking of all components of the Lift Station.

.2 Functional testing of the Lift Station control system.

.3 Testing and Acceptance of communications system.

.4 OWNER Site Acceptance Test (SAT) of the Lift Station.

.5 Acceptance Period after SAT of the Lift Station

1.4 Test Plans

1.4.1 The CONTRACTOR, in coordination with the ENGINEER, shall submit test plans and procedures for the OWNER's comment and approval at least two weeks prior to commencement of any test procedure based on the provided construction schedule provided by the CONTRACTOR.

1.4.2 As a minimum, the test plan and procedures shall include the following:

.1 The test objective;

.2 An overview of the hardware and software test configuration;

.3 A description of each test to be performed and the expected results;

.4 A step-by-step procedure for each test to be performed;

.5 Provision for discrepancy tracking and clearance system; and

.6 Detailed test results sheets for sign-off by the OWNER.

1.4.3 All tests shall be done with the support of the ENGINEER and witnessed by the OWNER REPRESENTATIVE. Signed copies of the test results shall be included in the O&M manual.

PART 2 PRODUCT

2.1 Tools and Testing Equipment

2.1.1 The CONTRACTOR shall be responsible for the provision of all tools and testing equipment required to perform complete commissioning tests.

2.1.2 This equipment shall include, but is not limited to:

.1 Process Calibrator capable of sourcing and measuring voltage and current signals.

.2 2-Way Radios to provide communication between the CONTRACTOR and ENGINEER during the SAT process.

.3 Sufficient TW105 wire and wire labels similar to panel wiring/labels to provide wiring services as required during SAT and commissioning process.

PART 3 EXECUTION

3.1 Loop Checks

3.1.1 The CONTRACTOR, with the support of the ENGINEER, shall verify all wiring from instrumentation and electrical systems back to the control panel to ensure all equipment is wired accordingly. A detailed report form shall be used to sign off on the wiring of each I/O.

3.2 Functional Testing, Site Acceptance Testing and Commissioning

3.2.1 The CONTRACTOR shall be responsible for supporting the commissioning process by providing sufficient manpower to complete THE WORK in the defined allotment of time.

3.2.2 Each subsystem shall be completely vested in coordination with the associated vendor and ENGINEER to determine the proper operation of the equipment. Only then shall the facility be commissioned and put into operation.

3.2.3 At the OWNER's request, specific equipment functionality shall be shown to operate as expected prior to the Acceptance Period.

3.2.4 Specific sub-system and system signoff forms shall be provided by the CONTRACTOR to allow signoff of system operation by the CONTRACTOR, ENGINEER, and OWNER.

.1 An example of a subsystem would be the discharge flow meter, which in of itself only provides instantaneous flow, where the complete discharge system would include the monitoring of flow, total flow, etc. from the flow meter as well as the subsystem of the level system controlling the start/stop requests of the pumps and the VFD control subsystem controlling the pumps starters.

3.3 Acceptance Period After Commissioning

3.3.1 The Acceptance Period, according to Division 1, shall commence at the discretion of the ENGINEER and OWNER REPRESENTATIVE after successful completion of Commissioning and SAT. During this period, the system shall be monitored for proper operation and to ensure compliance with the reliability criteria. The reliability criteria shall include operation of the facility as per the intended design.

3.3.2 In the event of a malfunction or a failure to meet the reliability criteria, the OWNER shall terminate the Site Acceptance Period until the CONTRACTOR, with the support of the ENGINEER, remedies the deficiency. The Site Acceptance Period shall then begin again. This process shall continue until the system performs satisfactorily for the full Acceptance Period in complete compliance with the specifications.

END OF SECTION 13180

PART 1 GENERAL

1.1 Related Work

1.1.1 Division 13 & 16 - General Electrical Provisions

1.1.2 Division 1 - General Requirements

1.2 Definitions

1.2.1 Supply - supply material only; installation by others.

1.2.2 Install - install and assist in commissioning of materials supplied by other trades, vendors or OWNER.

1.2.3 Provide - supply, install and commission material supplied in the work of this division.

1.2.4 EtherNet/IP - Industrial communications protocol managed by ODVA which utilizes TCP, UDP, and IP over Ethernet to deliver CIP.

1.3 General Requirements

1.3.1 The CONTRACTOR shall provide vendor operation and maintenance (O&M) manuals as specified herein for incorporation into project O&M manuals.

1.3.2 The CONTRACTOR shall provide as-builts (redlines) of SCADA layout, control schematics and/or wiring diagrams for incorporation into O&M manuals. Coordinate with Division 16.

1.3.3 Text data shall be in Microsoft Word format, drawings shall be in AutoCAD, spreadsheets shall be in Microsoft Excel format, database applications shall be in Microsoft Access format and project scheduling shall be in Microsoft Project format. For all cases, the format shall be of the most recent version of the software.

PART 2 PRODUCT

2.1 Shop Drawings and Product Data

2.1.1 For each piece of electrical/electronic equipment supplied by the CONTRACTOR, four (4) sets of shop drawings/product data shall be submitted for review. The submissions shall communicate the following:

.1 Outline drawings showing dimension weights, dimensional layouts, and mounting of panels and components/devices;

.2 Electrical drawings showing schematic, wiring and connection details;

.3 Installation and operation manuals;

.4 Recommended spare parts lists;

.5 Configuration procedures;

.6 Procedures for periodic adjustments by operators and maintenance personnel; and

.7 On-line and off-line troubleshooting procedures.

2.2 Drawings of Record

2.2.1 Provide an electronic copy of drawings on re-writable CDR, DVD±R, or USB in Adobe pdf format latest version; or hard copy of markups on the latest revision of the engineered drawings.

2.2.2 Provide record set of drawings.

2.2.3 Supplier drawings of critical control systems for vendor packages shall be provided in AutoCAD format (latest edition).

PART 3 EXECUTION

3.1 Maintenance Instructions

3.1.1 Provide manufacturer's maintenance instructions for all equipment during the submission of shop drawings.

3.2 Operation Instructions

3.2.1 Provide operation instructions for all systems (hardware and software) during the submission of shop drawings.

3.3 Operations and Maintenance Manuals

3.3.1 Refer to Division 1 for O&M manual preparation requirements.

3.3.2 Provide an electronic copy of O&M description and manuals (where applicable) on CD ROM or USB.

3.3.3 The O&M manuals shall include, but not be limited to, the following:

.1 Copies of reviewed equipment shop drawings;

.2 Modified data sheets (if applicable);

.3 Control schematic and ladder logic diagrams;

.4 PLC documentation;

.5 Operating logic descriptions for site;

.6 Listing of IP addresses for site;

.7 Equipment O&M manuals and spare parts list;

.8 Drawings of record (11 x 17 size); and

.9 All vendors contact information (telephone, fax and email address) and copies of warranties.

END OF SECTION 13190

PART 1 GENERAL

1.1 Related Work

1.1.1 Division 1 - General Requirements

1.1.2 Division 11 - Process Mechanical

1.1.3 Division 15 - Buildings Mechanical

1.1.4 Division 16 - Electrical

1.1.5 Section 13115 - Instrumentation Spare Parts and Maintenance Materials

1.1.6 Section 13310 - Control Panels

1.1.7 Section 13320 - Programmable Logic Controller

1.1.8 Section 13330 - Instruments

1.1.9 Section 13340 - Communications

1.1.10 Section 13345 - Wireless Communication Devices and Antennas

1.2 Definitions

1.2.1 Supply - supply material only; installation by others.

1.2.2 Install - install and assist in commissioning of materials supplied by other trades, vendors or OWNER.

1.2.3 Provide - supply, install and commission material supplied in the work of this division.

1.2.4 EtherNet/IP - Industrial communications protocol managed by ODVA which utilizes TCP, UDP, and IP over Ethernet to deliver CIP.

1.3 General Requirements

1.3.1 This section specifies the General Provisions for the supply, delivery, installation, calibration and commissioning of the process control and instrumentation system, including all control and graphic panels, as specified herein and/or detailed on the drawings.

1.3.2 It is the intention of these specifications and drawings to provide for a complete and fully operational control and instrumentation system, with facilities and services to meet the requirements described herein, and in complete accord with applicable codes and ordinances.

1.3.3 The work to be done shall include the provision of all labour, materials, tools, and equipment, as well as the application of a competent knowledge of construction, whether or not directly specified or shown on the plans, required for the installation testing and placing into service the complete control and instrumentation system, except when it is specifically mentioned that certain materials and/or labour are not part of the contract.

1.3.4 These specifications shall apply to and govern all trades doing control and instrumentation work, and shall be read in conjunction with and form a part of the general specifications of the project.

1.3.5 The control and instrumentation work includes, but is not limited to, the following:

.1 Control panels;

.2 Graphic Panels;

.3 Programmable Logic Controller System;

.4 Primary Elements for flow, level, temperature;

.5 Indicators where required;

.6 Uninterrupted Power Supply;

.7 Control Wiring;

.8 Annunciators;

.9 Communications Systems;

.10 Spare Parts & Manuals;

.11 Devices shown on the detailed drawings and listed in instrumentation data sheets; and

.12 Conduit, wiring and cable.

1.3.6 The CONTRACTOR shall ship or hand-deliver the PLC and HMI, complete with the corresponding software, to the INTEGRATIONS CONTRACTOR for programming. The equipment must be shipped a minimum of four months prior to the programmer being required on site. The CONTRACTOR shall be responsible for all shipping costs of the equipment to and from the INTEGRATIONS CONTRACTOR's office.

1.3.7 In the event that the field devices are not ready for commissioning and I/O checking, the programmer shall leave site and all costs incurred will be the responsibility of the CONTRACTOR.

1.4 Equipment Manufacturers

1.4.1 All equipment shall be manufactured by experienced manufacturers in a CSA approved facility or utilizing equipment bearing the CSA label who can demonstrate in-use records for all equipment offered.

1.4.2 Requests for approval of alternative suppliers shall be submitted to the ENGINEER. Refer to Section 01300 - Submittals.

1.4.3 The majority of equipment shall be supplied by a single manufacturer, particularly where aesthetics are of concern, such as in panels.

1.5 Codes, Permits and Fees

1.5.1 THE WORK shall comply with the requirements of the current edition of the Canadian Electrical Code, Part 1, and the regulations of the Alberta Government, Department of Labour, Electrical Protection Branch.

1.5.2 Obtain the required construction permits, arrange for inspections and supply the ENGINEER with approval certificates pertaining thereto, including a certificate of final inspection.

1.6 Reference Standards

1.6.1 Unless otherwise specified, equipment shall conform to appropriate standards and recommendations of:

.1 The American Society of Mechanical Engineers, hereinafter referred to as ASME Standards.

.2 The Instrument Society of America, hereinafter referred to as ISA.

.3 The Canadian Standards Association, hereinafter referred to as CSA.

1.6.2 All equipment shall be metric - SI Standard.

PART 2 PRODUCT

2.1 Setting Out of Work

2.1.1 Where equipment is combined with the work of other trades, supply equipment to be built-in or measurements to allow necessary openings to be left so as not to hold up THE WORK.

2.1.2 Make reference to electrical, mechanical, structural, process and architectural drawings when setting out THE WORK. Consult with respective Divisions in setting out locations for conduit runs, instrumentation boards, panel assemblies, etc., so that conflicts are avoided and symmetrical even spacing is maintained.

2.1.3 Layouts shown for facility are for estimating purposes only. Coordinate installation of conduit, outlets and equipment with other divisions for final equipment layout.

2.1.4 Where instrumentation equipment is in close proximity, said items are to be lined up horizontally unless otherwise called for by the ENGINEER.

2.2 General

2.2.1 Purchase all components required for the fabrication of process control panel(s) as detailed in the design drawings and control panel specifications.

2.2.2 Procure all specified process devices and instrumentation as indicated in the instrumentation specifications. Refer to Section 13330 for details.

2.2.3 Supply all other required equipment and cables to meet the intent of this specification.

PART 3 EXECUTION

3.1 Installation of Equipment

3.1.1 Install all equipment in accordance with the manufacturer's recommendations and in a manner that shall ensure satisfactory operation upon completion.

3.1.2 Provide all labour and all necessary equipment including timbers, scaffolding, tools, and rigging materials for installation of the equipment.

3.1.3 The CONTRACTOR shall be responsible for coordinating all mechanical, electrical and other work for the equipment being installed.

3.1.4 The in-line mechanical installation of certain items specified to be supplied in this section, are specified to be installed in Division 11 - Process Mechanical.

3.2 Manuals

3.2.1 Refer to Division 1, General Requirements, - Section 01700 for requirements for operation and maintenance (O&M) manuals.

3.2.2 Provide operating and maintenance documents for all equipment and arrange for their insertion into the O&M manuals. The documents shall include all applicable, descriptive and technical data; maintenance and operating procedures; wiring diagrams; spare parts lists; service representatives; and suppliers for replacement parts. The documents shall be neatly and orderly assembled in binders.

3.2.3 Requirements for O&M of process control and instrumentation equipment shall be as specified in various Sections of Division 13.

3.3 Drawings of Record

3.3.1 Refer to Division 1, General Requirements - Section 01390.

3.4 Coordination of Work

3.4.1 Cooperate and coordinate with other trades on the project.

3.4.2 Make suitable arrangements with other trades to make provision for the control and instrumentation work and be responsible for the assurance that such provisions are satisfactory for the control and instrumentation work.

3.4.3 Check drawings and specifications of other trades for conflict and coordination with the control and instrumentation trade. If any conflicts are found, obtain a ruling from the ENGINEER before proceeding.

3.5 Power Supply

3.5.1 Provide all necessary power supplies for controls and instruments.

3.5.2 120 V(ac) Power wiring to field devices shall be #12 AWG unless otherwise specified.

3.5.3 24 V(dc) Power wiring to field devices shall be #14 AWG unless otherwise specified.

3.6 Control Wiring

3.6.1 Unless specified otherwise, all conductors for control wiring shall be copper with TEW90, x-link insulation, 300 or 600 Volts.

3.6.2 Neutral conductors shall be white, grounding conductors shall be green, DC conductors shall be blue and AC conductors shall be red.

3.6.3 Instrumentation wiring for analog signals shall be individually shielded - multipair cable #16 AWG (7x16) tinned copper.

3.6.4 Control wiring for level and pressure switches shall be #14 THHN Black.

3.6.5 Where dimensional details are required, work with the applicable structural and architectural drawings.

3.6.6 The CONTRACTOR is responsible for correcting any work completed contrary to the intent of the drawings and specification and shall bear all costs for correcting same.

3.7 Start-Up and Commissioning

3.7.1 Upon completion of the installation, the CONTRACTOR shall be responsible for testing to determine correct system operation and sequences as intended in the CONTRACT DOCUMENTS. Process instruments such as flow, level, pressure transmitters, etc., shall be checked for operation prior to process start-up, by manipulating operating controls like set points, auto-manual selectors, etc. Status and alarm contacts to be checked by manipulation or jumpering at the sensing element.

3.7.2 Results of tests are to be logged by the CONTRACTOR and submitted to the ENGINEER. Any apparent defects shall be reported and corrected.

3.7.3 When preliminary checks have been completed and process equipment is operating or ready to operate, individual systems shall be calibrated in accordance with the latest ISA recommendation. After calibrations the system shall be placed in operation in conjunction with the ENGINEER and/or the OWNER's designated operating personnel.

3.7.4 In general, the start-up and commissioning shall be in accordance with specifications Section 01650 - Commissioning and Section 13180 - Testing and Commissioning.

3.8 Conduit, Wiring and Cable

3.8.1 Supply and install all conduit, wiring, control and instrumentation cables for the control, instrumentation and low line voltage control for building services.

3.8.2 Conduit and wiring for power, lighting, miscellaneous electrical systems and power supplies to control instrumentation and building service panels including other components requiring line voltage power supply shall be supplied and installed as specified in Division 16 - Electrical.

3.9 Spare Parts

3.9.1 Provide spare parts as required in Section 13115 - Instrumentation Spare Parts and Maintenance Materials.

3.9.2 Should conflicts arise between spare part quantities, the larger quantity of the conflicting item shall be provided.

END OF SECTION 13300

PART 1 GENERAL

1.1 Description

1.1.1 This section specifies the control and graphic panels which shall be supplied and installed as part of the control and instrumentation.

1.2 Related Work

1.2.1 Section 13115 - Instrumentation Spare Parts and Maintenance Materials

1.2.2 Section 13130 - SCADA Hardware

1.2.3 Section 13300 - Process Control and Instrumentation General Provisions

1.2.4 Section 13320 - Programmable Logic Controller

1.2.5 Section 13330 - Instruments

1.2.6 Section 13340 - Communications

1.2.7 Section 13345 - Wireless Communications Devices and Antennas

1.2.8 Section 16280 - Uninterruptible Power Supply

1.3 Work Included

1.3.1 This specification covers the supply and installation of complete control panel(s) and all associated equipment as described in these specifications and listed below.

1.3.2 Responsibility shall include the supply, fabrication, checkout, layout, documentation, delivery, and installation on site, fully equipped and functional control panel(s) as shown on the panel design drawings and as specified herein.

1.3.3 Responsibility shall include supply and installation of all components and vendor subsystems so as to provide functioning control panel(s).

1.3.4 Component subsystems shall include, but not be limited to:

.1 Programmable Logic Controller (PLC);

.2 Panel wiring;

.3 Breakers and power requirement; and

.4 Communications requirement.

1.3.5 Documentation referred to in 1.3.2 of this section shall include:

.1 Equipment descriptive data;

.2 Equipment installation, service manuals, operation/maintenance manuals;

.3 Control panel dimensional drawings (interior and exterior);

.4 Wiring drawings / schematics;

.5 Recommended spare parts lists;

.6 All control panel equipment, models, and details for integration into site O&M manuals;

.7 Conductor identification, field terminals, changes, etc. on the schematic drawings;

.8 As-built information for the completed control panel(s); and

.9 Copy of Panel Inspection Check Sheet(s), FAT sheet(s).

1.4 Qualifications

1.4.1 All work performed in this Division shall be completed by a firm normally engaged and fully competent in this type of work. The firm shall have been continuously engaged in the business for at least five (5) years.

1.4.2 Qualified Electricians shall perform the control wiring installation and field connections on the WORKSITE.

1.5 Testing

1.5.1 Arrange a simulated test of the control panel(s) at CONTRACTOR’s premises for ENGINEER’s review during fabrication.

1.5.2 Arrange a Factory Acceptance Test (FAT) at CONTRACTOR’s premises prior to shipment to site for installation.

PART 2 PRODUCTS

2.1 General

2.1.1 Spare parts requirements shall be as per Section 13115 - Instrumentation Spare Parts and Maintenance Materials.

2.1.2 Supply the control panel(s) in accordance with the general arrangement and dimensions indicated on the appropriate drawings. Panels must be complete with all instruments, meters, switches, indication lights, relays, controllers, amplifiers, modules, etc., as specified herein or as indicated in the detailed drawings.

2.1.3 The control panel(s) shall be constructed by a CSA approved panel manufacturer in a CSA approved facility.

2.2 Enclosures

2.2.1 All enclosures in control rooms and building rooms shall be CSA Type 12, with gasket seals on doors, unless otherwise stated.

2.2.2 All outdoor enclosures shall be rated for outdoor use and be CSA Type 4/4X, painted or stainless steel, unless otherwise detailed.

2.2.3 All enclosures installed in hazardous areas shall be rated for the area of install, and shall be resistant to corrosion.

2.3 Internal Works

2.3.1 This specification covers the minimum requirements for the shop fabrication and testing of control panel(s) as described herein.

2.3.2 All components contained on or within the panel(s) are to be supplied and fully wired under this contract.

2.3.3 The selection of all accessories, materials and methods for fabrication not specifically covered by this specification, but which are necessary to complete the fabrication of the control panel(s), shall be the responsibility of the panel fabricator and shall be carried out in accordance with good engineering practices.

2.3.4 The panels must bear approval from a recognized certification agency accredited by the Standards Council of Canada.

2.3.5 The control panels shall be fabricated to the applicable codes and standards as follows:

.1 National Electrical Manufacturers Association (NEMA).

.2 Canadian Standards Association (CSA).

.3 Canadian Electrical Code (CEC).

.4 Institute of Electronic and Electric Engineers (IEEE).

2.3.6 Wiring for control signals shall be a minimum of #16 AWG TEW105 tinned stranded copper; insulation rated at 600 V unless otherwise specified.

2.3.7 Wiring for AC power distribution shall be a minimum of #14 AWG TEW105 tinned stranded copper; insulation rated at 600 V unless otherwise specified.

2.3.8 Each wire must be tagged at both ends with a heat shrink sleeve that is machine printed or approved alternate.

2.3.9 Wiring systems with different voltage levels or types must be suitably segregated within the panel were applicable.

2.3.10 All wiring shall be run in enclosed plastic wireways such as Panduit. Wireways shall be sized so that the total cross sectional area of the insulated wire and cable does not exceed 40% of the cross sectional area of the wireways.

2.3.11 All wiring to panel door(s) shall be run in Braided Expandable Sleeving to protect against abrasion.

2.3.12 A minimum clearance of 30 mm shall be provided between wireways and any point of wire termination.

2.3.13 All panel wiring to a terminal strip shall come in from the right, and field wiring from the left.

2.3.14 Firmly bond all panel mounted device on or within the panels to ground. Provide supplementary bonding conductors for back panels and doors. Attach a separate bonding conductor to all devices that are not firmly fastened to the panels with screws for such devices as case mounted instruments, meters, etc.

2.3.15 Type 12 enclosures shall be fabricated with necessary stiffening to form a rigid assembly. The structures must be suitable for carrying the weight of the equipment mounted inside the panel and on the doors. Provide removable top and bottom cable entry panels.

2.3.16 All wiring incoming and outgoing, shall terminate at terminal strips mounted inside panels.

2.3.17 All terminal strips must be identified with a terminal strip number as per the panel design drawings.

2.3.18 All terminal blocks must be identified on both sides with machine printed terminal markers as per the panel design drawings.

2.3.19 Grounding lugs shall be provided for each panel, suitable for termination of up to #2 AWG copper grounding conductor.

2.3.20 A copper ground bar inside the control panel for TECK cable ground termination shall be provided.

2.3.21 Provide an interior LED fixture switched on when panel door is opened.

2.4 Control Panels

2.4.1 The site control panel shall be fabricated in accordance with Section 13310 and according to the detailed design drawings.

2.5 Uninterruptible Power Supplies (UPS)

2.5.1 Control Panels

.1 UPS must be supplied with power cables of the appropriate length, and proper communications cable for the alarms. See control panel detail construction drawings for UPS wiring diagrams, make and model.

.2 UPS to be installed in the bottom left of control panel.

.3 See Section 16280 - Uninterruptible Power Supply for minimum requirements.

2.5.2 Wrap-Around Bypass

.1 UPS shall be complete with a 120V(ac), 15 A wrap-around bypass switch, complete with automatic transfer switch and FORM C output.

.2 Bypass shall be manufactured by Always On UPS Systems Canada Inc., model DCC BPS12015, or approved equivalent.

2.6 Identification

2.6.1 All devices (Fuse Blocks, Circuit Breakers, Relays, etc.) on or within the panel(s) are to be identified in accordance with the device name or tag number on the panel design drawings.

2.6.2 Nameplates shall be provided on or within the panel(s) identified in accordance with the nameplates on the panel design drawings.

2.6.3 Nameplates shall be white with black lettering, sized to fit a minimum of 3 mm high lettering unless otherwise specified.

2.6.4 Nameplates shall be securely fastened to the panels with screws or rivets, and double sided tape. All tags must be permanent and placed in a visible location within the panel.

2.6.5 Identify all cables where they terminate at control panel, junction boxes and field devices with a cable tag number. Use Electrovert K Marker or approved alternate and Tywrap to cable.

2.6.6 Provide a Fuse Replacement Table inside the panel(s) when fuses are being used. Table to provide the following information: Fuse ID, Type, Size, and Part Number. Table to be adhered to the inside of the panel door or placed in the data pocket. Table to be a laminated excel document or approved alternate.

PART 3 EXECUTION

3.1 Equipment Mounting

3.1.1 All equipment must be mounted on a panel backplate, unless otherwise specified.

3.1.2 All new mounting plates, pedestals, bolts, shims, angle iron and other miscellaneous steel or hardware items required for the securing of equipment shall be supplied unless specifically noted otherwise.

3.1.3 All equipment to be installed in accordance with the manufacturer's installation instructions.

3.1.4 Instruments or raceway shall be installed so as not to obstruct access routes, equipment maintenance space or space for future equipment.

3.2 Wire and Cable

3.2.1 Internal panel wiring shall be type TEW105 degrees rated 600V, and color coded as listed below unless otherwise stated on the design drawings.

.1 240/208 V 3 Ph – Black, Red, Blue

.2 240/120 V 1 Ph – Black

.3 Neutral – White

.4 AC Control – Red

.5 DC Control – Blue

.6 Ground – Green

.7 24 V(dc) Power – (+) Yellow, (-) Brown

.8 Shield Cable – (+) Black, (-) Clear or White

3.2.2 Ethernet cable shall be CAT-6.

3.3 Testing and Commissioning

3.3.1 Testing of the control panel(s) shall include, but not be limited to the following:

.1 Correct components installed;

.2 Correct layout of components;

.3 All wires are labeled correctly;

.4 All devices and equipment are labeled correctly; and

.5 Wiring continuity test.

3.3.2 Commissioning of the control panel(s) shall include, but not be limited to the following:

.1 Supervision of installation of components and wiring connections;

.2 Supervision of wiring continuity tests;

.3 Verification of instrument calibration and provision of written report;

.4 Functional check and adjustment under operational conditions of the instruments and control equipment;

.5 Coordinate instrument and control equipment supplier's service personnel as required for complete system testing;

.6 Instruct OWNER's personnel in correct method of operation of instruments and control equipment;

.7 Direct OWNER's personnel at hand-over as to final adjustment to the system for correct operation of plant;

.8 Ensure that the instrumentation and control equipment suppliers cooperate to complete the work of this section;

.9 Verify signal levels and wiring connections to all instrumentation and control equipment; and

.10 Submit a "Loop Check Sheet" for each loop number and an "Instrument Calibration Sheet" for each device. Include all completed forms in the instruction books.

END OF SECTION 13310

PART 1 GENERAL

1.1 Description

1.1.1 This section specifies the Programmable Logic Controller (PLC) which shall be supplied and installed as part of the control and instrumentation.

1.2 Related Work

1.2.1 Section 01650 - Commissioning

1.2.2 Section 13110 - Scope of Work

1.2.3 Section 13115 - Instrumentation Spare Parts and Maintenance Materials

1.2.4 Section 13140 - SCADA Software

1.2.5 Section 13180 - Testing and Commissioning

1.2.6 Section 13300 - Process Control and Instrumentation General Provisions

1.2.7 Section 13310 - Control Panels

1.2.8 Section 13330 - Instruments

1.2.9 Section 13340 - Communications

1.3 Operation and Maintenance Manuals

1.3.1 Refer to Division 1, Section 01700 - Contract Closeout for the operation and maintenance (O&M) manual requirements.

1.3.2 Provide the following manuals:

.1 One (1) O&M manual for PLC hardware.

.2 O&M manual for PLC hardware documentation shall include as a minimum:

.1 List of components complete with description, part number and slot location;

.2 Installation Instructions for each component of the PLC; Chassis, Power Supply, I/O Cards etc.; and

.3 Recommended spare parts list.

1.4 Commissioning

1.4.1 Refer to Section 01650 - Commissioning and 13180 - Testing and Commissioning.

1.4.2 Continuity and insulation tests shall be carried out on all wiring.

1.4.3 Any equipment or device that may be damaged due to testing should be disconnected before the test, and reconnected after completion of the test.

1.4.4 All instruments and devices shall be calibrated immediately prior to commissioning.

1.4.5 After all devices in a loop have been calibrated the loop shall be functionally tested to ensure correct operation and signal routing.

1.4.6 Calibration and loop tests shall be witnessed by the ENGINEER. Provide certificates for each test.

PART 2 PRODUCTS

2.1 Programmable Logic Controller (PLC)

2.1.1 The CONTRACTOR shall provide and fabricate the control panel including the chassis, I/O cards, power supply and wiring as defined on the detailed drawings.

2.1.2 The components shall be manufactured by Allen Bradley. Supplied should include the communication modules, interface, input/output modules, and hardware for communication with a host PLC; power supply; and all power and interface cables necessary to function as a complete and operable PLC system. The controller shall come complete with an SD card for nonvolatile memory storage to prevent code loss upon power failure.

2.1.3 Refer to Section 13140 - SCADA Software for software requirements.

2.1.4 The control system for the Lift Station shall be based on Allen Bradley CompactLogix, and shall include the hardware specified in the detailed drawing package.

2.1.5 The CONTRACTOR shall provide and fabricate the control panel including the PLC, power supply, and wiring as defined herein and as detailed in the engineered drawings.

2.1.6 The PLC shall be programmed by others.

2.2 Zelio Smart Relay

2.2.1 The PLC backup controller shall be a Schneider Zelio Smart Relay as defined in the drawing package. It shall be supplied with the power supply and all power and interface cables necessary to function as a complete and operable pump control system. The Zelio shall be powered directly by the control panel’s UPS system using a dedicated resettable fuse circuit. See the engineered drawings for details on model, wiring, and power requirements.

2.2.2 The controller shall have nonvolatile memory storage to protect user programs upon power failure.

2.2.3 The Zelio Smart Relay shall have inputs and outputs wired as per the detailed drawings.

2.2.4 The Zelio Smart Relay shall be responsible for and act as the emergency backup pump control system for the Lift Station. The Lift Station level bulbs shall be tied into the Zelio controller in parallel with the PLC, as per the detailed drawings, to allow for the redundant system to function.

2.2.5 The controller shall be fully tested and commissioned in accordance with all applicable Commissioning specifications.

2.2.6 The Zelio Smart Relay inputs shall be wired in the fail-safe configuration where possible.

2.2.7 The CONTRACTOR shall provide the necessary programming software package for the Zelio Smart Relay.

2.2.8 The Zelio Smart Relay shall be programmed by others.

2.2.9 The Zelio Smart Relay shall have an output wired to a PLC input to allow for the implementation of a watchdog system of the backup controller within the PLC.

2.2.10 The PLC shall have an output wired to a Zelio Smart Relay input to allow for the implementation of a watchdog system of the PLC within the backup controller.

2.2.11 The controller shall have an Auto-Off selector switch, mounted to the front of the control panel, and tied into the VFD field logic as per the detailed drawings.

PART 3 EXECUTION

3.1 Installation

3.1.1 The CONTRACTOR shall install the new control panel as per the control panels and programmable logic controller specifications and drawings.

END OF SECTION 13320

PART 1 GENERAL

1.1 Description

1.1.1 This section specifies the supply installation, field testing, and placing into operation of flow, pressure, level and other instruments for control and instrumentation.

1.2 Related Work

1.2.1 Section 13300 - Process Control and Instrumentations General Provisions

1.2.2 Section 13310 - Control Panels

1.2.3 Section 13320 - Programmable Logic Controllers

1.2.4 Section 13340 - Communications

1.2.5 Division 11 - Process Mechanical

1.2.6 Division 15 - Building Mechanical

1.3 Instrument Tags

1.3.1 The Instrument Tags are based on ANSI/ISA standards. If any equipment/ instrumentation or controls are added or missing detailed tags within the package, the CONTRACTOR shall generate an appropriate tag based on ANSI/ISA format, confirm tag with the ENGINEER and OWNER, and apply labels as required in the contract.

PART 2 PRODUCTS

2.1 Instruments

2.1.1 Provide each instrument with mechanisms that are corrosion resistant unless otherwise specified.

2.1.2 Provide each instrument with mechanisms enclosed in a dustproof and a moistureproof case unless otherwise specified.

2.1.3 Provide all indicator and gauge dials finished in permanent white with black graduations and figures.

2.1.4 Potentiomeric signals shall have a "live" zero, or positive minimum value, in the signal range.

2.1.5 Each component shall be carefully selected and designed for a long lifetime (see Section 13300 - Process Control and Instrumentation General Provisions) with ample margin to withstand transient and other surge voltages which may occur in the circuits from any source in the power supply.

2.1.6 Each component and composite instrument shall be suitable for the location and installation position at the attitude designated on the drawings, e.g., horizontal, vertical or sloped position.

2.1.7 The CONTRACTOR shall provide all power supplies. Provide each instrument having a 120 V(ac) supply with a receptacle and plug assembly. Receptacles and plug shall be of "twist-lok," type.

2.1.8 Provide each instrument requiring 120 V(ac) with a circuit breaker.

2.1.9 Integrating counters and elapsed time meters shall show the total quantity that has passed through the meter and shall not require the use of a multiplier other than cipher additions. The integrators shall have at least seven figures.

2.1.10 All control panel mounted instruments shall be suitable for flush mounting and shall be furnished with bezel.

2.1.11 Unless otherwise indicated or specified, all signals shall be of the 4-20 mA DC type. This applies to both transmitting and receiving instruments.

2.1.12 All materials shall conform to the standards of the Canadian Standards Association (CSA), and the most recent version of the Canadian Electrical Code (CEC).

2.1.13 A minimum of one paper copy of each unique manual shall be provided.

2.1.14 Where instruments require a hand-held programmer for setting up and calibrating, one of each unique programmer shall be provided.

2.1.15 Instrumentation Data Sheets are included following this Section.

2.1.16 Instruments of one manufacturer shall be used throughout the installation to the extent practical.

2.2 Flow Monitoring System

2.2.1 Magnetic Flow Meters

.1 Magnetic flow meters shall be complete with signal converters/ transmitters, and shall be the following series:

Siemens/Sitrans	MAG 5000/MAG 5100
Rosemount	8700
Endress+Hauser	Proline Promag 50W
ABB	WaterMaster
Krohne	OPTIFLUX2000

.2 Flow meters shall have the following features:

- Continuous zero stability.
- Interchangeability with signal converters without calibration performance.
- End connections shall be compatible with process piping specifications and drawings.
- Grounding as specified by the flow meter manufacturer.
- HART capability.

.3 Signal converters shall have the following features:

- Continuous zero stability.
- Solid state electronics.
- Direct reading range adjustment permitting precise manual selecting of maximum flow rate.
- A local indicator that simultaneously displays instantaneous flow and totalized flow.
- Output analog 4-20 mA signal proportional to the instantaneous flow.
- Pulse output for totalized flow (Whenever a preset volume passes through the flow meter, there is a pulse output.)
- Interchangeability with any flow meter without affecting calibration performance.
- Field mounting design.

.4 The combined accuracy off the flow meter and converter shall be within 0.5% of the actual flow rate, when the actual flow rate is between 10% and 100% of the maximum flow setting.

.5 A handheld programmer is to be provided in accordance with the requirements in Section 2.1 above.

.6 Provide pipe spool pieces for the in-line replacement of each flow meter. Spool piece tube and end connections shall conform to the process piping specifications and drawings.

2.2.2 The in-line mechanical installation of magnetic flow meters and turbine meters is specified under Division 11 - Process Mechanical. Install per manufacturer's installation instructions and Division 11 specifications.

2.3 Submersible Pressure Transmitter Level Monitoring Instruments

2.3.1 Only those transmitters which been proven to perform satisfactorily in lift station applications shall be installed, and shall be one of the following series:

.1 Devar;

.2 Krohne;

.3 Endress+Hauser;

.4 Siemens;

.5 Global Water;

.6 Pressure Systems;

.7 Process Measurement and Controls;

.8 WIKA; or

.9 Approved alternate.

2.3.2 Transmitter shall be a 2-wire loop powered device with 4-20 mA output.

2.3.3 The transmitter shall be of a maintenance-free, hermetically sealed design.

2.3.4 The transducer shall be of manufactured using corrosion-resistant materials (such as PBT or PVDF) and be suitable for wastewater applications.

2.3.5 Transmitter shall be rated for the area, and be installed complete with all required safety interfaces.

2.3.6 Transmitter shall have a vent tube for atmospheric pressure compensation. The vent tube shall be terminated in a suitable filter or container filled with desiccant to prevent condensation in the vent tube. An aneroid bellows may be used if it does not prevent the transmitter from meeting the accuracy requirement. The location of the termination of the vent tube shall be in a junction box at ground level.

2.3.7 Transmitter error when measuring over a range of 0 to 10.0 m wastewater depth shall not be greater than ±0.1m due to the combined effects of accuracy, atmospheric pressure variation, long term stability (minimum one year), and a water temperature change of 10°C.

2.3.8 Transmitter shall have a face design or protective guard on the face that minimizes susceptibility to clogging of the pressure sensitive area.

2.3.9 The transmitter shall be installed by suspending it from its integral cable and attached to the rigid drop pipe.

2.3.10 Transducer shall meet the following minimum requirements:

.1 Sensor element:

.1 Silicone Diaphram

.2 Range:

.1 0-10 m

.3 Linearity and Hysteresis:

.1 ±0.1% full scale (FS)

.4 Accuracy:

.1 ±0.1% FS at constant temperature, ±0.2% over 35° to 70°F range

.5 Overpressure:

.1 Not to exceed 2 x full scale range

.6 Resolution:

.1 Infinitesimal (Analog)

.7 Outputs:

.1 4-20 mA

.8 Supply Voltage:

.1 10-36 V(dc) (loop powered)

.9 Operating temperature:

.1 -40° to +185°F

.10 Compensated temperature range:

.1 30° to 70°F submerged, automatic barometric compensation

.11 Material:

.1 304L SS, PBT, PVDF

.12 Jacket material:

.1 87A shore harness Polyurethane or Fluorinated Ethylene Propylene (FEP) Teflon

.13 Vent tube:

.1 HD Polyethylene

.14 Shield:

.1 Aluminum Mylar

2.4 Mechanical Level Switches

2.4.1 Requirements:

.1 Mechanical level switches shall be ENM-10 Liquid Regulators as manufacturer by Xylem Water and Wastewater Canada (formerly Flygt Canada). Switches shall not contain any mercury.

.2 Install as shown on Process Mechanical or Instrumentation/Controls drawings.

.3 Suspend the bulb the appropriate distance above the bottom of the wet well to obtain the desired switching point. For level switches sensing a high level the switching point is defined by a rising water level, and for level switches sensing a low level the switching point is defined by a falling water level.

.4 All floats shall provide FORM C contacts, with fail safe signal (high signal for the normal operation position) terminated back to the PLC and Zelio logic controller as per the detailed drawings.

.5 Protect level switches from turbulence during equipment operation. Use anti-sway rings where outlined in the details.

.6 The integral cable supplied with the level switches shall be terminated in a small junction box in the room above the wet well so that the switches can be replaced without pulling cable through a wall. Cable length to be minimum 15 m, with extra cable looped and neatly hung near the junction box.

.7 Where level bulbs are installed in hazardous rated areas, they shall be connected to CSA approved intrinsically safe barriers. The interfaces shall be Turck IM1-22EX-R, or approved equivalent. See drawings and bill of materials for details.

2.5 Pressure Gauge - Water Service

2.5.1 Pressure gauges shall be as specified under Division 15 - Building Mechanical.

2.5.2 Pressure gauges shall contain dual kPa and psi readouts.

2.5.3 Red Valve Series 48 Pressure Sensors or approved equivalent shall be used in conjunction with pressure gauges.

2.6 Pressure Gauge - Sewage Service

2.6.1 Sewage service pressure gauges shall have the following characteristics:

.1 Compound pressure/vacuum type

.2 max pressure 250kPa, range 0~500kPa

.3 115 mm dial face diameter

.4 12 mm connections

.5 stainless steel gear

.6 bronze bourdon tube

.7 adjustable pointer

.8 liquid silicone filled

.9 flanged diaphragm seal

.10 steel bottom housing

.11 Teflon diaphragm

.12 12 mm connections

.13 6 mm flushing connection

.14 gauge and diaphragm seal assembly, silicone filled, one unit

.15 isolating valve 50 mm flanged and with Buna N seat; non-rising stem, stainless steel shaft

.16 Valve - Seguro Model A1111AH gate valve or approved alternative

.17 diaphragm seal – Type 100 Ashcroft 303 TS

.18 gauge - Ashcroft Model 45

.19 maximum range at least twice the operating pressure

2.7 Isolation Valves

2.7.1 Each instrument sensing line shall be complete with an isolation valve. The isolation valves shall conform to Division 11 - Process Mechanical.

2.8 Gas Detection

2.8.1 The building shall have gas detection systems installed in the wet well room.

2.8.2 The wet well shall be monitored for the following gases:

.1 Hydrogen Sulfide (H2S); and

.2 Methane (CH4/LEL).

2.8.3 The sensor probes shall be installed at heights as indicated on the drawings, using these general guidelines:

.1 For heavier-than-air gases, as low as practical.

.2 For lighter-than-air gases, ceiling, as close to the potential source of gas emission as possible.

.3 For oxygen deficiency, at ergonomic height of 1500 mm and away from immediate fresh air sources such as air intake louvers and fans.

2.8.4 The gas monitors shall be manufactured by:

.1 NET Safety;

.2 Honeywell Analytics;

.3 RKI Instruments; or

.4 An approved alternate.

2.9 Building Monitoring

2.9.1 Smoke Detection:

.1 Three (3) smoke detectors shall be installed in the building: one in the electrical room, one in the pump/mechanical room, and one in the wetwell room. The detectors shall be wired such that electrical and pump room detector alarms are brought back to the PLC as a single input, and both detectors sound simultaneously. The wetwell room detector shall operate independently. Smoke detectors shall be powered by a dedicated 24 V(dc) UPS circuit, be ionization or photoelectric type, and shall have at least one FORM C output contact. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a switch).

.2 Smoke detectors shall provide local LED alarm indication. The LED is placed into red illumination by the control panel indicating that an alarm condition has been detected. A relay output contact shall be provided in the base to connect an external remote alarm strobe or sounder base. The detectors shall be ceiling-mount and shall be plug-in mounted into a twist-lock base.

.3 Smoke detectors shall be manufactured by one of the following:

.1 Honeywell;

.2 Siemens;

.3 Notifier;

.4 System Sensor;

.5 Simplex-Grinnell;

.6 Edwards; or

.7 Approved equivalent.

2.9.2 A limit switch / sensor shall be installed on each building exterior door to detect if the door is open. The limit switch signals shall be connected as inputs to the central PLC as per the detailed drawings. Reference the datasheet for performance specifications. Switches shall all be of a single manufacturer, and shall be of magnetic or inductive proximity sensor type. Sensors installed in hazardous areas shall be rated for the area, be appropriate for intrinsically safe applications, and shall have targets complete with anti-oxidant coatings; stainless steel enclosed magnets; or non-corrosive properties. All products must be Canadian certified. If required, the targets may be fabricated in the field. Acceptable manufacturers include Allen Bradley, Topworx, Eaton, or an approved alternate.

2.9.3 Building temperature sensors to detect abnormal room temperatures shall be installed in the Electrical Room and Wet Well Room. The sensors shall use a platinum RTD to detect temperature and shall be connected to a transmitter that has a 4 to 20 mA loop-powered output for a temperature range of -50 to 50ºC. The following or equivalent products shall be used.

.1 The RTDs shall be 3-wire, 100 ohm platinum, 0.00385 temperature coefficient, 1/4 inch OD with 6 inch leads complete with 1/4 inch compression fitting, unless otherwise recommended by the manufacturer. RTDs shall be manufactured by Thermo-Kinetics, WIKA, Siemens, or approved alternate.

.2 Transmitters connected to RTDs shall be manufactured by Thermo-Kinetics, WIKA, Siemens, or an approved alternate. Where possible, transmitters and RTDs shall be of the same manufacturer.

.3 All temperature devices shall be rated for the area of install. Devices installed within hazardous areas shall be resistant to corrosion. Provide Canadian certifications and area approvals in shop drawing submission.

2.9.4 Instruments for building mechanical are included under Division 15. Any alarm outputs from building mechanical equipment that indicate faults not detected by the above instrumentation shall be connected to the PLC.

2.9.5 A flow switch shall be installed downstream of the building’s air handling unit. The flow switch shall be thermal dispersion type for high reliability and good sensitivity. They shall be Magnetrol type TD1 electronics with TE probe or equivalent. A vane type flow switch is not acceptable.

2.9.6 A flow switch shall be installed on the eyewash/shower station water supply line. Should the station become activated, the flow switch shall send a signal to the PLC to alarm that the emergency wash station is in use.

2.9.7 Alarm beacons/strobes shall be installed on the exterior and interior of the building. The beacons shall be mounted at the locations identified in the detailed drawings, at a high but clearly visible elevation/orientation. Blue beacons shall be used to annunciate building high H2S levels; red beacons shall be used to annunciate high LEL (CH4) levels; and amber beacons shall be used to annunciate general faults (smoke/heat detection, pump faults, building intrusion, etc.). All beacons shall be complete with protective wire or cast guards. All beacons and pilot lights shall be 120 V(ac), complete with interposing relays to allow for control from 24 V(dc) PLC outputs. All beacons/lights shall be installed clear of architectural and structural features and mechanical equipment to provide for clear visibility of beacons when in the active state. All beacons shall be of the same manufacturer. Specific requirements for beacons include:

.1 Beacons installed outdoors shall be flashing strobe type, weather proof rated (Type 4/4X), and shall be surface mounted or wall mounted using brackets to maximize beacon visibility. All beacons installed outdoors shall be manufactured by Applied Strobe Technology Company Limited, AST-1 series. An approved equivalent may be accepted, provided it meets the product requirements given in the datasheet.

.2 Beacons installed indoors in the wet well room shall be flashing strobe type, explosion proof, rated for the area of install, and shall be surface/ceiling mounted, wall mounted using brackets, or pendant mount style to maximize beacon visibility. All beacons installed in the wet well room shall be manufactured by Applied Strobe Technology Company Limited, AST-4 series. An approved equivalent may be accepted, provided it meets the product requirements given in the datasheet.

2.9.8 Wet well room shall be outfit with an explosion proof electric horn for audio alarming of high hazardous gas levels (H2S, LEL), installed at the location indicated in the detailed drawings. Horn shall be powered by 24 V(dc). Unless otherwise directed by the OWNER or OWNER REPRESENTATIVE, default horn tone shall be Sweeping 1200/500 Hz @ 1 Hz. Products manufactured by Allen Bradley, Eaton, Edwards, or an approved Canadian certified equivalent may be accepted.

2.10 Instrument List and Specification Sheets

2.10.1 The Instrument List is included at the end of this section. In the list the instruments are grouped by P&ID drawing.

2.10.2 There is a detailed specification for each instrument type. On the Instrument List, the detailed specifications are associated with the P&ID drawing. A detailed specification lists characteristics that apply to all instruments of that type. The Instrument List has characteristics, such as size and calibrated range that are unique to individual instruments.

2.11 Detailed Specification Sheets

2.11.1 The following instruments are required and to be purchased within this contract by the Division 13 sub-trade. Detailed Specifications are provided, unless otherwise noted:

TAG NUMBER	PROBES/ELEMENTS	DESCRIPTION
AIT-911	AE-911A, AE-911B	Wet Well Room Gas Detector (H2S, LEL)
AS-918A		Fire Detector (Electrical Room)
AS-918B		Fire Detector (Pump/Mechanical Room)
AS-919		Fire Detector (Wetwell Room)
FQIT-105	FE-105	Discharge Flowmeter
FSL-701		MUA-701 Low Flow Switch
FSH-720		Emergency Wash Station Flow Switch
LT-106		Wet Well Level Transmitter
LSHH-106		Wet Well High High Level
LSLL-106		Wet Well Low Low Level
TT-931		Building Temperature (Electrical Room)
TT-932		Building Temperature (Wet Well Room)
TT-933		Outdoor Temperature
UL-921A		H2S Beacon (Blue) – Exterior, Weather Proof
UL-921B		H2S Beacon (Blue) – Wet Well, Explosion Proof
UL-922A		LEL Beacon (Red) – Exterior, Weather Proof
UL-922B		LEL Beacon (Red) – Wet Well, Explosion Proof
UL-923		Fault Beacon (Amber) – Exterior, Weather Proof
UA-924		Wet Well Alarm Horn, Explosion Proof
ZS-901		Building Intrusion (Electrical Room)
ZS-902		Building Intrusion (Wet Well Room)
ZS-903		Building Intrusion (Pump/Mechanical Room)

2.11.2 The following instruments are required to be purchased within this contract by other division(s) and have detailed specification sheets to be followed and updated as required.

TAG NUMBER	PROBES/ELEMENTS	DESCRIPTION
PG-xxx	xxxPRESSGAUGE	Various Pressure Gauges, refer to P&ID for exact tag numbers

2.11.3 The following instruments are required to be purchased within this contract but NOT INSTALLED (spare parts), and have detailed specification sheets to be followed and updated as required.

TAG NUMBER	PROBES/ELEMENTS	DESCRIPTION
AEA-SPARE01		Spare H2S Probe
AEB-SPARE01		Spare LEL Probe

AIT-SPARE01		Spare Gas Analyzer Indication Transmitter
AS-SPARE01		Spare Smoke Detector
FQIT-SPARE01	FE-SPARE01	Spare Flow Indication Transmitter c/w Element
FSL-SPARE01		Spare Low Flow Switch
FSH-SPARE01		Spare Wash Station Flow Switch
LT-SPARE01		Spare Submersible Level Transmitter
LS-SPARE01		Spare Level Bulb
TT-SPARE01		Spare Temperature Transmitter (Explosion Proof)
ULA-SPARE01		Spare Exterior Beacon (Blue)
ULA-SPARE02		Spare Exterior Beacon (Red)
ULA-SPARE03		Spare Exterior Beacon (Amber)
ULB-SPARE01		Spare Interior Beacon (Blue)
ULB-SPARE02		Spare Interior Beacon (Red)
ZS-SPARE01		Spare Door Switch (General Rated)
ZS-SPARE02		Spare Door Switch (Explosion Proof)

PART 3 EXECUTION

3.1 Installation

3.1.1 Install all instruments in strict accordance with the recommendation of the manufacturer.

3.1.2 Instruments located in hazardous areas shall be installed in a manner that meets the requirements of the Canadian Electrical Code (most recent version).

3.1.3 The in-line mechanical installation of items such as meters is specified in Division 11 Process Mechanical.

3.2 Gauges, Thermometers, And Indicators

3.2.1 Install flow meters or indicators in uninterrupted straight pipe, minimum 3 pipe diameters downstream and 5 pipe diameters upstream, on supply lines downstream of pumps, or according to manufacturer’s recommendations.

3.2.2 As applicable, select instruments so that normal operating point is approximately midpoint of instrument range.

3.3 Instrument Installation Locations

3.3.1 Installation height and distance from the wall shall be adjustable through the contract within 300 mm height and 1000 mm position along and from the wall without charge to best suit the requirements of the site and the OWNER.

END OF SECTION 13330

PART 1 GENERAL

1.1 Related Work

1.1.1 Section 13310 - Control Panels

1.1.2 Section 13320 - Programmable Logic Controller

1.1.3 Section 13330 - Instruments

1.1.4 Section 13345 - Wireless Communication Devices And Antennas

1.2 Definitions

1.2.1 Supply - supply material only; installation by others.

1.2.2 Install - install and assist in commissioning of materials supplied by other trades, vendors or OWNER.

1.2.3 Provide - supply, install and commission material supplied in the work of this division.

1.2.4 EtherNet/IP - Industrial communications protocol managed by ODVA which utilizes TCP, UDP, and IP over Ethernet to deliver CIP.

1.3 General Requirements

1.3.1 The data network shall be an Ethernet network, with a connection into the existing SCADA system via a VPN link to the Town's SCADA system at Broadway Ave Reservoir. See engineered drawings for details.

1.3.2 Provide integrated and functional telecommunications and data networks between all designated devices.

1.3.3 Provide communication links to the VFDs, the generator, and the corporate network, all back to the PLC cabinet. For all instances, the communication protocol shall be EtherNet/IP.

1.3.4 Provide markups for as-builts of wiring layouts, cable tagging and termination blocks. Coordinate with Division 16.

1.3.5 All cable shall be installed in a neat and functional manner, with final approval by the ENGINEER and OWNER.

1.3.6 Coordinate the installation of radio equipment with the communications system provider.

1.3.7 IP addresses shall be assigned by the programmer and documented for inclusion into the project O&M manuals.

PART 2 PRODUCTS

2.1 Materials

2.1.1 Supply, install and terminate all data and telecommunication cabling. Provide all wall plates, patch panels and other components as required in order to provide a clean installation.

2.1.2 Supply and install conduit and cable tray as required for communications cable routing.

2.1.3 Ethernet cable is to be of type CAT-6 with properly terminated ends to ANSI/TIA/EIA 568A wiring standards to support gigabit Ethernet.

2.1.4 Provide a N-TRON TX116 16-port Ethernet switch, to be installed within the McKay Ranch Lift Station PLC cabinet (defined in the material list for the PLC). This shall provide connections to the PLC, HMI, MCC line-up (VFDs), wireless radio, corporate network, and a programming port.

2.1.5 Supply, install, configure, and test a Barnett Engineering Ltd. ProTalk CV3 alarm dialer within PLC control panel. If antenna is required, the CONTRACTOR shall coordinate with the cellular communications supplier for supply and installation of antenna and all required associated infrastructure. See Section 13345 for details on antenna. See process control drawings for required callout alarms, details, and wiring tagging.

2.1.6 Supply and install an external cellular antenna for the cellular alarm dialer in a manner which provides a reliable signal during normal operation.

2.1.7 Provide radio equipment as outlined in Section 13345 - Wireless Communication Devices and Antennas.

PART 3 EXECUTION

3.1 Site Conditions

3.1.1 Provide a cable routing plan to be reviewed with the ENGINEER before installation. Any modifications to layout shall be clarified with the ENGINEER in writing before installation proceeds.

3.2 Telephone Service

3.2.1 CONTRACTOR shall install telephone back panel for future telephone service to lift station on the interior wall of the building. Backpanel shall be ¾" good-one-side plywood, painted.

3.2.2 CONTRACTOR shall install underground conduit, complete with #10, braided pull cord, between service provider pedestal and telephone back panel. Ensure wall penetration is adequately sealed, and buried portion of conduit is adequately capped. Conduit must be a minimum of 100 mm diameter and shall be Type DB2 PVC. Coordinate with telephone service provider specifications for installation requirements and standards.

END OF SECTION 13340

PART 1 GENERAL

1.1 Related Work

1.1.1 Section 13310 - Control Panels

1.1.2 Section 13320 - Programmable Logic Controller

1.1.3 Section 13340 - Communications

1.2 Definitions

1.2.1 Supply - supply material only; installation by others.

1.2.2 Install - install and assist in commissioning of materials supplied by other trades, vendors or OWNER.

1.2.3 Provide - supply, install and commission material supplied in the work of this division.

1.3 General Requirements

1.3.1 The CONTRACTOR shall supply and install a securely mounted antenna for the cellular alarm dialer to allow for alarm callouts from the McKay Ranch Lift Station. CONTRACTOR shall coordinate with the OWNER-preferred cellular communications equipment supplier to determine if and where antenna is required.

1.3.2 Antenna shall be installed with all required associated equipment as recommended by the cellular communications equipment supplier.

PART 2 PRODUCTS

2.1 General

2.1.1 Purchase all components required for the installation, including the alarm dialer, radio, lightning arrestor(s), feeder cable, ground clamp, antenna mast, antenna(s), pig tails and all other equipment required in the proper installation of the equipment. Requirements of the system include, but are not limited to:

.1 CSA/Canadian approved;

.2 Low loss LMR or Heliax antenna cable as required;

.3 Power feed and cable length as required for powering wireless device; backup power source is required;

.4 Surge/Lightning Arrestors; and

.5 Grounding of cables and equipment. Antenna cable grounded to separate ground rod. Polyphaser grounded to cabinet.

PART 3 EXECUTION

3.1 Installation

3.1.1 The CONTRACTOR shall ensure that the wireless equipment is properly installed by the wireless equipment supplier. Protection systems shall account for, but not be limited to:

.1 Grounding;

.2 Wind and Snow Loading;

.3 Lightning Protection;

.4 Rain;

.5 Daily and Seasonal Temperature variations; and

.6 Vandal Resistance.

3.1.2 Provide all labour and materials required to support the installation of this equipment.

END OF SECTION 13345

DIVISION 14 CONVEYING SYSTEMS

PART 1 GENERAL

1.1 **Work Included**

1.1.1 This section covers the supply, installation and testing of the following complete conveying systems in accordance with the CSA S-B167 and Z256 "Safety Code for Material Hoists."

One (1) wired explosion proof electrical motor driven, trolley and hoist, monorail, and surge monorail system for the lift station

1.1.2 The supply and installation of rail beams, support frames, bracing members, structural design of the entire support system as well as supervision of installation shall be included in this section.

1.1.3 The drawings indicate the general arrangement of the crane, hoist and support systems. The Contractor shall provide all necessary appurtenances and incidentals required for operating the crane and hoists in accordance with the specifications and in accordance with national and local governing codes of the safety standards for cranes, as published by ASME.

1.1.4 This section shall also include placing the hoists in service and making all necessary adjustments and corrections required for proper operation to the satisfaction of the Engineer.

1.1.5 The crane and hoist systems shall be the product of a company regularly engaged in the manufacture of this type of equipment and whose equipment is of a design, which has been in satisfactory service under similar conditions for not less than five years.

1.1.6 All Monorails, Beams, Bridges or Load lifting devices will be Field load tested and certified prior to initial use, at 125% of rated capacity, .

a) Test weights must be accurate to within –5%, +0% of stipulated values.

b) Test at 100% of rated capacity hoists with overload devices.

c) Test the function of the overload device Load

d) Certification c/w date shall be located in each lift station

1.1.7 Supplementary steel used to provide support for any suspension hardware from building structures other than those shown on the drawings shall conform to the specifications under Division 5 - Metals.

1.1.8 Conform to Division 1 - General Requirements.

1.2 **Related Work Specified Elsewhere**

1.2.1 Monorail, bridge crane and hoist alignment is shown on architectural, process and structural drawings. Confirm the alignment in the field based on the actual equipment layout.

1.2.2 Refer to Section 05120 for structural steel.

1.3 **Submittals**

1.3.1 Submittals shall be in accordance with Section 01300 - Submittals.

.1 Shop Drawings:

a) General arrangement drawings including dimension, size, and location of connections, and equipment weights.

b) Cross-sectional details including cross-referenced material list for all equipment

c) Complete catalogue information, descriptive literature, and specifications.

d) General layout of units complete with motor and drive showing directional rotation, and electric motor terminal box location.

e) Dimensional drawings of motors and drives and details including full output power in kilowatts, rpm and slip.

f) Submit operation and maintenance manuals 30 days prior to startup.

7. Two-year Warranty on all equipment.

.2 Spare Parts

a) Submit a list of recommended spare parts, including current prices and anticipated delivery times, required to maintain the equipment in reliable operation for five years.

1.4 **Delivery And Storage**

1.4.1 Do not deliver items or materials to site until the area in which they are to be installed is ready to receive them in their place of final installation.

1.4.2 Store materials in the storage area allotted and in such a manner as to prevent deterioration, damage, or loss of their essential properties.

1.4.3 All movable and operating equipment shall be fully protected from the weather.

1.4.4 All factory-finished materials shall be wrapped and crated in a manner to protect their finishes.

PART 2 PRODUCTS

2.1 Trolley and Hoist

.1 The electrical motorized trolley and hoist shall be installed on the surge monorail.

.2 The trolley and chain hoist equipment consists of the following:

.1 Corrosion resistant zinc plated electric chain hoist

.1 Manual trolley and hoist

.2 Chains and chain bucket

.3 Forged steel swivel hook block with latch

.4 Structural beam stops at each end of monorail

.5 All steel construction for external impact resistance.

.6 Single speed, 22 ft/min.

.7 3 phase, 575 voltage motor

.8 5.0 meter festoon cable to get power, 1 cable hanger/pulley assembly for every 1.5 m of cable. Provide any cabling required accommodate cable festoon system.

.9 2.0 meter control pendent cable

.10 Motorized trolley

.11 Explosion proof

.12 Local means of disconnection, explosion proof

.13 Chill-hardened, machine tread trolley wheels with 2 precision bearings per wheel.2 roller thrust bearings

.14 Designed and built to ANSI B30.16

.15 15 meters maximum lift distance

.16 1,000kg lifting capacity

2.2 **Monorail and Surge Monorail Beams**

.1 The structural W-beams (minimum 200 mm size) designed to carry specified trolley and hoist or bridge are shown on structural and process drawings. Ensure that suitable end stops are provided and installed on both ends of W-beam. Shop coat the monorail with corrosion resistant paint.

.2 Monorail W-bream connections to roof system shall be provided by the CONTRACTOR.

.3 Surge monorail connections to monorail shall be provided by the CONTRACTOR.

2.3 **Painting**

.1 The monorail assembly shall receive one shop coat of high visibility yellow anti-corrosive paint. Refer to Section 09910 - Painting for details.

.2 Monorail capacity shall be painted on in black.

.3 All exposed surfaces of the monorail assembly to be painted after installation, refer to Section 09910.

2.4 **Acceptable Manufacturers**

.1 Vulcan, Kito or Chester Low Headroom Electrical Chain Hoist

.2 Approved alternative.

PART 3 EXECUTION

3.1 Installation

.1 Provide the services of a qualified Manufacture’s Representative for installation, testing and commissioning.

.2 Install all equipment in accordance with manufacturer’s recommendations.

.3 Demonstrate proper operation of the hoisting equipment, and provide training of Owner’s operating personnel.

3.2 Testing

.1 Conduct testing in accordance with Section 11102 to prove equipment operation, performance, and function.

.2 Cooperate with the supplier to fulfill the requirements for successful testing of the equipment.

3.3 Training

.1 Provide the services of a qualified technical representative for personnel training.

3.4 Commissioning

.1 Commission the monorail, trolley and hoist system in accordance with Section 01650.

END OF SECTION 14300

DIVISION 15 BUILDING MECHANICAL

PART 1 GENERAL

1.1 Related Sections

1.1.1 Section 01300 - Submittals

1.1.2 Section 01700 - Contract Closeout.

1.1.3 Section 15950 - Testing, Adjusting and Balancing for HVAC.

1.2 Equipment List

1.2.1 Complete list of equipment and materials to be used on this project and forming part of tender documents by adding manufacturer's name, model number and details of materials, and submit for approval.

1.2.2 Submit for approval within 14 days after award of contract.

1.3 Trial Usage

1.3.1 Engineer may use equipment and systems for test purposed prior to acceptance. Supply labour, material and instruments required for testing.

1.4 Anchor Bolts & Templates

1.4.1 Supply anchor bolts and templates for installation by other divisions where required.

1.5 Protection Of Openings

1.5.1 General requirements: protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

1.6 Demonstration And Operating And Maintenance Instructions

1.6.1 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.

1.6.2 Where specified elsewhere in mechanical divisions, manufacturers to provide demonstrations and instructions.

1.6.3 Use operation and maintenance manual, as-built drawings, audio visual aids, etc. as part of instruction materials.

1.6.4 Operating personnel shall be contacted at the beginning of the project and encouraged to come on site at least once a week for the duration of the project. During these periods, they shall be given full explanation of the various systems as the project progresses.

1.6.5 Training to be provided to the requirements of Div 1. Training to be delivered prior to interium unless otherwise specified. Instruction to be provided during regular work hours.

1.6.6 Maintain log of all site visits. Personnel to login/out and be witnessed by Contractor. Submit log to Engineer upon completion all instruction as requested.

1.7 O&M Manuals

1.7.1 Provide operation and maintenance data for incorporation into manual specified in Section 01700 - Contract Closeout..

1.7.2 Operation and maintenance manual to be approved by, and final copies deposited with, Engineer.

1.7.3 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.

.6 Valves schedule.

.7 Colour coding chart.

1.7.4 Maintenance data shall 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.

1.7.5 Performance data to include:

.1 Equipment manufacturer's performance data sheets with point of operation as left after commissioning is complete.

.2 Equipment performance test results.

.3 Testing, adjusting and balancing reports as specified in Section 15950 - Testing, Adjusting and Balancing For HVAC.

1.7.6 Equipment data to include:

.1 Complete reviewed shop drawings of all mechanical equipment including details of suppliers.

1.7.7 Record Drawings:

.1 Provide electronic copy of mechanical as built drawings

1.8 Shop Drawings And Product Data

1.8.1 Submit shop drawings and product data in accordance with Section 01300 - Submittal.

1.8.2 In addition to transmittal letter referred to in Section 01300 - Submittal: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

1.9 Cleaning

1.9.1 Provide special emphasis on HVAC equipment and duct systems to remove contaminants from the systems prior to operation of any permanent ventilation equipment.

1.10 As-Built Drawings

1.10.1 Site records as per Section 01700 - Contract Closeout and as follows:

.1 Mark thereon all changes as work progresses and as changes occur. This shall include changes to existing mechanical systems, control systems and low voltage control wiring.

.2 Use different colour for each service.

.3 Make available for reference purposes and inspection at all times.

1.10.2 Record drawings as per 01700 - Contract Closeout and as follows:

.1 Prior to start of Testing, Adjusting and Balancing (TAB), finalize production of Record drawings.

.2 Record information to be transferred to final record files.

.3 Provide electronic copy including all necessary changes.

1.11 Spare Parts

1.11.1 Furnish spare parts in accordance with Section 01700 - Contract Closeout and as a minimum as follows:

.1 One set of belts for each piece of machinery.

.2 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.

.3 Additional spare parts as amended in related sections of this specification.

1.11.2 Provide complete list of spare parts to be supplied grouped by individual piece of equipment. Interim will not be granted with out list of supplied spare parts.

1.12 Special Tools

1.12.1 Provide one set of special tools required to service equipment as recommended by manufacturers and as indicated in equipment specifications and in accordance with 01700 - Contract Closeout.

1.13 Building Access Doors

1.13.1 Unless otherwise noted or detailed on Architectural drawings, supply access doors to concealed mechanical equipment for operating, inspecting, adjusting, servicing and balancing.

1.13.2 Flush mounted 600 x 600 mm for body entry and 300 x 300 mm for hand entry unless otherwise noted. Doors to open 180 deg., have rounded safety corners, concealed hinges, screwdriver latches and anchor straps.

1.13.3 Material:

.1 Remaining areas: use prime coated steel.

.2 Provide fire rated doors as required.

1.13.4 Installation:

.1 Locate so that concealed items are accessible.

.2 Locate so that hand or body entry is accessible.

.3 Locate access doors in service side of hidden equipment access panels, belt guards etc.

1.13.5 Acceptable material: Ancon Le Hage.

PART 2 PRODUCTS

2.1 Not Used

2.1.1 Not Used.

PART 3 EXECUTION

3.1 Not Used

3.1.1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

1.1.1 Section 01300 - Submittal

1.1.2 Section 15095 - Mechanical Startup

1.2 References

1.2.1 Canadian General Standards Board (CGSB).

1.2.2 American National Standards Institute/National Fire Prevention Association (ANSI/NFPA).

1.2.3 CAN/CSA-B139, Installation Code for Oil Burning Equipment.

1.3 General

1.3.1 This section covers testing of piping systems and duct systems and startup of systems common to all sections of Division 15.

1.4 Definitions

1.4.1 Initial Tests:

.1 Tests performed prior to final tests to verify general systems integrity. Tests are performed by the Contractor at their discretion.

.2 Final Tests:

.1 Mandatory tests performed to confirm system integrity. Final tests to be witnessed by Engineer and Authority having jurisdiction except where specifically noted.

PART 2 PRODUCTS

2.1 Not Used

2.1.1 Not Used.

PART 3 EXECUTION

3.1 Notification

3.1.1 Give 14 days written notice of date and test type for Final Site Tests.

3.1.2 Provide written notice as per the requirements of Section 01300-Submittal.

3.1.3 Written notice to include request for confirmation of witnessing of Final Site Tests by Engineer and Authority having jurisdiction.

3.2 Costs

3.2.1 Bear all costs for testing, making good and retesting.

3.2.2 Final Site Tests are not complete until accepted by Engineer and Authority having jurisdiction. No additional payment shall be made for retesting to meet requirement of these parties for acceptance of tests.

3.3 Witnesses

3.3.1 Witnessing of tests by the Engineer and Authority having jurisdiction may be provided by designated Alternates at the discretion of the Engineer or Authority having jurisdiction.

3.4 Acceptance

3.4.1 Initial tests are not required to be witnessed or accepted by Engineer or Authority having jurisdiction.

3.4.2 Final tests are required to be witnessed and accepted by Engineer and Authority having jurisdiction except where otherwise noted. Tests shall be deemed accepted when witnessed and relevant copies of test sheets signed and witnessed by Engineer and Authority having jurisdiction.

3.4.3 Waiving of Acceptance of Tests: The Engineer and Authority having jurisdiction may waive the requirement of witnessing final site tests. Obtain written verification that Acceptance of Test is waived prior to proceeding with test and append to relevant test certificates.

3.5 Testing (General)

3.5.1 Insulate or conceal work only after testing and approval by Engineer.

3.5.2 Conduct tests from commencement to finish in presence of Engineer and Authority having jurisdiction or designated Alternate witnesses except where Acceptance of test is waived as per Part 3.4.

3.5.3 Bear costs including retesting and making good.

3.5.4 Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures or test medium.

3.6 Pipework Tests

3.6.1 General:

.1 Provide the following tests for complete assembled systems.

.2 Section systems as necessary for all initial tests and test complete system for final tests.

.1 DWV piping:

.1 Initial test: Provide for sectional ball tests to CPC where directed by Engineer or Authorities having jurisdiction.

.2 Final tests: Hydraulic test for all drainage piping with minimum 1.5 m of hydrostatic head for 15 minutes

.2 Domestic water(Rigid Piping):

.3 Initial test: Pneumatic. Acceptable for boarding where heating not available. Test pressure not less than 413kPa. Minimum 30 minutes.

.4 Final test: Hydraulic. Minimum 860kPa. Minimum 12hrs. Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures or test medium.

3.7 Test Sheets & Log Books

3.7.1 General: for each test maintain log book/test sheets.

3.7.2 All Final Site test logs/sheets to be verified and signed by testing personnel and attending witnesses from Contractor, Engineer or designated alternate and Authority having jurisdiction or designated Alternate.

END OF SECTION

PART 1 GENERAL

1.1 Use of Systems

1.1.1 Construction use of air systems, air handling units, fans or any associated equipment and systems for ventilation, heating, dust control or any other use is strictly prohibited during the course of construction.

PART 2 PRODUCTS

2.1 Not Used

2.1.1 Not Used.

PART 3 EXECUTION

3.1 Not Used

3.1.1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

1.1.1 Section 01300 - Submittal.

1.1.2 Section 15072 - Vibration Controls for HVAC Piping and Equipment.

1.2 References

1.2.1 American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME)

1.2.2 American Society for Testing and Materials (ASTM)

1.2.3 Factory Mutual (FM)

1.2.4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)

1.2.5 Underwriter's Laboratories of Canada (ULC)

1.3 Design Requirements

1.3.1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.

1.3.2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.

1.3.3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.

1.3.4 Design hangers and supports to support systems under all conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.

1.3.5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment to be in accordance with MSS SP58.

1.4 Shop Drawings And Product Data

1.4.1 Submit shop drawings and product data in accordance with Section 01300 - Submittals

1.4.2 Submit shop drawings and product data for following items:

.1 Upper attachment.

.2 Middle attachment.

.3 Pipe attachment.

.4 Riser clamps.

1.5 Closeout Submittals

1.5.1 Provide maintenance data for incorporation into manual specified in Section 01700 - Contract Closeout.

PART 2 PRODUCTS

2.1 General

2.1.1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP58.

2.1.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.1.3 Support from structural members. Where structural bearing does not exist, provide supplementary structural members.

2.2 Upper Attachments

2.2.1 Steel joist:

.1 Cold piping 50 dia. and under: galvanized steel washer plate with double locking nuts.

.2 Steel channel, joist or angle (bottom):

.1 Malleable iron C clamp to MSS SP-58-1993, type 23, galvanized. ULC listed.

.3 Steel channel, joist or angle (top):

.1 Malleable iron top of beam C clamp to MSS SP-58-1993, type 19, galvanized. ULC listed.

.4 Concrete:

.1 Insert type expanding anchor with 10dia internal threaded rod connection, galvanized steel, CSTB approved. ULC listed.

.5 Wall Hangers:

.1 Carbon steel, plain, medium duty suitable for loads to 675kg, suitable for loading from top or bottom, width as required. Complying with MSS-SP-69(Type 32).

.2 Bottom loads: provide carbon steel washer plate, size to suit rod size.

2.3 Middle Attachment

2.3.1 Electro-galvanized carbon steel threaded rod material to MSS SP58.

2.4 Pipe Attachement

2.4.1 Cold steel, cast iron and PVC/ABS piping, all hot steel piping less than 75dia and all copper piping where insulation shields and inserts provided: plain steel, adjustable clevis to MSS-SP-69 (Type 1), ULC listed, rated to 343degC, extended vertical risers as required for insulation.

2.4.2 Hot steel piping 100dia and larger: cast iron roll, carbon steel yoke, roll rod and hex nuts, complying to MSS-SP-69(Type 43).

2.4.3 All cold and hot copper piping where insulation shields and inserts not provided: adjustable clevis to MSS IEEE 58-1978, type 1, Copper plated.

2.4.4 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563 where indicated.

2.4.5 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69 where indicated.

2.4.6 Trapeze hangers: continuous slot formed hot dipped or electro-galvanized channel, 12Ga minimum with proprietary mounted fasteners and electro galvanized pipe clamps.

2.5 Riser Clamps

2.5.1 Steel or cast iron pipe: galvanized carbon steel to MSS SP58, type 42, UL listed.

2.5.2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.

2.5.3 Bolts: to ASTM A307.

2.5.4 Nuts: to ASTM A563.

2.6 Insulation Protection Shields

2.6.1 Shields: Formed metal insulation shields, carbon steel, galvanized finish, to WW-H-171E(Type 41).

2.7 Equipment Anchor Bolts And Templates

2.7.1 Provide templates to ensure accurate location of anchor bolts.

2.8 Wall Clamps

2.8.1 Continuous slot formed hot dipped galvanized channel, 12-14Ga with proprietary mounted fasteners and standard pipe clamps.

PART 3 EXECUTION

3.1 Installation

3.1.1 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

3.1.2 Use approved constant support type hangers where:

3.1.3 Use variable support spring hangers where:

3.2 Hanger Spacing

3.2.1 Spacing and middle attachment (rod) diameter as specified in paragraphs below or as in table below, whichever is more stringent.

.1 Plumbing piping: most stringent requirements of Canadian Plumbing Code.

.2 Gas piping: up to NPS 1/2: every 1.8 m.

.3 Copper piping: up to NPS 1/2: every 1.5 m.

.4 Within 300 mm of each elbow.

.5 Pipework greater than NPS 12: to MSS SP69.

3.2.2 Hanger Schedule:

3.3 Maximum

3.3.1 Spacing Copper 1.8 m 2.4 m 2.7 m 3.0 m 3.0 m 3.6 m 5.1 m

3.4 Hanger Installation

3.4.1 Install hanger so that rod is vertical under operating conditions.

3.4.2 Adjust hangers to equalize load.

3.4.3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.4.4 Use of trapeze hangers is acceptable for parallel piping runs.

3.5 Horizontal Movement

3.5.1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.

3.5.2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 Insulation Protection Shields

3.6.1 Provide shields and saddles for all insulated rigid DW piping

3.6.2 Provide specified insulation insert for all shields.

3.7 Riser Clamps

3.7.1 Provide riser clamps at all floor penetrations and the base of all piping risers. Exception branch DW piping 25 dia. or smaller.

3.7.2 Isolate riser clamps at all floor penetrations where noted and detailed.

3.8 Final Adjustment

3.8.1 Adjust hangers and supports: to equalize load and maintain required grade.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

1.1.1 Section 01300 - Submittals

1.2 References

1.2.1 Canadian General Standards Board (CGSB)

1.3 Product Data

1.3.1 Submit product data in accordance with Section 01300 - Submittals

PART 2 PRODUCTS

2.1 Manufacturer's Equipment Nameplates

2.1.1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.

2.1.2 Lettering and numbers to be raised or recessed.

2.1.3 Information to include, as appropriate: size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power of motors.

2.2 System & Equipment Nameplates

2.2.1 Colours:

.1 Hazardous: red letters, white background.

.2 Elsewhere: black letters, white background

2.2.2 Construction:

.1 3mm thick, laminated plastic or white anodized aluminum, matte finish, square corners, letters accurately aligned and machine engraved into core.

2.2.3 Sizes:

.1 Conform to following table:

Size #	Max Dimensions (mm x mm)	No. of Lines	Letter Height (mm)
1	10 x 50	2	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	2	8
5	20 x 200	2	8
6	20 x 100	2	5
7	25 x 125	1	12
8	25 x 125	2	8

.2 Use average of 40 letters/numbers (maximum) per nameplate.

.3 Minimum sizes as follows:
.1 Access doors: Sizes 1/3.

2.2.4 Equipment names as noted on design schedules and drawings.

.1 Duct Access Doors:

.1 Indicate the following information;

.1 Service: (i.e. AS-1B E/A.....)

.2 Type: (i.e. Fire Damper/Control Damper...)

.3 Normal Position (i.e. NO....)

.4 Location (i.e. Area5130-Wing A-Rm001)

2.3 Identification Of Piping Systems

2.3.1 To CAN/CGSB 24.3 Identification of Piping Systems and requirements of ANSI/NFPA 13 except where specified otherwise.

2.3.2 Identify medium by background colour marking, pictogram (as necessary), lettered legend; direction of flow by arrows.

2.3.3 Sizes:

.1 Legend: block capitals to following table:

Outside Dia. of Pipe or Insulation (mm)	**Size of Letters (mm)**
19 or less	8
25 to 65	19
75 to 130	50
Over 150	90

.2 Colour bands:

.1 At valves and fittings: 500 mm long.

.2 Elsewhere: 1000 mm long.

.3 Arrows:

.1 Outside diameter of pipe/insulation 75 mm and greater: 150 mm long x 50 mm high.

.2 Outside diameter of pipe/insulation less than 75 mm: 100 mm long x 50 mm high.

.3 Use double headed arrows where flow is reversible.

.4 Material:

.1 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 150 deg.C and intermittent temperature of 200 deg.C. Apply to prepared surfaces.

Wrap tape around pipe or pipe covering with ends overlapping one (1) pipe diameter.

.2 Waterproof and heat resistant plastic marker tags: for pipes and tubing 20 mm nominal and smaller.

.5 Colours:

.1 Where not covered by table below, submit legend and classification colours to Engineer for approval.

.6 Legend:

.1 Pipe and valve identification.

Description	Legend Colour	Background
Domestic Cold Water	DCW	Green
Dom. Hot Water	DHW	Yellow
Sanitary Sewer	SAN	Green
Vent Plumbing	VP	Green
Nat Gas Supply	NAT	Yellow

.7 Legend and arrows:

.1 Black or white to contrast with primary colour.

2.4 Identification Ductwork Systems

2.4.1 50 mm high stenciled letters and directional arrows 150 mm long x 50 mm high.

2.4.2 Colours: Black, or co-ordinated with base colour to ensure strong contrast.

2.5 Valves, Controllers

2.5.1 Plastic laminated cards attached by chain or plastic tie clip.

2.5.2 Sizes: 50mmx75mm minimum.

2.5.3 Lettering: minimum 5mm high produced from laser printer in black.

2.5.4 Consecutively number valves in systems and provide the following information on valve tag:

.1 Service (i.e. HWS/DCW...)

.2 Normal Position (i.e. NC/NO)

.3 Control (i.e. ISOLATION/CONTROL/BALANCE..)

.4 Location (i.e. Boiler Rm 001)

2.6 Language

2.6.1 Identification to be in English.

2.6.2 Use one nameplate, label, etc. for each language.

2.7 Hazardous Goods

2.7.1 Provide pictograms where required to Workplace Hazardous Materials Information System (WHMIS) regulations.

PART 3 EXECUTION

3.1 Timing

3.1.1 Provide identification only after all painting has been completed.

3.2 Installation

3.2.1 Perform work in accordance with CAN/CGSB-24.3, ANSI/NFPA 13 and CSA B149 except as specified otherwise.

3.2.2 Provide ULC and CSA registration plates as required by respective agency.

3.3 Nameplates

3.3.1 Equipment: provide nameplates for all mechanical equipment. Identify to design schedules and drawings and include:

.1 Equipment description.

.2 Equipment Tag.

3.3.2 Duct Access Doors: provide nameplates at all duct access doors except where indicated:

.1 Nameplates not required at terminal reheat coil access doors.

.2 Nameplates not required on exposed duct access doors.

.3 Secure nameplates using adhesive backing of lamicoid and minimum two mechanical fasteners of either metal screws or pop rivets.

3.4 Location Of Identification On Piping And Ductwork Systems

3.4.1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: At not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.

3.4.2 Adjacent to each change in direction.

3.4.3 At least once in each small room through which piping or ductwork passes.

3.4.4 On both sides of visual obstruction or where run is difficult to follow.

3.4.5 On both sides of separations such as walls, floors, partitions.

3.4.6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.

3.4.7 At beginning and end points of each run and at each piece of equipment in run.

3.4.8 At point immediately upstream of major manually operated or automatically controlled valves, dampers, etc. Where this is not possible, place identification as close as possible, preferably on upstream side.

3.4.9 Identification to be easily and accurately readable from usual operating areas and from access points.

3.4.10 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.

3.4.11 Piping Identification Schedule

.1 Apply colour banding and identification to all exposed and concealed piping.

3.4.12 Duct Identification Schedule:

.1 Provide identification for all exposed ducts.

3.5 Valves, Controllers

3.5.1 Provide for all valves and operating controllers except at the following locations:

.1 Chrome plated plumbing fixture stops.

.2 Heating terminal unit radiator and isolation valves.

.3 All drain valves.

3.5.2 Secure tags with non-ferrous chains or plastic tie clips.

3.5.3 Install one valve schedule mounted in frame behind non-glare glass where directed by Engineer and in addition provide one softcopy in Microsoft Word format and one copy (reduced in size if required) in each operating and maintenance manual.

3.5.4 Number valves in each system consecutively.

3.5.5 Transfer tag schedule numbering to Record drawings specified in Section 15010 - Common Work Results - Mechanical.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

1.1.1 Section 01300 - Submittals

1.1.2 Section 15061 - Hangers And Supports For HVAC Piping and Equipment.

1.2 References

1.2.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

1.2.2 American Society for Testing and Materials (ASTM International)

1.2.3 Canadian General Standards Board (CGSB)

1.2.4 Thermal Insulation Association of Canada (TIAC)

1.2.5 Underwriters Laboratories of Canada (ULC)

1.2.6 National Energy Code for Buildings, NECB-2011.

1.2.7 ASHRAE 90.1-2001, Energy Standard for Buildings Except Low-Rise Residential Buildings.

1.3 Product Data

1.3.1 Submit Product Data in accordance with Section 01300 - Submittal

1.3.2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for pipe, fittings, valves and jointing recommendations.

1.3.3 Provide shop drawings as follows:

.1 A-3 Insulation

.2 Removable Insulation Enclosures.

.3 Insulation PVC Jackets.

.4 Insulation Inserts.

.5 Insulated Valve Jackets.

.6 Adhesives.

1.4 Manufacturer's Instructions

1.4.1 Submit manufacturer's installation instructions in accordance with 01300 - Submittals

1.4.2 Installation instructions to include procedures to be used, installation standards to be achieved.

1.5 Qualifications

1.5.1 Installer to be specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

1.6 Delivery, Storage And Handling

1.6.1 Deliver materials to site in original factory packaging, labeled with manufacturer's name, address.

1.6.2 Protect from weather and construction traffic.

1.6.3 Protect against damage from any source.

1.6.4 Store at temperatures and conditions recommended by manufacturer.

1.7 Definitions

1.7.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services and equipment in hung ceilings non-accessible chases, furred spaces and crawlspaces.

.2 "EXPOSED" - will mean "not concealed" as defined herein.

.3 "Runouts" - refers to piping to individual terminal units or fixtures not exceeding 3.6m in length.

PART 2 PRODUCTS

2.1 Fire And Smoke Rating

2.1.1 In accordance with CAN/ULC-S102:

2.1.2 All components of insulation system to have maximum flame spread rating of 25 and maximum smoke developed rating of 50 in accordance with ASTM E 84-01, Test Method for Surface Burning Characteristics of Building Materials and CAN/ULC-S102.

2.2 Type A-3 Insulation

2.2.1 TIAC Code A-3: Rigid molded formaldehyde free mineral fibre piping insulation with factory applied vapour retarder jacket to CAN/CGSB-51.9-92 and CGSB SI-GP-52M.

2.2.2 Thermal conductivity ("k" factor) not to exceed specified values at 24oC mean temperature when tested in accordance with ASTM C335.

2.2.3 Materials:

.1 Insulation: molded, heavy density one piece, inorganic glass fiber bonded with thermosetting resin.

.2 Jacket: white kraft paper bonded to aluminum foil and reinforced with glass fibers.

.1 Lap seal: self adhesive.

2.2.4 Temperature range: -29degC to 537degC

2.2.5 Thermal Conductivity "k" shall not exceed 0.031 W/m. deg.C at 24 deg.C mean temperature when tested in accordance with ASTM C 335-95.

2.2.6 Surface Burning Characteristics:

.1 To STM E84-98e, Test Method for Surface Burning Characteristics of Building Materials and ANSI/NFPA 255-2000, Burning Characteristics of Building Materials and CAN/ULC-S102-M88.

.2 UL Classified.

.3 Flame spread=25 as plain insulation or composite basis.

.4 Smoke developed=50 as plain insulation or composite basis.

2.2.7 Vapour Transmission:

.1 To ASTM E 96-00e1, Standard Test Methods for Water Vapor Transmission of Materials.

.2 Maximum: 0.02 perms.

2.2.8 Resistance to Fungi and Bacteria:

.1 ASTM listed to not promote growth of fungi or bacteria.

2.2.9 Acceptable material: Knauf Fiberglass Pipe Insulation, Johns Mansville, Fiberglass, Manson.

2.3 Cement

2.3.1 Thermal insulating and finish to CAN/CGSB-51.12-95 low VOC to the current content limits of SCAQMD Rule #1168.

2.4 Jackets

2.4.1 Polyvinyl Chloride (PVC):

.1 One piece premoulded PVC jacketing to AC774.1K82 with 25 flame and 50 smoke rating to ASTM E 84-01.

.2 Gloss finish, UV resistant, premoulded for fitting applications, jacket for straight pipe runs.

.3 Temperature rating: max insulation surface temperature 60degC.

.4 Secure with PVC tape with manufactured supplied rivets. Tape only is not acceptable.

.5 Acceptable material: Knauf Proto LoSmoke Fitting and Covers.

2.5 Insulation Securements

2.5.1 Tape: ULC listed self-adhesive, aluminum, plain, 50 mm wide minimum.

2.5.2 Contact adhesive: Quick setting, asbestos free, low VOC to the current content limits of SCAQMD Rule #1168.

2.5.3 Tie wire: 1.5 mm diameter stainless steel.

2.5.4 Bands: Aluminum, 19 mm wide, 0.5 mm thick.

2.6 Insulated Hanger Inserts

2.6.1 Molded perlite thermal insulation, service temp to 645°C.

2.6.2 Acceptable material: Innova Temperlite 1200.

2.6.3 Length: 300mm.

2.7 Indoor Vapour Retarder Finish

2.7.1 Vinyl emulsion type acrylic, compatible with insulation low VOC to the current content limits of SCAQMD Rule #1168.

2.8 Fitting Insert Insulation

2.8.1 TIAC Code C-2: Mineral fibre blanket insulation with factory applied vapour retarder jacket to CAN/CGSB-51.9-92 and CGSB SI-GP-52M.

2.8.2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C335.

2.8.3 Materials:

.1 Insulation: molded, inorganic glass fiber bonded with thermosetting resin.

.2 Jacket: kraft paper bonded to aluminum foil and reinforced with glass fibers.

.3 Lap seal: 50m stapling flange.

.4 Density: 16kg/m3.

2.8.4 Temperature range: -29degC to 121degC

2.8.5 Thermal Conductivity "k" shall not exceed 0.04 W/m. deg.C at 24 deg.C mean temperature when tested in accordance with ASTM C 335-95.

2.8.6 Surface Burning Characteristics:

.1 To STM E84-98e, Test Method for Surface Burning Characteristics of Building Materials and ANSI/NFPA 255-2000, Burning Characteristics of Building Materials and CAN/ULC-S102-M88.

.2 UL Classified.

.3 Flame spread=25 as plain insulation or composite basis.

.4 Smoke developed=50 as plain insulation or composite basis.

2.8.7 Vapour Transmission:

.1 To ASTM E 96-00e1, Standard Test Methods for Water Vapor Transmission of Materials.

.2 Maximum: 0.02 perms.

2.8.8 Resistance to Fungi and Bacteria:

.1 ASTM listed to not promote growth of fungi or bacteria.

2.8.9 Acceptable material: Knauf, Johns Mansville, Fiberglass, Manson.

PART 3 EXECUTION

3.1 Pre- Installation Requirement

3.1.1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.

3.1.2 Surfaces to be clean, dry, free from foreign material.

3.2 Installation (General)

3.2.1 Install in accordance with TIAC National Standards and the requirements of ANSI/NFPA 90A-1999 and ANSI/NFPA 90B-1999.

3.2.2 Install all insulation systems including minimum insulation thicknesses to the most stringent requirements of ASHRAE 90.1--2001, Energy Standard for Buildings Except Low-Rise Residential Buildings and the Canadian National Energy Code for Buildings-2011 unless otherwise noted in the insulation schedule.

3.2.3 Apply materials in accordance with manufacturers instructions and this specification.

3.2.4 Seal and finish exposed ends as follows:

.1 PVC Jacketed insulation: PVC jacket termination.

.2 Unfinished insulation: tape.

.3 Where insulation not provided at valves, fitting and trim delete insulation and finish away from studs and nuts to permit use of tools without damage to insulation.

3.2.5 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.

3.2.6 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

3.3 Removable, Pre-Fabricated Insulated Enclosures

3.3.1 Design: to permit periodic removal and replacement without damage to adjacent insulation.

3.3.2 Provide removable pre fabricated insulated enclosures for HW & DW valves and trim as follows:

.1 Provide in the following locations:

.1 For exposed DW valves

3.3.3 Do not provide valve jackets for the following valves:

.1 All drain valves.

3.4 Concealed Ball Valves

3.4.1 Concealed ball valves: insulate all concealed ball valves using specified pipe insulation continuous over valve. Core out insulation as required to suit valve body dimensions or provide one size larger pipe insulation.

3.5 Piping

3.5.1 Insulate piping for full length as per insulation schedule except as follows:

.1 Insulate DWV vents from exterior building termination penetration 1500 mm inside building.

3.5.2 Where insulation not provided at valves, fitting and trim delete insulation and finish away from studs and nuts to permit use of tools without damage to insulation.

3.5.3 Fastenings-Type A3: secure insulation by tape at each end and centre of each section, but not greater than 900 mm on centres.

3.5.4 Elastomeric Insulation: to remain dry, overlap to manufacturer's instructions. Joints tight and sealed properly.

3.6 Finishes

3.6.1 PVC:

.1 Provide where specified.

.2 Provide min 25mm overlap.

.3 Secure using flexible PVC tape and manufactured. approved rivets. Do not stretch final 50mm of tape.

3.7 Protection Of Insulation During Construction

3.7.1 Insulation is to be protected from moisture damage during all stages of construction.

3.7.2 Where insulation is damaged due to moisture damage either prior to installation, during or subsequent to installation up to and including final inspection replace damaged insulation to the satisfaction of the Engineer.

3.8 Piping Insulation Schedules

3.8.1 Schedule:

Application	Insulation Type	Thickness (mm)	Jacket
Rigid DCW(Exposed)	A3	25	N/A
Rigid DCW(Concealed)	A3	25	N/A
DWV(Concealed)	A3	25 (Note 1)	N/A
DWV(Exposed)	A3	25 (Note 1)	N/A

Note 1 Provide insulation for 1500mm inside building.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

1.1.1 Section 01300 - Submittals

1.1.2 Section 15061 - Hangers And Supports For HVAC Piping and Equipment.

1.2 References

1.2.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

1.2.2 American Society for Testing and Materials International, (ASTM)

1.2.3 Canadian General Standards Board (CGSB)

1.2.4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (R1999).

1.2.5 Underwriters Laboratories of Canada (ULC)

1.2.6 National Energy Code for Buildings, NECB-2011.

1.2.7 ASHRAE 90.1-2001, Energy Standard for Buildings Except Low-Rise Residential Buildings.

1.3 Definitions

1.3.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services and equipment in hung ceilings non-accessible chases, furred spaces and crawlspaces.

.2 "EXPOSED" - will mean "not concealed" as defined herein

1.4 Shop Drawings

1.4.1 Submit shop drawings in accordance with Section 01300 - Submittals

1.4.2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.

1.4.3 Provide shop drawings as follows:

.1 Type C1 Insulation.

.2 Type C2 Insulation.

.3 Adhesives.

1.5 Manufacturers' Instructions

1.5.1 Submit manufacturer's installation instructions in accordance with Section 01300 - Submittals

1.5.2 Installation instructions to include procedures used, and installation standards achieved.

1.6 Qualifications

1.6.1 Installer: specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

1.7 Delivery, Storage And Handling

1.7.1 Deliver materials to site in original factory packaging, labeled with manufacturer's name, address.

1.7.2 Protect from weather and construction traffic.

1.7.3 Protect against damage from any source.

1.7.4 Store at temperatures and conditions recommended by manufacturer.

PART 2 PRODUCTS

2.1 Fire And Smoke Rating

2.1.1 In accordance with CAN/ULC-S102:

2.1.2 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 Type C-1 Insulation

2.2.1 TIAC Code C-1: formaldehyde free, rigid mineral fibre board to ASTM C612 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).

2.2.2 Thermal conductivity ("k" factor) not to exceed specified values at 24 deg C mean temperature when tested in accordance with ASTM C335.

2.2.3 Material: resilient inorganic glass fibers bonded by thermosetting resin mineral fibre blanket w vapor foil-scrim-kraft(FSK) facing material and vinyl vapor retarder.

2.2.4 Density: 24 kg/m3 minimum.

2.2.5 Thermal conductivity "k" shall not exceed 0.024 W/m deg.C at 24 deg.C mean temperature an a density of 24kg/m3 when tested to ASTM C 177-85(1993).

2.2.6 Operating temperature: to 121degC.

2.2.7 Vapour permanence: maximum 0.02perms to ASTM E 96-00e1, Procedure A.

2.2.8 Vapor absorption: less than 5% by weight to ASTM C 1104/C 1104M-00.

2.2.9 Mold Growth: no growth to ASTM C 1338-00.

2.2.10 Puncture resistance: 25 beach units to TAPPI test T803.

2.2.11 Acceptable material: Knauf Duct Board, Johns Mansville, Fiberglass, Manson.

2.3 Type C-2 Insulation

2.3.1 TIAC Code C-2: formaldehyde free, mineral fibre blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).

2.3.2 Thermal conductivity ("k" factor) not to exceed specified values at 24degC mean temperature when tested in accordance with ASTM C335.

2.3.3 Material: resilient inorganic glass fibers bonded by thermosetting resin mineral fibre blanket w vapor foil-scrim-kraft(FSK) facing material and vinyl vapor retarder.

2.3.4 Density: 24 kg/m3 minimum.

2.3.5 Thermal conductivity "k" shall not exceed 0.024 W/m deg.C at 24 deg.C mean temperature an a density of 24kg/m3 when tested to ASTM C 177-85(1993).

2.3.6 Operating temperature: to 121degC.

2.3.7 Vapour permanence: maximum 0.02perms to ASTM E 96-00e1, Procedure A.

2.3.8 Vapor absorption: less than 5% by weight to ASTM C 1104/C 1104M-00.

2.3.9 Mold Growth: no growth to ASTM C 1338-00.

2.3.10 Puncture resistance: 25 beach units to TAPPI test T803.

2.3.11 Acceptable material: Knauf Duct Wrap with Kwikstretch, Johns Mansville, Fiberglass, Manson.

2.4 Insulation Securements Type C-1 & C-2

2.4.1 Tape: ULC listed Self-adhesive, stainless steel, plain, 50 mm wide minimum.

2.4.2 Contact adhesive: Quick setting, asbestos free, low VOC to the current content limits of SCAQMD Rule #1168.

2.4.3 Tie wire: 1.5 mm diameter stainless steel.

2.4.4 Bands: Aluminum, 19 mm wide, 0.5 mm thick.

2.5 Indoor Vapour Retarder Finish

2.5.1 Vinyl emulsion type acrylic, compatible with insulation low VOC to the current content limits of SCAQMD Rule #1168.

PART 3 EXECUTION

3.1 Pre-Installation Requirements

3.1.1 Pressure testing of ductwork systems where specified complete, witnessed and certified.

3.1.2 Surfaces clean, dry, free from foreign material.

3.2 Installation

3.2.1 Install in accordance with TIAC National Standards and in accordance with ANSI/NFPA 90A-1999, ANSI/NFPA 90B-1999 and ANSI/NFPA 96-1998.

3.2.2 Install all insulation systems including minimum insulation thicknesses to the most stringent requirements of ASHRAE 90.1--2001, Energy Standard for Buildings Except Low-Rise Residential Buildings and the Canadian National Energy Code for Buildings-2011 unless otherwise noted in the insulation schedule.

3.2.3 Apply materials in accordance with manufacturer’s instructions and as indicated.

3.2.4 Use two layers with staggered joints when required nominal thickness exceeds 75 mm secured with wire or bands at 400 mm on centre intervals.

3.2.5 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

3.2.6 Supports, Hangers in accordance with Section 15061 - Hangers and Supports for HVAC Piping and Equipment.

3.2.7 Insulation at bolts, studs, nuts, instrumentation: bevel to permit removal without damage to insulation or finish.

3.2.8 Fastenings:

.1 Type C1/C2: Contact adhesive and secure insulation with stainless steel wire//insulating tape or approved equal at 900mm on centre.

3.2.9 S/A Systems: provide insulation for full length of supply air ducts from air handling unit to grilles and diffusers for the following air systems.

3.2.10 O/A Systems: provide insulation for full length of outdoor air ducts from air handling unit/fans to hood/louvre for all air systems except where otherwise noted.

3.2.11 E/A Systems: provide insulation for full length of exhaust air ducts from air handling unit/fans to hood/louvre for all air systems except where otherwise noted.

3.2.12 Thermal insulation is not required for the following exceptions:

.1 Where acoustic lining is provided delete thermal insulation where specified.

3.3 Protection Of Insulation During Construction

3.3.1 Insulation is to be protected from moisture damage during all stages of construction.

3.3.2 Where insulation is damaged due to moisture damage either prior to installation, during or subsequent to installation up to and including final inspection replace damaged insulation to the satisfaction of the Engineer.

3.4 Ducting Insulation Schedule

3.4.1 Schedule:

Application	Insulation Type	Thickness	Jacket (mm)
Misc EF E/A(washroom)	C1	50	N/A
Combustion Air	C1/2	50	N/A

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

1.1.1 Section 01300 - Submittals

1.2 References

1.2.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible.

1.2.2 ASTM C 177, Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

1.2.3 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.

1.2.4 CAN/CGSB-51.10, Thermal Insulation, Mineral Fibre, Block or Board, for Ducting, Machinery and Boilers.

1.2.5 CAN/CGSB-51.11, Thermal Insulation, Mineral Fibre, Blanket, for Piping, Ducting, Machinery and Boilers.

1.2.6 ANSI/NFPA 90A, Installation of Air Conditioning and Ventilating Systems.

1.2.7 ANSI/NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.

1.3 Product Data

1.3.1 Submit product data in accordance with Section 01300 - Submittals

1.3.2 Provide shop drawings as follows:

.1 Acoustic Lining.

.2 Sealant.

.3 Tape.

.4 Weld pins.

1.4 Manufacturer's Instructions

1.4.1 Submit manufacturer's installation instructions in accordance with 01300 - Submittals

1.4.2 Installation instructions to include procedures to be used, installation standards to be achieved.

PART 2 PRODUCTS

2.1 Duct Liner

2.1.1 General:

.1 To requirements of CAN/CGSB-51.11-92 and CAN 4-S102.

.2 Fibrous glass duct liner of inorganic glass fibers bonded by thermosetting resin.

.3 Mat faced

.4 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50 when tested in accordance with ASTM E 84-01, UL 723-1995 and ANSI/NFPA 255-2000.

2.1.2 Density: 24 kg/m№ minimum.

2.1.3 Thermal resistance: minimum 0.74 W/m. deg.C for 25 mm thickness when tested in accordance with ASTM C 177-97, at 24 deg.C mean temperature.

2.1.4 Operating temperature: to 121degC.

2.1.5 Vapor absorption: less than 3% by weight to ASTM C 1104/C 1104M-00.

2.1.6 Microbial growth: mat finish treated with EPA registered anti-microbial agent.

2.1.7 Sound absorption: at 24 kg/m3 and to ASTM C 423-02 absorption coefficients as follows:

Hz	125	250	500	1000	2000	4000	8000
	.1	.34	.64	.96	1.03	1.00	1.03

2.1.8 Acceptable Material: Knauf Liner E-M.

2.2 External Duct Acoustic Lagging

2.2.1 Vinyl reinforced aluminum facing, nominal 25mm thick quilted fiberglass decoupler, scrim backing.

2.2.2 Composite weight: 1.0 lb/ft2.

2.2.3 Thickness: 25mm.

2.2.4 Flame spread: 10 to ASTM E84

2.2.5 Smoke spread: 40 to ASTM E84

2.2.6 Service Temperature: -40degC to 104degC

2.2.7 STC Rating: 27

2.2.8 Performance: in accordance with ASTM E90-90.

Hz	125	250	500	1000	2000	4000
Transmission Loss (db)	15	19	21	28	33	37

2.2.9 Acceptable material: Wilrep Ltd. Barymat FRC.

2.3 Adhesive

2.3.1 Meet requirements of ANSI/NFPA 90A-1999 and ANSI/NFPA 90B-1999 and to be low VOC to the current content limits of SCAQMD Rule #1168.

2.3.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 29°C to plus 93°C.

2.4 Fasteners

2.4.1 Weld pins 2.0 mm diameter, length to suit thickness of insulation. Nylon retaining clips, 32 mm square.

2.5 Joint Tape

2.5.1 Duct liner: Poly-Vinyl treated open weave fiberglass membrane 50 mm wide.

2.5.2 Acoustic Lagging: FSK tape.

2.6 Sealer

2.6.1 Meet requirements of NFPA 90A and NFPA90B and to be low VOC to the current content limits of SCAQMD Rule #1168.

2.6.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 68degC to plus 93degC.

2.7 Solid And Perforated Lining, Metal Lining

2.7.1 22 gauge perforated with 3mm hole staggered

PART 3 EXECUTION

3.1 General

3.1.1 Do work in accordance with recommendations of SMACNA duct liner standards as indicated in SMACNA HVAC Duct Construction Standards, Metal and Flexible, except as specified otherwise.

3.1.2 Line inside of ducts as shown in section 3.7.

3.1.3 Duct dimensions, as indicated, are clear inside duct lining.

3.2 Duct Liner

3.2.1 Install in accordance with manufacturer's recommendations, and as follows:

3.2.2 General ducts:

.1 Fasten to interior sheet metal surface with 100% coverage of adhesive.

.2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 425 mm on centres.

3.3 Duct Acoustic Lagging

3.3.1 Install in accordance with manufacturer's recommendations, and as follows:

.1 Weld pins not less than 2 rows per surface and not more than 425 mm on centres.

.2 All joints secured in place with FSK tape.

.3 Provide as indicated on drawings.

3.4 Duct Liner Joints

3.4.1 Seal butt joints, exposed edges, weld pin and clip penetrations and damaged areas of liner with joint tape and sealer. Install joint tape in accordance with manufacturer's written recommendations, and as follows:

.1 Bed tape in sealer.

.2 Apply 2 coats of sealer over tape.

3.4.2 Replace damaged areas of liner at discretion of Engineer.

3.4.3 Protect leading and trailing edges of duct sections with sheet metal nosing having 15 mm overlap and fastened to duct or with two coats sealer lapped minimum 50mm onto duct to approval of Engineer.

3.5 Solid/Perforated Metal Lining

3.5.1 Provide internal metal liners as follows:

.1 All acoustically lined round ducts.

3.6 Protection of Duct Liner During Construction

3.6.1 Duct liner is to be protected from moisture damage during all stages of construction.

3.6.2 Where duct liner is damaged due to moisture damage either prior to installation, during or subsequent to installation up to and including final inspection, replace damaged duct liner to the satisfaction of the Engineer.

3.7 Lining Schedule

Application	Duct Type	Lining Type	Lining Thick(mm)	Liner
MUA S/A	Rect	Flexible	50	As spec
	Round	Flexible	50	Perf
EF E/A	Rect	Flexible	50	As spec
	Round	Flexible	50	Perf
Plenum	Rect	Flexible	50	As spec

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

1.1.1 Section 15950 - Testing, Adjusting and Balancing For HVAC.

1.2 General

1.2.1 This section covers startup and testing of systems common to all sections of Division 15.

1.3 Start-Up Of Mechanical Systems

1.3.1 Conduct operating startup to confirm that equipment and systems meet specified requirements after mechanical installations are completed and pressure tested and all systems operational. Conduct startup as soon as conditions permit. Make changes, repairs, adjustments and replacements required as tests may indicate prior to final operating tests.

1.3.2 During start up advise Engineer in writing of any system deficiencies that are evident and request direction.

1.3.3 Make start up for a minimum of seven days under maximum available operating load conditions and include the following:

.1 Operate all air systems at normal operating set points.

.2 Operate all heating systems at normal operating set points.

.3 Operate all sanitary systems at normal operating set points.

.4 Operate all life safety systems at normal operating condition.

.5 Where seasonal lockout of equipment is specified override seasonal lockout and operate equipment for full seven days of startup.

.6 Where lead/lag or main/standby staging specified override normal staging to change lead equipment on 24 hour rotation for full seven days of startup.

1.3.4 During startup provide the following operations and maintenance procedures:

.1 Lubricate bearings, adjust and/or replace and set direct and V belt drives for proper alignment and tension.

.2 Calibrate and adjust thermostats, thermometers, gauges, linkage and dampers. Control valves shall operate freely.

.3 Operate and test motors and speed switches for correct wiring and sequences. Check overload heaters in motor starters.

.4 Replace and clean filters. Clean fan wheels and coils.

.5 Clean out and prime all floor drain traps using trap seal primers or other means acceptable to the Canadian Plumbing Code.

.6 Test freedom of movement of cleanouts.

.7 Aerator screens and strainers: clean out.

1.4 Log Books

1.4.1 General: for each system startup maintain log book of startup conditions including the following information:

.1 Day.

.2 Operating personnel.

.3 System status at 0800hrs/1300hrs/1800hrs including the following information:

.1 Weather conditions.

.2 Equipment set and operating points

.4 All Start Up logs to be verified and signed by testing personnel and attending witnesses from Contractor.

.5 Use of trend data from SCADA system is acceptable for systems status. Provide relevant print outs in tabular and graphic format.

1.5 System Tests

1.5.1 Conduct specified system tests in presence of Engineer to confirm that equipment and systems meet specified requirements. Conduct system tests during Interim inspection and only after system startup completed with the exception that system tests may take place during the final day of the Building Startup. System tests and startup are to occur prior to any Commissioning occurring which will be subsequent to a successful Interim inspection and prior to Interim acceptance.

1.5.2 Where directed by the Engineer make changes, repairs, adjustments and replacements within the scope of these documents as required to allow completion of the system tests.

1.5.3 Provide all tools and equipment necessary to complete specified tests. Patch and make good any damage created during tests at no additional cost.

1.5.4 Provide tradespersons as required to complete specified tests for the duration of the one day testing period.

1.5.5 Provide the following tests to be witnessed by the Engineer:

.1 Prove random access to cleanouts at the direction of the Engineer.

.2 Prove random access through access doors at the direction of the Engineer.

.3 Prove random operation of plumbing fixtures including maximum DHW temperature at high limit protected plumbing fixtures.

1.5.6 Prove operation of all safety systems from Authority having jurisdiction proving successful completion of tests.

PART 2 PRODUCTS

2.1 Not Used

2.1.1 Not Used.

PART 3 EXECUTION

3.1 Not Used

3.1.1 Not Used.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

1.1.1 Section 15188 - HVAC Water Treatment Systems.

1.2 References

1.2.1 Canadian General Standards Board (CGSB)

PART 2 PRODUCTS

2.1 Not Used

.1 Not Used.

PART 3 EXECUTION

3.1 Connections To Equipment

3.1.1 In accordance with manufacturer's instructions unless otherwise indicated.

3.1.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

3.1.3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.2 Clearances

3.2.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.

3.2.2 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

3.3.1 Install piping with grade in direction of flow except as indicated.

3.3.2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.

3.3.3 Pipe each drain valve discharge separately to above floor drain where indicated. Discharge to be visible.

3.4 Dielectric Couplings

3.4.1 General:

.1 To be compatible with and to suit pressure rating of piping system.

.2 Where pipes of dissimilar metals are joined.

3.4.2 Pipes NPS 2 and under: isolating unions, flanges or cast brass adapters.

3.4.3 Pipes NPS 2 1/2. and over: isolating flanges.

3.5 Pipework Installation

3.5.1 Screwed fittings jointed with Teflon tape unless otherwise noted.

3.5.2 Protect openings against entry of foreign material.

3.5.3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

3.5.4 Assemble piping using fittings manufactured to ANSI standards.

3.5.5 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of main.

3.5.6 Install exposed piping, equipment, rectangular clean outs and similar items parallel or perpendicular to building lines.

3.5.7 Install concealed pipework to minimize furring space, maximize headroom, conserve space. Run exposed piping parallel to walls.

3.5.8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

3.5.9 Install, except where indicated, to permit separate thermal insulation of each pipe.

3.5.10 Group piping wherever possible and as indicated.

3.5.11 Ream pipes, remove scale and other foreign material before assembly.

3.5.12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

3.5.13 Provide for thermal expansion as required and where indicated.

3.6 Sleeves

3.6.1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.

3.6.2 Material: min 16ga formed steel or galvanized sched 10 pipe.

3.6.3 Construction: provide sleeves with annular fin continuously welded at midpoint or offset.

.1 Where sleeve extends above finished floor. Secure fin in floor.

.2 Where sleeve set in wall. Sleeve offset to one side of wall or adjust annular fin to center sleeve thru wall. Secure fin to wall.

3.6.4 Sizes: 6 mm minimum, 13mm maximum clearance between sleeve and uninsulated pipe or between sleeve and insulation.

3.6.5 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint to CAN/CGSB-1.181-99.

3.7 Escutcheons

3.7.1 On pipes passing through walls, partitions, floors and ceilings in finished areas.

3.7.2 Simulated chrome finish plastic one piece or split type without set screws.

3.7.3 Outside diameter to cover opening or sleeve.

3.7.4 Inside diameter to fit around finished pipe.

3.8 Flushing Out Of Piping Systems

3.8.1 In accordance with Section 15095 - Start-up of Mechanical Piping Systems.

3.8.2 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 Related Sections

1.1.1 Section 01300 - Submittals.

1.1.2 Section 01700 - Contract Closeout.

1.2 References

1.2.1 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME).

1.2.2 American Society for Testing and Materials International, (ASTM).

1.2.3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).

1.3 Submittals

1.3.1 Submit shop drawings and product data in accordance with Section 01300 - Submittals. Include the following:

.1 Product data for all valves.

1.4 Maintenance Data

1.4.1 Provide maintenance data for incorporation into manual specified in Section 01700 - Contract Closeout.

PART 2 PRODUCTS

2.1 Ball Valves

2.1.1 Provide for all heating isolation valves 50 dia. and smaller and all DW valves.

2.1.2 Class 600, bronze body, full bore, forged brass ball, brass gland and PTFE Teflon seat, steel lever handle, screwed.

.1 Acceptable material: Kitz Fig 68/Toyo.

2.1.3 Class 600, bronze body, forged brass ball, brass gland and PTFE Teflon seat, steel lever handle, with soldered joint end.

.1 Acceptable material: Kitz Fig 69/Toyo.

2.2 Check Valves

2.2.1 To MSS SP-80-1997, Class 125, 860 kPa, bronze body, bronze swing disc, Y-pattern, screw in cap, regrindable seat, soldered.

.1 Acceptable material: Kitz Fig 23/Toyo.

2.2.2 To MSS SP-80-1997, Class 125, 860 kPa, bronze body, bronze swing disc, Y-pattern, screw in cap, regrindable seat, screwed.

.1 Acceptable material: Kitz Fig 22/Toyo.

2.2.3 Class 125, 860 kPa, bronze body, bronze disc, lift type, vertical way, screwed ends.

.1 Acceptable material: Kitz Fig 26/Toyo.

2.3 Drain Valves

2.3.1 Minimum 13dia, class 600, bronze body, full bore, forged brass ball, brass gland and PTFE Teflon seat, steel lever handle, screwed, male hose end c/w cap and chain.

.1 Acceptable material: Kitz /Toyo.

PART 3 EXECUTION

3.1 Installation

3.1.1 Install using stem valves in upright position with stem above horizontal unless otherwise approved by Engineer.

3.1.2 Remove internal parts before soldering.

3.1.3 Install valves with unions or flanges as indicated at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.

3.1.4 Install to manufacturer's recommendations.

3.1.5 Maintain proper clearance to permit service and maintenance.

3.1.6 Should deviations beyond allowable clearances arise, request and follow Engineer's directive.

3.1.7 Install specified valves at all branch take-offs and as indicated.

3.1.8 Provide silent check valves in vertical pipes with downward flow and as indicated.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

1.1.1 Section 01300 - Submittals.

1.1.2 Section 15075 - Mechanical Identification.

1.2 References

1.2.1 American Society of Mechanical Engineers (ASME).

1.2.2 Canadian General Standards Board (CGSB).

1.3 Submittals

1.3.1 Submittals in accordance with Section 01300 - Submittals.

1.3.2 Submit shop drawings and product data.

1.3.3 Submit manufacturer's product data for following items:

.1 Thermometers.

.2 Pressure gauges.

PART 2 PRODUCTS

2.1 General

2.1.1 Design point to be at mid point of scale or range.

2.1.2 Ranges: as indicated.

2.2 Direct Reading Thermometers

2.2.1 Bi-metal dial type direct reading.

2.2.2 Accuracy: +/-1% of dial span throughout entire range to CAN/CGSB-14.4-M88.

2.2.3 Case: hermetically sealed, 304 stainless steel socket with slip ring.

2.2.4 Helix: silicone dampening of bimetallic element.

2.2.5 Socket and Stem: 304 stainless steel.

2.2.6 Stem length: 100mm-150mm as required for insulation.

2.2.7 Dial: white coated aluminum with black lettering.

2.2.8 Lens: flat glass

2.2.9 Size: 50mm

2.2.10 Ranges:

.1 Duct: -70 to 70degC.

2.2.11 Acceptable Material: Marsh/Winters Bi-metal thermometers.

2.3 Thermometer Wells

2.3.1 Copper pipe: copper or bronze.

2.3.2 Steel pipe: brass or stainless steel.

2.4 Pressure Gauges

2.4.1 Dial type to ASME B40.1-2000, self indicating, 2% accuracy and plain case with twist locking ring and recalibration adjustment.

2.4.2 Bourdon tube: copper alloy tube, tip and socket.

2.4.3 Dial: Steel, white enamel background, black printed labels.

2.4.4 Lens: flat glass.

2.4.5 Movement: brass, bronze bushings, stainless steel pinion and arbor.

2.4.6 Size: 50mm.

2.4.7 Snubbers: brass body, as required.

2.4.8 Ranges:

.1 HW:0-413kPa

.2 DW:0-1100kPa

2.4.9 Acceptable Material: Marsh Standard Gauges/Winters.

PART 3 EXECUTION

3.1 General

3.1.1 Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units on approval of Engineer.

3.1.2 Install between equipment and first fitting or valve.

3.2 Thermometers

3.2.1 Install in wells on piping. Provide heat conductive material inside well.

3.2.2 Install in locations as indicated and as follows:

.1 HW/DW

.2 Ventilation:

.1 S/A, O/A, E/A,

.3 Use extensions where thermometers are installed through insulation.

3.3 Nameplates

3.3.1 Install engraved lamicoid nameplates as specified in Section 15075 - Mechanical Identification, identifying medium.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

1.1.1 Section 01300 - Submittals.

1.1.2 Section 01700 - Contract Closeout.

1.1.3 Section 15010 - Common Work Results - Mechanical.

1.1.4 Section 15011 - Pipework Testing.

1.1.5 Section 15101 - Installation of Pipework.

1.2 References

1.2.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME).

1.2.2 American Society for Testing and Materials International, (ASTM).

1.2.3 American Water Works Association (AWWA).

1.2.4 Canadian Standards Association (CSA International).

1.2.5 Department of Justice Canada (DJC).

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

1.2.7 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).

1.2.8 National Research Council (NRC)/Institute for Research in Construction.

1.2.9 Transport Canada (TC).

1.2.10 ASME B16.15-1985 (R1994), Cast Bronze Threaded Fittings, Classes 125 and 250.

1.2.11 ANSI B16.18-2001, Cast Copper Alloy Solder Joint Pressure Fittings.

1.2.12 ANSI B16.22-1980, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

1.2.13 ANSI B16.24-1979, Bronze Pipe Flanges and Fittings, Class 150 and 300.

1.2.14 ASTM A 307-02, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.

1.2.15 ASTM B 88M-99, Specification for Seamless Copper Water Tube (Metric).

1.2.16 MSS SP-80-1997, Bronze Gate, Globe, Angle and Check Valves.

1.3 Product Data

1.3.1 Submit shop drawings and product data in accordance with Section 01300 - Submittals

1.3.2 Submit data for following:

.1 Mechanical Joints.

PART 2 PRODUCTS

2.1 Piping

2.1.1 Domestic hot, cold and recirculation systems, within building.

.1 General: Copper tube, hard drawn, type K or L: to ASTM B 88M-99.

2.2 Fittings

2.2.1 50 dia and smaller:

.1 Cast bronze threaded fittings, Class 125: to ASME B16.15.

.2 Cast copper, solder type: to ANSI B16.18.

.3 Wrought copper and copper alloy, solder type: to ANSI B16.22.

2.2.2 63 dia and larger:

.1 Wrought copper, rol grooved fittings to CSA B242, ASTM B 75-02 and ANSI B16.22.

.2 Bronze pipe flanges and flanged fittings, Class 150: to ANSI/ASME B16.24.

.3 Concealed from manifolds to fixture stops:

.1 Brass crimp fitting to CSA B137.9-98 with double o-ring seal.

.1 Acceptable material: Kitec

2.3 Joints

2.3.1 Rubber gaskets, latex-free mm thick: to AWWA C111.

2.3.2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.

2.3.3 Solder: Lead Free

2.3.4 Teflon tape: for threaded joints.

2.3.5 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM flush seal gasket.

2.3.6 Dielectric connections between dissimilar metals: dielectric fitting to ASTM F492, complete with thermoplastic liner.

PART 3 EXECUTION

3.1 Installation

3.1.1 Install in accordance with National Plumbing Code of Canada and local authority having jurisdiction.

3.1.2 Install pipe work in accordance with Section 15101 - Installation of Pipework, supplemented as specified herein.

3.1.3 Assemble piping using fittings manufactured to ANSI standards.

3.1.4 Install CWS piping below and away from hot piping so as to maintain temperature of cold water as low as possible.

3.1.5 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.

3.1.6 Lay copper tubing so that it is not in contact with dissimilar metal and will not be kinked or collapsed.

3.1.7 Copper fixture supply pipes shall be secured to proper backing in the walls with wing back 90 degree elbows.

3.1.8 Install flanges or unions and isolation valves to permit removal of equipment without disturbing piping systems, as required by sizing standard.

3.1.9 Install pipetite bushings where piping passes through steel studs.

3.1.10 Connect to fixtures and equipment in accordance with manufacturers instructions unless otherwise indicated.

3.2 Pressure Tests

3.2.1 Test system in accordance with Section 15011 - Pipework Testing supplemented as specified herein.

3.3 Flushing And Cleaning

3.3.1 Flush entire system for 8 h. Ensure outlets flushed for 2 h. Let stand for 24 h, then draw one sample off longest run. Submit to testing in approved laboratory for analysis and provide certification that all samples are clean copper. Let system flush for additional 2 h, then draw off another sample for testing.

3.3.2 Obtain written approval from Engineer.

3.4 Pre-Start-Up Inspections

3.4.1 Systems to be complete, prior to flushing, testing and start-up.

3.4.2 Verify that system can be completely drained.

3.4.3 Ensure that air chambers, expansion compensators are installed properly.

3.5 Disinfection

3.5.1 Supply materials and test kit to carry out disinfection as follows:

.1 Fill piping system and tanks with chlorine/water solution with a strength of at least 50 mg/L. Ensure pipe is full and no air pockets remain.

.2 Leave solution in piping system for 24 hours, while maintaining a pressure of 175 kPa.

.3 After 24 hours sample and test the chlorine solution. If the chlorine residual is at least 25 mg/L, the disinfection will be considered successful. Flush chlorine solution from the system. Protect against contamination of the disinfected system.

3.5.2 If the chlorine residual is less than 25 mg/L, flush the system, clean any deleterious material, re-flush and disinfect again. Repeat until satisfactory.

3.5.3 If, in the opinion of the Engineer, any component of the potable water system becomes contaminated after disinfection, it shall be flushed and disinfected again at no additional cost.

3.5.4 Obtain water sample off longest run. Test in approved laboratory for bacteriological analysis and provide certification that all samples are suitable for human consumption prior to interim-occupancy inspection.

3.5.5 Upon completion, provide laboratory test reports on water quality for approval by Engineer.

3.6 Start-Up

3.6.1 Provide continuous supervision during start-up.

3.6.2 Start-up procedures:

3.6.3 Rectify start-up deficiencies.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

1.1.1 Section 15011 - Pipe Work Testing

1.1.2 Section 15101 - Installation Pipework

1.2 References

1.2.1 American Society for Testing and Materials International, (ASTM):

.1 ASTM B 32-00e1, Specification for Solder Metal.

.2 ASTM B 306-02, Specification for Copper Drainage Tube (DWV).

.3 ASTM C 564-97, Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

1.2.2 Canadian Standards Association (CSA International).

.1 CSA B67-1972 (R1996), Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.

.2 CSA B70-02, Cast Iron Soil Pipe, Fittings and Means of Joining.

.3 CSA B125-01, Plumbing Fittings.

PART 2 PRODUCTS

2.1 Copper Tube And Fittings

2.1.1 Above ground sanitary storm and vent Type DWV to: ASTM B 306-02.

.1 Fittings.

.1 DWV Cast brass: to CSA B125-01.

.2 DWV Wrought copper: to CSA B125-01.

.2 Solder: tin/antimony, 50:50, to ASTM B 32-00e1.

2.2 Cast Iron Piping And Fittings

2.2.1 Buried sanitary and vent minimum NPS 2, to: CAN/CSA-B70.

2.2.2 Above ground sanitary and vent: to CAN/CSA-B70.

2.2.3 Joints: mechanical joints with neoprene compression gaskets and stainless steel clamps.

PART 3 EXECUTION

3.1 Installation

3.1.1 In accordance with Section 15101 - Installation of Pipework and the National Plumbing Code of Canada, supplemented as specified herein.

3.1.2 Install piping parallel and close to walls to conserve headroom and space, and grade as indicated as per NPC.

3.1.3 Use of cast iron/copper DWV piping is mandatory for the following locations:

.1 DWV vent through roof for min 1500 mm to roof penetration and through roof.

.2 All piping located in non-accessible areas.

3.1.4 Use of cast iron/copper DWV is acceptable in all other locations in the building.

3.2 Testing

3.2.1 Test system in accordance with Section 15011 Pipework Testing supplemented as specified herein.

3.3 Performance Verification

3.3.1 Cleanouts: Prove freedom of access.

3.3.2 Test to ensure traps are fully and permanently primed.

3.3.3 Ensure that fixtures are properly anchored, connected to system and effectively vented.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

1.1.1 Section 15011 - Pipe Work Testing

1.1.2 Section 15101 - Installation Pipework

1.2 References

1.2.1 ASTM D 2564, Specification for Solvent Cements for Poly(Vinyl-Chloride) (PVC) Plastic Pipe and Fittings.

1.2.2 CSA B181.2, PVC Drain, Waste and Vent Pipe and Pipe Fittings.

1.2.3 CSA B181.12, Recommended Practice for the Installation of PVC Drain, Waste and Vent Pipe and Pipe Fittings.

PART 2 PRODUCTS

2.1 Piping And Fittings

2.1.1 For above ground:

.1 Certified PVC to CSA B181.2-96 listed for use in non-combustible construction, ULC listed to CAN4-S102.2, flame spread rating maximum 15.

.1 Acceptable material: IPEX System 15 XFR PVC-DWV.

2.2 Joints

2.2.1 Solvent cement:

.1 General: low VOC suitable for PVC pipe.

.2 Approvals: ASTM D-2564, SCAQMD Rule 1168/316A, Uniform Plumbing Code seal.

.3 Color: gray

.4 Resin: PVC

.5 Max VOC Emissions: 510G/L per SCAQMD Rule 1168, Method 316A.

.6 Acceptable material: IPS Weld-On 2711.

2.2.2 Primer:

.1 General: low VOC suitable for PVC pipe.

.2 Approvals: ASTM D-F-656, SCAQMD Rule 1168/316A, Uniform Plumbing Code seal.

.3 Color: purple

.4 Max VOC Emissions: 650G/L per SCAQMD Rule 1168, Method 316A.

.5 Acceptable material: IPS Weld-On P-70

PART 3 EXECUTION

3.1 Installation

3.1.1 In accordance with Section 15101 - Installation of Pipework and the National Plumbing Code of Canada, supplemented as specified herein.

3.1.2 Install piping parallel and close to walls to conserve headroom and space, and grade as indicated as per NPC.

3.1.3 Install PVC drain, waste and vent pipe and pipe fittings in accordance with CSA B181.12 and to the manufacturers listings.

3.1.4 Provide specified fire stopping systems for piping thru fire rated walls and floors where required.

3.1.5 Listed PVC DWV piping and fittings acceptable throughout building with the following exceptions:

.1 Use in Vertical Shafts as defined by NBCC not acceptable.

.2 DWV vent through roof for min 1500 mm to roof penetration and through roof.

.3 All exterior building DWV piping.

.4 All non-accessible utilidors.

.5 All buried piping.

3.2 Testing

3.2.1 Test system in accordance with Section 15011 Pipework Testing supplemented as specified herein.

3.3 Performance Verification

3.3.1 Cleanouts: Prove freedom of access.

3.3.2 Test to ensure traps are fully and permanently primed.

3.3.3 Ensure fixtures are properly anchored, connected to system and effectively vented.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

1.1.1 Section 01300 - Submittals

1.1.2 Section 01700 - Contract Closeout.

1.1.3 Section 15010 - Common Work Results - Mechanical.

1.1.4 Section 15011 - Pipework Testing.

1.1.5 Section 15101 - Installation of Pipework.

1.2 References

1.2.1 American Society of Mechanical Engineers (ASME)

.1 ASME B16.5-03, Pipe Flanges and Flanged Fittings.

.2 ASME B16.18-01, Cast Copper Alloy Solder Joint Pressure Fittings.

.3 ASME B16.22-01, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

.4 ASME B18.2.1-96, Square and Hex Bolts and Screws Inch Series.

1.2.2 American Society for Testing and Materials International (ASTM)

.1 ASTM A47/A47M-99(2004), Standard Specification for Ferritic Malleable Iron Castings.

.2 ASTM A53/A53M-04, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.

.3 ASTM B75M-99, Standard Specification for Seamless Copper Tube.

.4 ASTM B837-01, Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems.

1.2.3 Canadian Standards Association (CSA International)

.1 CSA W47.1-03, Certification of Companies for Fusion Welding of Steel.

1.2.4 Canadian Standards Association (CSA)/Canadian Gas Association (CGA)

.1 CAN/CSA B149.1HB-00, Natural Gas and Propane Installation Code Handbook.

.2 CAN/CSA B149.2-00, Propane Storage and Handling Code.

1.2.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.3 Product Data

1.3.1 Submittals in accordance with Section 01300 - Submittals

1.3.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.

.2 Indicate on manufacturer’s catalogue literature following: valves.

1.4 Closeout Submittals

1.4.1 Provide maintenance data and manufacturer’s instructions for incorporation into manual specified in Section 01700 - Contract Closeout.

1.5 Test Reports & Certificates

1.5.1 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

1.5.2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

PART 2 PRODUCTS

2.1 Pipe

2.1.1 Steel pipe: to ASTM A53/A53M, Schedule 40, seamless as follows:

.1 NPS 1/2 to 2, screwed.

.2 NPS2 1/2 and over, plain end.

2.2 Jointing Material

2.2.1 Screwed fittings: pulverized lead paste.

2.2.2 Welded fittings: to CSA W47.1.

2.2.3 Flange gaskets: non-metallic flat.

2.3 Fittings

2.3.1 Steel pipe fittings, screwed, flanged or welded:

.1 Malleable iron: screwed, banded, Class 150.

.2 Steel pipe flanges and flanged fittings: to ASME B16.5.

.3 Welding: butt-welding fittings.

.4 Unions: malleable iron, brass to iron, ground seat, to ASTM A47/A47M.

.5 Bolts and nuts: to ASME B18.2.1.

.6 Nipples: schedule 40, to ASTM A53/A53M.

2.4 Valves

2.4.1 Provincial Code approved, lubricated plug or ball type.

PART 3 EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Piping

3.2.1 Install in accordance with Section15101- Installation of Pipework, CAN/CSA B149.1HB, Natural Gas and Propane Installation Code Handbook and supplemented as specified.

3.2.2 Install drip points:

.1 At low points in piping system.

.2 At connections to equipment.

3.3 Valves

3.3.1 Install valves with stems upright or horizontal unless otherwise approved by Consultant.

3.3.2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.

3.4 Adjusting

3.4.1 Purging: purge after pressure test in accordance with CAN/CSA B149.1.

3.4.2 Pre-Start-Up Inspections:

.1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.

.2 Check gas trains, entire installation is approved by authority having jurisdiction.

3.5 Cleaning

3.5.1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

1.1.1 Section 01300 - Submittals

1.1.2 Section 01700 - Contract Closeout.

1.2 References

1.2.1 American Society for Testing and Materials (ASTM)

1.2.2 American Water Works Association (AWWA)

1.2.3 Canadian Standards Association (CSA)

1.2.4 Plumbing and Drainage Institute (PDI)

1.3 Submittals

1.3.1 Submit shop drawings and product data in accordance with Section 01300 - Submittals.

1.3.2 Indicate dimensions, construction details and materials for the following: floor drains,

.1 Floor drains.

.2 Cleanouts.

.3 Water hammer arrestors.

.4 Hose bibbs.

.5 Vent Flashing

.6 Air gap drains.

.7 DW Distribution Headers.

.8 Thermo-static Mixing Valve

1.4 Closeout Submittals

1.4.1 Provide maintenance data for incorporation into manual specified in Section 01700 - Contract Closeout.

1.4.2 Data to include:

.1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.

.2 Details of operation, servicing and maintenance.

.3 Recommended spare parts list.

PART 2 PRODUCTS

2.1 Floor Drains

2.1.1 Floor drains: to CSA B79.

2.1.2 Type 1: general duty; cast iron body round, adjustable head, sediment basket nickel bronze strainer, integral seepage pan suitable for installation in concrete deck, trap primer connection, and clamping collar.

.1 Acceptable material: Smith 2005-A-CP, Zurn, Watts.

2.1.3 Type 2: heavy duty; cast iron body, heavy duty non-tilting or hinged lacquered cast iron grate, integral seepage pan and clamping collar.

2.1.4 Type 3: combination funnel floor drain; cast iron body with integral seepage pan suitable for installation in concrete deck, trap primer connection, clamping collar, nickel-bronze adjustable head strainer with integral funnel.

.1 Acceptable material: Smith 2005-F25, Zurn, Watts.

2.2 Cleanouts

2.2.1 Cleanout plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.

2.2.2 Access covers:

.1 Access Covers: face of wall type, round frame with secured cover, chrome plated bronze, vandal proof screws, beveled edge frame complete with anchoring lugs.

.2 Acceptable material: Smith Fig 4720-U, Zurn, Watts.

.3 Floor Access Cleanouts- Cement floor finishes: heavy cast iron epoxy coated, MJ, brass screws, square nickel bronze top, adjustable collar, nickel bronze finish, bronze plug with gasket seal.

.1 Acceptable material: Smith Fig 4041S, Zurn, Watts.

2.3 Hose Bibb HB-1

2.3.1 HB Type 1: CSA approved, bent nose with flange, 19 dia., chrome plated brass construction complete with integral vacuum breaker, hose thread spout, replaceable composition disc for cold and hot water.

.1 Acceptable material: Acorn 8121, Watts.

2.4 Water Hammer Arrestors

2.4.1 Stainless steel construction, bellows type: to PDI-WH201.

2.4.2 Acceptable material: Smith Hydrotorol, Amtrol.

2.5 Domestic Water Distribution Headers

2.5.1 Distribution panel to include:

.1 DCW header.

.2 DHW header

.3 Distribution tubing isolation ball valves.

.4 DHW header isolation ball valve.

.5 DHW header isolation ball valve.

2.5.2 Panel:

.1 Finished steel cabinet, locking hinged access door, fully recessed mounting, powder coated off white finish.

.2 Dimensions: maximum 900Wx600Hx100D.

2.5.3 Headers:

.1 Copper tubing.

.2 Fittings:

.1 Cast bronze: to ANSI B16.18-1984/ wrought copper and bronze: to ANSI B16.22.

.3 Joints:

.1 Solder, tin-antimony, 95:5: to ASTM B 32-00e1.

.4 Valves:

.1 Ball valves.

.5 Header isolation valves:

.1 Bronze body, line size, lever/butterfly handle full port.

.6 Water hammer arrestors:

.1 Stainless steel construction, bellows type: to PDI-WH 201.

2.6 Vent Flashings

2.6.1 CSA approved stainless steel flashing sleeve with integral deck flange, premoulded urethane insulation liner, EPDM Triple Pressure Grommet Seal and EPDM Base Seal.

2.6.2 Acceptable material: Thaler SJ-37. This is the only acceptable material.

2.7 Air Gap Drains

2.7.1 Cast bronze, epoxy coated, connects to RPBP valve body, threaded outlet.

2.7.2 Acceptable material: Conbraco 40-200 AGD, Watts.

2.8 H & CW Interior Box Wall Hydrant HB-1

2.8.1 H & C.W., 1/4 turn, non drip ceramic cartridge 19mm size wall type with bronze face and stainless steel with full 180 deg. cover opening box, to suite wall thickness, operating key and integral vacuum breaker c/a wall mounted hose reel.

.1 Acceptable material: Smith Series 5560QTSAPH Box Type Wall Hydrant.

2.9 Water Meters

2.9.1 Displacement type to AWWA C700.Cast bronze, magnetic drive, hermetically sealed register.

2.9.2 Accessories:

.1 Remote readout device.

2.9.3 Type and manufactured as per local Municipal requirements.

2.9.4 Size: one size smaller than line size.

2.10 Reduced Pressure Backflow Preventer (Water Service)

2.10.1 Reduced pressure principle backflow preventer, dual resilient seated spring loaded poppet type check valved, hydraulically dependent differential pressure relief valve, top entry design, replaceable EPDM discs, FDA epoxy coated ductile iron body and steel cover, SS springs and fasteners, bronze seats. Full port ball valve test cocks.

2.10.2 Line size OS&Y isolation valves upstream and downstream of assembly.

2.10.3 Maximum working pressure: 1205kPa.

2.10.4 Working temperature range: 0.5degC to 60degC.

2.10.5 ULC, FM approved and to CSA B64.4

2.10.6 Straight pattern.

2.10.7 Acceptable material: Conbraco 40-200 Series, Watts.

2.11 Trap Guards

2.11.1 Material: smooth, soft, flexible, elastomeric PVC material molded into shape of duck's bill, open on top with curl closure at bottom.

2.11.2 Operation: allows wastewater to open and adequately discharge floor drain through its interior and closes and returns to original molded shape after wastewater discharge is complete.

2.11.3 Compliance: NSK/ANSI 14, CSA B79.

2.11.4 Acceptable material: ProSet Systems Trap Guard.

2.12 Gravity Feed Eyewash Station Ew-1

2.12.1 Self contained gravity feed eyewash.

2.12.2 Capacity: sufficient capacity to flush for 15min at 1.5L/min with 26.5L storage.

2.12.3 Tank: transparent yellow polycarbonate.

2.12.4 Pedestal: opaque yellow polypropylene with black pull down arm.

2.12.5 Concentrate: suitable to prevent bacteria, fungi and algae for up to four months, concentration of 0.24L per 26.5L.

2.12.6 Maintenance materials: provide one year supply of concentrate for each EW-1.

2.12.7 Wall bracket: stainless steel.

2.12.8 Acceptable material: Bradley S-19-921 / Guardian / Haws.

PART 3 EXECUTION

3.1 Installation

3.1.1 Install in accordance with National Plumbing Code of Canada, and as noted on drawings.

3.1.2 Install in accordance with manufacturer's instructions and as specified.

3.2 Cleanouts

3.2.1 In addition to those required by code, and as indicated, install at base of soil and waste stacks, and rainwater leaders.

3.2.2 Bring cleanouts to wall or finished floor unless serviceable from below floor.

3.2.3 Building drain cleanout and stack base cleanouts: line size to maximum 100 dia.

3.3 Water Hammer Arrestors

3.3.1 Install on branch supplies to fixtures or group of fixtures where indicated. Provide line size ball isolation valves.

3.4 3.4 Hose Bibbs

3.4.1 Install location as indicated on mechanical drawings at 1200 AFF.

3.5 Plumbing Vent

3.5.1 Coordinate with roof flashings and install as per manufacturers recommendations.

3.6 Floor Drains

3.6.1 Install with flange countersunk in floor 1 mm below floor level. Caulk perimeter prior to installing.

3.6.2 Finished flooring to cover flange and butt up to strainer.

3.6.3 Connect to specified TSP as specified.

3.7 Start-Up

3.7.1 Test, adjust and prove operation.

3.7.2 Clean out and prime all floor drain traps using trap guards.

3.7.3 Test freedom of movement of cleanouts.

3.7.4 Reduced pressure backflow preventers: test to requirements of CSA B64-Series-01.

3.7.5 All non emergency thermostatic and pressure mixing valves and DHW temperature stops: adjust for max DHW temp 40°C.

3.7.6 Reduced pressure backflow preventers: test to requirements of CSA B64-Series-01.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

1.1.1 Section 01300 - Submittals

1.1.2 Section 01700 - Contract Closeout.

1.2 References

1.2.1 CSA B45 Series-99 Series-88, CSA Standards on Plumbing Fixtures.

1.2.2 CSA B125.3-12, Plumbing Fittings.

1.3 Submittals

1.3.1 Submittals in accordance with Section 01300 - Submittals

1.3.2 Indicate:

.1 Dimensions and construction details

.2 Roughing-in dimensions

1.3.3 Provide for all fixtures and trim.

1.3.4 List of recommended spare parts.

1.4 Maintenance Data

1.4.1 Provide maintenance data for incorporation into manual specified in 01700 - Contract Closeout.

1.4.2 Indicate:

.1 Description of plumbing fixtures and trim giving manufacturers name, type, model, year and capacity.

.2 Details of operation, servicing and maintenance.

.3 Recommended spare parts list.

1.4.3 Provide for all fixtures and trim.

1.4.4 Trim of same service to be product of one manufacturer and of same type.

1.4.5 Exposed plumbing brass to be chrome plated.

PART 2 PRODUCTS

2.1 Manufactured Units

2.1.1 Manufacture plumbing fixtures in accordance with CAN/CSA B45 Series.

2.1.2 Manufacture plumbing fittings in accordance with CSA B125.3.

2.1.3 Architectural drawings to govern in determination of number and location of fixtures.

2.1.4 Fixtures of same service to be product of one manufacturer and of same type.

2.1.5 Trim of same service to be product of one manufacturer and of same type.

2.1.6 Exposed plumbing brass to be chrome plated.

2.1.7 Number, locations: as indicated.

2.1.8 Refer to Plumbing Fixture Schedule on drawings.

2.2 Emergency Eyewash Fixtures

2.2.1 Fixture must comply with ANSI/CSA Z358.1.

2.2.2 Refer to Plumbing Fixture Schedule on drawings.

2.3 Sink

2.3.1 Manufacture plumbing fixtures in accordance with CAN/CSA B45 Series.

2.3.2 Manufacture plumbing fittings in accordance with CSA B125.3.

2.3.3 Number, locations: as indicated.

2.3.4 Refer to Plumbing Fixture Schedule on drawings.

PART 3 EXECUTION

3.1 Installation

3.1.1 Connect fixtures complete with supplies and drains, trapped, supported level and square; hot water faucets shall be on left. Fixtures on outside walls to have supplies from floor; other fixtures to be served from wall. Wall hung fixtures to be securely and firmly mounted.

3.1.2 Mounting heights for wall hung fixtures measured from finished floor:

.1 Standard: to comply with manufacturers roughing-in details unless otherwise indicated or specified.

.2 Fixtures shall be serviced as follows:

Fixture	Waste (mm)	Vent (mm)	CW (mm)	HW (mm)
Mop Sinks	50	38	13	13
Floor Drains	75	38	-	-
Sink	32	38	13	13

3.2 Start Up

3.2.1 Aerator screens and strainers: clean out.

END OF SECTION

HEAT RECOVERY EQUIPMENT

Part 1 General

1.1 SCOPE

.1 Energy Recover Ventilator (ERV) – Air-to-Air Fixed Plate Exchanger

1.2 RELATED REQUIREMENTS

.1	Common Work Results	Section 15010
.2	Testing, Adjusting and Balancing for HVAC	Section 15950
.3	Metal Ducts	Section 15811

1.3 REFERENCE STANDARDS

.1 Air Conditioning, Heating, & Refrigeration Institute (AHRI)

.1	AHRI 1060	Performance Rating of Air-to-Air Exchangers for Energy Recovery Ventilation Equipment.

.2 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

.1	ASHRAE 84-2013	Method of Testing Air-to-Air Heat/Energy Exchangers (ANSI Approved).

.3 Canadian Standards Association (CSA)

.1	CSA 22.2 No. 0-10 (R2015)	General Requirements – Canadian Electrical Code, Part II

.4 Underwriters Laboratories (UL)

.1	UL 723	Standard for Test for Surface Burning Characteristics of Building Materials
.2	UL 1812	Standard for Ducted Heat Recovery Ventilators

1.4 QUALITY ASSURANCE

.1 The ERV core shall have a maximum flame spread index (FSI) of 25 and a maximum smoke developed index (SDI) of 50 The method of test shall be UL Standard 723.

.2 The ERV cores shall be third party Certified by AHRI under its Standard 1060 for Energy Recovery Ventilators. AHRI published certifications shall confirm manufacturer's published performance for airflow, static pressure, temperature and total effectiveness, purge air (OACF) and exhaust air leakage (EATR). OACF shall be no more than 1.02 and EATR shall be at 0% against balanced airflow.

.3 The unit shall be listed under UL 1812 Standard for Ducted Air to Air Heat Exchangers and comply with CSA Standard 22.2.

HEAT RECOVERY EQUIPMENT

.4 The unit shall be factory tested prior to shipping: Motor Dielectric Voltage-Withstand Bench Test, Unit Dielectric Voltage-Withstand Test, Continuity of Internal Control Circuits Test, Unit Amperage Test.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01300- Submittals.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for energy recovery equipment and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit shop drawings that include, at a minimum, the following information:

.1 Manufacturer and model number

.2 Unit performance data for both Supply Air and Exhaust Air, with system operating conditions indicated

.3 Enthalpy plate performance data for both summer and winter operation.

.4 Fan performance including capacity, external static pressure and fan speed

.5 Motor capacity and electrical characteristics

.6 Dimensions and weights – Indicate location of attached ductwork and service clearances

.7 Filter types, quantities, and sizes

.8 Accessories

1.6 MAINTENANCE MATERIAL SUBMITTALS

.1 Submit maintenance materials in accordance with Section 01400 – Quality Control

.2 Extra Materials:

.1 Furnish list of individual manufacturer's recommended spare parts for equipment include:

.1 Bearings and seals.

.2 Addresses of suppliers.

.2 List of specialized tools necessary for adjusting, repairing or replacing.

1.7 WARRANTY

.1 The ERV core shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of ten (10) years from the date of purchase.

HEAT RECOVERY EQUIPMENT

.2 The balance of the unit shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of two (2) years from the date of installation.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1 Greenheck, Johnson Controls, Lossnay, RenewAire, Tempeff

2.2 GENERAL

.1 Equipment shall be CSA certified or cETL listed.

2.3 ENERGY RECOVER VENTILATOR – AIR-TO-AIR FIXED PLATE EXCHANGER

.1 Cabinet

.1 Formed single wall insulated metal cabinet, fabricated to permit access to internal components for maintenance. Outside casing to be 20 gauge, galvanized (G90) steel meeting ASTM A653 for components that do not receive a painted finish. Painted components as supplied by the factory shall have polyester urethane paint on 20 gauge G90 galvanized steel.

.2 Cabinet Insulation: Unit walls and doors shall be insulated with 1 inch, 4 pound density, foil/scrim faced, high density fiberglass board insulation, providing a cleanable surface and eliminating the possibility of exposing the fresh air to glass fibers, and with a minimum R-value of 4.3 (hr-ft^2-°F/BTU).

.3 Access doors shall be hinged with airtight closed cell foam gaskets. Door pressure taps, with captive plugs, shall be provided for cross-core pressure measurement allowing for accurate airflow measurement.

.4 Unit shall have factory-installed duct flanges on all duct openings.

.5 The ERV shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connections to the non-fused disconnect.

.6 Passive Frost Control: The ERV core shall perform without condensing or frosting under normal operating conditions (defined as outside temperatures above -23°C (-10ºF) and inside relative humidity below 40%). Occasional more extreme conditions shall not affect the usual function, performance or durability of the core. No condensate drains will be allowed.

.2 Enthalpy Core

.1 Energy recovery core shall be of the total enthalpy type, capable of transferring both sensible and latent energy between airstreams. Latent energy transfer shall be accomplished by direct water vapor transfer from one airstream to the other, without exposing transfer media in succeeding cycles directly to the exhaust air and then to the fresh air. No condensate drains shall be allowed.

.2 The energy recovery core shall be designed and constructed to permit cleaning and removal for servicing.

HEAT RECOVERY EQUIPMENT

.3 Blower Section

.1 Supply air and exhaust air blower assemblies consist of an ODP, ECM motor, and a direct driven forward-curved blower.

.2 Blower assemblies shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.

.4 Motors

.1 Blower motors shall be Premium Efficiency, EISA compliant for energy efficiency.

.2 The blower motors shall be totally enclosed (TEFC) and shall be supplied with factory installed motor starters.

.5 Filters

.1 The unit shall have 50mm (2") thick MERV 8 disposable pleated filters located in the outdoor air and exhaust airstreams. All filters shall be accessible from the exterior of the unit.

.6 Unit Controls

.1 Fan control: Terminal strip for EC motors.

.2 Sensors: Dirty filter monitor for both airstreams.

.3 Timeclock: Digital Time Clock mouting in outdoor, enclosed NEMA 3R enclosure, with up to 8 on/off cycles per day or 50 per week, 24VAC power, with battery backup protection of program settings against power failure to energize unit

.4 Factory-installed microprocessor controller and sensors shall:

.1 Comply with requirements in Section 25 90 01 – EMCS: Site Requirements, Applications And Systems Sequences of Operation

.2 Have factory-installed hardware and software to enable the building automation interface via Modbus or BACnet to monitor, control, and display status and alarms. The controller shall have integrated ethernet interface and a web server for displaying unit parameters

.3 The microprocessor controller shall have the ability to communicate with the BMS via Modbus RTU/TCP and BACnet MSTP/IP

.4 The microprocessor controller shall be capable of operating at temperatures between -29°C to 71°C (-20°F to 160°F).

.5 The microprocessor controller shall come with backlit display that allows menu-driven display for navigation and control of unit.

.6 The microprocessor controller shall have an internal programmable time clock that will allow the user to add up to different occupancy schedules and add holidays.

.7 The microprocessor control shall be capable of integral diagnostics and be capable of capable of IP or SI unit display

HEAT RECOVERY EQUIPMENT

.8 The microprocessor controller shall at a minimum offer the ability for three modes of determining occupancy: a dry contact, the internal time clock or the BMS

.9 A remote user terminal to allow for remote monitoring and adjustment of parameters, allowing ease of control access without going outdoors or into the mechanical room if desired by the user

.10 The microprocessor controller shall have at a minimum (10) universal inputs/outputs (AI, DI, AO) and have (6) six relay outputs (DO). The microprocessor controller shall have an integrated fieldbus port and have the capability for I/O expansion

.11 The microprocessor controller shall have a micro USB port to load the application program, the unit parameters, saving logs, etc.

.5 The sensors that will be required for control are:

.1 (2) Temperature sensor for fresh air and exhaust air

.2 (2) Temperature and humidity sensor for outside air, return air

.3 (2) Differential pressure sensors for filter alarms

.4 (2) Differential pressure sensors for measuring pressure drop across energy recovery core and for determining airflow in both airstreams

.5 Adjustable current switch

.6 The microprocessor controller shall have the capability to monitor the unit conditions for alarm conditions. Upon detecting an alarm, the microprocessor controller shall have the capability to record the alarm description, time, date, available temperatures, and unit status for user review. A digital output shall be reserved for remote alarm indication and through BMS. Provide the following alarm functions:

.1 Outside air temperature sensor alarm

.2 Outside air humidity sensor alarm

.3 Return air temperature sensor alarm

.4 Return air humidity sensor alarm

.5 Fresh air sensor alarm

.6 Exhaust air sensor alarm

.7 Dirty filter alarm

.8 Supply and exhaust air proving alarm

.9 [Outside airflow sensor alarm]

.10 [Exhaust airflow sensor alarm]

.11 [Duct static pressure sensor alarm]

.12 [Room pressurization sensor alarm]

.13 [CO2 sensor alarm]

.14 [TVOC sensor alarm]

.15 [Airflow out of range alarm]

HEAT RECOVERY EQUIPMENT

.7 Display the following on the face of microprocessor controller:

.1 Unit on

.2 [Heating status]

.3 Outdoor air temperature

.4 Outdoor air humidity

.5 Return air temperature

.6 Return air humidity

.7 Supply air temperature

.8 Airflows in both airstreams

.9 Unit on/off

.10 Fan on/off

.11 Damper status

.12 Alarm digital display

.8 The microprocessor controller shall have factory pre-programmed multiple operating sequences for control of the ERV. Factory default settings shall be fully adjustable in the field. Available factory pre-programmed sequences on operations are:

.7 SEQUENCE OF OPERATIONS

.1 GENERAL OPERATION

.1 POWER UP:

.1 When the unit main disconnect is closed a delay of 10 seconds (adjustable) occurs for the controller to come online.

.2 ERV UNIT START COMMAND:

.1 An input signal is required to enable the unit operation. The unit will be commanded on by:

1. Digital input
2. BMS command
3. Internal time clock
4. Enable via controller display]

.2 All types of input that are enabled must be true before the unit will start.

1. The supply fan starts after a 6 second delay (adjustable). The supply fan will not start until the damper actuator end switch closes.
2. The supply fan, exhaust fan, [heating] are controlled based on the chosen unit operating modes and air conditions.

.2 ERV UNIT STOP COMMAND (OR DE-ENERGIZED):

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.1 The unit can then be commanded off by:

.1 [Digital input]

.2 [BMS command]

.3 [Internal time clock]

.4 [Disable via controller display]

.2 Supply fan and exhaust fan are de-energized.

.3 All dampers are unpowered and spring return to their default position after a 10 second delay (adjustable).

.3 SUPPLY FAN OPERATION:

.1 [The supply fan will operate at a constant speed.]

.2 [The supply fan speed will be controlled for:]

.1 [Fixed percentage of max speed (0%-100%)]

.2 [Supply air flow (CFM)]

.3 [Supply duct static pressure]

.4 [Room pressure]

.5 [IAQ (TVOC)]

.6 [Fixed CO_2]

.7 [CO_2 flow]

.3 The unit will attempt to start the supply fan when the supply fan delay timer expires. When the supply fan starts the supply fan adjustable current switch should close and remain closed until the fan is turned off.

.4 SUPPLY FAN STATUS:

.1 Once the supply fan current switch closes [heating] operation is allowed. After a delay of 90 seconds (adjustable) from supply fan start signal, if the supply fan current switch is still open the supply fan alarm should be set to true and [heating] operation shall be prohibited. The supply fan status shall be set to true only when the supply fan output is on and supply fan current switch is closed. The supply fan status shall be false in all other circumstances.

.5 FIXED FAN SPEED OPTION:

.1 The analog voltage command to the supply fan ECM can be set from the unit controller display [or by the BMS]. The adjustable range of 0% to 100% correspond to the minimum and maximum fan operating speed. This supply fan operation mode can be used to field balance the supply air flow rate.

.6 SUPPLY AIR FLOW CONTROL OPTION:

.1 The controller will adjust the supply fan ECM command to maintain the supply air flow rate at a set point. The supply air flow rate set point is entered and adjusted from the unit controller display [or provided by the BMS]. The minimum and maximum values for supply air flow rate set point are unit dependent. An adjustable PI (proportional & integral) loop

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will compare the measured supply air flow to the air flow rate set point and adjust the fan speed. If the measured supply air flow rate varies from the desired air flow rate by more than 10% (adjustable) for more than 60 seconds (adjustable) a supply air flow rate alarm will be set to true. This supply fan operation mode can be used to provide a constant supply air flow rate as the unit filters become loaded.

.7 SUPPLY DUCT STATIC PRESSURE CONTROL OPTION:

.1 The controller will adjust the supply fan ECM command to maintain the supply duct static pressure at a set point. The supply air duct static pressure set point is entered and adjusted from the unit controller display [or provided by the BMS]. The minimum and maximum values for supply air duct static pressure set point are unit dependent. An adjustable PI (proportional & integral) loop will compare the measured supply air duct static pressure to the static pressure set point and adjust the fan speed. If the measured static pressure varies from the desired static pressure by more than 0.05 inches water gauge (adjustable) for more than 60 seconds (adjustable) a supply air static pressure alarm will be set to true. This supply fan operation mode can be used to provide a constant supply duct pressure for VAV systems.

.8 ROOM STATIC PRESSURE CONTROL OPTION:

.1 The controller will adjust the supply fan ECM command to maintain the room static pressure at a set point. The room static pressure measurement is typically a differential pressure measurement between the room and an adjacent space or outdoors. The room static pressure set point is entered and adjusted from the unit controller display [or provided by the BMS]. An adjustable PI (proportional & integral) loop will compare the measured room static pressure to the static pressure set point and adjust the supply fan speed. If the measured static pressure varies from the desired static pressure by more than 0.05 inches water gauge (adjustable) for more than 60 seconds (adjustable) a supply air static pressure alarm will be set to true. This supply fan operation mode can be used to provide a constant static pressure in an area to control infiltration or exfiltration from an adjacent area or outdoors.

.9 IAQ (TVOC) CONTROL OPTION:

.1 The controller will adjust the supply fan ECM command to maintain the room or return air VOC level at a set point. The VOC set point is entered and adjusted from the unit controller display [or provided by the BMS]. An adjustable PI (proportional & integral) loop will compare the measured VOC level to the VOC set point and adjust the fan speed. The minimum and maximum fan speed commands are adjustable. If the measured VOC level exceeds 1000 ppm (CO_2 equivalent, adjustable) for more than 60 seconds (adjustable) a VOC alarm will be set to true. This supply fan operation mode can be used to provide demand controlled ventilation of a space. The minimum fan speed will provide the required minimum outdoor air when the VOC level is at or below the VOC set point.

.10 CO_2 CONTROL OPTION:

.1 The controller will adjust the supply fan ECM command to maintain the room or return air CO_2 level at a set point. The CO_2 set point is entered

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and adjusted from the unit controller display [or provided by the BMS]. An adjustable PI (proportional & integral) loop will compare the measured CO_2 level to the CO_2 set point and adjust the fan speed. The minimum and maximum fan speed commands are adjustable. If the measured CO_2 level exceeds 1000 ppm (adjustable) for more than 60 seconds (adjustable) a CO_2 alarm will be set to true. This supply fan operation mode can be used to provide demand controlled ventilation of a space. The minimum fan speed will provide the required minimum outdoor air when the CO_2 level is at or below the CO_2 set point.

.11 CO_2 FLOW CONTROL OPTION:

.1 The controller will adjust the supply fan ECM command based on the measured room or return air CO_2 level. The supply air flow set point is derived from the user entered minimum and maximum CO_2 levels and minimum and maximum desired air flow rates. When the CO_2 level is at or below the minimum CO_2 level the air flow set point is at the minimum and when the CO_2 level is at or above the maximum CO_2 level the air flow set point is at the maximum. Between the minimum and maximum CO_2 levels the air flow set point is linearly scaled. If the measured CO_2 level exceeds 1000 ppm (adjustable) for more than 60 seconds (adjustable) a CO_2 alarm will be set to true. This supply fan operation mode can be used to provide demand controlled ventilation of a space. The minimum fan speed will provide the required minimum outdoor air when the CO_2 level is at or below the CO_2 set point.

.12 HEATING OPERATION:

.1 Heating will be locked out if the outdoor air temperature is above 70 degrees (adjustable). The temperature set point can be configured as constant (adjustable) or can be reset by the outside air temperature. Heating will be controlled using the supply air temperature or return air temperature.

.13 CONSTANT TEMPERATURE OPTION:

.1 The controller will stage the heaters or adjust the 0 to 10 VDC analog output to the heating device to maintain the air temperature at a set point. The air temperature set point is entered and adjusted from the unit controller display [or provided by the BMS]. The minimum and maximum values for the air temperature set point are unit dependent and are adjustable. An adjustable PI (proportional & integral) loop will compare the measured air temperature to the air temperature set point and adjust the analog output. A digital output that indicates a call for heating will also be provided. The analog and digital output can be used to control a hot water valve, electric heater, gas heater, or heat pump.

.14 RESET AIR TEMPERATURE OPTION:

.1 The controller will adjust the 0 to 10 VDC analog output to the heating device to maintain the air temperature at a set point. The air temperature set point is calculated based on the outdoor air temperature. The air set point is adjusted between the 100 degree F maximum (adjustable) and the 70 degree F minimum (adjustable) as the measured temperature varies from the 20 degree F minimum (adjustable) to the 70 degree F maximum (adjustable). These values are entered and adjusted from the unit controller display [or provided by the BMS]. An adjustable PI

(proportional & integral) loop will compare the measured supply air temperature to the supply air temperature set point and adjust the 0 to 10 VDC analog output. A digital output that indicates a call for heating will also be provided. The analog and digital output can be used to control a hot water valve, electric heater, gas heater, or heat pump. Coil freeze protection must be provided by others in the field.

Part 3 Execution

3.1 INSTALLATION

.1 Install in accordance with manufacturers recommendations.

.2 Support independently of adjacent ductwork with flexible connections.

.3 Install access doors in accordance with Section 15820- Air Duct Accessories for access to coils, dampers, etc.

.4 Install unit with clearances for service and maintenance.

3.2 PERFORMANCE

.1 Refer to Energy Recovery Ventilator Schedule on drawings.

3.3 FIELD QUALITY CONTROL

.1 Contractor to inspect field assembled components and equipment installation, to include electrical and piping connections. Report results to Engineer in writing.

.2 Inspection must include a complete startup checklist to include (as a minimum) the following: Completed Start-Up Checklists as found in manufacturer's IOM. Insert any other requirements here.

3.4 START-UP SERVICES

.1 Contractor to perform startup service. Clean entire unit, comb coil fins as necessary, and install clean filters. Measure and record electrical values for voltage and amperage. Refer to section 23 05 00 – Common Work Results for HVAC.

END OF SECTION

1.1 Related Sections

a) Section 01300 - Submittals.

b) Section 01700 - Contract Closeout.

c) Section 15095 - Mechanical Startup.

d) Section 15950 - Testing, Adjusting and Balancing for HVAC.

1.2 References

a) Comply with local and Provincial Regulations

b) CAN/CSA-B149.1 - Natural Gas and Propane Installation Code

1.3 Shop Drawings And Product Data

.1 Submit shop drawings and product data in accordance with Section 01300 - Submittals.

.2 Indicate following:

a) Fan design and construction.

b) Fan curves showing point of operation.

c) Motor design and construction including electrical ratings, approvals, efficiency.

d) Filters.

e) Dampers.

f) Controls.

g) Unit wall, floor and casing details of construction.

h) Acoustic data including:

i) .Unit inlet and discharge SPL.

ii) Assembled unit radiated SPL.

i) Performance data including selection points and acoustic data.

1.4 Closeout Submittals

.1 Provide operation and maintenance data for incorporation into manual specified in Section 01700 - Contract Closeout.

1.5 Extra Materials

.1 Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

a) Filters: 1 set of MERV 14 (18X24X4) -(2) disposable filters for each unit.

b) One set of fan belts

2.1 General

.1 Factory assembled components suitable for site jointing to form units supplying air at designed conditions, as indicated.

.2 Unit to be shipped and installed as a single piece of equipment.

.3 Certify ratings: Unit shall bear CSA/NRTL/ETL/AMCA seal and where applicable be tested and rated in accordance with ANSI/ARI 430-1999.

.4 Horizontal type, as indicated, having air tight components, consisting of casing, fan sections with motors and drives, filter sections, and dampers.

.5 Dimensional standard: unit dimensions and weights are based on

.6 Make-up air unit shall be IRI & ETL listed to ANSI Z83.4 and CAN 3.7

.7 Acceptable Material: Greenheck.

2.2 Casings

.1 Materials: Formed double wall insulated metal cabinet, fabricated to permit access to internal components for maintenance.

.2 Outside casing: 18 gauge, galvanized steel meeting ASTM A653 for components that do not receive a painted finish.

.3 Cabinet Insulation: Comply with NFPA 90A and NFPA 90B and erosion requirements.

.4 Access panels: Unit shall be equipped with insulated removable hinged access panels to provide easy access to all major components. Access panels shall be fabricated of 18 gauge.

.5 Factory Finish: Hi-Pro Poly Concrete Gray (Ral-7023)

2.3 Indirect Gas Furnace

.1 Shall be ETL Certified as a component of the unit.

.2 Shall have an integral combustion gas blower.

.3 Shall have low leakage insulated O/A damper, two position.

.4 Shall have fault sensors to provide fault conditions to optional digital controller or building controls.

.5 Shall have 4-pass tubular heat exchangers, constructed of type 409 stainless steel. Heat exchanger tubes shall be installed on the vest plate by means of swaged assembly, welded connections are not acceptable. Heat exchanger tubes shall be supported by a minimum of two fabricated assemblies that support the tubes and also permit expansion and contraction of the tubes.

.6 Shall be encased in a weather-tight metal housing with intake air vents. Large, metal lift- off or hinged door shall provide easy access to the enclosed vest plate, control circuitry, gas train, burner assembly and exhaust blower

.7 Shall be equipped for operation on natural gas with a maximum rated inlet gas pressure of 1/2 psi.

.8 Shall have fault sensors to provide fault conditions to optional digital controller and building controls.

.9 Shall have temperature control provided by an electronic 16:1 turndown-ratio modulating discharge air sensor. Direct digital controller with integral discharge temperature limit using an external 4 - 20 mA signal.

.10 Options:

a) Control Center

b) Heat inlet air sensor

c) Dirty Filter Switch

d) Remote Panel: Industrial

e) Freeze protection

f) Heat Modulation

g) Fir Stat-Type III

h) Smoke Detector: 120v/24v

i) Inlet Damper End Switch

j) Insulation- Entire Unit

.11 Shall include the following safety controls:

a) Manual Reset, High Limit Switch: Main gas valve closes if high-limit temperature is exceeded.

b) Dual safety shutoff valves shall be provided that do not exceed 120 VAC control signals.

c) High and low Gas Pressure Switch: Main gas valve closes if high or low pressure switch faults.

d) FM global requirements: Include high and low gas pressure switches and visual indication gas valves.

e) Low temperature limit control.

f) One hydraulic proof of close valves shall be included.

g) A gas vent line shall be included that vents gas from between the safety shutoff valves. h. Visual indication: Clear visual signal demonstrating the position of the main gas safety shut-off valves.

.12 Shall be complete with MERV 14 filter section.

2.4 Fans

.1 Blower section construction, Supply Air: Belt drive motor and blower shall be assembled onto a minimum 14 gauge galvanized steel platform and must have [neoprene vibration isolation devices, minimum of 1 - 1/8 inches thick

.2 Blower assemblies: Shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.

.3 Centrifugal blower housing: Formed and reinforced steel panels to make curved scroll housing with shaped cutoff.

.4 Forward curved blower (fan) wheels: Galvanized or aluminum construction with inlet flange and shallow blades curved forward in direction of airflow. Mechanically attached to shaft with set screws.

.5 Blower section motor source quality control: Blower performance shall be factory tested for flow rate, pressure, power, air density, rotation speed and efficiency. Ratings are to be established in accordance with AMCA 210, "Laboratory Methods of Testing Fans for Rating.

.6 Controls:

a) VFD control: Gas detection/Occupancy Sensor

2.5 Filter Gauges

.1 Provide magnehelic gauges.

.2 Magnehelic gauges to be accurate to +/-2% of full range.

.3 Sensing probes and shut off valves to be provided for each gauge.

.4 One gauge to be provided for each filter bank.

.5 Gauges shall be surface mounted at site.

2.6 Controls

.1 The control unit shall be constructed so that it can function as a stand-alone makeup air system controlled by factory-supplied controllers, thermostats and sensors.

.2 The control unit to operate the MUA and exhaust fan units and control dampers as described in section 15900.

.3 Unit shall include a pre-wired control system with only connections required for power and field wiring.

.4 The control system shall include the following components required to provide automatic operation and low fire start:

a) Non-fused disconnect switch

b) Control circuit transformer

c) Magnetic fan starter and overloads

d) control circuit fuses

e) High and low fan speeds

f) High and low temperature limit switches

g) Supply fan velocity air proving differential switch

h) Flame safeguard relay

i) Flame Rod flame sensors

j) Ignition transformer

k) Electronic temperature control system.

l) Addiitonal contacts for connection to SCADA

.5 Remote control panel shall contain on-off auto switch indicating lights for supply fan, burner operation, clogged filter indication, lockout indication and air flow indication.

.6 Fan discharge thermostat shall control modulating gas valve to maintain supply air temperature. Provide remote discharge temperature adjustment.

.7 Acceptable Material: Greenheck TSCP

3.1 Installation

.1 Provide appropriate protection apparatus.

.2 Provide for installation, commissioning and warranty for all MUA.

.3 Ensure adequate clearance for servicing and maintenance..

3.2 Fans

.1 Install fan sheaves required for final air balance.

.2 Install flexible connections at unit inlet and outlets.

.3 Remove shipping bolts/tiedowns of fan base..

3.3 Construction Use Of Air Handling Units

.1 Construction use of air handling units for ventilation, heating, de-humidification, humidification, dust control or any other use is strictly prohibited.

.2 Startup of the AHU can only occur after all ducts installed and cleaned and building and systems are completed to the pre-requisite requirements for commencing Testing, Adjusting and Balancing as specified in Section 15950.

3.4 Start-Up

.1 Purpose: to confirm that the make up air units function in accordance with all contract requirements prior to commencing on site commissioning activities.

.2 Startup to be completed by manufacturer's representative in cooperation with the controls contractor.

.3 Startup and operate systems for at least 5 consecutive 24 hour days. Coordinate startup to ensure main units started up and operated in an integrated manner for same consecutive 5 day period

.4 .orrect all defects when they occur.

.5 Confirm in writing to Engineer successful completion of startup. Provide list of any outstanding deficiencies.

a) Bear signature of technician and supervisor (where applicable).

.6 Startup to include:

a) Lubricate all bearings as recommended by manufacturer.

b) Vacuum all units clean prior to operating fans.

c) Ensure filters are installed. Do not operate systems without filters installed.

.7 Engage a factory authorized service representative to train owner's maintenance personnel to adjust, operate and maintain the entire unit.

END OF SECTION

PART 1 GENERAL

1.1 References

1.1.1 Canadian Standards Association (CSA International)

.1 CSA B149.1

1.2 Product Data

1.2.1 Submit product data in accordance with Section 01300 - Submittals

1.2.2 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.

1.2.3 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence, cleaning procedures.

1.3 Closeout Submittals

1.3.1 Provide operation and maintenance data for unit heaters for incorporation into manual specified in Section 01700 - Contract Closeout.

PART 2 PRODUCTS

2.1 Unit Heaters

2.1.1 Acceptable Manufacturers

1. Reznor, Trane.

2.1.2 Type

.1 83% Thermal Efficient, separated combustion chamber.

.2 Provide self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, centrifugal direct drive multispeed blower, heat exchanger, gas burner and controls.

2.1.3 Construction

.1 Cabinet: Heavy gauge galvanized steel with baked enamel finish, easily removed and secured access doors, glass fiber insulation and reflective liner.

.2 Heat Exchanger: Aluminized, steel of welded construction.

.3 Supply Fan: Centrifugal type rubber mounted with direct drive, multispeed control, TEFC motor.

2.1.4 Burner

.1 Gas Burner: Power vented draft type, equipped with combination gas valve and pressure regulator incorporating manual shut-off, pilot valve, spark ignition automatic 100% shut-off and safety.

.2 Gas Burner Safety Controls: Thermocouple sensor prevents opening of solenoid gas valve until pilot flame is proven and stops gas flow on ignition failure; LED diagnostics.

2.1.5 Burner Operating Controls

.1 Low voltage, adjustable room thermostat, controls burner operation to maintain room temperature setting.

.2 High limit control, with fixed stop at maximum permissible setting, de-energizes burner on excessive bonnet temperature and energizes burner when temperature drops to lower safe value.

.3 Control supply fan in accordance with bonnet temperatures and independent of burner controls. Include manual switch for continuous fan operation.

2.1.6 Draft Control

.1 Provide each unit heater with galvanized steel flue pipe having airtight joints and insulated metal combustion air intake pipe.

.2 Provide combination combustion air/vent fitting for roof/wall penetration.

PART 3 EXECUTION

3.1 Installation

.1 Install in accordance with manufacturer's instructions.

.2 Install in accordance with piping layout and reviewed shop drawings.

.3 Check final location with Engineer if different from that indicated prior to installation. Should deviations beyond allowable clearances arise, request and follow Engineer's directive.

.4 Provide supplementary suspension steel as required.

.5 Before acceptance, set discharge patterns and fan speeds to suit requirements.

.6 Provide vibration isolation on supports.

.7 Make natural gas piping connections and flue/combustion air installations.

.8 Inspect unit heaters prior to start-up and submit report. Comply with Section 15095, Mechanical Startup.

.9 Refer to drawings for gas fired unit heater schedule.

3.2 Field Quality Control

.1 Conform to requirements of CSA, Provincial and Municipal Codes and be CSA listed.

.2 Certified by CSA to ANSI Z83.8 and CSA 2.6.

.3 Units shall be manufactured in an ISO9001 certified facility.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

1.1.1 Section 01300 - Submittals

1.1.2 Section 01700 - Contract Closeout.

1.2 References

1.2.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.46-M1988, Electric Air-Heaters.

1.3 Product Data

1.3.1 Submit product data in accordance with Section 01300 - Submittal

1.3.2 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.

1.3.3 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence, cleaning procedures.

1.4 Closeout Submittals

1.4.1 Provide operation and maintenance data for unit heaters for incorporation into manual specified in Section 01700 - Contract Closeout.

PART 2 PRODUCTS

2.1 Unit Heaters

2.1.1 CSA Approved, wall mounted or ceiling hung unit heater, built in linear high limit control with automatic reset.

2.1.2 Cabinet: 14 gauge steel cabinet with adjustable steel louvers

2.1.3 Heating elements: Durable tubular heating elements; stainless steel (2-10kW); finned (15-60kW).

2.1.4 Fan: Explosion proof, thermally protected permanently lubricated ball bearing motor.

2.1.5 Elements: stainless steel tubular heating element with fins. Floating heating element on high temperature nylon bushings eliminating expansion noises.

2.1.6 Control: Wall mounted thermostat Heat Exchanger: high grade metal sheathed element fins.

2.1.7 Accessories: XDC-01 explosion proof wall mounted disconnect switch, OHX-MB basic mounting bracket.

2.1.8 Capacity: Based on 21 deg. C air temperature

2.1.9 Acceptable Material: Refer to schedule.

2.1.10 Schedule: Refer to drawings.

2.2 Electric Baseboard Heater

2.2.1 CSA approved, wall mounted baseboard heater, built in linear high-limit control with automatic reset.

2.2.2 Cabinet: 20 ga steel front panel and connection box, 22 ga steel body.

2.2.3 Elements: Stainless steel tubular heating element with aluminum fins. Floating heating element on high-temperature nylon bushings eliminating expansion noises

2.2.4 Control: built in thermostat.

2.2.5 Power: 208V/1ph

2.2.6 Acceptable material: Ouellet Model OFM Series

2.2.7 Schedule:

Ref.	Length Inches	Capacity MBtu/hr	Power (V/PH/H)	Model
A	22 5/16	1.0	208/1/60	OFM 0308
A	27 3/16	1.8	208/1/60	OFM 0508
A	37 3/16	2.6	208/1/60	OFM 0508
A	47 1/2	3.4	208/1/60	OFM 0508

PART 3 EXECUTION

3.1 Installation

3.1.1 Install in accordance with manufacturer's instructions.

3.1.2 Check final location with Consultant if different from that indicated prior to installation. Should deviations beyond allowable clearances arise, request and follow Consultant's directive.

3.1.3 Provide supplementary suspension steel as required.

3.1.4 Before acceptance, set discharge patterns and fan speeds to suit requirements.

3.2 Field Quality Control

3.2.1 Perform tests in accordance with division 16.

3.2.2 Test cut-out protection when air movement is obstructed.

3.2.3 Test fan delay switch to assure dissipation of heat after element shut down.

3.2.4 Test unit cut-off when fan motor overload protection has operated.

3.2.5 Ensure heaters and controls operate correctly.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

1.1.1 Section 01300 - Submittals

1.2 References

1.2.1 American Society for Testing and Materials (ASTM):

.1 ASTM A 480/A 480M-94b, Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.

.2 ASTM A 525M-91b, Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process. (Metric).

.3 ASTM A 621/A 621M-92(1993), Specification for Steel Sheet and Strip, Carbon, Hot-Rolled, Drawing Quality.

1.2.2 National Fire Protection Agency (NFPA)

1.2.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible, 1985.

1.2.4 ASHRAE Handbook, Fundamental, and Systems Volumes.

1.3 Shop Drawings And Product Data

1.3.1 Submit shop drawings and product data in accordance with Section 01300 - Submittals

1.3.2 Indicate following:

.1 Sealants.

.2 Tape.

.3 Proprietary Joints.

.4 Hangers.

1.4 Certification Of Ratings

1.4.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.5 Scope Of Application

1.5.1 This section applies to all ducts of velocities below 10 m/s and 500Pa.

1.6 Definitions

1.6.1 For purposes of this section:

.1 "CONCEALED" - insulated duct work in hung ceilings non-accessible chases, furred spaces and crawlspaces.

.2 "EXPOSED" - will mean "not concealed" as defined herein.

1.7 Exposed Ducts

1.7.1 For all exposed galvanized ducts it will be responsibility of the Contractor to meet the aesthetic requirements of the Engineer within the reasonable limits of a tradesman like installation to SMACNA and industry standards.

1.7.2 Where exposed ducts fail to meet the aesthetic requirements of the Engineer the indicated ducts are to be repaired or replaced to the satisfaction of the Engineer.

PART 2 PRODUCTS

2.1 Seal Classification

2.1.1 Classification as follows:

Maximum Pressure (Pa)	SMACNA Seal Class
500	B

2.1.2 Seal classification:

.1 Class B: longitudinal seams, transverse joints and connections made airtight with sealant.

2.2 Sealant

2.2.1 Concealed: oil resistant, polymer type flame resistant duct sealant. Temperature range of minus 30 deg.C to plus 93 deg.C.

2.2.2 Exposed: latex duct sealant. Temperature range of minus 30degC to plus 93degC.

2.2.3 All sealants to be low VOC to the current content limits of SCAQMD Rule #1168.

2.3 Tape

2.3.1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

2.4 Fittings

2.4.1 Fabrication: to SMACNA.

2.4.2 Reduced elbows: short radius.

2.4.3 Square elbows: to 400 mm with single thickness vanes.

2.4.4 Square elbows: over 400 mm with double thickness vanes.

2.4.5 Main supply duct branches with balancing damper. Provide branch dampers as noted.

2.4.6 Sub branch duct with 45 deg. entry and balancing damper on branch unless otherwise noted.

2.4.7 Transitions unless otherwise noted:

.1 Diverging: 20 deg. maximum included angle.

.2 Converging: 30 deg. maximum included angle.

2.4.8 Offsets: to SMACMA unless otherwise noted.

2.4.9 Obstruction deflectors: maintain full cross- sectional area. Maximum included angles as for transitions unless otherwise noted.

2.4.10 Exposed spiral duct joints: Butt joint as per details to satisfaction of Engineer.

2.5 Firestopping

2.5.1 Retaining angles around duct, on both sides of fire separation.

2.5.2 Firestopping material and installation must not distort duct.

2.6 Galvanized Steel

2.6.1 Lock forming quality: to ASTM A653, Z90 zinc coating.

2.6.2 Thickness, fabrication and reinforcement: to SMACNA.

2.6.3 Joints: to SMACNA.

2.6.4 Round:

.1 Exposed and concealed 250dia and larger: single spiral wound.

.2 Concealed less than 250dia: snap lock acceptable alternate.

.3 All exposed: double spiral wound.

2.7 Proprietary Duct Joints

2.7.1 Proprietary manufactured flanged duct joint shall be considered to be a class A seal.

2.7.2 Acceptable material: Ductmate Canada Ltd. system for proprietary joints.

2.8 Hangers And Supports

2.8.1 Hidden ducts:

.1 Round to 500dia and rectangular to 300x200 strap hangers of same material as duct but next sheet metal thickness heavier.

.2 Rectangular ducts larger than 300 x 200 galvanized steel angle with galvanized steel rods to ASHRAE and SMACNA except where SRS required provide angle hangers to SMACNA.

.3 For round ducts 700dia and larger double hanger with formed 6mm thk steel saddle.

2.8.2 Exposed ducts: angle hangers for rectangular,

.1 Rectangular: angle hangers

.2 Round ducts 400 dia and smaller see details.

.3 Round ducts greater than 400dia double hanger with formed 6mm thk steel saddle. Where SRS required for ducts over 700dia provide angle hangers.

2.8.3 Angle hangers to meet the requirements of the following table:

Duct Size	Angle Size	Rod Size

(mm)	(mm)	(mm)
up to 750	25x25x3	6
751 to 1050	40x40x3	6
1051 to 1500	40x40x3	10
1501 to 2100	50x50x3	10
2101 to 2400	50x50x5	10
2401 and over	50x50x6	10

2.8.4 General hanger installation: to SMACNA unless otherwise noted.

2.9 Upper Attachments

2.9.1 Steel channel, joist or angle (bottom):

.1 Malleable iron C clamp to ANSI/MSS SP-58-1983, type 23. ULC listed.

.2 Quick clip malleable steel with threaded rod insert.

2.9.2 Steel channel, joist or angle (top):

.1 Malleable iron top of beam C clamp to ANSI/MSS SP-58-1983, type 19. ULC listed.

.2 Quick clip malleable steel with threaded rod insert.

.3 Concrete:

.1 Insert type expanding anchor with 10dia internal threaded rod connection, galvanized steel, CSTB approved. ULC listed.

2.10 Middle Attachment (Rod)

2.10.1 Electro-galvanized carbon steel threaded rod material to MSS SP58.

PART 3 EXECUTION

3.1 General

3.1.1 Do work in accordance with SMACNA and as indicated.

3.1.2 Do not break continuity of insulation vapour barrier with hangers or rods. Insulate strap hangers 100 mm beyond insulated duct.

3.1.3 Support risers in accordance with SMACNA and as indicated

3.1.4 Install breakaway joints in ductwork on sides of fire separation.

3.1.5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

3.2 Ductwork Routing & Site Review

3.2.1 Duct work routing as shown on drawings is schematic. Provide all necessary ductwork offsets and fitting in order to route ductwork as indicated within the mechanical drawings.

3.2.2 Verify ductwork routing by review of mechanical and structural steel/architectural drawings prior to ordering and shipping major ductwork elements.

3.2.3 Where a minor conflict between ductwork and other mechanical or electrical services occurs the conflict is to be resolved by rerouting the service that requires the lesser amount of work at no additional cost to the Engineer.

3.2.4 Where a conflict between ductwork and the building structural elements occurs that could have been identified prior to ordering and shipping the duct work elements provide the required remedial work at no additional cost to the Engineer.

3.3 Hangers

3.3.1 Strap hangers: install in accordance with SMACNA.

3.3.2 Angle hangers: complete with locking nuts and washers.

3.3.3 Hanger spacing: in accordance with ASHRAE SMACNA.as follows:

Duct Size (mm)	**Spacing(Maximum) (mm)**
To 1500	3000
1501 and over	2500

3.3.4 Support flexible ducts on 1200 mm centres.

3.4 Watertight Duct

3.4.1 Provide watertight duct for:

.1 Outdoor air intake ducts from hood louvre to AS units.

3.4.2 Form bottom of horizontal duct without longitudinal seams. Solder joints of bottom and side sheets. Seal other joints with duct sealer.

3.4.3 Fit base of riser with 150 mm deep drain sump and 32 mm drain connected, with deep seal trap and valve and discharging to open funnel drain.

3.5 Sealing

3.5.1 Concealed ducts: apply sealant to outside of duct joint to manufacturer's recommendations.

3.5.2 Exposed ducts: Apply silicone sealant to satisfaction of engineer. Sealant to be suitable for painting. See Arch. In lieu provide standard duct sealant and beauty rings.

3.6 Taping

3.6.1 Acceptable at connection between flexible ducts and rigid. Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturers recommendations.

3.7 Service Access Doors

3.7.1 Provide duct service access doors as follows:

.1 To ensure that any section of duct is not more than 15m from the service access.

.2 At the base of all main risers.

.3 Upstream and downstream of the following:

.1 Turning vanes.

.2 At all fire/smoke and motorized dampers.

3.8 Duct Protection During Construction

3.8.1 Store all sheet metal prior to installation to protect them from moisture or dust damage.

3.8.2 Where terminal units have been contaminated by moisture or dust damage clean to the satisfaction of the Engineer.

3.8.3 Seal off all supply, return and exhaust air system openings to prevent the accumulation of dust and debris in the systems at all times unless work is being completed on the immediate area of the system using plastic seals to the approval of the Engineer. This is to include overnight and longer work stoppages. Seal all until ventilation system openings until testing, adjusting and balancing commences.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

1.1.1 Section 01300 - Submittals

1.2 References

1.2.1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

1.2.2 SMACNA HVAC Duct Construction Standards, Metal and Flexible.

1.3 Product Data

1.3.1 Submit product data in accordance with Section 01300 - Submittals

1.3.2 Indicate the following:

.1 Flexible connections.

.2 Duct access doors.

.3 Turning vanes.

1.4 Certification Of Ratings

1.4.1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

PART 2 PRODUCTS

2.1 General

2.1.1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 Flexible Connections

2.2.1 Frame: galvanized sheet metal frame with fabric clenched by means of double locked seams.

2.2.2 Material:

.1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40 deg.C to plus 90 deg.C, density of 1.3 kg/sq.m.

2.3 Access Doors In Ducts

2.3.1 Non-insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.

2.3.2 Insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.

2.3.3 Gaskets: neoprene.

2.3.4 Hardware:

.1 Up to 300 x 300 mm: 2 sash locks complete with safety chain.

.2 301 to 450 mm: 4 sash locks complete with safety chain.

.3 451 to 1000 mm: piano hinge and minimum 2 sash locks.

.4 Doors over 1000 mm: piano hinge and 2 handles operable from both sides.

.5 Acceptable material: Nailor Hart.

2.4 Turning Vanes

2.4.1 Factory or shop fabricated single thickness and double thickness with trailing edge, to recommendations of SMACNA and as indicated.

2.5 Instrument Test Ports

2.5.1 1.6 mm thick steel zinc plated after manufacture.

2.5.2 Cam lock handles with neoprene expansion plug and handle chain.

2.5.3 28 mm minimum inside diameter. Length to suit insulation thickness.

2.5.4 Neoprene mounting gasket.

2.6 Backdraft Dampers

2.6.1 Frame: construct of minimum 1.3 mm galvanized steel channel.

2.6.2 Blades: construct of minimum 0.6 mm aluminum, complete with stiffeners along trailing edge.

2.6.3 Fabricate single blade dampers for duct sizes to 240 mm, multi-blade dampers for ducts greater than 240 mm.

2.6.4 Provide full blade-length shafts complete with brass or nylon bearings.

2.6.5 Provide neoprene anti-clatter blade strips on pivot side of blades.

2.6.6 Construct blade connecting linkage of minimum 2.0 mm aluminum rod with eyelet, pin bearings, and adjustable counter weight to assist blade opening action.

2.6.7 Maximum blade length of 750 mm.

2.6.8 Backdraft damper suitable for 10 m/s face velocity.

2.7 Sealants

2.7.1 Comply with South Coast Air Quality Management District (SCAQMD) Rule #1168.

2.8 Air Duct Heater

2.8.1 Finned tube tubular element installed in a horizontal duct with thermal housing on side.

2.8.2 Finned tubular elements constructed using a steel tube with corrugated steel fin wrapped and brazed.

2.8.3 Capacity: See drawing

2.8.4 Heater frame construction:

.1 Flange type

.2 16 Gauge satin coat steel

2.8.5 Control:

.1 Duct thermostat: model T678A (Two stage)

.2 Silent contactors

.3 Air proving switch

.4 Main disconnect

2.8.6 Standard Features:

.1 Primary Linear cutout 160 deg F (71 deg C)

.2 Secondary linear cutout - manual reset complete with backup magnetic contactor on units.

2.8.7 Acceptable Material: E.H. Price

PART 3 EXECUTION

3.1 Installation

3.1.1 Flexible connections:

.1 Install in following locations:

.1 Inlets and outlets of all MUA.

.2 Inlets and outlets of inline EF.

.3 Elsewhere as indicated.

.2 Length of connection: 100 mm.

.3 Minimum distance between metal parts when system in operation: 25 mm.

.4 Install in accordance with recommendations of SMACNA.

.5 When fan is running:

.1 Ducting on each side of flexible connection to be in alignment.

.2 Ensure slack material in flexible connection.

.6 Access doors:

.1 Size:

.1 630 x 350 mm for person size entry.

.2 530 x 530 mm for servicing entry.

.3 300 x 150 mm for viewing.

.4 As indicated.

.2 Location:

.5 Upstream and downstream at fire and smoke dampers.

.6 Upstream and downstream at control dampers.

.7 Upstream and downstream at turning vanes.

.8 At devices requiring maintenance.

.9 At locations required by code.

.10 At heat coils, upstream and downstream of coil except at VAV boxes.

.11 Base of all main risers.

.12 On all main ducts at a maximum 12m interval.

.13 Elsewhere as indicated.

.3 Turning vanes:

.14 Install in accordance with recommendations of SMACNA and as indicated.

.4 Instrument test ports:

.15 Install in accordance with SMACNA and as per manufacture instructions.

.16 Locations: At inlet and outlet AHU, main and sub main ducts.

.5 Heating coils:

.17 Install as per manufacturers recommendation.

.18 Provide access doors upstream of all coils.

END OF SECTION

PART 1 GENERAL

1.1 Related Section

1.1.1 Section 01300 - Submittals

1.2 References

1.2.1 Sheet Metal and Air Conditioning National Association (SMACNA)

1.2.2 SMACNA HVAC Duct Construction Standards, Metal and Flexible.

1.3 Product Data

1.3.1 Submit product data in accordance with Section 01300 - Submittals

1.3.2 Indicate the following:

.1 Single blade dampers.

.2 Multiple blade dampers.

PART 2 PRODUCTS

2.1 General

2.1.1 Manufacture to SMACNA standards.

2.2 Balancing Dampers (Ducts less than 275mm Depth)

2.2.1 Single blade, butterfly type.

2.2.2 Metal thickness and construction to SMACNA.

2.2.3 10dia threaded rod, with washer and locking nut, 22mmODx14mmIDx required length PVC sleeve for insulated ducts.

2.2.4 Continuous MIG welded 10dia angle rod handle continuous for full length.

2.2.5 Handle to extend minimum 50mm from duct wall/insulation for uninsulated and insulated ducts to 25mm thickness and 25mm from insulation for 50mm thickness insulation.

2.3 Balancing Dampers (Ducts 240mm or Greater in Depth)

2.3.1 Factory manufactured of material compatible with duct.

.1 Opposed blade configuration, metal thickness and construction to recommendations of SMACNA.

2.3.2 Maximum blade height: 100 mm.

2.3.3 Bearings: self-lubricating nylon.

2.3.4 Linkage: shaft extension with locking quadrant.

2.3.5 Channel frame of same material as adjacent duct, complete with angle stop.

PART 3 EXECUTION

3.1 Installation

3.1.1 Install where indicated.

3.1.2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

3.1.3 For supply, return and exhaust systems, locate balancing dampers in each branch duct.

3.1.4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.

3.1.5 All dampers to be vibration free.

3.1.6 Ensure damper operators are observable and accessible.

3.1.7 Install where indicated.

3.1.8 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

1.1.1 Section 01300 - Submittals

1.1.2 Section 15820 - Air Duct Accessories.

1.2 References

1.2.1 American Society for Testing and Materials (ASTM)

1.2.2 SMACNA HVAC Duct Construction Standards, Metal and Flexible-1985.

1.3 Product Data

1.3.1 Submit product data in accordance with Section 01300- Submittals

1.3.2 Provide for all operating dampers.

1.4 Certification Of Ratings

1.4.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency.

PART 2 PRODUCTS

2.1 General

2.1.1 Manufacture to SMACNA standards.

2.2 Thermally Broken Dampers

2.2.1 Frame: extruded 6063T5 steel, 2.03mm thick, 101.6mm deep, insulated with styrofoam on three sides for duct mounting and four sides for flanged mounting.

2.2.2 Blades: extruded 6063T5 aluminum, internally insulated with expanded polyurethane foam, thermally broken, minimum insulation value 0.4RSI.

2.2.3 Blade and Frame Seals: extruded silicone secured in integral slot with aluminum extrusions.

2.2.4 Bearings: celcon inner bearing, 11mm aluminum hexagon blade pin, polycarbonate outer bearing.

2.2.5 Linkage: frame side, aluminum and corrosion resistant zinc plated steel with slip proof cup-point trunion screws. Blade linkage hardware to be installed out of air-stream.

2.2.6 Jack shaft assemblies: to be provided for multiple damper installations.

2.2.7 Operating temperature range: -40degC to 100degC.

2.2.8 Leakage: 25L/s/m2 at 1kPa differential static pressure at -40degC.

2.2.9 Pressure drop: full open 1200x1200 damper not to exceed .007kPa at 5.08m/s.

2.2.10 Certification: AMCA 511.

2.2.11 Application:

.1 O/A and E/A dampers: opposed blade.

2.2.12 Mounting:

.1 Flanged to duct.

2.2.13 Acceptable material:

.1 TAMCO Series 9000 SC Thermally Insulated Damper.

PART 3 EXECUTION

3.1 Installation

3.1.1 Install where indicated.

3.1.2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

3.1.3 Seal multiple damper modules with silicon sealant.

3.1.4 Install access door adjacent to each damper where specified. See Section 15820 - Air Duct Accessories.

3.1.5 Ensure dampers are observable and accessible.

END OF SECTION

PART 1 GENERAL

1.1 Related Section

1.1.1 Section 01300 - Submittals

1.1.2 Section 01780 - Contract Closeout

1.2 References

1.2.1 ANSI/NFPA 90A Installation of Air Conditioning and Ventilating Systems.

1.2.2 CAN/ULC-S112-M90, Fire Test of Fire Damper Assemblies.

1.2.3 ULC-S505, Fusible Links for Fire Protection Service.

1.3 Product Data

1.3.1 Submit product data in accordance with Section 01300 - Submittals.

1.3.2 Provide for the following:

.1 Fire dampers.

.2 Fire damper mounting details.

1.4 Extra Materials

1.4.1 Provide maintenance materials in accordance with Section 01700 - Contract Closeout.

1.4.2 Provide following:

.1 6 fusible links of each type.

.2 Spare fusible links to facilitate fire damper drop tests as required.

1.5 Certification Of Ratings

1.5.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

PART 2 PRODUCTS

2.1 Fire Dampers

2.1.1 Fire dampers: ULC listed and bear label of ULC meet requirements of territorial fire authority and ANSI/NFPA 90A-1999.

2.1.2 Types:

.1 Type 1: curtain in air stream.

.2 Type 2: curtain out of air stream.

.3 Fabrication:

.1 General: Mild steel factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.

.2 Stainless steel or chemical resistant PVC ducts: Stainless steel factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.

.4 Top hinged: round or square; multi-blade hinge or guillotine type; sized to maintain full duct cross section unless otherwise required due to clearances.

.5 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.

.6 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.

.7 Acceptable material: Controlled Air.

PART 3 EXECUTION

3.1 Installation

3.1.1 Install in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing.

3.1.2 Maintain integrity of fire separation.

3.1.3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.

3.1.4 Install access door adjacent to each damper. See Section 15820 - Air Duct Accessories .

3.1.5 Coordinate with installer of firestopping.

3.1.6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.

3.1.7 Install break-away joints of approved design on each side of fire separation.

3.1.8 Type 2 FD to be provided except where alternate Type 1 approved by Engineer.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

1.1.1 Section 01300 - Submittals

1.1.2 Section 01700 - Contract Closeout.

1.1.3 Section 15095 - Mechanical Startup.

1.1.4 Section 15820 - Air Duct Accessories.

1.2 References

1.2.1 AMCA 99-1986, Standards Handbook.

1.2.2 ANSI/AMCA 210-1985, Laboratory Methods of Testing Fans for Rating.

1.2.3 AMCA 300-1985 Revised 1987, Reverberant Room Method for Sound Testing of Fans.

1.2.4 AMCA 301-1990, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

1.2.5 ANSI/ASHRAE 51- 2001, Laboratory Methods of Testing Fans for Rating.

1.2.6 CGSB 1-GP-181M-77, Coating, Zinc Rich, Organic, Ready Mixed.

1.2.7 CAN/CGSB-1.181-99, Coating, Zinc Rich, Organic, Ready Mixed.

1.2.8 CSA C22.2-94. 113 Fans & Ventilators.

1.3 Shop Drawings And Product Data

1.3.1 Submit shop drawings and product data in accordance with Section 01300 - Submittals

1.3.2 Product data to include fan curves and sound rating data, showing point of operation.

1.4 Extra Materials

1.4.1 Provide maintenance materials in accordance with Section 01700 - Contract Closeout.

1.4.2 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

1.5 Manufactured Items

1.5.1 Catalogued or published ratings shall 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.

PART 2 PRODUCTS

2.1 Fans General

2.1.1 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.

2.1.2 Sound ratings: comply with AMCA 301, tested to AMCA 300. Unit shall bear AMCA certified sound rating seal.

2.1.3 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210, and ANSI/ASHRAE 51. Unit shall bear AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

2.1.4 Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards, coupling guards fan inlet safety screens and inlet dampers and vanes as indicated.

2.1.5 Factory primed before assembly in colour standard to manufacturer.

2.2 Super Quiet Cabinet Fans

2.2.1 Wall mounted construction: acoustically insulated galvanized steel.

2.2.2 Fan: Energy star rated, super quiet, in line, totally enclosed condenser motor

2.2.3 Motor: built in thermal overload, 120v/1ph/60Hz.

2.2.4 Capacity: Refer to Schedule

2.2.5 Acceptable material: Refer to Schedule

2.3 Belt Drive In-Line Centrifugal Fans

2.3.1 Characteristics and construction: centrifugal fan wheels, with axial flow construction.

2.3.2 Casing: heavy gauge galvanized steel, square design, duct mounting collars, removable access panels, 25 mm thick acoustic lining with spark proof construction.

2.3.3 Fan: centrifugal backward inclined, aluminum, wheel cone, statically and dynamically balanced.

2.3.4 Motors: VFD rated heavy duty ball bearing type, belt driven, motor outside of air stream.

2.3.5 Bearings: permanently lubricated and sealed pillow block bearing.

2.3.6 Drives: belt driven. Belt driven drives to be rated to 150% of driven horsepower, adjustable sheaves.

2.3.7 Fans to bear AMCA ratings seal for sound and air performance.

2.3.8 Vibration Isolation: Manufacturer supplied open spring type with sound deadening pads.

2.3.9 Option: Packaged inline fan and filter box to come in galvanized and 1" aluminum mesh.

2.3.10 Power: As indicated on drawings

2.3.11 Coating: Hi-Pro Polyester

2.3.12 Acceptable material: Greenheck (see schedules)

2.3.13 Schedule: Refer to Schedule

PART 3 EXECUTION

3.1 Fan Installation

3.1.1 Install fans as indicated, complete with vibration isolation.

3.1.2 Provide sheaves and belts required for final air balance.

3.1.3 Bearings and extension tubes to be easily accessible.

3.1.4 Access doors and access panels to be easily accessible.

3.1.5 Install fans with 100 mm flexible connection on inlet ductwork and on discharge ductwork. Ensure metal bands of connectors are parallel with minimum 25 mm flex between ductwork and fan during running.

3.1.6 Install fan restraining snubbers as indicated.

3.1.7 Flexible connections shall not be in tension when fan running.

3.2 Construction Use Of Fans

3.2.1 Construction use of permanent fans for ventilation, heating, de-humidification, humidification, dust control or any other use is strictly prohibited.

3.2.2 Startup of the fans can only occur after all ducts installed and cleaned and building and systems are completed to the pre-requisite requirements for commencing Testing Adjusting and Balancing as specified in Section 15950.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

1.1.1 Section 01300 - Submittals

1.2 References

1.2.1 American National Standards Institute (ANSI)/ National Fire Protection Association (NFPA)

1.2.2 American Society for Testing and Materials (ASTM):

.1 ASTM E 90-02, Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.

1.2.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):

.1 SMACNA HVAC Duct Construction Standards.

1.2.4 Society of Automotive Engineers (SAE)

1.2.5 AMCA-Air Movement and Control Association Inc.

1.3 Product Data

1.3.1 Submit product data in accordance with Section 01300 - Submittals

1.3.2 Indicate the following:

.1 Louvres.

1.4 Test Reports

1.4.1 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E90.

1.5 Certification Of Ratings

1.5.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

PART 2 PRODUCTS

2.1 Hoods

2.1.1 Thickness: to ASHRAE and as indicated on drawings which ever is more stringent.

2.1.2 Fabrication: to ASHRAE and as indicated on drawings whichever is more stringent.

2.1.3 Joints: to ASHRAE. Proprietary manufactured flanged duct joint shall be considered to be a class A seal and as indicated on drawings whichever is more stringent.

2.1.4 Supports: as indicated.

2.1.5 Complete with integral bird screen of 2.7 mm diameter ss wire. Use 12 mm mesh on exhaust.

2.1.6 Vertical backdraft dampers where indicated on drawings.

2.1.7 Finish: Galvanized

2.2 Fixed Louvres

2.2.1 Construction: welded with exposed joints ground flush and smooth.

2.2.2 Material: extruded aluminum alloy.

2.2.3 Blade: storm proof pattern with centre watershed in blade, reinforcing bosses and maximum blade length to 1500 mm.

2.2.4 Frame, head, sill and jamb: 150 deep one piece extruded aluminum, minimum 3 mm thick with approved caulking slot, integral to unit.

2.2.5 Mullions: at 1500 mm maximum centres.

2.2.6 Fastenings: stainless steel (Society of Automotive Engineers) SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.

2.2.7 Screen: 19 mm exhaust intake mesh, 2 mm dia wire aluminum bird screen on inside face of louvres in formed U-frame.

2.2.8 Finish: factory applied enamel, prime coated anodized. Coordinate colour: with Engineer prior to fabrication.

2.2.9 Size: Refer to drawings

2.2.10 Acceptable Material: EH.Price Airolite K6776X.

PART 3 EXECUTION

3.1 Installation

3.1.1 In accordance with manufacturers and SMACNA recommendations.

3.1.2 Coordinate flashings and counter flashings with architectural.

3.1.3 Anchor securely into opening. Seal with caulking around to ensure weather tightness.

3.1.4 All curb mounted hoods to be provided with additional angle mounting. Provide min 32x32x3 angle screwed to hood and roof curb as per drawing details.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

1.1.1 Section 01300 - Submittals

1.2 Product Data

1.2.1 Submit product data in accordance with Section 01300 - Submittals

1.2.2 Indicate the following:

.1 Capacity.

.2 Throw and terminal velocity.

.3 Noise criteria.

.4 Pressure drop.

.5 Neck velocity.

.6 Details of custom manufacturer.

.7 Finish.

1.3 Certifications

1.3.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

1.4 Manufactured Items

1.4.1 Grilles, registers and diffusers shall be product of one manufacturer for a specified service.

PART 2 PRODUCTS

2.1 Standard Grilles And Diffusers

2.1.1 Product to meet capacity, pressure drop, terminal velocity, throw, noise level and neck velocity as indicated.

2.1.2 Colour: as per schedule.

2.1.3 Type and size: as per schedule.

2.1.4 Acceptable material: E.H.Price.

PART 3 EXECUTION

3.1 Installation

3.1.1 Install in accordance with manufacturer’s instructions.

3.1.2 Install with flat head screws in countersunk holes where fastenings are visible.

3.1.3 Bolt grilles, registers and diffusers, in place, in gymnasium and similar game rooms and provide concealed safety chain on each grille, register and diffuser and elsewhere as indicated.

3.1.4 All prime coated grilles and diffusers to be painted to match Architectural finishes.

3.1.5 All grilles and diffusers to be all aluminum construction unless otherwise noted.

3.1.6 Provide grille/diffuser mounted dampers where indicated on drawings. All dampers to be finished in matt black.

3.2 Protection Of Grilles And Diffusers During Construction

3.2.1 Store all materials prior to installation to protect them from moisture or dust damage.

3.2.2 Where grilles and diffusers have been contaminated by moisture or dust damage clean to the satisfaction of the Engineer.

3.2.3 Seal off all supply, return and exhaust air system openings to prevent the accumulation of dust and debris in the systems at all times unless work is being completed on the immediate area of the system using plastic seals to the approval of the Engineer. This is to include overnight and longer work stoppages. Seal all diffusers, grilles, and displacement ventilators in plastic until ventilation system testing, adjusting and balancing commences.

END OF SECTION

PART 1 GENERAL

1.1 Related Section

1.1.1 Section 01300 - Submittals.

1.1.2 Section 01700 - Contract Closeout.

1.2 Description Of Systems

1.2.1 Provide complete operating systems indicated herein and on the mechanical drawings.

1.2.2 Systems include:

.1 Ventilation systems

1.3 References

1.3.1 Canadian Standards Association (CSA)

.1 CSA C22.2-94. 0-M91, Canadian Electrical Code, Part II, General Requirements.

.2 CAN/CSA-Z234.1-89, Canadian Metric Practice Guide.

1.3.2 American National Standards Institute (ANSI)

.1 ANSI/ISAS5.5-1985, Graphic Symbols for Process Displays.

.2 ANSI/IEEE260-1978, Letter Symbols for SI and Certain Other Units of Measurements.

1.4 Shop Drawings Review

1.4.1 Submit in accordance with section 01300 - Submittals within 30 days of award of contract.

1.4.2 Include:

.1 Specification sheets for each item. To include manufacturer's descriptive literature, specification, drawings, diagrams, performance and characteristic curves, catalog cuts, manufacturer's name, trade name, catalog or model number, nameplate data, size, layout, dimensions, capacity, all other data to establish compliance.

.2 General logic diagrams and description.

.3 Controller locations.

.4 Panel layouts.

.5 Control cabinet locations.

.6 Schematic single line diagrams showing cable routing's, conduit sizes, field controllers and systems being controlled, panel layouts.

.7 Dampers: schedule listing operator locations, damper sizes, spring return.

1.5 Standard Compliance

1.5.1 All equipment and material to be from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.

1.5.2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.

1.5.3 Submit proof of compliance to specified standards with shop drawings and product data. Label or listing of specified organization is acceptable evidence.

1.5.4 In lieu of such evidence, submit certificate from testing organization, approved by Engineer, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.

1.5.5 For materials whose compliance with organizational standards/codes/specifications is not regulated by an organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard.

1.6 Qualifications

1.6.1 Control equipment supply and system design shall be developed by qualified contractor using specified manufacturers unless otherwise specified.

1.6.2 Installation of controls to be by approved controls installation firm. All work is to be performed by personnel under the direct supervision of this firm.

1.6.3 Controls contractor to have prior knowledge in the installation and maintenance of electro-mechanical control systems.

PART 2 PRODUCTS

2.1 General

2.1.1 Provide all wiring, conduit, relays, starters, electronics, etc., not indicated or specified but required for a complete and functional automatic control system.

2.1.2 Location of controllers and panels not as per drawing locations to be approved by Owner prior to installation.

2.1.3 All scales to be in degrees Celsius.

2.1.4 Operating range to suit application range.

2.2 Temperature Sensors

2.2.1 General: resistance or thermocouple type to following requirements:

.1 Sensing element: hermetically sealed.

.2 Stem and tip construction: copper or type 304 stainless steel.

.3 Time constant response: less than 3 seconds to temperature change of 10 degrees C.

.4 Room temperature sensors and display wall modules.

.5 Temperature sensing and display wall module.

.1 LCD display to show space temperature and temperature setpoint.

.2 Room temperature sensors.

.3 Wall mounting.

2.3 Control Panels

2.3.1 Fabrication: finished steel cabinet type for surface or recessed mounting as indicated, locking handle and gaskets.

2.3.2 Approvals: CSA approved construction.

2.3.3 Finish and mounting:

.1 Blue cover, grey cabinet, white backplate. Surface mounted.

2.3.4 Size:

.1 General:Where panel size inadequate for controllers specified provide two or more connected cabinets as required. For recessed panels minimize panel size and panel depth to be suitable for installation in nominal 100mm thick steel stud wall.

.2 Mechanical Rooms: max acceptable size 750mmx900mm.

2.3.5 Wiring: all wiring to be thru common terminal strip(s) located within cabinet.

2.3.6 Test/control buttons: intermittent push button type and size as indicated.

2.4 Transformers

2.4.1 Provide CSA approved transformers of required kVa and voltage.

2.5 Selector Switches

2.5.1 General: CSA approved, standard hand knob, non illuminated, gasketted, heavy duty.

2.5.2 Type: 2 or 3 position as indicated.

2.5.3 Contacts and Throws: as required.

2.5.4 Voltage: as required.

2.5.5 Acceptable material: Square D, Allen Bradley.

2.6 Pushbutton Switches

2.6.1 General: CSA approved, spring return, gasketted, full guard, heavy duty.

2.6.2 Contacts and Throws: as required.

2.6.3 Voltage: as required.

2.6.4 Acceptable material: Square D, Allen Bradley.

2.7 Pilot Lights

2.7.1 General: CSA approved, neon or LED, gasketted, spring return push to test, heavy duty.

2.7.2 Size:30.5mm

2.7.3 Colour: as indicated.

2.7.4 Voltage: as required.

2.7.5 Acceptable material: Square D, Allen Bradley.

2.8 Wiring

2.8.1 To requirements of Division 16.

2.9 Conduit

2.9.1 To requirements of Division 16.

2.10 Terminations, Boxes

2.10.1 To requirements of Division 16.

2.11 Control Relays And Transducers

2.11.1 Control relays and analog output transducers shall be compatible with PCP output signals. Relays shall be suitable for the loads encountered. Analog output transducers shall be designed for precision closed loop control with repeatability error no greater than 1 1/2%.

2.12 Airflow Sensors

2.12.1 Analog velocity pressure, and static pressure transmitter.

2.13 Fan System Static Pressure Sensors

2.13.1 Requirements:

.1 Multipoint element with self-averaging manifold.

.1 Maximum pressure loss: 160 Pa at 10 m/s. (Air stream manifold).

.2 Accuracy: plus or minus 1% of actual duct static pressure.

2.14 Fan System Static Pressure Transmitters

2.14.1 Solid state piezoresistive silicon suitable for the measured medium, range and pressures of the application, with adjustable span and zero, accuracy of plus or minus 1 percent of span, linearity and hysteresis of plus or minus 0.1 percent of span, and repeatability of 0.25 percent of span.

2.15 Electronic Control Damper Operators

2.15.1 Requirements:

.1 Rotating direct drive proportional type.

.2 Spring return for "fail-safe" in Normally Open or Normally Closed position as indicated.

.3 Operator: size so as to control dampers against maximum pressure or dynamic closing pressure (whichever is greater). Parallel mounting as integral unit is acceptable.

.4 Power requirements: 5 VA maximum at 24 V AC.

.5 Operating range: 0 - 20 V DC.

PART 3 EXECUTION

3.1 Installation

3.1.1 Install all systems and hardware in accordance with the requirements of this specification, good controls practice and the requirements of Division 16.

3.1.2 Install all equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.

3.1.3 Follow building lines.

3.1.4 Run all systems exposed and do not pass thru or touch un-heated ducts or enclosures.

3.1.5 Locate thermostat sensors 1500 mm above floor as indicated. When conflict occurs follow Engineer's instructions.

3.1.6 All wiring to be in conduit. Wiring conduit connections and fittings to be as per the requirements of Division 16.

3.1.7 Wiring of line voltage mechanical equipment as per Division 16.

3.2 Electrical General

3.2.1 Complete installation in accordance with requirements of:

.1 Division 16, this specification.

.2 Electrical safety Code of Province/Territory having jurisdiction.

.3 ANSI/NFPA 70-1996SB.

.4 ANSI C2-1997.

3.2.2 Fully enclose or properly guard electrical wiring, terminal blocks, all high voltage above 70 V contacts and mark to prevent accidental injury.

3.2.3 Conform to all manufacturer's recommendations for storage, handling and installation.

3.2.4 Check all factory connections and joints. Tighten where necessary to ensure continuity.

3.2.5 Install electrical equipment between 1000 and 2000 mm above finished floor wherever possible and adjacent to related equipment.

3.2.6 Shield and mark all live parts "LIVE 120 VOLTS" or other appropriate voltage.

3.2.7 Holes through exterior wall and roofs: flash and make weatherproof.

3.2.8 All digital controllers to be connected to dedicated surge and transient protected power supply. Reference Division 16.

3.3 Special Supports

3.3.1 Provide all special steelwork as required for installation of work at no additional cost.

3.4 Initial Start-Up And Pre Testing Report

3.4.1 One week prior to system Testing contractor is to start up all control systems and provide written report detailing results of initial start up.

3.4.2 Report is to detail any outstanding deficiencies, operating difficulties and how these items affect the present building operations.

3.4.3 Copy of report to be forwarded to Consultant.

3.5 Testing General

3.5.1 Testing to include:

.1 Acceptance testing and verification of all systems.

.2 Perform work under direction of, and in presence of, Owner or their representative where indicated.

.3 Provide all test equipment, two-way radios.

.4 Inform, and obtain approval from Owner in writing at least 14 days prior to tests. Indicate:

.1 Testing procedures, anticipated results.

.2 Names of testing personnel.

.5 Co-ordinate with all other trades.

.6 Correct deficiencies, re-test in presence of Owner until satisfactory performance is obtained.

.7 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.

3.6 Acceptance Tests

3.6.1 Upon completion of installation, perform operational test of entire system under direction of Owner or their representative.

3.6.2 Purpose: to demonstrate that control system functions in accordance with all contract requirements.

3.6.3 System is accepted if control system and devices operate as per intent of specifications and drawings to the satisfaction of the Owner.

3.6.4 Correct all defects when they occur and before resuming test.

3.7 Field Mounted Transmitters And Sensors

3.7.1 Support properly on pipe stands or channel brackets.

3.7.2 Install wall mounted devices on backing plate or junction box attached properly to wall.

3.7.3 Mounting height as per Architectural or where not indicated at 1250mm AFF.

3.8 Temperature Sensors

3.8.1 Stabilize to ensure minimum field adjustments or calibrations.

3.8.2 To be readily accessible and adaptable to each type of application so as to allow for quick easy replacement and servicing without special tools or skills.

3.8.3 Outdoor installation:

.1 Protect from solar radiation and wind effects by stainless steel shields.

.2 Install in NEMA12 enclosures.

3.8.4 Duct installations:

.1 Do not mount in dead air space.

.2 Location to be within sensor vibration and velocity limits.

.3 Securely mount extended surface sensor used to sense average temperature.

.4 Thermally isolate elements from brackets and supports so as to respond to air temperature only.

.5 Support sensor element separately from coils, filter racks.

3.8.5 Averaging duct type temperature sensors:

.1 Sensor length to be not less than 1000 mm for each square metre of duct cross-sectional area.

.2 Use multiple sensors where single sensor does not meet minimum length ratio. Wire multiple sensors in parallel for freeze protection applications.

.3 Wire multiple sensors separately for temperature measurement.

.4 Use either software averaging algorithm to derive overall average for control purposes or separate inputs, based on site requirements.

3.9 Panels

3.9.1 Arrange for conduit and tubing entry from top, bottom or either side.

3.9.2 Use modular multiple panels if necessary to handle all requirements, with space for additional 20% PCU or FID if applicable without adding additional panels. Space to accommodate maximum capacity of associated controller (ECU, LCU, MCU, PCU, TCU).

3.9.3 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.

3.9.4 Identify all wiring and conduit clearly.

3.10 Control Logic - Electric Heating Coil

3.10.1 Electric duct mounted temperature sensors included with heating coil package with two stages to satisy supply air temperature setpoint.

3.10.2 Initial setpoint = 16 deg C

3.11 Control Logic - Terminal Heat

3.11.1 Unit Heaters:

.1 Line voltage thermostat cycles blower to satisfy setpoint.

.2 Initial setpoint = 20 deg C.

3.12 Control Logic - Domestic Water

.1 Domestic Hot water

.1 Domestic hot water heater packaged temperature controller to cycle to satisfy setpoint. Initial setpoint = 40 deg C.

3.13 Control Logic – Ventilation And Heating

3.13.1 General System 1:

.1 The direct fired make up air unit (MUA-701) will provide ventilation air to lower levels of the building. It will operate as 100% outdoor air system. The system will be controlled by the PLC.

.2 The ventilation system is to operate at all times to ensure the building is available at any time and to supply ventilation air to 6 to 12 air changes per hour.

.3 The ventilation system is variable volume based on air quality, occupancy and space temperature using a variable frequency drive fan motors (VFD). During normal operation, the MUA-701 will operate at low speed; however, when there is a call for cooling, the temperature sensor located on the wall in either of the two zones (Service or Lower floor level) energizes the Variable air volume terminal unit (VAV) and the VAV opens to satisfy thermostat. Once the temperature sensor is satisfied the VAV returns to original operating position and the VFD fan motors return to normal operating flow of 6 ACH.

.4 A gas detector will be installed in the lower level supplied by DIV 16. In the event the gas detector is activated, AS-1 will enter into high speed mode until the gas detector is satisfied.

.2 Exhaust fan (EF) Control:

.1 The EF-703 is to be interlocked the MUA-701 to provide exhaust air from the lower floor. The EF-702 is equipped with a variable speed drive motor (VFD) and to operate at a speed of 5% less than the MUA-701.

.3 DFMUA Control:

.1 DFMUA to operate at all times and comes complete with a packaged control unit and variable frequency (VFD) drive motor. The unit to move from low to high speed mode by a pressure sensor located upstream in ductwork. During low speed mode if any zone (Service or lower floor) calls for more volume of air, the MUA-701 VFD motor to ramp to satisfy pressure. Initial setpoint: 0.5 inches of w.c.

.4 Air System Alarms: The following conditions will cause an alarm signal to the PLC:

.1 Any of the fans are operating outside their normal parameters for two minutes.

.2 Any of the temperatures sensors detecting temperatures outside their normal parameters for fifteen minutes.

.3 The following conditions will cause a trouble signal to PLC:

.1 The differential pressure sensors across the filters detect a pressure drop outside their normal range.

3.13.2 General System 2:

.1 The direct fired make up air unit (MUA-701) will provide ventilation air to lower levels of the building. It will operate as 100% outdoor air system. The system will be controlled by the PLC.

.2 The ventilation system is to operate at all times to ensure the building is available at any time and to supply ventilation air to 6 to 12 air changes per hour.

.3 The AS is variable volume based on air quality, occupancy and space temperature using a variable frequency drive fan motors (VFD). During normal operation, the MUA-701 will operate at low speed; however, when there is a call for cooling, the temperature sensor located on the wall in either of the two zones (Service or Lower floor level) energizes the Variable air volume terminal unit (VAV) and the VAV opens to satisfy thermostat. Once the temperature sensor is satisfied the VAV returns to original operating position and the VFD fan motors return to normal operating flow of 6 ACH.

.4 A gas detector will be installed in the lower level supplied by DIV 16. In the event the gas detector is activated, AS-1 will enter into high speed mode until the gas detector is satisfied.

.2 Exhaust fan (EF) Control:

.1 The EF-703 is to be interlocked the MUA-701 to provide exhaust air from the lower floor. The EF-702 is equipped with a variable speed drive motor (VFD) and to operate at a speed of 5% less than the MUA-701.

.3 DFMUA Control:

.1 DFMUA to operate at all times and comes complete with a packaged control unit and variable frequency (VFD) drive motor. The unit to move from low to high speed mode by a pressure sensor located upstream in ductwork. During low speed mode if any zone (Service or lower floor) calls for more volume of air, the MUA-701 VFD motor to ramp to satisfy pressure. Initial setpoint: 0.5 inches of w.c.

.4 Air System Alarms: The following conditions will cause an alarm signal to the PLC:

.1 Any of the fans are operating outside their normal parameters for two minutes.

.2 Any of the temperatures sensors detecting temperatures outside their normal parameters for fifteen minutes.

.3 The following conditions will cause a trouble signal to PLC:

.1 The differential pressure sensors across the filters detect a pressure drop outside their normal range.

END OF SECTION

PART 1 GENERAL

1.1 Related Section

1.1.1 Section 01700 - Contract Closeout.

1.2 General

1.2.1 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2.2 Do TAB over entire operating range in accordance with most stringent conditions of this specification and standards of the following organizations:

.1 AABC Associated Air Balance Council.

.2 ASHRAE.

1.3 Qualifications Of Tab Agency & Personnel

1.3.1 General:

.1 All work described in this section to be performed by qualified TAB Agency. The TAB agency company is to be independent in business to all other Contractors engaged on this project.

.2 Agency and all personnel to be current members in good standing of AABC certified to perform specified services unless otherwise noted.

1.3.2 Certification:

.1 Submit to Engineer TAB agency and personnel for approval within 90 days after award of Contract.

.2 Certification documentation to confirm qualifications, experience of TAB Agency personnel.

1.4 Quality Assurance

1.4.1 Perform TAB under direction of supervisor qualified by AABC and to standards of AABC.

1.5 Adequacy Of Systems For Tab

1.5.1 TAB Agency to review contract documents before construction work is started and confirm in writing to Engineer adequacy of provisions for TAB and all other aspects of installation pertinent to TAB.

1.5.2 Submit to Engineer for review a minimum 14 days prior to site construction work commencing on the mechanical systems.

1.6 Purpose Of Tab

1.6.1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads.

1.6.2 Adjust and regulate equipment and systems so as to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

1.6.3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.7 Exceptions

1.7.1 TAB of systems and equipment regulated by codes, standards to be to satisfaction of authority having jurisdiction.

1.8 Co-Ordination

1.8.1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule so as to ensure completion before acceptance of project.

1.8.2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.8.3 Co-ordinate all work specified in this Section.

1.8.4 Provide all facilities required by TAB Agency in order to carry out work of this Section.

1.9 Pre-Tab Review

1.9.1 Review contract documents before project construction is started confirm in writing to Engineer within 90 days of contract award adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.

1.9.2 Review specified standards and report to Engineer in writing all proposed procedures which vary from standard.

1.9.3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.10 Start-Up

1.10.1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.

1.10.2 Follow special start-up procedures specified elsewhere.

1.11 Operation Of Systems During Tab

1.11.1 Operate systems for length of time required for TAB and as required by Engineer for verification of TAB reports.

1.12 Start Of Tab

1.12.1 Notify Engineer 21 days prior to start of TAB.

1.12.2 Start TAB when building is essentially completed, including:

.1 Installation of ceilings, doors, windows, other construction affecting TAB.

.2 Application of weather stripping, sealing, caulking.

.3 All pressure, leakage, other tests specified elsewhere.

.4 All provisions for TAB installed and operational.

1.12.3 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:

.1 Proper thermal overload protection in place for electrical equipment.

.2 Air Systems:

.1 Filters in place and in clean condition.

.2 Duct systems clean of debris.

.3 Air shafts, ceiling plenums are airtight to within specified tolerances.

.4 All duct cleaning is completed and accepted by the Engineer.

.5 Correct fan rotation.

.6 Fire and volume dampers in place and open.

.7 Access doors closed and duct end caps in place.

.8 All outlets installed and connected.

1.13 Application Tolerances

1.13.1 Do TAB to following tolerances of design values:

.1 HVAC systems: Plus or minus 10%.

1.14 Accuracy Tolerances

1.14.1 Measured values to be accurate to within plus or minus 5 % of actual values.

1.15 Instruments

1.15.1 Prior to TAB, submit to Engineer list of instruments to be used together with serial numbers.

1.15.2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

1.15.3 Calibrate within 3 months of TAB. Provide certificate of calibration to Engineer.

1.16 Tab Agenda

1.16.1 Submit TAB agenda to Engineer minimum 21 days prior to start of TAB.

1.16.2 Commence TAB only upon receipt of approval of agenda.

1.16.3 Agenda to include the following:

.1 Methodology and procedures.

.2 Check lists and report forms less field data.

.3 List of instrumentation, including details and certificates of calibration.

.4 General schedule.

1.17 Preliminary Tab Report

1.17.1 Submit for checking and approval of Engineer, 14 days prior to Interim inspection and submission of formal TAB report on completion of preliminary TAB draft copy of TAB report. Include:

.1 Format to be in accordance with TAB referenced organization standard, but using SI units.

.2 Report to be in English.

.3 Report to include record full system schematics prepared utilizing ACAD R14 or approved alternate showing results of TAB. All data to be provided in tabular format utilizing Excel or Lotus spread sheets.

.4 Details of instruments used.

.5 Details of TAB procedures employed.

.6 Calculations procedures.

.7 Summaries.

1.17.2 Submit 6 copies of TAB Report to Engineer for approval, in D-ring binders, complete with index tabs.

1.18 Tab Report

1.18.1 Format to be in accordance with referenced standard and standards of preliminary draft report.

1.18.2 Provide any changes identified in the review of the draft report and any subsequent updates identified on site during the certification and site review process.

1.18.3 Submit 6 copies of TAB Report to Engineer for approval.

1.19 Verification

1.19.1 Reported results subject to verification by Engineer and Commissioning Agent as element of Commissioning Process where included.

1.19.2 Provide manpower and instrumentation to verify up to 30 % of reported results.

1.19.3 Number and location of verified results to be at discretion of Engineer and Commissioning Agent.

1.19.4 Bear costs to repeat TAB as required to satisfaction of Engineer.

1.19.5 Provide for personnel to be on site during Commissioning to complete the verification procedures.

1.20 Minimum Site Review Attendance

1.20.1 Provide for TAB personnel to be on site during the complete execution of the following minimum site activities in addition to site activities associated with completion to technical TAB:

.1 During construction at 50% complete

.2 Building startup.

.3 Substantial completion

1.21 Settings

1.21.1 After TAB is completed to satisfaction of Engineer, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.

1.21.2 Permanently mark settings to allow restoration at any time during life of facility. Markings not to be eradicated or covered in any way.

1.22 Completion Of Tab

1.22.1 TAB to be considered complete when final TAB Report received and approved by Engineer.

1.23 Air Systems

1.23.1 General: measurements as required by referenced organization standards, including, but not limited to, following:

- .1 Measurements:
  - .1 Air velocity.
  - .2 Static pressure.
  - .3 Velocity pressure.
  - .4 Temperature:
    - .1 Dry bulb.
    - .2 Wet bulb.
  - .5 Cross sectional area.
  - .6 RPM.
  - .7 Electrical power:
    - .1 Voltage
    - .2 Current draw.
    - .3 Size.
  - .8 Noise.
  - .9 Vibration.
  - .10 Pressure.
- .2 Location of equipment measurements:
  - .1 Inlet and outlet of each:
    - .1 Fans.
      - .1 All EF, transfer air and cooling fans: design flow
      - .2 AHU: measurements at design load.
    - .2 Coils.
    - .3 Filters.
    - .4 Main branch dampers and control dampers.
  - .2 Location of system measurements at:
    - .1 Main ducts, main branches and sub-branches.

.2 Supply outlets.

.3 Exhaust inlets.

.4 Ducted return inlets.

1.24 Domestic Hw Systems

1.24.1 Meet requirements as specified for hydronic systems.

1.24.2 Locations of equipment measurements: To include, but not be limited to, following as appropriate:

.1 Inlet and outlet of heaters.

PART 2 PRODUCTS

2.1 Not Used

2.1.1 Not used.

PART 3 EXECUTION

3.1 Not Used

3.1.1 Not used.

END OF SECTION

DIVISION 16 ELECTRICAL

PART 1 GENERAL

1.1 Related Work

1.1.1 Division 1 - General Requirements

1.2 Definitions

1.2.1 Supply - supply material only; installation by others.

1.2.2 Install - install and assist in commissioning of materials supplied by other trades, vendors or OWNER.

1.2.3 Provide - supply, install and commission material supplied in the work of this division.

1.2.4 EtherNet/IP - Industrial communications protocol managed by ODVA which utilizes TCP, UDP, and IP over Ethernet to deliver CIP.

1.3 Drawings and Specifications

1.3.1 Drawing use and interpretation:

.1 Drawings are diagrammatic and indicate general arrangement of systems and equipment, except when specifically dimensioned or detailed.

.2 For exact locations of structural elements, refer to dimensioned structural drawings.

.3 Field measurements take precedence over dimensioned drawings.

.4 Intention is to show size, capacity, approximate location, direction and general relationship of one work phase to another, but not exact detail or arrangement.

.5 Field-verify locations and arrangement of all existing systems and equipment.

1.3.2 Installation of all systems and equipment is subject to clarification as indicated in reviewed shop drawings and field coordination drawings.

1.3.3 Dimensions indicated anywhere are limiting dimensions.

1.3.4 Do not use equipment exceeding dimensions indicated or equipment or arrangements that reduce required clearances or exceed specified maximum dimensions.

1.3.5 Furnish and install all materials to provide functioning systems in compliance with performance requirements specified, and any modifications resulting from reviewed shop drawings and field coordinated drawings.

1.4 Codes, Permits and Inspections

1.4.1 The installation shall comply with the requirements of the current edition of the Canadian Electrical Code and the Electrical by-laws of the local Electrical Authority.

1.4.2 Obtain all permits required and, after completion of THE WORK, furnish to the ENGINEER the certificate of final inspection and approval from the local Inspection Authority. Take out all permits at the beginning of THE WORK.

1.4.3 Submit a set of electrical drawings to the local Inspection Authority under whose jurisdiction this comes within two (2) weeks from date CONTRACT was awarded.

1.4.4 In the event that this is not done and the local Inspection Authority requires some changes, the changes shall be made at no expense to the OWNER.

1.5 Submittals

1.5.1 See Division 1 regarding Submittal procedures.

1.6 Protection

1.6.1 Provide covering and shielding for all equipment provided to protect from damage.

1.6.2 Protect nameplates on equipment to prevent defacing.

1.6.3 Repair, restore or replace damaged, corroded, or rejected items.

1.7 Job Conditions

1.7.1 Schedule work which will cause interference or interruption in advance with ENGINEER, authorities having jurisdiction, and all affected trades.

1.7.2 Examine CONTRACT DOCUMENTS to determine how other work will affect the execution of electrical work.

1.7.3 Where any material, equipment or system components are installed differently from that shown, show such differences clearly and neatly, using ink or indelible pencil.

1.7.4 At project completion, submit the record set of drawings to the ENGINEER.

PART 2 PRODUCTS

2.1 Acceptable Manufacturers

2.1.1 As indicated for individual items.

2.1.2 Alternate material of superior or equal quality will be considered if quoted in Tender as a change to the base bid price. The specified item(s) shall be carried as the base bid.

2.2 Materials

2.2.1 Use only prime quality, new materials, apparatus and equipment.

2.2.2 All electrical equipment must be certified by a recognized certification agency adopted by the Standards Council of Canada. Equipment not having certification shall not be connected by CONTRACTOR unless application is made to a recognized certification agency for Special Inspection / Special Acceptance and the ENGINEER has approved the equipment to be installed. Refer to Section 16025 for list of certification agencies.

2.2.3 Structural steel for supports: ASTM A36.

.1 Galvanized members installed in all areas.

.2 Shop fabricate for field assemble using bolts.

.3 Minimize field welding.

.4 Repair damaged galvanized surfaces with a “cold-galv” type paint.

PART 3 EXECUTION

3.1 General

3.1.1 Use only thorough, highly skilled and experienced workmen.

3.1.2 When changes in location of any WORK are required, obtain approval of ENGINEER before making change.

.1 Make change within three (3) meters of indicated point at no extra cost.

3.1.3 Do not change indicated sizes without written approval of ENGINEER.

3.1.4 Provide all necessary offsets and crossovers in conduits, whether indicated or not.

3.1.5 Install conduits parallel to walls and ceilings and vertically plumb, unless otherwise indicated.

3.1.6 CONTRACTOR shall ensure pad mounted utility meter is installed as per the engineered drawings.

3.2 Cutting and Patching

3.2.1 In order to avoid cutting, sleeves or frames shall be cast into concrete sections.

3.2.2 Provide all necessary anchoring devices and supports.

.1 Use structural supports suitable for equipment, or as indicated.

.2 Check loading and dimensions of equipment with shop drawings.

.3 Do not cut or weld to bridge structural members.

3.2.3 Verify that equipment will fit support layouts indicated.

.1 Where substitute equipment is used, revise indicated supports to fit.

3.2.4 Arrange for necessary openings to allow for admittance of equipment.

.1 Where equipment cannot be installed as structure is being erected, provide and arrange for building-in of boxes, sleeves, or other devices to allow later installation.

3.2.5 Install equipment to permit easy access for normal maintenance.

.1 Maintain easy access to switches, motors, drives, pull boxes, receptacles, etc.

.2 Relocate items which interfere with access.

3.3 Field Quality Control

3.3.1 Perform tests to demonstrate workmanship, operation and performances.

.1 Conduct test in presence of ENGINEER and, if required, inspectors of agencies having jurisdiction.

.2 Arrange date(s) of test(s) in advance with ENGINEER, manufacturer and installer. Give all inspectors a minimum of 7 days notice.

.3 CONTRACTOR shall furnish or arrange for the use of electrical energy or fuel required for the test(s).

3.3.2 Repair or replace equipment and systems found inoperative or defective, and re-test.

.1 If equipment or system fails, re-test until satisfactory results are obtained.

.2 Continue remedial measures and re-tests until satisfactory results are obtained.

3.4 Final Performance Test

3.4.1 At completion of installation, test for operation, panel load balance, short circuits, and ground.

3.5 Adjust And Clean

3.5.1 Adjust all equipment and put in good working order.

3.5.2 Clean all exposed and concealed items.

3.6 Start-Up

3.6.1 Prior to final acceptance, at time agreed to by ENGINEER, put all systems into satisfactory operation.

3.6.2 Operate all systems in good working order for period of five working days.

3.7 Mounting Heights

3.7.1 If a conflict exists with architectural details such as a dado, heating radiation, etc., then obtain a ruling from the ENGINEER.

3.7.2 Unless otherwise noted on the drawings or in the specifications, electrical devices with their centerline located as follows:

Switches	1400 mm
Receptacles – Office areas	300 mm
Receptacles – Shop areas	1400 mm
Wall Telephone	1500 mm
Telephone and Computer	300 mm
Thermostats	1400 mm
Fire Alarm Pullstation	1400 mm
Fire Alarm Bell	300 mm below finished ceiling
H2S Sensor	150 mm
Methane Sensor	100 mm below finished ceiling

3.7.3 ENGINEER reserves the right to change location of any electrical device to within three (3) meters of point indicated on plans without extra charge provided the CONTRACTOR is advised prior to installation.

END OF SECTION 16010

PART 1 GENERAL

1.1 Related Work

1.1.1 Section 16010 - General Electrical Provisions

1.1.2 Division 1 - General Requirements

1.2 Definitions

1.2.1 Supply - supply material only; installation by others.

1.2.2 Install - install and assist in commissioning of materials supplied by other trades, vendors or OWNER.

1.2.3 Provide - supply, install and commission material supplied in the work of this division.

1.2.4 EtherNet/IP - Industrial communications protocol managed by ODVA which utilizes TCP, UDP, and IP over Ethernet to deliver CIP.

PART 2 PRODUCTS

2.1 Setting Out of Work

2.1.1 Where equipment is built-in with work of other trades, supply equipment to be built-in or measurements to allow necessary openings to be made so as not to hold up THE WORK.

2.1.2 Make reference to electrical, mechanical, structural, process and architectural drawings when setting out WORK. Consult with respective Divisions in setting out locations for conduit runs, luminaires, panel assemblies, etc., so that conflicts are avoided, equipment is operable and serviceable, and symmetrical even spacing is maintained.

2.1.3 Layouts shown for mechanical and electrical rooms are for estimating purposes only. Coordinate installation of conduit, outlets and equipment with final room equipment layout.

2.1.4 Where switches, receptacles, and fire alarm breakglass stations are in the same general location, outlets to be lined up vertically unless otherwise called for by the ENGINEER.

2.2 Excavation and Backfilling

2.2.1 Provide all excavation, sand leveling and bedding for electrical installation. Level all trenches for underground conduit and duct banks with a 75 mm layer of sand. Conduits not encased in concrete to be laid on sand bed then covered by a second 150 mm layer of compacted sand. Steel conduit not encased in concrete to be painted with two coats of asphaltum paint after assembly. Remainder of backfill, removal and disposal of surplus excavated material to be responsibility of the CONTRACTOR. Refer to Division 2 of the General Specifications.

PART 3 EXECUTION

3.1 Mechanical and Process Equipment Wiring - Power

3.1.1 Provide all labour and materials required to complete electrical power wiring for pumping, plumbing, heating and ventilating equipment as called for in these specifications and/or shown on the drawings.

3.1.2 Provide all single and 3 phase motor protection switches, combination starters, disconnects, and lock out control switches as required for mechanical and process equipment unless otherwise specifically noted in these specifications or on the drawings.

3.1.3 Provide VFDs and related equipment for pumps RSP-001 and RSP-002 as specified in Divisions 11 and 16.

3.1.4 Supply and installation of motors for mechanical and process equipment is specified in Division 15 and Division 11.

3.2 Mechanical and Process Equipment Wiring - Control

3.2.1 All control conduit and wiring unless specifically noted otherwise for motors and mechanical equipment is specified in Division 13.

3.2.2 All control components and control connections from control terminal sections of motor control centers to automatic devices, interlocking, etc., is specified in Division 13.

3.3 Temporary Power

3.3.1 Refer to Temporary Facilities Section 01500.

3.4 Scope

3.4.1 Work under this CONTRACT generally consists of supply, installation and putting into operation the electrical systems as indicated on the drawings and specified herein and work as outlined below.

3.4.2 All material supplied and installed under this CONTRACT shall be suitable for a heated, ventilated environment, and it shall have a minimum life expectancy of 18 years. In case the material specified does not comply with this requirement, CONTRACTOR shall submit an alternate material and price as an add-on to the base bid price.

3.4.3 All concrete work, unless specified elsewhere, shall be done by Division 3, but the support steel system necessary for electrical equipment, conduit, cables and devices shall be part of the CONTRACTOR's scope.

3.4.4 CONTRACTOR shall review and understand the design and construction for the installation of electrical equipment and conduit for distribution pumps, instrumentation, PLC control system, and H&V power.

3.4.5 CONTRACTOR is responsible for the testing and commissioning of the entire installations under this CONTRACT.

3.4.6 Work shall be performed in accordance with the attached drawings and specification and shall include but not be limited to the following:

.1 THE WORK for McKay Ranch Lift Station

3.4.7 Coordinate the installation of power feeder and transformer with utility company at the Lift Station.

END OF SECTION 16020

PART 1 GENERAL

1.1 Related Work

1.1.1 Section 16010 - General Electrical Provisions

PART 2 PRODUCTS

2.1 Excavation and Backfilling

2.1.1 Backfill required after sand bedding and sand cover and removal of disposal of surplus excavated material shall be the responsibility of the CONTRACTOR.

2.1.2 All concrete work related to electrical to be provided by the CONTRACTOR.

PART 3 EXECUTION

3.1 Mechanical Equipment Wiring

3.1.1 All HVAC control conduit and wiring, unless specifically noted otherwise for fans, dampers and unit heaters, shall be the responsibility of Division 15.

3.1.2 All HVAC control components and control connections from control terminal sections of motor control centers to automatic devices, interlocking, etc., shall be the responsibility of Division 15.

3.1.3 Motors for HVAC mechanical equipment shall be supplied and set in place by Division 15.

3.2 Firestops and Seals

3.2.1 Refer to Section 07840 for installation of firestops and smoke seals around conduit and cable which penetrate ULC rated fire separations. This work is to be performed by the trade responsible for installing firestops and smoke seals around and within ULC rated fire separations to maintain their integrity.

3.3 Utility Power System – Lift Station

3.3.1 Utility company shall pull primary cables through CONTRACTOR installed duct from property line to transformer location.

3.3.2 Padmount transformer will be supplied and installed by utility company.

3.3.3 Utility revenue metering (meter only) will be supplied and installed by the utility company.

END OF SECTION 16021

PART 1 GENERAL

1.1 Related Work

1.1.1 Section 01300 – Submittals

1.1.2 Section 01700 - Contract Closeout

1.1.3 Section 16960 - Starting of Electrical Equipment and system by Manufacturer's Representative

1.1.4 Section 16970 - Electrical Starting and Commissioning

1.2 General Instruction

1.2.1 Provide operation and maintenance (O&M) data as specified herein for incorporation into O&M manuals.

1.2.2 O&M data shall be organized as per Section 01700 - Contract Closeout.

PART 2 PRODUCTS

2.1 Shop Drawings and Product Data

2.1.1 Provide complete sets of reviewed shop drawings and product data to the ENGINEER for review as per section 01300.

PART 3 EXECUTION

3.1 Installation Instructions

3.1.1 Provide manufacturer's installation instructions for all systems and components during the submission of shop drawings.

3.2 Operation Instructions

3.2.1 Provide manufacturer's operation instructions for all systems and components during the submission of shop drawings.

3.3 Maintenance Instructions

3.3.1 Provide manufacturer's maintenance instructions for all systems and components. Include the following:

.1 Complete parts list for all serviceable components, including description and catalogue number.

.2 List of spare parts supplied under the CONTRACT and list of other spare parts recommended by manufacturers.

3.4 List of Subcontractors and Suppliers

3.4.1 Provide a detailed and comprehensive list of SUBCONTRACTORS, Sub-SUBCONTRACTORS, and suppliers who are going to supply and install systems and components on this project.

3.4.2 List to be submitted with Tender.

3.5 Contractor Designed System Data

3.5.1 Provide design data for all systems designed by the CONTRACTOR.

3.6 Certification

3.6.1 Provide copies of all inspection certification reports from authorities having jurisdiction.

3.7 Field Reports

3.7.1 Provide copies of reports documenting the results of all tests, including factory tests, required by the CONTRACT DOCUMENTS to be performed.

3.8 Warranties

3.8.1 Provide OWNER's copy of all manufacturer's warranties.

END OF SECTION 16022

PART 1 GENERAL

1.1 Related Work

1.1.1 Section 16010 - General Electrical Provisions

1.1.2 Division 1 - General Requirements

1.2 Codes, Permits and Fees

1.2.1 THE WORK shall comply with the requirements of the current edition of the 'Canadian Electrical Code' Part I and the local electrical authority.

1.2.2 Other codes or standards which apply are:

IEEE	International Electronic and Electrical Engineering Society
IES	Illumination Engineering Society
EEMAC	Electrical Equipment Manufacturers Association of Canada
NEMA	National Electrical Manufacturers Association
CSA	Canadian Standards Association
ANSI	American National Standards Institute
NBC	National Building Code
ABC	Alberta Building Code
UL	Underwriters Laboratory
ULC	Underwriters Laboratory Canada
FM	Factory Mutual
NFPA	National Fire Protection Agency

1.2.3 Obtain the required construction permits, arrange for inspections and supply the ENGINEER with certificate of final inspection and approval.

1.2.4 Electrical plans and specifications shall be submitted to the electrical inspection department by the CONTRACTOR for approval. The CONTRACTOR shall forward a copy of the letter and drawings to the ENGINEER.

1.3 Electrical Equipment Approval

1.3.1 All new electrical equipment or systems must be certified by a certification body recognized by the Standards Council of Canada.

1.3.2 Equipment not having certification shall have special inspection label and be inspected, tested and accepted by a certification body and the equipment bears evidence of having been accepted un a manner authorized by the certification body.

1.3.3 Canadian accredited certification organizations are:

CSA	Canadian Standards Association International
ENTELA	Entela
ESA	Electrical Safety Authority
ETL	Intertek Testing Services
FMc	FM Approvals for Canada
LCc	LabTest Certification Inc.
METc	MET Laboratories for Canada
Nc	Nemko Canada Inc.
NSFc	NSF International for Canada
OTLc	OMNI-Test Laboratories, Inc. for Canada
QAI	Quality Auditing Institute
SGSc	SGS North America, Inc. for Canada
ULC/cUL	Underwriters Laboratories of Canada

PART 2 PRODUCTS

2.1 NOT APPLICABLE

PART 3 EXECUTION

3.1 NOT APPLICABLE

END OF SECTION 16025

PART 1 GENERAL

1.1 Related Work

1.1.1 Section 16010 - General Electrical Provisions

1.1.2 Division 1 - General Requirements

1.1.3 Section 16960 - Starting of Electrical Equipment and system by Manufacturer's Representative

1.1.4 Section 16970 - Electrical Starting and Commissioning

1.1.5 Section 16980 - Electrical Equipment Systems Demonstration and Instruction

PART 2 PRODUCTS

2.1 Scope

2.1.1 Test and check all portions of the electrical systems for satisfactory operation.

2.1.2 Before energizing any portion of the electrical system, perform megger tests on all feeders and branch circuits. Results to conform to the Canadian Electrical Code (current edition), to the satisfaction of the authorized inspection authority and to the ENGINEER. Megger tests on all feeder conductors to be done in the presence of the ENGINEER, suitably logged, tabulated signed and included into the operation and maintenance (O&M) manuals.

2.1.3 Upon completion of the building and immediately prior to final inspection and takeover, check the load balance on all feeders at distribution centers, motor control centers and panelboards. Tests to be carried out by turning on all possible loads in the building and checking load current balance. If load unbalance exceeds 5 percent, reconnect circuits to balance load.

2.1.4 Make voltage checks throughout building after building is in operation for sixty (60) days and at this time, if directed by the ENGINEER, adjust transformer tap settings. Readings taken at this time to be logged, tabulated and any adjustments made to be suitably logged and incorporated into the O&M manuals.

2.1.5 Take clip-on ammeter readings on all phases of all mechanical equipment motors with motors running under full load condition. Readings to be logged, tabulated and incorporated into the O&M manual.

2.1.6 Printout power factor and harmonic readings on a 24 hour recording basis from the digital metering at the following locations after the building is fully occupied and operational:

.1 McKay Ranch Lift Station Main Breaker.

2.1.7 Refer to particular systems specification sections for special or additional testing.

2.1.8 Submit copies of all test results to the ENGINEER. Submit in accordance with Section 01300.

PART 3 EXECUTION

3.1 Startup

3.1.1 Refer to Section 16960.

3.1.2 Where required and specified in other sections, arrange and pay for the services of manufacturer's factory service engineer to supervise the startup of installation, checking, adjusting and balancing of components. Provide these services as often as necessary to put installation into working order and to ensure that operating personnel are conversant with all aspects of operation, care and maintenance.

3.2 Demonstration

3.2.1 Refer to Section 16980.

3.3 Factory Tests

3.3.1 The following equipment shall have tests performed at the factory prior to shipment and witnessed by the ENGINEER.

.1 Not Applicable.

3.3.2 Provide four (4) copies of testing procedures for approval a minimum fourteen (14) days ahead of scheduled testing.

3.3.3 Arrange with, and at a time suitable to, the ENGINEER a minimum seven (7) working days ahead of scheduled test.

3.3.4 The ENGINEER reserves the right to witness any or all the tests.

3.3.5 Submit four (4) copies of factory test results no later than fourteen (14) days after a test is performed, certified by a factory engineer.

3.4 Witness Tests on Site

3.4.1 All tests specified in Division 16 may be witnessed by the ENGINEER. Submit written notice a minimum of seven (7) days ahead of any scheduled tests.

3.5 Commissioning Tests

3.5.1 Conduct tests in accordance with the latest IEEE and IPCEA standards and recommendations.

3.5.2 Tests to be performed by an accredited firm experienced in the testing of the equipment.

3.5.3 Not withstanding the test levels listed, the maximum DC test level must not exceed the manufacturer's recommendation levels for the equipment. Factory test results must be available to the personnel conducting the commissioning tests.

3.5.4 Submit sample test sheets with testing procedures for approval a minimum of fourteen (14) days ahead of any scheduled tests.

3.5.5 Certify test results on site.

3.5.6 Systems to be commissioned as follows:

.1 Power Distribution;

.2 Motor Control Equipment;

.3 Power Monitoring;

.4 Generator and Transfer Switch;

.5 Motors and VFDs;

.6 Lighting;

.7 Heating and ventilation; and

.8 Building temperature and gas alarms.

3.6 Megger Tests and Voltage Drop

3.6.1 Megger 600 Volt feeder cables from 600 Volt switchboard using 2500 V(dc) meg-check to prove insulation and dielectric strength of cables.

3.6.2 Megger all other circuits, feeders and equipment up to 350 Volt with a 500 Volt instrument.

3.6.3 Megger all other circuits, feeders and equipment up to 600 Volt with a 1000 Volt instrument.

3.6.4 Measure for voltage drop with actual loads on. The voltage drop will be from secondary side of upstream transformer to equipment or receptacle. Report to ENGINEER any voltage drop greater than 2%.

3.7 Grounding

3.7.1 Carry out a ground grid test with facility grid initially isolated from the utility ground grid.

3.7.2 Add additional ground rod sections as required to obtain a ground resistance of less than 1 Ohm under the most unfavorable weather conditions.

3.7.3 Reconnect facility ground grid to utility ground grid at completion of testing.

3.8 Testing of Power and Distribution Transformers 208 V to 600 V

3.8.1 Verify polarity relationship (primary/secondary)

3.8.2 Verify terminal identification (H1, H2, H3, H0 - X1, X2, X3, X0)

3.8.3 Insulation Resistance: using appropriately sized and approved insulation resistance tester;

.1 primary/secondary

.2 primary/secondary and ground

.3 secondary/primary and ground

3.8.4 Core Ground:

.1 Verify that only one core ground exists using insulation resistance tester @ 250 V(dc).

3.9 Motor Control Centers

3.9.1 Confirm MCC phasing at main breaker, phase A/B/C left to right when viewed from the front.

3.9.2 Confirm motor nameplate data with motor starter heater overloads.

3.9.3 Ensure all starters are properly labeled prior to testing.

3.9.4 Confirm MCP setting.

3.9.5 Confirm motor overload relay settings.

3.9.6 Function test all metering.

3.9.7 Function test generator and transfer switch as required and detailed in specification.

3.10 Lighting

3.10.1 Function test all light switches, luminaries and lighting control equipment such as photo-cells, motion detectors, 3-way switches, etc.

END OF SECTION 16030

PART 1 GENERAL

1.1 General Instruction

1.1.1 Provide a complete inventory of electrical spare parts and maintenance materials as specified.

1.1.2 Provide all special tools required for normal maintenance in a heavy gauge, corrosion resistant metal box complete with lock and keys.

1.1.3 Provide wall mounted metal cabinet with adjustable shelving and hinged locking door to house all spare parts associated with power system.

1.1.4 See Section 13300 for additional information on spare parts.

PART 2 PRODUCTS

2.1 Spare Parts and Maintenance Materials Schedule

	Item	Quantity
2.1.1	Motor Control Centers:	
.1	VFD Keypad:	1
.2	VFD Ethernet Card:	1
.3	PICOPAK Analog Isolator 4-20 mA:	1
.4	Operating Coil for Each Size Starter:	1
.5	Interposing relays, 120 V(ac):	2
.6	Spare Control Terminals:	10
.7	Indicating Lights:	1 of each type and colour
.8	Potentiometer:	1
.9	Push button:	1 of each type
.10	Emergency Stop Devices:	1 of each type
2.1.2	Generator Engine:	
.1	Fuel Filter Replacement Elements:	2
.2	Lube Oil Filter Replacement Elements:	2
.3	Air Cleaner Filter Elements:	2
.4	Sets of Fuses for Control Panel:	4

2.1.3	Luminaires:		
	.1	LED Ballasts/Drivers:	2 of each type
	.2	Lamps:	3 of each size and type
2.1.4	Receptacles/Switches		
	.1	15 Amp Duplex Receptacles:	2 of each colour/type
	.2	Light Switches:	2 of each type
2.1.5	Panels		
	.1	Plug-in control relays c/w base:	2 of each type
	.2	Control Fuses:	20 of each size and type
	.3	Fuse Holders:	2 of each type
2.1.6	Motor Starters		
	.1	Stationary Contacts	3 of each size and type
	.2	Movable Contacts	3 of each size and type
	.3	Auxiliary Contacts	1 of each size and type
	.4	Control Transformer	1 of each type
	.5	Operating Coil	1 of each type
	.6	Fuses	1 of each type
	.7	Indicator Lamp Unit (complete)	1 of each type
	.8	Indicating Lamp Bulbs	10% used

PART 3 EXECUTION

3.1 NOT APPLICABLE

END OF SECTION 16031

PART 1 GENERAL

1.1 Related Work

1.1.1 Section 16010 - General Electrical Provisions

1.1.2 Division 1 - General Requirements

1.1.3 Division 9 - Finishes

PART 2 PRODUCTS

2.1 Identification

2.1.1 Refer to Section 01080.

2.1.2 Clearly identify switchboards, power distribution centers, cable tray, power panels, distribution panels, lighting panels, disconnect switches, starters, contactors, motor control centers, low voltage terminal cabinets, junction boxes, remote On/Off switches, selector switches, light switches, receptacles, and transformers by permanent nameplates described below.

2.1.3 Panels: identify the panels as shown on drawings and the main voltage.

2.1.4 Transformers: show capacity, primary and secondary voltages, identify the transformer as shown on drawings.

2.1.5 Disconnects, starters, and contactors: indicate equipment being controlled and voltage.

2.1.6 Terminal cabinets and pull boxes: indicate the system and the voltages.

2.1.7 Remote On/Off switches: indicate areas being served or equipment controlled.

2.1.8 Selector Switches: indicate selector switch position functions.

2.1.9 Motor Control Centers: identify distribution center as shown on drawings and the main voltage or voltages if more than one.

2.1.10 Cable tray identified to voltage being carried in part of tray.

2.1.11 Light switches to area being controlled.

2.1.12 Provide nameplates of lamicoid plastic, white background with 10 mm black letters beveled edges and two mounting screw holes, mounted in conspicuous locations on the surface of the equipment, except in finished areas locate nameplates in flush panels mounted on panel front inside enclosure.

2.1.13 Provide a complete list of nameplates for review by the ENGINEER.

2.1.14 Provide on each receptacle a lamicoid label as defined in 2.1.11 stating the panel and circuit number, i.e., A-21B - Panel 'A', circuit number 21B.

2.1.15 Provide neatly typed circuit directories in panel boards to indicate the area or equipment controlled by each branch circuit.

2.1.16 Provide plastic, hot stamped wire marker on all conductor terminations.

2.2 Painting/Identification

2.2.1 Refer to Section 01080 and 09900.

PART 3 EXECUTION

3.1 Conduit Identification

3.1.1 All cable and conduit for electrical systems to be identified within 200 mm of exiting panel locations, pull box locations, within 200 mm of where they enter or leave a room or non-accessible ceiling space, and 4 m on center within an area. Identification of cable and conduit to consist of Weidmuller type PKH retaining strips with PK 2/4 marking sleeves applied so as to provide easy identification, to satisfaction of the consultant.

3.1.2 Cable and conduit identification shall use a designation as identified on the drawings:

eg. FIT105-P1

Cable Suffix designation letters:
E Element
P Power
C Control and Instrumentation

3.2 Colour Coding of Conductors

3.2.1 Conductors to be colour coded throughout the building with the same colour applying to same phase throughout. Colour coding to be by insulation colour or permanently applied colour banding at all distribution centers and panels. Colour coding to be as follows:

Equipment grounding conductor - green.

Neutral conductor - white.
120/208 V phase wires - red, black, and blue.
600 V - phase wires - red, black and blue, or for larger conductor sizes, black with red, black, blue coloured tape.

3.2.2 At all distribution centers, pull boxes, wireways, etc., feeder conductors of each feeder group to be neatly laced or clipped into a feeder group with each conductor identified as to load fed.

3.2.3 At all pull boxes, junction boxes, and device outlet box locations; identify each conductor as to panel and circuit, ie., panel A circuit 23B - identify as A-23B using hot stamped heat shrink wire markers.

3.3 Single Line Electrical Diagrams

3.3.1 Provide a framed 22x34 ASBUILT single line electrical diagram(s) in MS-215 MAX-TEK R (Marking Services Canada, 780-955-9303) as follows:

.1 Electrical room.

END OF SECTION 16040

PART 1 GENERAL

1.1 Related Work

1.1.1 Section 16010 - General Electrical Provisions

1.1.2 Division 1 - General Requirements

PART 2 PRODUCTS

2.1 Materials

2.1.1 Ducts: Non-metallic polyvinyl chloride conduit rigid (PVC) or Fiberglass (FRE) as indicated.

2.1.2 Where indicated to be concrete encased, provide minimum 75 mm thick envelope about each duct.

2.1.3 Warning tape: Polyvinyl 75 mm wide foil backed detectable red tape marked “BURIED ELECTRIC LINE” or equivalent wording, T&B #NAF-0600.

END OF SECTION 16110

PART 1 GENERAL

1.1 Description

1.1.1 Building wiring raceway systems.

1.2 Related Work

1.2.1 Section 16010 - General Electrical Provisions

1.2.2 Section 16040 - Identification

PART 2 PRODUCTS

2.1 Materials

2.1.1 Metric Equivalent Conduit Table (CEC 22.1 Table 6)

10 mm is equal to 3/8"
16 mm is equal to 1/2"
21 mm is equal to 3/4"
27 mm is equal to 1"
35 mm is equal to 1¼"
41 mm is equal to 1½"
53 mm is equal to 2"
63 mm is equal to 2½"
78 mm is equal to 3"
91 mm is equal to 3½"
103 mm is equal to 4"
129 mm is equal to 5"
155 mm is equal to 6"

2.1.2 Conduits: rigid aluminum, rigid PVC, or electrical metallic tubing upon the exterior of the walls/floors/etc. Allowance for PVC within floors and walls to fashion a clean installation is permitted.

2.1.3 Flexible Conduit: aluminum armor PVC jacketed, minimum diameter 10 mm for fixtures and control wiring, 16 mm and larger for all other locations. Use watertight connectors with PVC jacketed flexible conduit.

2.1.4 Conduit couplings: rigid threaded aluminum, EMT watertight. All EMT connectors and couplings over 41 mm to be steel. Die cast zinc not permitted. Set screw type couplings not permitted.

2.1.5 Condulet conduit fittings: cast copper free aluminum, with cast cover and gasket, Appleton Crouse Hinds or Killark.

PART 3 EXECUTION

3.1 Installation

3.1.1 Conduits to be concealed wherever practical.

3.1.2 Except where otherwise noted or not permitted by applicable Codes, all wiring to be installed in rigid aluminum conduit. Electrical metallic tubing may only be utilized for all 120 V(ac) exposed lighting branch circuit runs where permitted by code.

3.1.3 Install PVC conduit encased in concrete where installed below structural floor slab, below slab-on-grade and for all stubouts to underground site wiring. All PVC conduits installed below grade that is not encased in concrete to be rated for such installation.

3.1.4 Do not install conduit in structural floor slabs without permission of the ENGINEER. Where conduit is installed under main floor slabs, utilize crawl space ceiling or provide suitable depression below the slab for conduit runs and concrete encasement as indicated. Conduits to be run in groups, channel anchored for separation and vertical support from structural slab above in the event of soil settlement below structural slab.

3.1.5 Every rigid, threaded conduit entering or leaving outlet boxes, pull boxes, panels, switchboards, motor starter enclosures, motor control centers, cabinets for the telephones, intercom, control, etc., enclosures in general of any kind, or stubbed out conduits, shall have an approved watertight threaded connection such as Myers Hub or Bullet nose connector. When EMT is used in above situations all terminations shall be made using watertight EMT connectors. When ACWU or Teck cable is used in above situations all terminations shall be made using watertight connectors.

3.1.6 Install exposed conduit parallel and perpendicular to building lines grouped as nearly as possible with concentric bends.

3.1.7 Fasten all conduits a minimum 1,500 mm on center.

3.1.8 Clean out conduit before installation of conductors.

3.1.9 Install conduit free from dents and bruises. Plug the ends to prevent the entrance of dirt or moisture.

3.1.10 Where conduits penetrate from heated to cold area, seal conduit with approved vapor sealing compound.

3.1.11 Do not pass conduits through roof membrane but achieve access to mechanical roof mounted equipment inside the roof curbs provided for those pieces of equipment.

3.1.12 Make connections to mechanical motors and equipment from conduit stub-ups and junction boxes with PVC jacketed flexible conduit and liquid tight connectors to avoid transmission of vibration from machinery to building structure.

3.1.13 Where conduits are installed in concrete floor slab, encase these conduits completely in a 75 mm concrete envelope and ensure a 50 mm spacing between conduits to avoid concrete voids.

3.1.14 Coordinate installation of conduit in brick or block walls with masonry trade to allow mason to thread brick or blocks over conduit.

3.1.15 Utilize approved expansion fittings complete with grounding jumper where conduit installed in concrete slabs or masonry walls cross building expansion lines. Install feeder runs of conduit in suspended ceiling spaces in such a manner that there is a bend or off-set adjacent to the major building expansion line to take up building movement. In lieu of this, utilize approved expansion fitting.

3.1.16 All conduits installed in ceiling spaces to be mounted on conduit racks. Conduit racks to be coordinated with mechanical ducting and the specific rack configuration to be approved by the ENGINEER prior to installation. Conduit racks to be sized and configured to provide at least 25 percent future capacity.

3.1.17 All openings for conduit penetrations in fire rated and smoke separations to be sealed using materials approved by the ENGINEER. All blockouts and access slots to be sealed using Dow Corning 3-6548 silicone RTF foam. Install silicone foam using fire approved damming material as required to provide designated fire ratings.

3.1.18 Provide pull wire in all empty conduit systems.

3.1.19 Provide for the identification of following systems. Conduit to be coded as Section 16040 Identification.

3.1.20 Where the engineered drawings specifically call for it, the CONTRACTOR shall install in slab conduit as detailed.

3.2 Hazardous Area

3.2.1 Where a process area is classified as hazardous as indicated on the drawings, requiring explosion-proof fittings, the following equipment shall be installed:

.1 Breather-drains, to prevent condensation in conduit systems, Crouse-Hinds Type ECD.

.2 Conduit seals – Crouse-Hinds Type EYS or EZS.

.3 Conduit drain seals – Course-Hinds Type.

.4 Conduit unions – Crouse-Hinds Type UNY.

.5 Fittings – Crouse-Hinds Type LBY, LBH, GUA, and GUB complete with corrosion-free Epoxy Enamel Coating.

.6 Conduit runs – complete with corrosion-free Epoxy Enamel Coating.

END OF SECTION 16111

PART 1 GENERAL

1.1 Description

1.1.1 Cable tray to form a complete system, including straight lengths, horizontal and vertical elbows, tees, crosses, reducers, coupler covers and accessories as detailed in this specification and as shown on drawings.

1.2 Related Work

1.2.1 Section 16010 - General Electrical Provisions

1.2.2 Section 16190 - Supporting Devices

1.2.3 Section 16450 - Grounding

1.3 Reference Standards

1.3.1 All cable tray to conform to CSA 22.2 No. 126.

PART 2 PRODUCTS

2.1 Cable Tray

2.1.1 Ladder type, or Wire Mesh type, Class D1 to CSA C22.2 No. 126-M91 (R2002).

2.1.2 Extruded aluminum tray or stainless steel type 316 wire mesh as indicated. Extruded FRP tray.

2.1.3 Horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints and reducers where required. Fittings: manufactured accessories for cable tray supplied.

2.1.4 Solid covers for cable tray system.

2.1.5 Barriers where different voltage systems are in the same cable tray.

2.1.6 Cable tray width as indicated with a cable depth 100 mm.

2.1.7 Localized Wireway may be used in ‘final run’ applications to instruments to allow for a clean and unobtrusive installation. Wireway to meet CSA approvals and be covered with all edges smoothed as to not leave sharp corners, etc.

2.2 Cable Tray Supports

2.2.1 Provide supports, hangers, and securing devices as required for complete installation.

2.3 Acceptable Manufacturers

2.3.1 Cablofil, Inc.

2.3.2 Cooper B-Line

2.3.3 CANSTRUT Products

2.3.4 Unitray Systems Inc. (Edmonton)

PART 3 EXECUTION

3.1 Installation

3.1.1 Prior to the placement of cable tray, confirm location of all services.

3.1.2 Confirmation to be provided in the form of contract drawings marked up with turn-up, vendor's shop drawings with turn-ups and locations indicated, or in a similar manner.

3.1.3 Install cable tray in accordance with the confirming information, making reasonable adjustments to the locations shown by scale on the contract documents without additional costs. In making such adjustments, reasonable adjustment is to be within 1,000 mm of the location required.

3.1.4 Support cable tray from ceilings with hanger rods and approved fittings. Support cable tray mounted on walls with wall bracket channels. Special runs of cable tray shall be supported as shown on drawings. Where hanger rods are used, rods to be galvanized steel and to be not smaller than 12 mm in diameter. Rods to be continuously threaded and utilize locknuts or other equivalent securing device.

3.1.5 All trays shall be checked for surface smoothness prior to and after installation, all burrs, ridges, etc., on tray surfaces facing cables to be removed.

3.1.6 Coordinate supports and tray location with work of other trades. Notify ENGINEER of any conflicts and obtain a ruling before proceeding with the installation. Prepare roughing-in drawings illustrating the locations and methods of supports of all components.

3.1.7 Where terminations are indicated, provide a grommet or protective bushing to protect exiting cables.

3.1.8 Provide cable tray covers on all trays at floor level and up to 2,000 mm above floor level.

3.1.9 Refer to Section 16450 - Grounding for cable tray grounding.

3.2 Cables in Cable Tray

3.2.1 Install cables individually.

3.2.2 Lay cables into cable tray. Use rollers when necessary to pull cables.

3.2.3 Secure cables in horizontal cable tray at 3 m intervals with nylon ties and in vertical cable tray at 1.5 m intervals with P type clamp fasteners.

3.2.4 The air space between Pump power cables shall be 25-100% of the largest conductor diameter where indicated on cable schedule.

3.2.5 Control, 120 V(ac) power and instrument cables shall be random fill and placed within the separate designated cable tray.

END OF SECTION 16114

PART 1 GENERAL

1.1 Related Work

1.1.1 Section 16010 - General Electrical Provisions

1.1.2 Section 16450 - Grounding

1.1.3 Section 13300 - Process, Control & Instrumentation General Provisions

PART 2 PRODUCTS

2.1 Materials

2.1.1 All interior building wiring to be 98% conductivity copper, with 600 Volt RW90 X-link insulation unless specified below. No aluminum conductor permitted.

2.1.2 Branch Circuit Wiring: conductors smaller than No. 12 AWG not permitted for 120 V(ac) lighting, power or motor branch circuits.

2.1.3 BX cable not permitted.

2.1.4 Instrumentation wiring installed in conduit to be twisted pair shielded cables #16 AWG copper conductors minimum, 300 Volt insulation, 100% coverage aluminum mylar shield, bare tinned copper drain wire #16 AWG minimum with overall flame retardant PVC jacket.

2.1.5 Where multiconductor twisted pair shielded cables are installed on cable tray, each pair shall be individually shielded, and the cable assembly shall have an overall shield with an inner PVC jacket, aluminum armor and outer PVC flame retardant jacket rated 600 Volt.

2.1.6 TECK/Armored cable to be 600 or 1,000 Volt RW90, X-link insulation, copper conductor, PVC inner jacket, aluminum interlocking armor, and flame retardant PVC outer jacket.

2.1.7 TECK /Armored connectors to be OZ Gedney Tek-Mate or T & B Star, water tight type in non-hazardous and corrosive areas.

2.1.8 Warning tape: Polyvinyl foil backed and detectable buried utility tape 75 mm wide marked “BURIED ELECTRIC LINE”, “TELEPHONE LINE” or equivalent wording as required, T&B #NAF-0600.

2.2 Control Cables

2.2.1 Control wiring installed in conduit shall be 600 Volt, type: T-90, stranded copper conductors, sizes as indicated.

2.2.2 Control wiring installed in cable tray shall be TECK cable type, unless otherwise noted.

PART 3 EXECUTION

3.1 Installation

3.1.1 All splices shall be made with Ideal 'TwisterPRO' connectors and taped with Scotch® Super 88 Premium Vinyl Electrical Tape.

3.1.2 All Stranded wiring terminating at devices that do not have box type terminals shall be terminated using self-insulating, fork type compression terminals.

3.1.3 Separation of cables by phase is not acceptable.

3.1.4 Three phase motors with bus bars shall be connected using one hole, tin-plated copper, compression type cable connectors on the motor feeder. Motor terminals shall then be bolted using SST bolt, nut, 2 flat washers and 1 lockwasher, and taped using not less than two layers of Scotch Silicone rubber tape No.70. The rubber tape shall then be tightly wrapped with two half lapped layers of Scotch® Super 88 Premium Vinyl Electrical Tape.

3.1.5 Three phase motors with wire leads shall be connected using one hole, tin-plated copper, compression type cable connectors on the motor leads and motor feeder. Motor leads shall then be bolted using SST bolt, nut, 2 flat washers and 1 lockwasher and insulated using T&B or Raychem motor lead termination kits.

3.1.6 Bolt tightening Torque:

Bolt Size	Torque (lb-in) SST
1/4 - 20	80
5/16 – 18	180
3/8 – 16	240
1/2 - 13	480
5/8 – 11	660
3/4 - 10	960

3.1.7 Single phase fractional horsepower motors shall be connected using set-screw type connectors with two half lapped layers of Scotch® Super 88 Premium Vinyl Electrical Tape.

3.1.8 Only commercially prepared wire pulling compounds approved by cable manufacturers shall be used. The use of soaps, soap flakes, detergents or similar preparations shall not be allowed.

3.1.9 Each wire entering a box shall be left with at least 200 mm of wire clear of the box after splicing to facilitate future alterations. Through wires in a box shall be 150 mm between the box and bottom of loop.

3.1.10 Communication and signal circuits shall not be installed in the same conduit with power and lighting circuits.

3.1.11 Where cable spacing must be maintained, cables run in cable trays are to be fastened with Cantrough “P” type clamp fasteners or equivalent.

3.1.12 All wiring shall be identified at junction boxes, terminal boxes, control panels, relay panels, power panels, etc. with permanent heat shrink type labels. Wiring shall be identified with the wire numbers as given on drawings.

3.1.13 All buried cable shall be a minimum 600 mm below finished grade. Install continuous warning tape over cables at 300 mm below finished grade.

3.2 Branch Circuit Wiring

3.2.1 Branch circuit wiring to utilize a common neutral per set of 3 phases, panel connections are to be in accordance with the panel bussing arrangement.

3.2.2 Strictly follow the circuit loading and circuit numbering as shown on the drawings. Should errors or omissions be detected in the circuitry shown, make note of corrections on marked up field prints and record drawings.

3.2.3 A ground wire shall be installed in all branch circuit conduits.

END OF SECTION 16122

PART 1 GENERAL

1.1 Related Work

1.1.1 Section 16010 - General Electrical Provisions

1.1.2 Section 16040 - Identification

1.1.3 Section 16111 - Conduit

1.2 Work Included

1.2.1 This section refers to the supply and installation methods applicable to electrical boxes and condulets.

1.3 Acceptable Suppliers

1.3.1 Crouse Hinds

1.3.2 Appleton

1.3.3 Killark

1.4 Definition (CEC Part 1, Section 0)

1.4.1 Outlet means a point in the wiring installation at which current is taken to supply utilization equipment.

PART 2 PRODUCTS

2.1 Materials

2.1.1 F.S. or F.D. cast copper free aluminum, epoxy powder coated boxes shall be used for all surface mounted outlets in EMT and Rigid conduit systems.

2.1.2 All outlet boxes used for lights and set in concrete shall be “concrete” boxes equal to Amalgamated #54531 or deeper. “Concrete” boxes shall have a 13 mm vertical clearance between knockouts and reinforcing bars. No “concrete” box shall be shallower than 50 mm.

2.1.3 Sectional type boxes shall not be used except for switches or duplex outlets in walls of frame construction. No box smaller than a #1004 box shall be used. #1104 and #1102 boxes shall not be used. Sectional boxes shall not be used for thermal switches (manual motor starters) or for any device that will overcrowd the box.

2.1.4 Condulet conduit fittings shall be cast aluminum complete with threaded hubs, solid gaskets and cast covers, Crouse-Hinds form 7 or approved alternate.

2.1.5 Terminals are to be supplied in junction boxes for control wiring where more than 6 conductors are to be spliced. Terminals to be spring cage type Phoenix ST6 or approved alternate.

2.1.6 All surface mounted junction boxes installed outdoors shall be sheet steel, hinged, CSA Type 4 or 4X, fully gasketted, unless otherwise specified. CSA Type 4X enclosures to be used in hazardous and Category 2 locations unless otherwise detailed. CSA Type 12 enclosures to be used in general rated areas unless otherwise detailed.

2.1.7 Square or octagonal prepunched boxes shall not be used.

PART 3 EXECUTION

3.1 Installation

3.1.1 Wherever necessary for the proper pulling or anchoring of cables, junction boxes, or cable anchor boxes shall be installed. All shall be installed so as to be accessible after the building is completed.

3.1.2 Provide all pull boxes and junction boxes as shown on the drawings required for particular job conditions or specified by the Canadian Electrical Code.

3.1.3 Each light, switch, wall plug, or other outlet shall be provided with an outlet box. All outlet boxes shall be adapted to their respective locations and shall be supported independently of the conduit. Not more than four conduits shall enter an outlet box.

3.1.4 Each wire entering a box shall be left with at least 200 mm of wire clear of the box after splicing to facilitate future alterations. Through wires in a box shall have 150 mm between the box and the bottom of the loop.

3.1.5 Outlet boxes shall be fastened with screws to a properly secured header at the back of the box.

3.1.6 Where conduits are exposed, condulets shall be used wherever required. Each conduit fitting shall be of a type suitable to its particular use, and of a type which allows for the installation of future conduits without blocking the covers of the existing condulets.

3.1.7 Where TECK cable, EMT or Rigid conduits enter or leave sheet steel junction boxes or panels of all types they shall be terminated using watertight connectors.

END OF SECTION 16130

PART 1 GENERAL

1.1 Related Work

1.1.1 Section 16010 - General Electrical Provisions

1.1.2 Division 15 - Installation of Mechanical Equipment Motors

1.2 Acceptable Suppliers

1.2.1 Motors

.1 General Electric;

.2 Hyundai;

.3 Reliance;

.4 Toshiba;

.5 US Motor; or

.6 Approved alternate.

PART 2 PRODUCTS

2.1 Motors

2.1.1 Motors less than 250 W or less shall be 120 V, single phase, 60 Hz, and all motors 370 W and greater shall be 575 V, three phase, 60 Hz. Refer to Motor Schedules for exact ratings.

2.1.2 All 3 phase motors shall have class F insulation with class B rise, 1.15 SF, high efficiency and high power factor.

2.1.3 If the motor comes complete with integral thermal protection, the motor shall use the integral protection provided by the manufacturer.

2.1.4 Notwithstanding 2.1.3, motors 37 kW and smaller shall be equipped with thermal winding temperature switches wired to separate terminal box unless otherwise specified.

2.1.5 Notwithstanding 2.1.3, motors 45 to 93 kW shall be equipped with thermistor winding temperature detectors wired to separate terminal box unless otherwise specified.

2.1.6 Notwithstanding 2.1.3, motors 112 kW and larger shall be equipped with 100 Ohm platinum RTD winding temperature detectors wired to separate terminal box unless otherwise specified.

2.1.7 Motor enclosures shall be ODP unless otherwise indicated.

2.1.8 Two speed motors shall be two winding design.

2.1.9 Motors powered by AC Variable Speed Drives (Inverter Grade)

.1 Motors shall be designed for use on generic PWM waveform to meet NEMA MG1, Part 31, Section 31.40.4.2.

.2 Motors shall be capable of operating a variable torque load over a 5:1 speed range.

.3 Motors shall be marked to CSA C22.2 No. 100-95 clause 12.4 and have in addition to the normal motor marking:

.1 motor application (e.g. Inverter-duty);

.2 speed range over which the machine is designed to operate;

.3 type of torque application for which the machine is designed e.g. VT (variable torque), CT (constant torque), CHp (constant horsepower) or equivalent; and

.4 type of inverter it is designed for e.g. PWM (pulse width modulated).

2.1.10 Where identified in the detailed drawings or specified herein, provide motors with overtemperature / leak detection sensors, relays, and/or controllers. Install as per drawings and specifications.

2.2 Motorized Actuators

2.2.1 General

.1 Provide motor operators including the motor, power gearing, torque switches and auxiliary handwheel or chain-operated handwheel, as a self-contained unit for the motor operated valves as shown on the drawings.

.2 Power gearing enclosures shall be of cast aluminum and gears shall run in oil or grease. Fill and drain plugs shall be provided for oil and bottom head lubrication fittings for grease.

.3 Operator shall be furnished with handwheel or chain-operated handwheel for emergency manual operation. The handwheel shall not rotate when motor is energized. Motor rotor shall not rotate when handwheel is in use.

.4 The handwheel shall engage by means of an automatic declutching device. Handwheels shall not require more than 180 N pull at the rim to operate.

.5 Electric motors shall be CSA approved, totally enclosed, non-ventilated with Class B insulation and windings specially impregnated to prevent moisture absorption. Motors shall operate on 600 volt 3 phase, 60 hertz power and shall be capable of 1,200 starts per hour on modulating duty.

.6 A thermal protector, CGE Thermo-Tector or approved alternative shall be embedded in the windings to stop the motor on over-heating. The motor shall be de-energized in the event of a stall.

PART 3 EXECUTION

3.1 Installation

3.1.1 Confirmation and coordination are required for final connections, loads and locations of motors, prior to installation.

3.1.2 Motors for mechanical equipment installed by that trade. Location of motors, conduit and connection points shown for equipment supplied by the mechanical trade are for estimating purposes only.

3.1.3 Provide line voltage connections for all mechanical equipment.

3.1.4 Use liquid tight flex for all motor connections from conduit systems.

3.1.5 Confirm proper nameplate markings before hooking up motors intended for use with AC variable speed drive.

3.1.6 Confirm that two speed motors are of the isolated, two winding design. If not isolated winding advise ENGINEER and do not terminate.

END OF SECTION 16150

PART 1 GENERAL

1.1 Related Work

1.1.1 Section 16010 - General Electrical Provisions

1.1.2 Section 16122 - Wire and Cable

1.1.3 Section 16130 - Boxes and Condulets

PART 2 PRODUCTS

2.1 Materials

2.1.1 Pressure type wire connectors: with current carrying parts of copper or copper alloy sized to fit copper conductors as required.

2.1.2 Fixtures type splicing connectors: with current carrying parts of copper alloy sized to fit copper conductors 10 AWG or less.

2.1.3 Connectors: Tin plated Burndy, or equal, copper short barrel, one hole, compression type sized to suit copper conductor required for 480 or 600 Volt, 3 phase power terminations.

PART 3 EXECUTION

3.1 Installation

3.1.1 Remove insulation carefully from ends of conductors and:

.1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation to meet secureness tests in accordance with CSA C22.2 No. 65-M1988.

.2 Install fixture type connectors and tighten. Replace insulating cap.

END OF SECTION 16151

PART 1 GENERAL

1.1 Related Work

1.1.1 Division 1 - General Requirements

1.1.2 Section 16010 - General Electrical Provisions

1.1.3 Section 16111 - Conduit

1.1.4 Section 16130 - Boxes and Condulets

PART 2 PRODUCTS

2.1 Conduit Supports

2.1.1 Single runs: Galvanized conduit straps, Gripple or ringbolt type hangers.

2.1.2 Multiple runs three or more: Conduit rack with 25% spare capacity.

2.1.3 Vertical runs: Channel support with conduit fittings.

2.2 Support Channels

2.2.1 U shape, size 41 X 41 mm, 2.5 mm thick, surface mounted, suspended, set in poured concrete walls and ceilings.

PART 3 EXECUTION

3.1 Installation

3.1.1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors.

3.1.2 Secure equipment to poured concrete with expandable inserts.

3.1.3 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

3.1.4 Fasten exposed conduit or cables to building construction or support system using straps.

.1 One-hole malleable iron straps to secure surface conduits and cables 50 mm and smaller.

.2 Two-hole steel straps for conduits and cables larger than 50 mm.

.3 Beam clamps to secure conduit to exposed steel work.

3.1.5 Suspended support systems.

.1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips or Gripple hangers.

.2 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod or Gripple hangers where direct fastening to building construction is impractical.

3.1.6 For surface mounting of two or more conduits use channels at 1.5 m on center spacing.

3.1.7 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

3.1.8 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

3.1.9 Do not use wire lashing or perforated strap to support or secure raceways or cables.

3.1.10 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of ENGINEER.

3.1.11 Install fastening and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

3.1.12 Install to maintain headroom, neat mechanical appearance and to support equipment loads required.

3.1.13 Where inserts are required in concrete, lead inserts may be used in drilled holes. Wood or fiber plugs are not permitted. Shot driven pins shall NOT be used.

3.1.14 Install supports as required for mounting equipment such as HOA/pushbuttons, small panels and field instruments where building structural supports are not within close proximity to equipment location.

END OF SECTION 16190

PART 1 GENERAL

1.1 Related Work

1.1.1 Section 16030 - Testing

1.1.2 Section 16210 - Generator

1.1.3 Section 16220 - Engine

1.1.4 Section 16230 - Cooling Equipment

1.1.5 Section 16240 - Exhaust Equipment

1.1.6 Section 16250 - Starting System

1.1.7 Section 16260 - Automatic Transfer Equipment

1.1.8 Section 16270 - Alarms and Instrumentation

1.2 Description

1.2.1 This section specifies the requirements for the supply, testing, and commissioning of a complete power generation unit.

1.2.2 The generating unit shall consist of an engine directly coupled to an AC generator complete with cranking batteries, battery charger, vibration isolators, flexible connectors for fuel and exhaust piping, exhaust silencer, control panel, direct driven pusher fan/radiator, skid base for both the engine.

1.2.3 The generator shall be housed in an outdoor, weather-rated enclosure. Access to all service points is to be unrestricted and follow all OH&S and relevant electrical codes.

1.2.4 The generator sound attenuation equipment (muffler, intake, etc) shall reduce the noise from the generator operating at full load to 76 dB or less at a 7 m distance from the building exterior.

1.2.5 The generator set and associated controls shall be supplied in as near to complete operating condition with all necessary components, safety devices, fan guards, connections, lubricants, etc., whether or not each and every individual item is specified.

1.2.6 Included in the work of this section shall be responsibility for supplying dimensional and quantity data for anchor bolt locations plus supplying all washers, nuts, and bolt studs to be welded to bearing plates and set into the concrete base as required.

1.2.7 Included in the work of this section shall be the responsibility for supplying dimensional data on all pertinent equipment as well as fuel system sizing data and expected noise levels under full load operating conditions.

1.2.8 Included in the work of this section shall be the responsibility for the supply of dimensional data of the required ductwork connection at the radiator, details of air flow requirements, exhaust silencer weight and dimensions with exhaust back pressure requirements.

1.2.9 The generator shall be fed via connection to natural gas utility line. CONTRACTOR shall ensure that gas lines are sized appropriately. Notify ENGINEER of any conflicts prior to shop drawing reviews.

1.2.10 Included in the work of this section shall be the responsibility for supplying all access platforms required to access any doors or generator maintenance entries into the enclosure at an ergonomic height for the operator.

1.3 Quality Assurance

1.3.1 The engine generator supplier shall pay all expenses for factory testing, to confirm that it will meet the specification requirements under 'Site Conditions' prior to shipment.

1.3.2 The engine generator set shall be load tested a minimum of two (2) hours, at 100% full load using resistor load banks with block loading in increments of 10% to full load.

1.3.3 All factory test results to be on-site when engine generator is being commissioned.

1.3.4 Factory representative to be on site when unit is being commissioned.

1.3.5 Manufacturer to submit list of standard tests to the ENGINEER. Additional tests may be requested by the ENGINEER.

1.3.6 Commissioning shall include load tests using site loads.

1.4 Submittals

1.4.1 Submit shop drawings, factory test reports, and maintenance manuals as required.

1.4.2 When submitting shop drawings, the following data is to be included:

.1 Engine test data and correction table/derating curves. Cooling air flow requirements. Fuel and exhaust systems. Details of control equipment components and wiring diagrams.

1.5 Pre-approved Suppliers

1.5.1 Cummins;

1.5.2 Kohler;

1.5.3 CAT/Finning; or

1.5.4 Approved alternate.

PART 2 PRODUCTS

2.1 Components

2.1.1 Individual components are listed in appropriate section.

2.1.2 Supplier shall provide padlocks as defined by the OWNER requirements.

PART 3 EXECUTION

3.1 N/A

END OF SECTION 16200

PART 1 GENERAL

1.1 Related Work

1.1.1 Section 16200 - Power Generation

1.1.2 Section 16220 - Engine

1.1.3 Section 16260 - Automatic Transfer Equipment

1.1.4 Section 16270 - Alarms and Instrumentation

1.2 Reference Standards

1.2.1 Manufacture unit to EEMAC, NEMA, IEEE, and ANSI Standards.

1.3 Submittals

1.3.1 Refer to Section 16200 - Power Generation.

PART 2 PRODUCTS

2.1 Components

2.1.1 Generator minimum capacity: 125 kW, .8 power factor, 347/600 V, 3 phase, 3 wire, 60 Hz, 1800 rpm.

2.1.2 The generator shall be four pole, brushless exciter with pilot excited PMG, single bearing. Class H insulation, temperature rise shall not be greater than 140 °C. Telephone influence factor to be less than 150 per NEMA MG1.22.43 latest edition.

2.1.3 A generator mounted solid state voltage regulation with ±2% from no load to full load readily accessible voltage drop, voltage level and voltage gain control to be provided. Voltage level to be a minimum of ±5%.

2.1.4 The generator shall be equipped with recommended rated molded case lockable disconnect on the generator with lugs suitable for #3/0 (minimum).

2.1.5 Generator control panel, see Section 16270 - Alarms and Instrumentation.

PART 3 EXECUTION

3.1 Installation

3.1.1 Provide terminal box for generator and exciter leads c/w current and potential transformers as required.

3.1.2 Install unit complete and make operational.

3.1.3 The generator to be machined aligned with ±.0254 mm (±.001 of an inch) with unit.

3.1.4 The skid for both engine and generator to be wide flange 1 channel, cross braced, tapered both ends, with pulling pipe, welded construction. Installation complete with vibration isolator capable of 97% isolation efficiency.

END OF SECTION 16210

PART 1 GENERAL

1.1 Related Work

1.1.1 Section 16031 - Electrical Spare Parts and Maintenance Materials

1.1.2 Section 16200 - Power Generation

1.1.3 Section 16210 - Generator

1.1.4 Section 16230 - Cooling Equipment

1.1.5 Section 16240 - Exhaust Equipment

1.1.6 Section 16250 - Starting Equipment

1.1.7 Section 16270 - Alarms and Instrumentation

1.2 Submittals

1.2.1 Refer to Section 16200 - Power Generation.

PART 2 PRODUCTS

2.1 Design/Components

2.1.1 Engine to be operating at 1,800 rpm, water cooled, 4 cycle. Both in-line and vee type acceptable.

2.1.2 Capacity: 100 % continuous standby operating on natural gas fuel at 880 m altitude at an ambient temperature of 40 °C.

2.1.3 Governor: speed regulation 3 cycles maximum from "No Load" to "Full Load" with two second maximum recovery to steady state. Governor to be solid state type used for synchronizing.

2.1.4 Engine block heater for 120 or 208 V(ac), single phase, thermostatically controlled to maintain engine temperature to meet startup requirements of NFPA 99.

2.1.5 Engine coolant heater for 120 or 208 V(ac), single phase, thermostatically controlled to prevent coolant from going below 4 °C.

2.1.6 Accessories: provide all replacement type oil filters, dry type air cleaners, automatic choke, lubricating oils and greases, etc. See Section 16031 - Electrical Spare Parts and Maintenance Materials for specific requirements.

2.1.7 Engine shall have oil drain extension with shutoff valve to outside skid.

2.1.8 The engine shall have an electrical solenoid fuel shut-off valve, 24 V(dc) coil, full port, suitable for diesel fuel. Solenoid to open on engine run as required.

2.1.9 The engine shall have an anticipated high coolant temperature, low oil pressure, high oil pressure alarms, low battery charge.

2.1.10 Unit shall be 12 V(dc) or 24V(dc) start.

2.1.11 Engine shall have a digital ignition system.

2.1.12 See Section 16270 - Alarms and Instrumentation for alarms.

2.1.13 Sound level rating not to exceed that outlined in Section 16200.

PART 3 EXECUTION

3.1 Installation

3.1.1 Manufacture unit complete and make operational.

3.1.2 The engine and generator shall be aligned within ±.0254 mm (±.001 of an inch).

3.1.3 The skid for both generator and engine to be wide flange 1 channel cross braced tapered both ends with pull pipes.

END OF SECTION 16220

PART 1 GENERAL

1.1 Related Work

1.1.1 Section 16200 - Power Generation

1.1.2 Section 16210 - Generator

1.1.3 Section 16220 - Engine

PART 2 PRODUCTS

2.1 Components

2.1.1 Engine - self-contained water to air radiator, set mounted with pusher type fan driven directly from engine to maintain safe jacket water operating temperature for unit under full load conditions.

2.1.2 The coolant shall be 50-50 mixture of glycol and treated water.

2.1.3 Radiator for 40 °C inlet air temperature.

2.1.4 Fan guards.

2.1.5 Low coolant level switch.

2.1.6 Radiator duct flange.

PART 3 EXECUTION

3.1 Installation

3.1.1 The generator supplier shall advise the ENGINEER in writing prior to tender close if either the air flow allowance is inadequate and/or the pressure restriction is excessive for application with his engine/generator to the building envelope/louver design.

END OF SECTION 16230

PART 1 GENERAL

1.1 Related Work

1.1.1 Section 16200 - Power Generation

1.1.2 Section 16210 - Generator

1.1.3 Section 16220 - Engine

PART 2 PRODUCTS

2.1 Components

2.1.1 Muffler: one (1) critical grade (to attenuate no less than 40 dB), completely sealed metal, primed finish, drain valve connection.

2.1.2 Adapter assembly shall suit engine to muffler piping.

2.1.3 Piping and Insulation as required for enclosure installation. Exhaust tip to be directed out of the enclosure as per manufacturer standards, with appropriate cap to prevent entry by animals/dirt/etc.

2.1.4 Insulate all exposed exhaust components as recommended

2.1.5 Flexible stainless steel vibration break, gas proof, seamless, threaded connections, minimum 600 mm long.

PART 3 EXECUTION

3.1 Installation

3.1.1 Insulate all exposed exhaust components as recommended by the manufacturer.

END OF SECTION 16240

PART 1 GENERAL

1.1 Related Work

1.1.1 Section 16200 - Power Generation

1.1.2 Section 16220 - Engine

1.1.3 Section 16270 - Alarm and Instrumentation

PART 2 PRODUCTS

2.1 Components

2.1.1 Battery Bank: lead acid, capacity suitable for three consecutive starting cycles on an eight-hour basis for engine/generator unit.

2.1.2 Battery cables suitable length between battery and starter.

2.1.3 Battery Charger: constant potential type with manual and automatic control for mounting inside of generator enclosure, complete with DC ammeter, volt meter, overload protection, AC input switch, pilot switch for AC "On", equalizing charge and high rate charge, with full charging period of 24 hours.

PART 3 EXECUTION

3.1 Operation

3.1.1 Stop/start sequence: in automatic position, auxiliary contacts in transfer switch initiates three (3) starting cycles of 15 seconds ON/15 seconds OFF, after which if engine fails to start, trouble circuit contacts close illuminating appropriate trouble annunciator window and locking out starting cycle until manually reset. On starting of engine, starting circuits automatically reset. On resumption of normal power after time delay in transfer switch, load to retransfer to normal supply and following rundown period of 5 minutes engine shall shutdown and return to starting condition.

3.1.2 Battery Units: housed on or adjacent to GenSet skid in own battery rack.

3.2 Installation

3.2.1 Battery shall be charged by engine alternator system when engine is running and charger to be connected to normal power supply protected with a 15 A single pole breaker.

3.2.2 Battery charger leads to batteries to be in conduit to terminal of battery.

END OF SECTION 16250

PART 1 GENERAL

1.1 Description

1.1.1 Fully Automatic load transfer system which senses utility failure, initiates generator start sequence, and transfers load under correct parameters; and reverses the sequence when utility power becomes available.

1.2 Related Work

1.2.1 Section 16010 - General Electrical Provisions

1.2.2 Section 16210 - Generator

1.2.3 Section 16220 - Engine

1.2.4 Section 16250 - Starting System

1.2.5 Section 16270 - Alarm and Instrumentation

PART 2 PRODUCTS

2.1 Equipment

2.1.1 CONTRACTOR to coordinate with MCC and generator vendors for transfer switch equipment that meets all requirements outlined herein.

2.1.2 The Automatic Transfer System (ATS) shall be provided by the CONTRACTOR, and shall be installed integral to the MCC lineup. The CONTRACTOR shall notify the ENGINEER of any conflicts regarding equipment installation.

2.1.3 The ATS shall be contain FORM C contacts capable of producing ATS On Utility; ATS On Emergency; Utility Power Available; and Emergency Power Available statuses, to be hardwired into the site PLC as per the detailed drawings.

PART 3 EXECUTION

3.1 Operation

3.1.1 Automatic start-up once normal power falls below 90% of rated line voltage.

3.1.2 Transfer when standby unit reached 90% of rated voltage.

3.1.3 Retransfer to normal supply after time delay (user defined, adjustable), when normal power is resumed.

3.1.4 Engine rundown period of "No Load".

3.1.5 Engine shutdown.

3.1.6 Operating sequences automatically reset.

END OF SECTION 16260

PART 1 GENERAL

1.1 Description

1.1.1 Provide audio and visual alarms in accordance with Section 46 of the Canadian Electrical Code and the electrical inspection authority.

1.2 Related Work

1.2.1 Section 16200 - Power Generation

1.2.2 Section 16210 - Generator

1.2.3 Section 16220 - Engine

1.2.4 Section 16250 - Starting System

1.2.5 Section 16260 - Automatic Transfer Equipment

PART 2 PRODUCTS

2.1 Engine/Generator Control Panel

2.1.1 Provide one engine generator control panel in a totally enclosed ventilated enclosure, code gauge metal panel tailpiece mounted, finished in enamel over corrosion resistant primer, complete with hinged door.

2.1.2 The panel shall incorporate the following: engine alarm and instrumentation package (as per manufacturer requirements), generator alarm and instrumentation package (as per manufacturer requirements).

2.1.3 Control panel shall be equal to Cummins PowerCommand 2100 or Kohler Decision-maker 550.

2.1.4 Control Panel shall have a FORM C Contact for the following outputs: Run Status, Fault Status.

2.1.5 If the generator controller does not support EtherNet/IP communications protocol by default, the CONTRACTOR shall supply and install an EtherNet/IP protocol convertor inside of the generator control panel, as per the direction of the generator manufacturer. Notify the ENGINEER of any communications conflicts. Communications shall provide the following signals, as a minimum:

1. Genset running
2. Genset not in auto
3. Genset fault - common alarm
4. Genset high temperature warning
5. Genset high temperature shutdown
6. Genset low oil pressure warning
7. Genset low oil pressure shutdown
8. Genset overcrank
9. Genset overspeed
10. Genset low engine/coolant temperature (block heater not working)
11. Genset low coolant level
12. Genset low fuel shutdown
13. Genset low battery voltage
14. Genset high battery voltage
15. Genset battery charger fault
From Fuel tank:
1. Point (discrete) level points - low low, low, high, high high
2. Fuel tank leak/rupture
3. Analog level - 0 to 100 percent

PART 3 EXECUTION

3.1 Installation

3.1.1 Auto start shall be from contact of transfer switch in MCC.

3.1.2 Communications to be wired between the generator and the PLC cabinet.

3.1.3 Set engine cooldown timer at 5 minutes on return to normal power.

END OF SECTION 16270

PART 1 GENERAL

1.1 Description

1.1.1 Uninterruptible power source built to all current codes and standards.

1.2 Related Work

1.2.1 Division 1 – General Requirements

1.2.2 Section 13310 - Control Panels

1.2.3 Section 16010 - General Electrical Provisions

PART 2 PRODUCTS

2.1 Central UPS System

2.1.1 Minimum UPS Input requirements:

.1 120 Volts, 1 phase, 60 Hz. (Range – 89 to 151 VAC, 56.5 to 70 Hz)

.2 1 x Nema 5-15P plug with cord.

2.1.2 Minimum UPS Output requirements:

.1 120 VAC, 60 Hz, minimum PF 0.7

.2 4 x Nema 5-15R receptacles.

2.1.3 Minimum UPS performance requirements:

.1 On Battery Runtime: 30 minutes under half load and 15 minutes under full load.

.2 User Interface: LED lights, 1 USB Port, 1 RS-232 Port with Relay Contacts.

.3 Operational temperatures: 0 to 35°C.

.4 Certification: ULC or CSA.

.5 Installed inside of the main control panel.

.6 Eaton Powerware series or equivalent.

.7 See engineered drawings for additional requirements and details.

PART 3 EXECUTION

3.1 Installation

3.1.1 Install factory built unit in PLC control panel supplied by the CONTRACTOR.

3.1.2 Hardwire both input and output as required by the CONTRACTOR.

END OF SECTION 16270

PART 1 GENERAL

1.1 Related Work

1.1.1 Section 16010 - General Electrical Provisions

1.1.2 Section 16110 - Underground Electrical Ducts

1.1.3 Section 16122 - Wire and Cable

1.1.4 Section 16450 - Grounding

1.2 Coordination with Power Supply Authority – Lift Station

1.2.1 Coordinate and meet all requirements of power supply authority. Ensure availability of power when required. Site contracts will be negotiated with Fortis Alberta by the CONTRACTOR. The CONTRACTOR shall be responsible for all costs associated with installation of transformer, concrete pad, bollards and rails, transformer vault, grounding, and any primary/secondary trenching per utility standards as required. This includes but is not limited to the installation of all required conduit inside the site property line. The transformer door location (orientation of transformer) is to be confirmed with Fortis Alberta. A primary 4” (103mm) conduit shall be supplied and installed in accordance with Fortis Alberta Specifications and Sections 16110 and 16402 for routing of primary cable.

1.2.2 It should be noted that Fortis Alberta requires an inspection of the following:

.1 All underground conduits to the transformer pad;

.2 Concrete transformer pad;

.3 Grounding grid.

1.2.3 Power supply authority will provide, including supply and installation of, the following at the McKay Ranch Lift Station:

.1 Primary cable;

.2 Transformer on pad; and

.3 Utility meter.

1.2.4 Coordinate with Fortis Alberta prior to the start of any construction.

1.2.5 The CONTRACTOR shall provide all conduits required to the connection point; the concrete vault/pad; all secondary cables; and all bollards and rails.

1.2.6 CONTRACTOR shall coordinate an inspection of the concrete transformer pad, grounding grid, and any underground conduit to the transformer pad prior to backfilling, with Utility. If this is not completed, the CONTRACTOR will be directed to expose the duct, pad and grounds to perform the inspections as required.

1.2.7 CONTRACTOR shall supply a meter base socket c/w test switch as part of padmount metering in accordance with the design drawings and the Utility requirements. Coordinate with Utility for acceptable products.

1.2.8 Temporary Power at the Lift Station shall be the responsibility of the CONTRACTOR. The CONTRACTOR shall be responsible for all coordination, fees, expenses and usage of temporary power at site.

1.2.9 Coordinate with Utility for transformer grounding requirements.

1.2.10 Refer to Utility standards for bollard requirements.

PART 2 PRODUCTS

2.1 Materials

2.1.1 Underground ducts: type FRE size as indicated, to Section 16110 - Underground Electrical Ducts.

2.1.2 Copper conductors type RW-90 X-Link to Section 16121, size as indicated in detailed drawings.

2.1.3 Meter base socket, complete with test switch (if required), shall be installed. See Utility standards for details.

PART 3 EXECUTION

3.1 Installation

3.1.1 Install ducts in trenches in accordance with Section 16110 - Underground Electrical Ducts.

3.1.2 Provide guardrail around transformer to requirements of power supply authority.

3.1.3 Space ducts in trench as per CEC configuration diagram B4-4.

3.1.4 Allow adequate conductor length for connection to supply by power supply authority.

3.1.5 Allow adequate conductor length for connection to service equipment.

3.1.6 Make grounding connections in accordance with Section 16450 - Grounding.

3.1.7 Install Utility meter socket using padmount metering configuration as outlined in the Utility standards. Coordinate with Utility.

END OF SECTION 16402

PART 1 GENERAL

1.1 Related Work

1.1.1 Section 13310 - Control Panels

1.1.2 Section 16010 - General Electrical Provisions

1.1.3 Section 16110 - Underground Electrical Duct System

1.1.4 Section 16111 - Conduit

1.2 Description

1.2.1 Install a complete grounding system as indicated and in accordance with the Canadian Electrical Code and Electrical Inspection authority having jurisdiction. All Grounding System Provisions shall meet or exceed the requirements set out in the Canadian Electrical Code Part 1, Section 10, Grounding and Bonding.

1.3 Reference Standards

1.3.1 Canadian Electrical Code.

1.3.2 IEEE/ANSI Standard 142-1982.

1.3.3 Equipment to CSA C22.2 No. 41.

1.4 Quality Assurance

1.4.1 Perform continuity and resistance tests using method appropriate to site conditions and to the approval of the local inspection authority.

1.4.2 Perform all tests prior to energizing electrical system.

PART 2 PRODUCTS

2.1 Materials

2.1.1 Clamps for grounding of conductor, size as indicated to electrically conductive underground water pipe.

2.1.2 Rod electrodes, copper clad steel 19 mm dia. by 3 m long, driven rods unless otherwise indicated.

2.1.3 System and circuit, equipment, grounding conductors, bare stranded copper, un-tinned, soft annealed, un-armored, size as indicated.

2.1.4 Insulated grounding conductors: type TW75, size as indicated.

2.1.5 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 Compression type conductor connectors. Burndy/T&B compression type where possible.

.5 Bonding jumpers, straps.

.6 Pressure wire connectors.

2.1.6 Connectors: Tin plated “Burndy”, or equal, copper short barrel, one hole compression type for connection to ground bars, motors, pipes, valves, vessels, etc.

2.1.7 Cable tray grounding hardware: “Burndy”, or equal.

PART 3 EXECUTION

3.1 Installation

3.1.1 Install a complete permanent, continuous, system, circuit and equipment grounding and bonding system, including but not limited to electrodes, conductors, connectors, accessories, as indicated, to conform to the requirements of the ENGINEER, and local authority having jurisdiction over installation.

3.1.2 Where EMT is used, run ground wire in conduit.

3.1.3 Install connectors in accordance with manufacturer's instructions.

3.1.4 Protect exposed grounding conductors from mechanical injury.

3.1.5 Make buried connections, and connections to conductive water main and electrodes, using compression connectors.

3.1.6 Use mechanical connectors for grounding connections to equipment provided with lugs.

3.1.7 Soldered joints not permitted.

3.1.8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

3.1.9 Install separate ground conductor to outdoor lighting standards.

3.1.10 Water piping shall be grounded as required by code.

3.1.11 Gas piping shall be grounded as required by code.

3.1.12 Metallic waste water piping shall be grounded as required by code.

3.1.13 In all cases where conduit is run underground or encased in concrete, a ground wire shall be run inside conduit. In these cases the conduit shall not be used as the ground path.

3.1.14 All ground wire to be installed in 21 mm PVC conduit when leaving cable tray, wall slab, floor slab or ground level. PVC conduit to extend within 150 mm of connection point. Provide conduit bushing.

3.1.15 All buried ground wire to be in 100 mm trench a minimum 650 mm below finished grade.

3.1.16 The ground grid shall also be connected to provide a resistance to ground which does not exceed 1 ohm under the most unfavorable weather conditions. This resistance must be checked with a 0-20 ohm earth megger and the value obtained, along with ground lengths used, recorded in a test report.

3.2 Electrodes

3.2.1 Make ground connections to continuously conductive underground water pipe on street side of water flowmeter.

3.2.2 Bond separate, multiple electrodes together.

3.2.3 Use size 4/0 AWG copper conductors for connections to electrodes unless otherwise specified.

3.3 System Grounding

3.3.1 Provide system grounding at each voltage level as required by the Canadian Electrical Code. Connect transformer neutral to ground as indicated in the detailed drawings.

3.4 Circuit Grounding

3.4.1 Install grounding bushings with grounding studs and grounding jumpers at all distribution centers, pull boxes, motor control centers and panel boards where separate grounding conductors are indicated.

3.4.2 Use only SST hardware with a serrated lock washer between panel steel, bus bar etc. and bolting hardware.

3.5 Equipment Bonding

3.5.1 Install bonding jumpers as per Canadian Electrical Code (latest version), sized for overcurrent devices protecting the wire, attached to the grounding bushings on conduits, to lugs on boxes, tubs, and other enclosures. Make connections to neutrals only at the service neutral bar.

3.6 Communication Systems

3.6.1 Install separate grounding rod to connect radio antenna sheath directly to ground to mitigate potential lightning strike damage.

END OF SECTION 16450

PART 1 GENERAL

1.1 General

1.1.1 This Section applies to starters which are to be supplied by the CONTRACTOR to install into Motor Control Centers or control panels.

1.2 Shop Drawings and Product Data

1.2.1 Submit shop drawings in accordance with Section 01330 - Submittal Procedures.

1.2.2 Indicate:

.1 Mounting method and dimensions.

.2 Starter size and type.

.3 Layout of identified internal and front panel components.

.4 Enclosure types, with external and internal dimensional drawings.

.5 Schematic and wiring diagram for each type of starter with identification specific to each unit.

.6 Interconnection diagrams.

1.3 Closeout Submittals

1.3.1 Provide operation and maintenance data for motor starters for incorporation into O&M manual specified in Section 01780 - Closeout Submittals.

1.3.2 Include operation and maintenance data for each type and style of starter.

1.4 Extra Materials

1.4.1 Provide listed spare parts for each different size and type of starter as per the requirements of Section 16031 - Electrical Spare Parts and Maintenance Materials.

PART 2 PRODUCTS

2.1 Materials

2.1.1 Starters: to CAN/CSA-C22.2 NO. 14-05.

2.2 Manual Motor Starters

2.2.1 Single and three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:

.1 Switching mechanism, quick make and break.

.2 One overload heater per phase, manual reset, trip indicating handle.

2.2.2 Accessories:

.1 Toggle switch: standard labeled as indicated.

.2 Indicating light: standard type and colour as indicated.

.3 Locking tab to permit padlocking in "ON" or "OFF" position.

2.3 Full Voltage Non Reversing Magnetic Starters

2.3.1 Combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:

.1 Contactor solenoid operated, rapid action type with auxiliary contacts as indicated.

.2 Electronic motor overload protective device for all three phases, manually reset from outside enclosure with ambient compensation, selectable trip class, phase loss, ground fault and jam protection as a minimum.

.3 Wiring and schematic diagram inside starter enclosure in visible location.

.4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.

2.3.2 Combination type starters to include motor circuit interrupter with operating lever on outside of enclosure to control motor circuit interrupter, and provision for:

.1 Locking in "OFF" position with up to 3 padlocks.

.2 Independent locking of enclosure door.

.3 Provision for preventing switching to "ON" position while enclosure door open.

2.4 Control Transformer

2.4.1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V(ac) secondary, complete with secondary fuse, installed in with starter as indicated.

2.4.2 Size control transformer for control circuit load plus 20% spare capacity.

2.5 AC Control Relays

2.5.1 Control relays (tag R or CR) for control and instrument panels shall be plug-in types with clear polycarbonate covers, 120 V(ac), 60 Hz, unless otherwise indicated on the drawings.

2.5.2 Plug-in relays shall have a minimum contact rating of 10 A, mechanical life expectancy 10 million operations, operating temperatures -45° to +50°C, dielectric strength 1,500 V(ac) for 1 minute, electrical spacing 1.6 mm minimum through air, 3 mm minimum over surfaces between current carrying parts.

2.5.3 The exact type of relay shall be determined from the number of contacts used as shown on each control diagram as indicated on the drawings. The minimum number of contacts shall be DPDT. If more than three contacts are shown, parallel relays shall be used.

2.5.4 All relays to be provided with neon lamps to indicate whether the relay is energized or not.

2.5.5 Acceptable products: IDEC IZUMI RR Series or Releco.

2.6 Solid State Timing Relays

2.6.1 Time delay relays (tag TD) to be plug-in solid state, similar to Agastat, series SSC, delay on energization, delay on de-energization with instant switch transfer as required.

2.6.2 Refer to operating voltage, time ranges and contact arrangements as shown on the drawings.

2.6.3 All time delay relays to be provided with knob adjustment. Contact rating 10 Amps, temperature range -30°C to 65°C.

2.7 Pushbuttons

2.7.1 Standard, operator flush type, as indicated. Black with 1-NO and 1-NC contacts rated at 10 A, ac, labels as indicated. Stop pushbuttons coloured red, provision for padlocking in depressed position labeled “emergency stop”.

2.8 Selector Switches

2.8.1 Maintained 3 position labeled as indicated, standard, operators standard knob, contact arrangement as indicated, rated 120 V(ac), 10 A.

2.9 Indicating Lights

2.9.1 Standard LED cluster, transformer type, push-to-test, lens colour: as indicated, supply voltage: 120 V(ac), labels as indicated. Similar to Allen-Bradley, Bulletin 800, 800T-N77x.

2.9.2 Pilot light colors:

.1 Red – Off

.2 Amber – Fault

.3 White – Overload

.4 Green – Run

2.10 Finishes

2.10.1 Apply finishes to enclosure in accordance with Section 16010 - General Electrical Provisions.

2.11 Equipment Identification

2.11.1 Provide equipment identification in accordance with Section 16010 - General Electrical Provisions and Section 01180 - Identification Systems.

2.11.2 Manual starter designation label, type 2, engraved as indicated.

2.11.3 Magnetic starter designation label, type 2, engraved as indicated.

PART 3 EXECUTION

3.1 Installation

3.1.1 Install starters, connect power and control as indicated.

3.1.2 Ensure correct fuses are installed.

3.1.3 Confirm motor current to Vendor shop drawings prior to selecting overload trip range.

3.2 Field Quality Control

3.2.1 Perform tests in accordance with Section 16010 - General Electrical Provisions and manufacturer's instructions.

3.2.2 Operate switches, contactors to verify correct functioning.

3.2.3 Perform starting and stopping sequences of contactors and relays.

3.2.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

END OF SECTION 16680

PART 1 GENERAL

1.1 Related Work

1.1.1 Section 16030 - Testing

1.1.2 Section 16820 - Motor Control Centers

1.1.3 Section 16960 - Starting of Electrical Equipment and Systems by Manufacturer's Representative

1.1.4 Section 16970 - Electrical Startup and Commissioning

1.1.5 Section 16980 - Electrical Equipment Systems Demonstration and Instruction

1.2 Scope

1.2.1 Two (2) Variable Frequency Drives (VFDs) shall be furnished to supply variable frequency AC Power to the following loads as described in these specifications and detailed on the data sheets at the end of this section. VFDs shall be installed integral to the MCC lineup as per the detailed drawings.

1.2.2 Harmonic filters rated at 35 HP (minimum) shall be provided and installed as per the detailed drawings. Where possible, harmonic filters shall be installed within the VFD sections in the MCC lineup.

1.2.3 CONTRACTOR shall retain provisional space above VFD enclosures for future 60 HP harmonic filters.

1.2.4 The system may include control devices such as circuit breakers, fused switches, contactors and filters: Where applicable these shall be detailed on the data sheets.

1.2.5 Vendor shall supply factory trained field representatives to supervise installation and commissioning.

1.3 Codes and Standards

1.3.1 Design and construct the VFD in accordance with the applicable sections of the following standards or as modified in this specification.

.1 ANSI C84.1-1982 Voltage Ratings for Electric Power Systems and Equipment.

.2 CAN/CSA-C22.2 Industrial Control Equipment No. 14-M91

.3 ANSI C37-90.1-1989 Guide for Surge Withstand Capability Tests.

.4 Equipment shall be approved by a recognized certification agency.

.5 Equipment shall comply with the electrical bylaws of the local electrical authority.

.6 Equipment shall be designed and manufactured in compliance with ISO-9001 quality standards.

1.4 Acceptable Suppliers

1.4.1 Qualifications: service and parts facilities in Calgary or Edmonton with 24-hour service technicians, experienced in installation and operation of VFDs.

1.4.2 Approved suppliers:

.1 Eaton Cutler-Hammer – DG1 series;

.2 Schneider Electric – Square D;

.3 General Electric – Vacon drives;

.4 Allen Bradley; or

.5 An approved alternate.

1.5 Shop Drawings

1.5.1 Submit service and parts facilities information along with manufacturer's published technical data.

1.5.2 Full shop drawings to be submitted for VFD equipment, submit as a minimum:

.1 Specification and Data Sheets.

.2 Interconnection, wiring, and integration into MCC.

.3 Manufacturer’s published warranty documents.

.4 Shop drawings showing plan and elevation views with certified overall and interconnection point dimensions.

.5 Interconnection wiring diagrams showing all external connections required; with all field wiring terminals marked in a consistent manner.

.6 Manufacturer’s installation instructions.

1.6 Maintenance Manuals

1.6.1 Provide final copies of operation and maintenance (O&M) documents as per Section 16022, incorporating illustrated manual for operating and maintenance including electrical schematic and wiring diagrams, recommended procedures for replacement and spare parts list for complete unit. Manuals to include factory and field test results together with dated guarantee/warranty and approval certificates as required.

1.7 Testing

1.7.1 Provide complete system testing of the VFD in accordance with Section 16030 – Testing and Section 16960 - Starting of Electrical Equipment and Systems By Manufacturers Representative.

1.7.2 Include commissioning and startup documents signed by the factory service engineer in maintenance manuals.

PART 2 PRODUCTS

2.1 General

2.1.1 The VFD assembly shall consist of two (2) @ 35 HP (34 A) minimum. The drives shall be integral to the MCC lineup. Individual drives shall be complete with breaker or fused disconnects, drive, front panel interface module, output dV/dt filter, and harmonic filter installed integral to the VFD enclosure where possible. VFDs shall communicate with a remote PLC primarily by hard wired interface for automatic control, and with EtherNet/IP communications connection providing additional diagnostic functions, speed/torque feedback, etc. The CONTRACTOR shall provide Ethernet/IP protocol converters as required if the VFDs are not capable of communicating via Ethernet/IP protocol.

2.1.2 The drive vendor shall be responsible for coordinating the drive and motor characteristics which shall include, but not be limited to, the following:

.1 A guarantee that the drive and motor meet the load demands and acceleration requirements of the driven equipment throughout the speed range when the input voltage varies over a range of ±10%; and

.2 Ensuring complete compatibility of the drive’s current limit protection with the motor thermal withstand capability.

2.1.3 Input power shall be as specified on the VFD Data Sheet.

2.1.4 Filter(s) shall be provided when indicated on the Data Sheet.

2.1.5 Controlled acceleration and deceleration times, separately adjustable, shall be provided. When requested on the Data Sheet, the vendor shall provide adjustable damping for the response to speed change.

2.1.6 Separately adjustable minimum and maximum frequency limits shall be provided.

2.1.7 The drive shall be capable of regulating the frequency to a ±1% of the setpoint over the full input voltage and ambient temperature operating range.

2.1.8 The vendor data shall indicate the efficiency, power factor, kW output, heat rejection and harmonic distortion of the drive at 25%, 50%, 75% and 100% operating points.

2.1.9 Audible noise levels produced by the drive shall be limited to 80 dBA sound pressure at one meter, at any point throughout the operating range of the drive.

2.1.10 The drive input shall be protected to withstand surges as defined in ANSI Std. C37.90.1 - 1989, Guide for Surge Withstand Capability (SWC) Tests.

2.1.11 Where specified in the datasheets and in the detailed drawings, VFDs shall have leakage and temperature sensors installed within the VFD enclosure.

2.1.12 Refer to VFD schematic in detailed drawings for VFD wiring and construction requirements.

2.2 Construction Requirements

2.2.1 The drive enclosure shall be CSA type 1 (as a minimum) unless otherwise specified on the Data Sheet. Hinged, front access doors shall be provided.

2.2.2 The drive shall be complete with cable compartments for connection of incoming and outgoing cables.

2.2.3 When auxiliary cooling is required, the drive shall have fans and the required controls for proper operation.

2.2.4 Front panel interface module with LCD display and entry keypad to provide the following functions as a minimum:

.1 Drive setup parameters;

.2 Diagnostic information;

.3 Drive operating values;

.4 Local/ Remote control selection;

.5 Start/Stop operation while in Local mode; and

.6 Raise/Lower speed/rpm operation while in Local mode.

2.2.5 The drive shall have, as a minimum, circuits within the drive for connection of remote signals as follows:

.1 Drive permissive signal (lock out switch): normally closed contact, open to emergency stop drive, operable in remote or local control mode;

.2 Remote Run signal: normally open contact, closed for run and open for stop; and

.3 Remote Speed Reference signal: Isolated analog 4-20 mA input for speed setpoint from the plant control system.

2.2.6 The drive shall have additional functions as specified on the Data Sheet. Alarms must be latched in with first-out indication.

2.2.7 The diagnostic system shall monitor each alarm and shutdown function and shall display the status of each point on the front panel interface module.

2.2.8 The drive shall provide the following relay outputs (FORM C, rated 2 amp at 120 V(ac)) as minimum:

.1 Run Status, normally open; and

.2 Fault signal: normally open contact: closed for normal, open for fault or loss of VFD control power.

2.2.9 The drive shall provide at least one isolated 4-20 mA analog output that is programmable to frequency, speed, current, torque, or power factory configured for:

.1 Remote Speed Indicator: Isolated analog 4-20 mA output for speed feedback to the plant control system; and

2.2.10 Terminal blocks for control, alarms, metering and diagnostics shall each be readily accessible, grouped and shall be segregated from power devices, for personnel safety.

2.2.11 Each terminal block, fuse, control switch, circuit breaker, auxiliary switch, relay, instrument transformer and other auxiliary component shall be permanently labeled to correspond with the schematics and wiring diagrams.

2.2.12 When the presence of corrosive gases is specified on the Data Sheet, the equipment shall be protected against corrosion from the gases by the use of proper coatings and material selection. The use of bare copper or silver or their alloys should be avoided.

2.2.13 The shop drawing shall state what corrosion protection is provided.

2.2.14 The VFD shall contain an Emergency Stop Device (ESD), to be wired into the VFD as per the detailed drawings. ESD shall contain contacts to wire status signal back to PLC when pressed.

2.2.15 Drive enclosure face shall contain all required equipment identified within the detailed drawings.

2.3 Protection Systems

2.3.1 The drive shall be capable of withstanding up to 42 kA asymmetric short circuit current.

2.3.2 The drive shall be equipped with a minimum of 15 ms power loss ride-through capability.

2.3.3 The loss of AC input power longer than 15 ms shall cause the drive to shutdown in an orderly fashion, without causing pulsations in the drive or motor system.

2.3.4 The drive must be programmable to attempt a restart at set intervals to recover from power brown out conditions.

2.3.5 The drive shall have the capability of being restarted, including fault reset, with a remote signal from the PLC control system.

2.3.6 The drive shall not be affected by radio frequencies emitted by portable radios/transmitters.

2.3.7 The drive shall protect itself against the following as a minimum:

.1 Under/over voltage;

.2 Overcurrent;

.3 Overtemperature;

.4 Output short circuit;

.5 Output ground fault; and

.6 Stall.

2.3.8 Integrate a pump temperature and leakage monitoring system, including power and space within the VFD cabinet and install within the front door the VFD Cabinet if a display is provided. Control unit shall interlock the drive from operating in Manual or Automatic.

VARIABLE FREQUENCY DRIVE (VFD)
DATA SHEET

DRIVE I.D. RSP-001, RSP-002

VFD Assembly ☐ Stand Alone ☒ Part of MCC MCC-800

Site Conditions: ☒ Indoor ☐ Outdoor

Ambient Temp: Max: 30 °C; Min 5°C

Altitude: 880 m

☐ Corrosive Gases:

☐ Dust:

Input Data:

☒ Voltage: 600 Phase: 3 Frequency: 60 Hz

☒ Systems Transformer: 150 kVA Impedance: 5 %

System Neutral: ☒ Grounded ☐ Ungrounded ☐ Resistance Grounded 5 Amp

Short Circuit Level: 42 kA Sym. RMS on 600 V side.

Utility Harmonic Distortion Allowable for voltage: 5%

Utility Harmonic Distortion Allowable for current: 5%

Motor Data:

Supplied By ☐ Owner ☐ VFD Vendor ☒ Pump Vendor

Type: ☐ DC ☐ Std. AC ☐ High Eff AC ☐ Wound Rotor ☒ Inverter Duty AC

Voltage: 575 Current: 34 Phase: 3

H.P.: 35 Speed: 1770 SF: 1.00

Torque Design: B Insulation Class: F

Enclosure: ODP

Temp. Sensors: ☐ Thermistor ☐ RTD ☒ Pump MiniCAS II

Distance from VFD 20 metres

Load Data:

☒ Centrifugal ☐ Reciprocating ☐ Compressor

☐ Fan ☒ Pump ☐ Gear Reducer, Ratio

☐ Pos. Displ Pump ☐ Blower ☐ Belt Drive, Ratio

☐ Constant Torque ☒ Variable Torque ☐ Constant Power

☐ Hi Shock ☐ Pulsating ☐ Other

☐ Braking Required ☐ Regeneration Required

Speed Range: 60 to 100 %

☐ Soft Start

☒ Controlled Acceleration 0 - 10 Sec.

☒ Controlled Deceleration 0 - 10 Sec.

VFD Drive Data

Cables: Line Side 3c #2 AWG — Load Side: 3c #2 AWG
- ☒ Top Entry — ☒ Top Entry
- ☐ Bottom Entry — ☐ Bottom Entry

Line Disconnect:
- ☐ Not Required
- ☐ Fused Fuse: _____ Type: _____ A _____ V
- ☒ Breaker Rating: 100A Frame, 80A Trip

Drive Type: ☒ PWM ☐ VVI ☐ CSI ☐ LCI

☒ 6 Pulse ☐ 12 Pulse ☐ 18 Pulse ☒ Sine Coded PWM

Drive Frequency Range: 0.5 to 60 Hz

External Control Inputs:

Discrete: ☒ Dry Contact ☐ 120 VAC ☐ Other _____

Analog: ☐ Potentiometer ☒ 4-20 ma ☐ 0-10 Volts

Control Functions Required: ☒ enable, run/stop

Control Outputs: ☐ Ready ☐ Alarm ☒ Fault ☒ Status

☒ Analog Output ☒ 4-20 ma ☐ 1-5V

Programmed for: speed

Local Control:
- ☐ Keypad Control Panel With Digital Speed Control
- ☒ Keypad Control Panel With Potentiometer Speed Control
- ☒ Hand/Off/Auto selector switch with speed potentiometer.

Options:

Communication Interface: ☐RS422 ☐RS232 ☒ Others: EtherNet/IP

- ☒ Motor Overload Relay – Pump Monitor Controller
- ☒ Motor RTD Protection
- ☐ Motor Thermistor Protection
- ☒ AC Line Reactors: ☒ 3% ☐ 5% ☒ Harmonic Filter(s)
- ☐ Separate adjustable torque and current limits
- ☐ I^2t protection
- ☐ Electronic stall protection
- ☐ Max. Frequency and over speed protection
- ☐ Power outage ride through standard 3 cycle ☒ Power outage ride through 5 cycles
- ☐ Auto restart after trip ☒ Auto restart after power outage
- ☐ Output Isolation: ☐ Contractor ☐ Switch
- ☐ Bypass: ☐ Contactor ☐ Switch
- ☒ dV/dt filter at output ☐ AC Load Reactors: ☐ 3% ☐ 5%
- ☐ VFD line-up as an integrated MCC assembly
- ☒ Copper bus ☒ Tin Plated ☐ Silver plated joints

CLIENT: Town of Blackfalds **PROJECT NO.** _____
PROJECT: McKay Ranch Lift Station **REQUISITION NO.** _____
LOCATION: Town of Blackfalds, AB

Vendor Data Required:

Model/Type: _____ Cat. No.: _____
Service Factor: _____ Phase: _____

Dimensions: Length _____ Height: _____ Depth: _____

Weight of Drive Enclosure: _____ kg

Performance	100% Spd	75% Spd	50% Spd	25% Spd
Efficiency				
Power Factor AF[1]				
Output kW				
Harmonic (% THD)[2]				
Heat Rejection				

1. True power factor not displacement power factor

Additional Requirements:

.1 Services of a factory service representative to commission the VFDs are required.

PART 3 EXECUTION

3.1 Installation

3.1.1 Install variable speed drives in MCC lineup as indicated on the drawings.

3.1.2 Protect against dust and damage during entire construction period.

3.1.3 Make power and control connections.

3.2 Start-Up Testing and Commissioning

3.2.1 Retain the services of the manufacturer's representative for commissioning of the equipment after installation. Testing to be in accordance with Section 16030 -Testing, and shall include but not be necessarily limited to:

.1 All equipment shall be function tested, calibrated and load tested.

.2 Prior to performing any tests or applying power to the drives, verify all cable and wiring connections as well as equipment setup and mounting arrangements (i.e., foundation, cable entry, operation of the HMI etc.)

.3 Verify the interface with the facility's PLC control system.

END OF SECTION 16690

PART 1 GENERAL

1.1 Description of System

1.1.1 Provide a new incoming telephone service facility from property line to Lift Station in underground duct.

1.2 Related Work

1.2.1 Section 16010 - General Electrical Provisions

1.2.2 Section 16110 - Underground Electrical Ducts

1.2.3 Section 16111 - Conduit

1.2.4 Section 16122 - Wire and Cable

1.2.5 Section 16450 - Grounding

1.3 Job Conditions

1.3.1 Coordinate with telephone authority to ensure availability of service.

PART 2 PRODUCTS

2.1 Materials

2.1.1 Duct banks: to Section 16110 - Underground Electrical Ducts.

2.1.2 Grounding: to Section 16450 - Grounding.

2.1.3 Direct buried telephone cables: to Section 16122 - Wire and Cable.

PART 3 EXECUTION

3.1 Installation

3.1.1 Provide empty 53 mm PVC Conduit from telephone service entry point to telephone backboard in Lift Station Electrical Room. Install nylon pull cord in telephone service duct.

3.1.2 Provide 19 mm thick 900 mm x 900 mm G1S fir plywood backboard in Lift Station Electrical Room. Plywood to be painted with 2 coats of gray enamel on all sides.

3.1.3 Install #6 ground from ground grid to backboard

3.1.4 All telephone conduits terminating at backboard to terminate 75 mm below the top or 75 mm above the bottom of backboard.

3.1.5 Provide 53 mm PVC Conduit from telephone backboard to outside of building extending 900 mm into the ground for new direct buried telephone cables.

END OF SECTION 16742

PART 1 GENERAL

1.1 Work Included

1.1.1 This specification covers the supply and installation of a complete motor control center(s) and all associated equipment as described in these specifications and listed below:

.1 McKay Ranch Lift Station

1.2 Related Work Specified In Other Sections

1.2.1 Division 1 - General Requirements

1.2.2 Section 13300 - Process Control and Instrumentation General Provision

1.2.3 Section 13310 - Control Panels

1.2.4 Section 16010 - General Electrical Provisions

1.2.5 Section 16031 - Electrical Spare Parts and Maintenance Materials

1.2.6 Section 16260 - Automatic Transfer Equipment

1.2.7 Section 16402 - Underground Service

1.2.8 Section 16680 - Motor Starters to 600V

1.3 Approved Supplier

1.3.1 Qualifications: service and parts facilities in Calgary or Edmonton with 24-hour service technicians, experienced in installation and operation of VFDs.

1.3.2 Approved suppliers:

.1 Eaton Cutler-Hammer;

.2 Allen Bradley;

.3 Siemens;

.4 Schneider Electric; or

.5 General Electric.

PART 2 PRODUCTS

2.1 General Description

2.1.1 The control center shall consist of vertical sections jointed together to form a rigid, free standing, completely enclosed dead-front control assembly. Continuous floor sills and lifting angle shall be provided to facilitate installation of the control center.

2.1.2 The entire assembly shall be in accordance with CSA classification, Class 1, Type B, 600 Volt, minimum 400 A bus, 3 phase, 3 wire system. Fault level, 42 kA sym.

2.1.3 MCC shall be top entry for cables.

2.1.4 Each vertical section shall be fabricated of code gauge steel, shaped and reinforced to form a rigid, free-standing structure. Each section shall be designed so that control units may readily be removed or added as required. Provisions shall be made for mounting starters etc. in the front only.

2.1.5 Each section shall be provided with flange-formed doors with concealed hinges for all starter units.

2.1.6 The top of each vertical section shall be provided with cutouts in the top and on the bottom for horizontal wiring.

2.1.7 The sides of each vertical section shall be provided with cutouts in the top and on the bottom for horizontal wiring.

2.1.8 A full height vertical wiring trough with cable supports shall be provided in each vertical section for wiring. Isolation barriers between units shall be easily removable to facilitate installation of outgoing wiring.

2.1.9 Each vertical section shall be provided with a three phase main horizontal bus as specified in details of units. Power shall be distributed to the control units in the vertical sections by means of a three-phase vertical bus with a minimum rating as specified in details of units. Main bus must be full size throughout, and suitable for easy future extensions at either end of motor control center.

2.1.10 All bus work shall be suitably braced to withstand a maximum fault current as specified in details of units.

2.1.11 Bus supports shall be formed of high-dielectric strength, low moisture-absorption material.

2.1.12 All devices and components shall be of one manufacture to facilitate maintenance and repair.

2.1.13 The external operating handle of the circuit breakers shall be interlocked with the door so that the handle must be in the “OFF” position before the door can be opened. This handle shall be arranged for padlocking either in the “ON” or “OFF” position.

2.1.14 A ground bus, located near the bottom, shall run horizontally through the entire assembly and shall also extend vertically through each section. Individual starter units shall plug on the ground bus. Each starter unit shall have an individual ground lug. (A vertical ground bus as above, but located in the vertical wireway, will be accepted as an alternate).

2.1.15 Panels shall have two coats of manufacturer's standard color paint.

2.1.16 Each unit shall be identified with a lamicoid nameplate using black lettering on white background. Nameplates shall be fastened with screws or provided with special holder.

2.1.17 Entire control center shall be fabricated and wired in accordance with CSA standards and must bear a CSA certification mark.

2.1.18 Copies of final as-built shop drawings and all pertinent instruction books shall be included in maintenance manuals described under Section 16022.

2.1.19 Provide one (1) copy of all construction, wiring, schematic and instrumentation drawings enclosed with the motor control center at time of shipment.

2.1.20 Starter units shall be of the motor circuit protector breaker combination type, drawout assembly with all components and wiring readily accessible for ease of maintenance, unless otherwise specified or required.

2.1.21 All starter units to be full NEMA size and shall be able to start their maximum rating when energizing a high efficiency motor on a generator at 20% volt dip.

2.1.22 Starter units shall have provision for Ethernet connection where possible.

2.1.23 All starter units shall have a Hand-Off-Auto switch with extra FORM C contact to indicate Auto position to control system and Run, Off, and Overload indication in door.

2.1.24 All starter units shall have an electronic overload relay with phase loss, selectable trip class, unbalance, wide adjustment range, ground fault features and communication interface, as specified in detail of units, minimum.

2.1.25 All starters shall have control transformers with primary and secondary fusing (primary fusing to be HRC type) and with sufficient VA to handle operating coil and associated control relays.

2.1.26 All control devices shall be wired direct to a terminal strip for interconnection by others. Terminals to accept one #8 or two #14 AWG wires. See Details of Units.

2.1.27 Each breaker to be sized to protect the load if feeds.

2.1.28 All indicating lights shall be of the transparent type with LED lamps. Supply spare bulbs / indicator lights as per Section 16031.

2.1.29 Motor control assembly and starter units to be by the same manufacturer.

2.1.30 Data for selection and calibration of circuit breakers, motor circuit protectors and overload heaters to be included with the shop drawings.

2.1.31 On the front of EACH MCC, provide a lamicoid nameplate, not smaller than 150 mm wide, 100 mm high with the following data:

MCC-800

Prime Consultant
Stantec Consulting Ltd.

Electrical Consultant
Stantec Consulting Ltd.

Electrical Contractor
“TBD”

Manufactured By
“TBD”

Date: “built date” Bus Fault Bracing: 42,000 A Sym.

2.1.32 On the front of each MCC section, provide an adhesive label warning of potential arc flash hazard.

2.1.33 All lighting panel branch circuit breakers shall be thermal-magnetic, trip-free bolt-on type with a minimum of 10,000 AIC Sym. RMS.

2.1.34 All bus without exception shall be tin plated copper.

2.1.35 Provide arc flash boundary labels and studies for review.

2.1.36 MCC length shall be minimized where possible.

2.1.37 MCC to contain minimum 10% space.

2.1.38 Provide MCC dimensional layout and wiring for review.

2.2 Surge Suppression Device

2.2.1 Provide 1 MCC mounted Surge Protection Device (SPD) unit that adheres to ANSI/UL 1449 3rd Edition standard.

2.2.2 Acceptable manufacturers include:

.1 General Electric;

.2 Eaton Electrical (C-H) CPS;

.3 Schneider Electric;

.4 Current Technology Inc.;

.5 Siemens; or

.6 Approved alternate.

2.2.3 Unit to operate on 3 phase, Solidly Grounded wye power system; line to line voltage is 600 V(ac).

2.2.4 Maximum continuous operating voltage of all suppression components shall be 115% of the facility's nominal operating voltage.

2.2.5 Operating frequency shall be from 50 to 62 Hz.

2.2.6 Protection Mode: The unit shall provide protection on wye configured systems for:

.1 Line to neutral transients;

.2 Line to ground transients;

.3 Line to line transients; and

.4 Neutral to ground transients.

2.2.7 Devices shall be Type 1 or Type 2 devices.

2.2.8 The unit shall include an engineered solid-state high performance hybrid suppression system utilizing an array of selenium cells and/or non-linear voltage dependent metal oxide varistors and capacitive filter components. The suppression system shall not utilize gas tubes, spark gaps, or silicon avalanche diodes.

2.2.9 The maximum UL 1449 3rd edition VPR for the device shall not exceed the following:

Modes	208Y/120	600Y/347
L-N; L-G; N-G	700	1500
L-L	1200	3000

2.2.10 The unit shall contain a high performance EM/RFI noise rejection filter. The filter shall reduce fast rise-time, high frequency, error producing transients and electrical line noise to harmless levels. The filter shall provide minimum insertion loss utilizing MIL-STD-E220A 50 ohm methodology as follows:

Attenuation Frequency	100 kHz	1 MHz	10 MHz
Attenuation (dB)	50	56	54.

2.2.11 The unit shall include LED indicators, which provide indication of suppression component failure for all modes including neutral to ground. Provide one (1) set of dry contacts for remote monitoring of protection failure. Contacts to activate upon failure of any one phase or degradation of total surge capacity to less than 75%.

2.2.12 All units shall be testable in the field in order to verify the exact level of protection remaining using either built-in features or a hand-held tester.

2.2.13 All units shall provide the following levels of diagnostic monitoring:

.1 Continuous monitoring of internal fuses and be equipped with the ability to alarm in event of a failure or blown fuse.

.2 Internal sensor system for monitoring MOVs including neutral to ground.

.3 Monitoring and adequate protection for temporary over voltage (TOV) condition.

2.2.14 Integral fusing shall be provided that provides proper fault protection per the CEC in the event of MOV failure but does not operate during normal operation where the unit is required to conduct an 8 x 20μs surge current equal to its per mode rating. Vendor shall provide independent single pulse test data verifying that the unit can withstand it's advertised per mode surge rating per NEMA LS1-1992 and IEEE/ANSI C62.45.

.1 Fusing shall be rated to 200kAIC.

.2 Thermal Protection: MOV's shall be equipped with thermal protection technology which allows disconnection of the suppression component at the overheated stage common during temporary over voltage condition. For small fault currents between 100mA to 30A, or if the occurrence is over a longer period of time, the thermal protection will disconnect first. Manufacturers that utilize fuse traces only shall not be approved.

.3 All overcurrent protection components shall be tested in compliance with UL 1449-Limited Current Test and AIC rating test.

2.3 Main Breaker

2.3.1 Provide molded case circuit breaker, minimum 300 A frame, with solid-state trip unit with interchangeable and adjustable 150 A rating plug , with associated current monitors and self-powered trip to provide as a minimum independently adjustable long time pickup and delay, short time pickup and delay, instantaneous pickup and delay and ground trip.

2.3.2 Provide a low voltage power breaker with features as given in 2.3.1, and;

2.3.3 Lugs suitable for #4/0 AWG copper (minimum), and;

2.3.4 Provide auxiliary switches for open/close remote signaling of breaker status, and tripped indication. Provide breaker for service entrance duty.

2.4 Transfer Switch

2.4.1 Refer to Section 16260 - Automatic Transfer Equipment

2.4.2 Provide one automatic transfer switch, 600 Volt, 400 Amp minimum, 3 phase, 3 wire, 42,000 Amp withstand rating, with the following features as a minimum:

.1 Lugs suitable for #4/0 AWG copper (minimum) for Utility and Generator Feeders.

.2 Automatic start-up once normal power falls below 90% of rated line voltage. Start delay 3 seconds or less.

.3 Transfer when standby unit reached 90% of rated voltage.

.4 In phase monitoring and open transfer to normal supply after time delay.

.5 Engine rundown period of "No Load".

.6 Engine shutdown period.

.7 Operating sequences automatically reset.

.8 Switch position-indicating contacts (EY-Generator and EY-Utility).

.9 Voltage indicating contacts (ES-Generator and ES-Utility)

.10 Engine start contact.

.11 Control panel with following features:

.1 Engine exerciser for weekly testing.

.2 In phase monitor.

.3 Switch position lights, source availability lights and contacts, test switch, and time delay bypass switch.

2.5 Metering

2.5.1 Each meter shall be a microprocessor based self-contained, door-mounted device designed to monitor and display 3 phase AC current and voltage. The device shall monitor the following electrical parameters as a minimum:

.1 AC line current (each phase). (1% accuracy)

.2 AC line to line voltage (all three). (1% accuracy)

.3 Watts. (2% accuracy)

.4 Vars. (2% accuracy)

.5 Power Factor. (4% accuracy)

.6 Watt demand. (2% accuracy)

.7 Frequency. (1.5% accuracy)

.8 Watt-hours. (2% accuracy)

.9 Line - Neutral Volts (1% accuracy)

.10 Harmonics analysis/display and % Total Harmonic Distortion

.11 The device also includes the following protective functions:

.1 over voltage (105%-140% in 5% increments)

.2 under voltage (95%-60% in 5% increments)

.3 voltage phase loss

.4 current phase loss

.5 line voltage unbalance

.6 voltage phase reversal

.12 Each function shall have the ability to perform a time-delayed or instantaneous trip/alarm through relays with FORM C contacts.

.13 Provide three relay accuracy current transformers to provide 5 A current signals to the instrument.

.14 This device shall be wired to Ethernet and be compatible with an AB CompactLogix platform as required (EtherNet/IP).

.15 The device shall (optionally) be capable of 4 programmable Analog outputs (4-20 ma), and 4 programmable FORM C relay outputs (required).

2.6 Utility Meter

2.6.1 Utility meter shall be padmount style, installed outdoors at the transformer pad as per the detailed drawings.

2.6.2 See Section 16402 - Underground Service for Utility meter requirements and CONTRACTOR's Scope of Work.

2.7 Low Voltage (LV) Distribution Transformer

2.7.1 Size as indicated on drawings.

2.7.2 Copper windings.

2.7.3 2 FCAN & 2 FCBN taps.

2.7.4 K Factor: K4 minimum.

2.7.5 Temperature Rise: 115 deg C.

2.8 LV Distribution Panel 'A'

2.8.1 As per panel schedule on drawings.

2.9 Control Transformer

2.9.1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V(ac) secondary, complete with secondary fuse, installed in with starter as indicated.

2.9.2 Size control transformer for control circuit load plus 20% spare capacity. Minimum size shall be 300 VA.

2.10 Solid State Soft Starters

2.10.1 Starters of size, type, rating and enclosure type as indicated. Starter suitable for variable torque type motor and with components as follows:

.1 One three pole contactor for isolation.

.2 One 3 pole contactor for power factor correction capacitors to close when motor reaches running speed.

.3 If required, one 3 pole bypass contactor to close when motor reaches running speed.

2.10.2 Accessories:

.1 Selector switch: 3 positions labelled HAND-OFF-AUTO with additional contact when switch is in Auto for input to PLC.

.2 Indicating lights: Run - Green, Off - Red, Fault - Amber, Overload - White.

.3 Elapsed Time Meter.

.4 Pump control mode with: Start 2-30 sec. adjustable and Stop 2-120 sec. adjustable

.5 One 4 to 20 mA current output proportional to the current in one of the phases.

.6 Ethernet connectivity to provide run, fault, and warning status, current indication and command control capabilities. The protocol shall be Ethernet/IP to allow communications to an Allen Bradley CompactLogix Controller.

2.11 Full Voltage Non-Reversing (FVNR) Magnetic Starters

.1 Refer to Section 16680 - Motor Starters to 600V.

2.12 AC Control Relays

2.12.1 Refer to Section 16680 - Motor Starters to 600V.

2.13 Selector Switches

2.13.1 Maintained 3 position labeled as indicated, standard, operators standard knob, contact arrangement as indicated, rated 120 V(ac), 10 A.

2.14 Indicating Lights

2.14.1 Standard LED cluster, transformer type, push-to-test, lens colour: as indicated, supply voltage: 120 V(ac), labels as indicated. Similar to Allen-Bradley, Bulletin 800, 800T-N77x.

.1 Pilot light colors:

.1 Green – Run

.2 Red – Off

.3 White – Overload

.4 Amber – Fault

PART 3 EXECUTION

3.1 Installation

3.1.1 Settings of overload trip and MCP trip to be confirmed by the CONTRACTOR based on actual motor nameplate data. Assume starter and associated motor at same ambient of 27°C.

3.1.2 Motor control center to be welded to steel floor sills, which have been leveled and grouted into place.

3.1.3 All bus connections to be torqued to manufacturers recommended standards after the control center is in place.

3.1.4 Before connecting incoming and outgoing wiring, the CONTRACTOR shall perform megger tests on the motor control center bus. Results shall be recorded and included in O&M manuals for “Electrical Data for Maintenance Personnel”.

3.1.5 In regards to SPDs:

.1 SPD shall be of the same manufacturer as the switchgear, MCC and busway.

.2 SPD shall be factory installed inside the switchgear or MCC at the assembly point by the original equipment manufacturer.

.3 Suppressor shall be installed on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.

.4 The SPD shall be connected through a disconnecting means (30A circuit breaker). The disconnect shall be located in the immediate proximity of the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.

.5 Suppressor's ground shall be bonded to the service entrance ground.

.6 Devices shall be rated 200kA per phase, 125kA per mode.

.7 All monitoring and diagnostic features shall be visible from the front of the equipment, without the need to expose any live parts.

END OF SECTION 16820

PART 1 GENERAL

1.1 Related Work

1.1.1 Section 16010 - General Electrical Provisions

1.1.2 Section 16111 – Conduit

1.1.3 Section 16130 - Boxes and Condulets

1.1.4 Section 11150 - Process Piping Materials and Methods

1.2 System

1.2.1 Provide pipe heat tracing, temperature control and monitoring for:

.1 Architectural heat tracing for building gutters and downspouts.

1.2.2 The CONTRACTOR shall engage the heat trace supplier for full design of the heat trace system.

PART 2 PRODUCTS

2.1 Components

2.1.1 Heating Cable: Raychem IceStop architectural heat trace cable type GM-1XT, 120 V(ac), single phase. Cable length to be as required. Confirm length and physical properties to suit application with manufacturer prior to tendering.

2.1.2 Thermostats: Raychem model AMC-1A with temperature range from -10°C to +60°C. Thermostat to be rated at 22 amp at 250 volts.

2.1.3 Resistance Temperature Detector: Resistance Temperature Detectors (RTD) sensors shall be the platinum 3 wire type, nominal 100 ohm at 0°C (32°F). Sensors shall be totally enclosed in a stainless steel cartridge. Sensor leads shall be Kapton or Teflon insulated, 3 conductor, copper, provided with a stainless steel over braid.

2.1.4 Solid State Electronic Controllers

.1 The controller shall be an On-Off, solid state, electronic system consisting of single or grouped controllers (Raychem APS series, or approved equal). Single and Grouped controllers shall be mounted in a stainless steel, weather proof, enclosure (Type 4X) with lifting eyes and a front hinged door equipped with easy entry latches. The enclosure shall be provided with a breather and drain. The enclosure front hinged door shall be provided with a door mounted display/keypad or a front hinged door with viewing window of adequate size to view all alarm lights.

.2 Each controller shall be completely factory wired and shall include the following:

.1 Solid state electronic temperature controller with 3 wire platinum resistance temperature detector (RTD) input and solid-state output rated at 30 A at 208 V(ac) maximum.

.2 Field adjustable control set point.

.3 Output rating of 100 A, 600 V(ac) maximum, when specified.

.4 Permanent identification of all wires, terminal blocks and control devices.

.3 Each assembly of single or grouped controllers shall include the following:

.1 An analog meter or digital display to read the measured temperature of each sensor.

.2 The controllers shall be capable of ambient on-off control, on-off and proportional line sensing, adjustable power limiting, and staggered starting.

.3 A SPDT alarm contact or a programmable NO or NC alarm contact and an acknowledge pushbutton to silence the remote alarm. Acknowledged alarms shall not block or silence additional alarms. Displayed alarms shall include low and high temperature, ground fault, low and high current, open and shorted (damaged) RTD sensor, communication fault, and dormant heater trouble.

.4 Individual field adjustable under-temperature and over-temperature alarm set points, output alarms, and power cutoff for over-temperature.

.5 Ethernet connection capability.

.6 High ground current alarm or trip (field selectable), field adjustable 20-150mA

.7 Self test and diagnostics

.8 Full text LCD backlit display with keypad

.4 Each control and monitoring unit shall be locally programmable without the use of an auxiliary handheld programmer.

.5 All enclosures shall be sized in accordance with manufacturer’s guidelines for total current switching capacity of the solid state power relay(s). Switching capacity/number of modules per enclosure shall be based on full load operating current of all circuits. If applicable, effect of solar gain shall be considered when sizing the enclosure and number of control circuits.

PART 3 EXECUTION

3.1 Installation

3.1.1 Determine exact length of cable required on jobsite prior to ordering.

3.1.2 Test cable during installation and replace if damaged.

3.1.3 Weatherproof thermostat to be mounted 1000 mm above grade adjacent to heat trace controller.

3.1.4 Provide conduit or TECK cable seal on thermostat conduit box and seal wiring with Duxseal to stop warm moist air entering thermostat box.

3.1.5 Follow manufacturer's recommendations for placement of junction boxes and maximum circuit length.

3.1.6 Provide ground fault circuit breaker at panel.

3.1.7 Install heating cable in accordance with manufacturer's instructions. Fully coordinate installation with project construction.

3.1.8 Test the heat tracing cable prior to install of insulation.

END OF SECTION 16857

PART 1 GENERAL

1.1 Related Work

1.1.1 Section 16970 - Electrical Starting and Commissioning

1.1.2 Section 16980 - Electrical Equipment and Systems Demonstration and Instruction

1.2 Coordination

1.2.1 Coordinate starting of electrical equipment and systems with testing, adjusting and balancing, and demonstration and instruction of:

.1 Electrical equipment and systems specified in Division 16.

.2 Programmable Logic Controller and Instrumentation in Division 13.

.3 Mechanical equipment and systems specified in Division 15.

.4 Other equipment and systems specified in other Divisions.

.1 Heating and Ventilation.

1.2.2 Where any equipment or system requires testing, adjusting or balancing prior to starting, ensure that such work has been completed prior to starting of electrical equipment and systems.

1.3 Manufacturer's Site Services

1.3.1 Arrange and pay for appropriately qualified manufacturer's representatives to supervise starting of the following electrical equipment and systems:

.1 Generator.

.2 Motor VFDs.

.3 Main Breaker and MCC.

PART 2 PRODUCTS

2.1 Not Applicable

PART 3 EXECUTION

3.1 Manufacturers Representative's Site Reports

3.1.1 All manufacturers' site representatives will provide CONTRACTOR with daily written report detailing work performed, problems encountered, and corrective action taken.

3.1.2 All manufacturers' site representatives will provide CONTRACTOR with a detailed commissioning report giving as left setup values. Report shall be signed by both the manufacturer's representative and the CONTRACTOR.

3.1.3 Include copies of daily reports and commissioning reports in the project instruction books.

END OF SECTION 16960

PART 1 GENERAL

1.1 Intent

1.1.1 Commissioning process shall be used to bring the facility to a fully operational state, free of deficiencies, in the most efficient and timely manner achievable.

1.1.2 The Commissioning process for THE WORK consists of:

Stage 1: Contractor Supplied Verification Forms

Stage 2: Component and Equipment Verification & Testing.

Level 1: Equipment Verification

Level 2: Point Verification

Stage 3: Starting and Testing of Subsystems.

Stage 4: Facility Startup testing and fine tuning

Level 1: System Verification

Level 2: Integrated Systems Verification.

1.1.3 Defined in this Section are the CONTRACTOR's and ENGINEER's responsibilities relating to the coordination and implementation of the commissioning process.

PART 2 PRODUCTS

2.1 NOT APPLICABLE

PART 3 EXECUTION

3.1 General

3.1.1 The process to be utilized for this project consists of Equipment, System, and Integrated Systems verification tests to be documented on CONTRACTOR developed verification forms. Submit forms for ENGINEER's review and approval.

3.1.2 Prior to starting and testing of equipment or subsystems, prepare a schedule for the required testing. Review with ENGINEER.

3.1.3 Schedule Facility Startup testing with the ENGINEER to minimize impact on processes or systems.

3.1.4 Generator startup and commissioning requirements include, but shall not be limited to, the following. Submit forms and demonstration documents for review, for inclusion into the O&M manuals.

.1 Selecting and reading information from operator interface.

.2 Manual start-up / shut-down.

.3 Routine maintenance procedures.

.4 Reading and interpreting Genset Error Codes.

.5 Basic troubleshooting to assist service engineers in assessing problem over phone prior to coming to site.

3.1.5 Arrange for manufacturers to submit copies of all factory test records prior to commissioning.

3.1.6 Have all verification sheets and testing sequences approved by the ENGINEER prior to starting.

3.1.7 The CONTRACTOR shall conduct testing in conjunction with the ENGINEER. CONTRACTOR shall ensure all the necessary SUBCONTRACTORS are available to correct any problems during testing. The ENGINEER may witness all or any portion of testing and starting procedures performed by the CONTRACTOR.

3.1.8 Provide two-way radios, ladders and other equipment as required to complete the commissioning as outlined.

3.1.9 Obtain certificates of approval, acceptance and comply with rules and regulation of authorities having jurisdiction. Provide copies of certificates to ENGINEER.

3.1.10 Submit completed verification forms immediately after tests are performed.

.1 Record all data on site on approved verification forms.

.2 Provide ENGINEER with the original of each completed verification. Make any necessary corrections and resubmit as requested by ENGINEER.

.3 Maintain one completed copy on site during starting and testing period.

.4 Maintain one copy of all final starting, testing balancing and adjusting reports on site up to substantial performance of THE WORK for reference purposes.

.5 All final verification forms are to be typewritten.

.6 Maintain one copy of drawings with red-line markups.

3.1.11 Thoroughly overhaul and restore to new condition all equipment that has been operated by CONTRACTOR during construction phase.

3.1.12 Permanently mark all settings in such a manner that they cannot be eradicated or obliterated in any way.

3.1.13 Record all final settings on record drawings.

3.2 Stage 1: Contractor Supplied Verification Forms

3.2.1 Verification forms generated by the CONTRACTOR shall supplement any factory provided test data.

3.2.2 Component Verification forms shall be provided for each piece of equipment, after receipt of approved shop drawings, and forwarded to the ENGINEER for review, revisions, and finalization.

3.3 Stage 2 – Component/Equipment Verification and Testing

3.3.1 Level 1 – Equipment Verification Forms:

.1 The CONTRACTOR is responsible for performing all tests and measurements and recording results on the component verification forms.

.2 Where additional verification forms are required, the CONTRACTOR shall develop appropriate forms and submit them to ENGINEER for review prior to use.

3.3.2 Level 2 – Point Verifications:

.1 The CONTRACTOR shall prove all wiring and loops between the various components.

.2 Confirmation that the loop test has been completed shall be recorded on the verification forms.

3.4 Stage 3: Starting and Testing of Subsystems:

3.4.1 All Subsystem verification and testing is to be executed by the CONTRACTOR.

3.4.2 All related components verification must be completed and approved prior to executing Subsystem verifications.

3.4.3 Subsystem verifications shall be detailed on verification forms provided by the CONTRACTOR, unless otherwise instructed by the ENGINEER.

3.4.4 The verification tests are intended to prove the integrity of the hardware and software for each individual subsystem. Tests to include (but not be limited to) the following:

.1 Operation of system in “Remote” mode (PLC).

.2 Operation of system in “Local” mode (operator initiated).

.3 Emergency Manual Mode (PLC Failed).

.4 Safe shutdown in response to a power failure.

.5 Quality and quantity of desired product.

3.5 Stage 4: Facility Startup Testing and Fine Tuning

3.5.1 For new water mains and specific treatment processes the ENGINEER’s guidelines for acceptance testing must be followed as provided in the specification package.

3.5.2 Prior to Facility Startup testing the CONTRACTOR must have the following documentation complete and on hand during the testing:

.1 All test reports (Manufacturer’s, as well as equipment, per respective division, and subsystems).

.2 Final reviewed Shop Drawings and Product Data.

.3 CONTRACT DOCUMENTS and redline drawings.

3.5.3 Responsibilities:

.1 ENGINEER will do the following during System and Integrated Systems testing and fine-tuning.

.1 Assist in the coordination of the preplanned integrated system performance tests under conditions simulating, the extent possible, full and partial operating loads and emergency load conditions.

.2 Record test results.

.3 Diagnose problems and determine whether they are the result of Contract Deficiencies.

.4 Request repeat tests as required following correction of Contract Deficiencies and execution of Change Orders by CONTRACTOR and verify results.

.5 Provide direction and instruct in the fine-tuning of the systems under test to satisfy the operating requirements.

.2 CONTRACTOR shall do the following during System and Integrated Systems testing and fine-tuning.

.1 Conduct Integrated System testing.

.2 Modify operating parameters of the systems to satisfy the fine turning requirements outlined by the ENGINEER, so as to ensure proper system operation. For example:

.1 Make adjustments that may become apparent as testing proceeds.

.2 Modifications to suit changes as equipment settles down during the “running in” period.

.3 Documentation of results.

.4 Diagnosis of problems.

.5 Correct Contract Deficiencies previously outstanding and those identified during Integrated Systems Testing and Fine-Tuning.

.6 Execute Change Orders issued by the ENGINEER.

.3 Fine-tuning shall provide for the adjustment of the systems and integrated systems testing have shown a need.

3.5.4 Start-Up Progress Meetings.

.1 Start-up meetings shall be held prior to each Systems and Integrated Systems tests.

.2 The CONTRACTOR shall put forward the agenda, chair the meeting as well as record and distribute the minutes.

.3 Meetings shall introduce, monitor progress, and resolve any issues or deficiencies relating to the Startup Process.

.4 Based on the requirements of the agenda the attendees shall include but not be limited to:

.1 CONTRACTOR’s representatives: CONTRACTOR’s site superintendent, mechanical and electrical SUBCONTRACTORs, controls SUBCONTRACTOR and when so requested by the ENGINEER: suppliers, inspection and testing companies and their parties involved in THE WORK. CONTRACTOR’s representatives shall be qualified and authorized to act on behalf of the party each represents.

.2 OWNER’s representatives: Project Managers, Consulting Engineers, Operations and Maintenance representatives as required.

3.5.5 Provide sufficient notice (minimum 72 hours) prior to commencing tests.

3.5.6 Coordinate all sub-trades, other divisions, manufacturers, suppliers and other specialists as required to ensure all phases of work shall be properly organized prior to commencement of each particular testing procedure. Establish all necessary staffing requirements.

3.5.7 Coordinate starting of mechanical equipment and systems with testing and demonstration and instruction of:

.1 Electrical equipment and systems as specified.

.2 Mechanical equipment and systems as specified.

.3 Other equipment and systems as specified.

3.6 Level 1: System Verifications

3.6.1 System tests shall verify proper operation of each system individually, including operation of ancillary subsystems.

3.6.2 All related component and subsystem verifications must be completed and approved prior to the execution of the system verifications.

3.6.3 To ensure system operations conform with the contract documents:

.1 Each system is operated for as long as required to commission the project and to verify performance.

.2 Results of testing and procedures are checked and verified to be correct within stated tolerances. If inconsistencies appear between reported results and demonstrated values, the relevant testing procedures are repeated and adjustments made until satisfactory results are obtained.

3.7 Level 2: Integrated System Verifications

3.7.1 The intent of these tests is to prove proper operation of the completed facility operating as an integrated system.

3.7.2 All relate component, subsystem and systems verifications must be completed and approved prior to the execution of the integrated system verifications.

3.7.3 Tests shall include:

.1 Behaviour during plant power failure.

.2 Behaviour during PLC failure.

.3 Failure of critical components in worst case scenarios.

.4 System interlocks.

.5 Operation in Auto, Manual, Emergency Manual modes.

3.7.4 To ensure operation conforms with the contract documents:

.1 Verify performance of system operating in conjunction with one another under all conditions and modes of operation. Each system is operated for as long as required to commission the project and to verify performance.

.2 Results of testing and procedures are checked and verified to be correct within stated tolerances. If inconsistencies appear between reported results and demonstrated values, the relevant testing procedures are repeated and adjustments made until satisfactory results are obtained.

3.8 Compliance With Defined Procedures

3.8.1 Failure to follow the specific instructions defined herein pertaining to correct starting procedures may result in re-evaluation of equipment by independent testing agency selected by ENGINEER at the CONTRACTOR's expense. Should results reveal that equipment has not been started in accordance with specified requirements, equipment may be rejected. If rejected, remove equipment from site and replace. Replacement equipment shall also be subject to full starting procedures, using same procedures specified on the originally installed equipment.

3.8.2 Performance testing of any system by ENGINEER does not reduce the CONTRACTOR's obligations for complete testing and start-up systems as specified.

END OF SECTION 16970

PART 1 GENERAL

1.1 Intent

1.1.1 Provide demonstration and instruction sessions to familiarize the OWNER's operation and maintenance personnel with electrical systems and their operation and maintenance.

1.1.2 Document the demonstration and instruction sessions for inclusion in the O&M manuals.

1.2 Manufacturer's Site Services

1.2.1 Arrange and pay for appropriately qualified manufacturer's representatives to provide or assist in providing electrical equipment and systems demonstration and instruction as specified herein.

1.3 Contractor

1.3.1 The ENGINEER will chair demonstration and instruction sessions.

1.3.2 Establish agendas for demonstration and instruction sessions in conjunction with the ENGINEER. Coordinate scheduling of sessions with the ENGINEER and the OWNER.

1.4 Demonstration and Instruction Seminars

1.4.1 Prepare a schedule identifying the proposed sequence of demonstration. Sequence of demonstration shall correspond to full system and sub system starting.

1.4.2 Include a description of each system and subsystem, and each piece of equipment.

1.4.3 Instruct the OWNER and his maintenance staff on operation and maintenance procedures of all major electrical systems. This instruction shall be performed twice, once when systems are being energized and tested and once before building is turned over to the OWNER.

1.4.4 Answer all questions raised by the ENGINEER at demonstrations. If unable to satisfactorily answer questions immediately, provide written response within three days.

PART 2 PRODUCTS

2.1 Not Applicable

PART 3 EXECUTION

3.1 Systems Demonstrations

3.1.1 Variable Frequency Drives

.1 Selecting and reading information from operator interface.

.2 Local – Remote operation of the VFD.

.3 Reading and interpreting VFD Error Codes.

.4 Basic troubleshooting to assist services engineers in assessing problems over phone prior to coming to site.

3.1.2 Safety and Lockout Procedures

.1 Instruct operators on locking out 600 Volt power circuits.

3.1.3 Generator

.1 Local-Remote operation of the Generator.

.2 Basic troubleshooting to assist services engineers in assessing problems over phone prior to coming to site.

3.1.4 Motor Control Center

.1 Operation and lockout procedure of all disconnects and breakers.

.2 Overview of all safety requirements.

.3 Operation of all equipment installed integral to MCC.

.4 Viewing and interfacing with all displays installed on the doors of the MCC.

END OF SECTION 16980

APPENDIX A – GEOTECHNICAL REPORT

Geotechnical, Environmental and Materials Engineering

Red Deer · Sherwood Park · Grande Prairie · Calgary · Fort McMurray
Peace River · Medicine Hat · Lethbridge · Estevan

GEOTECHNICAL INVESTIGATION

MCKAY RANCH LIFT STATION
BLACKFALDS, ALBERTA

PREPARED FOR

STANTEC CONSULTING LTD.

RED DEER, ALBERTA

PREPARED BY

PARKLAND GEOTECHNICAL CONSULTING LTD.

RED DEER, ALBERTA

PROJECT NO. RD7599

NOVEMBER 25, 2021

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Soil Test Results
Explanation of Terms and Symbols

LIMITATIONS
General Terms and Conditions

1.0 INTRODUCTION

The Town of Blackfalds is proposing to construct a lift station in southeast Blackfalds, Alberta. ParklandGEO was retained by Stantec Consulting Ltd. (Stantec) to conduct geotechnical investigations for the lift station. This report summarizes results of the field and laboratory testing programs and presents geotechnical recommendations for design and construction of the lift station.

1.1 SCOPE OF WORK

The scope of work for this investigation was outlined in ParklandGEO's proposal PRO9308 dated August 19, 2021. Authorization to proceed with this investigation was given by Mr. Patrick Hogan, E.I.T. of Stantec.

1.2 PREVIOUS INVESTIGATIONS

A previous report was issued for the McKay Ranch Lift Station in 2017:

- *"Geotechnical Investigation – McKay Lift Station – Blackfalds, Alberta"* Prepared for Stantec Consulting Ltd., Prepared by Parkland Geotechnical Consulting Ltd., dated February 2017 (File #: RD5235).

This report is an update to the 2017 report.

2.0 PROJECT AND INFORMATION

The proposed McKay Station is located in southeast Blackfalds, Alberta within NW 25-39-27-W4M, as shown on Key Plan, Figure 1. The access to the Blackfalds site is from South Street to the south. There are residential developments to the south and west of the site and agricultural lands to the north and east. The site is shown in Site Photographs, Figure 4. The elevation at the lift station is 872.51 m.

The McKay Lift Station Site is show in Site Plan, Figure 2. The lift station will be approximately 7.3 by 10.6 m in size with a 3.8 x 2.4 m wet well that will extend approximately 9.5 m below grade. The preferred foundation is a concrete base slab/raft for the wet well and the building will have a pile foundation through the wet well excavation fill.

3.0 FIELD AND LABORATORY PROGRAMS

On December 21, 2016, one borehole was drilled at the site to a depth of 15 m below grade. The borehole was located in the lift station footprint, as shown on the Site Plan, Figure 2 in Appendix A. The following investigation procedures were followed during the field program:

1. Prior to mobilizing the drilling rig, ParklandGEO personnel completed an Alberta One Call to verify the drill site was clear of underground utilities.

2. The boreholes were drilled using a track mounted geoprobe drill rig owned and operated by Darkhorse Drilling Ltd. of Lacombe, Alberta.

3. Drilling operations were monitored by ParklandGEO's geotechnical personnel, and the soil encountered was visually examined during excavation / drilling and logged according to the Modified Unified Soil Classification System.

4. Soil samples were collected from auger cuttings at 1.0 m intervals in order to determine the soil/moisture profile and from other selected depths for other testing. Disturbed soil samples were also obtained from Standard Penetrations Tests (SPTs), which were performed at selected depth intervals.

5. A hand slotted 25 mm diameter PVC standpipe was installed in the borehole upon completion of drilling, and backfilled with auger cuttings with a Bentonite plug below the ground surface. Excess auger cuttings were spread at the borehole location. The groundwater conditions were noted during drilling and on completion. Groundwater measurement was recorded on January 19, 2017 and October 27, 2021.

6. All soil samples were returned to ParklandGEO's Red Deer laboratory for selected soil testing to determine soil properties. The results of all laboratory testing are shown on the borehole logs and individual test results presented in Appendix A. The laboratory program consisted of moisture contents, Atterberg Limits, sieve and hydrometer particle size analysis and water soluble sulphates.

7. The local ground surface elevations and the borehole locations were surveyed by Stantec Consulting Ltd. The elevation is provided based on a geodetic datum.

4.0 SOIL CONDITIONS

The general soil profile encountered at this site was typical of this area and consisting of, in descending order: silty sand over clay. Bedrock was not encountered but based on water well records it is expected at a depth of 40 to 45 m below grade. The detailed soil conditions encountered at each borehole location are described on the borehole logs in Appendix A. The soil test results and definitions of the terminology and symbols used on the borehole logs are provided on the explanation sheets also in Appendix A. The following is a brief description of the soil types encountered.

4.1 SILTY SAND

Deposits of silty sand were encountered at the surface and extended to a depth of 14.0 m below grade. The sand contained trace to some silt. The sand was fine grained with a loose to compact relative density. The siltier deposits were some to stiff and low plastic. Standard Penetration test “N” values of 5 to 9 blows were encountered within the deposits.

4.2 CLAY

Clay was encountered below the silty sand in the borehole at a depth of 14.0 m and extended beyond the 15 m depth drilled. This clay deposit contained some silt and was medium to high plastic and was characterized as stiff to hard, brown/grey, and moist. The clay was considered to be stiff

4.3 SOIL CHEMISTRY

A soil sample was taken at a depth of 2.0 m for water soluble sulphate concentration testing. Results of the laboratory chemistry testing program are shown on the borehole log, and included in Appendix A. The concentrations of sulphate are expressed as a percentage of the dry mass of soil. The concentration of water soluble sulphate was 0.04 percent. The results indicating a negligible potential for sulphate attack on buried concrete in direct contact with soil at the site.

5.0 GROUNDWATER CONDITIONS

Sloughing conditions were observed in the sand layer throughout drilling. Groundwater seepage was observed in the borehole during and after drilling. The groundwater level was measured at a depth of 2.4 m below grade on January 19, 2017 and a depth of 3.2 m below grade on October 27, 2021.

The observed shallow groundwater measurements are considered to be typical for this area of Blackfalds. The local groundwater table is dependent on infiltration of precipitation and is expected to fluctuate on a season basis with the highest levels after periods of prolonged heavy precipitation or snowmelt. Groundwater seepage is expected in shallow excavations. The volumes and seepage rates for groundwater encountered will be dependent on seasonal conditions and the permeability of the soils within the profile.

6.0 DISCUSSION AND RECOMMENDATIONS

6.1 GEOTECHNICAL EVALUATION

The lift station will consist of 7.3 x 10.6 m^2 heated building surrounding a 3.8 x 2.4 m^2 concrete wet well based about 9.5 m below final grade. It is understood that the preferred foundation to support for the wet well is a concrete base slab or gravel mat. It is understood that the wet well will be incorporated into the building structure. An open excavation is expected to be used to construct the wet well; therefore the building would be within the backfill footprint. The building will extend past the wet well footprint. The foundation is expected to be supported on piles. The client indicated that the preferred foundation option for the building is steel screw piles.

1. The soil conditions at this site are considered to be marginally suitable for the proposed development. The wet native soils are not expected to be very stable in terms of excavation stability for wet slopes. Given the availability of space around the site, an open excavation is expected to be most economical. The extent of the excavation will impact foundation options for the building surrounding the wet well. Deep backfill around the wet well is expected to settle beyond the tolerance of slab on grade which will require the use of a structurally supported slab for the slab areas outside of the wet well footprint.

2. Dewatering may be required depending on conditions at the time of construction and volumes of groundwater infiltration may be high. Drainage control measures required may include numerous conventional sumps or well-points to remove excess water and stabilize the sand during excavation.

3. Foundation conditions at this site are suitable for driven steel piles. The foundations conditions are poorly suited to cast-in-place concrete piles due to the presence of saturated sand within the expected pile depth that will be prone to seepage and sloughing during excavation and may require the use of casing during installation. Driven steel piles are a well suited foundation system for the building. Foundation parameters are provided for driven steel piles for the building and a mat foundation for the wet well. Comment on other foundation systems can be provided upon request.

4. The present site is relatively level and it is ParklandGEO's understanding that the final site grades will remain close to existing grade. A significant amount of backfilling will be required around the wet well if an open excavation is used for construction. The native silty sand is considered marginally suitable for use as fill material. The native sand deposit above the groundwater table is considered to be close to OMC and may not require a substantial amount of moisture conditioning. The sand deposits below the water table are saturated and well above OMC.

5. The groundwater elevation was about 2.4 m below existing grade which will result in seepage into the excavation. Measures such as conventional pumping will be required and are expected to be effective. The wet well structure will extend into the groundwater table and should be designed to resist uplift forces due to hydrostatic pressures.

6.2 EXCAVATION

Excavations will be required for the wet well and underground utility installations. For excavations in the native silty sand at this site and above the water table, side slopes of at least 1H:1V from the base of the excavation are recommended. The required excavation for the wet well will extend into the water table. There is a high potential for seepage and sloughing from the sand below the groundwater table, so much flatter side-slopes may be required for deeper excavations. Steeper cuts may be possible by application of different configurations of braced/sloped excavations and dewatering measures. In all cases, the latest edition of the Construction Safety Regulations of the Occupational Health and Safety Act of Alberta should be followed.

The degree of stability of the side wall of the excavation decreases directly with time. Therefore construction should be coordinated to minimize construction time of open trenches or pits. In addition, surcharge loads, including excavation spoil, should be kept back from the crest of the excavation a minimum distance equal to the excavation depth. Monitoring and maintenance of the slopes should be carried out on a regular basis.

The excavation of such a large area for the lift station will impact the design of foundations for the lift station building. A deep foundation will be required to transfer the loads to the native soil below the backfill of the wet well.

6.3 BACKFILL

The wet well excavation will require a significant volume of backfill. Settlement in the fill should be expected. The magnitude of settlement in backfill is governed by several factors such as type of backfill material, density from initial compaction, moisture content, and volume/depth. The native sand material is considered marginally suitable for use as engineered fill for economic reasons, provided moisture conditioning is used and the specified compaction levels can be achieved. Services installed in the backfill around the well will be affected by settlement. Consideration should be given to support of the lines through the backfill zone.

Two of the most practical options for placing and compacting backfill around the wet well are discussed below.

6.3.1 Nominal Compaction and Structurally Supported Floor Slab Option

In this option, the backfill around the wet well structure is placed and compacted to about 95 percent of Standard Proctor Maximum Dry Density (SPMDD – ASTM D698). Settlement of native sand fill nominally compacted backfill to 95 percent SPMDD would be estimated at 3 to 4 percent of the total fill thickness, with post-construction settlement in the order of half of the total settlement. A structurally supported floor slab will be required since the settlement performance over the first 6 to 24 months will not meet the required tolerances for slab on grade floors. The structural floor slab alternative is the least time dependent option and performance levels for the slab can be engineered. The use of heavy compaction effort should be restricted within 1.0 m of the wet well walls and care should be taken when applying compaction energy on the soils to minimize the impact on the structure during backfill operations.

The settlement resulting from the lower compaction levels will apply a downdrag force of 10 kPa should to the wet well wall surface. A bond breaker could be used to minimize this downdrag which would reduce the friction bond between the wet well wall and the backfill. The most common bond breakers are grease or polyethylene wrap and can reduce the downdrag by up to 75 percent.

6.3.2 Heavy Compaction and Increased Structural Capacity of Walls

In this option, the backfill around the wet well structure is placed and compacted to at least 100 percent SPMDD. Settlement of backfill compacted to 100 percent SPMDD would be estimated at 0.5 to 1 percent of the total fill thickness. The higher compaction level will increase the lateral forces acting on the wet well wall, and will require more structural capacity. The use of heavy compaction effort should be restricted within 1.0 m of the wet well walls unless the larger lateral forces induced by heavy compaction are compensated for in the structural capacity of the walls. Given the depth of the excavation and the possible inability to achieve high density there is a risk that a structural slab will still be required. In most cases this option is not considered due to the potential risk involved.

6.3.3 Additional Backfill Recommendations

The initial lift of backfill may need to be relatively thick (i.e. nominally 0.5 m) to provide a bridge over the base of the excavation. To provide a stable working base the use of coarse (pit run) gravel is suggested for the first lift. Subsequent backfill should be compacted in lifts no greater than 200 mm thick using silty sand at moisture contents 0 to 2 percent below the Optimum Moisture Content (OMC). The fill should be placed evenly around the structure to distribute the stresses on the structure evenly during the backfilling process.

Fill placement and compaction during the winter months is challenging due to the difficulty in moisture conditioning fill soils and obtaining high compaction levels. Materials and methodology should be reviewed prior to construction if cold weather compaction of fills is proposed. High compaction levels can only be achieved using fill soils that are unfrozen provided the compaction area is heated and hoarded to prevent freezing and proper moisture conditioning during placement and compaction.

Surface water should be drained away from the site as quickly as possible, both during and after construction. Site drainage should be directed away from the foundation walls and equipment. It is recommended to provide a 5 percent back slope from buildings for a distance of at least 3 m. Roof and other drains should discharge well clear of buildings. The slope of exterior backfill should be checked periodically to verify water is shed away from buildings. If the backfill settles causing water to pond against foundation walls, the surface should be re-graded. Water should not be allowed to pond adjacent to buildings. A minimum grade of 5 percent is recommended around the lift station to promote surface runoff and minimize potential saturation and degradation of the parking area subgrade. The surface grades will need to be checked for settlement in the first couple of years. If settlement occurs, the grade away from the building should be re-established.

6.4 ALBERTA BUILDING CODE

In accordance with the National Building Code – 2019 Alberta Edition (NBC-AE), the use of Limit States Design (LSD) is required for the design of buildings and their structural components including foundations. The limit states of LSD design are classified into two groups; the Ultimate Limit States (ULS) and the Serviceability Limit States (SLS). The ULS design requirements in the ABC reference the Structural Commentaries in the User Guide of the National Building Code of Canada (NBCC).

6.4.1 Ultimate Limit States (ULS)

The ULS case is primarily concerned with safety and the levels of load and resistance at the point of collapse or structural failure. The geotechnical value for this case is the ultimate resistance. For foundation design this ultimate resistance value is reduced using a Geotechnical Resistance Factor (GRF) which is based on the reliability index of the geotechnical data used to determine the ultimate resistance for the foundation loading case. As per the NBCC the following GRF values should be used for foundation design for shallow and deep foundations:

TABLE 1
LSD GEOTECHNICAL RESISTANCE FACTORS

Geotechnical Case	Resistance Factors
DEEP FOUNDATIONS (PILES)	
Vertical resistance by semi-empirical analysis and in-situ test data	0.4
Vertical resistance from analysis of dynamic monitoring results	0.5
Vertical resistance from analysis of static load test results	0.6
Uplift resistance by semi-empirical analysis and in-situ test data	0.3
Uplift resistance from analysis of static load test results	0.4
SHALLOW FOUNDATIONS (MATS)	
Vertical resistance by semi-empirical analysis and in-situ test data	0.5

* NBCC - Users Guide - Structural Commentaries (Part 4 of Division B) - Commentary K –Foundations.

6.4.2 Serviceability Limit States (SLS)

The SLS occurs when the foundation loads cause movements or vibrations that are greater than the structure can tolerate before the intended use of the structure is restricted or hindered. The SLS case is addressed by determining the maximum available resistance to keep the foundation deformation within tolerable limits under service loads (i.e. settlement, lateral deflection, etc.). Typically, the foundation loads, configurations and serviceability tolerances have to be known to properly determine geotechnical SLS resistance values. In some foundation cases, such as small footings, basic assumptions can be used to provide preliminary SLS resistance values under specific stated conditions.

For axial loading conditions the SLS resistance is addressed by determining the limiting load to keep foundation settlements within tolerable limits. Tolerable total and differential settlements should be verified by the structural engineer, but for normal buildings the tolerable limit of total settlement for foundations is typically about 25 mm. For piles, less than 25 mm is often required to mobilize the ultimate resistance before soil failure. Therefore, the serviceability limit states are not expected to govern for pile foundations unless very strict settlement tolerances are required (i.e. less than 10 to 15 mm of settlement). The settlement potential of the proposed piles may be checked once pile design and loading conditions are finalized.

6.4.3 Seismic Classification

The National Building Code of Canada (2019) requires buildings to be designed to resist a minimum earthquake force. The formula for obtaining minimum earthquake force is dependent of several factors including Foundation Factors (F_a and F_v) which should be determined using a Site Class of D for this site (Table 4.1.8.4.A) for both sites. The subgrade soil is sand, silt and clay to below the maximum depth drilled of 15.0 m.

6.5 DRIVEN STEEL PILE FOUNDATIONS – ULS DESIGN

Driven steel piles are considered to be suitable for foundations for this site but relatively long piles may be required. Either steel H piles, open ended or closed ended pipe piles may be considered. Driven steel piles may be designed using the ultimate resistance values for shaft friction and end bearing provided in the following table.

TABLE 2
DRIVEN STEEL PILES - ULTIMATE RESISTANCE

Soil Type	Depth (m)	Ultimate Resistance (kPa)	
		Skin Friction	End Bearing
Silty Sand	0 – 1.5	0	0
Silty Sand	1.5 – 14.0	25	500
Clay	> 14.0	35	750

*For piles driven to minimum pile depth of 7.5 m or below the proposed wet well elevation, whichever is greater.

The ultimate resistance values in this table are based on semi-empirical data. Therefore, the “factored” resistance should be calculated by multiplying the ultimate values above by a geotechnical resistance factor (GRF) of 0.4, in accordance with the building code. The GRF for resistance to axial compression may be increased if the pile capacities are verified by a dynamic monitoring method or by a static load test.

The ULS capacity of driven steel piles is determined by multiplying the factored ULS skin friction resistance by the exterior surface area of the pipe pile or the surface area of the web and outside face of the flanges for H-piles. For unheated structures, the upper 2.5 m of pile shaft or the length of pile shaft in new fill, whichever is greater, should be assumed to carry no load. This depth can be reduced to 1.5 m or the length of pile shaft in for heated structures. For piles driven into the dense sand (at depth), an end bearing contribution acting on the gross area of the pile tip for H-piles, closed ended pile and open ended piles less than 300 mm in diameter may be added to the pile capacity. For open ended pipe piles with diameters greater than 300 mm, only 2/3 of the gross area should be used. The pile capacity should not exceed the structural capacity for the steel section of the pile. Piles driven through new fills should be assumed to have downdrag (negative skin friction) equal to 10 kPa for the section of pile within the fill. To resist uplift forces created by frost action, the minimum depth of driven steel piles for heated structures should 7.0 m below grade and 11.0 m below grade for unheated structures.

For steel pipe piles driven to practical refusal into the very dense sand deposits prior to achieving design depth, but beyond the required minimum embedment depth, the ultimate load capacity may be determined by multiplying the cross-sectional area of steel at the tip by 0.85 f_y where f_y is yield strength of steel (normally 300 MPa). The maximum permissible value of f_y should be supplied by the manufacturer.

Other design and construction recommendations for driven steel piles include:

1. The driving energy and driving criteria should be determined based on wave equation analysis (WEAP) for the proposed equipment. For preliminary purposes, steel piles should be driven using maximum hammer energies of 450 to 600 J per square centimetre of pile cross section.

2. For smaller pipe piles a minimum pipe wall thickness of 9 mm is recommended for this site. For pipe piles greater than 400 mm in diameter the minimum pipe wall thickness should be increased to 12.5 mm.

3. Steel piles should not be driven beyond practical refusal to avoid overstressing the steel section. Since a wide range of heavy walled sections may be used, the practical refusal criteria should be determined prior to piling once hammer energies and pile details are known. For preliminary purposes, the practical refusal criteria may be taken as 8 blows per each 25 mm interval for the last 250 mm of pile penetration.

4. The minimum allowable pile spacing should be taken as three pile diameters. Where groups of piles are to be installed, the piles should be installed starting at the centre with outer piles installed last. The elevations of the tops of piles already installed should be monitored as adjacent piles are driven in order to determine if heaving of the piles has occurred. Piles that have heaved must be re-driven. If groups of piles are installed at pile spacing less than the minimum, a group reduction factor must be applied to the bearing capacity of each pile.

5. If steel pipe piles are used, it is suggested to fill the piles with concrete after installation. Concrete filling of the open pipe will add strength to the section and reduce the corrosion potential inside the pipe. Corrosion of the pipe in a partially saturated medium must be considered in selecting pipe wall thickness.

6. The steel piles should be inspected prior to installation to confirm that the appropriate material specifications are satisfied; and to check that there are no protrusions on the shaft or at the tip which could result in voids along the shaft as the pile is driven.

7. Monitoring of the pile installation by experienced geotechnical personnel is recommended to confirm that the piles are installed in accordance with design assumptions and that the driving criteria are satisfied. A complete driving record of blows per 300 mm of penetration for each pile should be obtained and reviewed by the pile designer.

8. A Pile Driving Analyser (PDA) test program should be considered to verify the ultimate pile resistance for this site. For resistance values verified by this dynamic monitoring method the GFR used to calculate the factored resistance may be increased to 0.5, resulting in a 25 percent increase in pile capacity for the ultimate limit states. A static load test program could also be considered to further increase the factored resistance, and may result in further savings on foundation costs. The GRF can be increased to 0.6 if a static load test program is undertaken.

6.6 SCREW PILES – ULS DESIGN

Steel screw piles installed in the native silty sand or clay till are considered a feasible foundation option for this site. Foundation loads are expected to be light and moderate. The design and installation of screw piles is usually undertaken by specialty contractors based on column loads supplied by the structural engineer. The ultimate unfactored load carrying capacity of a multiple helix screw pile in vertical compression in cohesive (clay) and cohesionless (sand) soil may be calculated using the formula below.

For Cohesive Soil:

$$Q_u = A_H C_u N_c + \pi D_H C_u (H_3 - H_1)$$

For Cohesionless Soil - H/D ≥ 5:

$$Q_u = \gamma' H A_H N_q + 0.5\pi D_H \gamma' (H_3^2 - H_1^2) K_s tan\emptyset$$

Where:
Q_u = ultimate unfactored axial pile resistance (kN)
γ' = effective unit weight of soil (kN/m^3)
ϕ = internal friction angle (degrees)
N_q = bearing capacity factor for cohesionless soils
K_S = coefficient of lateral earth pressure in compression
H = embedment depth of pile below final grade (m)
H_3 = depth to bottom helix (m)
H_1 = depth to top helix (m)
A_H = gross area of the bottom helix (m^2)
D_H = average diameter of helix plates (m)
C_u = Undrained shear strength of cohesive soil (kPa)
N_c = compressive bearing capacity factor for cohesive soil

The formula above may also be used for a single helix screw pile since the second term of the formula is cancelled out (i.e. $H_3^2 - H_1^2 = 0$). For Ultimate Limit States (ULS) design the ultimate resistance values calculated by this method are based on semi-empirical data, therefore the "factored" ULS resistance should be calculated by multiplying the ultimate resistance values above by a geotechnical resistance factor of 0.4, in accordance with the Alberta Building Code. The GRF may be increased to 0.6 if a static load test program is performed.

The design parameters for the formula given above are provided in the table below:

TABLE 3
DESIGN PARAMETERS FOR SCREW PILES

	Silty Sand	Clay
Depth below final grade (m)	0 – 14.0	> 14.0
Effective Unit Weight of Soil, γ' (kN/m^3)	20	18
Internal Angle of Friction, ϕ	30^o	-
Undrained Shear Strength, C_u (kPa)	-	30 - 45
Bearing Capacity Factor for Cohesive soils (H/D>4)	-	N_c = 9
Bearing Capacity Factor for Cohesionless soils	N_q = 18	-
Coefficient of Lateral Earth Pressure, K_S (D_s>0.22m)	0.8	-

The effective unit weight used in the relationship will depend on the position of the helix relative to the groundwater table. Below the groundwater table use $\gamma` = \gamma_{Soil} - \gamma_{Water}$. Screw piles should have a minimum embedment depth from ground surface to achieve sufficient frost jacking resistance. The minimum screw pile embedment depth from ground surface to the top of the top helix should be taken as the greater of the five times the helix diameter or the frost depth plus one helix diameter. The helix should be installed through any fills if present.

The following design and construction recommendations should be followed:

1. The maximum torque allowed during installation or "torque rating" of the proposed pile section must be considered during screw pile selection. The torque rating is an allowable value based on the ultimate torque strength or point of torsional fracture for the cross-sectional area of the steel in the pile shaft. The torque rating should be provided by the pile manufacturer. The estimated torque required to install the screw pile to the design resistance should not exceed the torque rating for the pile. For preliminary purposes, the minimum required torque may be taken as:

   $T = Q / K_t$ (Hoyt & Clemence, 1989)[1]

   Where: T = Minimum Torque Requirement (kN-m)
   Q = Design resistance of the pile (kN)
   K_t = empirical torque correlation factor = 10 m^{-1} for $D_S \geq 0.22$ m

2. The torque rating for the pile shaft should not be exceeded during installation of the pile. Using excessive torque on the pile may cause damage to the pile shaft which would require the pile to be replaced.

[1] Uplift Capacity of Helical Anchors in Soil", by H.R. Hoyt and S.P. Clemence, 1989, In Proceedings of the 12th International Conference on Soil Mechanics and Foundation Engineering. Rio de Janerio, Brazil, Vol 2, pp. 1019-1022.

3. The minimum allowable centre to centre pile spacing should be taken as at least three helix diameters or 3.0 m. If groups of piles are installed at pile spacing less than the minimum, a group reduction factor must be applied to the bearing capacity of each pile.

4. The maximum vertical spacing for the helixes is 3 times the helix diameter for piles loaded in compression or tension. The method of determining pile capacity must be reviewed if this criterion is not met.

5. Corrosion of the pile shaft in a partially saturated medium must be considered in selecting pipe shaft wall thickness. It is suggested to fill the pile shafts with concrete after installation to add strength to the pile shaft and reduce the corrosion potential inside the shaft of the pipe pile.

6. The soil strength is considered to be sufficient to provide lateral confinement to the pile shaft. Therefore buckling of the shaft is not expected to be a concern.

7. Monitoring of the pile installation by experienced geotechnical personnel is recommended to confirm that the piles are installed in accordance with design assumptions and that the installation criteria are satisfied. The installation records should include a summary of the torque required to install the pile, particularly the average torque achieved during the last 1.5 m of pile installation.

6.7 FROST DESIGN FOR PILE CAPS

Pile shafts within the zone of frost of the subgrade will be subject to adfreeze forces which can cause frost jacking. The minimum embedment depth for driven steel piles is given above in Subsection 6.5 and for steel screw piles is given in Subsection 6.6.

Frost heave forces will also act on the underside of pile caps and grade beams with upward heaving pressure in the order of 1000 kPa or greater. The potential of frost heaving forces can be greatly reduced by the placement of a compressible material or by providing a void of at least 75 mm between the underside of the concrete cap or grade beam and soil. A product such as Voidform or an equivalent is recommended. If a compressible material is used as an alternative to the Voidform, the uplift pressure acting on the underside of the concrete may be taken as the crushing strength of the compressible medium. The finished grade adjacent to foundation walls should be sloped away so the surface runoff is not allowed to infiltrate and collect in the void space or in the compressible medium. If water is allowed to accumulate in the void space or the compressible medium becomes saturated, the beneficial effect will be negated and frost heaving pressures will occur.

6.8 LIFT STATION FOUNDATION

The lower level of the lift station will be founded within the native sand or clay at a proposed depth of 9.5 m below grade which corresponds to an elevation of 863 m. The present configuration is expected to be a relatively small rectangular pre-cast wet well. In this type of structure with an end bearing wet well on a pad footing can then act independently or it can be incorporated into the building foundation like a large diameter pile. It is understood that the preferred foundation option is large monolithic slab or raft. It is assumed that the slab will either be uniformly thick or will be thickened as required below bearing walls and columns.

The biggest issue for preparation of the lift station foundation is the potential susceptibility of the exposed surface to boiling due to groundwater pressures and/or disturbance from construction activity after initial excavation. If the subgrade consists of sensitive soils such as weak silt and sand, the material should be sub-cut down to the more competent till and replaced with suitable engineered fill (ie. drainage rock layer, or free draining coarse gravel). As previously discussed, dewatering of the base of the excavation will significantly increase the stability of the bearing soils. If there is significant seepage, a drainage layer should be provided below the proposed bearing elevation with de-watering sumps to maintain the groundwater level below the surface of the gravel working layer. If the base of the exposed excavation is stable, the placement of thin protective layer of lean mix concrete could be considered as a substitution to a thick drainage layer.

For monolithic mat foundations founded within undisturbed native sand or till at about 9 to 10 m below grade, an ultimate bearing capacity of 450 kPa may be used for ULS design. The “factored” ULS resistance may be calculated by multiplying the ultimate bearing capacity by a geotechnical resistance factor of 0.5, in accordance with the building code requirements summarized in Section 6.4. For SLS design on a monolithic mat up to 16 x 16 m^2, an allowable bearing resistance of 150 kPa may be used for preliminary purposes. This value can be confirmed once settlement tolerances for the lift station are known.

The bearing resistance provided assumes undisturbed native sand, clay or engineered gravel mat free from loosened material. All bearing surfaces should be monitored by qualified geotechnical personnel to verify that soil conditions meet design criteria and are capable of uniformly supporting the design loads.

6.9 LATERAL EARTH PRESSURES

It is understood soil will be backfilled around the outside of the wet well walls to provide positive drainage away from the structure and to provide frost protection for the bearing soils around the perimeter. The depth of frost penetration in this area is in the order of 2.5 m deep depending on winter temperatures and snowfall. The placement of backfill against the lift station foundation walls will produce earth pressures on the wall and possible down-drag associated with fill settlement. Three earth pressure cases may exist at this site.

1. Active Case. Active earth pressures (K_A) should be used behind retaining walls which are unrestrained at the top and flexible walls which are allowed to move away from the restrained soil mass (i.e. shoring).

2. "At Rest" Case. "At rest" pressures (K_O) should be used behind retaining walls which are restrained at the top and would include typical wet well walls. "At rest" conditions should be assumed for any sections of the sections of the shoring wall required to support adjacent development to minimize potential loss of support for existing foundations.

3. Passive Case. Passive earth pressures (K_P) act on the front of a wall (i.e. against the base of the wall). Horizontal stresses on the wall push against the soil creating a much larger resisting force than is produced by the active or at rest conditions.

Lateral earth pressures may be computed using the following equation:

$$P = K Q + K \gamma H + \gamma_w d (1 - K)$$

where:
- P = lateral earth pressure at depth H below ground level (kPa)
- γ_w = unit weight of water (9.8 kN/m^3)
- Q = any surcharge loading at the ground surface (kPa)
- K = coefficient of lateral earth pressure
- γ = total unit weight of backfill compacted to 95 percent of SPMDD (kN/m^3)
- H = depth below ground level
- d = depth below design high water elevation (estimated at 1 mbg)

This relationship makes allowance for hydrostatic pressure to build up on the wet well wall, since it expected that the lower levels of the lift station will not be protected by a permanent sub-drainage system.

Recommended design values for these parameters depend on the type of backfill used and are given in the following table.

TABLE 4
LATERAL EARTH PRESSURE PARAMETERS

Type of Backfill	Total Unit Weight (kN/m^3)	Coeff. of Lateral Earth Pressure		
		K_A	K_O	K_P
Sand Fill	19.5	0.36	0.53	2.77
Silty Clay Fill	19.0	0.41	0.58	2.46
Imported Gravel fill	20.5	0.33	0.50	3.00

The preceding relationship makes no allowance for additional horizontal forces due to frost to build up behind the wet well wall on the assumption that the building above the wet well will be heated and protected from frost action. The earth pressure relationship given above assumes nominal compaction of the backfill to a maximum of 95 percent SPMDD. Only light, hand operated equipment should be operated within 1.0 m of walls and walls should be braced prior to backfilling. If higher levels of compaction are proposed, the earth pressure relationship given above should be reviewed. If no frost protection is provided the active or at rest lateral earth pressures pushing on the wall should be increased by a factor of 2 for the depth of frost.

6.10 SUB-DRAINAGE

The lower levels of the proposed lift stations will be founded well below the groundwater table. The installation of a sub-drainage system may be warranted to allow for dewatering of the site in conjunction with construction dewatering requirements, post-construction maintenance programs and environmental monitoring initiatives. The temporary sub-drainage system could be allowed to be inundated with groundwater when not in use and could be buried during final backfill.

Long term sub-drainage is not expected to be proposed for the lower levels of the two lift station. Waterproofing of the foundation walls and tanking of the basement area with water-stops at cold joints is recommended to minimize seepage of groundwater through the concrete. Waterproofing products such as bentonite board, synthetic membranes and mastic coatings could be considered. The lower level should be provided with a sump to allow collection and removal of any seepage which does get in to the below grade spaces.

6.11 BUOYANCY

The lift station structures will extend into the groundwater table over 6.5 m. It is expected that the lower levels of the lift station will be made water tight with the use of water stops, waterproofing, slab thickening and slab anchorage to resist seepage and buoyant forces. Therefore, these structures should be designed to resist uplift or buoyant forces due to hydrostatic pressures. The recommended design groundwater table should be taken as 1.0 m below existing grade. Assuming the uplift potential is not controlled using a sub-drainage system; it can be managed by geometric design based on a resolution of forces; or by a combination of geometric design and anchors.

6.11.1 Dead Weight Resistance

In the case of wet well structure, the forces resisting buoyancy will include the weight of the concrete mat and the weight of the fluid in the structure, if any. The uplift resistance can be improved by extending the base dimensions out past the walls of the structure to add a resisting weight of soil above the outside edge of the base. For a geometric solution it is prudent to assume a design water table corresponding to the design high groundwater level of 1.0 m below existing grade. The alternative is to use a sub-drainage system to permanently keep groundwater levels below the structures; or to keep groundwater below levels which can be handled by geometric design. Buoyant unit weights should be used and a factor of safety of 1.5 against uplift should be used.

6.11.2 Anchored Resistance

If the wet well has a large base slab area, it could be subject to buoyant forces causing arching of the centre of the base. Uplift forces from the groundwater may be resisted by soil anchors at this site. The recommended ultimate shaft adhesion value for the soil/anchor contact in the till at both the Blackfalds and Lacombe sites is 50 kPa. The entire surface area of the anchor shaft may be used in calculation of the resistance. The factored ULS design uplift should be based on a GRF of 0.3 as per the NBCC - Users Guide - Structural Commentaries (Part 4 of Division B) - Commentary K on Foundations.

6.12 CONCRETE

The water soluble sulphate concentration of the soil sample at the site was 0.04 percent, which indicates a negligible potential for chemical attack of subsurface concrete. As per CSA A23.1-14, a General Use (GU) hydraulic cement is recommended with a minimum 28 day compressive strength of 28 MPa and a water cement ratio of 0.5. All concrete exposed to a freezing environment either during or after construction should be air entrained. Concrete should be placed in accordance with CSA Standard CAN3-A23.1-14. Calcium chloride used as accelerating admixture or any admixture formulation containing chloride should not be used in the subsurface concrete, since they may increase the severity of sulphate attack.

6.13 INSPECTION

It is recommended that on-site inspection and testing be performed to verify that actual site conditions are consistent with assumed conditions which meet or exceed design criteria. Based on the Alberta Building Code, adequate levels of inspection include: testing of engineered fill, review of all completed bearing surfaces for footings and full time inspection during construction deep foundations.

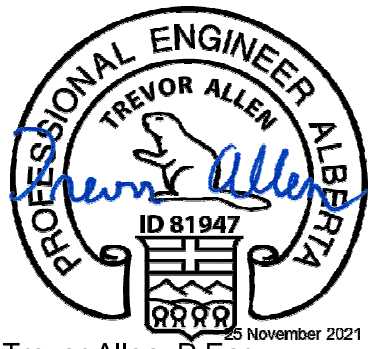
7.0 CLOSURE

This report is based on the findings at one borehole location at the site, soil testing and a review of other available site information. If new information or different subsoil/groundwater conditions are encountered, this office must be notified and recommendations submitted herein will be reviewed and revised as required.

This report has been prepared for the exclusive use of **Stantec Consulting Ltd.** and their approved agents for the specified application to the McKay Ranch Lift Station located in NE 29-040-26-W4M, Blackfalds, Alberta. This report has been prepared in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made. The General Terms and Conditions of this report are attached and should be considered part of this report.

We trust this meets with your present needs. If you have any questions or comments regarding this information, please do not hesitate to contact this office.

Respectfully submitted,
PARKLAND GEOTECHNICAL CONSULTING LTD.



Trevor Allen, P.Eng.
Geotechnical Engineer

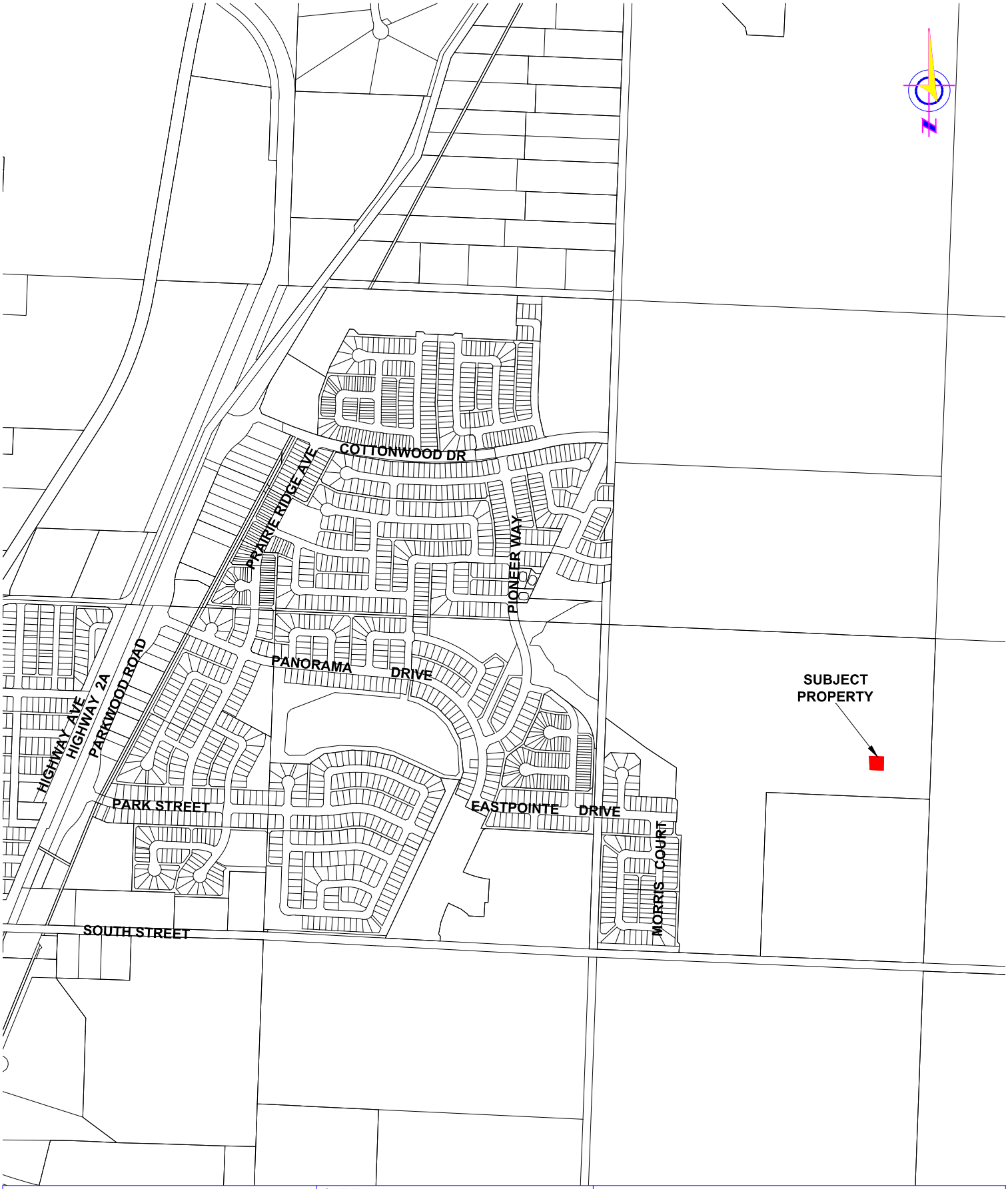
APEGA Permit to Practice No. P – 7312

ID 178900 2021-11-25

Scott Furlong, P.Eng.
Reviewer/ Responsible Member

FIGURES

Figure 1 – Key Plan
Figure 2 – Site Plan
Figure 3 - Aerial Plan
Figure 4 – Site Photographs



ParklandGEO

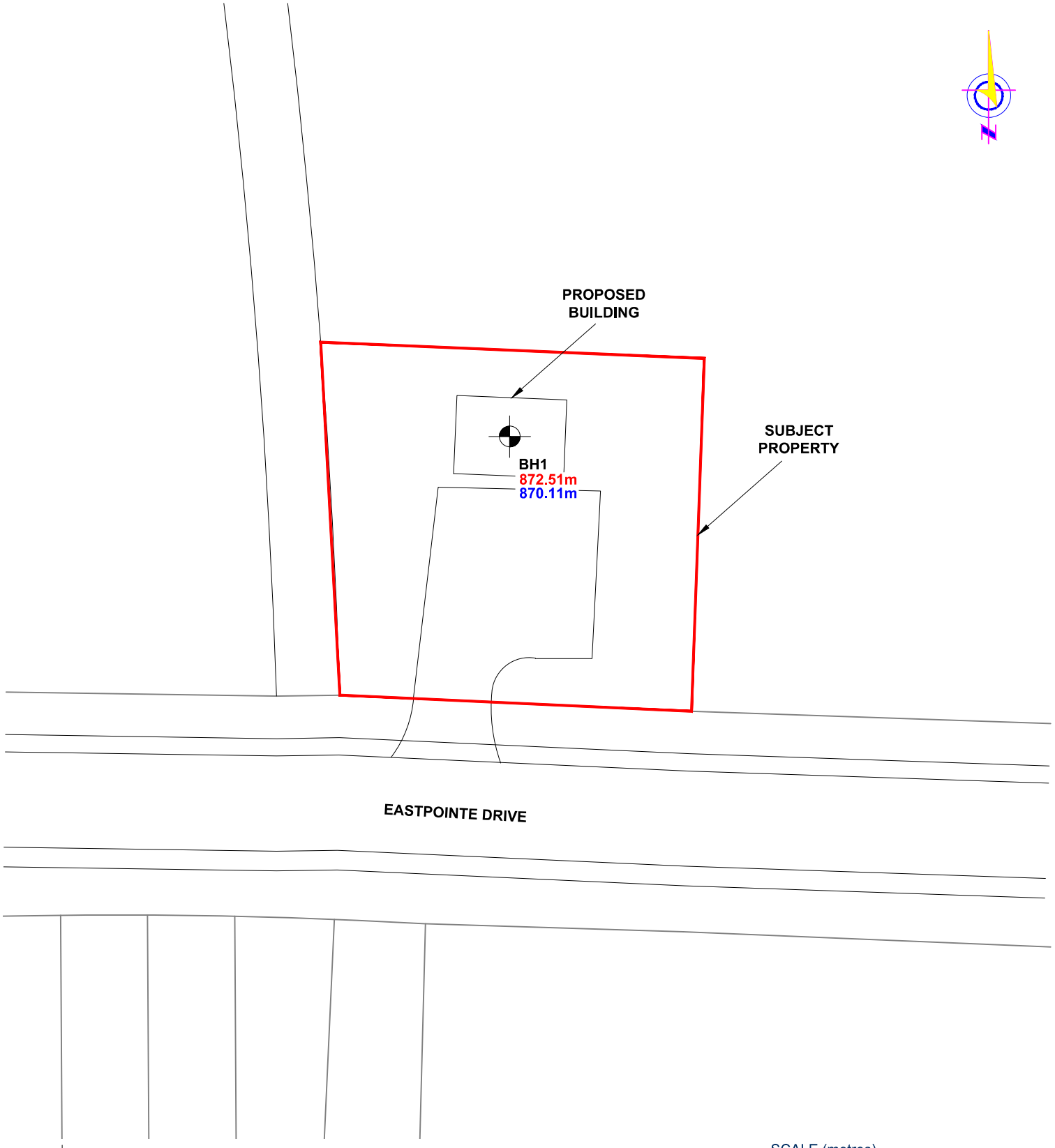
CLIENT: Stantec

KEY PLAN

McKAY RANCH LIFT STATION
WITHIN NW 25-39-27 W4M, BLACKFALDS, AB

DRAWN:	CHK'D.:	REV #:	DATE:
NC	TA	0	FEBRUARY 2017

SCALE:	JOB NO.	DRAWING NO.
NTS	RD5235	FIGURE 1



BOREHOLE LOCATION IS APPROXIMATE.

872.51m SURFACE ELEVATION

870.11m GROUNDWATER ELEVATION (JANUARY 19, 2017)

SCALE (metres)

-10 -5 0 5 10 20

ParklandGEO

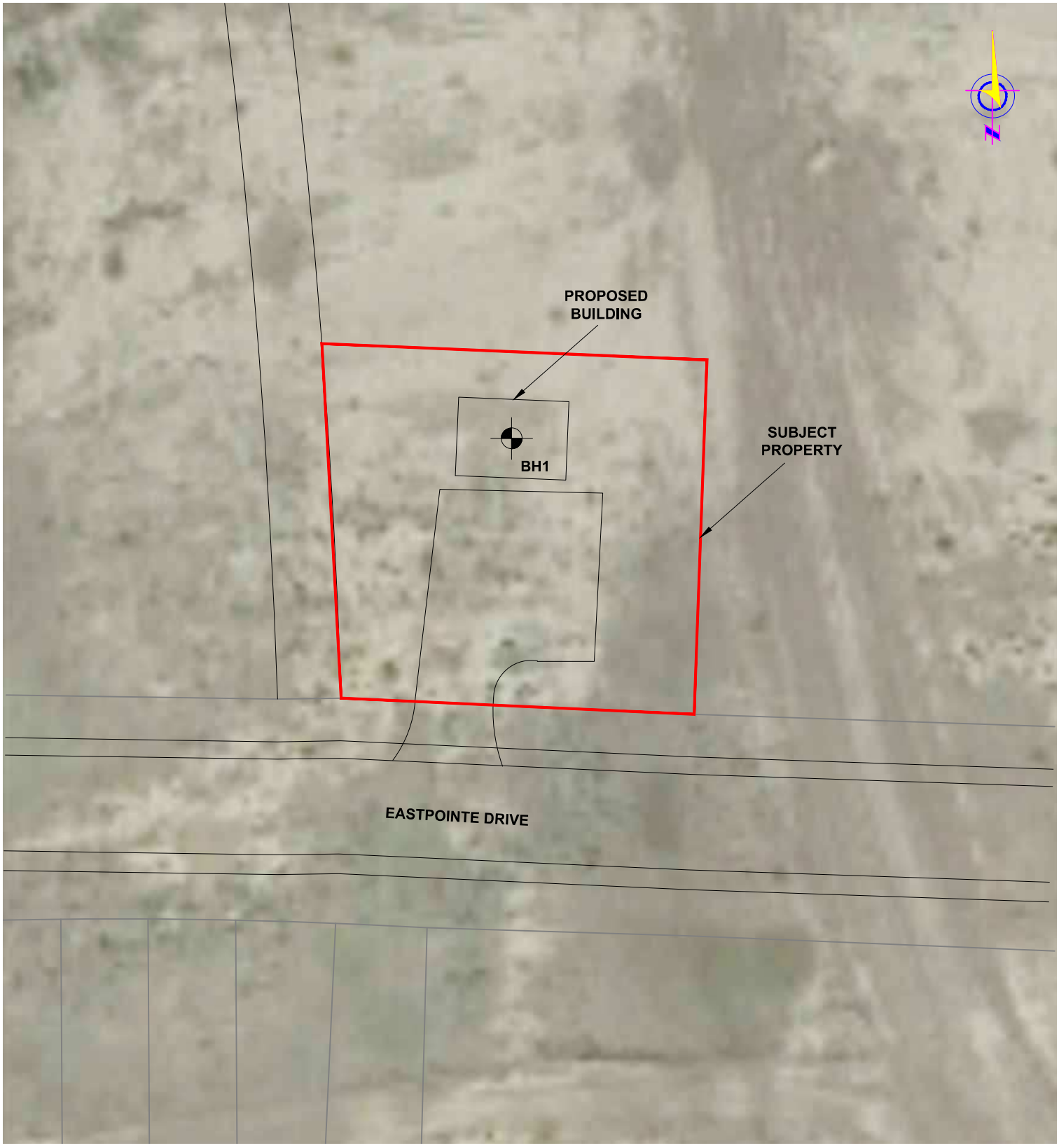
CLIENT: Stantec

SITE PLAN

McKAY RANCH LIFT STATION
WITHIN NW 25-39-27 W4M, BLACKFALDS, AB

DRAWN:	CHK'D.:	REV #:	DATE:
NC	TA	0	FEBRUARY 2017

SCALE:	JOB NO.	DRAWING NO.
1:500	RD5235	FIGURE 2



NOTE: AERIAL PHOTOGRAPH OBTAINED FROM GOOGLE EARTH, DATED AUGUST 22, 2015.

BOREHOLE LOCATION IS APPROXIMATE.

SCALE (metres)

-10 -5 0 5 10 20

ParklandGEO

CLIENT: Stantec

AERIAL PLAN

McKAY RANCH LIFT STATION
WITHIN NW 25-39-27 W4M, BLACKFALDS, AB

DRAWN:	CHK'D.:	REV #:	DATE:
NC	TA	0	FEBRUARY 2017

SCALE:	JOB NO.	DRAWING NO.
1:500	RD5235	FIGURE 3

PHOTOGRAPH 1: SHOWS SUBJECT PROPERTY, TAKEN FROM BH1, FACING NORTH

PHOTOGRAPH 2: SHOWS SUBJECT PROPERTY, TAKEN FROM BH1, FACING EAST

PHOTOGRAPH 3: SHOWS SUBJECT PROPERTY, TAKEN FROM BH1 FACING WEST

PHOTOGRAPH 4: SHOWS SUBJECT PROPERTY, TAKEN FROM BH1, FACING SOUTH

ParklandGEO	CLIENT: Stantec	**SITE PHOTOGRAPHS**	
		McKAY RANCH LIFT STATION WITHIN NW 25-39-27 W4M, BLACKFALDS, AB	
		DRAWN: NC / CHK'D.: TA / REV #: 0	DATE: FEBRUARY 2017
		SCALE: NTS / JOB NO. RD5235	DRAWING NO. FIGURE 4

APPENDIX A

Borehole Log (1)
Soil Test Results
Explanation Sheets

BOREHOLE NO.: 01

CLIENT: Stantec Consulting Ltd.
SITE: McKay Lift Station
NOTES:

PROJECT NO.: RD5235
BH LOCATION: Bldg Center

SUBSURFACE PROFILE

Depth (m)	Description	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Elevation (m)
0	GROUND SURFACE						872.51
	Topsoil Black, organic, frozen.					Frozen to 0.4 m.	
1	**Sand** Some silt, fine grained, loose to compact, brown, moist.	16	G	1G1			871.61
	Silt Some fine grained sand, trace to little clay, stiff, low plastic, brown, moist.	14	D	1D1	8	SO_4 = 0.04%	870.91
2			G	1G2			
3	**Sand** Trace to little silt, fine grained, loose to compact, brown, moist. - Some fine grained grey sand lenses, occasional silt inclusions at 2.3 m. - Some grey silt, some clay inclusions; at 2.8 m. - Coarse grained, little gravel, loose, brown, wet to saturated; at 3.0 m.	19				Grain Size Analysis: Gravel = 0.5% Sand = 75.8% Silt and Clay = 23.7%	
		17	G	1G3			
4							868.01
5		27	D	1D2	5		
			G	1G4			
6		28					
	Silt Little clay, trace to little fine grained sand, soft to firm, low plastic, brown, moist to wet. - Little fine grained sand, trace clay, grey; at 7.0 m.	25	G	1G5			
7							
8		24	D	1D3	9		
			G	1G6			
9		25					
10		25	G	1G7			
11		24					
			G	1G8			
12	- Firm to stiff, brown and grey, moist; at 12.0 m.	26					
13		23	G	1G9			
14		25					858.51
	Clay Some silt, stiff to hard, medium to high plastic, brown, moist.		G	1G10			
15		28					857.51
	End of Borehole at 15.0 m. Slough to 3.0 m upon completion. 25 mm PVC standpipe installed. Backfilled with auger cuttings. Wet upon completion. Water at 2.4 m on January 19, 2017. Water at 3.2 m on October 27, 2021.						
16							
17							

Well Completion Details: SOLID, SLOTTED, AUGER CUTTINGS, SLOUGH

LOGGED BY: NC
CONTRACTOR: Darkhorse Drilling Ltd.
RIG/METHOD: Geoprobe 7822DT / Solid Stem
DATE: December 21, 2016
CALIBRATION:

GROUND ELEVATION: 872.51 m
NORTHING: 5806876.06 m
EASTING: 312067.99 m

Project: McKay Ranch Lift Station
Subject: Geotechnical Testing - Soil Sulphate Test Results
Project #: RD5235 **Date:** January 16, 2017

Soil Sulphate Test Results

Laboratory: Parkland Geotechnical

Sample #: MC1-2 Borehole: 1 Depth: 2.0m Result (% Sulphate): 0.04	Sample #: Borehole: Depth: Result (% Sulphate):
Sample #: Borehole: Depth: Result (% Sulphate):	Sample #: Borehole: Depth: Result (% Sulphate):
Sample #: Borehole: Depth: Result (% Sulphate):	Sample #: Borehole: Depth: Result (% Sulphate):
Sample #: Borehole: Depth: Result (% Sulphate):	Sample #: Borehole: Depth: Result (% Sulphate):
Sample #: Borehole: Depth: Result (% Sulphate):	Sample #: Borehole: Depth: Result (% Sulphate):

Comments:

REQUIREMENTS FOR CONCRETE SUBJECTED TO SULPHATE ATTACK (CAN/CSA-A231-M09)

EXPOSURE CLASSIFICATION	DEGREE OF EXPOSURE	WATER-SOLUBLE SULPHATE(SO4) IN SOIL SAMPLE, %	SULPHATE(SO4) IN GROUND WATER SAMPLES, mg/L	MINIMUM SPECIFIED 56-DAY COMPRESSIVE STRENGTH, MPa	MAXIMUM WATER/CEMENTING MATERIALS RATIO	PORTLAND CEMENT TO BE USED
S-1	Very Severe	over 2.0	over 10,000	35	0.4	HS
S-2	Severe	0.20 to 2.0	1 500 to 10 000	32	0.45	HS
S-3	Moderate	0.10 to 0.20	150 to 1 500	30	0.5	MS or HS

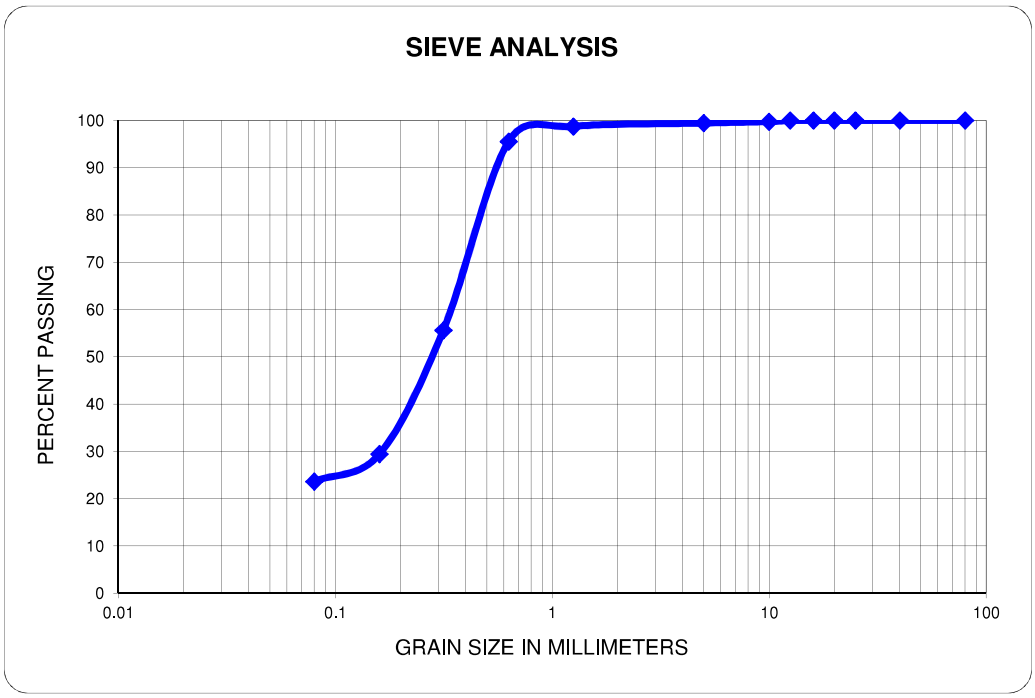
Tech: AB **Chkd:** TA

PROJECT - McKay Ranch Lift Station
PROJECT # RD5235 **DATE -** January 13, 2017
SAMPLE SOURCE -
PIT NAME -
TECHNICIAN - AB **SIEVE #** 1

SIEVE NO.	OPENING SIZE (mm)	WEIGHT RETAINED (g)	TOTAL WT. FINER (gms)	PERCENT PASSING	SPECIFICATION Min.	SPECIFICATION Max.
80000	80		1150.4	100.0		
40000	40		1150.4	100.0		
25000	25		1150.4	100.0		
20000	20		1150.4	100.0		
16000	16		1150.4	100.0		
12500	12.5		1150.4	100.0		
10000	10	2.7	1147.7	99.8		
5000	5	3.6	1144.1	99.5		
1250	1.25	8.1	1136	98.7		
630	0.63	36.3	1099.7	95.6		
315	0.315	459.2	640.5	55.7		
160	0.16	301.2	339.3	29.5		
80	0.08	67.2	272.1	23.7		
SIEVE PAN		19.8				

MOISTURE CONTENT SAMPLE		SIEVE ANALYSIS SAMPLE		D.W.W.CALCULATIONS
A-WT. WET SAMPLE + PAN	1924.8	G-WT. OF DRY SAMPLE	1150.4	
B-WT. DRY SAMPLE + PAN	1753.9	H- WASHED DRY +PAN	1501.6	
C-WT. OF WATER	170.9	I- WT OF WASHED DRY SAI	898.1	
D-WT. OF PAN	603.5	J- WT WASHED FINES	252.3	
E-WT. OF DRY SAMPLE	1150.4			
F-MOISTURE CONTENT	14.9			

DESCRIPTION OF SAMPLE/COMMENTS	METHOD OF PREPARATION	WASHED
BH1	TOTAL WEIGHT	1150.4
1G2	DRY WT.	1150.4
2.5m	DIFFERENCE	0
	% DIFFERENCE	0



THE PARKLANDGEO CONSULTING GROUP
EXPLANATION OF TERMS AND SYMBOLS

The terms and symbols used on the borehole logs to summarize the results of the field investigation and subsequent laboratory testing are described on the following pages.

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1. **PRINCIPAL SOIL TYPE** – The major soil type by weight of material or by behaviour.

Material	Grain Size
Boulders	Larger than 300 mm
Cobbles	75 mm to 300 mm
Coarse Gravel	19 mm to 75 mm
Fine Gravel	5 mm to 19 mm
Coarse Sand	2 mm to 5 mm
Medium Sand	0.425 mm to 2 mm
Fine Sand	0.075 mm to 0.425 mm
Silt	0.020 to 0.075 mm
Clay	Smaller than 0.020 mm

2. **DESCRIPTION OF MINOR SOIL TYPE** – Minor soil types are identified by weight of minor component.

Descriptor	Percent
and	35 to 50
some	20 to 35
little	10 to 20
trace	1 to 10

3. **CONSISTENCY OF FINE GRAINED SOILS** – The following terms are used relative to undrained shear strength and Standard Penetration Test (SPT), N value, for blows per 300 mm penetration (ASTM D1586).

Description	Undrained Shear Strength, C_u (kPa)	SPT N Value
Very Soft	Less than 12	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 150	15 to 30
Hard	Over 150	Over 30

4. **RELATIVE DENSITY OF COARSE GRAINED SOIL** – The following terms are used relative to Standard Penetration Test (SPT), N value, for blows per 300 mm penetration (ASTM D1586).

Description	SPT N Value
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Over 50

5. **TYPICAL SEDIMENTARY BEDROCK TYPES AND CLASSIFICATION** – The following terms are based on visual inspection and field/laboratory identification tests.

Characteristic	Sandstone	Mudrocks			
		Siltstone	Mudstone	Clayshale	Claystone
Composition	>50% Sand $CaCO_3$ or silica binder. Use weak acid to test for $CaCO_3$.	>50% Silt	33% to 66% Silt & 33% to 66% Clay	>50% Clay & <33% Silt	
Bedding	Banding possible Non- Fissile Wackes – dirty sandstone matrix (>15% clay)	Non-Fissile & Non-laminated	Non-Fissile & Non-laminated	Fissile	Non-Fissile

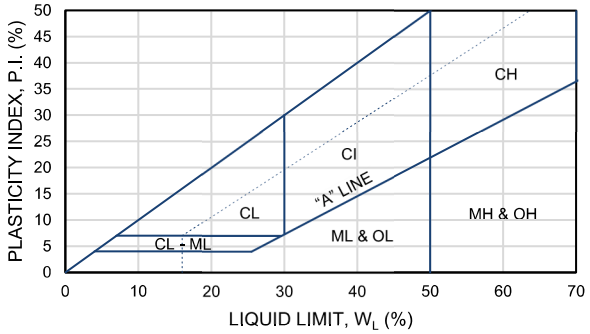
Definitions

Fissile	Breaks apart on bedding planes, not fractures.
Shale	Only used to describe a fissile clay mudrock.
Slate	Hard mudstone exposed to high pressure and temperature.
Limestone	Sedimentary rock (i.e. particles) formed from calcium carbonate minerals from skeletal fragments of marine organisms such as coral. Particles generally too small to see with eye.

THE PARKLANDGEO CONSULTING GROUP
EXPLANATION OF TERMS AND SYMBOLS

MODIFIED UNIFIED CLASSIFICATION SYSTEM FOR SOILS

MAJOR DIVISION			GROUP SYMBOL	GRAPH SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA	
COARSE GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN NO. 200 SIEVE)	GRAVELS MORE THAN HALF COARSE GRAINS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)	GW		WELL GRADED GRAVELS, GRAVEL-SAND MIXTURE, LITTLE OR NO FINES	$C_U = \frac{D_{60}}{D_{10}} \geq 4$ AND $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3	
			GP		POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS	
		DIRTY GRAVELS (WITH SOME FINES)	GM		SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
			GC		CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE "A" LINE AND P.I. GREATER THAN 7
	SANDS MORE THAN HALF FINE GRAINS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)	SW		WELL GRADED SANDS, GRAVELLY SANDS WITH LITTLE OR NO FINES	$C_U = \frac{D_{60}}{D_{10}} \geq 6$ AND $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3	
			SP		POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS	
		DIRTY SANDS (WITH SOME FINES)	SM		SILTY SANDS, SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
			SC		CLAYEY SANDS, SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE "A" LINE AND P.I. GREATER THAN 7
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT PASSES NO. 200 SIEVE)	SILTS BELOW "A" LINE NEGLIGIBLE ORGANIC CONTENT	$W_L < 50\%$	ML		INORGANIC SILTS & VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART (SEE BELOW)	
		$W_L > 50\%$	MH		INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS		
	CLAYS ABOVE "A" LINE NEGLIGIBLE ORGANIC CONTENT	$W_L < 30\%$	CL		INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY SOILS		
		$30\% < W_L < 50\%$	CI		INORGANIC CLAYS OF MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS		
		$W_L > 50\%$	CH		INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS		
	ORGANIC SILTS & CLAYS BELOW "A" LINE	$W_L < 50\%$	OL		ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW AND MEDIUM PLASTICITY		
		$W_L > 50\%$	OH		ORGANIC CLAYS OF HIGH PLASTICITY, ORGANIC SILTS		
HIGHLY ORGANIC SOILS			Pt		PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOR OR ODOR, AND OFTEN FIBROUS TEXTURE	



NOTES ON SOIL CLASSIFICATION AND DESCRIPTION:

1. Soil are classified and described according to their engineering properties and behaviour.
2. Boundary classification for soil with characteristics of two groups are given combined group symbols (e.g. GW-GC is a well graded gravel sand mixture with clay binder between 5 and 12%).
3. Soil classification is in accordance with the Unified Soil Classification System (ASTM D2487) with the exception that an inorganic clay of medium plasticity (CI) is recognized.
4. The use of modifying adjectives may be employed to define the estimated percentage range of minor components.

LIMITATIONS

General Terms and Conditions

The use of this attached report is subject to the following general terms and conditions.

1. STANDARD OF CARE - In the performance of professional services, ParklandGEO used the degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession practicing in the same or similar localities. No other warranty expressed or implied is made in any manner.

2. INTERPRETATION OF THE REPORT - The CLIENT recognizes that subsurface conditions will vary from those encountered at the location where borings, surveys, or explorations are made and that the data, interpretations and recommendation of ParklandGEO are based solely on the information available to him. Classification and identification of soils, rocks, geological units, contaminated materials and contaminant quantities will be based on commonly accepted practices in geotechnical or environmental consulting practice in this area. ParklandGEO will not be responsible for the interpretation by others of the information developed.

3. SITE INFORMATION - The CLIENT has agreed to provide all information with respect to the past, present and proposed conditions and use of the Site, whether specifically requested or not. The CLIENT acknowledged that in order for ParklandGEO to properly advise and assist the CLIENT, ParklandGEO has relied on full disclosure by the CLIENT of all matters pertinent to the Site investigation.

4. COMPLETE REPORT - The Report is of a summary nature and is not intended to stand alone without reference to the instructions given to ParklandGEO by the CLIENT, communications between ParklandGEO and the CLIENT, and to any other reports, writings or documents prepared by ParklandGEO for the CLIENT relative to the specific Site, all of which constitute the Report. The word "Report" shall refer to any and all of the documents referred to herein. In order to properly understand the suggestions, recommendations and opinions expressed by ParklandGEO, reference must be made to the whole of the Report. ParklandGEO cannot be responsible for use of any part or portions of the report without reference to the whole report. The CLIENT has agreed that "This report has been prepared for the exclusive use of the named CLIENT. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. ParklandGEO accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report."

   The CLIENT has agreed that in the event that any such report is released to a third party, the above disclaimer shall not be obliterated or altered in any manner. The CLIENT further agrees that all such reports shall be used solely for the purposes of the CLIENT and shall not be released or used by others without the prior written permission of ParklandGEO.

5. LIMITATIONS ON SCOPE OF INVESTIGATION AND WARRANTY DISCLAIMER
   There is no warranty, expressed or implied, by ParklandGEO that:
   a) the investigation uncovered all potential geo-hazards, contaminants or environmental liabilities on the Site; or
   b) the Site is entirely free of all geo-hazards or contaminants as a result of any investigation or cleanup work undertaken on the Site, since it is not possible, even with exhaustive sampling, testing and analysis, to document all potential geo-hazards or contaminants on the Site.

   The CLIENT acknowledged that:
   a) the investigation findings are based solely on the information generated as a result of the specific scope of the investigation authorized by the CLIENT;
   b) unless specifically stated in the agreed Scope of Work, the investigation will not, nor is it intended to assess or detect potential contaminants or environmental liabilities on the Site;
   c) any assessment regarding geological conditions on the Site is based on the interpretation of conditions determined at specific sampling locations and depths and that conditions may vary between sampling locations, hence there can be no assurance that undetected geological conditions, including soils or groundwater are not located on the Site;
   d) any assessment is also dependent on and limited by the accuracy of the analytical data generated by the sample analyses;
   e) any assessment is also limited by the scientific possibility of determining the presence of unsuitable geological conditions for which scientific analyses have been conducted; and
   f) the laboratory testing program and analytical parameters selected are limited to those outlined in the CLIENT's authorized scope of investigation; and
   g) there are risks associated with the discovery of hazardous materials in and upon the lands and premises which may inadvertently discovered as part of the investigation. The CLIENT acknowledges that it may have a responsibility in law to inform the owner of any affected property of the existence or suspected existence of hazardous materials and in some cases the discovery of hazardous conditions and materials will require that certain regulatory bodies be informed. The CLIENT further acknowledges that any such discovery may result in the fair market value of the lands and premises and of any other lands and premises adjacent thereto to be adversely affected in a material respect.

6. COST ESTIMATES - Estimates of remediation or construction costs can only be based on the specific information generated and the technical limitations of the investigation authorized by the CLIENT. Accordingly, estimated costs for construction or remediation are based on the known site conditions, which can vary as new information is discovered during construction. As some construction activities are an iterative exercise, ParklandGEO shall therefore not be liable for the accuracy of any estimates of remediation or construction costs provided.

7. LIMITATION OF LIABILITY - The CLIENT has agreed that to the fullest extent permitted by the law ParklandGEO's total liability to CLIENT for any and all injuries, claims, losses, expenses or damages whatsoever arising out of or in anyway relating to the Project is contractually limited, as outlined in ParklandGEO's standard Consulting Services Agreement. Further, the CLIENT has agreed that to the fullest extent permitted by law ParklandGEO is not liable to the CLIENT for any special, indirect or consequential damages whatsoever, regardless of cause.

8. INDEMNIFICATION - To the fullest extent permitted by law, the CLIENT has agreed to defend, indemnify and hold ParklandGEO, its directors, officers, employees, agents and subcontractors, harmless from and against any and all claims, defence costs, including legal fees on a full indemnity basis, damages, and other liabilities arising out of or in any way related to ParklandGEO's work, reports or recommendations.

ParklandGEO Ltd.
#102 – 4756 Riverside Drive
Red Deer, AB, T4N 2N7
www.parklandgeo.com
T: 403 343 2428
F: 403 343 7699

February 9, 2026
Project No. 26-0050RD

Brad.VanderHeyden@stantec.com
Original will remain on file

Stantec Consulting Ltd.
4900 50 Street
Red Deer, AB
T4N 1X7

Attn: Brad Vander Heyden, P.Eng.
Project Manager, Senior Associate

Re: Geotechnical Investigation – Groundwater Level
McKay Ranch Lift Station
Blackfalds, Alberta

1.0 INTRODUCTION

The Town of Blackfalds is proposing to construct a lift station in southeast Blackfalds, Alberta. ParklandGEO Ltd. (ParklandGEO) was retained by Stantec Consulting Ltd. (Stantec) to conduct a geotechnical investigation for the lift station. The following geotechnical reports were issued for the lift station:

- "*Geotechnical Investigation – McKay Ranch Lift Station – Blackfalds, Alberta"* Prepared for the Stantec Consulting Ltd., Prepared by Parkland Geotechnical Consulting Ltd., dated February 2017 (Project # RD5235).

- "*Geotechnical Investigation – McKay Ranch Lift Station – Blackfalds, Alberta"* Prepared for the Stantec Consulting Ltd., Prepared by Parkland Geotechnical Consulting Ltd., dated November 25, 2021 (Project # RD7599).

ParklandGEO Ltd. (ParklandGEO) was requested by Stantec to drill a new borehole at the lift station location and provide a new groundwater level measurement.

2.0 DRILLING PROGRAM

1. Prior to mobilizing the drilling rig, ParklandGEO personnel completed an Alberta One Call to verify the drill sites were clear of underground utilities.

2. On January 23, 2026, a new borehole was drilled at the site to a depth of 6 m below existing grade. The borehole was drilled using a truck mounted drilling rig with 150 mm diameter solid stem augers. The drill rig was owned and operated by J.E.D. Anchors & Environmental & Drilling of Penhold, Alberta.

3. Drilling operations were monitored by members of ParklandGEO's geotechnical staff. The soil encountered was visually examined during drilling and logged according to the Modified Unified Soil Classification System.

4. At the completion of drilling, a 25 mm hand-slotted PVC standpipe was installed in the boreholes and backfilled with auger cuttings and a bentonite chips. Groundwater levels and depths where seepage zones were encountered were noted during drilling. Groundwater measurements were recorded on February 5, 2026.

5. The borehole locations were surveyed by ParklandGEO using a Trimble GPS receiver and a pole mounted Trimble antenna. The estimated post data correction vertical accuracy of this equipment is ±10 cm. UTM coordinates and geodetic elevations are provided in the borehole log in Appendix A.

3.0 GROUNDWATER CONDITIONS

Sloughing conditions were observed in the sand layer throughout drilling. Groundwater seepage was observed in the borehole during and after drilling. The groundwater level was measured to a depth of 5.1 m below grade on February 5, 2026, 13 days after drilling.

Previously at the site, the groundwater level was measured at a depth of 2.4 m below grade on January 19, 2017 and a depth of 3.2 m below grade on October 27, 2021.

The observed shallow groundwater measurements are considered to be typical for this area of Blackfalds. The local groundwater table is dependent on infiltration of precipitation and is expected to fluctuate on a season basis with the highest levels after periods of prolonged heavy precipitation or snowmelt. Groundwater seepage is expected in shallow excavations. The volumes and seepage rates for groundwater encountered will be dependent on seasonal conditions and the permeability of the soils within the profile.

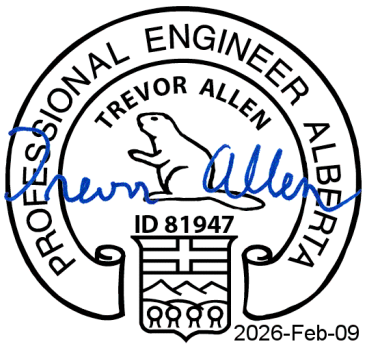
4.0 CLOSURE

Geological conditions are variable. The recommendations presented in this report, and any subsequent correspondence, are based on an evaluation of information derived from the boreholes, and additional sources of information referenced in this report. If conditions are noted during construction which are believed to be at variance with the conditions described in this report, this office should be contacted immediately.

This report has been prepared for the exclusive use of the Client and their approved agents for the scope of work and property outlined in this report. Use of the report is subject to acceptance of the General Terms, Conditions, and Limitations provided in this report. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. ParklandGEO Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

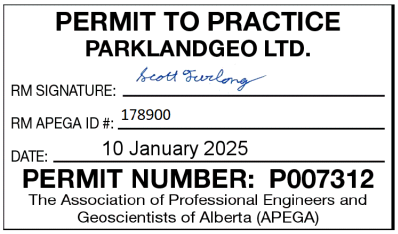
We trust that this report meets with your current requirements. If there are any questions, please do not hesitate to contact our office.

Respectfully Submitted,
PARKLANDGEO LTD.



Trevor Allen, P.Eng.
Geotechnical Engineer

APEGA PERMIT TO PRACTICE P007312



Scott Furlong, P.Eng.
Responsible Member

Parkland GEO

PROJECT: McKay Ranch Lift Station Groundwater
CLIENT: Stantec Consulting Ltd.
SITE: Blackfalds, AB

BOREHOLE NO. 26-01
PROJECT NO.: 26-0050 RD
BH LOCATION:

Depth (m)	Lithologic Description	Symbol	Atterberg Limits & Moisture (W_{PL} W W_{LL}) 20 40 60 80	Samples: No.	Samples: Blow Counts	Samples: Type	Comments	Well Completion Details
	EL 872.16 m							1m
0	**SAND** Some silt, fine to medium grained, loose, brown, damp to moist.							#1 Standpipe (PVC)
1								
	- Frozen to 1.5 m.							
2								
3	- Medium to coarse grained, wet at 3.0 m.							
	4 m EL 868.16 m							
4	**SILT** Some sand, firm, non to low plastic, brown, wet.							
5								
	6 m EL 866.16 m							
6	End of borehole at 6.0 m. 25 mm PVC standpipe installed. Backfilled with auger cuttings and bentonite chips. Water at 5.10 m on February 5, 2026.							
7								
8								
9								
10								
11								

LOGGED BY: SB
CONTRACTOR: J.E.D Anchors and Environment Drilling
RIG/METHOD: Truck Mount /Auger (Solid-Stem) (0-6 m)
NOTES:

DATE: Jan 23, 2026
GROUND ELEVATION (m): 872.16
NORTHING (m): 5806865.06
EASTING (m): 312031.55

RSLog / RD ParklandGEO Geotechnical Template / parklandgeo-ltd-ca / RSLOGrd.geo01 / February 05, 2026 10:34 AM

PARKLANDGEO LTD.
EXPLANATION OF TERMS AND SYMBOLS

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Fine Gravel	5 mm to 19 mm
Coarse Sand	2 mm to 5 mm
Medium Sand	0.425 mm to 2 mm
Fine Sand	0.075 mm to 0.425 mm
Silt	0.020 to 0.075 mm
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Bedding	Banding possible Non- Fissile Wackes – dirty sandstone matrix (>15% clay)	Non-Fissile & Non-laminated	Non-Fissile & Non-laminated	Fissile	Non-Fissile

Definitions

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Shale Only used to describe a fissile clay mudrock.
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Limestone Sedimentary rock (i.e. particles) formed from calcium carbonate minerals from skeletal fragments of marine organisms such as coral. Particles generally too small to see with eye.

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			GP		POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS	
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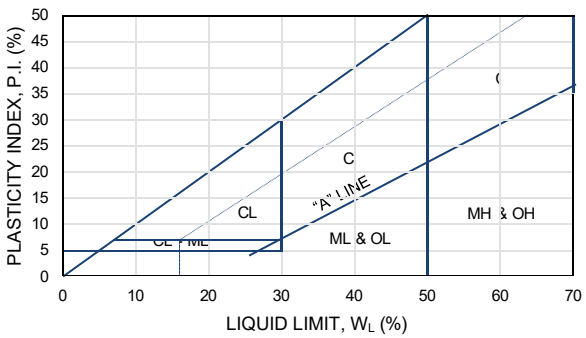
	SANDS MORE THAN HALF FINE GRAINS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)	SW		WELL GRADED SANDS, GRAVELLY SANDS WITH LITTLE OR NO FINES	$C_U = \frac{D_{60}}{D_{10}} \geq 6$ AND $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3	
			SP		POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS	
		DIRTY SANDS (WITH SOME FINES)	SM		SILTY SANDS, SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
			SC		CLAYEY SANDS, SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE "A" LINE AND P.I. GREATER THAN 7
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT PASSES NO. 200 SIEVE)	SILTS BELOW "A" LINE NEGLIGIBLE ORGANIC CONTENT	W_L < 50%	ML		INORGANIC SILTS & VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART (SEE BELOW)	
		W_L > 50%	MH		INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS		
	CLAYS ABOVE "A" LINE NEGLIGIBLE ORGANIC CONTENT	W_L < 30%	CL		INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY SOILS		
		30% < W_L < 50%	CI		INORGANIC CLAYS OF MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS		
		W_L > 50%	CH		INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS		
	ORGANIC SILTS & CLAYS BELOW "A" LINE	W_L < 50%	OL		ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW AND MEDIUM PLASTICITY		
		W_L > 50%	OH		ORGANIC CLAYS OF HIGH PLASTICITY, ORGANIC SILTS		
HIGHLY ORGANIC SOILS			Pt		PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOR OR ODOR, AND OFTEN FIBROUS TEXTURE	



NOTES ON SOIL CLASSIFICATION AND DESCRIPTION:

1. Soil are classified and described according to their engineering properties and behaviour.
2. Boundary classification for soil with characteristics of two groups are given combined group symbols (e.g. GW-GC is a well graded gravel sand mixture with clay binder between 5 and 12%).
3. Soil classification is in accordance with the Unified Soil Classification System (ASTM D2487) with the exception that an inorganic clay of medium plasticity (CI) is recognized.
4. The use of modifying adjectives may be employed to define the estimated percentage range of minor components.

Professional services are subject to the following general terms, conditions, and limitations. If there is a conflict between the general terms, conditions, and limitations stated herein and those in the fully executed agreement signed between the CLIENT and ParklandGEO Ltd. (the "CONSULTANT") those of the fully executed agreement have precedence.

1. STANDARD OF CARE

1.1. In the performance of professional services, the CONSULTANT will use that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession practicing in the same or similar localities. No other warranty, representation, or guarantee, either expressed or implied, is made or intended by this Agreement or by furnishing oral or written reports of the findings made, including but not limited as to CONSULTANT's professional services.

2. SITE INFORMATION

2.1. The CLIENT agrees to fully cooperate with the CONSULTANT and provide all information with respect to the past, present and proposed conditions and use of the project site (the "**Site**") whether specifically requested or not. The CLIENT acknowledges that in order for the CONSULTANT to properly provide the Services for which it is engaged and advise and assist the CLIENT, the CONSULTANT is relying upon full disclosure by the CLIENT of all matters and information pertinent to the Site, and upon the accuracy of such matters and information. The CONSULTANT shall not be responsible to the CLIENT or others for any consequences of any error or omissions contained in such CLIENT-supplied information, or as a result of the CLIENT's non-disclosure of information.

2.2. The CLIENT recognizes that subsurface conditions will vary from those encountered at the location where borings, surveys, or explorations are made and that the data, interpretations, and recommendation of the CONSULTANT are based solely on the information available to it. Classification and identification of soils, rocks, geological units, contaminated materials, and contaminant quantities will be based on commonly accepted practices in geotechnical and environmental consulting practice in this area.

2.3. Where specifically stated in the scope of work/Services, the CONSULTANT will perform a review of the historical information obtained or provided by the Client to assist in the investigation of the Site unless and except to the extent that such a review is limited or excluded from the scope of work.

3. WORK PRODUCT AND COMPLETE REPORT

3.1. Test results and reports, including the final report (the "**Report**"), provided by the CONSULTANT are of a summary nature and are not intended to stand alone without reference to the instructions given to the CONSULTANT by the CLIENT, communications between the CONSULTANT and the CLIENT, and to any other reports, writings or documents prepared by the CONSULTANT for the CLIENT relative to the specific Site, all of which shall constitute the "**Work Product**". In order to properly understand the suggestions, recommendations and opinions expressed by the CONSULTANT, reference must be made to the whole of the Work Product and Report. The CONSULTANT shall not be responsible for use of any part or portions of the of the Work Product or Report without reference to the whole of the Work Product and Report. The CLIENT agrees that any and all reports prepared by the CONSULTANT shall contain the following statement, and if such statement does not appear in the Work Product or Report the CLIENT agrees it is deemed to be included therein by way of this provision:

> *"This report has been prepared for the exclusive use of the Client and their approved agents for the scope of work and property outlined in this report. Use of the report is subject to acceptance of the General Terms, Conditions, and Limitations provided in this report. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. ParklandGEO Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report."*

3.2. The CLIENT agrees that in the event that any such report is released to a third party, such disclaimer shall not be removed, deleted, excluded or altered in any manner. The CLIENT further agrees that all Reports, including but not limited to any interim, preliminary or other reports, writings or documents prepared by the CONSULTANT for the CLIENT relative to the services and/or Site, shall be used solely for the purposes of the CLIENT and shall not be released, disclosed or used by others without the prior written permission of the CONSULTANT. No third parties are entitled to rely upon the Report or any portion thereof, and the Report shall not be considered accurate, complete or appropriate or suitable for such third parties.

4. INTERPRETATION OF THE REPORT AND/OR RESULTS

4.1. The CLIENT recognizes that subsurface conditions will vary from those encountered at the location where borings, surveys, or explorations are made and that the data, interpretations, and recommendations of the CONSULTANT are based solely on the information available to it. Classification and identification of soils, rocks, geological units, contaminated materials, and contaminant quantities will be based on commonly accepted practices in geotechnical and environmental consulting practice in this area. The CONSULTANT will not be responsible for the interpretation by others of the information developed by the CONSULTANT.

5. LIMITATIONS ON SCOPE OF INVESTIGATION AND WARRANTY

5.1. There is no warranty, expressed or implied, by the CONSULTANT that:

1. the investigation and services provided by the CONSULTANT shall uncover all potential geo-hazards, contaminants or environmental liabilities on the Site; or
2. the Site will be entirely free of all geo-hazards or contaminants as a result of any investigation and Services provided by the CONSULTANT, or cleanup work undertaken on the Site. The CLIENT acknowledges and agrees that it is not possible, even with exhaustive sampling, testing and analysis, to document all potential geo-hazards or contaminants on the Site.

5.2. The CLIENT acknowledges that:

1. the investigation findings, including but not limited to those in the Work Product and/or Report, are based solely on the information generated as a result of the specific scope of the investigation authorized by the CLIENT;
2. unless specifically stated in the agreed scope of work, the investigation will not, nor is it intended to assess or detect potential contaminants or environmental liabilities on the Site;
3. any assessment regarding geological conditions on the Site is based on the interpretation of conditions determined at specific sampling locations and depths, and that conditions may vary between sampling locations, hence there can be no assurance that undetected geological conditions, including soils or groundwater are not located on the Site;
4. any assessment is also dependent on and limited by the accuracy of the analytical data generated by the sample analyses;
5. any assessment is also limited by the scientific possibility of determining the presence of unsuitable geological conditions for which scientific analyses have been conducted;

6. the laboratory testing program and analytical parameters selected are limited to those outlined in the CLIENT's authorized scope of investigation; and
7. there are risks associated with the discovery of hazardous materials in and upon the lands and premises which may inadvertently be discovered as part of this investigation. The CLIENT acknowledges that it may have a responsibility in law to inform the owner of any affected property of the existence or suspected existence of hazardous materials. The CLIENT further acknowledges that any such discovery may result in the fair market value of the lands and premises and of any other lands and premises adjacent thereto to be adversely affected in a material respect.

6. COST ESTIMATES

6.1. Where provided, estimates of remediation or construction costs can only be based on the specific information generated and the technical limitations of the investigation authorized by the CLIENT at the date of the report. Accordingly, estimated costs for construction are based on the known Site conditions, which can vary as new information is discovered during construction or otherwise. The CLIENT acknowledges construction activities are an iterative exercise and cost estimates in relation to same may not be or remain accurate. The CONSULTANT shall not be liable for the accuracy of any estimates of remediation or construction costs provided.

7. LIMITATIONS OF LIABILITY AND INDEMNIFICATION

7.1. **LIMITATION OF LIABILITY** – The CLIENT hereby agrees that to the fullest extent permitted by the law the CONSULTANT's total liability to the CLIENT, and the CLIENT's maximum recourse against the CONSULTANT, for any and all manner of actions, causes of action, claims, injuries, demands, damages (including without limitation punitive, exemplary, indirect or consequential damages), losses, costs or expenses, of any and every kind and nature whatsoever, at law or in equity, in tort, contract, or other legal theory, whatsoever, in any way arising out of or in any way related or connected to this Agreement, the CONSULTANT's services, any communications, representations, warranties or otherwise in respect of same, the project, and/or the Site, including but not limited to the CONSULTANT's negligence, errors, omissions, strict liability, breach of contract, or breach of warranty, shall be absolutely limited and shall not exceed $50,000 (Canadian Dollars) or the total amount of the professional liability insurance amount, whichever is greater.

7.2. **NO SPECIAL OR CONSEQUENTIAL DAMAGES** – The CLIENT and CONSULTANT agree that to the fullest extent permitted by law the CONSULTANT shall not be liable to the CLIENT for any special, indirect, incidental, exemplary, punitive or consequential damages whatsoever, whether or not the CONSULTANT had or should have had knowledge of such damages, and on any theory of liability, whether in contract, strict liability, tort, negligence, or otherwise (including, but not limited to loss of use, loss of opportunity, loss of profits, or business interruption) arising out of or in any way related to this Agreement and/or the Services or any other services provided in connection with this Agreement, whether caused by the CONSULTANT's negligence, errors, omissions, strict liability, breach of contract, breach of warranty or otherwise.

7.3. **INDEMNIFICATION** – The CLIENT agrees to defend, indemnify and hold harmless the CONSULTANT, its directors, officers, employees, agents, subconsultants and subcontractors, from and against any and all manner of actions, injuries, claims, losses, expenses, damages (including without limitation punitive, exemplary, indirect or consequential damages), and costs, including legal fees on a solicitor-client full indemnity basis, and other liabilities, of any and every kind and nature whatsoever, at law or in equity, in tort, contract, or other legal theory, arising out of, or in any way related or connected to any one or more of the following: this Agreement; the Services; the CONSULTANT's reports or recommendations concerning this Agreement; the CONSULTANT's services; the CONSULTANT's presence on project property; the CONSULTANT's communications, representations, warranties or otherwise in respect of same; the presence, release, or threatened release of hazardous substances or pollutants on or from the Site. Notwithstanding the foregoing, the CLIENT shall not indemnify the CONSULTANT against liability for damages to the extent caused solely by the gross negligence or intentional misconduct of the CONSULTANT.

7.4. The CLIENT agrees that Section 13 of this Agreement, and all limitations, exclusions and indemnifications in respect of the CONSULTANT's liability, Services, or Work Product under this Agreement, including but not limited to waivers of damages and indemnifications by the CLIENT to the CONSULTANT, shall extend to and be for the benefit of those individuals and entities the CONSULTANT retains in connection with performance of the services under this Agreement, including but not limited to CONSULTANT's officers, directors, partners and employees, as well as CONSULTANT's subconsultants and subcontractors. The CLIENT further agrees that it shall make no claims or take any proceedings whatsoever directly against the CONSULTANT's officers, directors, partners and employees, whether the claims arise in contract, tort or otherwise, and whether covered by insurance. The CLIENT further agrees that Section 13 in its entirety shall survive termination of this Agreement for any reason.

8. DOCUMENTS, PATENTS, TRADEMARKS, AND INTELLECTUAL PROPERTY

8.1. The Report, documents and instruments in respect of the CONSULTANT's services, including but not limited to drawings, plans, digital and physical models, designs, specifications, studies, reports (including any drafts of reports), photographs, computer software, concepts, products, or processes if proprietary to the CONSULTANT, surveys, calculations and other data required by the scope of its services, and which were prepared by or on behalf of the CONSULTANT, including those which are deliverables in respect of its services hereunder (collectively, the "**Instruments**"), are the property of the CONSULTANT and the CONSULTANT shall retain the originals thereof, whether the work is completed or not. The CONSULTANT reserves the copyrights in connection with same.

8.2. The CLIENT may not use the Report and such Instruments without having paid all amounts owing to the CONSULTANT. Provided all amounts owing to the CONSULTANT are paid in full: (i) the CLIENT is entitled to keep a copy of the Report and those Instruments as agreed to by the CONSULTANT in writing, and (ii) the CLIENT shall have a non-exclusive license to use the Report and those Instruments as agreed to by the CONSULTANT in writing which relate to or result from the services provided by the CONSULTANT under this Agreement, but solely for purposes for which they were provided by the CONSULTANT under this Agreement. The CONSULTANT is entitled to injunctive relief in respect of the Report and Instruments if it is not paid. The CONSULTANT retains ownership of all patents, trademarks, copyrights, industrial or other intellectual property rights resulting from its services, from the Report and Instruments which are developed or first reduced to practice by the CONSULTANT in the provision of its services. The CLIENT shall not use, infringe or appropriate such proprietary rights without the prior written consent and compensation of the CONSULTANT.

8.3. Use of the Report and Instruments by the CLIENT for purposes other than the purpose for which provided by the CONSULTANT, including but not limited to in connection with the Site project, without notifying the CONSULTANT and without its prior written consent is done so at the sole risk of the CLIENT. In addition to and without limiting the indemnification obligations provided in this Agreement, the CLIENT shall indemnify the CONSULTANT against any and all manner of actions, injuries, claims, losses, expenses, damages (including without limitation punitive, exemplary, indirect or consequential damages), and costs (including legal fees on a solicitor-client full indemnity basis), arising out of, or in any way related or connected to (i) the CLIENT's improper use of the Report and Instruments, and each of them, and (ii) alterations to the Report and Instruments, and each of them, by, on behalf of, and/or at the direction of the CLIENT, without notifying the CONSULTANT and without the CONSULTANT's prior written consent.

8.4. The CONSULTANT shall not be responsible for the consequences of any such improper use and alterations as described herein. In addition to any rights or remedies under this Agreement or at law, the CONSULTANT shall be entitled to compensation for such improper use and alterations and to prevent such improper use and alterations.

APPENDIX B – COMISSIONING READINESS FORMS

FORM A – PRE-COMMISSIONING CHECKLIST

OWNER: _____ **PROJECT:** _____

EQUIPMENT TAG: _____ **EQUIPMENT LOCATION:** _____

EQUIPMENT DESCRIPTION: _____

Pre-Commissioning Requirements Checklist:

- ☐ Reviewed and accepted shop drawings for respective equipment.
- ☐ Vendor wiring diagrams reviewed and accepted.
- ☐ Valid test results, with signoff by Contractor and Engineer as required, for all applicable tests as outlined within the contract.
- ☐ Inspection reports submitted.
- ☐ FAT results submitted.
- ☐ Commissioning facility interruptions, and critical schedules, identified and communicated to all applicable parties.
- ☐ Communications regarding key testing and verifications, and major deficiency resolutions.
- ☐ Applicable process pipes, valves, reducers, expanders, pressure relief/sustaining systems, instrumentation; pumps support and guide system; structural and architectural support systems; electrical and controls wiring; electrical disconnect stations; underground raceway/ ducts; and calibration/tuning has been completed.
- ☐ Equipment pertaining to the control system, control interfaces, communications, and all other relevant components of the new facility can be demonstrated to be operational and meet the specification requirements.
- ☐ Detailed commissioning and testing schedules have been provided. Test schedules include a detailed description of the test to be performed along with proposed start and end dates.
- ☐ Test plans and procedures have been submitted for the Owner's comment and approval at least two weeks prior to commencement of any test procedure based on the provided construction schedule provided by the Contractor.
- ☐ All wiring from instrumentation and electrical systems have been verified back to the control panel, and all equipment is ensured to be wired properly.
- ☐ Utility Transformer information collected, recorded, and submitted to the Engineer.
- ☐ Redlines for install have been completed and are accessible for commissioning.

Pre-Commissioning Requirements Verification Signoff

Completed: _____ _____

Date Contractor Signature

FORM B – MAJOR EQUIPMENT FUNCTIONAL TEST REPORT

OWNER: _____ **PROJECT:** _____

EQUIPMENT TAG: _____ **EQUIPMENT LOCATION:** _____

EQUIPMENT DESCRIPTION: _____

MAKE, MODEL & SERIAL NO. _____

Equipment Technical Verification

Equipment Input Ratings (Voltage, Current, Power, Pressure, Flow)	Equipment Output Ratings (Voltage, Current, Power, Pressure, Flow)	Motor Data	
		Motor Rating (HP)	Motor Voltage and Phase #

YES	N/A	
☐	☐	Circuit breaker / fuse / overprotection devices sizes and settings verified
☐	☐	Field wiring connections verified
☐	☐	Torque values verified
☐	☐	Phase rotation on incoming and outgoing circuits verified
☐	☐	Operation of disconnect levers, interfaces, and mechanical assemblies verified
☐	☐	Safety lockouts for all disconnects and circuits verified
☐	☐	Megger / insulation resistance tests complete for each circuit and motor leads
☐	☐	Grounding and bonding verified
☐	☐	Equipment powered up and calibrated, including voltage checks
☐	☐	Configuration, size, ratings, settings, and operation of starters and drives verified
☐	☐	Power monitoring verified
☐	☐	Forward / reverse rotations verified
☐	☐	Controller and drive settings verified with motor nameplates
☐	☐	Vibrations monitoring complete
☐	☐	Interlocking conditions, including monitoring and controls units operations, verified
☐	☐	Control of device from drive / starter verified
☐	☐	Operation of subsystems required for overall operation of assembly tested
☐	☐	Operation of device through all modes, range of motion, speed, and frequency verified
☐	☐	Operation of equipment during utility / generator transitions, including power ridethroughs
☐	☐	Remote monitoring signals properly generated by unit for termination to PLC / controls

Equipment Verification Signoff

Completed: _____
Date Contractor Signature

Notes / Comments:

_____

_____

_____

FORM C – HVAC FUNCTIONAL TEST REPORT

OWNER: _____ **PROJECT:** _____

EQUIPMENT TAG: _____ **EQUIPMENT LOCATION:** _____

EQUIPMENT DESCRIPTION: _____

MAKE, MODEL & SERIAL NO. _____

Technical Verification

Duct Size	Heating Capacity (kW)	Re-Heat Coils # Rows	Motor Data		Airflow (L/s)	
			Motor Rating (HP)	Motor Voltage and Phase #	Min	Max

Static Checks

- ☐ Inlet discharge ducting complete, with insulation
- ☐ Minimum of four inlet diameters of straight duct at inlet of unit
- ☐ Terminal box properly supported
- ☐ Sufficient service access verified
- ☐ Access door installed on inlet and outlet of reheat coil(s) and accessibility verified
- ☐ Piping and insulation complete

Operational Checks

- ☐ Proper identification installed
- ☐ Balancing complete
- ☐ Air leaks and noise levels acceptable
- ☐ Thermostat operates as per design
- ☐ Unit controls and interlocks from field devices verified
- ☐ Unit controls and interlocks from control systems verified
- ☐ Vendor drawings with field interlocks and connections shown and verified

HVAC Equipment Verification Signoff

Completed: _____ _____
Date Contractor Signature

Notes / Comments:

_____
_____
_____
_____
_____
_____
_____

FORM D – INSTRUMENT FUNCTIONAL TEST REPORT

This form shall be completed by the Contractor, and is used to verify that all signals are being properly sourced by the instrument and measured in the field prior to testing within the PLC and that the instrument is fully calibrated.

OWNER: _____ **PROJECT:** _____

EQUIPMENT TAG: _____ **EQUIPMENT LOCATION:** _____

EQUIPMENT DESCRIPTION: _____

MAKE, MODEL & SERIAL NO. _____

CSA: _____ **ELEMENT TAG & TYPE:** _____

ADDITIONAL CERTIFICATIONS: _____

Instrument Calibration:

Instrument Power Supply (120 Vac, 24 Vdc)	Relays Configured (List Relays and Functions)	Offsets, Trims, Deadbands (If Non-zero, Identify Values)	Signal End Point Values (Range)	
			Minimum Scaled Engineering Value with Units*	Maximum Scaled Engineering Value with Units*

* Example, min and max scaled values may be 4 mA = X L/s, 20 mA = Y L/s for an analog; OFF = Open, ON = Closed for a digital

- ☐ Set-up wizards, configuration, and parameters completed
- ☐ Resistive checks completed
- ☐ Shield and drain checks completed
- ☐ Remote control / local interface stations provide proper control

Signal Input / Output Range Span Simulation and Verification:

	Percent of Signal Range				
	Test Point 1 0%	Test Point 2* 25%	Test Point 3* 50%	Test Point 4* 75%	Test Point 5 100%
Instrument Target Value (Sourced):					
Field Value (Measured):					

*Note: For digital signals, columns 25%, 50%, and 75% may be deemed Not Applicable (N/A)

Function Test: Equipment Verified to be Calibrated, Configured, and Field Tested

Completed: _____
Date Contractor Signature

Notes / Comments:

_____

_____

_____

_____

FORM E – DEVICE LOOP CHECK VERIFICATION

This form shall be completed by the Contractor in conjunction with the Programmer, and is used to verify that all signals are being properly input to / output by the PLC, and that the associated equipment is responding correctly.

OWNER: _____ **PROJECT:** _____

EQUIPMENT TAG: _____ **EQUIPMENT LOCATION:** _____

EQUIPMENT DESCRIPTION: _____

Signal Input / Output Information:

PLC Point Type (DI, DO, AI, AO, Comms Cable)	PLC Slot/Channel	Voltage / Current Rating	Wire Tags	Signal End Point Values (Range)	
				Minimum Scaled Engineering Value with Units*	Maximum Scaled Engineering Value with Units*

* Example, min and max scaled values may be 4 mA = X L/s, 20 mA = Y L/s for an analog; OFF = Open, ON = Closed for a digital

Signal Input / Output Range Span Verification:

	Percent of Signal Range				
	Test Point 1 0%	Test Point 2* 25%	Test Point 3* 50%	Test Point 4* 75%	Test Point 5 100%
Field Value:					
PLC Value:					
HMI Value:					
SCADA Value:					

*Note: For digital signals, columns 25%, 50%, and 75% may be deemed Not Applicable (N/A)

I/O Verification at Site Controller and Function Test: Equipment Provides Correct Signals to PLC From Field, and / or Responds Correctly to Voltage / Current Control From PLC

Completed: _____
Date Contractor Signature

Witnessed: _____
Date Programmer Signature

Notes / Comments:

_____

_____

_____

_____

APPENDIX A – GEOTECHNICAL REPORT

Geotechnical, Environmental and Materials Engineering

Red Deer · Sherwood Park · Grande Prairie · Calgary · Fort McMurray
Peace River · Medicine Hat · Lethbridge · Estevan

GEOTECHNICAL INVESTIGATION

MCKAY RANCH LIFT STATION
BLACKFALDS, ALBERTA

PREPARED FOR

STANTEC CONSULTING LTD.

RED DEER, ALBERTA

PREPARED BY

PARKLAND GEOTECHNICAL CONSULTING LTD.

RED DEER, ALBERTA

PROJECT NO. RD7599

NOVEMBER 25, 2021

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1.0 INTRODUCTION

The Town of Blackfalds is proposing to construct a lift station in southeast Blackfalds, Alberta. ParklandGEO was retained by Stantec Consulting Ltd. (Stantec) to conduct geotechnical investigations for the lift station. This report summarizes results of the field and laboratory testing programs and presents geotechnical recommendations for design and construction of the lift station.

1.1 SCOPE OF WORK

The scope of work for this investigation was outlined in ParklandGEO's proposal PRO9308 dated August 19, 2021. Authorization to proceed with this investigation was given by Mr. Patrick Hogan, E.I.T. of Stantec.

1.2 PREVIOUS INVESTIGATIONS

A previous report was issued for the McKay Ranch Lift Station in 2017:

- *"Geotechnical Investigation – McKay Lift Station – Blackfalds, Alberta"* Prepared for Stantec Consulting Ltd., Prepared by Parkland Geotechnical Consulting Ltd., dated February 2017 (File #: RD5235).

This report is an update to the 2017 report.

2.0 PROJECT AND INFORMATION

The proposed McKay Station is located in southeast Blackfalds, Alberta within NW 25-39-27-W4M, as shown on Key Plan, Figure 1. The access to the Blackfalds site is from South Street to the south. There are residential developments to the south and west of the site and agricultural lands to the north and east. The site is shown in Site Photographs, Figure 4. The elevation at the lift station is 872.51 m.

The McKay Lift Station Site is show in Site Plan, Figure 2. The lift station will be approximately 7.3 by 10.6 m in size with a 3.8 x 2.4 m wet well that will extend approximately 9.5 m below grade. The preferred foundation is a concrete base slab/raft for the wet well and the building will have a pile foundation through the wet well excavation fill.

3.0 FIELD AND LABORATORY PROGRAMS

On December 21, 2016, one borehole was drilled at the site to a depth of 15 m below grade. The borehole was located in the lift station footprint, as shown on the Site Plan, Figure 2 in Appendix A. The following investigation procedures were followed during the field program:

1. Prior to mobilizing the drilling rig, ParklandGEO personnel completed an Alberta One Call to verify the drill site was clear of underground utilities.

2. The boreholes were drilled using a track mounted geoprobe drill rig owned and operated by Darkhorse Drilling Ltd. of Lacombe, Alberta.

3. Drilling operations were monitored by ParklandGEO's geotechnical personnel, and the soil encountered was visually examined during excavation / drilling and logged according to the Modified Unified Soil Classification System.

4. Soil samples were collected from auger cuttings at 1.0 m intervals in order to determine the soil/moisture profile and from other selected depths for other testing. Disturbed soil samples were also obtained from Standard Penetrations Tests (SPTs), which were performed at selected depth intervals.

5. A hand slotted 25 mm diameter PVC standpipe was installed in the borehole upon completion of drilling, and backfilled with auger cuttings with a Bentonite plug below the ground surface. Excess auger cuttings were spread at the borehole location. The groundwater conditions were noted during drilling and on completion. Groundwater measurement was recorded on January 19, 2017 and October 27, 2021.

6. All soil samples were returned to ParklandGEO's Red Deer laboratory for selected soil testing to determine soil properties. The results of all laboratory testing are shown on the borehole logs and individual test results presented in Appendix A. The laboratory program consisted of moisture contents, Atterberg Limits, sieve and hydrometer particle size analysis and water soluble sulphates.

7. The local ground surface elevations and the borehole locations were surveyed by Stantec Consulting Ltd. The elevation is provided based on a geodetic datum.

4.0 SOIL CONDITIONS

The general soil profile encountered at this site was typical of this area and consisting of, in descending order: silty sand over clay. Bedrock was not encountered but based on water well records it is expected at a depth of 40 to 45 m below grade. The detailed soil conditions encountered at each borehole location are described on the borehole logs in Appendix A. The soil test results and definitions of the terminology and symbols used on the borehole logs are provided on the explanation sheets also in Appendix A. The following is a brief description of the soil types encountered.

4.1 SILTY SAND

Deposits of silty sand were encountered at the surface and extended to a depth of 14.0 m below grade. The sand contained trace to some silt. The sand was fine grained with a loose to compact relative density. The siltier deposits were some to stiff and low plastic. Standard Penetration test “N” values of 5 to 9 blows were encountered within the deposits.

4.2 CLAY

Clay was encountered below the silty sand in the borehole at a depth of 14.0 m and extended beyond the 15 m depth drilled. This clay deposit contained some silt and was medium to high plastic and was characterized as stiff to hard, brown/grey, and moist. The clay was considered to be stiff

4.3 SOIL CHEMISTRY

A soil sample was taken at a depth of 2.0 m for water soluble sulphate concentration testing. Results of the laboratory chemistry testing program are shown on the borehole log, and included in Appendix A. The concentrations of sulphate are expressed as a percentage of the dry mass of soil. The concentration of water soluble sulphate was 0.04 percent. The results indicating a negligible potential for sulphate attack on buried concrete in direct contact with soil at the site.

5.0 GROUNDWATER CONDITIONS

Sloughing conditions were observed in the sand layer throughout drilling. Groundwater seepage was observed in the borehole during and after drilling. The groundwater level was measured at a depth of 2.4 m below grade on January 19, 2017 and a depth of 3.2 m below grade on October 27, 2021.

The observed shallow groundwater measurements are considered to be typical for this area of Blackfalds. The local groundwater table is dependent on infiltration of precipitation and is expected to fluctuate on a season basis with the highest levels after periods of prolonged heavy precipitation or snowmelt. Groundwater seepage is expected in shallow excavations. The volumes and seepage rates for groundwater encountered will be dependent on seasonal conditions and the permeability of the soils within the profile.

6.0 DISCUSSION AND RECOMMENDATIONS

6.1 GEOTECHNICAL EVALUATION

The lift station will consist of 7.3 x 10.6 m^2 heated building surrounding a 3.8 x 2.4 m^2 concrete wet well based about 9.5 m below final grade. It is understood that the preferred foundation to support for the wet well is a concrete base slab or gravel mat. It is understood that the wet well will be incorporated into the building structure. An open excavation is expected to be used to construct the wet well; therefore the building would be within the backfill footprint. The building will extend past the wet well footprint. The foundation is expected to be supported on piles. The client indicated that the preferred foundation option for the building is steel screw piles.

1. The soil conditions at this site are considered to be marginally suitable for the proposed development. The wet native soils are not expected to be very stable in terms of excavation stability for wet slopes. Given the availability of space around the site, an open excavation is expected to be most economical. The extent of the excavation will impact foundation options for the building surrounding the wet well. Deep backfill around the wet well is expected to settle beyond the tolerance of slab on grade which will require the use of a structurally supported slab for the slab areas outside of the wet well footprint.

2. Dewatering may be required depending on conditions at the time of construction and volumes of groundwater infiltration may be high. Drainage control measures required may include numerous conventional sumps or well-points to remove excess water and stabilize the sand during excavation.

3. Foundation conditions at this site are suitable for driven steel piles. The foundations conditions are poorly suited to cast-in-place concrete piles due to the presence of saturated sand within the expected pile depth that will be prone to seepage and sloughing during excavation and may require the use of casing during installation. Driven steel piles are a well suited foundation system for the building. Foundation parameters are provided for driven steel piles for the building and a mat foundation for the wet well. Comment on other foundation systems can be provided upon request.

4. The present site is relatively level and it is ParklandGEO's understanding that the final site grades will remain close to existing grade. A significant amount of backfilling will be required around the wet well if an open excavation is used for construction. The native silty sand is considered marginally suitable for use as fill material. The native sand deposit above the groundwater table is considered to be close to OMC and may not require a substantial amount of moisture conditioning. The sand deposits below the water table are saturated and well above OMC.

5. The groundwater elevation was about 2.4 m below existing grade which will result in seepage into the excavation. Measures such as conventional pumping will be required and are expected to be effective. The wet well structure will extend into the groundwater table and should be designed to resist uplift forces due to hydrostatic pressures.

6.2 EXCAVATION

Excavations will be required for the wet well and underground utility installations. For excavations in the native silty sand at this site and above the water table, side slopes of at least 1H:1V from the base of the excavation are recommended. The required excavation for the wet well will extend into the water table. There is a high potential for seepage and sloughing from the sand below the groundwater table, so much flatter side-slopes may be required for deeper excavations. Steeper cuts may be possible by application of different configurations of braced/sloped excavations and dewatering measures. In all cases, the latest edition of the Construction Safety Regulations of the Occupational Health and Safety Act of Alberta should be followed.

The degree of stability of the side wall of the excavation decreases directly with time. Therefore construction should be coordinated to minimize construction time of open trenches or pits. In addition, surcharge loads, including excavation spoil, should be kept back from the crest of the excavation a minimum distance equal to the excavation depth. Monitoring and maintenance of the slopes should be carried out on a regular basis.

The excavation of such a large area for the lift station will impact the design of foundations for the lift station building. A deep foundation will be required to transfer the loads to the native soil below the backfill of the wet well.

6.3 BACKFILL

The wet well excavation will require a significant volume of backfill. Settlement in the fill should be expected. The magnitude of settlement in backfill is governed by several factors such as type of backfill material, density from initial compaction, moisture content, and volume/depth. The native sand material is considered marginally suitable for use as engineered fill for economic reasons, provided moisture conditioning is used and the specified compaction levels can be achieved. Services installed in the backfill around the well will be affected by settlement. Consideration should be given to support of the lines through the backfill zone.

Two of the most practical options for placing and compacting backfill around the wet well are discussed below.

6.3.1 Nominal Compaction and Structurally Supported Floor Slab Option

In this option, the backfill around the wet well structure is placed and compacted to about 95 percent of Standard Proctor Maximum Dry Density (SPMDD – ASTM D698). Settlement of native sand fill nominally compacted backfill to 95 percent SPMDD would be estimated at 3 to 4 percent of the total fill thickness, with post-construction settlement in the order of half of the total settlement. A structurally supported floor slab will be required since the settlement performance over the first 6 to 24 months will not meet the required tolerances for slab on grade floors. The structural floor slab alternative is the least time dependent option and performance levels for the slab can be engineered. The use of heavy compaction effort should be restricted within 1.0 m of the wet well walls and care should be taken when applying compaction energy on the soils to minimize the impact on the structure during backfill operations.

The settlement resulting from the lower compaction levels will apply a downdrag force of 10 kPa should to the wet well wall surface. A bond breaker could be used to minimize this downdrag which would reduce the friction bond between the wet well wall and the backfill. The most common bond breakers are grease or polyethylene wrap and can reduce the downdrag by up to 75 percent.

6.3.2 Heavy Compaction and Increased Structural Capacity of Walls

In this option, the backfill around the wet well structure is placed and compacted to at least 100 percent SPMDD. Settlement of backfill compacted to 100 percent SPMDD would be estimated at 0.5 to 1 percent of the total fill thickness. The higher compaction level will increase the lateral forces acting on the wet well wall, and will require more structural capacity. The use of heavy compaction effort should be restricted within 1.0 m of the wet well walls unless the larger lateral forces induced by heavy compaction are compensated for in the structural capacity of the walls. Given the depth of the excavation and the possible inability to achieve high density there is a risk that a structural slab will still be required. In most cases this option is not considered due to the potential risk involved.

6.3.3 Additional Backfill Recommendations

The initial lift of backfill may need to be relatively thick (i.e. nominally 0.5 m) to provide a bridge over the base of the excavation. To provide a stable working base the use of coarse (pit run) gravel is suggested for the first lift. Subsequent backfill should be compacted in lifts no greater than 200 mm thick using silty sand at moisture contents 0 to 2 percent below the Optimum Moisture Content (OMC). The fill should be placed evenly around the structure to distribute the stresses on the structure evenly during the backfilling process.

Fill placement and compaction during the winter months is challenging due to the difficulty in moisture conditioning fill soils and obtaining high compaction levels. Materials and methodology should be reviewed prior to construction if cold weather compaction of fills is proposed. High compaction levels can only be achieved using fill soils that are unfrozen provided the compaction area is heated and hoarded to prevent freezing and proper moisture conditioning during placement and compaction.

Surface water should be drained away from the site as quickly as possible, both during and after construction. Site drainage should be directed away from the foundation walls and equipment. It is recommended to provide a 5 percent back slope from buildings for a distance of at least 3 m. Roof and other drains should discharge well clear of buildings. The slope of exterior backfill should be checked periodically to verify water is shed away from buildings. If the backfill settles causing water to pond against foundation walls, the surface should be re-graded. Water should not be allowed to pond adjacent to buildings. A minimum grade of 5 percent is recommended around the lift station to promote surface runoff and minimize potential saturation and degradation of the parking area subgrade. The surface grades will need to be checked for settlement in the first couple of years. If settlement occurs, the grade away from the building should be re-established.

6.4 ALBERTA BUILDING CODE

In accordance with the National Building Code – 2019 Alberta Edition (NBC-AE), the use of Limit States Design (LSD) is required for the design of buildings and their structural components including foundations. The limit states of LSD design are classified into two groups; the Ultimate Limit States (ULS) and the Serviceability Limit States (SLS). The ULS design requirements in the ABC reference the Structural Commentaries in the User Guide of the National Building Code of Canada (NBCC).

6.4.1 Ultimate Limit States (ULS)

The ULS case is primarily concerned with safety and the levels of load and resistance at the point of collapse or structural failure. The geotechnical value for this case is the ultimate resistance. For foundation design this ultimate resistance value is reduced using a Geotechnical Resistance Factor (GRF) which is based on the reliability index of the geotechnical data used to determine the ultimate resistance for the foundation loading case. As per the NBCC the following GRF values should be used for foundation design for shallow and deep foundations:

TABLE 1
LSD GEOTECHNICAL RESISTANCE FACTORS

Geotechnical Case	Resistance Factors
DEEP FOUNDATIONS (PILES)	
Vertical resistance by semi-empirical analysis and in-situ test data	0.4
Vertical resistance from analysis of dynamic monitoring results	0.5
Vertical resistance from analysis of static load test results	0.6
Uplift resistance by semi-empirical analysis and in-situ test data	0.3
Uplift resistance from analysis of static load test results	0.4
SHALLOW FOUNDATIONS (MATS)	
Vertical resistance by semi-empirical analysis and in-situ test data	0.5

* NBCC - Users Guide - Structural Commentaries (Part 4 of Division B) - Commentary K –Foundations.

6.4.2 Serviceability Limit States (SLS)

The SLS occurs when the foundation loads cause movements or vibrations that are greater than the structure can tolerate before the intended use of the structure is restricted or hindered. The SLS case is addressed by determining the maximum available resistance to keep the foundation deformation within tolerable limits under service loads (i.e. settlement, lateral deflection, etc.). Typically, the foundation loads, configurations and serviceability tolerances have to be known to properly determine geotechnical SLS resistance values. In some foundation cases, such as small footings, basic assumptions can be used to provide preliminary SLS resistance values under specific stated conditions.

For axial loading conditions the SLS resistance is addressed by determining the limiting load to keep foundation settlements within tolerable limits. Tolerable total and differential settlements should be verified by the structural engineer, but for normal buildings the tolerable limit of total settlement for foundations is typically about 25 mm. For piles, less than 25 mm is often required to mobilize the ultimate resistance before soil failure. Therefore, the serviceability limit states are not expected to govern for pile foundations unless very strict settlement tolerances are required (i.e. less than 10 to 15 mm of settlement). The settlement potential of the proposed piles may be checked once pile design and loading conditions are finalized.

6.4.3 Seismic Classification

The National Building Code of Canada (2019) requires buildings to be designed to resist a minimum earthquake force. The formula for obtaining minimum earthquake force is dependent of several factors including Foundation Factors (F_a and F_v) which should be determined using a Site Class of D for this site (Table 4.1.8.4.A) for both sites. The subgrade soil is sand, silt and clay to below the maximum depth drilled of 15.0 m.

6.5 DRIVEN STEEL PILE FOUNDATIONS – ULS DESIGN

Driven steel piles are considered to be suitable for foundations for this site but relatively long piles may be required. Either steel H piles, open ended or closed ended pipe piles may be considered. Driven steel piles may be designed using the ultimate resistance values for shaft friction and end bearing provided in the following table.

TABLE 2
DRIVEN STEEL PILES - ULTIMATE RESISTANCE

Soil Type	Depth (m)	Ultimate Resistance (kPa)	
		Skin Friction	End Bearing
Silty Sand	0 – 1.5	0	0
Silty Sand	1.5 – 14.0	25	500
Clay	> 14.0	35	750

*For piles driven to minimum pile depth of 7.5 m or below the proposed wet well elevation, whichever is greater.

The ultimate resistance values in this table are based on semi-empirical data. Therefore, the "factored" resistance should be calculated by multiplying the ultimate values above by a geotechnical resistance factor (GRF) of 0.4, in accordance with the building code. The GRF for resistance to axial compression may be increased if the pile capacities are verified by a dynamic monitoring method or by a static load test.

The ULS capacity of driven steel piles is determined by multiplying the factored ULS skin friction resistance by the exterior surface area of the pipe pile or the surface area of the web and outside face of the flanges for H-piles. For unheated structures, the upper 2.5 m of pile shaft or the length of pile shaft in new fill, whichever is greater, should be assumed to carry no load. This depth can be reduced to 1.5 m or the length of pile shaft in for heated structures. For piles driven into the dense sand (at depth), an end bearing contribution acting on the gross area of the pile tip for H-piles, closed ended pile and open ended piles less than 300 mm in diameter may be added to the pile capacity. For open ended pipe piles with diameters greater than 300 mm, only 2/3 of the gross area should be used. The pile capacity should not exceed the structural capacity for the steel section of the pile. Piles driven through new fills should be assumed to have downdrag (negative skin friction) equal to 10 kPa for the section of pile within the fill. To resist uplift forces created by frost action, the minimum depth of driven steel piles for heated structures should 7.0 m below grade and 11.0 m below grade for unheated structures.

For steel pipe piles driven to practical refusal into the very dense sand deposits prior to achieving design depth, but beyond the required minimum embedment depth, the ultimate load capacity may be determined by multiplying the cross-sectional area of steel at the tip by 0.85 f_y where f_y is yield strength of steel (normally 300 MPa). The maximum permissible value of f_y should be supplied by the manufacturer.

Other design and construction recommendations for driven steel piles include:

1. The driving energy and driving criteria should be determined based on wave equation analysis (WEAP) for the proposed equipment. For preliminary purposes, steel piles should be driven using maximum hammer energies of 450 to 600 J per square centimetre of pile cross section.

2. For smaller pipe piles a minimum pipe wall thickness of 9 mm is recommended for this site. For pipe piles greater than 400 mm in diameter the minimum pipe wall thickness should be increased to 12.5 mm.

3. Steel piles should not be driven beyond practical refusal to avoid overstressing the steel section. Since a wide range of heavy walled sections may be used, the practical refusal criteria should be determined prior to piling once hammer energies and pile details are known. For preliminary purposes, the practical refusal criteria may be taken as 8 blows per each 25 mm interval for the last 250 mm of pile penetration.

4. The minimum allowable pile spacing should be taken as three pile diameters. Where groups of piles are to be installed, the piles should be installed starting at the centre with outer piles installed last. The elevations of the tops of piles already installed should be monitored as adjacent piles are driven in order to determine if heaving of the piles has occurred. Piles that have heaved must be re-driven. If groups of piles are installed at pile spacing less than the minimum, a group reduction factor must be applied to the bearing capacity of each pile.

5. If steel pipe piles are used, it is suggested to fill the piles with concrete after installation. Concrete filling of the open pipe will add strength to the section and reduce the corrosion potential inside the pipe. Corrosion of the pipe in a partially saturated medium must be considered in selecting pipe wall thickness.

6. The steel piles should be inspected prior to installation to confirm that the appropriate material specifications are satisfied; and to check that there are no protrusions on the shaft or at the tip which could result in voids along the shaft as the pile is driven.

7. Monitoring of the pile installation by experienced geotechnical personnel is recommended to confirm that the piles are installed in accordance with design assumptions and that the driving criteria are satisfied. A complete driving record of blows per 300 mm of penetration for each pile should be obtained and reviewed by the pile designer.

8. A Pile Driving Analyser (PDA) test program should be considered to verify the ultimate pile resistance for this site. For resistance values verified by this dynamic monitoring method the GFR used to calculate the factored resistance may be increased to 0.5, resulting in a 25 percent increase in pile capacity for the ultimate limit states. A static load test program could also be considered to further increase the factored resistance, and may result in further savings on foundation costs. The GRF can be increased to 0.6 if a static load test program is undertaken.

6.6 SCREW PILES – ULS DESIGN

Steel screw piles installed in the native silty sand or clay till are considered a feasible foundation option for this site. Foundation loads are expected to be light and moderate. The design and installation of screw piles is usually undertaken by specialty contractors based on column loads supplied by the structural engineer. The ultimate unfactored load carrying capacity of a multiple helix screw pile in vertical compression in cohesive (clay) and cohesionless (sand) soil may be calculated using the formula below.

For Cohesive Soil:

$$Q_u = A_H C_u N_c + \pi D_H C_u (H_3 - H_1)$$

For Cohesionless Soil - H/D ≥ 5:

$$Q_u = \gamma' H A_H N_q + 0.5\pi D_H \gamma' (H_3^2 - H_1^2) K_s tan\emptyset$$

Where:
Q_u = ultimate unfactored axial pile resistance (kN)
γ' = effective unit weight of soil (kN/m^3)
ϕ = internal friction angle (degrees)
N_q = bearing capacity factor for cohesionless soils
K_S = coefficient of lateral earth pressure in compression
H = embedment depth of pile below final grade (m)
H_3 = depth to bottom helix (m)
H_1 = depth to top helix (m)
A_H = gross area of the bottom helix (m^2)
D_H = average diameter of helix plates (m)
C_u = Undrained shear strength of cohesive soil (kPa)
N_c = compressive bearing capacity factor for cohesive soil

The formula above may also be used for a single helix screw pile since the second term of the formula is cancelled out (i.e. $H_3^2 - H_1^2 = 0$). For Ultimate Limit States (ULS) design the ultimate resistance values calculated by this method are based on semi-empirical data, therefore the "factored" ULS resistance should be calculated by multiplying the ultimate resistance values above by a geotechnical resistance factor of 0.4, in accordance with the Alberta Building Code. The GRF may be increased to 0.6 if a static load test program is performed.

The design parameters for the formula given above are provided in the table below:

TABLE 3
DESIGN PARAMETERS FOR SCREW PILES

	Silty Sand	Clay
Depth below final grade (m)	0 – 14.0	> 14.0
Effective Unit Weight of Soil, γ' (kN/m^3)	20	18
Internal Angle of Friction, ϕ	30^o	-
Undrained Shear Strength, C_u (kPa)	-	30 - 45
Bearing Capacity Factor for Cohesive soils (H/D>4)	-	N_c = 9
Bearing Capacity Factor for Cohesionless soils	N_q = 18	-
Coefficient of Lateral Earth Pressure, K_S (D_s>0.22m)	0.8	-

The effective unit weight used in the relationship will depend on the position of the helix relative to the groundwater table. Below the groundwater table use $\gamma` = \gamma_{Soil} - \gamma_{Water}$. Screw piles should have a minimum embedment depth from ground surface to achieve sufficient frost jacking resistance. The minimum screw pile embedment depth from ground surface to the top of the top helix should be taken as the greater of the five times the helix diameter or the frost depth plus one helix diameter. The helix should be installed through any fills if present.

The following design and construction recommendations should be followed:

1. The maximum torque allowed during installation or "torque rating" of the proposed pile section must be considered during screw pile selection. The torque rating is an allowable value based on the ultimate torque strength or point of torsional fracture for the cross-sectional area of the steel in the pile shaft. The torque rating should be provided by the pile manufacturer. The estimated torque required to install the screw pile to the design resistance should not exceed the torque rating for the pile. For preliminary purposes, the minimum required torque may be taken as:

   $T = Q / K_t$ (Hoyt & Clemence, 1989)[1]

   Where: T = Minimum Torque Requirement (kN-m)
   Q = Design resistance of the pile (kN)
   K_t = empirical torque correlation factor = 10 m^{-1} for $D_S \geq 0.22$ m

2. The torque rating for the pile shaft should not be exceeded during installation of the pile. Using excessive torque on the pile may cause damage to the pile shaft which would require the pile to be replaced.

[1] Uplift Capacity of Helical Anchors in Soil", by H.R. Hoyt and S.P. Clemence, 1989, In Proceedings of the 12th International Conference on Soil Mechanics and Foundation Engineering. Rio de Janerio, Brazil, Vol 2, pp. 1019-1022.

3. The minimum allowable centre to centre pile spacing should be taken as at least three helix diameters or 3.0 m. If groups of piles are installed at pile spacing less than the minimum, a group reduction factor must be applied to the bearing capacity of each pile.

4. The maximum vertical spacing for the helixes is 3 times the helix diameter for piles loaded in compression or tension. The method of determining pile capacity must be reviewed if this criterion is not met.

5. Corrosion of the pile shaft in a partially saturated medium must be considered in selecting pipe shaft wall thickness. It is suggested to fill the pile shafts with concrete after installation to add strength to the pile shaft and reduce the corrosion potential inside the shaft of the pipe pile.

6. The soil strength is considered to be sufficient to provide lateral confinement to the pile shaft. Therefore buckling of the shaft is not expected to be a concern.

7. Monitoring of the pile installation by experienced geotechnical personnel is recommended to confirm that the piles are installed in accordance with design assumptions and that the installation criteria are satisfied. The installation records should include a summary of the torque required to install the pile, particularly the average torque achieved during the last 1.5 m of pile installation.

6.7 FROST DESIGN FOR PILE CAPS

Pile shafts within the zone of frost of the subgrade will be subject to adfreeze forces which can cause frost jacking. The minimum embedment depth for driven steel piles is given above in Subsection 6.5 and for steel screw piles is given in Subsection 6.6.

Frost heave forces will also act on the underside of pile caps and grade beams with upward heaving pressure in the order of 1000 kPa or greater. The potential of frost heaving forces can be greatly reduced by the placement of a compressible material or by providing a void of at least 75 mm between the underside of the concrete cap or grade beam and soil. A product such as Voidform or an equivalent is recommended. If a compressible material is used as an alternative to the Voidform, the uplift pressure acting on the underside of the concrete may be taken as the crushing strength of the compressible medium. The finished grade adjacent to foundation walls should be sloped away so the surface runoff is not allowed to infiltrate and collect in the void space or in the compressible medium. If water is allowed to accumulate in the void space or the compressible medium becomes saturated, the beneficial effect will be negated and frost heaving pressures will occur.

6.8 LIFT STATION FOUNDATION

The lower level of the lift station will be founded within the native sand or clay at a proposed depth of 9.5 m below grade which corresponds to an elevation of 863 m. The present configuration is expected to be a relatively small rectangular pre-cast wet well. In this type of structure with an end bearing wet well on a pad footing can then act independently or it can be incorporated into the building foundation like a large diameter pile. It is understood that the preferred foundation option is large monolithic slab or raft. It is assumed that the slab will either be uniformly thick or will be thickened as required below bearing walls and columns.

The biggest issue for preparation of the lift station foundation is the potential susceptibility of the exposed surface to boiling due to groundwater pressures and/or disturbance from construction activity after initial excavation. If the subgrade consists of sensitive soils such as weak silt and sand, the material should be sub-cut down to the more competent till and replaced with suitable engineered fill (ie. drainage rock layer, or free draining coarse gravel). As previously discussed, dewatering of the base of the excavation will significantly increase the stability of the bearing soils. If there is significant seepage, a drainage layer should be provided below the proposed bearing elevation with de-watering sumps to maintain the groundwater level below the surface of the gravel working layer. If the base of the exposed excavation is stable, the placement of thin protective layer of lean mix concrete could be considered as a substitution to a thick drainage layer.

For monolithic mat foundations founded within undisturbed native sand or till at about 9 to 10 m below grade, an ultimate bearing capacity of 450 kPa may be used for ULS design. The “factored” ULS resistance may be calculated by multiplying the ultimate bearing capacity by a geotechnical resistance factor of 0.5, in accordance with the building code requirements summarized in Section 6.4. For SLS design on a monolithic mat up to 16 x 16 m^2, an allowable bearing resistance of 150 kPa may be used for preliminary purposes. This value can be confirmed once settlement tolerances for the lift station are known.

The bearing resistance provided assumes undisturbed native sand, clay or engineered gravel mat free from loosened material. All bearing surfaces should be monitored by qualified geotechnical personnel to verify that soil conditions meet design criteria and are capable of uniformly supporting the design loads.

6.9 LATERAL EARTH PRESSURES

It is understood soil will be backfilled around the outside of the wet well walls to provide positive drainage away from the structure and to provide frost protection for the bearing soils around the perimeter. The depth of frost penetration in this area is in the order of 2.5 m deep depending on winter temperatures and snowfall. The placement of backfill against the lift station foundation walls will produce earth pressures on the wall and possible down-drag associated with fill settlement. Three earth pressure cases may exist at this site.

1. Active Case. Active earth pressures (K_A) should be used behind retaining walls which are unrestrained at the top and flexible walls which are allowed to move away from the restrained soil mass (i.e. shoring).

2. "At Rest" Case. "At rest" pressures (K_O) should be used behind retaining walls which are restrained at the top and would include typical wet well walls. "At rest" conditions should be assumed for any sections of the sections of the shoring wall required to support adjacent development to minimize potential loss of support for existing foundations.

3. Passive Case. Passive earth pressures (K_P) act on the front of a wall (i.e. against the base of the wall). Horizontal stresses on the wall push against the soil creating a much larger resisting force than is produced by the active or at rest conditions.

Lateral earth pressures may be computed using the following equation:

$$P = K Q + K \gamma H + \gamma_w d (1 - K)$$

where:
- P = lateral earth pressure at depth H below ground level (kPa)
- γ_w = unit weight of water (9.8 kN/m^3)
- Q = any surcharge loading at the ground surface (kPa)
- K = coefficient of lateral earth pressure
- γ = total unit weight of backfill compacted to 95 percent of SPMDD (kN/m^3)
- H = depth below ground level
- d = depth below design high water elevation (estimated at 1 mbg)

This relationship makes allowance for hydrostatic pressure to build up on the wet well wall, since it expected that the lower levels of the lift station will not be protected by a permanent sub-drainage system.

Recommended design values for these parameters depend on the type of backfill used and are given in the following table.

TABLE 4
LATERAL EARTH PRESSURE PARAMETERS

Type of Backfill	Total Unit Weight (kN/m^3)	Coeff. of Lateral Earth Pressure		
		K_A	K_O	K_P
Sand Fill	19.5	0.36	0.53	2.77
Silty Clay Fill	19.0	0.41	0.58	2.46
Imported Gravel fill	20.5	0.33	0.50	3.00

The preceding relationship makes no allowance for additional horizontal forces due to frost to build up behind the wet well wall on the assumption that the building above the wet well will be heated and protected from frost action. The earth pressure relationship given above assumes nominal compaction of the backfill to a maximum of 95 percent SPMDD. Only light, hand operated equipment should be operated within 1.0 m of walls and walls should be braced prior to backfilling. If higher levels of compaction are proposed, the earth pressure relationship given above should be reviewed. If no frost protection is provided the active or at rest lateral earth pressures pushing on the wall should be increased by a factor of 2 for the depth of frost.

6.10 SUB-DRAINAGE

The lower levels of the proposed lift stations will be founded well below the groundwater table. The installation of a sub-drainage system may be warranted to allow for dewatering of the site in conjunction with construction dewatering requirements, post-construction maintenance programs and environmental monitoring initiatives. The temporary sub-drainage system could be allowed to be inundated with groundwater when not in use and could be buried during final backfill.

Long term sub-drainage is not expected to be proposed for the lower levels of the two lift station. Waterproofing of the foundation walls and tanking of the basement area with water-stops at cold joints is recommended to minimize seepage of groundwater through the concrete. Waterproofing products such as bentonite board, synthetic membranes and mastic coatings could be considered. The lower level should be provided with a sump to allow collection and removal of any seepage which does get in to the below grade spaces.

6.11 BUOYANCY

The lift station structures will extend into the groundwater table over 6.5 m. It is expected that the lower levels of the lift station will be made water tight with the use of water stops, waterproofing, slab thickening and slab anchorage to resist seepage and buoyant forces. Therefore, these structures should be designed to resist uplift or buoyant forces due to hydrostatic pressures. The recommended design groundwater table should be taken as 1.0 m below existing grade. Assuming the uplift potential is not controlled using a sub-drainage system; it can be managed by geometric design based on a resolution of forces; or by a combination of geometric design and anchors.

6.11.1 Dead Weight Resistance

In the case of wet well structure, the forces resisting buoyancy will include the weight of the concrete mat and the weight of the fluid in the structure, if any. The uplift resistance can be improved by extending the base dimensions out past the walls of the structure to add a resisting weight of soil above the outside edge of the base. For a geometric solution it is prudent to assume a design water table corresponding to the design high groundwater level of 1.0 m below existing grade. The alternative is to use a sub-drainage system to permanently keep groundwater levels below the structures; or to keep groundwater below levels which can be handled by geometric design. Buoyant unit weights should be used and a factor of safety of 1.5 against uplift should be used.

6.11.2 Anchored Resistance

If the wet well has a large base slab area, it could be subject to buoyant forces causing arching of the centre of the base. Uplift forces from the groundwater may be resisted by soil anchors at this site. The recommended ultimate shaft adhesion value for the soil/anchor contact in the till at both the Blackfalds and Lacombe sites is 50 kPa. The entire surface area of the anchor shaft may be used in calculation of the resistance. The factored ULS design uplift should be based on a GRF of 0.3 as per the NBCC - Users Guide - Structural Commentaries (Part 4 of Division B) - Commentary K on Foundations.

6.12 CONCRETE

The water soluble sulphate concentration of the soil sample at the site was 0.04 percent, which indicates a negligible potential for chemical attack of subsurface concrete. As per CSA A23.1-14, a General Use (GU) hydraulic cement is recommended with a minimum 28 day compressive strength of 28 MPa and a water cement ratio of 0.5. All concrete exposed to a freezing environment either during or after construction should be air entrained. Concrete should be placed in accordance with CSA Standard CAN3-A23.1-14. Calcium chloride used as accelerating admixture or any admixture formulation containing chloride should not be used in the subsurface concrete, since they may increase the severity of sulphate attack.

6.13 INSPECTION

It is recommended that on-site inspection and testing be performed to verify that actual site conditions are consistent with assumed conditions which meet or exceed design criteria. Based on the Alberta Building Code, adequate levels of inspection include: testing of engineered fill, review of all completed bearing surfaces for footings and full time inspection during construction deep foundations.

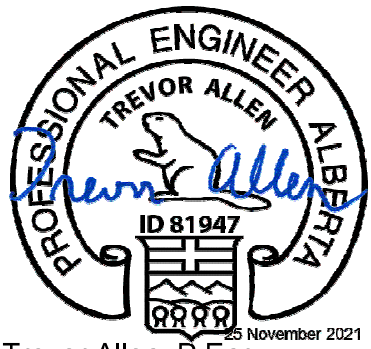
7.0 CLOSURE

This report is based on the findings at one borehole location at the site, soil testing and a review of other available site information. If new information or different subsoil/groundwater conditions are encountered, this office must be notified and recommendations submitted herein will be reviewed and revised as required.

This report has been prepared for the exclusive use of **Stantec Consulting Ltd.** and their approved agents for the specified application to the McKay Ranch Lift Station located in NE 29-040-26-W4M, Blackfalds, Alberta. This report has been prepared in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made. The General Terms and Conditions of this report are attached and should be considered part of this report.

We trust this meets with your present needs. If you have any questions or comments regarding this information, please do not hesitate to contact this office.

Respectfully submitted,
PARKLAND GEOTECHNICAL CONSULTING LTD.



Trevor Allen, P.Eng.
Geotechnical Engineer

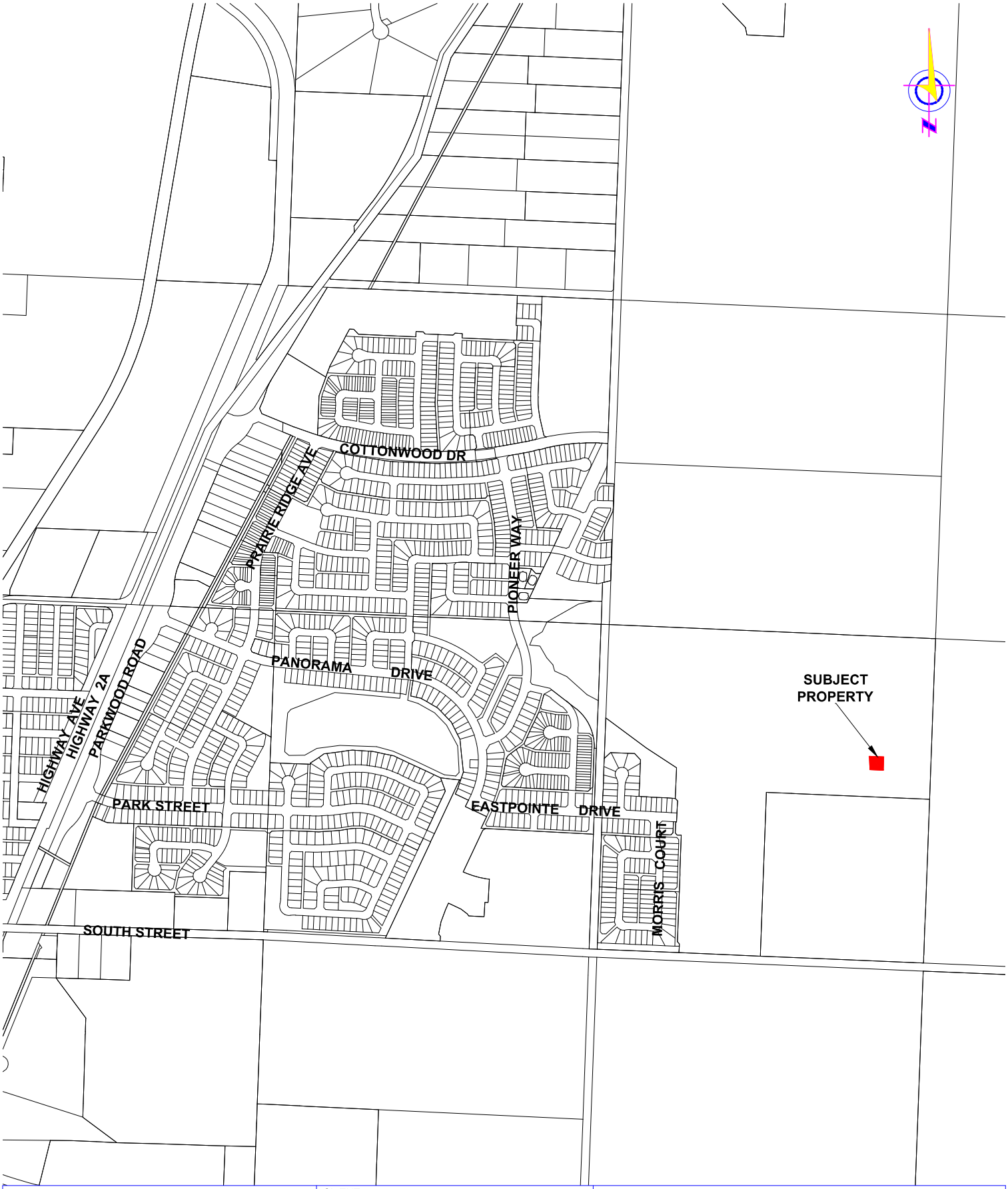
APEGA Permit to Practice No. P – 7312

ID 178900 2021-11-25

Scott Furlong, P.Eng.
Reviewer/ Responsible Member

FIGURES

Figure 1 – Key Plan
Figure 2 – Site Plan
Figure 3 - Aerial Plan
Figure 4 – Site Photographs



ParklandGEO

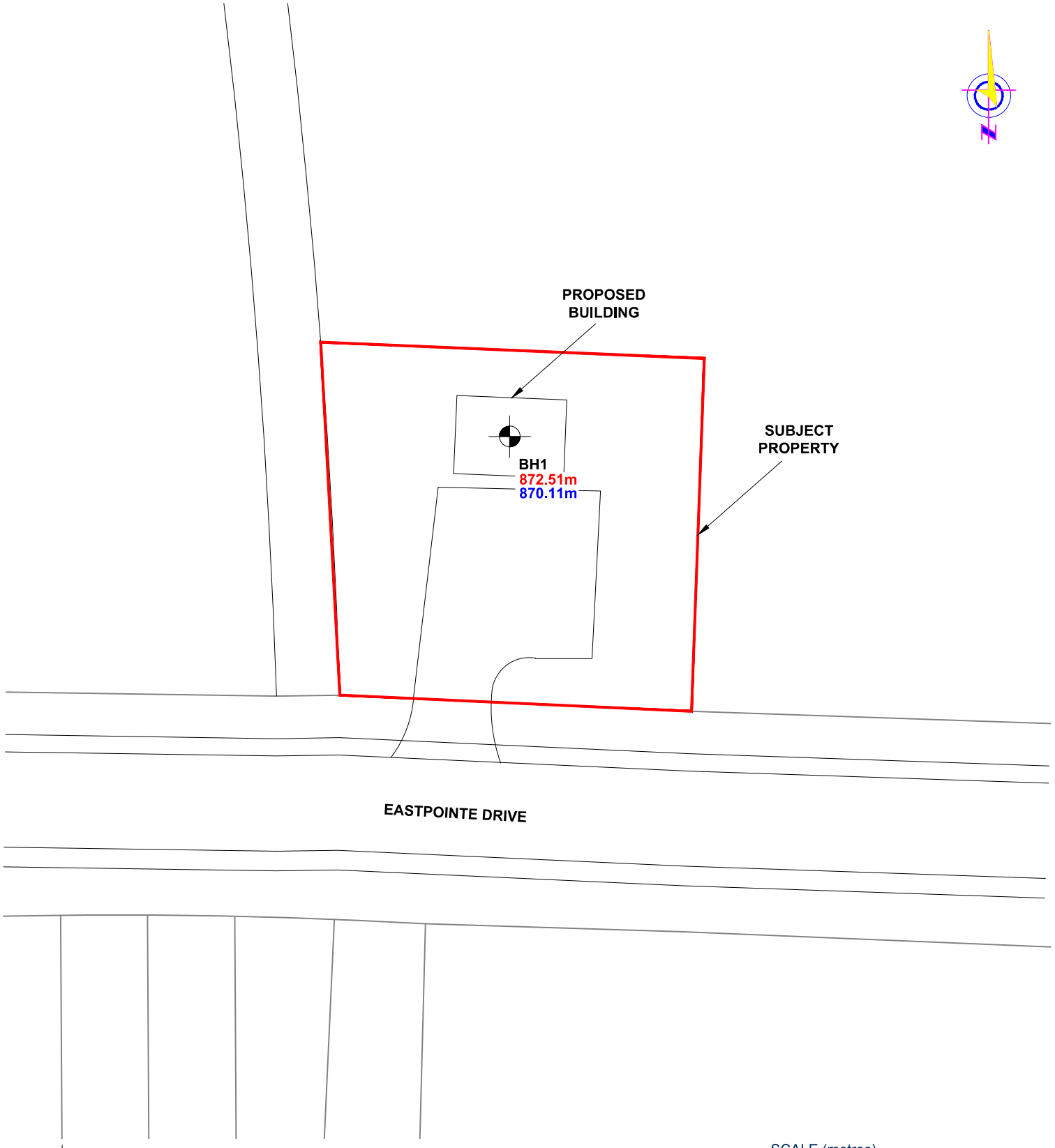
CLIENT: Stantec

KEY PLAN

McKAY RANCH LIFT STATION
WITHIN NW 25-39-27 W4M, BLACKFALDS, AB

DRAWN:	CHK'D.:	REV #:	DATE:
NC	TA	0	FEBRUARY 2017

SCALE:	JOB NO.	DRAWING NO.
NTS	RD5235	FIGURE 1



BOREHOLE LOCATION IS APPROXIMATE.

872.51m SURFACE ELEVATION

870.11m GROUNDWATER ELEVATION (JANUARY 19, 2017)

SCALE (metres)

-10 -5 0 5 10 20

ParklandGEO

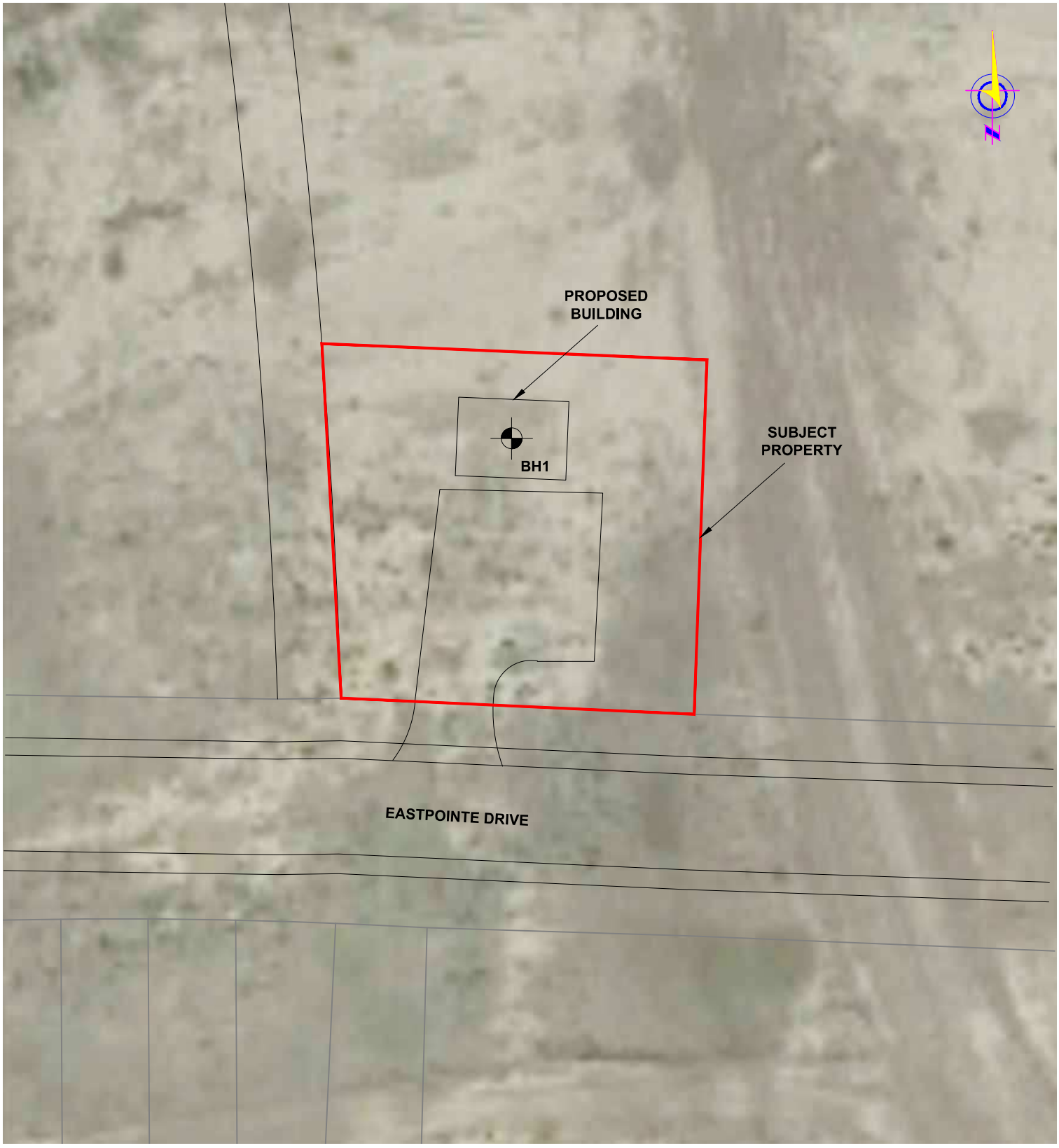
CLIENT: Stantec

SITE PLAN

McKAY RANCH LIFT STATION
WITHIN NW 25-39-27 W4M, BLACKFALDS, AB

DRAWN:	CHK'D.:	REV #:	DATE:
NC	TA	0	FEBRUARY 2017

SCALE:	JOB NO.	DRAWING NO.
1:500	RD5235	FIGURE 2



NOTE: AERIAL PHOTOGRAPH OBTAINED FROM GOOGLE EARTH, DATED AUGUST 22, 2015.

BOREHOLE LOCATION IS APPROXIMATE.

SCALE (metres)

-10 -5 0 5 10 20

ParklandGEO

CLIENT: Stantec

AERIAL PLAN

McKAY RANCH LIFT STATION
WITHIN NW 25-39-27 W4M, BLACKFALDS, AB

DRAWN:	CHK'D.:	REV #:	DATE:
NC	TA	0	FEBRUARY 2017

SCALE:	JOB NO.	DRAWING NO.
1:500	RD5235	FIGURE 3

PHOTOGRAPH 1: SHOWS SUBJECT PROPERTY, TAKEN FROM BH1, FACING NORTH

PHOTOGRAPH 2: SHOWS SUBJECT PROPERTY, TAKEN FROM BH1, FACING EAST

PHOTOGRAPH 3: SHOWS SUBJECT PROPERTY, TAKEN FROM BH1 FACING WEST

PHOTOGRAPH 4: SHOWS SUBJECT PROPERTY, TAKEN FROM BH1, FACING SOUTH

ParklandGEO	CLIENT: Stantec	**SITE PHOTOGRAPHS**	
		McKAY RANCH LIFT STATION WITHIN NW 25-39-27 W4M, BLACKFALDS, AB	
		DRAWN: NC / CHK'D.: TA / REV #: 0	DATE: FEBRUARY 2017
		SCALE: NTS / JOB NO. RD5235	DRAWING NO. FIGURE 4

APPENDIX A

Borehole Log (1)
Soil Test Results
Explanation Sheets

BOREHOLE NO.: 01

CLIENT: Stantec Consulting Ltd.
SITE: McKay Lift Station
NOTES:

PROJECT NO.: RD5235
BH LOCATION: Bldg Center

SUBSURFACE PROFILE

Depth (m)	Description	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Elevation (m)
0	GROUND SURFACE						872.51
	Topsoil Black, organic, frozen.					Frozen to 0.4 m.	
1	***Sand*** Some silt, fine grained, loose to compact, brown, moist.	16		1G1			871.61
	Silt Some fine grained sand, trace to little clay, stiff, low plastic, brown, moist.	14		1D1	8	SO_4 = 0.04%	870.91
2				1G2			
3	***Sand*** Trace to little silt, fine grained, loose to compact, brown, moist. - Some fine grained grey sand lenses, occasional silt inclusions at 2.3 m. - Some grey silt, some clay inclusions; at 2.8 m. - Coarse grained, little gravel, loose, brown, wet to saturated; at 3.0 m.	19				Grain Size Analysis: Gravel = 0.5% Sand = 75.8% Silt and Clay = 23.7%	
		17		1G3			
4							868.01
5		27		1D2	5		
				1G4			
6		28					
	Silt Little clay, trace to little fine grained sand, soft to firm, low plastic, brown, moist to wet. - Little fine grained sand, trace clay, grey; at 7.0 m.	25		1G5			
7							
8		24		1D3	9		
				1G6			
9		25					
		25		1G7			
10							
11		24					
				1G8			
12	- Firm to stiff, brown and grey, moist; at 12.0 m.	26					
		23		1G9			
13							
14		25					858.51
	Clay Some silt, stiff to hard, medium to high plastic, brown, moist.			1G10			
15		28					857.51
	End of Borehole at 15.0 m. Slough to 3.0 m upon completion. 25 mm PVC standpipe installed. Backfilled with auger cuttings. Wet upon completion. Water at 2.4 m on January 19, 2017. Water at 3.2 m on October 27, 2021.						
16							
17							

Well Completion Details: SOLID, SLOTTED, AUGER CUTTINGS, SLOUGH

LOGGED BY: NC
CONTRACTOR: Darkhorse Drilling Ltd.
RIG/METHOD: Geoprobe 7822DT / Solid Stem
DATE: December 21, 2016
CALIBRATION:

GROUND ELEVATION: 872.51 m
NORTHING: 5806876.06 m
EASTING: 312067.99 m

Project: McKay Ranch Lift Station
Subject: Geotechnical Testing - Soil Sulphate Test Results
Project #: RD5235 **Date:** January 16, 2017

Soil Sulphate Test Results

Laboratory: Parkland Geotechnical

Sample #: MC1-2 Borehole: 1 Depth: 2.0m Result (% Sulphate): 0.04	Sample #: Borehole: Depth: Result (% Sulphate):
Sample #: Borehole: Depth: Result (% Sulphate):	Sample #: Borehole: Depth: Result (% Sulphate):
Sample #: Borehole: Depth: Result (% Sulphate):	Sample #: Borehole: Depth: Result (% Sulphate):
Sample #: Borehole: Depth: Result (% Sulphate):	Sample #: Borehole: Depth: Result (% Sulphate):
Sample #: Borehole: Depth: Result (% Sulphate):	Sample #: Borehole: Depth: Result (% Sulphate):

Comments:

REQUIREMENTS FOR CONCRETE SUBJECTED TO SULPHATE ATTACK (CAN/CSA-A231-M09)

EXPOSURE CLASSIFICATION	DEGREE OF EXPOSURE	WATER-SOLUBLE SULPHATE(SO4) IN SOIL SAMPLE, %	SULPHATE(SO4) IN GROUND WATER SAMPLES, mg/L	MINIMUM SPECIFIED 56-DAY COMPRESSIVE STRENGTH, MPa	MAXIMUM WATER/CEMENTING MATERIALS RATIO	PORTLAND CEMENT TO BE USED
S-1	Very Severe	over 2.0	over 10,000	35	0.4	HS
S-2	Severe	0.20 to 2.0	1 500 to 10 000	32	0.45	HS
S-3	Moderate	0.10 to 0.20	150 to 1 500	30	0.5	MS or HS

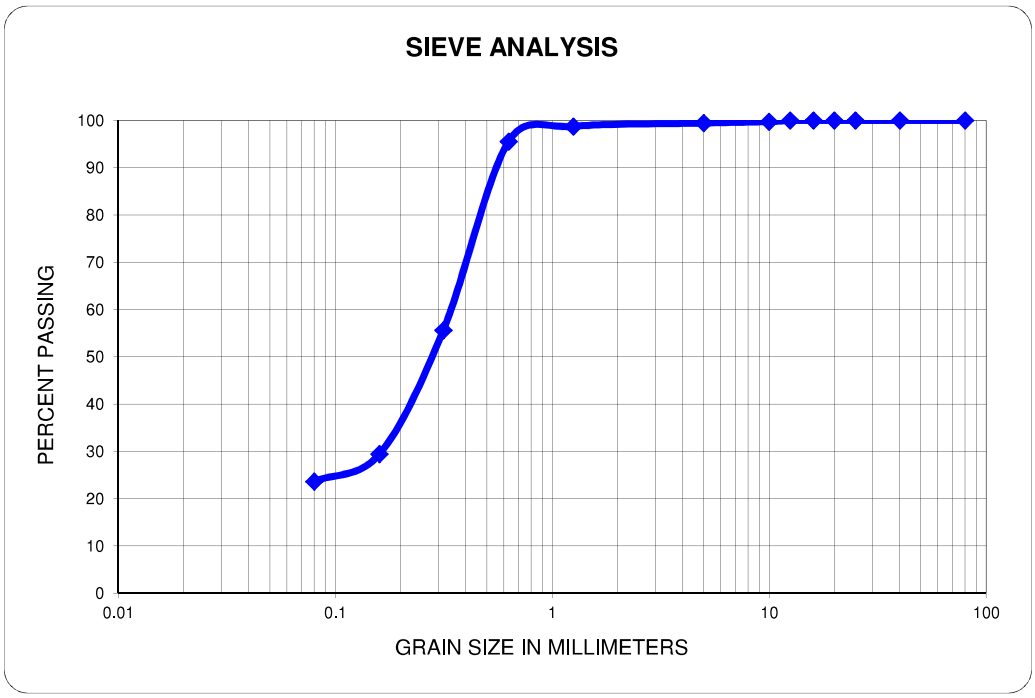
Tech: AB **Chkd:** TA

PROJECT - McKay Ranch Lift Station
PROJECT # RD5235 **DATE -** January 13, 2017
SAMPLE SOURCE -
PIT NAME -
TECHNICIAN - AB **SIEVE #** 1

SIEVE NO.	OPENING SIZE (mm)	WEIGHT RETAINED (g)	TOTAL WT. FINER (gms)	PERCENT PASSING	SPECIFICATION Min.	SPECIFICATION Max.
80000	80		1150.4	100.0		
40000	40		1150.4	100.0		
25000	25		1150.4	100.0		
20000	20		1150.4	100.0		
16000	16		1150.4	100.0		
12500	12.5		1150.4	100.0		
10000	10	2.7	1147.7	99.8		
5000	5	3.6	1144.1	99.5		
1250	1.25	8.1	1136	98.7		
630	0.63	36.3	1099.7	95.6		
315	0.315	459.2	640.5	55.7		
160	0.16	301.2	339.3	29.5		
80	0.08	67.2	272.1	23.7		
SIEVE PAN		19.8				

MOISTURE CONTENT SAMPLE		SIEVE ANALYSIS SAMPLE		D.W.W.CALCULATIONS
A-WT. WET SAMPLE + PAN	1924.8	G-WT. OF DRY SAMPLE	1150.4	
B-WT. DRY SAMPLE + PAN	1753.9	H- WASHED DRY +PAN	1501.6	
C-WT. OF WATER	170.9	I- WT OF WASHED DRY SAI	898.1	
D-WT. OF PAN	603.5	J- WT WASHED FINES	252.3	
E-WT. OF DRY SAMPLE	1150.4			
F-MOISTURE CONTENT	14.9			

DESCRIPTION OF SAMPLE/COMMENTS	METHOD OF PREPARATION	WASHED
BH1	TOTAL WEIGHT	1150.4
1G2	DRY WT.	1150.4
2.5m	DIFFERENCE	0
	% DIFFERENCE	0



THE PARKLANDGEO CONSULTING GROUP
EXPLANATION OF TERMS AND SYMBOLS

The terms and symbols used on the borehole logs to summarize the results of the field investigation and subsequent laboratory testing are described on the following pages.

The borehole logs are a graphical representation summarizing the soil profile as determined during site specific field investigation. The materials, boundaries, and conditions have been established only at the borehole location at the time of drilling. The soil conditions shown on the borehole logs are not necessarily representative of the subsurface conditions elsewhere across the site. The transitions in soil profile can have gradual rather than distinct boundaries.

1. **PRINCIPAL SOIL TYPE** – The major soil type by weight of material or by behaviour.

Material	Grain Size
Boulders	Larger than 300 mm
Cobbles	75 mm to 300 mm
Coarse Gravel	19 mm to 75 mm
Fine Gravel	5 mm to 19 mm
Coarse Sand	2 mm to 5 mm
Medium Sand	0.425 mm to 2 mm
Fine Sand	0.075 mm to 0.425 mm
Silt	0.020 to 0.075 mm
Clay	Smaller than 0.020 mm

2. **DESCRIPTION OF MINOR SOIL TYPE** – Minor soil types are identified by weight of minor component.

Descriptor	Percent
and	35 to 50
some	20 to 35
little	10 to 20
trace	1 to 10

3. **CONSISTENCY OF FINE GRAINED SOILS** – The following terms are used relative to undrained shear strength and Standard Penetration Test (SPT), N value, for blows per 300 mm penetration (ASTM D1586).

Description	Undrained Shear Strength, C_u (kPa)	SPT N Value
Very Soft	Less than 12	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 150	15 to 30
Hard	Over 150	Over 30

4. **RELATIVE DENSITY OF COARSE GRAINED SOIL** – The following terms are used relative to Standard Penetration Test (SPT), N value, for blows per 300 mm penetration (ASTM D1586).

Description	SPT N Value
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Over 50

5. **TYPICAL SEDIMENTARY BEDROCK TYPES AND CLASSIFICATION** – The following terms are based on visual inspection and field/laboratory identification tests.

Characteristic	Sandstone	Mudrocks			
		Siltstone	Mudstone	Clayshale	Claystone
Composition	>50% Sand $CaCO_3$ or silica binder. Use weak acid to test for $CaCO_3$.	>50% Silt	33% to 66% Silt & 33% to 66% Clay	>50% Clay & <33% Silt	
Bedding	Banding possible Non- Fissile Wackes – dirty sandstone matrix (>15% clay)	Non-Fissile & Non-laminated	Non-Fissile & Non-laminated	Fissile	Non-Fissile

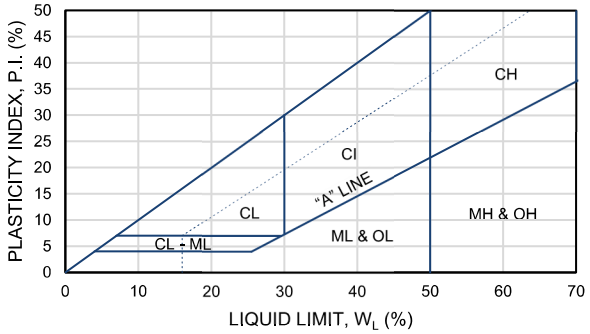
Definitions

Fissile	Breaks apart on bedding planes, not fractures.
Shale	Only used to describe a fissile clay mudrock.
Slate	Hard mudstone exposed to high pressure and temperature.
Limestone	Sedimentary rock (i.e. particles) formed from calcium carbonate minerals from skeletal fragments of marine organisms such as coral. Particles generally too small to see with eye.

THE PARKLANDGEO CONSULTING GROUP
EXPLANATION OF TERMS AND SYMBOLS

MODIFIED UNIFIED CLASSIFICATION SYSTEM FOR SOILS

MAJOR DIVISION			GROUP SYMBOL	GRAPH SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA	
COARSE GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN NO. 200 SIEVE)	GRAVELS MORE THAN HALF COARSE GRAINS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)	GW		WELL GRADED GRAVELS, GRAVEL-SAND MIXTURE, LITTLE OR NO FINES	$C_U = \frac{D_{60}}{D_{10}} \geq 4$ AND $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3	
			GP		POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS	
		DIRTY GRAVELS (WITH SOME FINES)	GM		SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
			GC		CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE "A" LINE AND P.I. GREATER THAN 7
	SANDS MORE THAN HALF FINE GRAINS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)	SW		WELL GRADED SANDS, GRAVELLY SANDS WITH LITTLE OR NO FINES	$C_U = \frac{D_{60}}{D_{10}} \geq 6$ AND $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3	
			SP		POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS	
		DIRTY SANDS (WITH SOME FINES)	SM		SILTY SANDS, SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
			SC		CLAYEY SANDS, SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE "A" LINE AND P.I. GREATER THAN 7
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT PASSES NO. 200 SIEVE)	SILTS BELOW "A" LINE NEGLIGIBLE ORGANIC CONTENT	$W_L < 50\%$	ML		INORGANIC SILTS & VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART (SEE BELOW)	
		$W_L > 50\%$	MH		INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS		
	CLAYS ABOVE "A" LINE NEGLIGIBLE ORGANIC CONTENT	$W_L < 30\%$	CL		INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY SOILS		
		$30\% < W_L < 50\%$	CI		INORGANIC CLAYS OF MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS		
		$W_L > 50\%$	CH		INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS		
	ORGANIC SILTS & CLAYS BELOW "A" LINE	$W_L < 50\%$	OL		ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW AND MEDIUM PLASTICITY		
		$W_L > 50\%$	OH		ORGANIC CLAYS OF HIGH PLASTICITY, ORGANIC SILTS		
HIGHLY ORGANIC SOILS			Pt		PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOR OR ODOR, AND OFTEN FIBROUS TEXTURE	



NOTES ON SOIL CLASSIFICATION AND DESCRIPTION:

1. Soil are classified and described according to their engineering properties and behaviour.
2. Boundary classification for soil with characteristics of two groups are given combined group symbols (e.g. GW-GC is a well graded gravel sand mixture with clay binder between 5 and 12%).
3. Soil classification is in accordance with the Unified Soil Classification System (ASTM D2487) with the exception that an inorganic clay of medium plasticity (CI) is recognized.
4. The use of modifying adjectives may be employed to define the estimated percentage range of minor components.

LIMITATIONS

General Terms and Conditions

The use of this attached report is subject to the following general terms and conditions.

1. STANDARD OF CARE - In the performance of professional services, ParklandGEO used the degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession practicing in the same or similar localities. No other warranty expressed or implied is made in any manner.

2. INTERPRETATION OF THE REPORT - The CLIENT recognizes that subsurface conditions will vary from those encountered at the location where borings, surveys, or explorations are made and that the data, interpretations and recommendation of ParklandGEO are based solely on the information available to him. Classification and identification of soils, rocks, geological units, contaminated materials and contaminant quantities will be based on commonly accepted practices in geotechnical or environmental consulting practice in this area. ParklandGEO will not be responsible for the interpretation by others of the information developed.

3. SITE INFORMATION - The CLIENT has agreed to provide all information with respect to the past, present and proposed conditions and use of the Site, whether specifically requested or not. The CLIENT acknowledged that in order for ParklandGEO to properly advise and assist the CLIENT, ParklandGEO has relied on full disclosure by the CLIENT of all matters pertinent to the Site investigation.

4. COMPLETE REPORT - The Report is of a summary nature and is not intended to stand alone without reference to the instructions given to ParklandGEO by the CLIENT, communications between ParklandGEO and the CLIENT, and to any other reports, writings or documents prepared by ParklandGEO for the CLIENT relative to the specific Site, all of which constitute the Report. The word "Report" shall refer to any and all of the documents referred to herein. In order to properly understand the suggestions, recommendations and opinions expressed by ParklandGEO, reference must be made to the whole of the Report. ParklandGEO cannot be responsible for use of any part or portions of the report without reference to the whole report. The CLIENT has agreed that "This report has been prepared for the exclusive use of the named CLIENT. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. ParklandGEO accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report."

   The CLIENT has agreed that in the event that any such report is released to a third party, the above disclaimer shall not be obliterated or altered in any manner. The CLIENT further agrees that all such reports shall be used solely for the purposes of the CLIENT and shall not be released or used by others without the prior written permission of ParklandGEO.

5. LIMITATIONS ON SCOPE OF INVESTIGATION AND WARRANTY DISCLAIMER
   There is no warranty, expressed or implied, by ParklandGEO that:
   a) the investigation uncovered all potential geo-hazards, contaminants or environmental liabilities on the Site; or
   b) the Site is entirely free of all geo-hazards or contaminants as a result of any investigation or cleanup work undertaken on the Site, since it is not possible, even with exhaustive sampling, testing and analysis, to document all potential geo-hazards or contaminants on the Site.

   The CLIENT acknowledged that:
   a) the investigation findings are based solely on the information generated as a result of the specific scope of the investigation authorized by the CLIENT;
   b) unless specifically stated in the agreed Scope of Work, the investigation will not, nor is it intended to assess or detect potential contaminants or environmental liabilities on the Site;
   c) any assessment regarding geological conditions on the Site is based on the interpretation of conditions determined at specific sampling locations and depths and that conditions may vary between sampling locations, hence there can be no assurance that undetected geological conditions, including soils or groundwater are not located on the Site;
   d) any assessment is also dependent on and limited by the accuracy of the analytical data generated by the sample analyses;
   e) any assessment is also limited by the scientific possibility of determining the presence of unsuitable geological conditions for which scientific analyses have been conducted; and
   f) the laboratory testing program and analytical parameters selected are limited to those outlined in the CLIENT's authorized scope of investigation; and
   g) there are risks associated with the discovery of hazardous materials in and upon the lands and premises which may inadvertently discovered as part of the investigation. The CLIENT acknowledges that it may have a responsibility in law to inform the owner of any affected property of the existence or suspected existence of hazardous materials and in some cases the discovery of hazardous conditions and materials will require that certain regulatory bodies be informed. The CLIENT further acknowledges that any such discovery may result in the fair market value of the lands and premises and of any other lands and premises adjacent thereto to be adversely affected in a material respect.

6. COST ESTIMATES - Estimates of remediation or construction costs can only be based on the specific information generated and the technical limitations of the investigation authorized by the CLIENT. Accordingly, estimated costs for construction or remediation are based on the known site conditions, which can vary as new information is discovered during construction. As some construction activities are an iterative exercise, ParklandGEO shall therefore not be liable for the accuracy of any estimates of remediation or construction costs provided.

7. LIMITATION OF LIABILITY - The CLIENT has agreed that to the fullest extent permitted by the law ParklandGEO's total liability to CLIENT for any and all injuries, claims, losses, expenses or damages whatsoever arising out of or in anyway relating to the Project is contractually limited, as outlined in ParklandGEO's standard Consulting Services Agreement. Further, the CLIENT has agreed that to the fullest extent permitted by law ParklandGEO is not liable to the CLIENT for any special, indirect or consequential damages whatsoever, regardless of cause.

8. INDEMNIFICATION - To the fullest extent permitted by law, the CLIENT has agreed to defend, indemnify and hold ParklandGEO, its directors, officers, employees, agents and subcontractors, harmless from and against any and all claims, defence costs, including legal fees on a full indemnity basis, damages, and other liabilities arising out of or in any way related to ParklandGEO's work, reports or recommendations.

ParklandGEO Ltd.
#102 – 4756 Riverside Drive
Red Deer, AB, T4N 2N7
www.parklandgeo.com
T: 403 343 2428
F: 403 343 7699

February 9, 2026
Project No. 26-0050RD

Brad.VanderHeyden@stantec.com
Original will remain on file

Stantec Consulting Ltd.
4900 50 Street
Red Deer, AB
T4N 1X7

Attn: Brad Vander Heyden, P.Eng.
Project Manager, Senior Associate

Re: Geotechnical Investigation – Groundwater Level
McKay Ranch Lift Station
Blackfalds, Alberta

1.0 INTRODUCTION

The Town of Blackfalds is proposing to construct a lift station in southeast Blackfalds, Alberta. ParklandGEO Ltd. (ParklandGEO) was retained by Stantec Consulting Ltd. (Stantec) to conduct a geotechnical investigation for the lift station. The following geotechnical reports were issued for the lift station:

- "*Geotechnical Investigation – McKay Ranch Lift Station – Blackfalds, Alberta"* Prepared for the Stantec Consulting Ltd., Prepared by Parkland Geotechnical Consulting Ltd., dated February 2017 (Project # RD5235).

- "*Geotechnical Investigation – McKay Ranch Lift Station – Blackfalds, Alberta"* Prepared for the Stantec Consulting Ltd., Prepared by Parkland Geotechnical Consulting Ltd., dated November 25, 2021 (Project # RD7599).

ParklandGEO Ltd. (ParklandGEO) was requested by Stantec to drill a new borehole at the lift station location and provide a new groundwater level measurement.

2.0 DRILLING PROGRAM

1. Prior to mobilizing the drilling rig, ParklandGEO personnel completed an Alberta One Call to verify the drill sites were clear of underground utilities.

2. On January 23, 2026, a new borehole was drilled at the site to a depth of 6 m below existing grade. The borehole was drilled using a truck mounted drilling rig with 150 mm diameter solid stem augers. The drill rig was owned and operated by J.E.D. Anchors & Environmental & Drilling of Penhold, Alberta.

3. Drilling operations were monitored by members of ParklandGEO's geotechnical staff. The soil encountered was visually examined during drilling and logged according to the Modified Unified Soil Classification System.

4. At the completion of drilling, a 25 mm hand-slotted PVC standpipe was installed in the boreholes and backfilled with auger cuttings and a bentonite chips. Groundwater levels and depths where seepage zones were encountered were noted during drilling. Groundwater measurements were recorded on February 5, 2026.

5. The borehole locations were surveyed by ParklandGEO using a Trimble GPS receiver and a pole mounted Trimble antenna. The estimated post data correction vertical accuracy of this equipment is ±10 cm. UTM coordinates and geodetic elevations are provided in the borehole log in Appendix A.

3.0 GROUNDWATER CONDITIONS

Sloughing conditions were observed in the sand layer throughout drilling. Groundwater seepage was observed in the borehole during and after drilling. The groundwater level was measured to a depth of 5.1 m below grade on February 5, 2026, 13 days after drilling.

Previously at the site, the groundwater level was measured at a depth of 2.4 m below grade on January 19, 2017 and a depth of 3.2 m below grade on October 27, 2021.

The observed shallow groundwater measurements are considered to be typical for this area of Blackfalds. The local groundwater table is dependent on infiltration of precipitation and is expected to fluctuate on a season basis with the highest levels after periods of prolonged heavy precipitation or snowmelt. Groundwater seepage is expected in shallow excavations. The volumes and seepage rates for groundwater encountered will be dependent on seasonal conditions and the permeability of the soils within the profile.

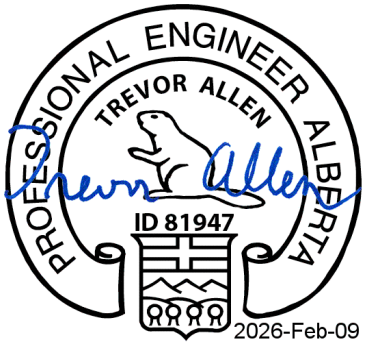
4.0 CLOSURE

Geological conditions are variable. The recommendations presented in this report, and any subsequent correspondence, are based on an evaluation of information derived from the boreholes, and additional sources of information referenced in this report. If conditions are noted during construction which are believed to be at variance with the conditions described in this report, this office should be contacted immediately.

This report has been prepared for the exclusive use of the Client and their approved agents for the scope of work and property outlined in this report. Use of the report is subject to acceptance of the General Terms, Conditions, and Limitations provided in this report. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. ParklandGEO Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

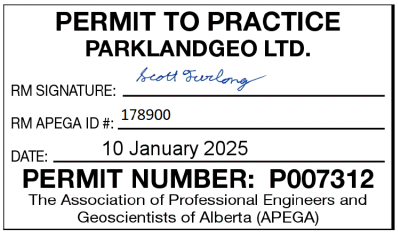
We trust that this report meets with your current requirements. If there are any questions, please do not hesitate to contact our office.

Respectfully Submitted,
PARKLANDGEO LTD.



Trevor Allen, P.Eng.
Geotechnical Engineer

APEGA PERMIT TO PRACTICE P007312



Scott Furlong, P.Eng.
Responsible Member

Parkland GEO

PROJECT: McKay Ranch Lift Station Groundwater
CLIENT: Stantec Consulting Ltd.
SITE: Blackfalds, AB

BOREHOLE NO. 26-01
PROJECT NO.: 26-0050 RD
BH LOCATION:

Depth (m)	Lithologic Description	Symbol	Atterberg Limits & Moisture (W_{PL} W W_{LL}) 20 40 60 80	Samples: No.	Samples: Blow Counts	Samples: Type	Comments	Well Completion Details
	EL 872.16 m							1m
0	**SAND** Some silt, fine to medium grained, loose, brown, damp to moist.							#1 Standpipe (PVC)
1								
	- Frozen to 1.5 m.							
2								
3	- Medium to coarse grained, wet at 3.0 m.							
	4 m EL 868.16 m							
4	**SILT** Some sand, firm, non to low plastic, brown, wet.							
5								
	6 m EL 866.16 m							
6	End of borehole at 6.0 m. 25 mm PVC standpipe installed. Backfilled with auger cuttings and bentonite chips. Water at 5.10 m on February 5, 2026.							
7								
8								
9								
10								
11								

LOGGED BY: SB
CONTRACTOR: J.E.D Anchors and Environment Drilling
RIG/METHOD: Truck Mount /Auger (Solid-Stem) (0-6 m)
NOTES:

DATE: Jan 23, 2026
GROUND ELEVATION (m): 872.16
NORTHING (m): 5806865.06
EASTING (m): 312031.55

RSLog / RD ParklandGEO Geotechnical Template / parklandgeo-ltd-ca / RSLOGrd.geo01 / February 05, 2026 10:34 AM

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EXPLANATION OF TERMS AND SYMBOLS

The terms and symbols used on the borehole logs to summarize the results of the field investigation and subsequent laboratory testing are described on the following pages.

The borehole logs are a graphical representation summarizing the soil profile as determined during site specific field investigation. The materials, boundaries, and conditions have been established only at the borehole location at the time of drilling. The soil conditions shown on the borehole logs are not necessarily representative of the subsurface conditions elsewhere across the site. The transitions in soil profile can have gradual rather than distinct boundaries.

1. **PRINCIPAL SOIL TYPE** – The major soil type by weight of material or by behaviour.

Material	Grain Size
Boulders	Larger than 300 mm
Cobbles	75 mm to 300 mm
Coarse Gravel	19 mm to 75 mm
Fine Gravel	5 mm to 19 mm
Coarse Sand	2 mm to 5 mm
Medium Sand	0.425 mm to 2 mm
Fine Sand	0.075 mm to 0.425 mm
Silt	0.020 to 0.075 mm
Clay	Smaller than 0.020 mm

2. **DESCRIPTION OF MINOR SOIL TYPE** – Minor soil types are identified by weight of minor component.

Descriptor	Percent
and	35 to 50
some	20 to 35
little	10 to 20
trace	1 to 10

3. **CONSISTENCY OF FINE GRAINED SOILS** – The following terms are used relative to undrained shear strength and Standard Penetration Test (SPT), N value, for blows per 300 mm penetration (ASTM D1586).

Description	Undrained Shear Strength, C_u (kPa)	SPT N Value
Very Soft	Less than 12	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 150	15 to 30
Hard	Over 150	Over 30

4. **RELATIVE DENSITY OF COARSE GRAINED SOIL** – The following terms are used relative to Standard Penetration Test (SPT), N value, for blows per 300 mm penetration (ASTM D1586).

Description	SPT N Value
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Over 50

5. **TYPICAL SEDIMENTARY BEDROCK TYPES AND CLASSIFICATION** – The following terms are based on visual inspection and field/laboratory identification tests.

Characteristic	Sandstone	Mudrocks			
		Siltstone	Mudstone	Clayshale	Claystone
Composition	>50% Sand $CaCO_3$ or silica binder. Use weak acid to test for $CaCO_3$.	>50% Silt	33% to 66% Silt & 33% to 66% Clay	>50% Clay & <33% Silt	
Bedding	Banding possible Non- Fissile Wackes – dirty sandstone matrix (>15% clay)	Non-Fissile & Non-laminated	Non-Fissile & Non-laminated	Fissile	Non-Fissile

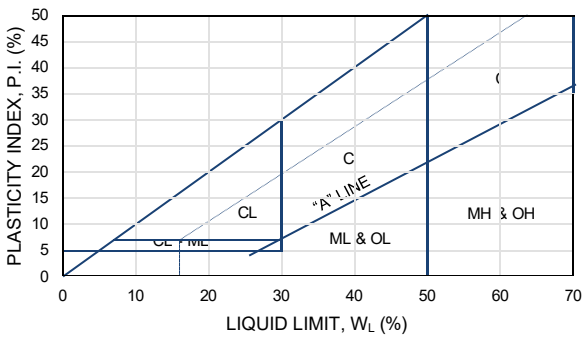
Definitions

Fissile Breaks apart on bedding planes, not fractures.
Shale Only used to describe a fissile clay mudrock.
Slate Hard mudstone exposed to high pressure and temperature.
Limestone Sedimentary rock (i.e. particles) formed from calcium carbonate minerals from skeletal fragments of marine organisms such as coral. Particles generally too small to see with eye.

PARKLANDGEO LTD.
EXPLANATION OF TERMS AND SYMBOLS

MODIFIED UNIFIED CLASSIFICATION SYSTEM FOR SOILS

MAJOR DIVISION			GROUP SYMBOL	GRAPH SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA	
COARSE GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN NO. 200 SIEVE)	GRAVELS MORE THAN HALF COARSE GRAINS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)	GW		WELL GRADED GRAVELS, GRAVEL-SAND MIXTURE, LITTLE OR NO FINES	$C_U = \frac{D_{60}}{D_{10}} \geq 4$ AND $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3	
			GP		POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS	
		DIRTY GRAVELS (WITH SOME FINES)	GM		SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
			GC		CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE "A" LINE AND P.I. GREATER THAN 7
	SANDS MORE THAN HALF FINE GRAINS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)	SW		WELL GRADED SANDS, GRAVELLY SANDS WITH LITTLE OR NO FINES	$C_U = \frac{D_{60}}{D_{10}} \geq 6$ AND $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3	
			SP		POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS	
		DIRTY SANDS (WITH SOME FINES)	SM		SILTY SANDS, SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
			SC		CLAYEY SANDS, SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE "A" LINE AND P.I. GREATER THAN 7
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT PASSES NO. 200 SIEVE)	SILTS BELOW "A" LINE NEGLIGIBLE ORGANIC CONTENT	W_L < 50%	ML		INORGANIC SILTS & VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART (SEE BELOW)	
		W_L > 50%	MH		INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS		
	CLAYS ABOVE "A" LINE NEGLIGIBLE ORGANIC CONTENT	W_L < 30%	CL		INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY SOILS		
		30% < W_L < 50%	CI		INORGANIC CLAYS OF MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS		
		W_L > 50%	CH		INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS		
	ORGANIC SILTS & CLAYS BELOW "A" LINE	W_L < 50%	OL		ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW AND MEDIUM PLASTICITY		
		W_L > 50%	OH		ORGANIC CLAYS OF HIGH PLASTICITY, ORGANIC SILTS		
HIGHLY ORGANIC SOILS			Pt		PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOR OR ODOR, AND OFTEN FIBROUS TEXTURE	



NOTES ON SOIL CLASSIFICATION AND DESCRIPTION:

1. Soil are classified and described according to their engineering properties and behaviour.
2. Boundary classification for soil with characteristics of two groups are given combined group symbols (e.g. GW-GC is a well graded gravel sand mixture with clay binder between 5 and 12%).
3. Soil classification is in accordance with the Unified Soil Classification System (ASTM D2487) with the exception that an inorganic clay of medium plasticity (CI) is recognized.
4. The use of modifying adjectives may be employed to define the estimated percentage range of minor components.

Professional services are subject to the following general terms, conditions, and limitations. If there is a conflict between the general terms, conditions, and limitations stated herein and those in the fully executed agreement signed between the CLIENT and ParklandGEO Ltd. (the "CONSULTANT") those of the fully executed agreement have precedence.

1. STANDARD OF CARE

1.1. In the performance of professional services, the CONSULTANT will use that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession practicing in the same or similar localities. No other warranty, representation, or guarantee, either expressed or implied, is made or intended by this Agreement or by furnishing oral or written reports of the findings made, including but not limited as to CONSULTANT's professional services.

2. SITE INFORMATION

2.1. The CLIENT agrees to fully cooperate with the CONSULTANT and provide all information with respect to the past, present and proposed conditions and use of the project site (the "**Site**") whether specifically requested or not. The CLIENT acknowledges that in order for the CONSULTANT to properly provide the Services for which it is engaged and advise and assist the CLIENT, the CONSULTANT is relying upon full disclosure by the CLIENT of all matters and information pertinent to the Site, and upon the accuracy of such matters and information. The CONSULTANT shall not be responsible to the CLIENT or others for any consequences of any error or omissions contained in such CLIENT-supplied information, or as a result of the CLIENT's non-disclosure of information.

2.2. The CLIENT recognizes that subsurface conditions will vary from those encountered at the location where borings, surveys, or explorations are made and that the data, interpretations, and recommendation of the CONSULTANT are based solely on the information available to it. Classification and identification of soils, rocks, geological units, contaminated materials, and contaminant quantities will be based on commonly accepted practices in geotechnical and environmental consulting practice in this area.

2.3. Where specifically stated in the scope of work/Services, the CONSULTANT will perform a review of the historical information obtained or provided by the Client to assist in the investigation of the Site unless and except to the extent that such a review is limited or excluded from the scope of work.

3. WORK PRODUCT AND COMPLETE REPORT

3.1. Test results and reports, including the final report (the "**Report**"), provided by the CONSULTANT are of a summary nature and are not intended to stand alone without reference to the instructions given to the CONSULTANT by the CLIENT, communications between the CONSULTANT and the CLIENT, and to any other reports, writings or documents prepared by the CONSULTANT for the CLIENT relative to the specific Site, all of which shall constitute the "**Work Product**". In order to properly understand the suggestions, recommendations and opinions expressed by the CONSULTANT, reference must be made to the whole of the Work Product and Report. The CONSULTANT shall not be responsible for use of any part or portions of the of the Work Product or Report without reference to the whole of the Work Product and Report. The CLIENT agrees that any and all reports prepared by the CONSULTANT shall contain the following statement, and if such statement does not appear in the Work Product or Report the CLIENT agrees it is deemed to be included therein by way of this provision:

> *"This report has been prepared for the exclusive use of the Client and their approved agents for the scope of work and property outlined in this report. Use of the report is subject to acceptance of the General Terms, Conditions, and Limitations provided in this report. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. ParklandGEO Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report."*

3.2. The CLIENT agrees that in the event that any such report is released to a third party, such disclaimer shall not be removed, deleted, excluded or altered in any manner. The CLIENT further agrees that all Reports, including but not limited to any interim, preliminary or other reports, writings or documents prepared by the CONSULTANT for the CLIENT relative to the services and/or Site, shall be used solely for the purposes of the CLIENT and shall not be released, disclosed or used by others without the prior written permission of the CONSULTANT. No third parties are entitled to rely upon the Report or any portion thereof, and the Report shall not be considered accurate, complete or appropriate or suitable for such third parties.

4. INTERPRETATION OF THE REPORT AND/OR RESULTS

4.1. The CLIENT recognizes that subsurface conditions will vary from those encountered at the location where borings, surveys, or explorations are made and that the data, interpretations, and recommendations of the CONSULTANT are based solely on the information available to it. Classification and identification of soils, rocks, geological units, contaminated materials, and contaminant quantities will be based on commonly accepted practices in geotechnical and environmental consulting practice in this area. The CONSULTANT will not be responsible for the interpretation by others of the information developed by the CONSULTANT.

5. LIMITATIONS ON SCOPE OF INVESTIGATION AND WARRANTY

5.1. There is no warranty, expressed or implied, by the CONSULTANT that:

1. the investigation and services provided by the CONSULTANT shall uncover all potential geo-hazards, contaminants or environmental liabilities on the Site; or
2. the Site will be entirely free of all geo-hazards or contaminants as a result of any investigation and Services provided by the CONSULTANT, or cleanup work undertaken on the Site. The CLIENT acknowledges and agrees that it is not possible, even with exhaustive sampling, testing and analysis, to document all potential geo-hazards or contaminants on the Site.

5.2. The CLIENT acknowledges that:

1. the investigation findings, including but not limited to those in the Work Product and/or Report, are based solely on the information generated as a result of the specific scope of the investigation authorized by the CLIENT;
2. unless specifically stated in the agreed scope of work, the investigation will not, nor is it intended to assess or detect potential contaminants or environmental liabilities on the Site;
3. any assessment regarding geological conditions on the Site is based on the interpretation of conditions determined at specific sampling locations and depths, and that conditions may vary between sampling locations, hence there can be no assurance that undetected geological conditions, including soils or groundwater are not located on the Site;
4. any assessment is also dependent on and limited by the accuracy of the analytical data generated by the sample analyses;
5. any assessment is also limited by the scientific possibility of determining the presence of unsuitable geological conditions for which scientific analyses have been conducted;

6. the laboratory testing program and analytical parameters selected are limited to those outlined in the CLIENT's authorized scope of investigation; and
7. there are risks associated with the discovery of hazardous materials in and upon the lands and premises which may inadvertently be discovered as part of this investigation. The CLIENT acknowledges that it may have a responsibility in law to inform the owner of any affected property of the existence or suspected existence of hazardous materials. The CLIENT further acknowledges that any such discovery may result in the fair market value of the lands and premises and of any other lands and premises adjacent thereto to be adversely affected in a material respect.

6. COST ESTIMATES

6.1. Where provided, estimates of remediation or construction costs can only be based on the specific information generated and the technical limitations of the investigation authorized by the CLIENT at the date of the report. Accordingly, estimated costs for construction are based on the known Site conditions, which can vary as new information is discovered during construction or otherwise. The CLIENT acknowledges construction activities are an iterative exercise and cost estimates in relation to same may not be or remain accurate. The CONSULTANT shall not be liable for the accuracy of any estimates of remediation or construction costs provided.

7. LIMITATIONS OF LIABILITY AND INDEMNIFICATION

7.1. **LIMITATION OF LIABILITY** – The CLIENT hereby agrees that to the fullest extent permitted by the law the CONSULTANT's total liability to the CLIENT, and the CLIENT's maximum recourse against the CONSULTANT, for any and all manner of actions, causes of action, claims, injuries, demands, damages (including without limitation punitive, exemplary, indirect or consequential damages), losses, costs or expenses, of any and every kind and nature whatsoever, at law or in equity, in tort, contract, or other legal theory, whatsoever, in any way arising out of or in any way related or connected to this Agreement, the CONSULTANT's services, any communications, representations, warranties or otherwise in respect of same, the project, and/or the Site, including but not limited to the CONSULTANT's negligence, errors, omissions, strict liability, breach of contract, or breach of warranty, shall be absolutely limited and shall not exceed $50,000 (Canadian Dollars) or the total amount of the professional liability insurance amount, whichever is greater.

7.2. **NO SPECIAL OR CONSEQUENTIAL DAMAGES** – The CLIENT and CONSULTANT agree that to the fullest extent permitted by law the CONSULTANT shall not be liable to the CLIENT for any special, indirect, incidental, exemplary, punitive or consequential damages whatsoever, whether or not the CONSULTANT had or should have had knowledge of such damages, and on any theory of liability, whether in contract, strict liability, tort, negligence, or otherwise (including, but not limited to loss of use, loss of opportunity, loss of profits, or business interruption) arising out of or in any way related to this Agreement and/or the Services or any other services provided in connection with this Agreement, whether caused by the CONSULTANT's negligence, errors, omissions, strict liability, breach of contract, breach of warranty or otherwise.

7.3. **INDEMNIFICATION** – The CLIENT agrees to defend, indemnify and hold harmless the CONSULTANT, its directors, officers, employees, agents, subconsultants and subcontractors, from and against any and all manner of actions, injuries, claims, losses, expenses, damages (including without limitation punitive, exemplary, indirect or consequential damages), and costs, including legal fees on a solicitor-client full indemnity basis, and other liabilities, of any and every kind and nature whatsoever, at law or in equity, in tort, contract, or other legal theory, arising out of, or in any way related or connected to any one or more of the following: this Agreement; the Services; the CONSULTANT's reports or recommendations concerning this Agreement; the CONSULTANT's services; the CONSULTANT's presence on project property; the CONSULTANT's communications, representations, warranties or otherwise in respect of same; the presence, release, or threatened release of hazardous substances or pollutants on or from the Site. Notwithstanding the foregoing, the CLIENT shall not indemnify the CONSULTANT against liability for damages to the extent caused solely by the gross negligence or intentional misconduct of the CONSULTANT.

7.4. The CLIENT agrees that Section 13 of this Agreement, and all limitations, exclusions and indemnifications in respect of the CONSULTANT's liability, Services, or Work Product under this Agreement, including but not limited to waivers of damages and indemnifications by the CLIENT to the CONSULTANT, shall extend to and be for the benefit of those individuals and entities the CONSULTANT retains in connection with performance of the services under this Agreement, including but not limited to CONSULTANT's officers, directors, partners and employees, as well as CONSULTANT's subconsultants and subcontractors. The CLIENT further agrees that it shall make no claims or take any proceedings whatsoever directly against the CONSULTANT's officers, directors, partners and employees, whether the claims arise in contract, tort or otherwise, and whether covered by insurance. The CLIENT further agrees that Section 13 in its entirety shall survive termination of this Agreement for any reason.

8. DOCUMENTS, PATENTS, TRADEMARKS, AND INTELLECTUAL PROPERTY

8.1. The Report, documents and instruments in respect of the CONSULTANT's services, including but not limited to drawings, plans, digital and physical models, designs, specifications, studies, reports (including any drafts of reports), photographs, computer software, concepts, products, or processes if proprietary to the CONSULTANT, surveys, calculations and other data required by the scope of its services, and which were prepared by or on behalf of the CONSULTANT, including those which are deliverables in respect of its services hereunder (collectively, the "**Instruments**"), are the property of the CONSULTANT and the CONSULTANT shall retain the originals thereof, whether the work is completed or not. The CONSULTANT reserves the copyrights in connection with same.

8.2. The CLIENT may not use the Report and such Instruments without having paid all amounts owing to the CONSULTANT. Provided all amounts owing to the CONSULTANT are paid in full: (i) the CLIENT is entitled to keep a copy of the Report and those Instruments as agreed to by the CONSULTANT in writing, and (ii) the CLIENT shall have a non-exclusive license to use the Report and those Instruments as agreed to by the CONSULTANT in writing which relate to or result from the services provided by the CONSULTANT under this Agreement, but solely for purposes for which they were provided by the CONSULTANT under this Agreement. The CONSULTANT is entitled to injunctive relief in respect of the Report and Instruments if it is not paid. The CONSULTANT retains ownership of all patents, trademarks, copyrights, industrial or other intellectual property rights resulting from its services, from the Report and Instruments which are developed or first reduced to practice by the CONSULTANT in the provision of its services. The CLIENT shall not use, infringe or appropriate such proprietary rights without the prior written consent and compensation of the CONSULTANT.

8.3. Use of the Report and Instruments by the CLIENT for purposes other than the purpose for which provided by the CONSULTANT, including but not limited to in connection with the Site project, without notifying the CONSULTANT and without its prior written consent is done so at the sole risk of the CLIENT. In addition to and without limiting the indemnification obligations provided in this Agreement, the CLIENT shall indemnify the CONSULTANT against any and all manner of actions, injuries, claims, losses, expenses, damages (including without limitation punitive, exemplary, indirect or consequential damages), and costs (including legal fees on a solicitor-client full indemnity basis), arising out of, or in any way related or connected to (i) the CLIENT's improper use of the Report and Instruments, and each of them, and (ii) alterations to the Report and Instruments, and each of them, by, on behalf of, and/or at the direction of the CLIENT, without notifying the CONSULTANT and without the CONSULTANT's prior written consent.

8.4. The CONSULTANT shall not be responsible for the consequences of any such improper use and alterations as described herein. In addition to any rights or remedies under this Agreement or at law, the CONSULTANT shall be entitled to compensation for such improper use and alterations and to prevent such improper use and alterations.

APPENDIX B – COMISSIONING READINESS FORMS

FORM A – PRE-COMMISSIONING CHECKLIST

OWNER: _____ **PROJECT:** _____

EQUIPMENT TAG: _____ **EQUIPMENT LOCATION:** _____

EQUIPMENT DESCRIPTION: _____

Pre-Commissioning Requirements Checklist:

- ☐ Reviewed and accepted shop drawings for respective equipment.
- ☐ Vendor wiring diagrams reviewed and accepted.
- ☐ Valid test results, with signoff by Contractor and Engineer as required, for all applicable tests as outlined within the contract.
- ☐ Inspection reports submitted.
- ☐ FAT results submitted.
- ☐ Commissioning facility interruptions, and critical schedules, identified and communicated to all applicable parties.
- ☐ Communications regarding key testing and verifications, and major deficiency resolutions.
- ☐ Applicable process pipes, valves, reducers, expanders, pressure relief/sustaining systems, instrumentation; pumps support and guide system; structural and architectural support systems; electrical and controls wiring; electrical disconnect stations; underground raceway/ ducts; and calibration/tuning has been completed.
- ☐ Equipment pertaining to the control system, control interfaces, communications, and all other relevant components of the new facility can be demonstrated to be operational and meet the specification requirements.
- ☐ Detailed commissioning and testing schedules have been provided. Test schedules include a detailed description of the test to be performed along with proposed start and end dates.
- ☐ Test plans and procedures have been submitted for the Owner's comment and approval at least two weeks prior to commencement of any test procedure based on the provided construction schedule provided by the Contractor.
- ☐ All wiring from instrumentation and electrical systems have been verified back to the control panel, and all equipment is ensured to be wired properly.
- ☐ Utility Transformer information collected, recorded, and submitted to the Engineer.
- ☐ Redlines for install have been completed and are accessible for commissioning.

Pre-Commissioning Requirements Verification Signoff

Completed: _____ _____

Date Contractor Signature

FORM B – MAJOR EQUIPMENT FUNCTIONAL TEST REPORT

OWNER: _____ **PROJECT:** _____

EQUIPMENT TAG: _____ **EQUIPMENT LOCATION:** _____

EQUIPMENT DESCRIPTION: _____

MAKE, MODEL & SERIAL NO. _____

Equipment Technical Verification

Equipment Input Ratings (Voltage, Current, Power, Pressure, Flow)	Equipment Output Ratings (Voltage, Current, Power, Pressure, Flow)	Motor Data	
		Motor Rating (HP)	Motor Voltage and Phase #

YES	N/A	
☐	☐	Circuit breaker / fuse / overprotection devices sizes and settings verified
☐	☐	Field wiring connections verified
☐	☐	Torque values verified
☐	☐	Phase rotation on incoming and outgoing circuits verified
☐	☐	Operation of disconnect levers, interfaces, and mechanical assemblies verified
☐	☐	Safety lockouts for all disconnects and circuits verified
☐	☐	Megger / insulation resistance tests complete for each circuit and motor leads
☐	☐	Grounding and bonding verified
☐	☐	Equipment powered up and calibrated, including voltage checks
☐	☐	Configuration, size, ratings, settings, and operation of starters and drives verified
☐	☐	Power monitoring verified
☐	☐	Forward / reverse rotations verified
☐	☐	Controller and drive settings verified with motor nameplates
☐	☐	Vibrations monitoring complete
☐	☐	Interlocking conditions, including monitoring and controls units operations, verified
☐	☐	Control of device from drive / starter verified
☐	☐	Operation of subsystems required for overall operation of assembly tested
☐	☐	Operation of device through all modes, range of motion, speed, and frequency verified
☐	☐	Operation of equipment during utility / generator transitions, including power ridethroughs
☐	☐	Remote monitoring signals properly generated by unit for termination to PLC / controls

Equipment Verification Signoff

Completed: _____
Date Contractor Signature

Notes / Comments:

_____

_____

_____

FORM C – HVAC FUNCTIONAL TEST REPORT

OWNER: _____ **PROJECT:** _____

EQUIPMENT TAG: _____ **EQUIPMENT LOCATION:** _____

EQUIPMENT DESCRIPTION: _____

MAKE, MODEL & SERIAL NO. _____

Technical Verification

Duct Size	Heating Capacity (kW)	Re-Heat Coils # Rows	Motor Data		Airflow (L/s)	
			Motor Rating (HP)	Motor Voltage and Phase #	Min	Max

Static Checks

- ☐ Inlet discharge ducting complete, with insulation
- ☐ Minimum of four inlet diameters of straight duct at inlet of unit
- ☐ Terminal box properly supported
- ☐ Sufficient service access verified
- ☐ Access door installed on inlet and outlet of reheat coil(s) and accessibility verified
- ☐ Piping and insulation complete

Operational Checks

- ☐ Proper identification installed
- ☐ Balancing complete
- ☐ Air leaks and noise levels acceptable
- ☐ Thermostat operates as per design
- ☐ Unit controls and interlocks from field devices verified
- ☐ Unit controls and interlocks from control systems verified
- ☐ Vendor drawings with field interlocks and connections shown and verified

HVAC Equipment Verification Signoff

Completed: _____ _____
Date Contractor Signature

Notes / Comments:

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_____

FORM D – INSTRUMENT FUNCTIONAL TEST REPORT

This form shall be completed by the Contractor, and is used to verify that all signals are being properly sourced by the instrument and measured in the field prior to testing within the PLC and that the instrument is fully calibrated.

OWNER: _____ **PROJECT:** _____

EQUIPMENT TAG: _____ **EQUIPMENT LOCATION:** _____

EQUIPMENT DESCRIPTION: _____

MAKE, MODEL & SERIAL NO. _____

CSA: _____ **ELEMENT TAG & TYPE:** _____

ADDITIONAL CERTIFICATIONS: _____

Instrument Calibration:

Instrument Power Supply (120 Vac, 24 Vdc)	Relays Configured (List Relays and Functions)	Offsets, Trims, Deadbands (If Non-zero, Identify Values)	Signal End Point Values (Range)	
			Minimum Scaled Engineering Value with Units*	Maximum Scaled Engineering Value with Units*

* Example, min and max scaled values may be 4 mA = X L/s, 20 mA = Y L/s for an analog; OFF = Open, ON = Closed for a digital

- ☐ Set-up wizards, configuration, and parameters completed
- ☐ Resistive checks completed
- ☐ Shield and drain checks completed
- ☐ Remote control / local interface stations provide proper control

Signal Input / Output Range Span Simulation and Verification:

	Percent of Signal Range				
	Test Point 1 0%	Test Point 2* 25%	Test Point 3* 50%	Test Point 4* 75%	Test Point 5 100%
Instrument Target Value (Sourced):					
Field Value (Measured):					

*Note: For digital signals, columns 25%, 50%, and 75% may be deemed Not Applicable (N/A)

Function Test: Equipment Verified to be Calibrated, Configured, and Field Tested

Completed: _____
Date Contractor Signature

Notes / Comments:

_____

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_____

_____

FORM E – DEVICE LOOP CHECK VERIFICATION

This form shall be completed by the Contractor in conjunction with the Programmer, and is used to verify that all signals are being properly input to / output by the PLC, and that the associated equipment is responding correctly.

OWNER: _____ **PROJECT:** _____

EQUIPMENT TAG: _____ **EQUIPMENT LOCATION:** _____

EQUIPMENT DESCRIPTION: _____

Signal Input / Output Information:

PLC Point Type (DI, DO, AI, AO, Comms Cable)	PLC Slot/Channel	Voltage / Current Rating	Wire Tags	Signal End Point Values (Range)	
				Minimum Scaled Engineering Value with Units*	Maximum Scaled Engineering Value with Units*

* Example, min and max scaled values may be 4 mA = X L/s, 20 mA = Y L/s for an analog; OFF = Open, ON = Closed for a digital

Signal Input / Output Range Span Verification:

	Percent of Signal Range				
	Test Point 1 0%	Test Point 2* 25%	Test Point 3* 50%	Test Point 4* 75%	Test Point 5 100%
Field Value:					
PLC Value:					
HMI Value:					
SCADA Value:					

*Note: For digital signals, columns 25%, 50%, and 75% may be deemed Not Applicable (N/A)

I/O Verification at Site Controller and Function Test: Equipment Provides Correct Signals to PLC From Field, and / or Responds Correctly to Voltage / Current Control From PLC

Completed: _____
Date Contractor Signature

Witnessed: _____
Date Programmer Signature

Notes / Comments:

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