
DIVISION 01 – GENERAL REQUIREMENTS

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GENERAL REQUIREMENTS**

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END OF SECTION

WORK RESTRICTIONS

1.0 CONSTRUCTION EXECUTION PLAN

- 1.1 The *Contractor* must submit to the *Consultant* at least ten (10) *Working Days* prior to mobilization, a construction execution plan in an organized digital (pdf) format.
- 1.2 The construction execution plan must describe in detail the plan and schedule to complete the *Project* and manage potential risks and day to day activities, at a minimum, it must include:
 - 1.2.1 Site access, haul routes and constructions staging locations;
 - 1.2.2 Construction sequencing and scheduling, for each phase of *Work*;
 - 1.2.3 Notification templates for residents regarding access and service interruptions;
 - 1.2.4 Access plan for emergency services;
 - 1.2.5 Adherence to the noise bylaw;
 - 1.2.6 Control of dust and mud tracking during construction and non-construction times;
 - (a) The Town will provide water for dust control during the summer months. The *Contractor* is required for handling and storage of water provided by the Town.
 - (b) Dust Control and mud tracking to follow all regulatory requirements including Alberta Transportation.
 - 1.2.7 Erosion and Environmental Plans as described in Section 01 35 43;
 - 1.2.8 Traffic Accommodation Strategy as described in Section 01 55 27;
 - 1.2.9 Pre-construction reporting as described in Section 01 14 00; and
 - 1.2.10 Coordination with shallow utility companies.
 - 1.2.11 Preparation of a temporary servicing and bypass pumping plans.
- 1.3 The *Consultant* and *Owner* will review the construction execution plan and may require additions, increased detail and other edits prior to approval.
- 1.4 All *Work* must comply with the approved construction execution plan.

2.0 PRE-CONSTRUCTION REPORTING

- 2.1 The *Contractor* is responsible for completing thorough pre-construction documentation for each property adjacent to the *Place of the Work*. At a minimum, the pre-construction documentation shall include a digital (pdf) copy of the following:
 - 2.1.1 Photographs labeled with date, location, and direction of view.
 - 2.1.2 Photographs showing the road frontage, house, private property, landscape features, fences, and all other features that are subject to potential damage by the *Contractor*.

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- 2.1.3 Photographs shall clearly document the pre-existing condition of all features including any defects or degradation.
- 2.2 A digital (pdf) copy of the pre-construction documentation is to be provided to the *Consultant* prior to mobilization for retention and distribution to the *Owner*.
- 2.3 Any features not clearly documented will be deemed to have been in pristine condition prior to construction.
- 2.4 The *Contractor* is responsible for all costs arising from claims by home or business owners that can't be defended against due to inadequate or unclear pre-construction documentation.

3.0 NOTIFICATION OF PROPERTY OWNERS AND RESIDENTS

- 3.1 The *Contractor* must provide notification of all service and access disruptions to all property owners and residents affected by the *Work* in accordance with the *Owner's* policies.
- 3.2 Notify, in writing, all property owners and residents affected by proposed construction. The notice shall provide contact names and phone numbers of the *Contractor*. Notification shall be done on a parcel-by-parcel basis, with each occupied business and/or residence contacted one week (7 days) in advance of construction activities. Notification shall be provided by the *Contractor*, to both the landowners and occupants / operators in advance of any access restrictions, or service interruption during the construction. The content and form of the written notification shall first be reviewed by the *Consultant*. The *Contractor* shall incorporate any modifications or comments made by the *Consultant* into the notification form, prior to issuance.
- 3.3 If the *Contractor* fails to provide timely notice as described in this article, the *Contractor* must not proceed with *Work* in the affected area without the *Consultant's* written permission. Any delays incurred by the *Contractor* for failure to notify the property owners and residents will not serve as a reason to extend the *Contract Time*.

4.0 CONSTRUCTION STAGING AREAS

- 4.1 The *Contractor* shall be responsible for the delivery, storage and security of products, materials and equipment.
- 4.2 The *Owner* is not providing any space, outside of the *Place of the Work*, for the *Contractor's* use.
- 4.3 The *Contractor* is to provide to the *Consultant* with proof of Provincial Approval or, Municipal Approval, and landowner agreement prior to using any crown land or private land for any purpose.

5.0 WORK ON PRIVATE PROPERTY

- 5.1 For all *Work* on private land, the *Contractor* must complete the following:
 - 5.1.1 Confirm site specific requirements as per the individual written agreements or easements,

WORK RESTRICTIONS

- 5.1.2 Meet with the landowner to confirm schedule and any site-specific concerns of the landowner, and
- 5.1.3 Restore the private property to conditions similar to the preconstruction conditions.

6.0 SHALLOW UTILITIES

- 6.1 The *Contractor* must coordinate the *Work* with the shallow utility companies and provide adequate notice to the shallow utility companies for lines to be disconnected and/or installed as required to complete the *Work*.

7.0 MATERIAL DISPOSAL

- 7.1 The *Owner* is not providing any location for offsite disposal of surplus material. It is the *Contractor's* responsibility to legally dispose of all surplus material offsite.
- 7.2 The *Contractor* is to provide to the *Consultant* proof of all approvals and agreements prior to using any offsite disposal areas or facilities other than a licensed landfill.
- 7.3 The *Contractor* is responsible for material management and to provide any required stockpile storage as necessary to undertake the *Work*.

8.0 TREE CLEARING

- 8.1 No tree clearing is permitted from February 15 through August 25 unless an active nest survey is conducted by a qualified environmental professional.

9.0 RESIDENT PROXIMITY

- 9.1 The *Owner* has provided a platform to the public to issue complaints. To mitigate complaints during construction, the *Owner* may request the *Contractor* to adjust work including, but not limited to the following:
 - 9.1.1 Improved dust control through watering or other approved method.
 - 9.1.2 Change of equipment to limit vibration and potential damage to offsite properties.
 - 9.1.3 Work hours.

END OF SECTION

1.0 GENERAL

- 1.1 Section 01 22 17 addresses general requirements for Measurement and Payment for all *Items* under the *Schedule of Quantities and Prices*.
- 1.2 All Measurement and Payment provisions under any particular Section are applicable to the same *Items* or components of *Work* involved in other Sections.
- 1.3 All units of measurement for payment will be as given in the *Schedule of Quantities and Prices*. All payments will be based on respective unit or lump prices in the *Schedule of Quantities and Prices*, or for *Change Orders* issued.
- 1.4 Payment for *Items* under the *Schedule of Quantities and Prices* covers supply and installation of *Work* described under the *Items* and referenced by the Measurement and Payment clauses. Payment shall be full compensation for:
 - 1.4.1 The costs of all labour, equipment and material included in or required for the *Work* which, while not specifically listed in the *Schedule of Quantities and Prices*, are included in the *Work* specifically or by necessary inference from the *Scope of Work Documents*;
 - 1.4.2 All assessments payable with respect to labour as required by any statutory scheme such as unemployment insurance, holiday pay, insurance, CPP and all employee benefits and the *Workers' Compensation Act*; and
 - 1.4.3 All overhead costs, including head office, on-site overhead costs and all amounts for the *Contractor's* profit.
- 1.5 No payment will be made for unauthorized *Work* or *Work* beyond the limits shown on the *Contract Drawings*.
- 1.6 Unless specified otherwise, the standard methods of measurement will be as follows:
 - 1.6.1 Lineal measurements will be taken from end to end of the *Item* measured, or as described in individual Measurement and Payment clauses.
 - 1.6.2 Area measurements will be the geometric area calculated from conventionally accepted lineal measurements of applicable dimensions of the area to be measured, or as described in individual Measurement and Payment clauses.
 - 1.6.3 Volume measurements will be made using TIN surface models, based on surveys performed on a maximum 20 m grid, or as described in individual Measurement and Payment clauses or Specifications and Supplementary Specifications.
 - 1.6.4 Weight measurements for *Items* with materials delivered in truckloads shall be scaled and recorded by the *Contractor* on duplicate weigh slips at a certified scale, or as described in individual Measurement and Payment clauses or Specifications and Supplementary Specifications. Weigh slips must be signed by the *Contractor*

at the time of delivery and a copy supplied to the *Consultant* prior to each *Payment Certificate*.

- 1.7 Unless otherwise noted, this *Contract* has been designed and is to be constructed in the S.I. metric system of measurements.
- 1.8 Unless otherwise specified, accuracy of measurement will be to the nearest significant decimal value as given below:
- | | |
|------------------------|------------------------------|
| Length items | 0.1 metre |
| Area items | 0.1 square metre |
| Volume or weight items | 0.1 tonne or 0.1 cubic metre |
| Per unit items | Each |
| Lump sum items | As specified |
- 1.9 References given against each *Item* in the *Schedule of Quantities and Prices*, such as “2.3.4”, refer to articles in this section.
- 1.10 References given against *Items* in the *Schedule of Quantities and Prices*, such as “402.02.01”, refer to City of Calgary Standard Specifications Sub-section 0.1 in Section 402.02.
- 1.11 Conversion factors for cubic metres to tonnes shall be as given below:

Material	Conversion Factor
Pit Run / Sub-base Gravel	2.2 t/m ³
Base Gravel	2.2 t/m ³
Asphalt Pavement	2.4 t/m ³

These conversion factors are not to be used for converting from tonnes to cubic metres.

- 1.12 The following summaries are provided for information only and shall not limit the work required to satisfactorily complete an *Item*.

2.0 MEASUREMENT AND PAYMENT

2.1 General Requirements

2.1.1 Traffic Accommodation

Measurement

Traffic Accommodation shall be measured on a lump sum basis to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for Traffic Accommodation as specified in the *Contract Documents* including traffic management *Consultant*, preparation and approval of a traffic accommodation strategy (TAS), permits as required by

governing authorities, certified flag persons, supply, installation, maintenance and removal of pylons, barriers, lighting, signage, and message and arrow boards, necessary or incidental to implement the TAS and to safely manage traffic for the duration of the *Project*. All traffic control and management shall be done in accordance with the governing authority's specifications.

2.1.2 Mobilization & De-mobilization

Measurement

Mobilization and De-mobilization shall be measured on a lump sum basis to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for Mobilization and De-mobilization as specified in the *Contract Documents* including loading, hauling, and unloading of all labour, materials and equipment to and from the site, permits as required by governing authorities, and fines. No more than 20% of the value of the work can be paid on the first progress payment. No less than 20% of the value of the work can be paid in the final progress claim and will not be paid until Schedule A.5, A.6, and A.7 of the Schedule of Prices have been complete.

2.1.3 Temporary Silt Fence

Measurement

Silt Fence shall be measured on a lineal metre basis at the base of the fence to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for Silt Fence as specified in the *Contract Documents* including supply, delivery, and installation of silt fence, excavation, keying in, maintenance for the duration of the *Contract*, and removal and disposal of silt fence at a suitable site located and paid for by the *Contractor* after *Maintenance Period* completion.

2.1.4 Construction Survey

Measurement

Construction Survey shall be measured on a lump sum basis to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for Construction Survey as specified in the *Contract Documents* including supply and distribution of grade sheets and survey layout for all permanent and temporary construction works, topographic survey of all required information for as-built drawings, topographic survey of all required

information for quantity and grade verification, and removal and disposal of all layout stakes and hubs at a suitable site located and paid for by the *Contractor* upon project completion.

2.1.5 Redline Drawings

Measurement

Redline Drawings shall be measured on a lump sum basis to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for Redline Drawings as specified in the *Contract Documents* including all record information for constructed works including topography, pipe, valves, liner, underdrain, manholes, roads, fencing, etc.

2.1.6 Operations & Maintenance Manuals

Measurement

Operations & Maintenance Manuals shall be measured on a lump sum basis to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for Operations & Maintenance Manuals as specified in the *Contract Documents* which includes providing all data sheets and manuals for products and materials used for construction works.

2.1.7 Overall Systems Testing and Commissioning

Measurement

Overall Systems Testing and Commissioning shall be measured on a lump sum basis to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for Overall Systems Testing and Commissioning as specified in the *Contract Documents* including time, materials, equipment, labour, and any miscellaneous work required for reservoir testing and commissioning for the overall FORW project wide function testing and integration with the pump stations and pipelines.

2.1.8 Erosion and Sediment Control

Measurement

Erosion and Sediment Control shall be measured on a lump sum basis to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for Erosion and Sediment Control as specified in the *Contract Documents* including gravel pad installation, street sweeping and cleaning, track packing of all perimeter slopes following completion of grading, and ongoing ESC Inspections and Reporting by a qualified inspector as per City of Calgary ESC specifications until perimeter slopes are stabilized.

2.2 Earthworks

2.2.1 Topsoil Stripping to Stockpile

Measurement

Topsoil Stripping to Stockpile shall be measured on a cubic metre basis to limits as defined by the *Contract Documents*. The volume excavated will be calculated based on survey of the surfaces before and after stripping operations.

Payment

Payment shall be full compensation for Topsoil Stripping to Stockpile as specified in the *Contract Documents* including excavation, loading, hauling, dust control, placement at stockpile area, levelling, shaping, track packing, and erosion and sediment control of stockpile.

2.2.2 Scarify and Re-compact Embankment Subgrade

Measurement

Scarify and Re-compact Subgrade shall be measured on a square metre basis to limits as defined by the *Contract Documents*. The area will be measured onsite based on surveys of the surfaces before and after excavation operations, or as measured onsite by the Consultant.

Payment

Payment shall be full compensation for Scarify and Re-compact Subgrade as specified in the *Contract Documents* including scarification, re-compaction to specified density, excavation, dust control, dewatering, loading, and hauling. No payment will be made for scarification and re-compaction in cut areas.

2.2.3 Undercut and Replace with Suitable Onsite Fill (Optional)

Measurement

Undercut and Replace with Suitable Onsite Fill (Optional) shall be measured on a cubic metre basis to limits as defined by the Consultant. The volume excavated

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will be calculated based on surveys of the surfaces before and after excavation operations, or as measured by the Consultant.

Payment

Payment shall be full compensation for Undercut and Replace with Suitable Onsite Fill (Optional) as specified in the *Contract Documents* including excavation, dewatering, dust control, loading, hauling and disposing of excavated soil at a suitable onsite location, supply and placement of suitable fill as specified, grading to specified tolerance, moisture conditioning, dust control, dewatering, dust control, compaction, and proof rolling.

2.2.4 Common Excavation to Embankment (Zone 1 Clay)

Measurement

Common Excavation to Embankment (Zone 1 Clay) shall be measured on a cubic metre basis to limits as defined by the *Contract Documents*. The volume excavated will be calculated based on surveys of the surfaces before and after excavation operations.

Payment

Payment shall be full compensation for Common Excavation to Embankment (Zone 1 Clay) as specified in the *Contract Documents* including excavation, loading, hauling, placement, grading to specified tolerance, dust control, dewatering, keying-in slopes, moisture conditioning, and compaction.

2.2.5 Common Excavation to Stockpile (Zone 2 Fill)

Measurement

Common Excavation to Stockpile (Zone 2 Fill) shall be measured on a cubic metre basis to limits as defined by the *Contract Documents*. The volume excavated will be calculated based on surveys of the surfaces before and after excavation operations.

Payment

Payment shall be full compensation for Common Excavation to Embankment (Zone 2 Fill) as specified in the *Contract Documents* including excavation, loading, hauling, dewatering, dust control, placement, dust control, and dewatering.

2.2.6 Import Suitable Clay to Embankment (Zone 1 Clay)

Measurement

Import Suitable Clay to Embankment (Zone 1 Clay) shall be measured on a cubic metre basis to limits as defined by the *Contract Documents*. The volume placed will be calculated based on surveys of the surfaces before and after import operations.

Payment

Payment shall be full compensation for Import Suitable Clay to Embankment (Zone 1 Clay) as specified in the *Contract Documents* including locating and paying for source of acceptable fill, road permits, loading, hauling, placement, grading to specified tolerance, keying-in slopes, dust control, moisture conditioning, and compaction.

2.2.7 Common Stockpile to Embankment (Zone 2 Fill)

Measurement

Common Stockpile to Embankment (Zone 2 Fill) shall be measured on a cubic metre basis to limits as defined by the *Contract Documents*. The volume excavated will be calculated based on surveys of the surfaces before and after excavation operations.

Payment

Payment shall be full compensation for Common Stockpile to Embankment (Zone 2 Fill) as specified in the *Contract Documents* including excavation, loading, hauling, placement, grading to specified tolerance, dust control, dewatering, keying-in slopes, moisture conditioning, and compaction.

2.2.8 Import to Stockpile from TCL Gravel (Optional)

Measurement

Import to Stockpile from TCL Gravel (Optional) shall be measured on a cubic metre basis to limits as defined by the *Contract Documents*. The volume placed will be calculated based on surveys of the surfaces before and after import operations.

Payment

Payment shall be full compensation for Import to Stockpile from TCL Gravel (Optional) as specified in the *Contract Documents* including locating and paying for source of acceptable fill, road permits, excavation, loading, hauling, placement, moisture conditioning, compaction, dust control, and dewatering.

2.2.9 Topsoil Stockpile to Embankment

Measurement

Topsoil Stockpile to Embankment shall be measured on a cubic metre basis to limits as defined by the *Contract Documents*. The volume excavated will be calculated based on surveys of the surfaces before and after excavation operations.

Payment

Payment shall be full compensation for Topsoil Stockpile to Embankment as specified in the *Contract Documents* including excavation, loading, hauling, placement, grading to specified tolerance, keying-in slopes, placement, dust control, dewatering, removal of rocks, sod, and debris, moisture conditioning, and compaction or track-packing.

2.2.10 Topsoil Export (Optional)

Measurement

Topsoil Export shall be measured on a cubic metre basis to limits as defined by the *Contract Documents*. The volume exported will be calculated based on surveys of the surfaces before and after excavation operations.

Payment

Payment shall be full compensation for Topsoil Export as specified in the *Contract Documents* including excavation, loading, hauling, road permits dewatering, dust control, and disposal of topsoil at a suitable site located and paid for by the *Contractor*.

2.2.11 Type 'A' Rock Excavation (Optional)

Measurement

Type 'A' Rock Excavation (Optional) shall be measured on a cubic metre basis to limits as defined by the *Contract Documents*. Volumes shall be calculated using field measurements as agreed upon between the *Contractor* and the *Consultant*. Type 'A' Rock shall be defined as material that can be ripped or excavated with a ripper, regardless of excavator class, size, or configuration.

Payment

Payment shall be full compensation for Type 'A' Rock Excavation (Optional) as specified in the *Contract Documents* including excavation, additional wear on equipment, ripping, breaking of the rock for reuse in embankment, loading, dust control, dewatering, hauling, and disposal of rock at a suitable location.

2.2.12 Type 'B' Rock Excavation (Optional)

Measurement

Type 'B' Rock Excavation (Optional) shall be measured on a cubic metre basis to limits as defined by the *Contract Documents*. Volumes shall be calculated using field measurements as agreed upon between the *Contractor* and the *Consultant*. Type 'B' Rock shall be defined as material requiring pneumatic hammering or blasting to remove.

Payment

Payment shall be full compensation for Type 'B' Rock Excavation (Optional) as specified in the *Contract Documents* including excavation, additional wear on equipment, ripping, breaking of the rock for reuse in embankment, loading, dust control, dewatering, hauling, and disposal of rock at a suitable location.

2.2.13 Standpipe Piezometers

Measurement

Standpipe Piezometers shall be measured on a per unit basis to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for Standpipe Piezometers as specified in the *Contract Documents* including supply and installation of piezometers which includes drilling of borehole, pipe installation to specified depth, sand and bentonite placement, standpipe stickup protector, and detailed record of installations.

2.2.14 Slope Inclinometers

Measurement

Slope Inclinometers shall be measured on a per unit basis to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for Slope Inclinometers as specified in the *Contract Documents* including supply and installation of Slope Inclinometers which includes drilling borehole to required depth, inclinometer casing install, correctly orienting, grout in the borehole annulus, filling casing with water during grouting, instrument enclosure install, backfill, acceptance testing, and detailed records of installation.

2.3 Liner Underdrain and Venting

2.3.1 Underdrain Pipe and Fittings

Measurement

Underdrain Pipe and Fittings shall be measured in lineal metres for each combination of pipe size, material type, depth category, pipe classification, and location to limits as defined by the *Contract Documents*. Lengths of fittings will not be deducted from the total length of pipe.

Payment

Payment shall be full compensation for Underdrain Pipe and Fittings as specified in the *Contract Documents* including supply and installation of pipe including

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bedding, drain rock, flushing, excavation, trenching, shoring, backfilling, dewatering, moisture conditioning, compaction, geotextile filter fabric, testing, and commissioning as needed. Also includes supply and installation of all fittings including bends, elbows, reducers, sweeps, risers, caps, tees, wyes, crosses, or other specified fittings, and bedding, flushing, excavation, trenching, dewatering, shoring, backfilling, moisture conditioning, compaction, and geotextile filter fabric.

2.3.2 Manhole (Type 5-A)

Measurement

Manhole shall be measured on a per unit basis to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for Manhole as specified in the *Contract Documents* including supply and installation of manhole base, slab top, collars, riser rings, frame, cover, gaskets, and bedding, connections to pipes, setting of appurtenances to final grade, benching, channelling, sealing, coring, patching, flushing, excavation, trenching, shoring, backfilling, dewatering, moisture conditioning, compaction, testing, infiltration and exfiltration testing, commissioning, and dewatering.

2.3.3 1200mm Manhole Barrel

Measurement

1200mm Manhole Barrel shall be measured in metres vertically from the lowest invert to the finished rim elevation for Type 5-A Manholes to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for 1200mm Manhole Barrel as specified in the *Contract Documents* including supply and installation of manhole barrels, ladder rungs, and gaskets, connections to pipes, sealing, coring, patching, dewatering, flushing, excavation, trenching, shoring, backfilling, moisture conditioning, compaction, testing, and commissioning and dewatering.

2.3.4 HydraNet Geo-Composite Membrane (Purchase and Delivery Date Confirmed)

Measurement

HydraNet Geo-Composite Membrane (Purchase and Delivery Date Confirmed) shall be measured in square metres to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for HydraNet Geo-Composite Membrane (Purchase and Delivery Date Confirmed) as specified in the *Contract Documents* including supply of geo-composite, joints, fasteners, and any other material required for installation. The *Contractor* shall be paid material supply costs upon material procurement and delivery date confirmation.

2.3.5 HydraNet Geo-Composite Membrane (Installation)

Measurement

HydraNet Geo-Composite Membrane (Installation) shall be measured in square metres to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for HydraNet Geo-Composite Membrane (Installation) as specified in the *Contract Documents* including installation per manufacture specifications, joints, testing as needed, fastening, and dewatering.

2.3.6 Liner Vent Flaps

Measurement

Liner Vent Flaps shall be measured on a per unit basis to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for Liner Vent Flaps as specified in the *Contract Documents* including supply, installation per manufacture specifications, sealing, testing as needed, and connections to HydraNet geo-composite membrane.

2.4 Liner

2.4.1 Subgrade Preparation

Measurement

Sub-grade Preparation shall be measured on a square metre basis to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for Sub-grade Preparation as specified in the *Contract Documents* including scarifying to the depth specified from design sub-grade, fine grading to specified tolerance, moisture conditioning, and compaction.

2.4.2 Subgrade Undercuts (Optional)

Measurement

Subgrade Undercuts (Optional) shall be measured on a cubic metre basis to limits as defined by the *Consultant*. The volume excavated will be calculated based on surveys of the surfaces before and after excavation operations, or as measured by the *Consultant* in cut areas only.

Payment

Payment shall be full compensation for Subgrade Undercuts (Optional) as specified in the *Contract Documents* including excavation, loading, hauling and disposing of excavated soil at a suitable location onsite, supply and placement of suitable fill as specified, grading to specified tolerance, moisture conditioning, dewatering, dust control, and compaction.

2.4.3 Non-Woven Geotextile Fabric

Measurement

Non-Woven Geotextile Fabric shall be measured on a square metre basis to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for Non-Woven Geotextile Fabric as specified in the *Contract Documents* including supply and installation of geotextile and fasteners, excavation and backfill of key trench, dewatering, keying in, overlaps and joints as per manufacturer's specifications.

2.4.4 Liner (EL6060) (Purchase and Delivery Date Confirmed)

Measurement

Liner (EL6060) (Purchase and Delivery Date Confirmed) shall be measured on a square metre basis to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for Liner (EL6060) (Purchase and Delivery Date Confirmed) as specified in the *Contract Documents* including supply of liner and fasteners, and any materials required for liner installation. The *Contractor* shall be paid material supply costs upon material procurement and delivery date confirmation.

2.4.5 Liner (EL6060) (Installation)

Measurement

Liner (EL6060) (Installation) shall be measured on a square metre basis to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for Liner (EL6060) (Installation) as specified in the *Contract Documents* including installation of liner and fasteners, excavation and backfill of key trench, anchor trench, keying in, dewatering, testing, quality control, overlaps and joints as per manufacturer's specifications, and puddle testing.

2.4.6 HDPE Safety Ladders and Bollards

Measurement

HDPE Safety Ladders and Bollards shall be measured on a per unit basis to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for HDPE Safety Ladders and Bollards as specified in the *Contract Documents* including supply and installation of all materials as per manufacturer's specifications, including overlaps and joints, fasteners, bollards, hardware, testing, quality control, excavation or drilling of post holes, backfill, and compaction.

2.4.7 Liner Penetrations

Measurement

Liner Penetrations shall be measured on a per unit basis to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for Liner Penetrations as specified in the *Contract Documents* including supply and installation as per manufacturer's specifications, extrusion welds, extrusion weld to pipe, sealing, and fastening.

2.5 Fill, Equalization, and Intake Water Piping

2.5.1 Pipeline and Fittings

Measurement

Pipeline and Fittings shall be measured in lineal metres for each combination of pipe size, material type, pipe classification, and location to limits as defined by the *Contract Documents*. Lengths of fittings will not be deducted from the total length of pipe.

Payment

Payment shall be full compensation for Pipeline and Fittings as specified in the *Contract Documents* including supply and installation of pipe and bedding, flushing, pressure testing where applicable, infiltration and exfiltration testing

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where applicable, excavation, trenching, shoring, backfilling, moisture conditioning, compaction, and dewatering. Also includes all fittings supply and installation including bends, elbows, reducers, sweeps, caps, tees, liner penetrations. other fittings as needed, concrete thrust blocks, bearing blocks, cathodic protection, and bedding, flushing, pressure testing, excavation, trenching, shoring, backfilling, moisture conditioning, compaction, and dewatering.

2.5.2 Pipeline and Fittings (Installation of Owner Supplied Pipe)

Measurement

Pipeline and Fittings (Installation of Owner Supplied Pipe) shall be measured in lineal metres for each combination of pipe size, material type, pipe classification, and location to limits as defined by the *Contract Documents*. Lengths of fittings will not be deducted from the total length of pipe.

Payment

Payment shall be full compensation for Pipeline and Fittings (Installation of Owner Supplied Pipe) as specified in the *Contract Documents* including installation of pipe and bedding, pressure testing, excavation, trenching, shoring, backfilling, moisture conditioning, compaction, and dewatering. Also includes all fittings supply and installation including bends, elbows, reducers, sweeps, caps, tees, liner penetrations. other fittings as needed, concrete thrust blocks, bearing blocks, cathodic protection, and bedding, flushing, pressure testing, excavation, trenching, shoring, backfilling, moisture conditioning, compaction, and dewatering. Pipe supplied by Owner, fittings supplied by Contractor.

2.5.3 600mm Fullport Plug Valves (Direct Bury) (Purchase and Delivery Date Confirmed)

Measurement

600mm Fullport Plug Valves (Direct Bury) (Purchase and Delivery Date Confirmed) shall be measured on a per unit basis to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for 600mm Fullport Plug Valves (Direct Bury) (Purchase and Delivery Date Confirmed) as specified in the *Contract Documents* including supply of valve, top box, bottom box, casing, valve rod, and extensions. The *Contractor* shall be paid material supply costs upon material procurement and delivery date confirmation.

2.5.4 600mm Fullport Plug Valves (Direct Bury) (Installation)

Measurement

600mm Fullport Plug Valves (Direct Bury) (Installation) shall be measured on a per unit basis to limits as defined by the *Contract Documents*.

MEASUREMENT AND PAYMENT

Payment

Payment shall be full compensation for 600mm Fullport Plug Valves (Direct Bury) (Installation) as specified in the *Contract Documents* including installation of valve, top box, bottom box, casing, valve rod, extensions, cap, concrete thrust blocks, bearing blocks, cathodic protection, and bedding, setting of appurtenances to final grade, flushing, pressure testing, excavation, trenching, shoring, backfilling, moisture conditioning, compaction, and dewatering.

2.5.5 500mm Fullport Plug Valves (Direct Bury) (installation of Owner Supplied Valve)

Measurement

500mm Fullport Plug Valves (Direct Bury) (Installation of Owner Supplied Valve) shall be measured on a per unit basis to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for 500mm Fullport Plug Valves (Direct Bury) (Installation of Owner Supplied Valve) as specified in the *Contract Documents* including installation of valve, top box, bottom box, casing, valve rod, extensions, cap, concrete thrust blocks, bearing blocks, cathodic protection, and bedding, setting of appurtenances to final grade, flushing, pressure testing, excavation, trenching, shoring, backfilling, moisture conditioning, compaction, and dewatering. Valve supplied by Owner, appurtenances and fittings supplied by Contractor.

2.5.6 Watermain Tie-in

Measurement

Watermain Tie-in shall be measured on a per unit basis to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for Watermain Tie-in as specified in the *Contract Documents* including locating and exposing existing pipelines, tie-in to existing pipelines, supply and installation of fittings as specified or required for tie-in, bedding, cutting and removal of existing caps as required, removal of existing thrust block as needed, restrained couplings, flushing, pressure testing, excavation, trenching, shoring, backfilling, moisture conditioning, compaction, and dewatering.

2.5.7 Flushing, Mandrel Testing and Video Inspection (CCTV)

Measurement

Flushing, Mandrel Testing and Video Inspection shall be measured on a lump sum basis to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for Flushing, Mandrel Testing and Video Inspection as specified in the *Contract Documents* including complete inspection and acceptance as per the Town's requirements, flushing, cleaning, debris removal and dewatering of mains and manholes, mandrel testing, supply of two copies of the video report and inspection report for all fill piping. The *Certificate of Substantial Performance* will not be issued until Flushing, Mandrel Testing and Video Inspection has been completed, and all resulting deficiencies have been corrected.

2.6 Intake Structure and Screen

2.6.1 Intake Screen (Purchase and Delivery Date Confirmed)

Measurement

Intake Screen (Purchase and Delivery Date Confirmed) shall be measured on a per unit basis to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for Intake Screen (Purchase and Delivery Date Confirmed) as specified in the *Contract Documents* including supply of screen, fastening, mounting hardware, and supports. The *Contractor* shall be paid material supply costs upon material procurement and delivery date confirmation.

2.6.2 Intake Screen (Installation)

Measurement

Intake Screen (Installation) shall be measured on a per unit basis to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for Intake Screen (Installation) as specified in the *Contract Documents* including supply and installation of the screen, fastening, mounting hardware, supports, pipe connection, flushing, testing, commissioning, and liner sealing.

2.6.3 Concrete Intake Structure Design, Supply, and Installation

Measurement

Concrete Intake Structure Design, Supply and Installation shall be measured on a lump sum basis to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for Concrete Intake Structure Design, Supply and Installation as specified in the *Contract Documents* including design signed

and sealed by a professional engineer registered with APEGA, supply, and installation including rebar, form work as needed, concrete, compressive strength testing as needed, mounting hardware, intake screen fastening, subgrade preparation, bedding, compaction, and liner sealing.

2.7 Reservoir Access Roads (6m Width)

2.7.1 Sub-grade Preparation

Measurement

Sub-grade Preparation shall be measured on a square metre basis to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for Sub-grade Preparation as specified in the *Contract Documents* including scarifying to 250mm depth from design sub-grade, fine grading to specified tolerance, moisture conditioning, compaction, dust control, dewatering, and proof rolling.

2.7.2 Granular Sub-base and Base

Measurement

Granular Sub-base and Base shall be measured on a square metre basis to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for Granular Sub-base (150mm depth) and Base (100mm depth) as specified in the *Contract Documents* including supply and placement of granular sub-base and/or granular base, grading to specified tolerance, moisture conditioning, compaction, and proof rolling.

2.7.3 Geoweb Spillway/Road Armouring c/w Non-woven Geotextile

Measurement

Geoweb Spillway/Road Armouring c/w Non-woven Geotextile shall be measured on a square metre basis to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for Geoweb Spillway/Road Armouring c/w Non-woven Geotextile as specified in the *Contract Documents* including excavation, grading, supply and placement of Geoweb, geotextile, infill aggregate, high-flow low-strength cement grout over filled Geoweb, and final grading.

2.7.4 Rip Rap Armouring

MEASUREMENT AND PAYMENT

Measurement

Rip Rap and Geotextile shall be measured on a square metre basis to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for Rip Rap and Geotextile as specified in the *Contract Documents* including excavation, grading, supply and placement of geotextile and rip rap material, and final grading.

2.7.5 Undercuts – For Road and Subgrade Reinforcement (Optional)

Measurement

Undercuts – For Road and Subgrade Reinforcement (Optional) shall be a cash allowance to limits as defined by the *Consultant*. The volume excavated will be calculated based on surveys of the surfaces before and after excavation operations, or as measured by the *Consultant* in cut areas only. No payment will be made for undercuts in fill areas.

Payment

Payment shall be full compensation for Undercuts – For Road and Subgrade Reinforcement (Optional) as specified in the *Contract Documents* including excavation, loading, hauling and disposing of excavated soil at a suitable site located and paid for by the *Contractor*, supply and placement of imported aggregate or soil as specified, grading to specified tolerance, moisture conditioning, compaction, and proof rolling.

2.8 Landscaping and Restoration

2.8.1 Hydro-Seeding

Measurement

Hydro Seeding shall be measured on a square metre basis to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for Hydro Seeding as specified in the *Contract Documents* including supply and application of seed mix, water, hydro-mulch, fertilizer, and tackifier, and seed purity testing.

2.8.2 Landscape Maintenance

Measurement

Landscape Maintenance shall be measured on a month basis to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for Landscape Maintenance as specified in the *Contract Documents* including weed treatment and removal, mowing, water as needed, redo hydro-seed as needed, redo hydro-mulch as needed, add more fertilizer as needed, and tackifier as needed.

2.8.3 Topsoil Placement from Stockpile

Measurement

Topsoil Placement from Stockpile shall be measured on a cubic metre basis to limits as defined by the *Contract Documents*. The volume excavated will be calculated based on surveys of the surfaces before and after excavation operations.

Payment

Payment shall be full compensation for Topsoil Placement from Stockpile as specified in the *Contract Documents* including excavation, loading, hauling, placement, grading to specified tolerance, keying-in slopes, placement, dust control, dewatering, removal of rocks, sod, and debris, moisture conditioning, and compaction or track-packing.

2.8.4 Grass Swale Fine Grading

Measurement

Grass Swale Fine Grading shall be measured on a lineal metre basis to limits as defined by the *Contract Documents*.

Payment

Payment shall be full compensation for Grass Swale Fine Grading as specified in the *Contract Documents* including ditching, fine grading, compaction, dust control, and dewatering.

2.9 Fencing

2.9.1 2.4m Chain Link Fence c/w Security Top

Measurement

2.4m Chain Link Fence c/w Security Top shall be measured on a lineal metre basis to limits as defined by the *Contract Documents*. All measurements shall be taken along the base of the fence after installation.

Payment

Payment shall be full compensation for 2.4m Chain Link Fence c/w Security Top as specified in the *Contract Documents* including supply and installation of all fence materials as specified in the *Contract Documents*, excavation or drilling of

MEASUREMENT AND PAYMENT

post holes, concrete bases, construction of fence, fence mesh and barbed wire, supports and bracing, application of finishes, backfill, compaction, and clean up.

2.9.2 Steel Post and Chain Fence

Measurement

Steel Post and Chain Fence shall be measured on a lineal metre basis to limits as defined by the *Contract Documents*. All measurements shall be taken along the base of the fence after installation.

Payment

Payment shall be full compensation for Steel Post and Chain Fence as specified in the *Contract Documents* including supply and installation of all fence materials as specified in the *Contract Documents*, excavation or drilling of chain post holes, concrete bases, construction of fence, chain, supports and bracing, dome top, application of finishes, backfill, compaction, and clean up.

END OF SECTION

PROJECT MEETINGS

1.0 PRE-CONSTRUCTION MEETING

- 1.1 Following Contract award, the *Consultant* will request a pre-construction meeting of the parties to the *Contract* to discuss and resolve administrative procedures and responsibilities.
- 1.2 Representatives of the *Owner*, *Consultant*, *Contractor*, any major *Subcontractors*, field inspectors, supervisors and surveyors shall be in attendance.
- 1.3 After the time and location of this meeting has been established, the *Contractor* shall notify all concerned parties a minimum four days before the meeting.
- 1.4 The *Consultant* shall chair and record discussions and decisions and circulate the meeting notes to all parties concerned.

2.0 PROGRESS MEETINGS

- 2.1 The *Consultant* shall schedule, chair and administer progress meetings throughout the progress of the *Work*, as required.
- 2.2 Representatives of the *Contractor*, and any *Subcontractors* and *Suppliers* attending meetings, must be qualified and authorized to act on behalf of the party each represents.

END OF SECTION

SUBMITTALS PROCEDURES

1.0 SHOP DRAWINGS

- 1.1 *Shop Drawings* are to clearly indicate materials, methods of construction and attachment of anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of the *Work*. Where articles or equipment attach or connect to other articles or equipment, clearly indicate that all such attachments and connections have been properly coordinated, regardless of the trade under which the adjacent articles or equipment will be supplied and installed. *Shop Drawings* are to indicate their relationship to *Drawings* and *Specifications*. Notify the *Consultant* in writing of any deviations in *Shop Drawings* from the requirements of the *Contract Documents*. Submit digital copy of *Shop Drawings* only. Hard copy submissions of *Shop Drawings* will not be reviewed.
- 1.2 Shop drawing file names must use the following format:
- Division Number.Shop Drawing Number_Section Reference_Title_Revision
- For example, a vertical turbine pump shop drawing could be named:
- 43.01_43 21 40_Vertical Turbine Pumps_Rev.0
- 1.3 *Shop Drawings* not stamped, signed and dated by the *Contractor* will be returned without being reviewed and will be stamped "Re-submit".
- 1.4 Failure to submit *Shop Drawings* in a timely manner shall not be considered sufficient reason for an extension to the *Contract Time*.
- 1.5 *Shop Drawings* will be returned to the *Contractor* with one of the following notations:
- 1.5.1 When stamped "NO EXCEPTIONS TAKEN", distribute additional copies as required for execution of the *Work*.
- 1.5.2 When stamped "REVIEWED AS MODIFIED - PROCEED", ensure that all copies for use are modified and distributed, same as specified for "NO EXCEPTIONS TAKEN".
- 1.5.3 When stamped REVISE & RE-SUBMIT", make the necessary revisions, as indicated, consistent with the *Contract Documents* and submit again for review.
- 1.5.4 When stamped "NOT REVIEWED", submit other drawings, brochures, etc. for review consistent with the *Contract Documents*.
- 1.5.5 Only *Shop Drawings* bearing "NO EXCEPTIONS TAKEN" or "REVIEWED AS MODIFIED - PROCEED" shall be used on the *Work* unless otherwise authorized by the *Consultant*.
- 1.6 After submittals are stamped "NO EXCEPTIONS TAKEN" or "REVIEWED AS MODIFIED - PROCEED", no further revisions are permitted unless re-submitted to the *Consultant* for further review.
- 1.7 Any adjustments made on *Shop Drawings* by the *Consultant* are not an authorization to change the *Contract Price*. If it is considered that such adjustments affect the *Contract*

SUBMITTALS PROCEDURES

Price, the *Contractor* shall clearly state as such, in writing, and obtain the *Owner's* agreement prior to proceeding with fabrication and installation of *Work*.

- 1.8 The *Contractor* shall make changes in *Shop Drawings* which the *Consultant* may require that are consistent with the *Contract Documents*. When re-submitting, notify the *Consultant* in writing of any revisions other than those requested by the *Consultant*.
- 1.9 The *Consultant's* review 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 the same. Review by the *Consultant* shall not relieve the *Contractor* of its responsibility for errors or omissions in the *Shop Drawings* or of its 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.

2.0 SAMPLES

- 2.1 Submit samples for the *Consultant's* review as specified or as the *Consultant* may reasonably request. Clearly label samples as to origin and intended use in the *Work*. Reference samples to *Contract Documents*.
- 2.2 Submit samples with reasonable promptness and in orderly sequence so as to cause no delay in the *Work*.
- 2.3 Notify the *Consultant* in writing, at the time of submission, of any deviations in samples from requirements of *Contract Documents*.
- 2.4 The *Consultant's* review will be for conformity of design concept and general arrangement only. Such review is not to be considered relief of responsibility for errors or omissions in samples or of responsibility for meeting all requirements of the *Contract Documents*.
- 2.5 Make changes in samples which the *Consultant* may require consistent with *Contract Documents*.

3.0 OPERATING/MAINTENANCE MANUALS

- 3.1 Not less than four (4) weeks prior to the scheduled *Ready-for-Takeover* date, the *Contractor* must submit to the *Consultant* a digital copy (in indexed pdf format) of operating and maintenance manuals containing information required by the *Specifications*. Revise the digital copy of the manual as directed by the *Consultant* and provide the *Owner* with an updated digital copy and four (4) hard copies. At least one hard copy of the operation and maintenance manual must be on site before proceeding with *Commissioning*. All instructions in the manuals shall be in simple language to guide the *Owner* in the proper operation and maintenance of the installation.

SUBMITTALS PROCEDURES

- 3.2 Bind contents in a three-ring, hard covered, plastic jacketed binder. Organize contents into applicable sections of work, parallel to *Specifications* break-down. Name of facility to be embossed onto binder cover.
- 3.3 In addition to information called for in the *Specifications*, include the following:
 - 3.3.1 Title sheet, labeled "Operation and Maintenance Instructions", and containing project name and date.
 - 3.3.2 List of contents.
 - 3.3.3 Reviewed *Shop Drawings* of all equipment.
 - 3.3.4 As-built drawings of all mechanical, electrical, control, and alarm installations.
 - 3.3.5 Full description of entire mechanical, electrical, control, and alarm system and operation.
 - 3.3.6 Names, addresses and telephone numbers of all major *Subcontractors* and *Suppliers*.
 - 3.3.7 Operating instructions for all equipment.
 - 3.3.8 Maintenance and troubleshooting instructions for all equipment, including frequency of maintenance tasks. All routine maintenance tasks and frequencies to be summarized in one section within the operating and maintenance manual.
 - 3.3.9 Equipment parts lists.
 - 3.3.10 Emergency operating procedures.
 - 3.3.11 Certified head/capacity curves for pumps.
- 3.4 Each section shall be separated from the preceding section with a plasticized cardboard divider with a tab denoting contents of the section.

4.0 RECORD DRAWINGS AND SURVEY

- 4.1 Following *Notice of Award*, the *Consultant* will provide a complete set of *Contract Drawings* for the purpose of maintaining "as-built" record drawings. Accurately record deviations from *Contract Documents* caused by site conditions and changes approved by the *Consultant*. Update as required and at intervals not exceeding one month.
- 4.2 Identify drawings as "Project Record Copy". Maintain in good condition and make available for inspection on site by *Consultant* at all times.
- 4.3 Not less than two (2) weeks prior to application for *Ready-for-Takeover* submit record drawings to *Consultant* for review. Provide the *Consultant* with a clearly legible hand marked as-constructed set of *Drawings* and an as-constructed 3D digital topographic survey compatible with the most recent version of AutoCAD in UTM NAD 83 local zone coordinates and a PNEZD comma delimited survey point file, including a complete and accurate record of the details and precise locations of the *Work* as they have been

SUBMITTALS PROCEDURES

constructed in relation to the legal boundaries of the property or easement. The record shall include:

- 4.3.1 confirmation of all material sizes, types and classifications;
- 4.3.2 locations and inverts of all installed watermains, sewer mains, reclaimed watermains, culverts, storm sewers and other utilities;
- 4.3.3 locations and profiles of all relocated watermains, storm sewers and other utilities;
- 4.3.4 locations, sizes and inverts of all existing services and utilities exposed during the course of the construction; and horizontal alignments of curbs, sidewalks and line painting that are constructed or reinstated.
- 4.3.5 location of surface features including building corners, building aprons, building overhangs, fencing, access roads, utility poles, transformers, kiosks, utility vaults, valve boxes, manhole lids, trees, shrubs, signs, retaining walls, ditches, top of slope, bottom of slope and open raw land ground shots taken on a 2 m grid.

5.0 PHOTOGRAPHS AND PUBLICITY

- 5.1 No press or publicity releases will be permitted without approval of the *Consultant*.

END OF SECTION

ENVIRONMENTAL PROCEDURES

1.0 GENERAL

1.1 Fires

1.1.1 Fires and burning of rubbish on site are not permitted.

1.2 Disposal of Wastes

1.2.1 Do not bury rubbish and waste materials on site unless approved by the *Consultant*.

1.2.2 Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner into watercourses, storm or sanitary sewers.

1.3 Drainage

1.3.1 Prepare and submit an Erosion and Sediment Control Plan prepared by a qualified Environmental Professional or another qualified party acceptable to the *Owner*.

1.3.2 Provide temporary drainage and dewatering pumping system as necessary to keep excavations and site free from water.

1.3.3 Do not discharge water containing suspended materials into watercourses, sewer or drainage systems.

1.3.4 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with Federal, Provincial and Municipal requirements.

1.4 Site Clearing and Plant Protection

1.4.1 Protect existing trees and plants / shrubs on site and on adjacent properties except as indicated otherwise by *Contract Documents*. Carefully wrap all trees with burlap and encase with substantial timbers to a height of minimum 2.5 m where adjacent to construction work, material storage areas, and vehicle lanes. Similarly protect plants.

1.4.2 Protect roots during excavation and grading to minimize possible disturbance and damage. Do not allow traffic, vehicles and equipment to compact soil over tree and plant root systems.

1.4.3 Minimize stripping of topsoil and vegetation.

1.4.4 No tree removal will be permitted, unless otherwise indicated or designated by the *Consultant*.

1.5 Work Adjacent to Watercourses

1.5.1 Do not operate *Construction Equipment* in watercourses.

1.5.2 Do not use watercourse beds for borrow material without approval from Federal, Provincial and Municipal authorities.

1.5.3 Do not dump excavated fill, waste material or debris in or adjacent to watercourses.

ENVIRONMENTAL PROCEDURES

- 1.5.4 Design and construct temporary crossings to minimize erosion to watercourses.
- 1.5.5 Do not skid logs or construction materials across watercourses.
- 1.5.6 Avoid spawning beds when constructing temporary crossings of watercourses.
- 1.5.7 Do not blast under water or within 100 m of spawning beds without approval from Federal, Provincial and Municipal authorities.
- 1.6 Pollution Control
 - 1.6.1 Maintain temporary erosion and pollution control features installed under this *Contract*.
 - 1.6.2 Control emissions from equipment and plant to local authorities' emission requirements.
 - 1.6.3 Prevent sandblasting and other extraneous materials from contaminating air beyond application area, by providing temporary enclosures.
 - 1.6.4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. *Provide* dust control for temporary roads.
- 1.7 ECO Plan
 - 1.7.1 The *Contractor* will prepare an ECO Plan for the *Contractor's* work related to the *Project* in accordance with the most current version of The City of Calgary's Environmental Construction Operations (ECO) Plan Framework and be in compliance with applicable *Construction Laws* and environmental permits.
 - 1.7.2 The ECO Plan must address all environmental conditions and sensitivities including, but not limited to, erosion control measures under the *Contractor's* control during the *Project*, statutory and regulatory requirements and appropriate mitigation measures to address risks identified in the *Contract Documents*.
 - 1.7.3 The *Consultant* will review the ECO Plan and will advise the *Contractor* a minimum of seven (7) days prior to mobilization on whether the ECO Plan provides sufficient detail with respect to the *Project* and appears to be compliant. The *Contractor* must address any issues or concerns regarding the proposed ECO Plan to the satisfaction of the *Consultant* prior to mobilization. Nothing in this section in any way relieves the *Contractor* of its responsibility to comply with the applicable *Construction Laws* and environmental permits.
 - 1.7.4 The completion of the ECO Plan to the mutual satisfaction of the *Consultant* and the *Contractor* does not constitute an approval or assurance from the *Consultant* that the mitigation measures detailed in the ECO Plan are sufficient to ensure compliance with all applicable legislation, regulations or Environmental Permits. The *Contractor* is ultimately responsible for ensuring that mitigation measures used on the project are sufficient for compliance with all *Construction Laws* and environmental permits.

ENVIRONMENTAL PROCEDURES

- 1.7.5 In cases where the *Contractor* is not in conformance with its ECO Plan or is causing a significant adverse environmental impact, the *Consultant* has the authority to order the immediate suspension of *Work* until the issue is corrected to the satisfaction of the *Consultant*. Such orders will be made in writing.

2.0 DEFINITIONS

- 2.1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade environment aesthetically, culturally and/or historically.
- 2.2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction. Control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

3.0 PRODUCTS

- 3.1 Silt Fence
- 3.1.1 Silt fence to be manufactured from a woven, slit film geotextile material with a shiny to smooth surface texture designed to reduce velocity of runoff to point that suspended particles settle out due to reduction of hydraulic energy.
- 3.1.2 Minimum Requirements: (All values are "minimum average roll values".)
- (a) Grab Tensile: 500 N
 - (b) Mullen Burst: 1,900 kPa
 - (c) Elongation at Break: 25% maximum
 - (d) Opening: 600 um maximum
 - (e) UV Rating at 500 hours: 90% retained
 - (f) Efficiency: >75% minimum
 - (g) Construction: woven (tape)
 - (h) Texture: smooth, shiny
 - (i) Posts: 4x4 cm, treated
 - (j) Post Spacing (centres): 2 m maximum
 - (k) Permittivity: 10 L/s/m²

4.0 EXECUTION

- 4.1 Placement

ENVIRONMENTAL PROCEDURES

- 4.1.1 Place silt barrier in a manner that will intercept runoff at or close to right angles to flow. In areas where problem is severe, erect two or more silt barriers parallel to each other, until required degree of control is achieved.
- 4.1.2 Position posts in such a manner that fence, structure remains naturally taut and placed or driven a minimum of 500 mm into ground. Posts to always be positioned downstream.
- 4.1.3 Where a 500 mm depth is impractical or impossible adequately secure or brace posts to prevent overturning of fence due to sediment loading.
- 4.1.4 Bury excess geotextile at bottom of silt fence minimum of 150 mm in trench located upstream such that no flow can pass under fence.
- 4.1.5 Splice subsequent lengths of barrier only at support post locations. Splice by wrapping geotextile fabric completely around each of two abutting support posts such that gap between abutting posts is completely covered by both sections of fabric.
- 4.2 Quantities
 - 4.2.1 Limit silt fence to handle area equivalent to maximum 100 m² per 3 m of fence.
 - 4.2.2 Do not use where site slope is steeper than 3:1 and water flow rates exceed 0.03 m²/s per 3 m of fence.
 - 4.2.3 Silt barrier to have efficiency > 75%. Employ successive, parallel fences to achieve required degree of control.
- 4.3 Maintenance
 - 4.3.1 Maintain integrity of silt fences as long as necessary to contain sediment runoff. Inspect all temporary silt fences immediately after each rainfall and at least daily during prolonged rainfall. Immediately correct any deficiencies. In addition, make daily review of location of silt fences in areas where construction activities have changed natural contours and drainage runoff to ensure that silt fences are properly located for effectiveness. Where deficiencies exist, install additional silt fences. Should silt fence become damaged or otherwise ineffective while barrier is still necessary, repair or replace promptly.
 - 4.3.2 Remove sediment deposits when deposit reaches approximately one-third of height of silt fence or install second silt fence upslope.
 - 4.3.3 Do not remove silt fence until *Consultant* directs that it be removed.
- 4.4 Clean Up
 - 4.4.1 At completion of construction phase or as directed by *Consultant*, remove and dispose of any silt accumulations, dress area to give a pleasing appearance, and vegetate all bare areas as specified.

END OF SECTION

ABBREVIATIONS AND ACRONYMS

1.0 GENERAL

1.1 This section must be referenced to, and interpreted simultaneously with, all other sections pertinent to the *Works* described herein.

1.2 Abbreviations and Acronyms

1.2.1 General

(a)	AASHTO	American Association of State Highway and Transportation Officials
(b)	ACI	American Concrete Institute
(c)	AI	Asphalt Institute
(d)	AISC	American Institute of Steel Construction
(e)	AISI	American Iron and Steel Institute
(f)	ARCA	Alberta Roofing Contractors Association
(g)	ASCE	American Society of Civil Consultants
(h)	ASTM	American Society for Testing and Materials
(i)	AWPA	American Wood Preservers Associations
(j)	AWS	American Welding Society
(k)	BCLMA	B.C. Lumber Manufacturer's Association
(l)	BCLNA	B.C. Landscape and Nursery Association
(m)	BCBC	BC Building Code
(n)	CAN	National Standard of Canada
(o)	CCA	Canadian Construction Association
(p)	CISC	Canadian Institute of Steel Construction
(q)	CITC	Canadian Institute of Timber Construction
(r)	CPCI	Canadian Prestressed Concrete Institute
(s)	CRCA	Canadian Roofing Contractors Association
(t)	CSA	Canadian Standards Association
(u)	C-SHRP	Strategic Highway Research Program – Canadian Component
(v)	CWB	Canadian Welding Bureau
(w)	ISO	International Organization for Standardization
(x)	MSS	Manufacturer's Standardization Society
(y)	NACE	National Association of Corrosion Engineers

ABBREVIATIONS AND ACRONYMS

	(z)	NBC	National Building Code
	(aa)	PCI	Prestressed Concrete Institute
	(bb)	PMBC	Plywood Manufacturer's Association
	(cc)	SJI	Steel Joist Institute
	(dd)	SSPC	Steel Structures Painting Council
	(ee)	WCB	Worker's Compensation Board
1.2.2	Utilities		
	(a)	API	American Petroleum Institute
	(b)	AWWA	American Water Works Association
	(c)	CGA	Canadian Gas Association
	(d)	CGSB	Canadian General Standards Board
	(e)	CSPI	Corrugated Steel Pipe Institute
	(f)	IAO	Insurer's Advisory Organization
	(g)	RTAC	Roads and Transportation Association of Canada
	(h)	ULC	Underwriters Laboratories of Canada
	(i)	USA	United States of America Standards (ASA)
1.2.3	Mechanical		
	(a)	AFBMA	Anti Friction Bearing Manufacturer's Association
	(b)	AGMA	American Gear Manufacturer's Association
	(c)	AMCA	Air Moving and Conditioning Association
	(d)	ANSI	American National Standards Institute
	(e)	ACR	Air Conditioning and Refrigeration Institute
	(f)	ASHRAE	American Society of Heating Refrigerating and Air Conditioning Consultants
	(g)	ASME	American Society of Mechanical Engineers
	(h)	EJMA	Expansion Joint Manufacturers Association
	(i)	NFPA	National Fire Protection Association
	(j)	SAE	Society of Automotive Consultants
	(k)	SMACNA	Sheet Metal and Air Conditioning Contractor's National Association
1.2.4	Electrical		

ABBREVIATIONS AND ACRONYMS

(a)	AIEE	American Institute of Electrical Consultants
(b)	CEC	Canadian Electrical Code
(c)	EEMAC	Electrical and Electronic Manufacturers Association of Canada
(d)	IEC	International Electrotechnical Commission
(e)	IEEE	Institute of Electrical and Electronic Consultants
(f)	IES	Illuminating Consultants Society
(g)	IPCEA	Insulated Power Cable Consultant's Association
(h)	LEMA	Lighting Equipment Manufacturer's Association
(i)	NEC	National Electrical Code
(j)	NEMA	National Electrical Manufacturers Association
(k)	NESC	National Electrical Safety Code

1.3 Use of Abbreviations

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

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

1.4 Units

1.4.1 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.

1.4.2 Linear Measure

(a)	Meter	m
(b)	Millimeter	mm
(c)	Kilometer	km
(d)	Micrometer	micro-m

1.4.3 Area

(a)	Square meter	m ²
(b)	Square millimeter	mm ²
(c)	Hectare	ha

1.4.4 Volume

(a)	Cubic meter	m ³
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ABBREVIATIONS AND ACRONYMS

	(b)	Liter	L
1.4.5		Mass and Density	
	(a)	Kilogram	kg
	(b)	Gram	g
	(c)	Tonne	t
	(d)	Kilogram per meter	kg/m
	(e)	Gram per meter	g/m
	(f)	Kilogram per square meter	kg/m ²
	(g)	Gram per square meter	g/m ²
	(h)	Kilogram per cubic meter	kg/m ³
1.4.6		Temperature	
	(a)	Degree Celsius	°C
1.4.7		Force, Pressure, Stress	
	(a)	Newton	N
	(b)	Kilonewton	kN
	(c)	Pascal	Pa
	(d)	Kilopascal	kPa
	(e)	Megapascal	MPa
1.4.8		Velocity, Rate of Flow	
	(a)	Meter per second	m/s
	(b)	Meter per hour	m/h
	(c)	Kilometer per hour	km/h
	(d)	Liter per second	L/s
	(e)	Cubic meter per second	m ³ /s
1.4.9		Power, Energy, Heat, Work	
	(a)	Watt	W
	(b)	Kilowatt	kW
	(c)	Kilowatt hour	kWh
	(d)	Joule	J
1.4.10		Electricity	
	(a)	Ampere	A

ABBREVIATIONS AND ACRONYMS

(b) Volt

V

END OF SECTION

QUALITY REQUIREMENTS

1.0 GENERAL

- 1.1 The *Contractor* is fully responsible for the quality of material and *Product* which they provide and the quality of the *Work*.
- 1.2 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*.
- 1.3 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.
- 1.4 Minimum requirements regarding quality control are specified in various sections of the *Specifications* and hereunder, however, 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*.
- 1.5 Inspection and testing shall be in accordance with the pertinent codes and regulations, and with selected standards of the American Society for Testing and Material (ASTM), Canadian Standards Association (CSA), and other standards as specified in the *Contract Documents*.
- 1.6 *Product* testing, mill tests and laboratory reports to demonstrate that the *Product* and material supplied by the *Contractor* meets the *Specifications* are specified under various sections of the *Contract Documents*.

2.0 QUALITY CONTROL TESTING BY THE CONTRACTOR

- 2.1 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:
 - 2.1.1 Sieve analysis of aggregates to be supplied to the *Work*;
 - 2.1.2 Aggregates and mix design for concrete;
 - 2.1.3 Aggregates and mix designs for soil cement base course;
 - 2.1.4 Aggregates and mix designs for asphaltic concrete;
 - 2.1.5 Standard Proctor Density curves for backfill materials;
 - 2.1.6 Standard Proctor Density curves for approved native backfill;
 - 2.1.7 Compaction test results for backfill and embankment material;
 - 2.1.8 All concrete tests in accordance with CSA A23.1. This will include:
 - (a) Air and slump tests;
 - (b) Cylinder compression tests (minimum 3 per each 60 m³ of concrete placed);

QUALITY REQUIREMENTS

- 2.1.9 A 10-point composite soil sample analysis for the following:
 - (a) BTEX, PHCs F1 to F4
 - (b) PAHs
 - (c) Metals
 - (d) Salinity
- 2.1.10 Groundwater and surface water analysis for the following:
 - (a) BTEX, PHCs F1/F2
 - (b) PAHs
 - (c) Dissolved Metals (groundwater) or total metals (surface water)
 - (d) Routine potability
- 2.1.11 Any other *Product* testing that is required and is specified under various sections of the *Specifications*.
- 2.2 The *Contractor* is responsible for all other testing as required by the *Contract Documents*.
- 2.3 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.
- 2.4 The *Contractor* shall promptly provide the *Consultant* with copies of all test results.
- 2.5 The *Contractor* shall provide a final submission package including all quality records stamped by the *Contractor's* quality control firm's Engineer of Record prior to issuance of *Ready-for-Takeover* certificate.

3.0 QUALITY ASSURANCE TESTING BY THE OWNER

- 3.1 The *Owner* will retain the services of an independent testing agency to approve subgrade. The *Contractor* is to provide a minimum of three *Working Days* notice prior to when a subgrade inspection is required.
- 3.2 The *Owner* may also retain and pay for the services of an independent testing agency for *Quality Assurance* testing, for the *Owner's* purposes.
- 3.3 The *Owner's* testing agency and the *Consultant* 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.
- 3.4 Inspections and tests by the *Owner's* testing agency and by the *Consultant* do not relieve the *Contractor* of their responsibility to supply material and *Product* and to perform the *Work* in accordance with the requirements of the *Contract Documents*.
- 3.5 The *Consultant*, at their direction, may order or perform any additional inspections and tests for the purposes of their own or for purposes of the *Owner*.

QUALITY REQUIREMENTS

- 3.6 The *Contractor* shall coordinate with the *Consultant* the scheduling of the testing and inspection by the *Owner's* testing agencies or by the *Consultant*, to enable testing to be done as necessary, without delay, and the *Contractor* shall notify the *Consultant* sufficiently in advance of operations to allow for such inspection and tests by the *Consultant's* or the *Owner's* testing agency.
- 3.7 The *Contractor* shall allow the *Consultant* and the *Owner's* testing agencies access to all portions of the *Work* and manufacturing or fabrication plants as necessary. Provide facilities for such access.

4.0 CODE COMPLIANCE TESTING

- 4.1 Inspections and tests required by the codes or ordinances, or by a plan approval authority, shall be the responsibility of and shall be paid for by the *Contractor*.
- 4.2 Copies of reports resulting from such inspections shall be submitted in a timely manner by the *Contractor* to the *Owner*.

5.0 RETESTING

- 5.1 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.
- 5.2 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*.
- 5.3 If the *Contractor* fails or refuses to do remedial work or replace unacceptable material or *Product*, the *Consultant* 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

1.0 FIELD OFFICES AND SHEDS

1.1 General

1.1.1 The location of temporary structures and storage sites provided by the *Contractor* shall be subject to the approval of the *Consultant*.

1.1.2 The *Contractor* shall maintain temporary structures and storage sites in good order and on completion of the *Work* shall remove all temporary structures from the site.

1.2 Contractor's Office

1.2.1 Provide and maintain, in clean condition during entire progress of the *Work*, a suitable office adequately lighted, heated and ventilated, for own use. The location shall be subject to the approval of the *Consultant*.

1.2.2 Completely furnish office to allow for proper filing and examination of *Contract Documents* and regulatory documents.

1.2.3 Provide within office space a table and chairs to accommodate progress meetings.

1.2.4 Provide within office space a location for the *Consultant* to conduct work throughout the day.

1.2.5 Provide within office space adequate first aid facilities as required under the Occupational Health and Safety Act.

1.3 Equipment and Tool Storage

1.3.1 Provide and maintain in a clean and orderly condition adequate lockable storage sheds for tools and equipment.

1.4 Materials and Storage

1.4.1 Provide and maintain in a clean and orderly condition suitable weatherproof and lockable sheds for storage and protection of materials which require such protection.

1.4.2 Allocate storage areas on site for materials which do not require weatherproof sheds. Maintain areas in clean and orderly condition. Limit storage of materials and items to storage areas only.

2.0 UTILITIES

2.1 Sanitary Facilities

2.1.1 Provide sanitary facilities for workers in accordance with local health authorities. Maintain facilities in clean and tidy condition.

2.2 Water Supply

2.2.1 Provide a supply of potable water for use during construction. Make necessary arrangements for connection with the appropriate utility.

CONSTRUCTION FACILITIES

2.3 Heating and Air Conditioning

- 2.3.1 Provide all heating and air conditioning required during construction period, including attendants, maintenance and fuel.
- 2.3.2 Pay for all costs in maintaining and providing temporary heat.
- 2.3.3 Be responsible for any damages to the *Work* due to failure in providing adequate heat and protection during construction.

2.4 Power and Light

- 2.4.1 Provide power and light. Install in accordance with regulations of governing authorities.

3.0 BARRIERS

3.1 Hoarding

- 3.1.1 Provide and erect hoardings as required by the *Owner*.
- 3.1.2 Provide covered walkways where hoardings run parallel and adjacent to pedestrian traffic complete with caution signs and lighting. Hoardings and covered walkways are to be minimum 2.5 m high.
- 3.1.3 Provide lockable gates within hoardings as required for entrance to site by workers and vehicles. Locate where least disruptive to normal street traffic.
- 3.1.4 Hoardings and covered walkways are to present a smooth, continuous and painted surface on public side, unbroken by supports, battens, perforations, or other structural members.

3.2 Guard Rail and Barricades

- 3.2.1 In accordance with local safety regulations, provide guard railings and barricades, detour signs, watch persons, warning lights, flag persons around all excavations and provide railings and barricades around all elevated workspaces

4.0 CONSTRUCTION AIDS

4.1 Temporary Retaining Walls

- 4.1.1 Provide temporary sheeting, piling, or shoring as required to protect excavations, and trenches from damage caused by rain water, groundwater, and other soil and weather conditions. Erect in a manner which will not encumber the performance of the *Work*.

4.2 Explosives

- 4.2.1 Provide for the use of explosives when required. Advise *Consultant* if explosives are required. When using, conform to the requirements of local governing authorities.
- 4.2.2 Explosives are to be handled and used only by licensed personnel.

CONSTRUCTION FACILITIES

- 4.2.3 Protect adjacent properties, work in progress, and workers from damage or injury when using explosives. Place sufficient and adequate signs around site to warn the public that explosives are being used.
- 4.2.4 Instruct workers as to the procedures to be taken prior to and during each detonation. Provide ample warning prior to each detonation and ensure all workers fully recognize these warnings.
- 4.2.5 The *Contractor* shall have adequate Comprehensive General Liability Insurance endorsed for his blasting operations to the value of that required by the *Contract Documents*.
- 4.2.6 The *Contractor* shall contact the various utility owners to ensure that a conflict does not result when blasting.

END OF SECTION

TRAFFIC CONTROL, VEHICLE ACCESS AND PARKING

1.0 GENERAL

- 1.1 This specification covers all aspects of traffic accommodation including the supply, installation, maintenance and removal of temporary construction signing and traffic control devices which are specifically related to construction, repair or emergency situations and which are generally removed when the *Work* is completed, or the *Work* no longer impacts traffic.
- 1.2 Submit a Traffic Management Plan to the *Consultant* prior to the commencement of construction. Plan to indicate alternate routes and accesses for all private property and will be reviewed with affected property owners prior to construction taking place.
- 1.3 During progress of the *Work*, make adequate provision to accommodate normal traffic along streets and highways immediately adjacent to or crossing the *Work* so as to cause minimum of inconvenience to general public.
- 1.4 Give minimum 7 days' notice to emergency services and municipal works authorities prior to beginning construction and comply in all respects with their requirements.
- 1.5 Comply with stated requirements regarding closure of streets or highways and post proper notices and/or signals, and provide necessary barriers, guards, lights, flagmen or watchmen as may be necessary in best interests of public. All costs involved in respect of above requirements will be deemed to be included in the *Contract Price*.
- 1.6 Inform all owners, occupants or properties where access is affected in advance of proposed road and/or sidewalk closures.
- 1.7 Traffic accommodation and temporary construction signing is the sole responsibility of the *Contractor*.
- 1.8 Parking will be permitted on the site provided it does not disrupt the performance of the *Work*.
- 1.9 Maintain existing access roads to the site(s) at all times including supply and placement of gravel to repair damage resulting from *Contractor's* use of roads, grading, providing dust control and snow removal. If access will be temporarily interrupted, a minimum of 7 days' notice must be provided to the *Consultant*. Schedule work to minimize interruptions to access.

2.0 REFERENCE STANDARD

- 2.1 Regulate traffic in general accordance with local requirements and City of Calgary Temporary Traffic Control Manual.

3.0 PROTECTION OF PUBLIC TRAFFIC

- 3.1 Comply with requirements of Acts, Regulations, and By-Laws in force for regulation of vehicle and pedestrian traffic or use of roadways upon or over which it is necessary to carry out work or haul materials or equipment.

TRAFFIC CONTROL, VEHICLE ACCESS AND PARKING

- 3.2 When working on travelled way:
 - 3.2.1 Place equipment in position to present minimum of interference and hazard to travelling public.
 - 3.2.2 Keep equipment units as close together as working conditions will permit and preferably on same side of travelled way.
 - 3.2.3 Do not leave equipment on travelled way overnight.
- 3.3 Do not close any lanes of road or highway without approval of the *Consultant*. Before rerouting traffic erect suitable signs and devices, provide sufficient crushed gravel to ensure a smooth riding surface.
- 3.4 At no time shall any intersection be closed over any weekend without the written permission of the *Consultant*.
- 3.5 Keep travelled way well graded, free of potholes and of sufficient width that required number of lanes of traffic may pass.
- 3.6 When directed by the *Consultant*, provide well graded, graveled detours or temporary roads to facilitate passage of traffic around restricted construction area. Provide and maintain signs and lights and maintain roadway, including gravel surfacing, dust palliative or paving of detour or temporary road as described and/or appropriate to such work.
- 3.7 Provide and maintain reasonable road and accessible pedestrian access and egress to property fronting along or in vicinity of *Work* unless approved otherwise by the *Consultant*.
- 3.8 Excavation shall be conducted in a manner to cause the least interruption to traffic. When traffic must cross open trenches, the *Contractor* shall provide suitable "bridges" at street intersections, lanes, and driveways.
- 3.9 Maintain access for emergency vehicles through or around the *Place of the Work*.

4.0 INFORMATIONAL AND WARNING DEVICES

- 4.1 Meet with the *Consultant* prior to commencement of the *Work* to prepare list of signs and other devices required for *Project*.
- 4.2 Provide and maintain signs and other devices required to indicate construction activities or other temporary and unusual conditions resulting from the *Work*.
- 4.3 Supply and erect signs, delineators, barricades, and miscellaneous warning device as specified by Provincial highways ministry publications.
- 4.4 Place signs and other devices in additional locations as appropriate or as directed by the *Consultant*.
- 4.5 Continually maintain traffic control devices in use by:
 - 4.5.1 Checking signs daily for legibility, damage, suitability and location. Clean, repair or replace to ensure clarity and reflectance.

TRAFFIC CONTROL, VEHICLE ACCESS AND PARKING

- 4.5.2 Removing or covering signs which do not apply to conditions existing from day to day.

5.0 CONTROL OF PUBLIC TRAFFIC

- 5.1 Provide flag persons, trained and properly equipped in following situations:
 - 5.1.1 When public traffic is required to pass working vehicles or equipment which may block all or part of travelled roadway.
 - 5.1.2 When it is necessary to institute one-way traffic system through the construction area or other blockage where traffic volumes are heavy, approach speeds are high and traffic signal system is not in use.
 - 5.1.3 When workmen or equipment are employed on travelled way over brow of hills, around sharp curves or at other locations where oncoming traffic would not otherwise have adequate warning.
 - 5.1.4 Where temporary protection is required while other traffic control devices are being erected or taken down.
 - 5.1.5 For emergency protection when other traffic control devices are not readily available.
 - 5.1.6 In situations where complete protection for workmen, working equipment and public traffic is not provided by other traffic control devices.
 - 5.1.7 At each end of restricted sections where pilot cars are required.
- 5.2 Provide pilot cars where public traffic must use particularly hazardous routes or where traffic is required to remain in one lane or change periodically from one lane to another or negotiate sections of construction at restricted speed. Equip pilot cars with orange flashing lights and signs clearly designating vehicles as pilot cars.
- 5.3 Provide and maintain suitable detours or temporary access routes for accessible pedestrian traffic, complete with suitable warning and advisory signs.

END OF SECTION

PRODUCTS/WORKMANSHIP

1.0 PRODUCTS

1.1 Quality of *Products*

- 1.1.1 If requested, furnish evidence as to type, source and quality of *Products* provided.
- 1.1.2 Should any dispute arise as to the quality or fitness of materials, equipment or articles, the decision rests strictly with the *Consultant* based upon the requirements of the *Contract Documents*.
- 1.1.3 Unless otherwise indicated in the *Specifications*, maintain uniformity of manufacturer for any particular or like *Products*.
- 1.1.4 Permanent labels, trademarks, and nameplates on materials, equipment and articles are not acceptable in prominent locations except where required for operating instructions and when located in mechanical or electrical rooms.

1.2 Availability of *Products*

- 1.2.1 Following *Notice of Award*, review *Product* requirements and anticipate foreseeable delivery delays in any items. If delays in deliveries of materials, equipment or articles are foreseeable, propose substitutions or other remedial action in ample time to prevent delay in performance of the *Work*.
- 1.2.2 If such proposal is not provided to the *Consultant*, the *Consultant* reserves the right to substitute more readily available *Products* later in order to prevent delays, at no additional cost to the *Owner*.
- 1.2.3 No substitution of any *Product* will be permitted unless the *Product* cannot be incorporated into the *Work* within the *Contract Time*.
- 1.2.4 To receive approval, proposed substitutes must equal or exceed the quality, finish and performance of those specified and/or shown and must not exceed the space requirements allotted on the *Drawings*.
- 1.2.5 Provide documentary proof of equality, difference in price (if any) and delivery dates in the form of certified quotations from *Suppliers* of both specified *Products* and proposed substitutions.
- 1.2.6 Include all costs in the difference in price (if any) for any required revisions to other structures and *Products* to accommodate such substitutions.

1.3 Storage, Handling, and Protection of *Products*

- 1.3.1 Handle and store *Products* in a manner to prevent damage, contamination, deterioration and soiling and in accordance with manufacturer's recommendations when applicable.
- 1.3.2 Store packaged or bundled *Products* in original and undamaged condition with manufacturers' seals and labels intact. Do not remove from packaging or bundling until incorporated into the *Work*.

PRODUCTS/WORKMANSHIP

- 1.3.3 *Products* subject to damage from weather are to be stored in weatherproof enclosures.
- 1.3.4 Store cementitious materials clear of earth on concrete floors and away from walls.
- 1.3.5 When used for grout or mortar materials, keep sand clean and dry. Store sand on polyethylene and cover with waterproof tarpaulins during inclement weather.
- 1.3.6 Store sheet material and lumber on flat, solid supports and keep clear of ground.
- 1.3.7 Store and mix paints in a room assigned for this purpose. Keep room under lock and key at all times. Remove oily rags and any other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- 1.3.8 Remove and replace damaged *Products* at own expense.
- 1.4 Manufacturer's Directions
 - 1.4.1 Unless otherwise specified, install or erect all *Products* in accordance with manufacturers' recommendations. Do not rely on labels or enclosures provided with *Products*. Obtain instructions directly from manufacturers.
 - 1.4.2 Notify the *Consultant*, in writing, of any conflicts between the *Contract Documents* and manufacturers' instructions.
- 1.5 Transportation Costs of *Products*
 - 1.5.1 Pay all costs for transportation of *Products* required for the *Work*.
 - 1.5.2 Transportation costs for *Products* supplied by the *Owner* will be paid by the *Owner*. Be responsible for unloading, handling and storage of such *Products* unless specified otherwise.

2.0 WORKMANSHIP

- 2.1 Co-ordination
 - 2.1.1 Co-ordinate the work of all *Subcontractors*, if such are engaged by the *Contractor*.
 - 2.1.2 Ensure that all *Subcontractors* examine the *Contract Documents* for other parts of the *Work* which may affect the performance of their work.
 - 2.1.3 Ensure that sleeves, openings and miscellaneous foundations are provided as required for the *Work*.
 - 2.1.4 Ensure that items to be built in are supplied, when required, with all necessary templates, measurements and *Shop Drawings*.
- 2.2 Cutting and Remedial *Work*
 - 2.2.1 Perform all cutting and remedial work that may be required to make the several parts of the *Work* come together properly. Co-ordinate and schedule the *Work* to ensure that cutting and remedial work are kept to a minimum.

PRODUCTS/WORKMANSHIP

- 2.2.2 Should the *Owner* or anyone employed by him be responsible for ill-timed work necessitating cutting and/or remedial work to be performed, the cost of such work will be valued as provided in the General Conditions.
- 2.2.3 Employ specialists familiar with the materials affected in performing cutting and remedial work. Perform in a manner to neither damage nor endanger any portion of the *Work*.

3.0 MEASUREMENTS

3.1 Metric *Project*

- 3.1.1 Unless otherwise noted, this *Project* has been designed and is to be constructed in the S.I. metric system of measurements.
- 3.1.2 During construction, when specified metric elements are unattainable at the time they are required to meet the *Contract Time*, the *Contractor* shall notify the *Consultant* in writing and suggest alternative substitutions. Costs due to these substitutions shall be borne by the *Contractor*.

END OF SECTION

1.0 REQUIREMENTS INCLUDED

- 1.1 The *Contractor* shall be responsible for:
 - 1.1.1 Topographic surveys prior to and post stripping, excavation, backfilling, and grading.
 - 1.1.2 Providing an as-constructed survey per Section 01 33 00 – Submittal Procedures.
- 1.2 The *Owner* shall be responsible for:
 - 1.2.1 Field engineering survey services to measure and stake the site.
 - 1.2.2 Survey services to establish and confirm alignment and grade measurements for the *Work*
 - 1.2.3 Providing a maximum of three control monuments and one benchmark for use by the *Contractor*.

2.0 RELATED REQUIREMENTS

- 2.1 Section 01 33 00 – Submittals Procedures.

3.0 SURVEY REFERENCE POINTS

- 3.1 Existing base horizontal and vertical control points are designated on the *Drawings*.
- 3.2 Locate, confirm, and protect control points. Preserve permanent reference points during construction.
- 3.3 Make no changes or relocations without prior written notice to the *Consultant*.
- 3.4 Report to *Consultant* when a reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
- 3.5 *Contractor* to replace control points in accordance with the original survey control.

4.0 DRAWINGS AND DIGITAL INFORMATION

- 4.1 Issued for Construction Drawings
 - 4.1.1 The *Consultant* will provide the *Contractor* with three (3) full size colour copies of the Issued for Construction drawings and all revisions thereto for the *Contractor's* use.
 - 4.1.2 The *Consultant* will provide a PDF copy of the Issued for Construction drawings and all revisions thereto for the *Contractor's* use.
 - 4.1.3 This PDF file may be used by the *Contractor* to produce any paper copies, at the *Contractor's* cost, required in addition to those provided in Section 4.1.1.
- 4.2 AutoCAD Files

FIELD ENGINEERING

- 4.2.1 The *Consultant* will provide an AutoCAD copy of the Issued for Construction line work and all revisions thereto for the sole purpose of survey layout.
- 4.2.2 No reproductions are permitted from the AutoCAD file.
- 4.2.3 All information obtained from the AutoCAD files, must be verified against the Issued for Construction drawings. Any discrepancies between the AutoCAD file and the Issued for Construction drawings must be immediately reported to the *Consultant*.

5.0 SURVEY REQUIREMENTS

- 5.1 Establish at least two additional permanent benchmarks on site, referenced to established benchmarks by survey control points. Record locations with horizontal and vertical data in Project Record Documents.
- 5.2 Establish all lines and levels; locate and lay out by instrumentation.
- 5.3 Stake for excavation, pipe laying and other related installations.
- 5.4 Establish pipe invert elevations.
- 5.5 All pipe grades shall be established by survey instruments and laser, unless otherwise approved by the *Consultant*.
- 5.6 The *Contractor* shall provide the *Consultant* with assistance as required, to aid in checking the layout surveys and the grades of the installed *Work*. There shall be no additional cost to the *Owner* for the provision of such assistance to the *Consultant*. The surveyors and the assistants provided by the *Contractor* shall be the same person or persons at all times for the duration of the *Contract*, or as otherwise approved by the *Consultant*.
- 5.7 The *Contractor* shall be charged with the cost of verifying or replacing any legal survey pins, monuments, or reference stakes damaged during construction by the *Contractor's* operations. In the event that the *Contractor* requires the removal of any legal survey markers for the purpose of the *Work*, the cost of replacement will be borne by the *Owner*, provided the written consent of the *Consultant* is first received and the pin has been adequately referenced by a Professional Land Surveyor.
- 5.8 The *Consultant* will make "random checks" of the *Contractor's Work* and will review the layout to ascertain general conformity with the intent of the *Contract Documents*. The *Consultant's* review shall in no way relieve the *Contractor* of his responsibilities for errors or omissions in the field surveys or of responsibility for meeting all requirements of the *Contract*.

END OF SECTION

CLOSEOUT PROCEDURES

1.0 FINAL CLEANING

- 1.1 Prior to *Ready-for-Takeover*, remove surplus *Products*, tools, construction machinery and equipment not required for the performance of the remaining *Work*.
- 1.2 Remove waste *Products* and debris and leave the *Work* clean and suitable for occupancy by *Owner*.
- 1.3 Prior to the *Construction Completion Certificate*, remove surplus *Products*, tools, construction machinery, equipment, waste products and debris.
- 1.4 Leave the *Work* clean before the final inspection process commences.
- 1.5 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.
- 1.6 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, floors, and ceilings.
- 1.7 Vacuum clean and dust building interiors, behind grilles, louvers and screens.
- 1.8 Wax, seal, shampoo or prepare building floor finishes, as recommended by the manufacturer.
- 1.9 Inspect finishes, fitments, and equipment and ensure specified workmanship and operation.
- 1.10 Broom clean and wash exterior walks, steps and surfaces.
- 1.11 Remove dirt and other disfigurements from exterior building surfaces.
- 1.12 Clean and sweep roofs, gutters, downspouts, areaways, and sunken walls.
- 1.13 Sweep and wash clean site paved areas.
- 1.14 Clean equipment and fixtures to a sanitary condition, clean or replace filters of mechanical equipment.

2.0 SYSTEMS DEMONSTRATIONS

- 2.1 Prior to final inspection of the *Work*, demonstrate operation of each system to *Owner* and *Consultant*. Final inspection is to occur following *Ready-for-Takeover* once all deficiencies have been rectified to the sole satisfaction of the *Owner*.
- 2.2 Instruct *Owner's* personnel in operation, adjustment, and maintenance of equipment and systems, using provided operation and maintenance data as the basis for instruction.

3.0 DOCUMENTS

- 3.1 Collect reviewed submittals and assemble documents completed by *Subcontractors*, *Suppliers*, and Manufacturers.

CLOSEOUT PROCEDURES

- 3.2 Submit material prior to application for *Ready-for-Takeover*. For equipment put into use with *Owner's* permission during construction, submit within ten (10) *Working Days* after start-up.
- 3.3 Provide warranties fully executed and notarized.
- 3.4 Execute transition of Performance and *Labour and Materials Payment Bond* to warranty period requirements.

4.0 REMOVAL OF TEMPORARY FACILITIES

- 4.1 Prior to application for *Ready-for-Takeover* remove all temporary offices and furniture, hoardings, fencing, tree and plant protection and all other items used to aid the performance of the *Work*. Make good surfaces.

5.0 PROJECT COMMISSIONING

- 5.1 Expedite and complete deficiencies and defects identified by the *Consultant*.
- 5.2 Review maintenance manual contents (operating, maintenance instructions, record "as-built" drawings, spare parts, materials) for completeness.
- 5.3 Submit required documentation such as statutory declarations, Workers' Compensation Certificates, warranties, certificates of approval or acceptance from regulating bodies.
- 5.4 Attend "end-of-work" testing and break-in or start-up demonstrations.
- 5.5 Review inspection and testing reports to verify conformance to the intent of the documents and that changes, repairs or replacements have been completed.
- 5.6 Meet with other *Project* consultants to co-ordinate completion testing approvals.
- 5.7 Review condition of equipment which has been used in the course of the *Work* to ensure all equipment is in "as new condition" with warranties dated and certified from date of *Ready-for-Takeover*.
- 5.8 Arrange and co-ordinate instruction of *Owner* staff in care, maintenance and operation of building systems and finishes by *Suppliers* or *Subcontractors*.
- 5.9 When partial occupancy of uncompleted *Project* is required by the *Owner*, co-ordinate *Owner's* uses, requirements, access, with *Contractor's* requirements to complete the *Work*.
- 5.10 Co-ordinate *Owner's* moving-in of staff, furnishings, equipment with building accessibility, traffic, and *Contractor's* and *Subcontractor's* cleaning-up and completion activities all to suit *Owner's* work schedule and to not disrupt *Owner's* productivity.
- 5.11 Provide on-going review, inspection and attendance to call-back, maintenance and repair problems during the Warranty Period.

6.0 INSPECTION/TAKEOVER PROCEDURES

- 6.1 During the final inspection of the *Work*, a list of deficiencies and defects will be tabulated. The *Contractor* is to correct all deficiencies.

TOWN OF OKOTOKS
FOOTHILLS OKOTOKS REGIONAL WATER PROJECT
RAW WATER RESERVOIR

CLOSEOUT PROCEDURES

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END OF SECTION

GENERAL COMMISSIONING REQUIREMENTS

1.0 GENERAL

1.1 Summary

- 1.1.1 This section specifies requirements for *Commissioning* the *Works* into operation. This section must be referenced to, and interpreted simultaneously with, all other sections pertinent to the *Work* described herein.
- 1.1.2 Provide, commission, and turn over to the *Owner* the complete *Work*. During the *Commissioning* period demonstrate that the operation of the System as a whole, as well as all components, is correct and in accordance with the *Contract* requirements.
- 1.1.3 Testing and *Commissioning* shall be performed by the *Contractor* and witnessed by Manufacturer's representative(s) where specified, in the presence of the *Consultant* and the *Owner's* representative.
- 1.1.4 The *Consultant* will act as the *Commissioning* agent for the *Owner*.
- 1.1.5 Related Requirements
 - (a) Start up and test all pieces of equipment in accordance with individual *Specification* Sections.
 - (b) All Divisions to ensure that their specification results in all systems being fully tested and operational prior to *Commissioning*.
 - (c) Where not specifically detailed in individual *Specification* Sections, each piece of equipment shall be installed, started up and tested in accordance with the manufacturer's written instructions and procedures and in accordance with procedures and standards of applicable certification sponsoring associations before the system is commissioned as a whole.

1.2 Submittals for review

- 1.2.1 Prepare a written Testing and *Commissioning* Plan prior to commencement of testing and submit to the *Consultant* no later than 1 month before the start of testing and *Commissioning* for review and comment.
 - (a) A Testing and *Commissioning* Plan will be required for:
 - (i) Watermains, valves, and related equipment.
 - (ii) Reservoir intake screen and structure.
 - (iii) Underdrain, Manholes, and venting system.
 - (iv) Reservoir Liner.
 - (b) The Testing and *Commissioning* Plan will include but not be limited to;
 - (i) Submittal of Draft Operations and Maintenance Manual

GENERAL COMMISSIONING REQUIREMENTS

- (ii) Schedule of training sessions for each system and piece of equipment
 - (iii) Duration of *Commissioning* period
 - (iv) Name of organization and/or *Contractor* personnel proposed to perform *Commissioning* services.
 - (v) Designate who has managerial responsibility for coordination of entire *Commissioning* process and procedures.
 - (vi) Timing of site visits by Manufacturer's Representatives
 - (vii) Sequencing of equipment testing
 - (viii) Sequencing of connection to existing facilities
 - (ix) Sequencing of connection to source of process fluid
 - (x) Bypass procedures of the *Work* during *Commissioning* if required.
 - (xi) *Contractor*, *Subcontractor* and *Supplier* personnel to be present.
 - (xii) List of data to be recorded and analyses to be performed during the testing and *Commissioning* period.
 - (xiii) Form of final *Commissioning* report.
- 1.2.2 Provide summary of qualifications, certifications, training and experience of testing personnel if requested.
- 1.2.3 Provide final testing reports from equipment manufacturers or their representatives. Organization having managerial responsibility shall make reports. Final reports will include but not be limited to:
- (a) Signature of recorder and supervisor of reporting organization on each testing record.
 - (b) Make and model of each instrument used, and latest date of calibration of each.
 - (c) Records of all operational data identified in the *Commissioning* Plan for each piece of equipment.
- 1.2.4 Provide Form 101 to 103 for the equipment listed below and other equipment identified throughout the *Contract Documents* per part 3 of this Section:
- (a) Valves.
 - (b) Geomembrane.
 - (c) Liner.
 - (d) Intake screen and structure.
 - (e) Underdrain System.

GENERAL COMMISSIONING REQUIREMENTS

- (f) Fill, equalization, and intake pipes.
- (g) Manholes.
- (h) Geogrid.
- (i) Piezometers.
- (j) Geotextile.
- (k) Safety ladders.

1.3 Testing requirements

- 1.3.1 Testing personnel shall have the training, experience and qualifications necessary to undertake the specified testing services specified in other sections and to undertake trouble-shooting and operation of the equipment.
- 1.3.2 Comply with procedural standards of certifying association under whose standard *Commissioning* will be performed. Perform *Commissioning* under direction of supervisor qualified under certification requirements of applicable certifying association.
- 1.3.3 Comply with applicable procedures and standards of the equipment manufacturer. Perform *Commissioning* under direction of supervisor qualified by the manufacturer.
- 1.3.4 Laboratory services that are required to demonstrate compliance will be paid for by the *Contractor*.

2.0 PRODUCTS

- 2.1.1 Consumables
- 2.1.2 The cost of power (as needed) to commission the facilities will be paid for by the *Contractor*.
- 2.1.3 Provide all miscellaneous required for testing and commissioning.
- 2.1.4 The *Owner* will Provide any process chemicals required to commission the facilities.
- 2.1.5 Replace any spare parts used during the *Commissioning* period.

2.2 Testing Personnel

- 2.2.1 Provide and pay for all testing personnel, regardless of the length of time required for *Commissioning* of the *Work*.

3.0 EXECUTION

3.1 General

- 3.1.1 Prepare each system for *Commissioning*.

GENERAL COMMISSIONING REQUIREMENTS

- 3.1.2 Cooperate with testing organization(s) and provide access to equipment and systems.
- 3.1.3 Provide personnel and operate systems at designated times in *Commissioning Plan*.
- 3.1.4 Operate equipment in accordance with manufacturers' instructions and the *Commissioning Plan*.
- 3.1.5 Submit proposed changes or deviations from the Testing and *Commissioning Plan* in writing to the *Consultant* for review and comment, and acceptance of proposed deviations must be received from *Consultant* prior to making change(s) or deviation(s).
- 3.1.6 Report to *Consultant* any deficiencies or defects noted during testing and *Commissioning*.
- 3.1.7 Operation of any existing system not part of the *Work* must be by *Owner's* personnel only.
- 3.2 Preparation
 - 3.2.1 Testing and *Commissioning Plan*.
 - (a) Revise Testing and *Commissioning Plan* based on *Consultant's* Review comments.
 - (b) Testing and *Commissioning* cannot proceed until the *Contractor's* plan has been approved by the *Consultant*.
 - 3.2.2 Failure to provide O&M manuals as specified prior to *Commissioning* may result in delay to *Commissioning* at the *Contractor's* expense.
 - 3.2.3 Instruments
 - (a) Provide instruments/appurtenances required for monitoring and adjusting operations.
 - (b) Make instruments/appurtenances available to *Consultant* as requested and as appropriate to facilitate spot checks during *Commissioning*.
 - (c) Retain possession of instruments/appurtenances and remove at satisfactory completion of *Commissioning*.
 - 3.2.4 Notify *Consultant* 10 *Working Days* prior to beginning of testing and *Commissioning* operations.
 - 3.2.5 Other sections of the *Specifications* may contain specific testing, cleaning, balancing and operation requirements, which are to be followed in conjunction with this Section. Complete all testing required by individual Sections and the items listed below prior to *Commissioning*;
 - (a) Perform all specified static testing for pipe or ducting connected to the equipment.

GENERAL COMMISSIONING REQUIREMENTS

- (b) Inspect and clean all pipe, vessels and equipment and all electrical connections.
 - (c) Verify all equipment provided as part of the *Work* including but not limited to computers and electronic equipment are ready for full operation. Inspection must include but not be limited to:
 - (i) Soundness without damaged parts;
 - (ii) Completeness in all details as specified;
 - (iii) Correctness of setting, alignment and arrangements of parts;
 - (iv) Proper rotation of motors and drives;
 - (v) Adequacy and correctness of packing, sealing and lubrication.
 - (d) Submit Form 101 – Certificate of Satisfactory Installation for specified equipment.
 - (e) Run each piece of equipment for a minimum of 24 hours in accordance with the testing requirements in individual sections and in accordance with equipment manufacturer's recommended start-up testing procedures in the presence of the *Consultant* and *Owner's* Representatives.
 - (i) Test with water for equipment conveying liquid
 - (ii) Test with air for equipment conveying air
 - (f) Run each system for a minimum of 24 hours to demonstrate;
 - (i) The function of all components over the entire range of specified operation including variations in flow, pressures, speeds and controls.
 - (ii) Proper operation in hand and automatic control
 - (iii) All alarms, safety devices, interlocks, and annunciation by simulation of malfunctions
 - (g) Submit a brief testing report to the *Consultant* for each individual item and for each system.
 - (h) Submit Form 102 – Certificate of Satisfactory Testing for specified equipment.
- 3.2.6 Testing must indicate that individual items and systems are in good operating condition, comply with specified requirements and are ready for operation. Only alarms deliberately initiated for testing and verification will be acceptable.
- 3.2.7 Complete any adjustments recommended by the Manufacturer's Representative or rectification of deficiencies observed by the *Owner* or the *Consultant*.
- 3.2.8 Co-ordinate with *Owner* to ensure that all required *Owner* supplied consumables are on site and available for *Commissioning*.

GENERAL COMMISSIONING REQUIREMENTS

3.2.9 Following the *Consultant's* acceptance of successful start-up and testing of all individual pieces of equipment the *Contractor* should begin *Commissioning* the facility.

3.3 *Commissioning*

3.3.1 The *Contractor* must connect the *Work* to the source of design process fluid and run the System for 4 weeks. During this time the *Contractor* is responsible for operating the System and must coordinate integration into the overall System with the *Owner*.

3.3.2 During Week 1 and 2:

- (a) *Subcontractors, Suppliers/manufacturers* must be available for questions, troubleshooting, problem-solving and operation optimization.
- (b) Complete training sessions as called for in the separate specification sections of Divisions. Training sessions may be scheduled earlier through collaboration with the *Consultant* and *Owner*. All training must be completed before the end of Week #1.
- (c) The *Owner* will observe the operation by the *Contractor*, with the intention that the *Contractor, Subcontractors, Suppliers* and manufacturers will be available to provide instruction and training to the *Owner* and available to answer questions from the *Owner* and *Consultant*.
- (d) Complete equipment and systems testing that require the equipment to be handling the design process fluid.
- (e) Accurately record data as described in the *Commissioning* Plan. Submit for review.

3.3.3 After completion of Week 1 and after receiving the recorded data from Week 1 the *Consultant* will undertake final inspection of the *Work* for *Ready-For-Takeover*.

3.3.4 During Week 3 and 4:

- (a) The *Owner* will operate the *Work*, and the *Contractor* must observe.
- (b) *Subcontractors, Suppliers/manufacturers* must be available to answer questions from the *Owner* and *Consultant* to assist with troubleshooting, problem solving and operation optimization.
- (c) Additional deficiencies that are identified during Week #2 will be added to the *Ready-For-Takeover* list of deficiencies, and the *Contractor* will resolve issues and deficiencies arising out of Week #1 and Week #2 *Commissioning*.

3.3.5 Only alarms deliberately initiated for testing and verification will be acceptable.

3.3.6 Once *Commissioning* and *Owner* Training are complete to the satisfaction of the Manufacturer's Representative and the *Contractor*, a Certificate of Satisfactory

GENERAL COMMISSIONING REQUIREMENTS

Commissioning Form 103 must be completed for each system's component and presented to the *Consultant*.

- 3.3.7 The *Consultant* must sign the Certificate of Satisfactory *Commissioning* Form 103(s) when *Commissioning* and training has been completed to the satisfaction of the *Consultant*.
- 3.3.8 Following satisfactory completion of Week # 2 of *Commissioning*, the *Consultant* will issue a Certificate of *Commissioning* Completion.
- 3.3.9 During the Warranty Period, the *Contractor*, *Subcontractors*, *Suppliers*, and manufacturers must be available to address questions by the *Owner* and the *Consultant* as part of the *Work*.

Comments: _____

GENERAL COMMISSIONING REQUIREMENTS

Date:

Manufacturer
(PRINT, Company, and Authorized Representative)

Signature of Authorized Representative

Date:

Contractor
(PRINT, Company and Authorized Representative)

Signature of Authorized Representative

Comments: _____

GENERAL COMMISSIONING REQUIREMENTS

Date:

Manufacturer
(PRINT, Company, and Authorized Representative)

Signature of Authorized Representative

Date:

Contractor
(PRINT, Company, and Authorized Representative)

Signature of Authorized Representative

Date:

Consultant
(PRINT, Company, and Authorized Representative)

Signature of Authorized Representative

Comments: _____

GENERAL COMMISSIONING REQUIREMENTS

Date:

Manufacturer
(PRINT, Company, and Authorized Representative)

Signature of Authorized Representative

Date:

Contractor
(PRINT, Company and Authorized Representative)

Signature of Authorized Representative

Date:

Consultant
(PRINT, Company and Authorized Representative)

Signature of Authorized Representative

END OF SECTION

DIVISION 03 – CONCRETE

1.0 GENERAL

1.1 Related Requirements

- 1.1.1 Section 03 20 00 – Concrete Reinforcing
- 1.1.2 Section 03 30 00.09 – Cast-In-Place Concrete
- 1.1.3 Section 03 35 00 – Concrete Finishing
- 1.1.4 Section 03 41 – Precast Structural Concrete

1.2 Definitions

- 1.2.1 Environmental Product Declaration (EPD): Third-party verified documentation with the supporting Product Category Rule (PCR) and Life cycle assessment information. Prepared in accordance with ISO 14025, 14040, 14044, and EN 15804 or ISO 21930 and have at least a cradle to gate scope.
 - (a) Industry-wide (generic) EPD with third-party certification (Type III), including external verification in which the manufacturer is explicitly recognized as the participant by the program operator.
 - (b) Product-specific Type III EPD - Products with third-party certification (Type III), including external verification in which the manufacturer is explicitly recognized as the participant by the program operator.

1.3 Reference Standards

1.3.1 CSA Group (CSA)

- (a) CSA A23.1-/A23.2 - 14/19, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete
- (b) CAN/CSA O86- 19, Engineering Design in Wood
- (c) CSA O121- 17, Douglas Fir Plywood
- (d) CSA O141- 05 (R2014), Softwood Lumber
- (e) CSA O151- 17, Canadian Softwood Plywood
- (f) CSA O153- 19, Poplar Plywood.
- (g) CSA O325.0- 16, Construction Sheathing
- (h) CSA O437 Series- 93(R2011), Standards for OSB and Waferboard
- (i) CSA S269.1- 16, Falsework and Formwork

1.3.2 Underwriters' Laboratories of Canada (ULC)

- (a) CAN/ULC-S701.1- 17, Standard for Thermal Insulation, Polystyrene, Boards

1.4 Administrative Requirements

CONCRETE FORMING AND ACCESSORIES

- 1.4.1 Preinstallation Meetings: in accordance with Section 01 31 19 - Project Meetings, convene preinstallation meeting one week before beginning concrete works.
 - (a) Ensure key personnel, site supervisor, Consultant, speciality contractor – finishing and forming attend.
 - (i) Verify Project requirements.
- 1.5 Action and Informational Submittals
 - 1.5.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - 1.5.2 Product Data:
 - (a) Submit manufacturer's instructions, printed product literature and data sheets for proprietary materials used in formwork liners and coatings and include product characteristics, performance criteria, physical size, finish, and limitations.
 - (b) Submit 2 copies of WHMIS SDS.
 - 1.5.3 Submit shop drawings for formwork and falsework.
 - (a) Submit drawings stamped and signed by professional engineer registered or licensed in Alberta, Canada.
 - (b) Prepare Shop Drawings in accordance with CSA S269.1 for formwork and falsework.
 - (c) Indicate formwork design data: permissible rate of concrete placement, and temperature of concrete, in forms.
 - (d) Indicate sequence of erection and removal of formwork/falsework as directed by Consultant.
 - (e) When slip forming and flying forms are used, submit details of equipment and procedures for review by Consultant.
 - (f) Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts.
 - (g) Indicate sequence of erection and removal of formwork and falsework.
 - (h) Include the following information on falsework Shop Drawings:
 - (i) Longitudinal, lateral, vertical, dead, live and impact loads used in design.
 - (ii) Safe bearing capacity of soil underneath mud sills.
 - (iii) Maximum column, post and support loads.
 - (iv) Deflection diagrams for beams with deflection of 10 mm or more.

CONCRETE FORMING AND ACCESSORIES

- (v) Deflection diagrams indicating initial and final elevation of deck surfaces, roofs and soffits.
- (vi) Grade of structural steel.
- (vii) Indicate steel posts, girders, beams, connections, bracing and welding, providing sufficient detail for safe performance of falsework.
- (viii) Fully detailed steel frame shoring.
- (ix) Species, grades and sizes of wood.
- (x) Type and weight of equipment (moving or stationary) supported by falsework.
- (xi) Sequence, methods and rate of concrete placement.
- (xii) Proprietary equipment, adequately identified for checking purposes.
- (xiii) Full details and locations of splices.

1.5.4 Sustainable Design Submittals:

- (a) Low-Emitting Materials:
 - (i) Submit listing of agents used in structure, comply with VOC and chemical component limits or restriction requirements.

1.6 Quality Assurance

1.6.1 Quality Assurance: In accordance with Section 01 43 00 - Quality Requirements.

1.6.2 Retain a professional engineer registered or licensed in Alberta, Canada, with experience in formwork and falsework design of comparable complexity and scope, to perform following services as part of Work of this Section:

- (a) Design of formwork and falsework:
- (b) Review, stamp, and sign fabrication and erection Shop Drawings, design calculations and amendments.
- (c) Conduct on-site inspections and prepare and submit inspection reports verifying this part of Work is in accordance with Contract Documents and reviewed Shop Drawings. Perform inspections a minimum of once per month.

1.7 Delivery, Storage, and Handling

1.7.1 Deliver, store, and handle materials in accordance with Section 01 63 00 – Products/Workmanship.

1.7.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

CONCRETE FORMING AND ACCESSORIES

1.7.3 Storage and Handling Requirements:

- (a) Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- (b) Store and protect formwork from damage.

2.0 PRODUCTS

2.1 Materials

2.1.1 Formwork materials:

- (a) For concrete without special architectural features, use wood and wood product formwork materials to CSA O121, CAN/CSA O86, CSA O437 Series, and CSA O153.
- (b) For concrete with special architectural features, use formwork materials to CSA A23.1/A23.2 .
- (c) Wood cement composites: Confirmed by the Contractor's engineer.
- (d) Rigid insulation board: to CAN/ULC-S701.

2.1.2 Pan forms: to be free of bends, dents, and residual concrete; having a high potential for reuse as indicated.

2.1.3 Form ties:

- (a) For concrete not designated 'Architectural': removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes minimum 25 mm diameter in concrete surface.
- (b) For Architectural concrete; snap ties complete with plastic cones and light grey concrete plugs.

2.1.4 Form liner:

- (a) Plywood: Determined by the Contractor's Engineer.
- (b) Waferboard: to CAN/CSA O325.0, grade determined by the Contractor's Engineer, and thickness determined by the Contractor's Engineer.

2.1.5 Form release agent: Proprietary, non-volatile material not to stain concrete or impair subsequent application of finishes or coatings to surface of concrete, derived from agricultural sources, non-petroleum containing, non-toxic, biodegradable, and non-VOC.

2.1.6 Falsework materials: to CSA S269.1 .

3.0 EXECUTION

3.1 Fabrication and Erection

CONCRETE FORMING AND ACCESSORIES

- 3.1.1 Verify lines, levels, and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.
- 3.1.2 Obtain Consultant's approval for use of earth forms framing openings not indicated on drawings.
- 3.1.3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
- 3.1.4 Fabricate and erect falsework in accordance with CSA S269.1.
- 3.1.5 Refer to architectural drawings for concrete members requiring architectural exposed finishes.
- 3.1.6 Do not place shores and mud sills on frozen ground.
- 3.1.7 Provide site drainage to prevent washout of soil supporting mud sills and shores.
- 3.1.8 Fabricate and erect formwork in accordance with CAN/CSA S269.1 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA A23.1/A23.2 .
- 3.1.9 Align form joints and make watertight.
 - (a) Keep form joints to minimum.
- 3.1.10 Locate horizontal form joints for exposed columns 2400 mm above finished floor elevation.
- 3.1.11 Use 25 mm chamfer strips on external corners and 25 mm fillets at interior corners, joints, unless specified otherwise.
- 3.1.12 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
- 3.1.13 Construct forms for architectural concrete, and place ties as indicated and as directed.
 - (a) Joint pattern not necessarily based on using standard size panels or maximum permissible spacing of ties.
- 3.1.14 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections.
 - (a) Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.
- 3.1.15 Line forms for following surfaces:
 - (a) Outer face of outside girders beams and vertical edge of bridge sidewalk slab.
 - (b) Soffit of girders and underside of bridge decks if exposed.

CONCRETE FORMING AND ACCESSORIES

- (c) Exposed faces of abutments, wingwalls, piers and pylons: do not stagger joints of form lining material and align joints to obtain uniform pattern.
- (d) Secure lining taut to formwork to prevent folds.
- (e) Pull down lining over edges of formwork panels.
- (f) Ensure lining is new and not reused material.
- (g) Ensure lining is dry and free of oil when concrete is poured.
- (h) Application of form release agents on formwork surface is prohibited where drainage lining is used.
- (i) If concrete surfaces require cleaning after form removal, use only pressurized water stream so as not to alter concrete's smooth finish.
- (j) Cost of textile lining is included in price of concrete for corresponding portion of Work.

3.1.16 Clean formwork in accordance with CSA A23.1/A23.2, before placing concrete.

3.1.17 When slip forming or flying forms are used, submit details as indicated in PART 1 - SUBMITTALS.

3.2 Removal and Reshoring

3.2.1 Leave formwork in place for following minimum periods of time after placing concrete.

- (a) 2 days for walls and sides of beams.
- (b) 2 days for columns.
- (c) 14 days for beam soffits, slabs, decks and other structural members, or 3 days when replaced immediately with adequate shoring to standard specified for falsework.
- (d) 2 days for footings and abutments.

3.2.2 Remove formwork when concrete has reached 70 % of its 28-day design strength or minimum period noted above, whichever comes later, and replace immediately with adequate reshoring.

3.2.3 Provide necessary reshoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.

3.2.4 Space reshoring in each principal direction at not more than 3000 mm apart.

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

3.3 Cleaning

3.3.1 Progress Cleaning: Site to remain clean throughout project duration.

CONCRETE FORMING AND ACCESSORIES

- 3.3.2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment
- 3.3.3 Waste Management: separate waste materials for reuse and recycling.

END OF SECTION

1.0 GENERAL

1.1 Related Requirements

- 1.1.1 Section 03 10 00 – Concrete Forming and Accessories
- 1.1.2 Section 03 30 00.09 – Cast-In-Place Concrete
- 1.1.3 Section 03 35 00 – Concrete Finishing
- 1.1.4 Section 03 41 – Precast Structural Concrete

1.2 Price and Payment Procedures

1.2.1 Measurement and Payment:

- (a) Measure reinforcing steel in kilograms or tonnes of steel incorporated into Work, computed from theoretical unit mass specified in CSA G30.18 for lengths and sizes of bars as indicated or authorized in writing by Consultant.
- (b) No measurement made under this Section.
 - (i) Include reinforcement costs in items of concrete work in Section 03 30 00 - Cast-In-Place Concrete.

1.3 Definitions

- 1.3.1 Environmental Product Declaration (EPD): Third-party verified documentation with the supporting Product Category Rule (PCR) and Life cycle assessment information. Prepared in accordance with ISO 14025, 14040, 14044, and EN 15804 or ISO 21930 and have at least a cradle to gate scope.
 - (a) Industry-wide (generic) EPD with third-party certification (Type III), including external verification in which the manufacturer is explicitly recognized as the participant by the program operator.
 - (b) Product-specific Type III EPD - Products with third-party certification (Type III), including external verification in which the manufacturer is explicitly recognized as the participant by the program operator.

1.4 Reference Standards

1.4.1 American Concrete Institute (ACI)

- (a) SP-66-04, ACI Detailing Manual 2004

1.4.2 ASTM International (ASTM)

- (a) ASTM A108-18, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
- (b) ASTM A123/A123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- (c) ASTM A143/A143M-07(2014), Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement

CONCRETE REINFORCING

- (d) ASTM A641/A641M-19, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
 - (e) ASTM A775/A775M-19, Standard Specification for Epoxy-Coated Reinforcing Steel Bars
 - (f) ASTM A884/A884M-19, Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement
 - (g) ASTM A1064/A1064M-18a, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- 1.4.3 CSA Group (CSA):
 - (a) CSA A23.1/A23.2-14/19 , Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - (b) CSA A283-19, Qualification code for concrete testing laboratories
 - (c) CAN/CSA A23.3-19, Design of Concrete Structures
 - (d) CSA G30.18-09(R2019), Carbon Steel Bars for Concrete Reinforcement.
 - (e) CSA G40.20/G40.21-13 (R2018), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
 - (f) CSA W186-M1990(R2016), Welding of Reinforcing Bars in Reinforced Concrete Construction.
- 1.4.4 Reinforcing Steel Institute of Canada (RSIC):
 - (a) RSIC-2018, Reinforcing Steel Manual of Standard Practice
- 1.5 Administrative Requirements
 - 1.5.1 Preinstallation Meetings: In accordance with Section 01 31 19 - Project Meetings, convene preinstallation meeting one week before beginning concrete works.
 - (a) Ensure key personnel, site supervisor, Consultant, specialty contractor - finishing, specialty contractor – forming attend.
 - (i) Verify project requirements.
- 1.6 Action and Informational Submittals
 - 1.6.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
 - 1.6.2 Product Data:
 - (a) Submit manufacturer's instructions, printed product literature and data sheets for proprietary materials used in Cast-In-Place Concrete and additive and include product characteristics, performance criteria, physical size, finish, and limitations.
 - (b) When Chromate solution used as replacement for galvanizing non-prestressed reinforcement, provide product description for review by Consultant before its use.
 - 1.6.3 Shop Drawings:
 - (a) Submit drawings stamped and signed by professional engineer registered or licensed in Alberta, Canada.
 - (i) Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice and SP-66.

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- (ii) Indicate placing of reinforcement and:
- (iii) Detail lap lengths and bar development lengths to CAN/CSA A23.3.
- (iv) Indicate position and size of openings in slabs and walls. Coordinate with trades requiring openings.

1.6.4 Sustainable Design Submittals:

- (a) Environmental Product Declaration (EPD): Submit both Industry-wide EPD with at least a cradle to gate scope, identifying the following impact categories:
 - (i) Global Warming Potential (GWP): All GWP information submitted in the form of kg CO₂ eq/kg.
 - (ii) Ozone Depletion Potential (ODP): All ODP information submitted in the form of kg CFC-11/kg.
 - (iii) Acidification Potential (AP): All AP information submitted in the form of kg SO₂ /kg.
 - (iv) Eutrophication Potential (EP): All EP information submitted in the form of kg N/kg.
 - (v) Photochemical Ozone Creation/Smog Formation Potential (SFP): All SFP information submitted in the form of kg O₃ /kg.
- (b) Environmental Product Declaration (EPD): Submit both Industry-wide EPD and Product specific EPD for each mill providing reinforcing steel with at least a cradle to gate scope, identifying the following impact categories:
 - (i) Global Warming Potential (GWP): All GWP information submitted in the form of kg CO₂ eq/kg.
 - (ii) Ozone Depletion Potential (ODP): All ODP information submitted in the form of kg CFC-11/kg.
 - (iii) Acidification Potential (AP): All AP information submitted in the form of kg SO₂ /kg.
 - (iv) Eutrophication Potential (EP): All EP information submitted in the form of kg N/kg.
 - (v) Photochemical Ozone Creation/Smog Formation Potential (SFP): All SFP information submitted in the form of kg O₃ /kg.
- (c) Recycled Content: Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-consumer content, and total cost of materials for project.

1.6.5 Quality Assurance Submittals:

- (a) Submit in accordance with Section 01 43 00 - Quality Requirements.
- (b) Mill Test Report: Upon request, submit to Consultant certified copy of mill test report of reinforcing steel, minimum 4 weeks before beginning reinforcing work].
- (c) Upon request submit in writing to Consultant proposed source of reinforcement material.
- (d) Upon request submit to Consultant epoxy coating applicator certificates identified in Quality Assurance.

1.7 Delivery, Storage and Handling

- 1.7.1 Deliver, store and handle materials in accordance with Section 01 63 00 – Products/Workmanship.
- 1.7.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.7.3 Storage and Handling Requirements:
 - 1.7.4 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area. Handle, transport, store, and install epoxy coated reinforcing steel bars to prevent damage to coating. Prevent bar-to-bar abrasion and excessive sagging. Do not drop or drag bars. Store on suitable non-metallic supports. For lifting use nylon lifting slings, padded slings, separators or other means recommended by epoxy coated reinforcing steel supplier.

2.0 PRODUCTS

2.1 Materials

- 2.1.1 Substitute different size bars as decided by the Contractor's engineer.
- 2.1.2 Reinforcing Steel: Billet steel, grade determined by the Contractor's engineer, deformed bars to CSA G30.18, unless indicated otherwise.
- 2.1.3 Reinforcing steel: Weldable low alloy steel deformed bars to CSA G30.18.
- 2.1.4 Cold-drawn annealed steel wire ties: To ASTM A1064/A1064M.
- 2.1.5 Deformed steel wire for concrete reinforcement: To ASTM A1064/A1064M.
- 2.1.6 Welded steel wire fabric:
 - (a) In accordance ASTM A1064/A1064M, fabricated from as drawn steel wire into flat sheets; sizes as indicated on Drawings.
 - (b) Finish:
 - (i) Galvanized: Fabricated from galvanized wire or Hot dip galvanized after welding as determined by the Contractor's engineer having Class A coating in accordance with ASTM A641/A641M.
 - (ii) Epoxy Coated: Epoxy coated after welding in accordance with ASTM A884/A884M, Class A coated <175 µm, Type 1 intended for use in concrete or masonry, colour contrasting with rust.
- 2.1.7 Epoxy Coating of non-prestressed reinforcement: to ASTM A775/A775M.
- 2.1.8 Galvanizing of non-prestressed reinforcement: to ASTM A123/A123M, Coating Grade 85, minimum zinc coating 610 g/m².
 - (a) Protect galvanized reinforcing steel with chromate treatment to prevent reaction with Portland cement paste.
 - (b) If chromate treatment carried out immediately after galvanizing, soak steel in aqueous solution containing minimum 0.2% by weight sodium dichromate or 0.2% chromic acid.

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- (i) Temperature of solution minimum 32 degrees and galvanized steels immersed for minimum 20 seconds.
 - (c) If galvanized steels at ambient temperature, add sulphuric acid as bonding agent at concentration of 0.5% to 1%.
 - (i) No restriction applies to temperature of solution.
 - (d) Chromate solution sold for this purpose may replace solution described above, provided if of equivalent effectiveness.
 - (i) Provide product description as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- 2.1.9 Chairs, bolsters, bar supports, spacers: to CSA A23.1/A23.2.
- 2.1.10 Tie wire: 1.5 mm diameter annealed wire, epoxy coated.
- 2.1.11 Mechanical splices: As required by the Contractors Engineer.
- 2.1.12 Plain Round Bars: To CSA G40.20/G40.21.
- 2.2 Fabrication
 - 2.2.1 Fabricate reinforcing steel in accordance with CSA A23.1/A23.2 SP-66b and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
 - (a) SP-66 unless indicated otherwise.
 - 2.2.2 Obtain Contractor Engineer's written approval for locations of reinforcement splices other than those shown on placing drawings.
 - 2.2.3 Upon approval of Contractor's Engineer, weld reinforcement in accordance with CSA W186.
 - 2.2.4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.
 - (a) Ship epoxy coated bars in accordance with ASTM A775A/A775M.
- 2.3 Source Quality Control
 - 2.3.1 Provide Consultant with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 4 weeks before beginning reinforcing work].
 - 2.3.2 Inform Consultant of proposed source of supplied material.

3.0 EXECUTION

- 3.1 Preparation
 - 3.1.1 Galvanizing to include chromate treatment.
 - (a) Duration of treatment 1 hour per 25 mm of bar diameter.
 - 3.1.2 Conduct bending tests to verify galvanized bar fragility in accordance with ASTM A143/A143M.
- 3.2 Site Bending

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- 3.2.1 Do not site bend or site weld reinforcement except where indicated or authorized by the Contractor's Engineer.
- 3.2.2 When site bending authorized, bend without heat, applying slow and steady pressure.
- 3.2.3 Replace bars, which develop cracks or splits.
- 3.3 Placing Reinforcement
 - 3.3.1 Cutting or puncturing vapour retarder is not permitted; repair damage and reseal vapour retarder before placing concrete.
 - 3.3.2 Place reinforcing steel in accordance with CSA A23.1/A23.2.
 - 3.3.3 Use plain round bars as slip dowels in concrete.
 - (a) Paint portion of dowel intended to move within hardened concrete with one coat of asphalt paint.
 - (b) Apply thick even film of mineral lubricating grease when paint is dry.
 - 3.3.4 Before placing concrete, obtain Contractor's Engineer approval of reinforcing material and placement.
 - 3.3.5 Maintain cover to reinforcement during concrete pour.
 - 3.3.6 Protect epoxy and paint coated portions of bars with covering during transportation and handling.
- 3.4 Site Touch-up
 - 3.4.1 Touch up damaged and cut ends of epoxy coated or galvanized reinforcing steel with compatible finish to provide continuous coating.
- 3.5 Site Quality Control
 - 3.5.1 Site tests: Conduct tests as follows in accordance with Section 01 43 00 - Quality Requirements and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - (a) Epoxy coating.
 - (b) Reinforcing steel and welded wire fabric.
 - 3.5.2 Inspection and testing of reinforcing and reinforcing materials carried out by testing laboratory designated by the Contractor's Engineer for review to CSA A23.1/A23.2.
 - (a) Ensure testing laboratory certified to CSA A283.
 - 3.5.3 Ensure test results distributed for discussion at pre-pouring concrete meeting between testing laboratory and Consultant.
 - 3.5.4 Inspection or testing by Consultant not to augment or replace Contractor quality control nor relieve Contractor of contractual responsibility.
- 3.6 Cleaning
 - 3.6.1 Progress Cleaning: Maintain site cleanliness daily.
 - 3.6.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

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END OF SECTION

CAST-IN-PLACE CONCRETE – SHORT FORM

1.0 GENERAL

- 1.1 Related Requirements
 - 1.1.1 Section 03 20 00 - Concrete Reinforcing
 - 1.1.2 Section 03 35 00 – Concrete Finishing
- 1.2 Reference Standards
 - 1.2.1 ASTM International (ASTM)
 - (a) ASTM A641/A641M-19, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 - (b) ASTM A775/A775M-22, Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
 - (c) ASTM A884/A884M-19E01 Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement.
 - (d) ASTM A1064/A1064M-24 Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 - (e) ASTM C920-18R24 Standard Specification for Elastomeric Joint Sealants.
 - (f) ASTM D1751-23, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Asphalt Types).
 - 1.2.2 CSA Group (CSA)
 - (a) CSA A23.1/A23.2-24, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - (b) CSA A3000-23, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - (c) CSA G30.18-21, Billet-Steel Bars for Concrete Reinforcement.
- 1.3 Administrative Requirements
 - 1.3.1 Preinstallation Meetings: convene preinstallation meeting one week before beginning concrete works.
 - (a) Ensure key personnel, site supervisor, Consultant attend.
 - (b) Verify project requirements.
- 1.4 Action and Informational Submittals
 - 1.4.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - 1.4.2 Product Data:

CAST-IN-PLACE CONCRETE – SHORT FORM

- (a) Submit manufacturer's instructions, printed product literature and data sheets for proprietary materials used in Cast-In-Place Concrete and additives and include product characteristics, performance criteria, physical size, finish and limitations.
- (b) Submit WHMIS Safety Data Sheet (SDS)
 - (i) Submit 2 copies of WHMIS SDS.

1.4.3 Shop Drawings:

- (a) Submit drawings stamped and signed by professional engineer registered or licensed in Alberta of Canada.
 - (i) Submit placing drawings prepared in accordance with plans to clearly show size, shape, location and necessary details of reinforcing.
 - (ii) Submit drawings showing formwork and falsework design to: CSA A23.1/A23.2.
- (b) Submit drawings stamped and signed by professional engineer registered or licensed in Alberta, Canada.

1.4.4 Samples:

- (a) Upon request, submit two (2) samples for review and acceptance of materials proposed for use as follows:
 - (i) curing compound
 - (ii) joint filler
 - (iii) waterstops

1.4.5 Provide testing, inspection results and reports for review by Consultant and do not proceed without written approval when deviations from mix design or parameters found.

1.4.6 Concrete hauling time: provide for review by Consultant deviations exceeding maximum allowable time of 120 minutes for concrete delivered to site of Work and discharged after batching.

1.4.7 Quality Assurance Submittals:

- (a) Submit in accordance with Section 01 43 00 - Quality Assurance.
- (b) Mill Test Report: upon request, submit to Consultant certified copy of mill test report of reinforcing steel, minimum 4 weeks before beginning reinforcing work].
- (c) Upon request submit in writing to Consultant proposed source of reinforcement material.

CAST-IN-PLACE CONCRETE – SHORT FORM

- (d) Upon request submit to Consultant epoxy coating applicator certificates identified in Quality Assurance.
- (e) Upon request, inform Consultant of source of fly ash.
 - (i) Changing source of fly ash without written approval of Consultant is prohibited.

1.5 Quality Assurance

1.5.1 Provide to Consultant, four (4) weeks minimum before starting concrete work, valid and recognized certificate from plant delivering concrete.

1.5.2 Quality Control Plan: provide written report to Consultant verifying compliance concrete in place meets performance requirements.

1.5.3 Mock-Ups:

- (a) Provide site mock-up for architectural finished concrete indicating forming methods and materials, and procedures proposed to achieve architectural finish in accordance with Section 01 43 00 - Quality Assurance, and to comply with following requirements, using materials indicated for completed work:
 - (i) Build mock-ups in location and of size as directed by Consultant.
 - (ii) Obtain Consultant's acceptance of mock-ups before starting construction; mock-up used throughout construction period and used as standard of acceptance for subsequent architectural concrete work.
 - (iii) Mock-up may form part of permanent structure when accepted by Consultant; repair or replace unacceptable mock-ups at no additional cost to Owner.
 - (iv) In presence of Consultant, damage part of exposed face for each finish, colour, and texture, and demonstrate materials and techniques proposed for repairs to match adjacent undamaged surfaces.

1.6 Delivery, Storage, and Handling

1.6.1 Delivery and Acceptance Requirements:

- (a) Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.
 - (i) Modifying maximum time limit without receipt of before written agreement from Consultant and concrete producer as described in CSA A23.1/A23.2 is prohibited.
 - (ii) Deviations submitted for review by Consultant.

CAST-IN-PLACE CONCRETE – SHORT FORM

- 1.6.2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.
- 1.6.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials.
- 1.7 Ambient Conditions
 - 1.7.1 Placing concrete during rain or weather events damaging to concrete is prohibited.
 - 1.7.2 Protect newly placed concrete from rain or weather events in accordance with CSA A23.1/A23.2.
 - 1.7.3 Cold weather protection:
 - (a) Maintain protection equipment, in readiness on Site.
 - (b) Use such equipment when ambient temperature below 5°C, or when temperature may fall below 5°C before concrete cured.
 - (c) Placing concrete upon or against surface at temperature below 5°C is prohibited.
 - 1.7.4 Hot weather protection:
 - (a) Protect concrete from direct sunlight when ambient temperature above 27°C.
 - (b) Prevent forms of getting too hot before concrete placed. Apply accepted methods of cooling not to affect concrete adversely.
 - 1.7.5 Protect from drying.

2.0 PRODUCTS

- 2.1 Design Criteria
 - 2.1.1 To CSA A23.1/A23.2, and as described in MIXES of PART 2 - PRODUCTS.
- 2.2 Performance Criteria
 - 2.2.1 Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established by Consultant and provide verification of compliance as described in PART 1 - QUALITY ASSURANCE.
- 2.3 Materials
 - 2.3.1 Portland Cement: Portland Cement in accordance with CAN/CSA A3001, Type GU Sulphate Resisting Portland Cement in accordance with CAN/CSA A3001, Type HS.
 - 2.3.2 Blended hydraulic cement: Type HSb to CAN/CSA A3001.

CAST-IN-PLACE CONCRETE – SHORT FORM

- 2.3.3 Supplementary cementitious materials: Type F fly ash replacement by mass of total cementitious materials to CAN/CSA A3001-08. Maximum CaO content of a maximum 12%.
- 2.3.4 Water: to CSA A23.1/A23.2.
- 2.3.5 Reinforcing bars:
 - (a) Billet steel, grade 400, deformed bars to CSA G30.18, unless indicated otherwise.
 - (b) Epoxy Coating of reinforcement: to ASTM A775/A775M.
- 2.3.6 Welded steel wire fabric:
 - (a) Deformed in accordance ASTM A1064/A1064M, fabricated from as drawn steel wire into flat sheets; sizes as indicated on Drawings.
 - (b) Finish:
 - (i) Galvanized: Fabricated from galvanized wire having Class A coating in accordance with ASTM A1064/A1064M.
 - (ii) Epoxy Coated: Epoxy coated after welding in accordance with ASTM A884/A884M, Class A coated <175 µm, Type 1 intended for use in concrete or masonry, colour contrasting with rust.
- 2.3.7 Premoulded joint filler:
 - (a) Bituminous impregnated fibreboard: to ASTM D1751.
- 2.3.8 Joint sealer/filler: grey to ASTM C920, Type M, Grade NS.
- 2.3.9 Sealer: proprietary poly-siloxane resin blend.
- 2.3.10 Other concrete materials: to CSA A23.1/A23.2.
- 2.4 Mixes
 - 2.4.1 Performance Method for specifying concrete: to meet Consultant performance criteria to CSA A23.1/A23.2.
 - (a) Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as described in PART 3 - VERIFICATION.
 - (b) Provide concrete mix to meet following hard state requirements:
 - (i) Durability and class of exposure: C-2.
 - (ii) Compressive strength at 28 day age: 32 MPa minimum. Concrete placed between September 30 and May 1 are to achieve minimum compressive strength in seven (7) days.
 - (iii) Maximum air void spacing factor: 230 µm.

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- (iv) Intended application: sidewalk, curb, and gutter.
- (v) Aggregate size 20 mm maximum.
- (vi) Air content: 5% to 8%.
- (vii) Type of Cement: GU, GUb, or HSb.
- (viii) Supplementary Cementing Materials: Type F (CaO content of Type F fly ash shall not exceed 12%), up to 20% by mass of total cementing materials.
- (ix) Maximum water-to-cementing materials ratio: 0.45.
- (c) Concrete supplier's certification.
- (d) Provide quality management plan to ensure verification of concrete quality to specified performance.

3.0 EXECUTION

3.1 Preparation

- 3.1.1 Provide Consultant 24 hours notice before each concrete pour.
- 3.1.2 Place concrete reinforcing in accordance with Section 03 20 00 - Concrete Reinforcing.
- 3.1.3 During concreting operations:
 - (a) Development of cold joints not allowed.
 - (b) Concrete delivery and handling to facilitate placing with minimum of rehandling, and without damage to existing structure or Work.
- 3.1.4 Protect previous Work from staining.
- 3.1.5 Clean and remove stains before application of concrete finishes.

3.2 Installation/Application

- 3.2.1 Do cast-in-place concrete work in accordance with CSA A23.1/A23.2 .
- 3.2.2 Sleeves and inserts:
 - (a) Cast in sleeves, ties, slots, anchors, reinforcement, frames, conduit, bolts, waterstops, joint fillers and other inserts required built-in.
 - (b) Sleeves and openings minimum 100 mm x 100 mm not indicated, reviewed by Consultant.

3.3 Finishes

- 3.3.1 Formed surfaces exposed to view: sack rubbed finish in accordance with CSA A23.1/A23.2.
- 3.3.2 Equipment pads: provide smooth trowelled surface.

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- 3.3.3 Pavements, walks, curbs and exposed site concrete:
 - (a) Screed to plane surfaces and use magnesium floats.
 - (b) Provide round edges and joint spacings using standard tools.
 - (c) Trowel smooth and provide lightly brushed non-slip finish.
- 3.4 Control Joints
 - 3.4.1 Cut and Form control joints in slabs on grade at locations indicated, to CSA A23.1/A23.2 and install specified joint sealer/filler.
- 3.5 Expansion and Isolation Joints
 - 3.5.1 Install premoulded joint filler in expansion and isolation joints full depth of slab flush with finished surface to CSA A23.1/A23.2.
- 3.6 Curing
 - 3.6.1 Use curing compounds compatible with applied finish on concrete surfaces free of bonding agents and to CSA A23.1/A23.2.
- 3.7 Site Tolerances
 - 3.7.1 Concrete floor slab finishing tolerance to CSA A23.1/A23.2.
- 3.8 Site Quality Control
 - 3.8.1 Concrete testing: to CSA A23.1/A23.2 by testing laboratory designated and paid for by Consultant.
- 3.9 Cleaning
 - 3.9.1 Progress Cleaning:
 - (a) Leave Work area clean at end of each day.
 - 3.9.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
 - 3.9.3 Use trigger operated spray nozzles for water hoses.
 - 3.9.4 Designate cleaning area for tools to limit water use and runoff.
 - 3.9.5 Clean concrete equipment.

END OF SECTION

CONCRETE FINISHING

1.0 GENERAL

- 1.1 Related Requirements
 - 1.1.1 Section 03 30 00 - Cast-in-place Concrete
- 1.2 Reference Standards
 - 1.2.1 ASTM International (ASTM)
 - (a) ASTM C309- 11, Liquid Membrane-Forming Compounds for Curing Concrete
 - 1.2.2 Canadian General Standards Board (CGSB)
 - (a) CAN/CGSB-25.20- [95], Surface Sealer for Floors
 - 1.2.3 CSA Group (CSA)
 - (a) CSA A23.1/A23.2- 14 & 19, Concrete Materials and Methods of Concrete Construction/ Test Methods and Standard Practices for Concrete
- 1.3 Action and Informational Submittals
 - 1.3.1 Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - 1.3.2 Product Data:
 - (a) Provide manufacturer's printed product literature and data sheets for concrete finishes and include product characteristics, performance criteria, physical size, finish and limitations.
 - (b) Submit WHMIS Safety Data Sheet (SDS).
 - (c) Include application instructions for concrete floor treatment [s].
 - 1.3.3 Samples:
 - (a) Minimum four (4) weeks prior to beginning Work, submit two (2) samples for review and acceptance of materials proposed for use as follows:
 - (i) five (5) L of chemical hardeners.
 - (ii) five (5) L of sealing compounds.
 - (iii) five (5) L of curing compound.
 - (iv) five (5) L of concrete stains.
- 1.4 Quality Assurance
 - 1.4.1 Quality Assurance: in accordance with Section 01 43 00 - Quality Requirements.
 - 1.4.2 Minimum 4 weeks prior to starting concrete finishing work, provide proposed quality control procedures for review by Consultant on following items:
 - (a) Hardening.

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- (b) Sealing.
 - (c) Curing.
 - (d) Finishes.
- 1.5 Delivery, Storage, and Handling
 - 1.5.1 Deliver, store and handle materials in accordance with Section 01 63 00 – Products/Workmanship and with manufacturer's written instructions.
 - 1.5.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name, and address.
- 1.6 Site Conditions
 - 1.6.1 Temporary lighting: Minimum 1200 W light source, placed 2.5 m above slab surface, for each 40 m² of slab being treated.
 - 1.6.2 Electrical power: Provide sufficient electrical power to operate equipment normally used during construction.
 - 1.6.3 Work area: Make work area watertight protected against rain and detrimental weather conditions.
 - 1.6.4 Temperature: Maintain minimum 10 degrees C ambient temperature for 7 days before installation and minimum 48 hours after completion of work and maintain relative humidity maximum 40 % during same period.
 - 1.6.5 Moisture: Ensure concrete substrate is within moisture limits prescribed by manufacturer.
 - 1.6.6 Safety: Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.
 - 1.6.7 Ventilation:
 - (a) Ventilate enclosed spaces.
 - (b) Provide continuous ventilation during and after coating application.

2.0 PRODUCTS

- 2.1 Performance Requirements
 - 2.1.1 Product quality and quality of work in accordance with Section 01 63 00 – Products/Workmanship.
 - 2.1.2 Submit written declaration components used compatible and not adversely affect finished flooring products and their installation adhesives.
- 2.2 Chemical Hardeners
 - 2.2.1 As required by the Contractor's Engineer.

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- 2.2.2 Water: potable.
- 2.3 Sealing Compounds
 - 2.3.1 Surface sealer: acrylic carnuba wax.
 - 2.3.2 Surface sealers not contain aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium hexavalent chromium and any other harmful chemicals.
 - 2.3.3 To be NSF 61 Compliant.
- 2.4 Curing Compounds
 - 2.4.1 Waterborne membrane forming curing membrane to ASTM C309, Class B and as directed by the Contractor's Engineer.
 - (a) Verify compatibility with subsequent finishes.
- 2.5 Concrete Stains
 - 2.5.1 Select non-VOC, water-based concrete stains.
- 2.6 Mixes
 - 2.6.1 Mixing ratios in accordance with manufacturer's written instructions.

3.0 EXECUTION

- 3.1 Examination
 - 3.1.1 Verify concrete surfaces are ready to receive work and elevations as indicated on shop drawings recommended by manufacturer's written instructions.
- 3.2 Preparation of Existing Slab
 - 3.2.1 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radius edges unless otherwise indicated.
 - 3.2.2 Saw cut control joints to CSA A23.1, 24 hours maximum after placing of concrete.
 - 3.2.3 Use strong solvent mechanical stripping to remove chlorinated rubber or existing surface coatings.
 - 3.2.4 Use protective clothing, eye protection, respiratory equipment, during stripping of chlorinated rubber or existing surface coatings.
- 3.3 Concrete Staining
 - 3.3.1 Coordinate with Section 03 30 00 - Cast-in-place Concrete for wet curing. Liquid curing compounds not permitted under staining.
 - 3.3.2 Cure concrete for minimum 60 days.
 - 3.3.3 Clean and prepare concrete in accordance with manufacturers written instructions.

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- 3.3.4 Apply two (2) coats of chemical stain materials in accordance with manufacturers written instructions; obtain Contractor Engineer's acceptance after application of both first and second coats.
 - 3.3.5 Apply recommended cure/seal materials in accordance with manufacturer's written instructions.
- 3.4 Application
 - 3.4.1 Apply concrete finishing floor hardener in accordance with manufacturer's written instructions.
 - 3.4.2 After floor treatment dry, seal control joints and joints at junction with vertical surfaces with sealant.
 - 3.4.3 Apply floor treatment in accordance with Sealer manufacturer's written instructions.
 - 3.4.4 Clean over spray. Clean sealant from adjacent surfaces.
- 3.5 Cleaning
 - 3.5.1 Progress Cleaning: Leave Work area clean at end of each day.
 - 3.5.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
- 3.6 Protection
 - 3.6.1 Protect finished installation in accordance with manufacturer's instructions.

END OF SECTION

1.0 GENERAL

1.1 Related Requirements

- 1.1.1 Section 03 20 00 – Concrete Reinforcing
- 1.1.2 Section 03 10 00 – Concrete Forming and Accessories
- 1.1.3 Section 03 35 00 – Concrete Finishing

1.2 Reference Standards

1.2.1 ASTM International (ASTM)

- (a) ASTM A123/A123M - 17 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- (b) ASTM A775/A775M- 17, Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
- (c) ASTM A884/A884M- 14 Epoxy-Coated Steel Wire and Welded Wire Reinforcement.
- (d) ASTM A 1064/A 1064M- 16b, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- (e) ASTM C260/C260M- 10a (2016), Standard Specification for Air-Entraining Admixtures for Concrete.
- (f) ASTM D412- 16, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension.
- (g) ASTM D2240- 15, Standard Test Method for Rubber Property - Durometer Hardness.

1.2.2 CSA Group (CSA)

- (a) CSA A23.1/A23.2- 19, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
- (b) CSA A23.3- 19, Design of Concrete Structures.
- (c) CAN/CSA-A23.4- 16, Precast Concrete - Materials and Construction.
- (d) CAN/CSA- A3000- 18, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
- (e) CAN/CSA-G30.18- 09(R2014), Carbon steel bars for concrete reinforcement.
- (f) CAN/CSA-G40.20/G40.21- 13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- (g) CAN/CSA-G164- M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

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- (h) CSA G279- M1982 (R1998), Steel for Prestressed Concrete (Metric Version).
 - (i) CSA S6- 14, Canadian Highway Bridge Design Code.
 - (j) CSA W47.1- 09 (R2014), Certification of Companies for Fusion Welding for Steel.
 - (k) CSA W48- 14, Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).
 - (l) CSA W59 2013, Welded Steel Construction (Metal Arc Welding) (Metric version).
 - (m) CSA W186- M1990 (R2016), Welding of Reinforcing Bars in Reinforced Concrete Construction.
- 1.2.3 The Master Painters Institute (MPI)
 - (a) MPI # 18, Organic Zinc Rich Primer.
 - (b) MPI # 23, Primer, Metal, Surface Tolerant.
- 1.2.4 ULC Standards
 - (a) CAN/ULC-S701- 11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- 1.3 Design Requirements
 - 1.3.1 Design precast elements to CSA A23.3 and CAN/CSA A23.4 to carry handling stresses.
 - 1.3.2 Design precast elements to carry loads in accordance with applicable codes.
 - 1.3.3 Carry out vibration analysis and test if and as required by the Contractor's Engineer.
 - 1.3.4 Design connections/attachments of precast elements to load/forces specified by Contractor's Engineer.
 - 1.3.5 Provide detailed calculations and design drawings for typical precast elements and connections as described in PART 1 - SUBMITTALS.
- 1.4 Performance Requirements
 - 1.4.1 Tolerance of precast elements to CAN/CSA-A23.4 .
 - 1.4.2 Length of precast elements as indicated by the Contractor's Engineer.
 - 1.4.3 Cross sectional dimensions of precast elements as indicated by the Contractor's Engineer.
 - 1.4.4 Deviations from straight lines as indicated by the Contractor's Engineer.

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- 1.4.5 Precast elements not to vary as indicated by the Contractor's Engineer from true overall cross-sectional shape as measured by difference in diagonal dimensions.
- 1.5 Action and Informational Submittals
 - 1.5.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - 1.5.2 Product Data:
 - (a) Submit manufacturer's instructions, printed product literature and data sheets for proprietary materials used in Precast Structural Concrete and include product characteristics, performance criteria, physical size, finish and limitations.
 - (b) Submit WHMIS Safety Data Sheet (SDS).
 - 1.5.3 Shop Drawings:
 - (a) Submit drawings stamped and signed by qualified professional engineer registered or licensed in Alberta of Canada.
 - (b) Submit shop drawings prepared in accordance with CSA A23.3 and CAN/CSA-A23.4 and include following items:
 - (i) Design calculations for items designed by manufacturer.
 - (ii) Details of prestressed and non-prestressed members, reinforcement and connections.
 - (iii) Camber.
 - (iv) Finishing schedules.
 - (v) Methods of handling and erection.
 - (vi) Openings, sleeves, inserts and related reinforcement.
 - (c) Submit 2 copies of detailed calculations and design drawings for typical precast elements and connections for review by Consultant 4 weeks before manufacture.
 - 1.5.4 Samples:
 - (a) Submit samples in accordance with Section 01 33 00 - Submittal Procedures and provide sample and sample number of each finish used on project to Consultant.
 - 1.5.5 Quality Assurance Submittals:
 - (a) Submit in accordance with Section 01 43 00 - Quality Requirements and as described in PART 2 - SOURCE QUALITY CONTROL.
 - (b) Mill Test Report: Submit to Consultant certified copy of mill test report of reinforcing steel, minimum 4 weeks before beginning reinforcing work.

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- (c) Submit in writing to Consultant proposed source of reinforcement material.
- (d) Submit in writing to Consultant epoxy coating applicator certificates identified in Quality Assurance.
- (e) Provide quality management plan to ensure verification of concrete quality to specified performance.
- (f) Submit concrete supplier's certification.

1.6 Quality Assurance

- 1.6.1 Quality Control Plan: submit written report, to Consultant verifying concrete provided meets performance requirements of concrete as established in PART 2 - PRODUCTS.
- 1.6.2 Precast concrete manufacturers to be certified to an appropriate Canadian Precast Concrete Quality Assurance (CPCQA) Certification before the time of bid.
- 1.6.3 Only precast elements fabricated under the CPCQA plant certification program to be acceptable, and plant certification is to be maintained for the duration of fabrication, erection, and until warranty expires.

1.7 Qualifications

- 1.7.1 Precast concrete manufacturer certified in accordance with CSA's certification procedures for precast concrete plants before submitting Bid and to verify as part of Bid that plant has current certification in appropriate categories.
- 1.7.2 Welding companies certified to CSA W47.1 .

1.8 Delivery, Storage and Handling

- 1.8.1 Deliver, handle and store precast/ units according to manufacturer's instructions.
- 1.8.2 Protect unit corners from contacting earth to prevent from staining.

1.9 Warranty

- 1.9.1 Warrant precast element not to spall or show visible evidence of corrosion of embedded steel and cracking, except for normal hairline shrinkage cracks, in accordance with General Conditions (GC) - CCDC GC 12.3, but for 2 years.
- 1.9.2 Warrants precast elements not to spall or show visible evidence of cracking, except for normal hairline shrinkage cracks, in accordance with subsection GC 32.1 of General Conditions "C", but warranty period extended to 24 months.

2.0 PRODUCTS

2.1 Materials

- 2.1.1 Cement to CAN/CSA-A3001, Type GU.

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- 2.1.2 Blended hydraulic cement: type GU to CAN/CSA-A3001 as indicated by the Contractor's Engineer.
- 2.1.3 Supplementary cementitious materials (SCM): with minimum 20 % Type as indicated by the Contractor's Engineer fly ash replacement, by mass of total cementitious materials to CAN/CSA-3001 .
- 2.1.4 Water: to CSA 23.1/A23.2.
- 2.1.5 Reinforcing steel: to CSA 30.18, epoxy coated.
- 2.1.6 Prestressing steel tendons and bars: to CSA S6.
- 2.1.7 Welded wire fabric:
 - (a) In accordance ASTM A1064/A1064M, fabricated from as drawn steel wire into flat sheets; sizes as indicated on Drawings.
 - (b) Finish:
 - (i) Galvanized: Fabricated from galvanized wire or Hot dip galvanized after welding having Class A coating in accordance with ASTM A641/A641M .
 - (ii) Epoxy Coated: Epoxy coated after welding in accordance with ASTM A884/A884M, Class A coated <175 µm, Type 1 intended for use in concrete or masonry, colour contrasting with rust.
- 2.1.8 Hardware and miscellaneous materials: to CSA A23.1/A23.2 .
- 2.1.9 Forms: to CAN/CSA-A23.4 .
- 2.1.10 Anchors and supports: to CAN/CSA-G40.20/G40.21 Type 300 W epoxy coated or galvanized after fabrication] .
- 2.1.11 Welding materials: to CSA W48.
- 2.1.12 Welding electrodes: to CSA W48 certified by Canadian Welding Bureau.
- 2.1.13 Galvanizing: hot dipped galvanizing with minimum zinc coating of 610 g/m² to CAN/CSA-G164 and ASTM A 123/123M, Coating Grade 85.
- 2.1.14 Epoxy coating: to ASTM A775/A775M .
- 2.1.15 Steel primer: to MPI #23.
- 2.1.16 Zinc-rich primer: to MPI#18.
- 2.1.17 Post-tensioning ducts: to CSA A23.1/A23.2 .
- 2.1.18 Bearing pads: smooth, high impact plastic or steel.
- 2.1.19 Bearing pads: neoprene, durometer hardness to ASTM D2240, and minimum tensile strength to ASTM D412, moulded to size or cut from moulded sheet.
- 2.1.20 Air entrainment admixtures: to ASTM C260/C260M.

- 2.1.21 Chemical admixtures: to ensure potable water safe.
- 2.1.22 Shims: plastic.
- 2.1.23 Weephole tubes: purpose made galvanized steel or plastic.
- 2.1.24 Insulation: Extruded or expanded polystyrene to CAN/ULC-S701.
- 2.2 Mixes
 - 2.2.1 Concrete:
 - (a) Alternative 1 - Performance Method for specifying concrete: to meet performance criteria in accordance with CSA A23.1/A23.2 .
 - (i) Ensure concrete supplier meets performance criteria as established below and provide verification of compliance.
 - (ii) Provide concrete mix to meet following plastic state requirements:
 - (iii) Provide concrete mix to meet following hard state requirements:
 - 2.2.2 Alternative 2 - Prescriptive Method for specifying concrete: owner's concrete mix to CSA A23.1/A23.2 .
 - (a) Ensure materials used in concrete mix have been submitted for testing and meet requirements of CSA A23.1/A23.2 .
 - (b) Coordinate construction methods to suit Consultant concrete mix proportions and parameters.
 - (c) Identify and report immediately to Consultant when concrete mix design and parameters pose anticipated problems or deficiencies related to construction.
 - (d) Consultant to proportion concrete mix for normal HVSCM including:
 - (i) Class of exposure: as indicated by the Contractor's Engineer.
 - (ii) Intended application: as identified in Contact Drawings.
 - (iii) Aggregate: as indicated by the Contractor's Engineer.
 - (iv) Admixture: as indicated by the Contractor's Engineer.
 - (v) Supplementary cementitious materials (SCM): as indicated by the Contractor's Engineer.
 - (vi) Water: as indicated by the Contractor's Engineer.
 - (vii) Air content category: as indicated by the Contractor's Engineer.
 - (viii) Slump: as indicated by the Contractor's Engineer..
 - (ix) Quality Plan: as indicated by the Contractor's Engineer. .
 - 2.2.3 Grout :

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- (a) Cement grout: Sufficient water for placement and hydration. Type as indicated by the Contractor's Engineer.
- (b) Minimum compressive strength: as indicated by the Contractor's Engineer.
- (c) Shrinkage compensating grout: to Section 03 30 00 - Cast-in-Place Concrete.

2.3 Fabrication

- 2.3.1 Precast fabrication to meet the requirements of CAN/CSA-A23.4, including Annexes A and B, PCI MNL-116 and 117 and CPCQA certification requirements.
- 2.3.2 Mark each precast unit to correspond to identification mark on shop drawings for location with date cast in location not exposed in finished work.
- 2.3.3 Cast members in accurate rigid moulds designed to withstand high frequency vibration. Set reinforcing anchors and auxiliary items to indicated on shop drawings. Cast in anchors, blocking and inserts supplied by other Sections as required to accommodate their work. Vibrate concrete during casting for full thickness. Provide necessary holes and sinkages for flashings, anchors, and cramps. Maintain even and uniform appearance.
- 2.3.4 Anchors, lifting hooks, shear bars, spacers and other inserts or fittings required for a complete and rigid installation. Each to conform to requirements of local codes. Lift hooks adequately sized to safely handle panels according to member dimension and weight. Conceal anchors and inserts where practical.
- 2.3.5 Provide thick insulation as indicated by the Contractor's Engineer at each cell end of floor units of hollow core design.
- 2.3.6 Design tendons and anchorages and install post tensioning ducts in accordance with CSA A23.3.
- 2.3.7 Shop prime anchors and steel inserts after fabrication and touch up primer on anchors after welding. Do not apply primer to embedded portion of anchor or inserts.
- 2.3.8 Galvanize anchors and steel embedments after fabrication and touch up with zinc-rich primer after welding.

2.4 Finishes

- 2.4.1 Finish units to CAN/CSA-A23.4 .

2.5 Source Quality Control

- 2.5.1 Provide Consultant with certified copies of quality control tests related to this project as specified in [CAN/CSA-A23.4.
- 2.5.2 Inspect concrete tendons in accordance with CSA-G279 .

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- 2.5.3 Provide records from in-house quality control program based upon plant certification requirements to Consultant for inspection and review.
- 2.5.4 Provide Consultant with certified copy of mill test report of reinforcing steel supplied, showing physical and chemical analysis.
- 2.5.5 Precast plants to keep complete records of supply source of concrete material, steel reinforcement, prestressing steel and provide to Consultant for review upon request.

3.0 EXECUTION

3.1 Erection

- 3.1.1 Precast concrete work in accordance with CAN/CSA-A23.4, CSA A23.3, and CSA S6.
- 3.1.2 Welding in accordance with CSA-W59, for welding to steel structures and CSA-W186, for welding of reinforcement.
- 3.1.3 Erect precast elements within allowable tolerances as indicated.
- 3.1.4 Non-cumulative erection tolerances in accordance with CAN/CSA-A23.4 .
- 3.1.5 Set elevations and alignment between units to within allowable tolerances before connecting units.
- 3.1.6 Grout underside of unit bearing plates with shrinkage compensating grout.
- 3.1.7 Fasten precast units in place as indicated on approved shop drawings.
- 3.1.8 Secure with bolts using lockwashers or tack-weld nut to bolt.
- 3.1.9 Uniformly tighten bolted connections with torque indicated.
- 3.1.10 Do not weld or secure bearing plates at sliding joints.
- 3.1.11 Install precast concrete closures between stems of flanged units where indicated.
- 3.1.12 Use grout to align elevations of surfaces at joints. Slope grout maximum 1:12. Key in grout to thickness as indicated by the Contractor's Engineer.
- 3.1.13 Clean site welds with wire brush and touch-up shop primer with primer or galvanized finish with zinc-rich primer.

3.2 Cleaning

- 3.2.1 Progress Cleaning: leave Work area clean at end of each day.
- 3.2.2 Use cleaning methods as reviewed by Consultant before cleaning soiled precast concrete surfaces.
- 3.2.3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

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FOOTHILLS OKOTOKS REGIONAL WATER PROJECT
RAW WATER RESERVOIR

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END OF SECTION

DIVISION 31 – EARTHWORKS

All Earthworks are to comply with and follow the below order of precedence:

1. FORW – Reservoir Geotechnical Design Report – Revision 1 (April 2025)
2. Town of Okotoks Infrastructure Design & Construction Specification 2024
3. City of Calgary Road Construction 2021 Standard Specifications

The Geotechnical Report is included in the *Contract Documents*. The remaining specifications are linked below.

Reference Town of Okotoks Specifications

- Town of Okotoks Infrastructure Design & Construction Specification 2024
 - <https://www.okotoks.ca/sites/default/files/2024-09/Infrastructure%20Design%20and%20Construction%20Specifications%202024.pdf>

Reference City of Calgary Specifications

- Road Construction 2021 Standard Specifications
 - <https://www.calgary.ca/content/dam/www/transportation/roads/documents/contractors-and-consultants/roads-construction-2021-standard-specifications.pdf>

END OF SECTION

GEOTECHNICAL INSTRUMENTS

1 GENERAL

- 1.1 This section specifies requirements for the Geotechnical Instruments to be installed during the work.
- 1.2 The geotechnical instruments are to be installed after construction completion of the reservoir but prior to reservoir filling. Instruments to be installed includes two slope inclinometers and six standpipe piezometers.
- 1.3 Any conflicts between the drawings and specifications with the manufacturer's requirements are to be brought to the attention of the Engineer before ordering any materials. Should the manufacturer require additional parts, materials, or quality checks to be added or completed as part of the work to meet the manufacturer's requirements and to obtain a warranty, the contractor is to include those materials and methods.

1.2 DEFINITIONS

- .1 Engineer means the geotechnical engineer overseeing the site supervision on behalf of the designer.
- .2 Owner means the Town of Okotoks and Foothills County or any entity duly authorized to act on behalf of the owner.
- .3 Contractor refers to the company or consortium contracted to carry out the Foothills Okotoks Regional Water Project construction and related works per the tender documents' specifications, drawings, and conditions.
- .4 Specifications or Technical Specifications means the content of this document.
- .5 Drawings means all drawings, plans, sketches, and directions issued in writing from the Engineer or Owner with the specifications pertaining to the Foothills Okotoks Regional Water Project.
- .6 Permission refers to authorization by Owner, or Engineer in writing and includes any of the following words in their general meaning of their use: "accepted", "approved", "directed", "permitted", "required", "receipt", "rejected", or "satisfactory".
- .7 Direction, unless otherwise expressly stated, incremental in part or whole for the works, the permission to proceed with the construction of the works based on the specification requirements or at the direction by Owner or Engineer in writing includes any of the following words in their general meaning of their use: "acceptance", "approval", "direction", "permission", "rejection", "requirements", or "satisfaction".
- .8 Instrument refers to geotechnical instruments and shall include groundwater monitoring points, ground movement and structural deformation monitoring points and the like.
- .9 Instrumentation refers to the instruments, all associated apparatus, connecting leads/cables/tubes, readout or recording equipment, and any housing or protection systems. it encompasses the installation, regular calibration and testing, maintenance,

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data collection and processing, data interpretation, and data presentation of instruments placed in or on the ground or structures. This is done to provide information on ground conditions and to monitor specific variations from ambient levels for geotechnical design, construction control, and performance monitoring purposes.

- .10 Datum Station refers to a stable mark for which the horizontal and vertical locations have been fixed, and which is to be used as a reference station in a monitoring or control survey.
- .11 Accuracy refers to an instrument's ability to measure compared to the true value.
- .12 Precision quantifies the ability of a typical sensor to produce the same reading again and should be qualified by a confidence interval (e.g. 99% confidence).
- .13 Resolution describes the smallest change in measurement that can be captured.
- .14 Non-linearity describes the distortion of what is measured compared to the true field value.
- .15 Repeatability refers to the ability of a sensor to produce uniform data.
- .16 Sensor Noise refers to the changes in measurement that occur within the specified range of precision.
- .17 Words importing the singular shall include the plural and vice versa, words importing the masculine gender shall include the feminine, and words importing persons shall include legal entities such as companies and proprietorships.
- .18 Reference to the specifications and drawings, unless expressly stated, includes any of the following words in the general meaning of their use: "detailed", "indicated", "seen", "shown", "specified", or other synonymous words.

1.3 REFERENCES

- .1 Provide geotechnical instruments in accordance with the following standards (latest revision), except where specified otherwise.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.40 Anticorrosive Structural Steel Alkyd Primer.
- .3 American Society for Testing and Materials (ASTM)
 - .1 ASTM C99 Standard Test Method for Flow of Grout for Preplaced Aggregate Concrete (Flow Cone Method)
 - .2 ASTM A53 Specification for Structural Steel Pipe, Steel, Black and Hot Dipped, Zinc-Coated Welded and Seamless.

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| .3 | ASTM C150 | Standard specification for Portland cement. |
| .4 | ASTM D1785 | Standard specification for polyvinyl chloride (PVC), plastic pipe, schedules 40, 80, and 120. |
| .5 | ASTM A312/A312M | Standard specification for seamless, welded, and heavily cold-worked austenitic stainless-steel pipes. |
| .6 | ASTM D6286 | Standard guide for selection of drilling and direct push methods for geotechnical and environmental subsurface site characterization. |
| .7 | ASTM D5720 | Standard practice for static calibration of electronic transducer-based pressure measurement systems for geotechnical purposes. |
| .8 | ASTM F480 | Standard specification for thermoplastic well casing pipe and couplings made in standard dimension ratios (SDR), SCH 40 and SCH 80. |
| .9 | ASTM 36 | Standard Specification for Carbon Structural Steel. |
| .4 | U.S. Army Corps of Engineers (USACE) | |
| .1 | EM 1110-1-1002 | Survey markers and monumentations. |
| .2 | EM 1110-2-1908 | Instrumentation of embankment dams and levees. |
| .3 | ER 1110-1-1807 | Drilling in earth embankment dams and levees. |
| .5 | Canadian Standards Association (CSA) | |

1.4 SUBMITTALS

- | | |
|----|--|
| .1 | Provide the following submittals in accordance with Section 01330 - Submittal Procedures. |
| .1 | The name, qualifications, and relevant experience of the company and personnel who will install the geotechnical instruments at least thirty (30) calendar days prior to their installation. |
| .2 | Product Data: |

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- .1 Detailed descriptions for all the instruments and associated equipment, fourteen (14) calendar days prior to their purchase.
- .2 The manufacturer's installation and operation instructions as well as Operation and maintenance manuals for each instrument prior to delivery to the Site.
- .3 All manufacturer calibration sheets upon delivery to the site.
- .3 Shop Drawings:
 - .1 A detailed description of the drilling and sampling equipment at least 30 calendar days prior to mobilizing the equipment to the Site.
 - .2 A drawing illustrating the layout of the instrumentation enclosures, fourteen (14) days prior to purchasing the instrumentation enclosure or instrumentation. The drawing is to be completed to scale and is to include all dataloggers and support equipment.
 - .3 Marker sign diagrams are to be submitted fourteen (14) calendar days prior to their ordering.
- .4 Pre-installation Acceptance Checklist:
 - .1 Blank pre-installation acceptance test record forms for each instrument type shall be submitted for review by the Engineer fourteen (14) calendar days prior to installing the first instrument of each type.
 - .2 Completed instrumentation checklist 48 hours before installing each instrument.
- .5 Details of the installation procedures to be used for the instruments at least 14 calendar days prior to their installation.
- .6 A copy of the daily field log of the drilling and installation operations within forty-eight (48) hours. Daily field logs shall include, but not be limited to:
 - .1 Project Name.
 - .2 Instrument ID.
 - .3 Instrument type and number, including readout unit type(s), trade name, model number, and Manufacturer's name.
 - .4 Planned horizontal and vertical installation location.
 - .5 Planned backfill lengths and volumes.
 - .6 Names of personnel responsible for installation.

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- .7 Plant and equipment used.
- .8 Installation start and end times.
- .9 Measurements or readings taken at hold points during installation. Readings provided by the Engineer.
- .10 Backfilling, sealing, and grouting material details.
- .11 As-built horizontal and vertical position (accuracy $\pm 1-2$ mm).
- .12 Weather conditions during installation.
- .13 Description of any delays or equipment failures.
- .14 Notes on any events that may affect instrument behaviour.
- .15 A dimensioned sketch of each instrument installation, showing the component layout and surrounding material context.

1.5 QUALITY CONTROL

- .1 Provide qualified personnel with experience in the drilling methods and installation of the geotechnical instruments to be used in the work, to direct and supervise the work required by this section.
- .2 Provide sonic and rotary drilling rigs equipped for geotechnical drilling and sampling and operated by personnel experienced in installation of the geotechnical instruments to be installed. The rotary drilling equipment must be suitable for high quality core recovery in shale sedimentary bedrock. The Engineer may authorize that some of the installation tasks can be completed by the Contractor's personnel (not a drilling subcontractor), provided that they have the necessary experience and have demonstrated competence in the completion of such tasks.
- .3 A pre-installation checklist for the acceptance tests shall be prepared and pre-installation acceptance tests shall include relevant items from the following list:
 - .1 Verify that the quantities received correspond to quantities ordered.
 - .2 Inspect all components for signs of damage incurred during transit.
 - .3 Verify, by comparing with procurement document, that model, dimensions, and materials are correct.
 - .4 Examine factory calibration curve and tabulated data, to verify completeness.
 - .5 Review Manufacturer's final Quality Assurance inspection checklist, to verify completeness.

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- .6 Verify serial numbers on each instrument and ensure the corresponding calibration data sheet is included.
- .7 Verify the cable length, if applicable.
- .8 Verify that all components fit together properly in the correct configuration.
- .9 Complete any and all preinstallation checks that are recommended by the manufacturer.
- .10 An instrument that fails the specified pre-installation acceptance test shall be either: Repaired such that it passes a subsequent pre-installation acceptance test, or Replaced with an identical, fully compliant instrument at no additional cost.
- .4 Maintain a daily log of the drilling and instrumentation installation operations.
- .5 Contractor to measure and record mud density and marsh funnel viscosity for each batch of grout.

1.6 QUALITY ASSURANCE

- .1 The Engineer will observe and assist in the pre-installation acceptance tests, calibration and post-installation acceptance tests of each instrument.
- .2 The Engineer will provide the final locations and depths for each instrument.
- .3 The Engineer will monitor the instruments after their installation and report any defects to the Contractor.
- .4 The Engineer reserves the right to reject any work that in the Engineer's opinion is of poor quality. This may include but not limited to poor sample recovery while drilling, damage to samples, and apparent damage to instruments during installation. Continued rejections may require that the drilling supervisor, and/or drilling equipment be replaced.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Inspect each shipment of material and timely replace any damaged materials.
- .2 Handle and store products in accordance with the manufacturer's recommendations and protect them from damage, contamination, or deterioration. Store all packaged or bundled products in their original packaging with the manufacturer's seals and labels intact. Do not remove products from the packaging or bundling until required.
- .3 All instruments shall be protected from damage at all times. Appropriate measures shall be implemented to ensure that instruments are not disturbed and that their functionality and performance remain unimpaired throughout handling, storage, installation, and construction.

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- .4 Instruments shall not be exposed to temperatures outside the Manufacturer's stated working temperature range.

2 PRODUCTS

2.1 GENERAL

- .1 Instrumentation to be provided by RST Instruments Ltd., Durham Geo Slope Indicator, or a similar reputable geotechnical instrumentation supplier, approved by the Engineer. All instruments of the same type are to be from the same manufacturer and are to be paired with matching dataloggers as applicable. All instruments shall be manufactured by companies with proven experience. Only instruments that are well-established and recognized for a high degree of reliability and success shall be used. Typically, this means that similar equipment must have been used on engineering sites for a minimum of five (5) years in environments comparable to the one intended for this project.
- .2 All materials, designs, and construction shall be of the highest quality to ensure robust, corrosion-resistant, and, where applicable, vibration-resistant installations. Instruments embedded in concrete shall be capable of withstanding vibrations from compacting equipment
- .3 All geotechnical instruments and their accessories supplied by the Contractor shall be new. Instruments shall be delivered complete with all necessary cabling, connectors, monitoring equipment, readout units, and any additional tools required for installation, calibration, commissioning, and maintenance.
- .4 The Contractor shall maintain on-site a sufficient stock of spare parts, of appropriate types and quantities, to prevent delays during routine maintenance or when replacing damaged instrument components.
- .5 The instrument Manufacturer shall provide drawings and data sheets describing the principal features, operating mode, measurement range, and degree of accuracy, including reading repeatability, of the equipment. All items shall be manufactured in accordance with the Manufacturer's Drawings. All instruments supplied shall be unused at the time of installation.
- .6 The Contractor shall be responsible for calculating the required quantity of materials based on the Drawings and Specifications.
- .7 The Contractor shall bear all costs associated with delays, material quantity or volume shortfalls due to miscalculations, or rework required as a result of failure to meet material, placement, or installation specifications.

2.2 MATERIALS

- .1 Provide materials in accordance with the following:
- .1 Inclinator casing:
- .1 Inclinator casing, approximately 70 or 85 mm outside diameter, depending on location. Casing to have biaxial guide grooves. When

GEOTECHNICAL INSTRUMENTS

required, the telescoping sections must be from the same manufacturer and be the same size as the non-telescoping sections.

- .2 Casing not to have more than 0.1° (angular measure) per metre length of twist at any temperature between +25°C and –25°C, and under axial loading (tension or compression) equal to the weight of 50 m (minimum) of the casing.
 - .3 Couplings and all recommended accessories, including screws, rivets, lubricant, casing anchor, telescopic section, grout cap, and waterproof tape to provide a waterproof, non-rotating joint.
- .2 Standpipe Piezometer Pipe:
- .1 Standpipe Piezometer Pipe, approximately 50 mm inside diameter schedule 40 PVC, with threaded connections.
 - .2 Screened pipe machine slotted to 0.25 mm.
 - .3 All accessories, including end caps, are to be PVC, and specifically intended to be used with Schedule 40 PVC pipe. Bottom caps are to be simple female slip end caps affixed to the pipe. Top cap to be threaded with a male plug.
- .3 Stickup Protectors:
- .1 Steel casings and lockable caps, in accordance with ASTM A53 and ASTM A36, respectively, as specified by the Contract Documents.
 - .2 Paint the exterior of all steel casings as well as the interior and exterior of all caps against corrosion with two (2) coats of red coloured oil alkyd paint in accordance with CAN/GGSB-1.40.
 - .3 All stickup protectors to be installed a minimum of 300 mm below the finished ground surface and to the dimensions specified in the Contract Documents.
- .4 Backfill Materials:
- .1 The Contractor shall provide bentonite chips or pellets for backfilling instrumentation boreholes as shown on the drawings. Bentonite pellets shall be premium-grade natural sodium montmorillonite and shall have a maximum chip size of 9.53 mm and a minimum chip size of 6.35 mm.
 - .2 Concrete shall be used for prism survey monument.
 - .3 The Contractor shall provide sand for backfilling standpipe piezometers borehole as shown on the Drawings. Sand shall be clean natural sand that meets the requirements for fine filter sand Zone 3A.

GEOTECHNICAL INSTRUMENTS

- .4 Grout:
 - .1 Cement/bentonite grout: A liquid slurry consisting of water, Portland cement, and powdered bentonite proportioned by weight unless noted otherwise for specific instruments. (table in 3.12) Mix the cement and water first, then add the dry bentonite to the slurry.
 - .2 Thoroughly mix the grout from precisely recorded weights and volumes of materials using a paddle-type mechanical mixer or re-circulate through a pump until all lumps are disintegrated.
 - .3 Revise the grout mix proportions as directed by the Engineer based on encountered soil and rock conditions and testing during the work.

3. EXECUTION

3.1 GENERAL

- .1 Install all products in accordance with the manufacturer's written recommendations or as directed by the Engineer.
- .2 Obtain the Engineer's authorization prior to the installation of each instrument component and prior to covering any instrument or component thereof.
- .3 Install geotechnical instruments and their components, holes for instrument installation, instrumentation trenches, lead rise ducts, and the like at the locations, depths, elevations, and alignments specified in the Contract Documents. Confirm information with the Engineer prior to installation.
- .4 Contractor is responsible for all instruments until overall project has reached substantial completion. Any instruments that become non-functional prior to substantial completion are to be repaired or replaced to the satisfaction of the Engineer without delay.

3.2 EXISTING INSTRUMENTATION

- .1 The Contractor shall maintain and protect existing instrumentation unless specified otherwise in the Contract Documents.
- .2 The Contractor shall protect all existing instrumentation to remain undamaged and operational. Promptly repair or replace any existing instrumentation which has been damaged by the Contractor's operations, at no additional cost.

3.3 DRILLING EQUIPMENT

- .1 Provide a self-propelled drill rigs and support equipment, and rated for drilling boreholes in soil and sedimentary bedrock up to 15 m in depth.

GEOTECHNICAL INSTRUMENTS

- .2 Obtain the Engineer's authorization to drill holes larger than specified.
- .3 Provide a drilling rig equipped with front and rear levelling devices to drill vertical holes.
- .4 The Contractor shall provide soil and rock sampling equipment.
- .5 Provide a 1,200 L minimum capacity mixer and 10 L/s pump capable of handling thick bentonite/cement and cement/bentonite grout. Provide a tremie pipe to allow pumping of grout from the bottom of the drill holes upwards.
- .6 Provide all supplementary equipment required to complete the work, including a storage trailer, water, electric generators, water pumps, water truck, storage tanks, welding equipment, crew trucks, and communications equipment.
- .7 The Contractor shall provide adequate lighting at each drill rig location to enable drilling and instrument assembly after dark to proceed safely and efficiently.

3.4 INSTALLATION OF INCLINOMETER CASING

- .1 Drill a vertical borehole to the depth required for installing the inclinometer casing.
- .2 Clean the borehole of drill cuttings at the completion of the drilling operations.
- .3 Install the inclinometer casing in each borehole to the elevation or depth specified, in accordance with manufacturer recommendations.
- .4 Orient the inclinometer casing with one (1) pair of grooves perpendicular to the crest line of the dam or slope.
- .5 The Contractor shall ensure that the spiral of the inclinometer casing grooves does not exceed 1° per 3 m of length. The orientation of the grooves at the top of the inclinometer casing shall be within 10° of the planned orientation.
- .6 Place grout in the borehole annulus as specified by the manufacturer. Tremie the grout, starting at the bottom of the borehole and progressing upwards.
- .7 Resist buoyant forces on the inclinometer from the bottom of the inclinometer. Do not clamp or weight inclinometer tops. The inclinometer casing should be filled with water during grouting to absorb heat generated by cement hydration.
- .8 Do not cut the coupling of the exposed inclinometer casing after installation and grouting.
- .9 Inclinometer instrument enclosure to be installed after completion of backfill of each stage as required.
- .10 Inclinometer casing to be extended in 1520 mm lengths preceding the compacted fill as required.

GEOTECHNICAL INSTRUMENTS

- .11 Compact backfill within 1.5 m of the inclinometer casing to match surrounding fill and to be compacted to the required standard using hand-controlled compaction equipment. Mobile compaction equipment shall not be used. Voids within the fill around the casing to be grouted.
- .12 Upon completion of installation, the Contractor shall perform a post-installation acceptance test to verify that the inclinometer has been installed in accordance with the requirements of this section. This includes verifying that no grout has entered the inclinometer casing, the groove orientation and verticality are correct, and the inclinometer probe tracks correctly in all four (4) orientations.
- .13 Detailed records of installations, including, but not limited to, the following, shall be documented:
 - .1 Final borehole depth.
 - .2 Total length of inclinometer installed.
 - .3 Length of inclinometer casing above ground surface.
 - .4 Number of grout batches.
 - .5 Grout density and viscosity for each batch of grout.

3.5 INSTALLATION OF STANDPIPE PIEZOMETER

- .1 Drill a vertical borehole to the depth required for installing the standpipe.
- .2 Clean the borehole of drill cuttings at the completion of the drilling operations.
- .3 Install the pipe in each borehole to the elevation or depth specified with a screen length of 1.5 m, in accordance with manufacturer recommendations.
- .4 Place sand and bentonite in borehole.
- .5 Install standpipe stickup protector.
- .6 Detailed records of installations including but not limited to the following shall be documented:
 - .1 Final borehole depth.
 - .2 Total length of standpipe installed and screen length.
 - .3 Length of standpipe casing above ground surface.
 - .4 Serial number and installation details of the instruments.
 - .5 Initial instrumentation readings.

GEOTECHNICAL INSTRUMENTS

3.6 LOCATION OF INSTRUMENTATION

- .1 The location of the installations is roughly indicated on Figure 6 of the Geotechnical Report as attached. The exact location of the proposed instruments are to be determined after construction with direction from the Engineer.

3.7 TOLERANCES

- .1 Inclinometers: Maintain a vertical plumb within +/-10 mm for each 1,500 mm section.
- .2 All other components: +/-50 mm, or as otherwise authorized by the Engineer.

3.8 PROTECTION OF INSTRUMENTATION

- .1 The Contractor is responsible for protecting instruments and other equipment associated with geotechnical instrumentation during delivery, during storage at the site, and during installation and subsequent construction activities. This includes damage due to construction operations, weather, traffic, and vandalism.
- .2 Provide measures to protect instruments, cables, leads, tubing, and other components from damage resulting from construction activities. Such measures may include providing high visibility markings, warning lights, barricades, precast concrete barriers, portable corrals fabricated from steel pipe, or other provisions as required by the Engineer, around all instrument and instrument component locations.
- .3 The Contractor shall not allow concentrated, repetitive, vehicle or equipment traffic over instruments or instrument components until the compacted backfill reaches a minimum of 1500 mm above the instruments or instrument components.
- .4 At all times the cable or tube ends of each instrument must have a permanent tag indicating the serial number of the instrument and the ID of the instrument location. Tags should be weatherproof and should be replaced without delay if any degradation is noted. New tags are to be applied at the new end if spliced extensions are required. The ends should be protected from the elements until connected within the instrumentation cabinets. Instruments with unidentified cable ends may require replacement at the Contractors cost.
- .5 The Contractor shall notify the Designer at least 24 hours prior to repairing or replacing a geotechnical instrument.

3.9 MAINTENANCE

- .1 All instruments must be maintained in accordance with the procedures and schedule recommended by the Manufacturer, or as directed by the Engineer.
- .2 Installations damaged by the Contractor's operations must be replaced immediately.
- .3 All damaged or non-functional instruments must be immediately reported to the Engineer.

END OF SECTION

1.0 GENERAL

- 1.1 Related Requirements
 - 1.1.1 Section 31 00 00 – Earthworks General
 - 1.1.2 Section 31 32 19.16 - Geotextile
- 1.2 Reference Standards
 - 1.2.1 ASTM International (ASTM):
 - (a) ASTM D1248- 16, Standard Specification for Polyethylene Plastics Extrusion Materials For Wire and Cable
 - (b) ASTM D4101- 17e1, Standard Specification for Polypropylene Injection and Extrusion Materials
 - (c) ASTM D4218- 20, Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds By the Muffle-Furnace Technique
 - (d) ASTM D5262- 20, Standard Test Method for Evaluating the Unconfined Tension Creep Behaviour of Geosynthetics
 - (e) ASTM D6637/D6637M- 15, Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method
 - 1.2.2 Geosynthetic Institute (GSI):
 - (a) GSI GT7- 12, Determination of the Long-Term Design Strength of Geotextiles
- 1.3 Action and Informational Submittals
 - 1.3.1 Provide in accordance with Section 01 33 00 - Submittal Procedures.
 - 1.3.2 Certificates:
 - (a) Submit copies of mill test data and certificate 4 weeks before start of Work.
- 1.4 Delivery, Storage, and Handling
 - 1.4.1 Deliver, store and handle materials in accordance with Section 01 63 00 – Products / Workmanship.
 - 1.4.2 During delivery and storage, protect geogrids from direct sunlight, ultraviolet rays, excessive heat, mud, dirt, dust, debris and rodents.

2.0 PRODUCTS

- 2.1 Material

GEOGRID

- 2.1.1 Geogrid shall be PR25151 Diversion Channel Geoweb Channel Protection manufactured by Presto GeoSystems or approved equal by the Consultant.
- 2.1.2 Geogrid shall be infilled with crushed aggregate with low-strength cement grout otop to prevent stone wash out as recommended by the manufacturer.
- 2.2 Examination
 - 2.2.1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for soil stabilization installation in accordance with manufacturer's written instructions.
 - (a) Visually inspect substrate in presence of Consultant.
 - (b) Inform Consultant of unacceptable conditions immediately upon discovery.
 - (c) Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.
- 2.3 Installation
 - 2.3.1 Place geogrid material by unrolling onto graded surface in manner and locations indicated and retain in position in accordance with manufacturer's written recommendations.
 - 2.3.2 Place geogrid on sloping surfaces in one continuous length from toe of slope to upper extent of geogrid.
 - 2.3.3 Overlap each successive strip of geogrid per manufacturer recommendations.
 - 2.3.4 Join successive strips of geogrid as recommended by manufacturer.
 - 2.3.5 Protect geogrid from displacement, damage or deterioration before and during placement of overlaid aggregate, geotextiles and soil layers.
 - 2.3.6 After installation, cover with overlay layer within 10 days of placement.
 - 2.3.7 Replace damaged or deteriorated geogrid to approval of Consultant.
 - 2.3.8 Place and compact soil layers in accordance with Section 31 00 00 – Earthworks General.
- 2.4 Cleaning
 - 2.4.1 Progress Cleaning: Maintain site cleanliness at the end of each day.
 - 2.4.2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment.
- 2.5 Protection
 - 2.5.1 Do not overload soil or aggregate covering on geogrid.

END OF SECTION

GEOTEXTILE

1. GENERAL

1.1 INTENT

- .1 Read this Section in conjunction with other Sections for location use and placement of "Geotextile Fabric" specified herein.

1.2 SUBMITTALS

- .1 Provide the following submittals:
- .1 Submit manufacturer's certificate and installation instructions for the specified geotextile.
- a) The certificate shall be signed by an authorized representative of the manufacturer who is legally empowered to bind the company.
 - b) The manufacturer's certificate shall state that the furnished geotextile meets the Minimum Average Roll Values (MARV) requirements, except as otherwise specified, of the specification as evaluated under the manufacturer's quality control program.
- .2 Submit requests for approval of alternative products no later than 7 days prior to tender closing. Alternative products must be submitted with the following (incomplete submittals will not be reviewed):
- a) Manufacturer's technical data sheet. Technical data sheets with distributor or private label letterhead will not be accepted. Approval will not be based on mechanical properties alone.
 - b) NTPEP audit test results as per REGEO performed by an independent testing agency shall be provided to the Engineer that quantifies the installation damage, creep strength loss, and durability reduction factors.
 - c) Three 300 mm x 300 mm samples. Certification that the manufacturer quality control system is certified to ISO 9001 or equivalent quality standards.
 - d) Certification that the manufacturer quality control system is certified to ISO 9001 or equivalent quality standards.

1.3 DELIVERY, STORAGE, AND HANDLING

- .1 Keep geotextile wrapped in its original packaging until immediately prior to its installation. Protect geotextile from direct sunlight, excessive heat, dirt, and rodents while in transit and storage.

GEOTEXTILE

2. PRODUCTS

2.1 MATERIALS

2.1.1 HYDRANET GEOCOMPOSITE

- .1 For Hydranet Geocomposite as specified on the Geotechnical Report and Drawings, provide Biplanar Geocomposite with laminated geotextile layers to prevent the movement of soil fines into the drainage path that could otherwise lead to clogging and reduced drainage performance long term.

Property	Value	Unit	ASTM Test Method
Grab Strength	1001	N	D-4632
Elongation	50	%	D-4632
CBR Puncture	2670	N	D-6241
Trapezoidal Tear	400	N	D-4533
Apparent Opening Size (AOS)	0.212	mm	D-4751
Permittivity	1.26	Sec ⁻¹	D-4491
Water Flow Rate	4075	l/min/m ²	D-4491
Transmissivity	4.83	Gal/min/ft	D-4716

Approved Products: Layfield HydraNet 220-1-8E or approved equal.

2.1.2 NON-WOVEN GEOTEXTILE

- .1 For 8 oz geotextile as specified on the Geotechnical Report and Drawings, provide non-woven geotextile fabric material, needle punched, composed of a minimum 85% polypropylene or polyester polymers, formulated to resist deterioration by ultraviolet exposure and free of manufacturing defects, cuts, tears, or any other physical damage, that meets or exceeds the following physical properties:

Property	Value	Unit	ASTM Test Method
Grab Strength	912	N	D-4632
Elongation	50	%	D-4632
CBR Puncture	2224	N	D-6241
Trapezoidal Tear	356	N	D-4533
Ultraviolet Degradation	70	%	D-4355
Apparent Opening Size (AOS)	0.180	mm	D-4751
Permittivity	1.4	Sec ⁻¹	D-4491
Water Flow Rate	3870	l/min/m ²	D-4491

Approved Products: Armtex 250 - non-woven geotextile or approved equal.

GEOTEXTILE

- .2 For 16 oz geotextile as specified on the Geotechnical Report and Drawings, provide non-woven geotextile fabric material, needle punched, composed of a minimum 85% polypropylene or polyester polymers, formulated to resist deterioration by ultraviolet exposure and free of manufacturing defects, cuts, tears, or any other physical damage, that meets or exceeds the following physical properties:

Property	Value	Unit	ASTM Test Method
Grab Strength	1691	N	D-4632
Elongation	50	%	D-4632
CBR Puncture	4561	N	D-6241
Trapezoidal Tear	-	N	D-4533
Ultraviolet Degradation	70	%	D-4355
Apparent Opening Size (AOS)	0.150	mm	D-4751
Permittivity	0.7	Sec ⁻¹	D-4491
Water Flow Rate	2037	l/min/m ²	D-4491

Approved Products: Armtex 400 - non-woven geotextile or approved equal.

2.2 SHOP FABRICATION

- .1 Provide shop-made sewn seams as required to produce the minimum roll widths and specified lengths. Provide seams that meet or exceed the geotextile's strength properties. Use sewing thread with equal or better resistance to chemical and biological degradation than the geotextile.

3. EXECUTION

3.1 PREPARATION

- .1 Excavate and prepare the subgrade to the lines, grades, and elevations specified in the Contract Documents. Remove rock fragments or other objects having sharp projections.
- .2 Remove snow, ice, loose or other deleterious materials from the subgrade.
- .3 Do not place geotextile until the prepared subgrade surfaces have been inspected by the Owner's Representative. Rectify any defects identified by the Owner's Representative.

3.2 NON-WOVEN GEOTEXTILE INSTALLATION

- .1 Install geotextile products at the locations specified in the Contract Documents and in accordance with the manufacturer's recommendations.
- .2 Minimum allowable overlap of the geotextile will be 0.5 metres. Overlap sections must be anchored sufficiently to prevent separation due to weather or the placement of granular material.
- .3 Temporarily anchor the geotextile with sandbags or weights placed at the outer edges, along seams, and at other intermediate points as required to prevent displacement.

GEOTEXTILE

- .4 Extend the geotextile to the outer edges of the specified lines, and trim any excess geotextile.
- .5 Protect the geotextile from damage. Repair or replace geotextile damaged during installation or construction of subsequent Work.
- .6 Do not allow any equipment to operate directly on the geotextile or the overlying material.
- .7 Cover the geotextile within 1 day of installation with the specified fill material.
- .8 During placement of the specified material, limit the height from which the fill material is placed to 0.3 m or lower, as required to avoid damaging or displacing the geotextile. Install the geotextile with sufficient slack to prevent tearing during placement of the fill material.

END OF SECTION

RIP-RAP

1.0 GENERAL

1.1 Related Requirements

1.1.1 Section 31 00 00 – Earthworks General

1.1.2 Section 31 32 19.16 – Geotextile

1.2 Reference Standards

1.2.1 ASTM International (ASTM):

- (a) ASTM C109/C109M-23, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 50 mm [2 in.] Cube Specimens)
- (b) ASTM C144-18, Standard Specification for Aggregate for Masonry Mortar
- (c) ASTM C185-20, Standard Test Method for Air Content of Hydraulic Cement Mortar
- (d) ASTM C618-23e1, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- (e) ASTM C952-12, Standard Test Method for Bond Strength of Mortar to Masonry Units
- (f) ASTM C1506-17, Standard Test Method for Water Retention of Hydraulic Cement-Based Mortars and Plasters

1.2.2 CSA Group (CSA):

- (a) CSA A23.1/A23.2-24, Concrete materials and methods of concrete construction/Test methods and standard practices for concrete
- (b) CAN/CSA A179-14 (R2024), Mortar and grout for unit masonry
- (c) CSA-A3000-23, Cementitious materials compendium

1.3 Action and Informational Submittals

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

2.0 PRODUCTS

2.1 Material

2.1.1 Stone:

- (a) Size as indicated on drawings.
- (b) Hard, dense, durable quarry stone, free from seams, cracks or other structural defects, to meet the following size distribution for use intended:
 - (i) Culvert ends:

RIP-RAP

	Equivalent Diameter (mm)	Percentage (by weight) of Riprap Greater than Equivalent Diameter
	300	0%
	200	20% to 50%
	175	50% to 80%
	125	100%

2.1.2 Geotextile Filter:

- (a) Geotextile soil stabilization: In accordance with Section 31 32 19.16 - Geotextile.

2.1.3 Bedding Material:

- (a) Aggregate: In accordance with Section 31 05 16 – Aggregates for Earthwork.
- (b) Compose material of tough, durable particles.

3.0 EXECUTION

3.1 Examination

- 3.1.1 Verification of Conditions: In accordance with Section 01 71 23 – Field Engineering.

3.2 Surface Preparation

- 3.2.1 Where rip-rap is to be placed on slopes, excavate trench at toe of slope to dimensions as indicated on Drawings.
- 3.2.2 Fine grade area to be rip-rapped to uniform, even surface. Fill depressions with suitable aggregate material and compact to provide firm bed.
- 3.2.3 Place geotextile on prepared surface in accordance with Section 31 32 19.16 - Geotextile. Avoid puncturing geotextile. Vehicular traffic over geotextile is not permitted (except over the geoweb on the reservoir access road).

3.3 Placing

- 3.3.1 Place rip-rap to thickness and details as indicated on Drawings.
- 3.3.2 Produce a well graded mass with a maximum 5% of voids, in conformance with lines and grades indicated.
- 3.3.3 Place stones in manner acceptable to Consultant to secure surface and create a stable mass. Place larger stones at bottom of slopes.
- 3.3.4 Hand placing:

RIP-RAP

- (a) Use larger stones for lower courses and as headers for subsequent courses.
- (b) Stagger vertical joints and fill voids with rock spalls or cobbles.
- (c) Finish surface evenly, free of large openings and neat in appearance.

3.4 Cleaning

3.4.1 Progress Cleaning:

- (a) Leave Work area clean at end of each day.

3.4.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools, and equipment.

3.4.3 Divert left over geotextiles to local plastic recycling facility.

END OF SECTION

DIVISION 32 – ROAD AND SITE IMPROVEMENTS

ROADWORKS GENERAL

Roadworks specifications are to follow the Town of Okotoks specifications as linked below.

Reference Town of Okotoks Specifications

- Town of Okotoks Infrastructure Design & Construction Specification 2024
 - <https://www.okotoks.ca/sites/default/files/2024-09/Infrastructure%20Design%20and%20Construction%20Specifications%202024.pdf>

For all other roadworks specifications, refer to City of Calgary as linked below:

Reference City of Calgary Specifications

- Road Construction 2021 Standard Specifications
 - <https://www.calgary.ca/content/dam/www/transportation/roads/documents/contractors-and-consultants/roads-construction-2021-standard-specifications.pdf>

END OF SECTION

FENCING

1.0 GENERAL

1.1 Related Requirements

1.1.1 Section 32 00 00 – Roadworks General

1.1.2 Section 03 30 00 - Cast-in-Place Concrete

1.2 Reference Standards

1.2.1 ASTM International (ASTM):

- (a) ASTM A53/A53M- 20 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
- (b) ASTM A90/A90M- 21, Standard Test Method for Weight of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
- (c) ASTM A121- 19, Standard Specification for Zinc-Coated (Galvanized) Steel Barbed Wire
- (d) ASTM A123/A123M- 13, Standard Specification for Zinc (Hot Dip Galvanized) coatings on Iron and Steel Products
- (e) A653/A653M- 13, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- (f) ASTM C618- 19, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
- (g) ASTM F1664- 08, Standard Specification for Poly(Vinyl Chloride) (PVC)-Coated Steel Tension Wire Used with Chain-Link Fence

1.2.2 Canadian General Standards Board (CGSB):

- (a) CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating
- (b) CAN/CGSB-138.1-96, Fabric for Chain Link Fence
- (c) CAN/CGSB-138.2-96, Steel Framework for Chain Link Fence
- (d) CAN/CGSB-138.3-96, Installation of Chain Link Fence
- (e) CAN/CGSB-138.4-96, Gates for Chain Link Fence

1.2.3 CSA Group (CSA):

- (a) CSA A23.1/A23.2- 14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete
- (b) CAN/CSA-A3000- 18, Cementitious Materials Compendium

1.2.4 Master Painters Institute (MPI):

- (a) Architectural Painting Specification Manual

FENCING

- 1.3 Action and Informational Submittals
 - 1.3.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
 - 1.3.2 Product Data:
 - (a) Submit manufacturer's instructions, printed product literature and data sheets for concrete mixes, fences, posts and gates and include product characteristics, performance criteria, physical size, finish and limitations.
- 1.4 Delivery, Storage and Handling
 - 1.4.1 Deliver, store and handle materials in accordance with Section 01 63 00 – Products / Workmanship.
 - 1.4.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
 - 1.4.3 Storage and Handling Requirements:
 - (a) Store materials in accordance with manufacturer's recommendations.
 - (b) Store and protect fence materials from damage.

2.0 PRODUCTS

- 2.1 Chain Link Materials
 - 2.1.1 Concrete mixes and materials: in accordance with Section 03 30 00.09 - Cast-in-Place Concrete and CSA A23.1.
 - (a) Nominal coarse aggregate size: 20-5.
 - (b) Compressive strength: 20 MPa minimum at 28 days.
 - (c) Additives: Fly ash to CSA A3000.
 - 2.1.2 Chain-link fence fabric: to CAN/CGSB-138.1, and as required by manufacturer.
 - (a) 50 mm diamond mesh fabric style.
 - (b) Height of fabric: as indicated.
 - (c) Post spacing: as indicated.
 - 2.1.3 Posts, braces and rails: To CAN/CGSB-138.2, and as required by manufacturer. Dimensions as indicated.
 - 2.1.4 Top and bottom tension wire: to CAN/CGSB-138.2, and as required by manufacturer.
 - 2.1.5 Tie wire fasteners: Per manufacturer.
 - 2.1.6 Tension bar: To ASTM A653/A653M, and as required by manufacturer.
 - 2.1.7 Fittings and hardware: To CAN/CGSB-138.2, and as required by manufacturer.

FENCING

- (a) Tension bar bands: as required by manufacturer.
 - (b) Post caps to provide waterproof fit, to fasten securely over posts and to carry top rail.
 - (c) Overhang tops to provide waterproof fit, to hold top rails and an outward projection to hold barbed wire overhang.
 - (d) Include projection with clips or recesses to hold 3 strands of barbed wire.
- 2.1.8 Organic zinc rich coating: To CAN/CGSB-1.181 MPI #18, and as required by manufacturer.
- 2.1.9 Barbed wire: As recommended by manufacturer.
- 2.2 Steel Post and Chain Materials
 - 2.2.1 Concrete mixes and materials: in accordance with Section 03 30 00.09 - Cast-in-Place Concrete and CSA A23.1.
 - (a) Nominal coarse aggregate size: 20-5.
 - (b) Compressive strength: 20 MPa minimum at 28 days.
 - (c) Additives: Fly ash to CSA A3000.
 - 2.2.2 Post and Chain fence:
 - (a) Chain: 8mm Dia hot dip galvanized chain, chain length 0.25m longer than post spacing.
 - (b) Post spacing: as indicated.
 - (c) Height of fabric: as indicated.
 - 2.2.3 Posts, braces and rails: To CAN/CGSB-138.2, and as required by manufacturer.
 - 2.2.4 Fittings and hardware: To CAN/CGSB-138.2, and as required by manufacturer.
 - (a) Post caps to provide waterproof fit, to fasten securely over posts and to 76 mm galvanized dome with attachment link.
 - 2.2.5 Organic zinc rich coating: To CAN/CGSB-1.181 MPI #18.
- 2.3 Bollards
 - 2.3.1 As indicated in the *Contract Drawings* and as per Section 32 00 00 – Roadworks General.
- 2.4 Finishes
 - 2.4.1 Galvanizing:
 - (a) For chain link fabric: To CAN/CGSB-138.1.
 - (b) For pipe: to ASTM A90.
 - (c) For barbed wire: To CAN/CGSB-138.2.

- (d) For other fittings: To ASTM A123/A123M.

3.0 EXECUTION

3.1 Examination

- 3.1.1 Verification of Conditions: Verify conditions of substrate previously installed under other Sections or Contracts are acceptable for fence and gate installation in accordance with manufacturer's written instructions.
 - (a) Inform Consultant of unacceptable conditions immediately upon discovery.
 - (b) Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 Preparation

3.2.1 Grading:

- (a) Remove debris and correct ground undulations along fence line to obtain smooth uniform gradient between posts.
 - (i) Provide clearance between bottom of fence and ground surface of 30 mm to 50 mm.

3.3 Erection of Fence (Chain Link and Post & Chain Where Applicable)

- 3.3.1 Erect fence along lines as indicated and to CAN/CGSB-138.3.
- 3.3.2 Excavate post holes to dimensions indicated and provide 150mm of 19mm wash rock at the bottom.
- 3.3.3 Space line posts 3 m apart, measured parallel to ground surface.
- 3.3.4 Space straining posts at equal intervals not to exceed 150 m if distance between end or corner posts on straight continuous lengths of fence over reasonably smooth grade, is greater than 150 m.
- 3.3.5 Install additional straining posts at sharp changes in grade and where directed by Consultant.
- 3.3.6 Install corner post where change in alignment exceeds 10 degrees.
- 3.3.7 Install end posts at end of fence and at buildings.
- 3.3.8 Place concrete in post holes then embed posts into concrete to depths indicated.
 - (a) Extend concrete 50 mm above ground level and slope to drain away from posts.
 - (b) Brace to hold posts in plumb position and true to alignment and elevation until concrete has set.
- 3.3.9 Install fence fabric after concrete has cured, minimum of 5 days.

FENCING

- 3.3.10 Install brace between end and nearest line post, placed in centre of panel and parallel to ground surface.
 - (a) Install braces on both sides of corner and straining posts in similar manner.
- 3.3.11 Install overhang tops and caps.
- 3.3.12 Install top rail between posts and fasten securely to posts and secure waterproof caps and overhang tops.
- 3.3.13 Install bottom tension wire, stretch tightly and fasten securely to end, corner, gate and straining posts with turnbuckles and tension bar bands.
- 3.3.14 Lay out fence fabric. Stretch tightly to tension recommended by manufacturer and fasten to end, corner, gate and straining posts with tension bar secured to post with tension bar bands spaced at 300 mm intervals.
 - (a) Knuckled selvedge at bottom.
 - (b) Twisted selvedge at top.
- 3.3.15 Secure fabric to top rails, line posts and bottom tension wire with tie wires at 450 mm intervals.
 - (a) Give tie wires minimum two twists.
- 3.3.16 Install barbed wire strands and clip securely to lugs of each projection.
- 3.3.17 Install grounding rods as indicated.
- 3.4 Touch Up
 - 3.4.1 Clean damaged surfaces with wire brush removing loose and cracked coatings. Apply two coats of organic zinc-rich paint to damaged areas.
 - (a) Pre-treat damaged surfaces according to manufacturers' instructions for zinc-rich paint.
- 3.5 Cleaning
 - 3.5.1 Progress Cleaning: Maintain site cleanliness daily.
 - 3.5.2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

1.0 GENERAL

- 1.1 Related Requirements
 - 1.1.1 Section 32 00 00 – Roadworks General
- 1.2 Reference Standards
 - 1.2.1 Canadian Society of Landscape Architects (CSLA) / Canadian Nursery Landscape Association (CNLA)
 - (a) Canadian Landscape Standard (2024)
 - (b) Canadian Nursery Stock Standard, Ninth Edition
- 1.3 Administrative Requirements
 - 1.3.1 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, installation instructions and warranty requirements.
 - 1.3.2 Scheduling:
 - (a) Schedule hydraulic seeding to coincide with preparation of soil surface.
- 1.4 Action and Informational Submittals
 - 1.4.1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - 1.4.2 Product Data:
 - (a) Submit manufacturer's instructions, printed product literature and data sheets for seed, mulch, tackifier, fertilizer, liquid soil amendments and micronutrients.
 - 1.4.3 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
 - 1.4.4 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.
- 1.5 Delivery, Storage, and Handling
 - 1.5.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - 1.5.2 Delivery and Acceptance Requirements:
 - (a) Labelled bags of fertilizer identifying mass in kg, mix components and percentages, date of bagging, supplier's name and lot number.
 - (b) Inoculant containers to be tagged with expiry date.
 - 1.5.3 Storage and Handling Requirements:

- (a) Store fertilizer in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- (b) Replace defective or damaged materials with new.

1.6 Warranty

- 1.6.1 For seeding, 12 months warranty period is extended to 1 full growing season.
- 1.6.2 Contractor hereby warrants that seeding will remain free of defects for 1 full growing season.
- 1.6.3 End-of-warranty inspection will be conducted by Consultant.

2.0 PRODUCTS

2.1 Materials

- 2.1.1 Seed: "Canada pedigreed grade" in accordance with Government of Canada Seeds Act and Regulations.
 - (a) Grass mixture: "Certified", "Canada No. 1 Lawn Grass Mixture" in accordance with Government of Canada "Seeds Act" and "Seeds Regulations".
 - (b) Mixture composition:
 - (i) Kentucky Blue Grass (drought-tolerant cultivars) 20%
 - (ii) Fine Fescue Blend (creeping, chewing, hard) 65%
 - (iii) Perennial Rye Grass 15%
- 2.1.2 Mulch: specially manufactured for use in hydraulic seeding equipment, non-toxic, water activated, green colouring, free of germination and growth inhibiting factors with following properties:
 - (a) Type I mulch:
 - (i) Made from wood cellulose fibre
 - (ii) Organic matter content: 99.2%
 - (iii) Ash Content: 8%
 - (iv) Value of pH: 4.8
 - (v) Potential water absorption: 1000%
- 2.1.3 Tackifier: TA200 is an acceptable colloidal polysaccharide tackifier, adhering to mulch during manufacturing, non-toxic, and without growth or germination inhibiting factors. Apply as per labeled manufacturer's specifications for slopes 4:1 and greater.

- 2.1.4 Water: free of impurities that would inhibit germination and growth.
- 2.1.5 Fertilizer:
 - (a) To Canada "Fertilizers Act" and Regulations.
 - (b) Complete synthetic, slow release with 35% of nitrogen content in water-insoluble form.

3.0 EXECUTION

- 3.1 Examination
 - 3.1.1 Verification of Conditions: verify conditions of substrate previously installed under other Sections or Contracts are acceptable for hydraulic seeding in accordance with manufacturer's written instructions.
 - (a) Visually inspect substrate in presence of Consultant.
 - (b) Inform Consultant of unacceptable conditions immediately upon discovery.
 - (c) Proceed with installation only after unacceptable conditions have been remedied.
- 3.2 Protection of Existing Conditions
 - 3.2.1 Protect structures, signs, guide rails, fences, plant material, utilities and other surfaces not intended for spray.
 - 3.2.2 Immediately remove any material sprayed where not intended as directed by Consultant.
- 3.3 Preparation of Surfaces
 - 3.3.1 Do not perform work under adverse field conditions such as wind speeds over 10 km/h, frozen ground or ground covered with snow, ice or standing water.
 - 3.3.2 Fine grade areas to be seeded free of humps and hollows.
 - (a) Ensure areas are free of deleterious and refuse materials.
 - 3.3.3 Cultivated areas identified as requiring cultivation to depth of 25 mm.
 - 3.3.4 Ensure areas to be seeded are moist to depth of 150 mm before seeding.
 - 3.3.5 Obtain Consultant's approval of grade and topsoil depth before starting to seed.
- 3.4 Preparation of Slurry
 - 3.4.1 Measure quantities of materials by weight or weight-calibrated volume measurement satisfactory to Consultant. Supply equipment required for this work.

- 3.4.2 Charge required water into seeder. Add material into hydraulic seeder under agitation. Pulverize mulch and charge slowly into seeder.
- 3.4.3 After materials are in seeder and well mixed, charge tackifier into seeder and mix thoroughly to complete slurry.
- 3.5 Slurry Application
- 3.5.1 Hydraulic seeding equipment:
- (a) Slurry tank.
 - (b) Agitation system for slurry to be capable of operating during charging of tank and during seeding, consisting of recirculation of slurry and/or mechanical agitation method.
 - (c) Capable of seeding by 50 m hand operated hoses and appropriate nozzles.
 - (d) Tank volume to be certified by certifying authority and identified by authorities "Volume Certification Plate".
- 3.5.2 Slurry mixture applied:
- (a) Seed: 130 kg/ha.
 - (b) Mulch:

Slope and/or Wind Conditions	Minimum Application Rate
<6:1 (H:V) or Light Wind	1,400 kg/ha
6:1 to 3:1 or Medium Wind	1,700 kg/ha
>3:1 or High Wind	2,000 kg/ha

- (c) Tackifier:

Slope and/or Wind Conditions	Minimum Application Rate
<6:1 (H:V) or Light Wind	55 kg/ha
6:1 to 3:1 or Medium Wind	85 kg/ha
>3:1 or High Wind	115 kg/ha

- (d) Water: Minimum 30,000 L/ha.
- (e) Fertilizer: as recommended by manufacturer.

- (f) Liquid Soil Amendment/Micronutrients: as recommended by manufacturer.
- 3.5.3 Apply slurry uniformly, at optimum angle of application for adherence to surfaces and germination of seed.
 - (a) Using correct nozzle for application.
 - (b) Using hoses for surfaces difficult to reach and to control application.
- 3.5.4 Blend application 150 mm into adjacent grass areas or sodded areas to form uniform surfaces.
- 3.5.5 Re-apply where application is not uniform.
- 3.5.6 Remove slurry from items and areas not designated to be sprayed.
- 3.6 Cleaning
 - 3.6.1 Progress Cleaning:
 - (a) Leave Work area clean at end of each day.
 - (b) Keep pavement and area adjacent to site clean and free from mud, dirt, and debris at all times.
 - 3.6.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment
 - (a) Clean and reinstate areas affected by Work.
- 3.7 Protection
 - 3.7.1 Protect seeded areas from trespass until established.
 - 3.7.2 Remove protection devices as directed by Consultant.
- 3.8 Maintenance During Establishment Period
 - 3.8.1 Perform following operations from time of seed application until acceptance by Consultant.
 - 3.8.2 Grass Mixture:
 - (a) Repair and reseed dead or bare spots to allow establishment of seed before acceptance.
 - (b) Mow grass at regular intervals to maintain grass at maximum height of 60mm. Remove clippings which will smother grass as directed by Consultant.
 - (c) Fertilize seeded areas after first cutting 10 weeks after germination provided plants have mature true leaves in accordance with fertilizing

HYDRAULIC SEEDING

program. Spread half of required amount of fertilizer in one direction and remainder at right angles; water it well.

- (d) Control weeds by mechanical or chemical means utilizing acceptable integrated pest management practices.
 - (i) If chemical means are used, comply with manufacturer's written instructions.
- (e) Water seeded area to maintain optimum soil moisture level for germination and continued growth of grass. Control watering to prevent washouts.

3.9 Acceptance

3.9.1 Seeded areas will be accepted by Consultant provided that:

- (a) Plants are uniformly established. Seeded areas are free of rutted, eroded, bare or dead spots.
- (b) Areas have been mown at least twice.
- (c) Areas have been fertilized.

3.9.2 Areas seeded in fall will achieve final acceptance in following spring, one month after start of growing season provided acceptance conditions are fulfilled.

3.10 Maintenance During Warranty Period

3.10.1 Perform following operations from time of acceptance until end of warranty period:

- (a) Repair and reseed dead or bare spots to satisfaction of Consultant.

END OF SECTION

DIVISION 33 – UTILITIES

CCTV INSPECTION OF PIPELINES

1.0 GENERAL

- 1.1 Section 33 01 30.1 refers to those portion of the *Work* that are unique to the requirements for inspecting new and existing sanitary sewers and gravity watermain, storm and combined sewers and pipe culverts by closed circuit television.
- 1.2 Related Work
 - 1.2.1 Cleaning of Sewers Section 33 01 30.02
- 1.3 References
 - 1.3.1 These specifications must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
 - 1.3.2 Reference standards, specification or publications.
 - (a) Water Research Centre (WRC) publication Manual of Sewer Condition Classification (MSCC), Third Edition, 1993 including Addendum - February 1996.
 - 1.3.3 Nomenclature
 - (a) NAAPI – North American Association of Pipeline Inspectors)
 - (b) CCTV – Closed Circuit Television
 - (c) JPEG – Joint Photographic Experts Group
 - (d) MPEG – Movie Photographic Experts Group
 - (e) S-VHS – Super VHS format
 - 1.3.4 Submission of Certification
 - (a) Cleaning of Sewers Section 33 01 30.02
 - 1.3.5 Submission of Certification
 - (a) Submit copy of the CCTV operator's training certification to the *Prime Consultant* at least one week prior to the start of the CCTV inspection operations.
 - (b) Submit copy of certificate for each CCTV operator working on the contract.
 - 1.3.6 Work Regulations
 - (i) Work to conform to all applicable regulations of the Alberta Government and OH&S Standards. Confirm training compliance in the following:
 - (ii) Confined space entry
 - (iii) Ventilation

- (iv) Atmospheric monitoring
- (v) Personal protective equipment
- (b) .2 Provide written confirmation to the *Prime Consultant* that workers have knowledge of confined space entry practices and of equipment required for confined space entry.

1.3.7 Scheduling of Work

- (a) Schedule work to minimize interruptions to existing services.
- (b) Maintain existing flow during inspection survey unless flow reduction measures required (see Clause 3.11).

2.0 PRODUCTS

2.1 Equipment

2.1.1 Survey Vehicle to contain a separate area for viewing, recording and controlling the CCTV operation.

- (a) Viewing and control area to be insulated against noise and extremes in temperature. External and internal sources of light to be controlled to ensure the light does not impede the view of the monitor screen. Proper seating accommodation to be provided to enable one person in addition to the operator to clearly view the monitor screen.
- (b) All equipment utilized within the pipeline to be stored outside the viewing, recording and control area.
- (c) Vehicle to be equipped with a telephone for communication with the *Prime Consultant* for the duration of the work.
- (d) Electrical power for the system to be self-contained. External power sources from public or private sources not permitted.

2.1.2 Survey Equipment to have sufficient cables to view the lengths of pipe as specified.

- (a) Survey unit to be a self-propelled crawler type with a means of transporting the CCTV camera in a stable condition through the pipeline.
- (b) Each unit to carry sufficient numbers of guides and rollers such that, when surveying, all cables are supported away from pipe and manhole edges. All CCTV cables and lines used to measure the camera's location within the pipeline shall be maintained in a taut manner and set at right angles, where possible, to run through or over the measuring equipment.
- (c) Each unit to interface with a data generator and appropriate software to record the alpha-numeric data associated with the pipeline condition and header reference location information.

CCTV INSPECTION OF PIPELINES

- 2.1.3 Camera to be capable of producing high quality colour imagery and provide complete inspections and view of all laterals and deficiencies.
- (a) Camera to be "Pan & Tilt" and have the capability of panning the pipe at 360° with tilt capability of 270°.
 - (b) Live picture to be visible with no interference and capable of registering a minimum number of 400 lines of resolution at the periphery.
 - (c) Focus and iris adjustment to allow optimum picture quality to be achieved and to be remotely adjusted. The adjustment of focus and iris shall provide a focal range from 150 mm in front of the camera's lens to infinity. The distance along the sewer in focus from the initial point of observation shall be a minimum of twice the vertical height of the sewer.
 - (d) Camera to be waterproof with a self-contained lighting system capable of being remotely adjusted. Lights to provide an even distribution of light around the pipeline perimeter without the loss of contrast or flare out or picture shadowing.
- 2.1.4 Digital video files shall be MPEG2 and conform to the following requirements:
- (a) Picture Size: NTSC 704 x 480 at 29.97 frames per second
 - (b) Digital video files to be stored on new, unused DVD media.
- 2.1.5 Photographs to be colour, minimum image size 90 mm x 70 mm and reproduced on premium glossy ink jet paper when required, as specified in the Agreement.

3.0 EXECUTION

3.1 CCTV Inspection

- 3.1.1 CCTV operator to have received training by NAAPI or NASSCO.
- 3.1.2 Submit sample of inspection reports, video in DVD format together with corresponding digital data file for review within one week of receipt of notice to proceed with contract. Submission to satisfy all of the specifications contained herein and the accepted report submission will be used as a benchmark for subsequent inspection report submissions.
- 3.1.3 No inspection surveys to be carried out under this contract until an acceptable sample inspection report has been approved by the *Prime Consultant*.
- 3.1.4 Flow in the pipeline not to exceed approximately 20% of the pipe diameter. Notify *Prime Consultant* of excessive flows, inspect using flow reduction method (See Clause 3.11).
- 3.1.5 Eliminate steaming and fogging encountered during the inspection survey by introducing forced air flow by means of fan.

CCTV INSPECTION OF PIPELINES

- 3.1.6 Camera lens to remain free of grease or other deleterious matter to ensure optimal clarity.
- 3.1.7 Inspection video image to be produced in MPEG2 format:
 - (a) Create separate digital file for each individual Manhole to manhole inspection report.
- 3.1.8 Set zero chainage at face of every manhole or on entrance into pipe or start or pipe culvert.
- 3.1.9 Report and record on full length of pipeline from inside face to inside face between manhole or outlet end of pipes and from one end of pipe culvert to the other.
- 3.1.10 Note condition of pipe joints at manhole walls at the beginning and end of each pipeline.
- 3.1.11 Data generator to electronically generate and clearly display on the viewing monitor and video recording a record of data in alpha-numeric form containing the following minimum information prior to the start of each run:
 - (a) Manhole (from-to) / pipe length reference numbers.
 - (b) Pipeline dimensions
 - (c) Pipe material (i.e. vitrified clay, concrete, PVC etc.)
 - (d) Type or use of pipe (i.e. sanitary, storm or combined sewer)
 - (e) Date of survey (yyyy.mm.dd)
 - (f) Road name/location
 - (g) Direction of travel of survey equipment (U or D, Upstream or Downstream)
 - (h) Inspection (report) number
 - (i) Verbal description of all the above on screen information.
- 3.1.12 Note condition of pipe joints at manhole walls at the beginning and end of each pipeline.
- 3.1.13 Data generator to continuously electronically generate and clearly display on the viewing monitor and video recording a record of data in alpha-numeric form containing the following information during each run:
 - (a) Automatic update of the camera's metre reading position from adjusted zero.
 - (b) Manhole/pipe length reference numbers.

CCTV INSPECTION OF PIPELINES

- (c) Type or use of pipe (i.e. sanitary, gravity watermain, storm or combined sewer)
 - (d) The unique inspection/report number of the run.
 - (e) Display digital information such that it will not interfere with the video image on the screen.
- 3.1.14 Stop camera at each defect, change of condition of pipe and service connection to record defect in accordance with WRC codes.
- 3.1.15 Pan each service connection (junction) such that the camera looks down the centerline of the service, pause for a minimum of five (5) seconds and note condition of the joint and /or pipe/service interface.
- 3.1.16 Immediately notify the *Prime Consultant* of any blockage or obstruction that will not allow passage of survey equipment.
- 3.1.17 Restart inspection survey from the opposite end of pipeline or culvert when blockage or obstruction is encountered unless directed by the *Prime Consultant*.
- 3.2 Recording Resolution
 - 3.2.1 At the beginning of each video tape, day of inspection or when a substitute camera is introduced perform necessary checks to ensure recording resolution satisfies these specifications.
- 3.3 Site Coding Sheets
 - 3.3.1 Each pipeline length to be recorded according to the MSCC. Any variation from the manual to be noted in the survey report.
 - 3.3.2 Standard coding form shown on page 14 of MSCC to be modified as follows:
 - (a) Line 2, field 8 (date) to be eight (8) characters in the format of yyyy.mm.dd (year, month, day)
 - (b) Condition detail number (video count) to be six (6) characters in the format of hh.mm.ss (hours, minutes, seconds)
 - (c) Note observations as to condition of service connections beyond mainline in remarks column using standard codes as per MSCC
- 3.4 Camera Position
 - 3.4.1 Position camera lens centrally in the pipeline with a positioning tolerance of $\pm 10\%$ off the vertical centerline axis of the pipeline. For elliptical pipe the camera to be positioned 2/3 the height of the pipe measured from the invert.
 - 3.4.2 Position camera lens looking along the longitudinal axis of pipeline except when viewing service connections or panning defects.
- 3.5 Camera Travel Speed

CCTV INSPECTION OF PIPELINES

- 3.5.1 Travelling speed of the camera in the pipeline to be as follows:
 - (a) 6 m/min for pipeline of diameter less than 200 mm.
 - (b) 9 m/min for diameters 200 mm and larger but not exceeding 310 mm:
and
 - (c) 12 m/min for diameters exceeding 310 mm.
- 3.6 Camera Position Chainage Device
 - 3.6.1 Use a chainage device which enables the cable length to be accurately measured to indicate the location of the camera
 - (a) Chainage information to be transmitted electronically to control area and displayed on the monitor.
 - (b) Chainage device to be accurate to within 0.3 m up to the first 50 m and within $\pm 1\%$ for lengths exceeding 50 m.
 - (c) Chainage tolerance to be checked at the start of contract and a minimum of once every two weeks thereafter or every 5,000 m of pipeline inspected, whichever is greater.
 - (d) Provide audit form showing dates and distances checked to meet both tolerance requirements. Chainage linear measurement to be checked by use of a cable calibration device or tape or electronic measurement between fixed points.
- 3.7 Photographs and/or Digital Images
 - 3.7.1 Photograph all major defects as defined by condition codes: B, CXI, D, FC, FL, FM, H, IR, IG, JDL, JX, OB, OJL, RM, and X
 - 3.7.2 Overlay on photographs the following data in alpha-numeric form such that it will not interfere with the defect condition reported:
 - (a) Report/job number
 - (b) .2 Metre reading position (chainage)
 - (c) .3 Manhole/pipe length reference numbers (from - to)
 - (d) .4 Photograph number
 - (e) .5 WRC. condition defect code
 - (f) .6 Date of survey (yyyy.mm.dd)
 - 3.7.3 Capture photograph and alpha-numeric data as a digital image in a JPEG file format if required, as specified in the Agreement.
 - 3.7.4 Co-ordinate photographs with the hard-copy report by reference number and inserting into the report following the relevant section of pipeline inspected.

CCTV INSPECTION OF PIPELINES

- 3.8 Inspection Reporting Hard copies & Digital Format
 - 3.8.1 Submit reports to the *Prime Consultant* within ten (10) working days of completion of the field work on a continuous basis as the inspection area or pipeline types are finalized.
 - 3.8.2 Present machine printed (hard copy) and computer generated data base reports according to the MSCC format.
 - (a) Each binder to commence with an index of all survey inspection reports contained within.
 - (b) Hard copy reports to be presented in tabular form in accordance with WRc MSCC
 - (c) Reports to be presented in sections or drainage areas and/or by pipeline type or as specified in the *Agreement*.
 - (d) Computer database file to contain identical survey report information as the printed report exclusive of photographs.
 - (e) Digital information to be presented in tabular configuration in accordance with the Municipality's standard file format in Microsoft ACCESS (.MDB)
 - (f) Provide CD ROM of digital photographs. Disk to be labelled with photo and contract numbers.
 - (g) .7 Include Municipality supplied, scale drawings showing highlight inspected pipeline. Drawing to be attached to inspection condition report for each section of sewer pipeline surveyed.
 - 3.8.3 Present report in 215 mm x 280 mm three ring (D type) binder. DVD's containing relevant CCTV inspections surveys to be included in the binder.
 - 3.8.4 Attach computer disks in three hole plastic diskette sheet holder in back of binder.
 - 3.8.5 Attach identical identification labels on the three ring binder, DVD's (video files) and CD's (database and still digital images).
 - 3.8.6 All dimensions and chainages in the reports to be metric.
- 3.9 Cleaning
 - 3.9.1 Clean pipelines to Section 33 01 30.2 immediately prior to CCTV inspection survey, unless otherwise specified in the *Agreement*.
- 3.10 Root Cutting & Removal
 - 3.10.1 Remove roots to Section 33 01 30.2 for condition codes RT and RM where required, to allow for CCTV equipment to pass.
- 3.11 Flow Reduction

CCTV INSPECTION OF PIPELINES

- 3.11.1 Reduce flow in pipeline to approximately 20% of pipe diameter to allow CCTV inspection by combination of the following:
- 3.11.2 Schedule work for off peak flow times.
- 3.11.3 Plug or block flow at upstream manhole.
 - (a) Plug designed to either plug all flow or impede flow ("flow through" plug) to the approximate 20% of pipe diameter.
 - (b) Obtain the *Prime Consultant's* approval prior to plugging or impeding any flow.
 - (c) Remove plug or blocks to slowly return flow to normal without surge or surcharging downstream pipeline.
- 3.11.4 Temporary bypass pump flow around inspection section when *Contractor* demonstrates that off peak inspection, plugging and /or the use of sewer cleaning equipment cannot effectively reduce flow levels to specified levels. Bypass pump plugs to be flow through with hoses and pump of sufficient capacity to handle the peak flow. Hoses and couplings to be leak free. Flow to be pumped to downstream manhole on same system or run as inspection is to take place. Obtain the *Prime Consultant's* approval prior to setting up temporary bypass pump system.
- 3.12 Coding Accuracy
 - 3.12.1 Coding accuracy to be a function of the number of defects or construction features not recorded (omissions) and the correctness of the coding and classification recorded. Coding accuracy to satisfy the following requirements:
 - (a) header accuracy - 95%
 - (b) detail accuracy - 85%
 - 3.12.2 *Contractor* to implement a formal coding accuracy verification system at the onset of the work. Coding accuracy to be verified by the *Contractor* on a random basis on a minimum of 10% of the inspection reports. The *Prime Consultant* to be entitled to review the accuracy verification system and results and be present when the assessments are being conducted.
 - 3.12.3 A minimum of two accuracy verifications to be performed for each operator for each working week. Coding not satisfying the accuracy requirements to be re-coded and the accuracy of the inspection report immediately preceding and following the non-compliant inspection to be verified. Process to be repeated until the proceeding and subsequent inspections meet accuracy requirements.

END OF SECTION

CLEANING OF SEWERS

1.0 GENERAL

- 1.1 Section 33 01 30.02 refers to those portions of the work that are unique to the requirements for cleaning of new and existing sanitary, gravity watermain, storm and combined sewer pipe and pipe culverts.
- 1.2 Related Work
 - 1.2.1 CCTV Pipeline Inspection Section 33 01 30.01
- 1.3 Work Regulations
 - 1.3.1 Work to conform to all applicable regulations of the Alberta Government and confirm training compliance in the following:
 - (a) Confined space entry procedures
 - (b) Atmospheric monitoring and ventilation methods
 - (c) Personal protective equipment
 - (d) Interpretation of Material Safety Data Sheets (MSDS)
- 1.4 Terminology
 - 1.4.1 Flushing is defined as a maximum of three (3) passes of high pressure jetting equipment to allow for passage of CCTV or other forms of inspection equipment.
 - 1.4.2 Cleaning is defined as the removal of all debris by means of high pressure jetting equipment including: gravel, sand, rocks (to 300mm in diameter), grease and other deleterious material.
- 1.5 Submissions
 - 1.5.1 Submit the following information seven (7) days prior to the commencement of work;
 - (a) Provide schedule and sequence of flushing or cleaning activities
 - (b) Provide written confirmation to the *Prime Consultant* that workers have knowledge of confined space entry practices and of equipment required for confined space entry
- 1.6 Scheduling
 - 1.6.1 Schedule work to minimize interruptions to existing services.
 - 1.6.2 Hours of work to comply with noise restriction bylaw unless granted exemption by Municipality.
 - 1.6.3 Maintain existing flow during sewer cleaning and debris removal unless directed otherwise in contract document.

2.0 PRODUCTS

- 2.1 Equipment

CLEANING OF SEWERS

- 2.1.1 High velocity cleaning equipment to be capable of providing a minimum flow of 200 litres per minute (60 GPM) at 140 bar (2000 psi). Cleaning nozzle to be hydraulically or hydro-dynamically propelled and capable of producing a scouring action from 15 to 45 degrees. A variety of ancillary equipment and nozzles to be available including; standard flushing nozzles, high efficiency, spinning jet and plough jet to address all anticipated debris conditions. The equipment to include a water tank, pumps and hydraulically driven hose reel. Equipment to include a wash down gun for cleaning manholes and an approved back flow preventing device for water tank filling.
- 2.1.2 Debris removal equipment to consist of a vacuum pump complete with positive displacement pumps or fans producing a minimum of 700 l/s air movement. Equipment to be capable of removing debris at a minimum of 4.5 metres vertical head. Suction hose to be a minimum of 150 mm diameter. Debris tank to be water tight and capable of returning the liquid portion of the debris to the sewer.
- 2.1.3 Debris cutting equipment to be an accessory or attachment to hydraulic cleaning equipment. Equipment to be capable of removing heavy roots and solid debris such as encrustation and grease.
- 2.1.4 Backflow prevention valves for the purpose of drawing water from hydrants to have air gap and must be pre-approved by the utility having jurisdiction.

3.0 EXECUTION

3.1 Clean or Flush

- 3.1.1 Clean or flush all pipelines. Notify the *Prime Consultant* immediately in the event that roots, grease or unusual quantities of debris is observed after three passes.
- 3.1.2 Notify all affected residence connected to the sanitary sewers in writing of proposed sewer cleaning and CCTV inspection process as specified in the Agreement. Notice to be distributed two (2) working days in advance of flushing. Notice to include Contractor's name and contact information.
- 3.1.3 Begin cleaning or flushing from the upstream sewer in the system and proceed downstream. Under no circumstances is the sewer cleaning or flushing process to proceed downstream until all contributing upstream sewers have been cleaned. Sewers to be cleaned or flushed in the direction of flow.
- 3.1.4 Manholes to be washed down with high pressure wand AFTER manhole inspection has been completed.
- 3.1.5 Remove debris by vacuum pumping at each manhole. Do not pass debris from manhole to manhole.
- 3.1.6 Dispose of debris at an approved landfill site
- 3.1.7 Comply with applicable Provincial and Municipal environmental laws with regard to the decanting of accumulated waste water with respect to spills and discharge of contaminants.

CLEANING OF SEWERS

- 3.1.8 Decanting of liquid waste accumulated during debris removal is permitted at a controlled release rate of a maximum of 8 litres per second.
- 3.2 Water Supply
 - 3.2.1 Contractor to supply water for cleaning and flushing.
- 3.3 Root Removal
 - 3.3.1 Inform the *Prime Consultant* prior to undertaking any root cutting or grease removal where cutting equipment is required.
 - 3.3.2 Run root cutter through entire section of pipeline from manhole to manhole or end of pipe to end of pipe
 - 3.3.3 Select root cutting devise or grease removal nozzle of appropriately size and configuration for the diameter of the pipeline.

END OF SECTION

SITE WATER UTILITY DISTRIBUTION PIPING

1.0 GENERAL

1.1 Related Requirements

- 1.1.1 Section 03 20 00 - Concrete Reinforcing
- 1.1.2 Section 03 30 00 - Cast-in-Place Concrete
- 1.1.3 Section 31 00 00 – Earthworks General

1.2 Reference Standards

1.2.1 Department of Justice Canada (Jus)

- (a) SOR/2018-196 Prohibition of Asbestos and Products Containing Asbestos Regulations.

1.2.2 American National Standards Institute/American Water Works Association (ANSI/AWWA)

- (a) AWWA B300-24, Hypochlorites.
- (b) AWWA B301-24, Liquid Chlorine.
- (c) AWWA B303-24, Sodium Chlorite.
- (d) AWWA C104/A21.4-22, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
- (e) AWWA C105/A21.5-18, Polyethylene Encasement for Ductile-Iron Pipe Systems.
- (f) AWWA C111/A21.11-23, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- (g) AWWA C110-21, Ductile-Iron and Gray-Iron Fittings.
- (h) AWWA C150/A21.50-21(R23), Thickness Design of Ductile-Iron Pipe.
- (i) AWWA C151/A21.51-23, Standard for Ductile-Iron Pipe, Centrifugally Cast.
- (j) AWWA C153-19, Ductile-Iron Compact Fittings.
- (k) AWWA C200-23, "Steel Water Pipe.
- (l) AWWA C203-20, Coal-Tar Protective Coatings and Linings for Steel Water Pipe.
- (m) AWWA C205-24, "Cement-Mortar Protective Lining and Coating for Steel Water Pipe 4 In. (100 mm) and Larger.
- (n) AWWA C206-23, Field Welding of Steel Water Pipe.
- (o) AWWA C207-23, Standard for Steel Pipe Flanges for Waterworks Service, 4 Inch through 144 Inch (100 mm through 3,600 mm).
- (p) AWWA C208-22, Dimensions for Fabricated Steel Water Pipe Fittings.

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- (q) AWWA C300-22, Standard for Reinforced Concrete Pressure Pipe, Steel-Cylinder Type.
- (r) AWWA C301-14(R19), Standard for Prestressed Concrete Pressure Pipe, Steel-Cylinder Type.
- (s) AWWA C303-24, Standard for Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type.
- (t) AWWA C500-19, Metal-Seated Gate Valves for Water Supply Service.
- (u) AWWA C504-15, Rubber-Seated Butterfly Valves.
- (v) AWWA C517-16(R21), Resilient-Seated Cast-Iron Eccentric Plug Valves.
- (w) AWWA C600-23, Standard for Installation of Ductile-Iron Water Mains, and Their Appurtenances.
- (x) AWWA C602-23, Cement-Mortar Lining of Water Pipelines in Place--4 In. (100 mm) and Larger.
- (y) AWWA C651-23, Disinfecting Water Mains.
- (z) AWWA C800-21, Underground Service Line Valves and Fittings.
- (aa) AWWA C900-22, Standard for Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 Inch through 12 Inch (100 mm - 300 mm), for Water Transmission and Distribution.

1.2.3 ASTM International (ASTM)

- (a) ASTM A53/A53M-24, Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless.
- (b) ASTM A123/A123M-24, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- (c) ASTM A307-21, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
- (d) ASTM B88M-20, Standard Specification for Seamless Copper Water Tube (Metric).
- (e) ASTM C117-23, Standard Test Methods for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
- (f) ASTM C136/C136M-19, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
- (g) ASTM C478/C478M-22, Standard Specification for Circular Precast Reinforced Concrete Manhole Sections.
- (h) ASTM D698-12R21, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).

SITE WATER UTILITY DISTRIBUTION PIPING

- (i) ASTM D2657-07(2023), Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
 - (j) ASTM D2992-24, Standard Practice for Obtaining Hydrostatic or Pressure Design Basis for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fitting.
 - (k) ASTM D2996-23, Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe.
 - (l) ASTM F714-24, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
 - (m) ASTM C618-23e1, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
- 1.2.4 American Water Works Association (AWWA)/Manual of Practice
- (a) AWWA M9 (THIRD EDITION), Concrete Pressure Pipe.
 - (b) AWWA M11 (FIFTH EDITION), Steel Pipe - A Guide for Design and Installation.
 - (c) AWWA M17 (FIFTH EDITION), Installation, Field Testing, and Maintenance of Fire Hydrants.
- 1.2.5 Canadian General Standards Board (CGSB)
- (a) CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
 - (b) CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- 1.2.6 CSA Group (CSA)
- (a) CSA A257 SERIES:24, Standards for Concrete Pipe (Consists of A257.0, A257.1, A257.2, A257.3 and A257.4).
 - (b) CSA A3000-23, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - (c) CSA B137:23 SERIES PACKAGE, Thermoplastic Pressure Piping Compendium. (Consists of B137.0, B137.1, B137.2, B137.3, B137.4, B137.4.1, B137.5, B137.6, B137.8, B137.9, B137.10, B137.11 and B137.12).
 - (d) CSA G30.18-21, Carbon and Steel Bars for Concrete Reinforcement.
- 1.2.7 The Master Painters Institute (MPI)
- (a) Architectural Painting Specification Manual (current edition).
- 1.2.8 Underwriters' Laboratories of Canada (ULC)
- (a) CAN/ULC-S520:2022A, Standard for Fire Hydrants.
 - (b) CAN/ULC-S543:2023, Standard for Internal-Lug, Quick Connect Couplings for Fire Hose.

SITE WATER UTILITY DISTRIBUTION PIPING

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- 1.3 Action and Informational Submittals
 - 1.3.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
 - 1.3.2 Product Data:
 - (a) Submit manufacturer's instructions, printed product literature and data sheets for distribution piping materials and include product characteristics, performance criteria, physical size, finish and limitations.
 - (b) Pipe certification to be on pipe.
 - 1.3.3 Shop Drawings:
 - (a) Submit drawings stamped and signed by professional engineer registered or licensed in Alberta, Canada.
 - (b) Submit complete drawings and construction schedule for water mains. Include method for installation of water main.
 - 1.3.4 Samples:
 - (a) Submit adequate samples of materials for testing purposes.
 - (b) Submit manufacturer's test data and certification that pipe materials meet requirements of this section 4 weeks minimum prior to beginning work. Include manufacturer's drawings, information and shop drawings where pertinent.
 - 1.3.5 Commissioning Plan:
 - (a) Prior to starting construction on the water mains, submit a commissioning plan that describes how the watermain will be pressure tested, flushed, and disinfected.
 - 1.4 Closeout Submittals
 - 1.4.1 Submit in accordance with Section 01 77 00 - Closeout Procedures.
 - 1.4.2 Submit record drawings, including directions for operating valves, list of equipment required to operate valves, details of pipe material, location of air and vacuum release valves.
 - (a) Include top of pipe, horizontal location of fittings and type, valves, valve boxes, valve chambers, and pig launch & retrieval stations.
 - 1.4.3 Operation and Maintenance Data: submit operation and maintenance data for pipe, valves, valve boxes, valve chambers, pig launch & retrieval stations for incorporation into manual.
 - 1.5 Delivery, Storage and Handling
 - 1.5.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

SITE WATER UTILITY DISTRIBUTION PIPING

- 1.5.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- 1.5.3 Storage and Handling Requirements:
 - (a) Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - (b) Store and protect all materials from damage.
 - (c) Replace defective or damaged materials with new.
- 1.6 Scheduling of Work
 - 1.6.1 Schedule Work to minimize interruptions to existing services.
 - 1.6.2 Submit schedule of expected interruptions for approval and adhere to interruption schedule as approved by Consultant.
 - 1.6.3 Notify Consultant minimum of 24 hours in advance of interruption in service.
 - 1.6.4 Do not interrupt water service for more than 3 hours and confine this period between 10:00 and 16:00 hours local time unless otherwise authorized.
 - 1.6.5 Notify fire department of planned or accidental interruption of water supply to hydrants.
 - 1.6.6 Provide and post "Out of Service" sign on hydrant not in use.
 - 1.6.7 Advise local police department of anticipated interference with movement of traffic.
- 1.7 MAINTENANCE MATERIAL SUBMITTALS
 - 1.7.1 Submit in accordance with Section 01 77 00 - Closeout Procedures.

2.0 PRODUCTS

- 2.1 Pipe, Joints, and Fittings
 - 2.1.1 Polyethylene pressure pipe:
 - (a) HDPE pipe and fittings must confirm to AWWA C906.
 - (b) Shall be 4710.
 - (c) DR as indicated on drawings.
 - (d) The pipe Manufacturer, Distributor, and Installer shall ensure that the ends of each pipe length remain sealed in a manner acceptable to the Consultant during the transportation and storage of the pipe. The purpose of the end-seals is to prevent contaminants from entering the interior of the pipe from the time of manufacture to the time of installation.
 - 2.1.2 Polyvinyl Chloride:
 - (a) PVC pipe and fittings must confirm to AWWA C900.
 - (b) DR as indicated on drawings.

SITE WATER UTILITY DISTRIBUTION PIPING

- (c) The pipe Manufacturer, Distributor, and Installer shall ensure that the ends of each pipe length remain sealed in a manner acceptable to the Consultant during the transportation and storage of the pipe. The purpose of the end-seals is to prevent contaminants from entering the interior of the pipe from the time of manufacture to the time of installation.
- 2.2 Pipe Protection
 - 2.2.1 Provide means of protection for pipe in corrosive soils identified on drawings.
- 2.3 Insulation
 - 2.3.1 Factory applied, Urecon Standard U.I.P. or approved equivalent.
 - 2.3.2 Styrofoam HI-40 as manufactured by Dow Chemical Canada Inc. or approved equivalent.
- 2.4 Tracer Wire
 - 2.4.1 Wire
 - (a) All tracer wire shall have HDPE insulation intended for direct bury, color coated white.
 - (b) Open Trench: Tracer wire shall be Copper Clad Steel, High Strength with minimum 2 kN break load, with minimum 0.762 mm HDPE insulation thickness.
 - (c) Trenchless Installation: Tracer wire shall be Copper Clad Steel, Extreme Strength with a minimum 15.6 kN break load, with minimum 1.143 mm HDPE insulation thickness.
 - 2.4.2 Connectors
 - (a) Three wires shall be joined using a single 3-way lockable connector. Four wires shall be joined using a 4-way connector. Use of two 3-way connectors with a short jumper wire between them is an acceptable alternative.
 - (b) Connectors shall be dielectric silicon filled to seal out moisture and corrosion and shall be installed in a manner so as to prevent any uninsulated wire exposure.
 - (c) Non-locking friction fit, twist on or taped connectors are prohibited.
 - (d) Connectors shall be rated for direct bury applications.
 - 2.4.3 Termination/Access
 - (a) Tracer wires shall be terminated at each mainline valve.
 - 2.4.4 Grounding
 - (a) Grounding of tracer wire shall be achieved by use of a drive-in magnesium grounding anode rod with a minimum of 6 m of #14 red HDPE insulated copper clad steel wire connected to anode (minimum 2.3 kg) specifically

SITE WATER UTILITY DISTRIBUTION PIPING

manufactured for this purpose and buried at the same elevation as the utility

2.4.5 Prohibited Products

- (a) Uninsulated tracer wire.
- (b) Tracer wire insulations other than HDPE.
- (c) Non-locking, friction fit, twist on or taped connectors.
- (d) Brass or copper ground rods.
- (e) Wire connections utilizing taping or spray-on waterproofing.
- (f) Brass fittings with tracer wire connection lugs.

2.5 Valves and Valve Boxes

2.5.1 Valves to open counter-clockwise.

2.5.2 Gate valves: to AWWA C500.

2.5.3 Plug valves: to AWWA C517.

2.5.4 All valves must incorporate an independent packing retaining plate or recessed packing retaining device to accommodate the actuator removal under fully system pressure.

2.5.5 The actuator must not be used to retain the valve packing on any valve size.

2.5.6 The coating requirements will be per the valve exterior coating specification.

2.5.7 All valves shall be zero leakage at rated pressures for bi-directional flow conditions and satisfactory for applications involving operation after long periods of inactivity.

2.5.8 All materials shall be in compliance with ANSI/NSF Standard 61.

2.5.9 Underground type indicator valve where indicated. Indicator post to accurately indicate valve open or closed.

2.5.10 Air and vacuum release valves: heavy duty combination air release valves employing direct acting kinetic principle.

- (a) As per AWAA 512
- (b) Double acting (Air Release and Vacuum Break functions)
- (c) To be supplied with a written Lifetime Warranty for all internal parts.
- (d) Shall come with provisions for draining.
- (e) Shall have a non-slam or three stage design to reduce transients.

2.5.11 Cast iron valve boxes: As per drawings.

- (a) Top of box to be marked "WATER".

2.6 Pipe Bedding and Surrounding Material

SITE WATER UTILITY DISTRIBUTION PIPING

2.6.1 Granular material to: Section 31 00 00 – Earthworks General and following requirements:

- (a) Crushed or screened stone, gravel, or sand.
- (b) Suitable material for bedding shall consist of material free from large rocks, boulders and frozen lumps.
- (c) The suitability of this material shall be determined at the sole discretion of the Consultant.
- (d) Suitable granular bedding material shall be well rounded pea gravel conforming to the following gradation, unless otherwise specified:
- (e) Table

Sieve Designation (mm)	% Passing
20	100
12	60-100
10	20-80
4.75	0-10
2.36	0-3

2.6.2 Concrete mixes and materials required for bedding cradles, encasement, supports, thrust blocks: to Section 03 30 00.09 - Cast-in-Place Concrete – Short Form.

2.7 Backfill Material

2.7.1 In accordance with Section 31 00 00 – Earthworks General.

2.8 Pipe Disinfection

2.8.1 Calcium hypochlorite or Liquid chlorine to AWWA B300 and AWWA B301, respectively to disinfect water mains.

2.8.2 Disinfect water mains in accordance with AWWA C651.

3.0 EXECUTION

3.1 Examination

3.1.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for distribution piping installation in accordance with manufacturer's written instructions.

- (a) Visually inspect substrate in presence of Consultant.

SITE WATER UTILITY DISTRIBUTION PIPING

- (b) Inform Consultant of unacceptable conditions immediately upon discovery.
 - (c) Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.
- 3.2 Preparation
 - 3.2.1 Clean pipes, fittings, valves, and appurtenances of accumulated debris and water before installation.
 - (a) Inspect materials for defects to approval of Consultant.
 - (b) Remove defective materials from site as directed by Consultant.
- 3.3 Trenching
 - 3.3.1 Do trenching work in accordance with Section 31 00 00 – Earthworks General.
 - 3.3.2 Ensure trench depth allows coverage over pipe as indicated on drawings.
 - 3.3.3 Trench alignment and depth require Consultant's approval prior to placing bedding material and pipe.
- 3.4 Concrete Bedding and Encasement
 - 3.4.1 Do concrete work in accordance with Section 03 30 00.09 - Cast-in-Place Concrete – Short Form.
 - (a) Place concrete to details as directed by Consultant.
 - 3.4.2 Pipe may be positioned on concrete blocks to facilitate placing of concrete. When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.
 - 3.4.3 Do not backfill over concrete within 24 hours after placing.
- 3.5 Granular Bedding
 - 3.5.1 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth as indicated.
 - 3.5.2 Bedding material shall not be dropped onto pipe from a height exceeding 600 mm. Where this requirement cannot be met, rockshield material approved by the Consultant shall be supplied.
 - 3.5.3 Do not place material in frozen condition.
 - 3.5.4 Shape bed true to grade to provide continuous uniform bearing surface for pipe.
 - 3.5.5 Shape transverse depressions in bedding as required to suit joints.
 - 3.5.6 Compact each layer full width of bed to 90% Standard Proctor Density.
 - 3.5.7 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding in accordance with Section 31 00 00 – Earthworks General with compacted bedding material.

SITE WATER UTILITY DISTRIBUTION PIPING

- 3.6 Pipe Installation
 - 3.6.1 Lay pipes to manufacturer's standard instructions and specifications.
 - (a) Do not use blocks except as specified.
 - 3.6.2 Join pipes in accordance with manufacturer's guidelines and under the approval of the Consultant.
 - 3.6.3 Bevel or taper ends of PVC pipe to match fittings.
 - 3.6.4 Handle pipe by methods recommended by pipe manufacturer. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.
 - 3.6.5 Operator certification shall be available for inspection and issued no more than one calendar year ahead of construction to be considered valid.
 - 3.6.6 Fusion equipment must be serviced and maintained to the manufacturer's specifications.
 - 3.6.7 Butt and sidewall fusion machines shall be A H McElroy or approved equal.
 - 3.6.8 Electrofusion fittings and equipment shall be by Friatec or Central Plastics.
 - 3.6.9 Lay pipes on prepared bed, true to line and grade.
 - (a) Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
 - (b) Take up and replace defective pipe.
 - (c) Correct pipe which is not in true alignment or grade or pipe which shows differential settlement after installation greater than 10 mm in 3 m.
 - 3.6.10 Face socket ends of pipe in direction of laying. For mains on grade of 2% or greater, face socket ends up-grade.
 - 3.6.11 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.
 - 3.6.12 Keep jointing materials and installed pipe free of dirt and water and other foreign materials.
 - (a) Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
 - 3.6.13 Position and join pipes with equipment and methods approved by Consultant.
 - 3.6.14 Cut pipes in approved manner as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
 - 3.6.15 Align pipes before jointing.
 - 3.6.16 Install gaskets to manufacturer's recommendations. Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.

SITE WATER UTILITY DISTRIBUTION PIPING

- 3.6.17 Avoid displacing gasket or contaminating with dirt or other foreign material.
 - (a) Remove disturbed or contaminated gaskets.
 - (b) Clean, lubricate and replace before jointing is attempted again.
- 3.6.18 Complete each joint before laying next length of pipe.
- 3.6.19 Minimize deflection after joint has been made.
- 3.6.20 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.
- 3.6.21 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by Consultant.
- 3.6.22 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.
- 3.6.23 Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.
- 3.6.24 Do not lay pipe on frozen bedding.
- 3.6.25 Do hydrostatic and leakage test and have results approved by Consultant before surrounding and covering joints and fittings with granular material.
- 3.6.26 Backfill remainder of trench.
- 3.7 Tracer Wire
 - 3.7.1 General
 - (a) Tracer wire installation shall be performed in such a manner that allows proper access for connection of line tracing equipment, proper locating of wire without loss or deterioration of low frequency (512 Hz) signal for distances in excess of 1,000 m, and without distortion of signal caused by multiple wires being installed in close proximity to one another.
 - (b) Tracer wire systems must be installed as a single continuous wire, except where using approved connectors. No looping or coiling of wire is allowed.
 - (c) Connectors are only permitted for use at valves or intersections of three or more mainline pipes. All other tracer wire must be continuous and splice free unless otherwise approved by the Consultant.
 - (d) Any damage occurring during installation of the tracer wire must be immediately repaired by removing the damaged wire and installing a new section of wire with approved connectors. Taping and/or spray coating shall not be allowed.
 - (e) Tracer wire shall be installed on all mainline pipe. For open cut installations the wire shall be installed at the top of the pipe and taped at 3 m intervals. For trenchless installations, top of pipe installation and taping are not required.

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- (f) Tracer wire must be properly grounded.
- (g) At all mainline dead-ends, tracer wire shall go to ground using an approved connection to a drive-in magnesium grounding anode rod, buried at the same depth as the tracer wire.
- (h) Mainline tracer wire shall not be connected to existing conductive pipes. Treat as a mainline dead-end, ground using an approved waterproof connection to a grounding anode buried at the same depth as the tracer wire.
- (i) In occurrences where an existing tracer wire is encountered on an existing utility that is being extended or tied into, the new tracer wire and existing tracer wire shall be connected using approved splice connectors and shall be properly grounded at the splice location as specified.
- (j) When grounding the tracer wire at dead ends/stubs, the grounding anode shall be installed in a direction 180 degrees opposite of the tracer wire, at the maximum possible distance.
- (k) When grounding the tracer wire in areas where the tracer wire is continuous and neither the mainline tracer wire or the grounding anode wire will be terminated at/above grade, install grounding anode directly beneath and in-line with the tracer wire. Do not coil excess wire from grounding anode. In this installation method, the grounding anode wire shall be trimmed to an appropriate length before connecting to tracer wire with a mainline to lateral lug connector.
- (l) Where the tracer wire terminates, a minimum of 500 mm excess wire is required after meeting final elevation.

3.7.2 Testing

- (a) All new tracer wire installations shall be located using typical low frequency (512 Hz) line tracing equipment, completed by a third-party locating agency, selected by the Contractor and approved by the Consultant. Testing shall be witnessed by the Contractor and Consultant prior to acceptance.
- (b) Contractor shall pay costs for tracer wire locating and testing.
- (c) Continuity testing in lieu of actual line tracing shall not be accepted.

3.7.3 Prohibited Installations

- (a) Looped wire or continuous wire installations, that has multiple wires laid side-by side or in close proximity to one another.
- (b) Tracer wire wrapped around the corresponding utility.
- (c) Brass fittings with tracer wire connection lugs.
- (d) Connecting tracer wire to existing conductive utilities.

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- 3.8 Valve Installation
 - 3.8.1 Install valves to manufacturer's recommendations at locations as indicated.
 - 3.8.2 Support valves located in valve boxes by means of concrete located between valve and solid ground. Valves not to be supported by pipe.
 - 3.8.3 Install underground post-type indicator valves as indicated.
- 3.9 Insulation
 - 3.9.1 Install insulation in accordance with manufacturer's instructions.
- 3.10 Undercrossing
 - 3.10.1 Excavate working pit to dimensions indicated, outside right-of-way to be crossed.
 - 3.10.2 Excavate working pit to not less than 0.6 m below lowest invert of encasing pipe.
 - 3.10.3 Dewater excavation.
 - 3.10.4 Dewater area of undercrossing.
 - 3.10.5 Install backstop.
 - 3.10.6 Place encasing pipe to exact line and grade indicated. Encasing pipe to cross under obstruction at the angle indicated on the drawings.
 - 3.10.7 Install encasing pipe by jacking.
 - 3.10.8 Ensure encasing pipe is not in tension.
 - 3.10.9 Joints for encasing pipe: welded type.
 - 3.10.10 Insert water main into encasing pipe.
 - 3.10.11 Use approved blocking method to guide water main in true alignment.
 - 3.10.12 Clearance between blocks and encasing pipe: maximum 15 mm when water main is in position.
 - 3.10.13 Join water main one length at time outside encasing pipe. Pull water main into position.
 - 3.10.14 Couplings of water main shall not rest on levelling pad when water main is in position.
- 3.11 Thrust Blocks and Restrained Joints
 - 3.11.1 For thrust blocks: do concrete Work in accordance with Section 03 30 00.09 - Cast-in-Place Concrete – Short Form.
 - 3.11.2 Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, and fittings and undisturbed ground as indicated, or as directed by Consultant.
 - 3.11.3 Keep joints and couplings free of concrete.

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- 3.11.4 Alternative restraints may be used in place of thrust blocks at the discretion of the Consultant.
- 3.11.5 Concrete shall be CSA Type HS with Fly Ash or Silica Fume for Sulphate and Chloride resistance, as well as 20 MPa at 28 days strength.
- 3.11.6 Do not backfill over concrete within 24 hours after placing.
- 3.11.7 For restrained joints: only use restrained joints approved by Consultant.
- 3.12 Pipe Surround
 - 3.12.1 Upon completion of pipe laying and after Consultant has inspected Work in place, surround and cover pipes as indicated.
 - 3.12.2 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
 - 3.12.3 Place layers uniformly and simultaneously on each side of pipe.
 - 3.12.4 Do not place material in frozen condition.
 - 3.12.5 Compact each layer, with final densities confirmed by geotechnical testing and documentation.
- 3.13 Backfill
 - 3.13.1 Place backfill material, above pipe surround, in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.
 - 3.13.2 Do not place backfill in frozen condition.
 - 3.13.3 Approved warning tape must be installed above all watermain installations at the discretion of the Consultant.
 - 3.13.4 Inspection of Sacrificial Anodes and Test Points prior to Backfilling
 - (a) All installations of sacrificial anodes, test points, and related wiring shall be inspected by the Contractor prior to backfilling.
 - (b) It is the Contractor's responsibility to notify the Consultant and request inspection of each cathodic protection installation.
 - (c) If backfilling over anodes and test wires has been carried out prior to inspection, the Contractor shall, when requested by the Consultant, re-excavate and expose all anodes and test wires, at no cost, for the purpose of inspection.
 - 3.13.5 All engineered fills shall be compacted to 98% of Standard Proctor Maximum Dry Density.
- 3.14 Hydrostatic Testing
 - 3.14.1 Do tests in accordance with the manufacturer's specifications, AWWA M55/AWWA C906-21 for HDPE pipe, and AWWA M23/AWWA C605 for PVC pipe.

SITE WATER UTILITY DISTRIBUTION PIPING

- 3.14.2 Provide labour, equipment and materials required to perform hydrostatic tests hereinafter described.
- 3.14.3 Notify Consultant at least 24 hours in advance of proposed tests.
 - (a) Perform tests in presence of *Consultant*.
- 3.14.4 Where section of system is provided with concrete thrust blocks, conduct tests at least 5 days after placing concrete or 2 days if high early strength concrete is used.
- 3.14.5 Test pipeline in sections not exceeding 365 m in length, unless otherwise authorized by *Consultant*.
- 3.14.6 When testing is done during freezing weather, protect valves, joints and fittings from freezing.
- 3.14.7 Open valves.
- 3.14.8 Expel air from main by slowly filling main with potable water.
 - (a) Install corporation stops at high points in main where no air-vacuum release valves are installed.
 - (b) Remove stops after satisfactory completion of test and seal holes with plugs.
- 3.14.9 Apply hydrostatic test pressure of 1,380 kPa minimum after complete backfilling of trench, based on elevation of lowest point in main and corrected to elevation of gauge, for period of 2 hours.
- 3.14.10 Repeat hydrostatic test until defects have been corrected.
- 3.14.11 Define leakage as amount of water supplied from water metre in order to maintain test pressure for 2 hours.
- 3.14.12 Do not exceed allowable leakage as per the appropriate AWWA manual including lateral connections.
- 3.14.13 Locate and repair defects if leakage is greater than amount specified.
- 3.14.14 Repeat test until leakage is within specified allowance for full length of water main.
- 3.15 Flushing and Disinfecting
 - 3.15.1 Flushing and disinfecting operations: witnessed by *Consultant* and local water work department.
 - (a) Notify *Consultant* at least 4 days in advance of proposed date when disinfecting operations will begin.
 - 3.15.2 Flush water mains through available outlets with a sufficient flow of potable water to produce velocity of no greater than 0.3 m/s to avoid transients.
 - 3.15.3 Provide connections and pumps for flushing as required.
 - 3.15.4 Open and close valves to ensure thorough flushing.

SITE WATER UTILITY DISTRIBUTION PIPING

- 3.15.5 When flushing has been completed to Consultant approval, introduce strong solution of chlorine as approved by Consultant into water main and ensure that it is distributed throughout entire system.
- 3.15.6 Disinfect water mains to the requirements of local authority.
- 3.15.7 Rate of chlorine application to be proportional to rate of water entering pipe.
- 3.15.8 Chlorine application to be close to point of filling water main and to occur at same time.
- 3.15.9 Operate valves and appurtenances while main contains chlorine solution.
- 3.15.10 Flush line to remove chlorine solution after 24 hours.
- 3.15.11 Measure chlorine residuals at extreme end of pipe-line being tested.
- 3.15.12 Perform bacteriological tests on water main, after chlorine solution has been flushed out.
 - (a) Take samples daily for minimum of 2 days.
 - (b) Should contamination remain or recur during this period, repeat disinfecting procedure.
- 3.15.13 Take water samples from the source water to test for chlorine residual.
- 3.15.14 After adequate chlorine residual not less than 0.4 mg/L has been obtained leave system charged with chlorine solution for 24 hours.
 - (a) After 24 hours, take further samples to ensure that there is still not less than 10 ppm of chlorine residual remaining throughout system.
- 3.16 Surface Restoration
 - 3.16.1 After installing and backfilling over water mains, restore surface to original condition as directed by Consultant.
- 3.17 Cleaning
 - 3.17.1 Progress Cleaning:
 - (a) Leave Work area clean at end of each day.
 - 3.17.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
 - 3.17.3 Waste Management:
 - (a) Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

SANITARY SEWERS

1.0 GENERAL

- 1.1 Section 33 30 01 refers to those portions of the Work that are unique to the supply and installation of gravity sanitary sewers and service connections. Related appurtenances are included in other Sections. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- 1.2 Related Work
 - 1.2.1 Concrete Reinforcement Section 03 20 00
 - 1.2.2 Cast-in-Place Concrete Section 03 30 00
 - 1.2.3 Earthworks General Section 31 00 00
 - 1.2.4 CCTV Pipeline Inspection Section 33 01 30.01
 - 1.2.5 Manholes and Catchbasins Section 33 44 01
 - 1.2.6 Cleaning of Sewer Section 33 01 30.02
- 1.3 References
 - 1.3.1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in Quality Assurance - Section 01 45 00.
- 1.4 Scheduling of Work
 - 1.4.1 Schedule work to minimize interruptions to existing services.
 - 1.4.2 Maintain existing sewage flows during construction.
 - 1.4.3 Submit schedule of expected interruptions for approval by the *Prime Consultant* and adhere to approved schedule.
 - 1.4.4 Notify residents of dates and periods when service will be interrupted.

2.0 PRODUCTS

- 2.1 Concrete Pipe
 - 2.1.1 Non-reinforced concrete pipe and fittings: to ASTM C14M maximum diameter 400mm, strength class as shown on Contract Drawings, designed for flexible rubber gasket joints to ASTM C443M.

SANITARY SEWERS

2.1.2 Reinforced circular concrete pipe and fittings: to ASTM C76M for all pipe greater than 400mmØ, strength class as shown on Contract Drawings, designed for flexible rubber gasket joints to ASTM C443M.

2.1.3 Lifting holes:

- (a) Pipe 900mm and less diameter - no lift holes.
- (b) Pipe greater than 900mm diameter - lift holes not to exceed two in a piece of pipe.
- (c) Provide pre-fabricated plugs to seal lift holes watertight after installation of pipe.

2.2 Plastic Pipe, Mainline Smooth Profile

2.2.1 Type PSM polyvinyl chloride (PVC) to highest requirements of: CAN/CSA B182.1 (100mm to 150mm diameter); CAN/CSA B182.2 (200mm to 675mm diameter); ASTM C-3034 (100mm to 375mm diameter) and ASTM F789.

- (a) Dimension Ratio (DR): 35 for 100mm to 675mm, and 28 for 100mm to 150mm.
- (b) Joints: push-on type comprised of integral bell with single elastomeric gasket to ASTM D3212 and ASTM F477 or F913.
- (c) Normal pipe laying length joint to joint to be 3.96m.

2.3 Plastic Pipe, Mainline Ribbed Profile

2.3.1 Ribbed profile PVC pipe to CSA B182.4

- (a) Pipe stiffness Class V.
- (b) Joints: push-on type comprised of single elastomeric gasket to ASTM D3212 and ASTM F477 or F913.
- (c) Normal pipe laying length joint to joint to be 4.00m.

2.4 Service Connections

2.4.1 All sanitary sewer connections to be PVC type PSM sewer pipe, Dimension Ratio (DR) 28.

SANITARY SEWERS

-
- 2.4.2 Minimum diameter 100mm, maximum diameter 150mm.
 - 2.4.3 Extrusion moulded PVC wyes to be used for all connections to new PVC mainline pipe.
 - 2.4.4 All connections to new non-reinforced or reinforced concrete pipe to be made using PVC pipe stub with integral bell, epoxy resin cemented in neatly cored hole in pipe wall by concrete pipe manufacturer. Stub and bell orientation to be 45° to centreline of concrete pipe. PVC pipe stub and bell to conform to ASTM D3034 complete with locked-in single elastomeric gasket conforming to ASTM D3212 and ASTM F477 or F913.
 - 2.4.5 All connections to existing mainline pipe to be made using Crowle or approved equal strap on saddles which will allow completion of push-on joint conforming to ASTM D3034, ASTM D3212 and ASTM F477 or F913.
 - 2.4.6 Plastic service piping PVC type PSM as specified for plastic pipe, mainline, smooth profile.
 - 2.4.7 Fittings: PVC to ASTM D3034.
 - 2.4.8 Pipe and fitting joints: push-on type comprised of integral bell with single locked-in elastomeric gasket to ASTM D3212 and ASTM F477 or F913.
 - 2.4.9 Normal pipe laying length joint to joint to be 3.96 m.
 - 2.5 Concrete
 - 2.5.1 Concrete mixes and materials required for bedding cradles, encasement, and incidental uses: to Section 03 30 00 - Cast-in-Place Concrete.
 - 2.5.2 Concrete to be minimum 20 MPa.
 - 2.6 Granular Pipe Bedding and Surround Material
 - 2.6.1 As shown on Contract Drawings.
 - 2.6.2 Refer to Section 31 05 16 - Aggregates and Granular Materials for material specifications.
 - 2.7 Backfill Material
 - 2.7.1 As shown on Contract Drawings.
 - 2.7.2 Refer to Section 31 05 16 - Aggregates and Granular Materials for material specifications.

SANITARY SEWERS

3.0 EXECUTION

3.1 General

- 3.1.1 Pipe bedding details, including granular surround (pipe cushion) and material specifications to be as shown on Contract Drawings including Standard Detail Drawings.

3.2 Survey Layout

- 3.2.1 For sewer mains, the *Contractor* shall supply the *Prime Consultant* with completed copies of all grade sheets along the cuts to pipe invert from hub elevations along a prescribed line of offset hubs, along with original ground elevation along the pipe centreline at 15m intervals and any high or low points in between, and the pipe design invert at each hub location.
- 3.2.2 In built up areas, prior to the installation of sewer mains on each street, lane, or easement, the Contractor's shall set a 25mm x 50mm stake, projecting at least 0.3 meters, at the property line of the lot to be served, or at the terminus of the service. The stake location will be determined from consultation by the Contractor with the homeowner and the *Prime Consultant*.
- 3.2.3 For each service connection, the *Contractor* shall supply the *Prime Consultant* with completed grade sheets listing:
- the invert of the service wye (or manhole stub where a wye is not used);
 - the original ground elevation at the main;
 - the service invert at the property line;
 - the original ground elevation at the property line;
 - the invert of any risers on the service line;
 - the length and slope of the service piping between the main and property line where a riser is not installed, or the length and slope of the service between the riser and the property line where a riser is installed.

3.3 Preparation

- 3.3.1 Clean pipes and fittings of debris and water before installation. Carefully inspect materials for defects before installing. Remove defective materials from site.

3.4 Trenching

SANITARY SEWERS

- 3.4.1 Do trenching in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
 - 3.4.2 Trench alignment and depth as shown on Contract Drawings.
- 3.5 Concrete Bedding and Encasement
 - 3.5.1 Do concrete work to Section 03 30 00 - Cast-in-Place Concrete. Place concrete to details as shown on Contract Drawings.
 - 3.5.2 Pipe may be positioned on concrete blocks to facilitate placing of concrete. When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.
 - 3.5.3 Do not backfill over concrete within 24 h after placing.
- 3.6 Granular Bedding
 - 3.6.1 Fill over excavation below design elevation of bottom of specified bedding with approved drain rock or granular bedding placed and compacted to 100% Standard Proctor to ASTM D698.
 - 3.6.2 Place granular bedding material across full width of trench bottom in uniform layers not exceeding 150mm compacted thickness to depth as shown on Contract Drawings.
 - 3.6.3 Shape bed true to grade to provide continuous uniform bearing surface for pipe. Do not use blocks when bedding pipe.
 - 3.6.4 Shape transverse depressions in bedding as required to suit joints.
 - 3.6.5 Compact each layer full width of bed to minimum 95% Standard Proctor Density in compliance with ASTM D698. (All following references to density imply in compliance with ASTM D698).
- 3.7 Pipe Installation
 - 3.7.1 Handle pipe in accordance with manufacturer's recommendations. Do not use chains or cables passed through pipe bore so that weight of pipe bears upon pipe ends.
 - 3.7.2 Lay and join pipes to manufacturer's instructions and specifications except as noted otherwise herein.
 - 3.7.3 Horizontal tolerances: plus, or minus 30mm from specified alignment;

Vertical tolerances: plus, or minus 5mm from specified grade.

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- 3.7.4 Lay pipes on prepared bed, true to line and grade. Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
- 3.7.5 Commence laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- 3.7.6 Do not exceed one-half permissible joint deflection recommended by pipe manufacturer. Joint deflection not permitted for PVC pipe.
- 3.7.7 Keep jointing materials and installed pipe free of dirt, water and other foreign materials. Whenever work is stopped, install removable watertight bulkhead at open end of last pipe laid to prevent entry of water and foreign materials.
- 3.7.8 Cut pipes as required, as recommended by pipe manufacturer, without damaging pipe and leave smooth end at right angles to axis of pipe.
- 3.7.9 Joints:
 - (a) Install gaskets as recommended by manufacturer.
 - (b) Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
 - (c) Align pipes carefully before joining.
 - (d) Maintain pipe joints free from mud, silt, gravel, and other foreign material.
 - (e) Avoid displacing gasket or contaminating with dirt or other foreign material. Remove disturbed or dirty gaskets; clean, lubricate and replace before joining is attempted.
 - (f) Complete each joint before laying next length of pipe.
 - (g) Minimize joint deflection after joint has been to avoid joint damage.
 - (h) Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.
- 3.7.10 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as specified otherwise.
- 3.7.11 When any stoppage of work occurs, restrain pipes in an approved manner to prevent "creep" during down time.
- 3.7.12 Plug lifting holes with approved prefabricated plugs, to pipe supplier's recommendations for sealing methods.

SANITARY SEWERS

- 3.7.13 Make watertight connections to manholes. Use shrinkage compensating grout when suitable gaskets are not available.
- 3.7.14 Use prefabricated saddles or approved field connections for connecting pipes to existing sewer pipes. Joint to be structurally sound and watertight.
- 3.8 Pipe Surround
 - 3.8.1 Upon completion of pipe laying and after the *Prime Consultant* has inspected work in place, surround and cover pipes as shown on Contract Drawings.
 - 3.8.2 Hand place surround material in uniform layers not exceeding 150mm compacted thickness simultaneously on both sides. Do not dump material within 1 m of pipe.
 - 3.8.3 Compact each layer from pipe invert to underside of backfill to minimum 95% Standard Proctor Density.
- 3.9 Backfill
 - 3.9.1 Place and compact backfill material in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
 - 3.9.2 Backfill requirements, including type of material and compaction requirements, as shown on Contract Drawings, including Standard Detail Drawings.
- 3.10 Service Connection Installation
 - 3.10.1 Install service connections to 3.7 and as shown on Standard Detail Drawings.
 - 3.10.2 Junction of service connection pipe and main to be no further upstream than service terminus at property line nor more than 1.5 downstream of service terminus at property line. Junction shall not be further downstream than the downstream property of lot being served.
 - 3.10.3 Install 38 x 89mm marker stake at service terminus. Paint and mark as shown on Standard Detail Drawings with fluorescent yellow waterproof paint.
 - 3.10.4 Sawcut adjacent curb on alignment of service connection.
- 3.11 Cleaning and Flushing
 - 3.11.1 Before flushing and testing, ensure sewer system is completely finished and make arrangements with the *Prime Consultant* for scheduling of testing.
 - 3.11.2 Contractor may obtain water from utility as specified below:

SANITARY SEWERS

- (a) Water may be supplied from fire hydrants upon application for a Hydrant Use Permit and presentation of valid test certificate for reduced pressure principle backflow prevention device conforming to AWWA C506.
- 3.11.3 Repair or replace pipe, pipe joints, or bedding found defective.
- 3.11.4 Remove foreign material from pipe and related appurtenances by flushing with water. Main to be flushed at water velocities as high as can be obtained from available water sources. Flushing water to be discharged to water courses or ditches that have sufficient capacity to carry flow. Flushing to continue at least until flow from most distant point has reached discharge point and until water discharged is clean and clear.
- 3.12 Testing - General
 - 3.12.1 Carry out following tests upon completion of cleaning and flushing of each section.
 - (a) Exfiltration test - using low pressure air test
 - (b) Infiltration test
 - (c) Lamp test
 - (d) Video Inspection test
 - 3.12.2 Perform testing as soon as practicable after jointing and bedding are complete, and service connections have been installed.
 - 3.12.3 Do testing as directed by the *Prime Consultant*. Perform tests in presence of the *Prime Consultant*. Notify the *Prime Consultant* minimum 24 h in advance of proposed tests.
 - 3.12.4 All testing, including video inspections, shall be completed prior to paving of streets over newly installed sanitary sewer mains and services.
- 3.13 Low Pressure Exfiltration Air Test
 - 3.13.1 Sewer main and service connections in each section to be tested by low pressure air test. Manholes to be tested by exfiltration test utilizing water.
 - 3.13.2 Air test to be conducted by wetting inside perimeter of pipes in test section, then increasing pressure in test section to 24 kPa above average groundwater pressure and observing rate of pressure drop.
 - 3.13.3 Before commencement of test period, internal air pressure in test section to be maintained 27.6 kPa above average ground water pressure for at least 5.0

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minutes. Air pressure to be regulated to prevent pressure inside test section from exceeding 35 kPa above average ground water pressure.

- 3.13.4 Test period to commence when pressure decreases to 24.0 kPa above average groundwater pressure and to end when pressure decreases to 20.5 kPa above average groundwater pressure. During test period no additional air to be added to test section. If test period is less than:

2 minutes and 32 seconds for 100 mm pipe

3 minutes and 50 seconds for 150 mm pipe

5 minutes and 6 seconds for 200 mm pipe

6 minutes and 22 seconds for 250 mm pipe

7 minutes and 39 seconds for 300 mm pipe

8 minutes and 56 seconds for 350 mm pipe

9 minutes and 35 seconds for 375 mm pipe

10 minutes and 12 seconds for 400 mm pipe

11 minutes and 34 seconds for 450 mm pipe

12 minutes and 45 seconds for 500 mm pipe

13 minutes and 45 seconds for 525 mm pipe

Sewer section to be deemed to have failed test and is to be retested upon completion of repairs of any leaks.

- 3.13.5 Manholes to be tested for water tightness by filling structure with water to 2m above invert of pipe (or to 150mm below bottom of concrete lid, if pipe invert is less than 2m). No measurable drop in one hour will constitute an acceptance test.

3.14 Infiltration Test

- 3.14.1 Infiltration test to include testing of sewer main, service connections and manholes in each section or sections.

- 3.14.2 Test section to be sealed at highest point with removable watertight plug. Leakage to be measured by means of an approved weir or meter. Duration of test to be determined by the *Prime Consultant*.

SANITARY SEWERS

- 3.14.3 Allowable leakage to be same as that calculated using following formula less 10% if external head is 600 mm or less. Above infiltration limits to constitute maximum total allowable infiltration for section.

$$AllowableLeakage(Litres) = \frac{HxDxL}{k}$$

Where: H = duration of test in hours (minimum 1 hour)

D = pipe diameter in millimetres

L = length of test section in metres

k = 840

3.15 Rubber Ball Test

- 3.15.1 Pass rubber ball or test plug having a minimum dimension of 95% of sewer pipe completely through pipes and appurtenances. A light test may be performed in lieu of ball test at discretion of the *Prime Consultant*.

3.16 Video Inspection

- 3.16.1 Unless noted otherwise, in the Contract Documents, all sewers to be video inspected immediately following required flushing and testing as described in 3.11, 3.12, 3.13, 3.14, and 3.15.

- 3.16.2 The video inspection shall be considered as completed when the *Prime Consultant* has received and reviewed the written report and video record and found the video inspection and the installation of the pipe, as indicated by the testing, including video inspection, to be satisfactory.

- 3.16.3 Refer to Section 33 01 30.1 - Video Inspection, for specifications for video work.

3.17 Installation Standard

- 3.17.1 Repair visible leaks regardless of test results.

- 3.17.2 All pipes to be installed without any repairs to inside of pipe and joints. Contractor to either repair installation from outside of pipe or replace whole installation at Contractor's sole cost.

SANITARY SEWERS

- 3.17.3 Test procedures, including video inspection, to be repeated and repairs made until satisfactory results are obtained. Contractor to be responsible for any and all additional inspection and testing costs including video inspection costs incurred by Owner.

END OF SECTION

BOSS 2000 UNDERDRAIN PIPE AND FITTINGS

1.0 GENERAL

1.1 INTENT

- 1.1.1 Read this Section in conjunction with other Sections for location, use and placement of “Boss 2000 HDPE Pipe and Fittings” as provided by Armtec, a division of WGI Westman Group Inc. (Armtec) specified herein.

2.0 PRODUCTS

2.1 MATERIALS

2.1.1 Boss 2000 HDPE pipe and fittings:

- (a) To CSA B182.8 Standards.
- (b) Dual-walled corrugated HDPE drainage pipe with a smooth inner wall. Nominal inside diameter of 150 mm, outside diameter of 177 mm.
- (c) Stiffness of 320 kPa (CSA 182.8).
- (d) All pipes will be provided with “Bell and Gasket” type joint couplings. Gasketed joint integrity of 100 kPa.
- (e) All pipes will have either perforated wall or non-perforated wall.
- (f) Perforated 150 mm pipe will have perforations around entire perimeter to provide a minimum of 1600 mm² opening area per meter length.

2.1.2 GEOTEXTILE FILTER SOCKS FOR PERFORATED PIPE

- (a) All geotextile filter socks will be manufactured from polyester with a minimum specific weight of 1.3.
- (b) “Regular” geotextile filter sock will weigh 83 to 115 g/m² in accordance with ASTM D-191 and ASTM D-231, latest revisions, and have a minimum thickness of 1.0 mm.

2.1.3 GRANULAR FILTER MATERIAL

Drainage trench to be backfilled with granular filter material in accordance with the following requirements:

- (a) Gravel to be manufactured, processed aggregate, dense graded and clean. Conforming to City of Calgary Waterworks Construction Standards Class 1B for pipe 375 mm or smaller.
- (b) Gradations to be within limits specified when tested to ASTM D2321.

BOSS 2000 UNDERDRAIN PIPE AND FITTINGS

(c) Table:

Sieve Designation	% Passing
200 mm	-
75 mm	-
50 mm	-
38.1 mm	-
25 mm	-
20 mm	100
12.5 mm	-
9.5 mm	-
4.75 mm	10 - 50
2.5 mm	< 5
0.425 mm	-
0.180 mm	-
0.075 mm	< 5

(d) Drainage trench to be wrapped with 16 oz non-woven geotextile.

3.0 EXECUTION

3.1 BEDDING

3.1.1 Place 100 mm layer of bedding filter material to full trench width as indicated and compact to minimum 95% of corrected maximum dry density (ASTM D698).

3.2 INSTALLATION OF PIPE

3.2.1 Install high density polyethylene drain pipe to the lines and grades shown in the Contract Documents.

3.2.2 Install geotextile filter sock around the perforated pipe and protect from displacement, damage or clogging with dirt.

BOSS 2000 UNDERDRAIN PIPE AND FITTINGS

- 3.2.3 Backfill the perforated drain pipe and filter sock with drainage granular filter material, as shown in the Contract Documents.
- 3.2.4 All backfill to be compacted to 95% of standard proctor density (ASTM D698).
- 3.3 TOLERANCE
 - 3.3.1 Maintain constructed grade to within - 15 mm and + 15 mm from the lines, grades and elevations shown in the Contract Documents.

END OF SECTION

1.0 GENERAL

- 1.1 Section 33 44 01 refers to those portions of the Work that are unique to the supply and installation of manholes, cleanouts, catchbasins, storm sewer endwalls, lawn drains and related appurtenances. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- 1.2 References
 - 1.2.1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in Quality Requirements - Section 01 43 00.
- 1.3 Samples
 - 1.3.1 Samples may be requested
- 1.4 Material Certification
 - 1.4.1 Products having CSA certification to be used where readily available. Product to be certified to CSA standards(s) by an approved independent third party certification body accredited by the Standards Council of Canada and that is acceptable to the Consultant. Products to be marked with certification body logo and CSA standard markings.
 - 1.4.2 At least 14 days prior to commencing *Work*, submit to the Consultant manufacturer's recent test data and certification that materials meet requirements of this section. Include manufacturer's Drawings, information and shop drawings where pertinent.
 - 1.4.3 For cast iron products, provide load tests results performed by an independent laboratory for each casting lot as defined by ASTM A48.

2.0 PRODUCTS

- 2.1 Materials
 - 2.1.1 Concrete:
 - (a) To Section 03 30 00 - Cast-in-Place Concrete.
 - (b) Concrete to be minimum 35 MPa, Sulphate resistant Type HS Cement or as specified otherwise on *Drawings*.
 - 2.1.2 Concrete reinforcement: to Section 03 20 00 - Concrete Reinforcement.
 - 2.1.3 Precast manhole sections to be precast reinforced spun concrete to ASTM C478M and CSA A257.4-03 complete with ladder rungs.
 - 2.1.4 Precast "Tee" Sections: precast "Tee" sections constructed as an integral component of mainline pipe will be acceptable where shown on *Drawings* as an approved alternative.

MANHOLES AND CATCHBASINS

- 2.1.5 Manhole lids: to be precast reinforced concrete shall be designed to withstand H20 loading.
- 2.1.6 Cast iron frame and cover: as shown on *Drawings*.
 - (a) Frame and cover must conform to Class 30B ASTM A48 and be designed to withstand H20 loading.
 - (b) Frame and cover must bear manufacturer identification on castings.
 - (c) Castings to be sand blasted or cleaned and ground to eliminate surface imperfections and coated with two applications of asphalt varnish.
- 2.1.7 Ladder rungs to be:
 - (a) As shown on *Drawings*.
 - (b) To conform to ASTM C497, ASTM C478M load test.
 - (c) 20 mm aluminum alloy #6061-76 (CSA-S157 and NBC 1977), complete with polyethylene anchor insulating sleeves and installed in 25 mm or 26 mm precast or drilled holes in manholes sections.
 - (d) Polypropylene encased steel ladder rungs: polypropylene ASTM D4101 steel core to be 12 mm diameter grade 60 as per ASTM A615M.
 - (e) Distance from top of manhole cover to top rung to be maximum 500 mm where no handhold provided. Maximum distance may be extended to 660 mm where handhold provided.
 - (f) In compliance with all Workers' Compensation Board requirements.
 - (g) Safety platform: to be installed as shown on *Drawings* in all manholes in excess of 6 m deep.
 - (h) Precast catchbasin sections:
 - (i) As shown on *Drawings*.
 - (ii) To be precast reinforced concrete to ASTM C478M.
- 2.1.8 Not Used Inspection Chambers: as shown on *Drawings*.
- 2.1.9 Mortar:
 - (a) Aggregate: to CSA A82-56.
 - (b) Cement: to CAN/CSA-A8.
- 2.1.10 Adjusting rings manufactured to:
 - (a) Concrete ASTM C478M
 - (b) HDPE to ASTM D1248.
- 2.1.11 Concrete Brick: to CAN3-A165 Series.
- 2.1.12 Drop manhole pipe: to be as shown on *Drawings*.

MANHOLES AND CATCHBASINS

- 2.1.13 Lawn drains to be as shown on *Drawings*.
- 2.1.14 Concrete bags to be: Jute, burlap or synthetic bag of suitable size and texture filled to 2/3 capacity with mixture of 1 part Portland cement to 2 parts sand, thoroughly mixed, and weighing approximately 27 kg.
- 2.1.15 Concrete blocks: to be H type concrete construction blocks conforming to latest ASTM specifications.
- 2.1.16 Prebenched manhole bases:
 - (a) Where precast manhole sections are incorporated into precast base by bonding to concrete benching, use precast reinforced concrete manhole section to ASTM C478M complete with ladder rungs above benching.
 - (b) Where base benching is cast monolithically with manhole walls, reinforce wall and joint sections as specified in ASTM C478M.
 - (c) Precast concrete bases section minimum thickness to be 120 mm, measured from underside of base to lowest point in concrete channelling.
- 2.1.17 Flared End Outlet Structure
 - (a) Precast unit complete with grillage. Provide shop drawings sealed by Professional Engineer per General Requirements.

3.0 EXECUTION

- 3.1 Excavation and Backfill
 - 3.1.1 Excavate and backfill in accordance with Section 31 00 00 - Earthworks General.
- 3.2 Concrete Work
 - 3.2.1 Place concrete reinforcement in accordance with Section 03 20 00 - Concrete Reinforcement.
 - 3.2.2 Do concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- 3.3 Manhole Installation
 - 3.3.1 Install manholes as shown on Drawings, concurrently with pipe laying. Maximum of 3 uncompleted units behind point of pipe laying permitted.
 - 3.3.2 Excavation to be free of water prior to placing concrete.
 - 3.3.3 Place minimum 150 mm of 25 mm granular base under base compacted to minimum 95% SPMDD in compliance with ASTM D1557.
 - 3.3.4 Construct base to ensure first precast riser section is set plumb.
 - 3.3.5 Set all inlet and outlet pipes to specified alignments and elevations.
 - 3.3.6 Connect PVC pipe into manhole using "manhole adaptor ring" or approved equal.

MANHOLES AND CATCHBASINS

- 3.3.7 Connect concrete pipe into manhole using spigot or bell precast into manhole wall or, alternatively, grout pipe into pre-formed rough core in manhole wall using fast-setting grout.
- 3.3.8 Ensure placement of concrete does not disturb connecting pipes.
- 3.3.9 Set remaining precast riser sections plumb with joints, sealed with rubber gasket conforming to ASTM C443M to eliminate ground water infiltration. Grout inside and exterior of manhole joints.
- 3.3.10 Where possible, form channelling using half-sections of pipe or suitable fillings. Benching to direct flow parallel to main flow of sewer. Top of benching to be at least as high as crown of sewer pipe. Finish concrete to smooth surface using steel trowel.
- 3.3.11 Brace capped or plugged inlets or stubs to withstand hydrostatic testing head.
- 3.3.12 Installation of Masonry & Cementitious Riser Rings:
 - (a) Allowable number of courses is three and minimum is one.
 - (b) Allowable products; bricks, precast concrete risers, and cast-in place form system
 - (c) Due regard must be observed to the maximum distance to the first step.
 - (d) Pre-wet all joints before placing mortar.
 - (e) "Butter" inside and outside faces of bricks with mortar to ensure neat even finish. Pre-wet all joints before placing mortar.
 - (f) Grout inside and outside paces of brick with mortar to ensure neat even grout.
- 3.3.13 Plug lifting holes in pipe.
- 3.3.14 Install drop structures where required on *Drawings*.
- 3.3.15 Clean units of debris and foreign materials. Remove fins and sharp projections. Prevent debris from entering system.
- 3.3.16 Ensure frames conform to contour of pavement or existing surface.
- 3.3.17 Paint manhole covers as specified on *Drawings*.
- 3.3.18 Pre-fabricated Corrugated Steel Pipe Manholes to be installed as shown on the *Drawings* and to manufacturers' specifications.
- 3.4 Cleanout and Inspection Chamber Installation
 - 3.4.1 Install cleanouts and inspection chambers as shown on *Drawings*, to standards and installation procedures described in 3.3.
- 3.5 Lawn Drain Installation
 - 3.5.1 Install lawn drains as shown on *Drawings*.

MANHOLES AND CATCHBASINS

-
- 3.6 Endwall Installation
- 3.6.1 Supply and install precast concrete endwalls where shown on *Drawings*.
- 3.7 Grillage Trash Screens
- 3.7.1 Where specified, install grillage trash screens as shown on *Drawings*.
- 3.8 Adjusting Tops of Existing Units
- 3.8.1 Remove existing gratings, frames and store for re-use at locations indicated on *Drawings*.
- 3.8.2 Precast units:
- (a) Raise or lower precast units by adding or removing precast sections as required.
 - (b) When amount of raise is less than 300 mm use standard manhole bricks, pre-cast riser rings or cast-in-place form system.
- 3.8.3 Cast-in-Place units:
- (a) Raise cast-in-place units by roughening existing top to ensure proper bond and extend to required elevation with cast-in-place concrete.
 - (b) Lower cast-in-place units with straight wall by removing concrete to elevation indicated for rebuilding.
 - (c) Install additional manhole ladder rungs in adjusted portion of units as required.
 - (d) Re-use existing gratings, frames.
 - (e) Re-set gratings and frames to required elevation on not more than 3 courses of brick. Make brick joints and join brick to frame with cement mortar, parge and trowel smooth.
- 3.9 Remove Existing Units
- 3.9.1 Remove existing structures where shown on *Drawings*. Backfill in accordance with Section 31 00 00 – Earthworks General.
- 3.10 Leakage Test
- 3.10.1 Leakage testing of sanitary manholes in accordance with Section 33 30 01 - Sanitary Sewers.
- 3.10.2 Consultant will issue Test Certificate for each manhole passing test.
-

END OF SECTION

ENVIRO LINER 6060 GEOMEMBRANE

1.0 GENERAL

1.1 INTENT

- 1.1.1 Read this Section in conjunction with other Sections for location, use and placement of “Enviro Liner 6060 Geomembrane” as manufactured by Layfield specified herein.

1.2 REFERENCES

1.2.1 Reference Standards

- (a) ASTM D638 – Standard Test Method for Tensile Properties of Plastics.
- (b) ASTM D6693 – Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes
- (c) ASTM D5199 – Standard Test Method for Measuring the Nominal Thickness of Geosynthetics
- (d) ASTM D4533 – Standard Test Method for Trapezoidal Tearing Strength
- (e) ASTM D4833 – Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
- (f) ASTM D4329 – Practice for Fluorescent UV Exposure of Plastics
- (g) ASTM D5617 – Standard Test Method for Multi-Axial Tension Test for Geosynthetics
- (h) ASTM D6497 – Standard Guide for Mechanical Attachment of Geomembrane to Penetrations or Structures.
- (i) ASTM D6392 – Test Method for Determining the Integrity of Non-Reinforced Geomembrane Seams Produced Using Thermo-Fusion Methods

2.0 PRODUCTS

2.1 MATERIALS

- 2.1.1 Enviro Liner 6060 composed of coextruded material with one white and one black surface and a black core layer, as manufactured by Layfield:
- (a) Thickness (ASTM D5199): average thickness must exceed value with no individual reading lower than 10% below the average: 1.50 mm (60 mil; 0.060 inches).
 - (b) Surface: Smooth, no striations, gels, pinholes or bubbles.
 - (c) Tensile strength and elongation at break (ASTM D638):

ENVIRO LINER 6060 GEOMEMBRANE

- (i) Tensile strength: minimum 44 N/mm.
- (ii) Elongation: minimum 800% calculated from a gauge length of 50 mm.
- (d) Minimum Trapezoidal Tear Resistance (ASTM D4533): 590 N.
- (e) Minimum Puncture Resistance (ASTM D4833): 4000 N.
- (f) UV Resistance (ASTM D4329):
 - (i) Minimum 90% strength retained after 10,000 hours testing
 - (A) Testing performed on 1.50 mm (60 mil) specimen
 - (B) Irradiance of 0.90 w/m² at a wavelength of 310 nm
 - (C) Alternating 10 hour UV cycles at 60C followed by 2 hour condensation cycles at 50C
- (g) Axi-Symmetric Break Resistance (ASTM D5617): minimum: 80%
- (h) Field Seam Properties (ASTM D6392):
 - (i) Shear Strength: 15.7 N/mm.
 - (ii) Peel Strength (wedge welds): 11.5 N/mm.
 - (iii) Peel Strength (extrusion welds): 11.6 N/mm.

2.2 QUALITY CONTROL

- 2.2.1 Contractor to require sheet manufacturer and lining fabricator to perform quality control testing to ensure that all the lining being supplied for the Contract meets or exceeds the physical properties specified. Submit test results to the Owner prior to delivery.

3.0 EXECUTION

3.1 PREPARATION

- 3.1.1 Prepare the sub-grade to the lines, grades, elevations and tolerances specified in the Contract. Any oversized gravel to be removed and the voids filled with bedding sand. The finished subgrade should be smooth rolled and proof rolled to identify any soft areas requiring additional work.
- 3.1.2 LP8 nonwoven geotextile shall be placed prior to liner placement.
- 3.1.3 Excavate anchor trench to line, grade, and width indicated on drawings, prior to liner placement. Provide slightly rounded corners in the trench to avoid sharp bends in the geomembrane.
- 3.1.4 Prepare mechanical attachments according to ASTM D6497 Standard Guide for Mechanical Attachment of Geomembrane to Penetrations or Structures.

ENVIRO LINER 6060 GEOMEMBRANE

- 3.1.5 A certificate of subgrade acceptance will be prepared by the liner installation contractor prior to liner installation.

3.2 INSTALLATION

- 3.2.1 Sufficient thermal slack shall be incorporated during placement to ensure that harmful stresses do not occur in service.
- 3.2.2 Weather Conditions at Time of Installation:
- (a) Site welding may proceed at any temperature providing a suitable qualification weld can be prepared at site conditions using the operator, equipment, and materials intended for the project.
 - (b) Installation of membrane in winds above 20 km/h (12 mph) can proceed only if the installer can demonstrate that the liner will not be at risk of damage.
 - (c) Do not install membrane during precipitation or in the presence of excessive moisture.
 - (d) Do not install in weather conditions that may be detrimental to the function of the membrane.
- 3.2.3 Compaction at pipe penetrations and areas of mechanical attachment will be inspected carefully as these are areas where differential settlement can occur.
- 3.2.4 Protect the lining from damage at all times. Do not allow construction equipment to operate directly on the membrane or on the granular cover materials. Repair lining damaged during installation or construction of subsequent work.
- 3.2.5 Test field seams as seaming work progresses by non-destructive methods over their full length. Repair seams which do not pass non-destructive test. Reconstruct seam between failed location and any passed test location, until non-destructive testing is successful.
- 3.2.6 Upon completion of installation, inspect seams and non-seam areas for defects, holes, blisters, undispersed raw materials.
- 3.2.7 Repair minor tears and pinholes by patching until non-destructive testing is successful. Patches to be round or oval in shape, made of same geomembrane material, and extend minimum of 75 mm beyond edge of defect. Keep records of all repairs and the results of repair testing.

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3.3 CLEANING

- 3.3.1 Cleaning solvents shall not be used unless product is approved by membrane manufacturer.
- 3.3.2 Use water and rags for all cleaning. If soap is used for cleaning rinse with clean water and dry before welding.

3.4 QUALITY ASSURANCE

- 3.4.1 Test quality of resin and membrane to ensure consistency of raw material and geomembrane quality in accordance with manufacturer's recommendations.
- 3.4.2 Test seams in strength and peel at beginning of each seaming period, and at least once every 150 m of field seam, or 4 hours if welding operation is interrupted, for each seaming apparatus and seamer used that day.
 - (a) Also test at least two samples from each panel, with samples taken from extra material, such that panel is not damaged and blanket geometry is not altered.
- 3.4.3 If seam test specimen fails in seam, repeat on new specimen.
 - (a) If new specimen fails in seam, material will not be used for seaming until deficiencies are corrected and two consecutive successful test seams are achieved.
- 3.4.4 Test seams by non-destructive methods over their full length, using vacuum test unit or air pressure test.
 - (a) Vacuum chamber to contain glass viewport and seal for sealing chamber to seam area. With chamber sealed in place and after partly filling chamber with water, apply vacuum of 17.2 kPa. Seam failure is detected by presence of air bubbles through water.
 - (b) Use air lance to apply air at 343 kPa through nozzle directed at edge of overlap seam. Seam failure is indicated by inflation or lifting of any part of geomembrane.
- 3.4.5 Provide test results to prime contractor and client for each shift's production, including documentation of non-destructive testing and repairs at end of each shift.
- 3.4.6 Third-party Water Puddle test to be performed after installation to ensure leaks or deficiencies of the liner are identified and fixed post installation.

END OF SECTION

1.0 GENERAL

- 1.1 Section 33 60 00 refers to those portions of the Work that are unique to the supply and installation of intake screens, structures, supports, connections, and related appurtenances. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- 1.2 The *Contractor* is responsible for providing signed and sealed shop drawings for the concrete intake foundation and support structure by a Professional Engineer registered in Alberta, Canada. Dimensions and design intent of the concrete intake support structure is as identified in the *Contract Drawings*. Concrete and structural design for the support structure is to follow all concrete specification identified in Division 03 – Concrete.
- 1.3 Related Requirements
 - 1.3.1 Section 33 14 16 – Site Water Utility Distribution Piping
 - 1.3.2 Section 03 30 00.09 – Cast-In-Place Concrete
 - 1.3.3 Section 03 10 00 – Concrete Forming and Accessories
 - 1.3.4 Section 03 20 00 – Concrete Reinforcing
 - 1.3.5 Section 03 35 00 - Concrete Finishing
 - 1.3.6 Section 03 41 00 – Precast Structural Concrete
- 1.4 References
 - 1.4.1 Reference Standards
 - (a) American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - (i) ANSI/AWWA C104/A21.4- 08, Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
 - (ii) ANSI/AWWA C111/A21.11- 07, American National Standard for Rubber-Gasket Joints for Ductile-Iron and Fittings.
 - (iii) ANSI/AWWA C110/A21.10- 08, American National Standard for Ductile-Iron and Grey Iron Fittings for Water.
 - (iv) ANSI/AWWA C207- 07, Standard for Steel Pipe Flanges for Waterworks Service, 4 Inch through 144 Inch (100 mm through 3,600 mm).
 - (b) ASTM International (ASTM)
 - (i) ASTM A53/A53M- 10, Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless.
 - (ii) ASTM A123/A123M- 09, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

INTAKE SCREEN

- (iii) ASTM A307- 10, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
- (c) Canadian General Standards Board (CGSB)
 - (i) CAN/CGSB-8.1- 88, Sieves, Testing, Woven Wire, Inch Series.
 - (ii) CAN/CGSB-8.2- M88, Sieves, Testing, Woven Wire, Metric.
 - (iii) CAN/CGSB-34.1- 94, Pipe, Asbestos Cement, Pressure.
 - (iv) CGSB 41-GP-25M- 77, Pipe, Polyethylene, for the Transport of Liquids.
- (d) CSA Group (CSA)
 - (i) CAN/CSA-A3000- 08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - (ii) CSA G30.18- 09, Carbon and Steel Bars for Concrete Reinforcement.

1.4.2 Shop Drawings and Technical Data

- (a) Submit manufacturer's instructions, printed product literature and data sheets for distribution piping materials and include product characteristics, performance criteria, physical size, finish and limitations.
- (b) Submittals to be in accordance with Section 01 33 00 – Submittal Procedures.

1.4.3 Material Certification

- (a) Products having CSA certification to be used where readily available. Products to be certified to CSA standard(s) by an approved independent third body accredited by the Standards Council of Canada and that is acceptable to the *Consultant*. Products to be marked with certification body logo and CSA standard markings.
- (b) At least two weeks prior to commencing work, submit manufacturer's recent test data and certification that materials to be incorporated into works are representative and meet requirements of this section. Include manufacturer's drawings where pertinent.

1.5 Maintenance Material Submittals

- 1.5.1 Contractor to provide relevant maintenance data as per manufacturer procedure.

1.6 Products

1.7 General

- 1.7.1 Intake Screen material as indicated on *Contract Drawings*: Johnson Screens Tee Max Flow Intake T36MF or approved equal that meet the following specifications.

INTAKE SCREEN

- 1.7.2 All products are specified by reference to approved specifications and/or standards. Refer to *Contract Drawings* for specified or approved manufacturers or trade names.
- 1.7.3 All waterworks products shall be approved for potable water use to NSF 61.
- 1.7.4 Any differing materials that are in contact and are subject to galvanic corrosion require dielectric isolation kits and gaskets.

1.8 Intake Screen Requirements

1.8.1 Dimensions and sizing

Dimension/Sizes	Value	Unit
OD	36	In
OAL	77	in
CL to Flange	36	in
Outlet Connection size	30PS	
ABW Connection size	4PS	
Estimated Weight	1130	lbs
Left/Right End Closure	Plate	
Intake Orientation	Horizontal	

1.8.2 Screen specifications

Dimension/Sizes	Value	Unit
Slot Opening	0.5	In
Open Area %	87.57%	
L/D ratio	1	
Effective Rating	30	in
Wire Type	69	

INTAKE SCREEN

1.8.3 Design Specifications

Dimension/Sizes	Value	Unit
Depth	16	ft
Collapse Rating	6.94	psi
Material	304 SS	

1.8.4 Flow Capacities

Dimension/Sizes	Value	Unit
Flow/Screen	3742.2	GPM
Maximum Slot Velocity	0.21	fps
Average Slot Velocity	0.19	fps
Estimated DP/Screen	0.0003	psi
Estimated DP/Assy	0.0810	psi

1.9 Concrete Support Structure

1.9.1 Concrete:

- (a) To Section 03 30 00 - Cast-in-Place Concrete, Section 03 35 00 – Concrete Finishing, and Section 03 10 00 – Concrete Forming and Accessories.
- (b) Concrete support structure dimensions as shown in *Contract Drawings*.
- (c) Concrete mix to be suitable for potable water applications and approved by the *Consultant*.

1.9.2 Reinforcement

- (a) To Section 03 20 00 – Concrete Reinforcement.
- (b) As designed by Contractor's Engineer.

1.10 Intake Supports

1.10.1 As required by the manufacturer and identified in the *Contract Drawings*.

1.10.2 Intake fasteners as per manufacturer recommendations.

INTAKE SCREEN

2.0 EXECUTION

2.1 Excavation and Backfill

2.1.1 Excavate and backfill in accordance with Section 31 00 00 – Earthworks General.

2.1.2 Excavation to be free of water prior to placing concrete.

2.2 Intake Installation

2.2.1 Install as per manufacture recommendations and as identified in the *Contract Drawings*.

2.2.2 The Contractor shall test the installed intake screen in accordance with the manufacturer's recommendations and any applicable requirements identified in the *Contract Drawings*. The Contractor shall submit complete test reports and supporting documentation to the *Consultant* for review.

END OF SECTION

DIVISION 40 – PROCESS

COMMON REQUIREMENTS FOR PROCESS VALVES

1.0 GENERAL

1.1 Summary

1.1.1 This Section specifies supply and installation of all valves and related appurtenances installed on process piping systems. This section must be referenced to and interpreted simultaneously with all other Sections pertinent to the *Work* described herein.

1.1.2 Related Requirements

- (a) Section 40 05 01: Common Requirements for Process Piping Systems
- (b) Valve data sheets and details are provided in separate Sections for each valve type
 - (i) Section 40 05 62.02: Full Port Plug Valves

1.2 References

1.2.1 Reference Standards

- (a) Conform with the most recent version of all standards referenced in this Section.
 - (i) ANSI B1.20.1: Pipe Threads, General Purpose, Inch
 - (ii) ANSI B16.1: Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250
 - (iii) ANSI B16.5: Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard
 - (iv) MSS SP-25: Marking System for Valves, Fittings, Flanges and Unions
 - (v) AWWA C504 (for gear actuators only): Rubber-Seated Butterfly Valves, 3 In. (75 mm) through 72 In. (1800 mm).

1.3 Submittals - Review

1.3.1 Provide catalogue cuts and/or shop drawings for each type of valve and actuator indicating the valve number, materials of construction, dimensions, head loss characteristics through the valve, operating torque and maximum pull on actuator, and valve end configuration.

1.3.2 Provide valve pressure/temperature rating. For bidirectional valves provide rating for both sealing directions.

1.3.3 For butterfly and globe valves provide headloss vs. percent open curves.

1.3.4 Canadian Registry Number (CRN) designated by the Province of Alberta where applicable.

COMMON REQUIREMENTS FOR PROCESS VALVES

- 1.3.5 A copy of the specific valve specification sections marked to indicate with check marks where the valve supplied meets the specification and with written amendments with explanation where the product differs from the specification.
- 1.3.6 On piping submittals, indicate direction of sealing.
- 1.4 Submittals – For Operations and Maintenance Manuals
 - 1.4.1 Submit operation and maintenance data for incorporation into operation and Maintenance manual, including detailed exploded views, a complete numbered list of replacement and repair parts, and supplier and parts manufacturer's contact information.
- 1.5 Quality Assurance
 - 1.5.1 If a CRN is not available, provide a letter notarized in Canada and stating:
 - (a) The standard or code under which the valve was manufactured (ANSI, MSS, AWWA, etc.)
 - (b) If not stated under the code in Item (a), state the pressure/temperature rating of the valve body, seat, and all seals.
 - (c) The quality control program under which the valve was manufactured.
 - 1.5.2 Provide valves marked in accordance with MSS SP-25 for type, size, rating, and where applicable, direction of flow.
- 1.6 Delivery, Storage and Handling
 - 1.6.1 Deliver valves and unload at site using methods which do not damage casings, coatings or any valve or actuator parts.
 - 1.6.2 Clear tag each valve stating size, type, coatings and mating parts.
 - 1.6.3 Store on site using methods recommended by the manufacturer to prevent damage, stress, weathering or corrosion.

2.0 PRODUCTS

- 2.1 General
 - 2.1.1 Provide valves of the same type, size range and service from a single manufacturer.
 - 2.1.2 All valves to have true alignment or bores.
 - 2.1.3 Unless otherwise indicated on the Process and Instrumentation drawings valves shall be the same size as the pipe run in which they are to be installed.
 - 2.1.4 Valves to open counter-clockwise.
 - 2.1.5 The process drawings indicate major process valves required for the process to operate as intended. Where a valve may be required for the process to function correctly or is required to satisfy fire and safety codes but is not shown in the drawings, inform the *Consultant* and provide details and suggestions for remedial

COMMON REQUIREMENTS FOR PROCESS VALVES

action. Do not commence piping in the related pipe run until obtaining the *Consultant's* approval.

2.2 Valve Ends

2.2.1 Valves less than 75 mm diameter shall have female threaded connections conforming to ANS B1.20.1. Valve sizes greater or equal to 75 mm shall have flanged connections to ANSI B16.1 or ANSI B16.5. Valves with grooved joint ends are not to be used without the written approval of the *Consultant*.

2.2.2 Not used.

2.2.3 Lug style water body valves shall have tapped holes.

2.3 Manual Lever or Handwheel Actuators

2.3.1 Provide lever actuators for quarter turn valves. Operator to be perpendicular to the pipe run when the valve is closed.

2.3.2 Provide lever operator for ball valves less than 150 mm diameter, butterfly valves less than 250 mm diameter, and plug valves less than 100 mm diameter, unless noted otherwise on drawings.

2.3.3 Not used.

2.3.4 Provide handwheel actuator for butterfly valves 250 mm and greater.

2.3.5 Maximum pull on the end of the lever arm or at the rim of a handwheel not to exceed 300 N when one side of the valve is at test pressure and one side is at atmospheric pressure. If greater force is required, provide a gear operator.

2.3.6 Provide pad lockable lockout feature on all control valves and manual isolation and shut-off valves.

2.3.7 Provide valve stem extensions where additional clearance is required for pipe insulation or where operation without the extension is difficult.

2.3.8 Minimum hand wheel diameter:

- (a) 38 mm valve: 75 mm handwheel
- (b) 50 mm valve: 85 mm handwheel
- (c) 250 mm valve: 400 mm handwheel

2.3.9 Minimum lever operator length:

- (a) 25 mm valve: 125 mm lever
- (b) 38 mm valve: 150 mm lever
- (c) 50 mm valve: 150 mm lever
- (d) 75 mm valve: 175 mm lever
- (e) 100 mm valve: 225 mm lever
- (f) 150 mm valve: 250 mm lever

COMMON REQUIREMENTS FOR PROCESS VALVES

(g) 200 mm valve: 300 mm lever

2.4 Manual Gear Actuators

- 2.4.1 Provide manual gear actuators for valves not specified to have a manual lever or handwheel actuator.
- 2.4.2 Gear operator to be worm gear type equipped with a non-rising stem handwheel and an integrated visual indicator of the valve position. Gear operators shall be grease lubricated. Where gear operators are intended for direct bury or submergence, seal units with long life lubricant recommended by the gear operator manufacturer for the specific application. Gear operators for direct bury or submergence to be manufactured in accordance with AWWA C504.
- 2.4.3 Equip operators with mechanical stop-limiting devices to prevent over travel of the disc, ball or plug in the open and closed positions, self-locking to hold the valve in any intermediate position between full open and full closed. Actuator components between the input and the stop limiting device shall be designed to withstand, without damage, a rim pull of 890 N for a handwheel or chainwheel and an input torque of 400 N m for wrench nuts.
- 2.4.4 Actuator shall provide 1.25 times required operating torque under full rated line pressure for direct bury or submergence applications, or for commodities with 2% or greater solids content; 1.0 times required operating torque under full rated line pressure in other applications.
- 2.4.5 Maximum pull at rim of hand wheel with gear operator – 300 N.
- 2.4.6 Manual operators for buried service valves to include an AWWA operating nut and be gasketed and grease packed for submerged operation at water pressures up to 700 kPa. Where angle valve stem extensions are employed, they shall be angle geared. Provide valve stem extension to surface with cast iron valve box, lid and rock plate.
- 2.4.7 Actuator body to be exterior epoxy coated.
- 2.4.8 Orientation of valve as per mechanical drawings or to allow for the greatest degree of hand wheel access.
- 2.4.9 For manual valves on pipes 75 mm and greater mounted over 2 m above the operating floor, provide chain wheel gear operators, sized so that a force of 150 N is sufficient to open the valve when one side of valve is at test pressure and the other side is at atmospheric pressure. Chain pulley to mesh positively with the chain. Extend chain from valve operator to 1.2 m above the operating floor or as directed by the *Consultant*, with exact dimensions field determined. Provide approved chain hooks where required to prevent chain from hanging within traffic paths.

2.5 Electric Actuators

- 2.5.1 Not used.

COMMON REQUIREMENTS FOR PROCESS VALVES

2.6 Valve Identification

- 2.6.1 Tag all valves using AISI 304 stainless steel tags with 12 mm high engraved letters and numbers. Fill numbers and letters with black paint. Attach tag to valve using a 304 stainless steel chain or braided wire. Inscription to include valve ID number from the Process and Instrumentation drawings, valve size in mm, manufacturer and model number.

2.7 Coating

- 2.7.1 Coat all carbon steel, ductile iron and cast-iron valves and actuators for corrosion protection.
- 2.7.2 All valves and actuators to be provided with standard shop finish rated and warrantied for the intended service application.

3.0 EXECUTION

3.1 Preparation

- 3.1.1 The valve and piping arrangement indicated on the drawings is based on typical dimensions for valves of the specified type. Make all necessary modifications in the *Work* to allow for discrepancies between the valve dimensions shown and those supplied for the *Work*, at no extra cost.
- 3.1.2 Ensure that valve location and orientation provide suitable access to manual operators and that sufficient space and accessibility is available for automatic actuators.
- 3.1.3 Ensure that valve location and orientation provide sufficient space for tightening of flange and valve nuts with a standard wrench.
- 3.1.4 Ensure that valve actuators can operate without conflicting with other piping, equipment, structures or insulation. Do not cut insulation to allow valve actuators to operate. Where conflicts are identified, inform the *Consultant* and propose modifications. Do not commence work on the affected piping run until modifications are approved.

3.2 Installation

- 3.2.1 Install all valves in accordance with manufacturer's instructions.
- 3.2.2 In horizontal pipe runs other than in locations where space does not permit, mount all valves except for butterfly valves and trunnion ball and plug valves with a vertical operating shaft with the actuator at the top. In no case install a valve with the operator shaft pointing down.
- 3.2.3 Mount butterfly valves and trunnion ball and plug valves with the shaft in a horizontal orientation. Plugs to rotate to top of pipe to open. Disks to swing up in direction of flow to open.
- 3.2.4 Provide spool pieces between butterfly valves, swing check valves and fittings as required to allow for free disc movement.

COMMON REQUIREMENTS FOR PROCESS VALVES

- 3.2.5 Do not over torque bolts to correct for misalignment.
- 3.2.6 Support valves in position using temporary supports until valves are fixed in place.
- 3.2.7 Not used.
- 3.2.8 Unless otherwise specified, install single seated ball valves and knife gate valves with the seat downstream. Install at tank connections with seat away from tank. Install on pump discharge and suction lines with seat adjacent to the pump.
- 3.3 Coating
 - 3.3.1 Repair and damage to shop coating as recommended by valve manufacturer, including and not limited to:
 - (a) Steel brushing for removal of any rust
 - (b) Solvent cleaning of repair and surrounding area
 - (c) Priming coat
 - (d) Two coats of topcoat
- 3.4 Testing
 - 3.4.1 All valves to be shop tested according to current applicable AWWA Standards and the standards under which the valves were manufactured.
 - 3.4.2 Operate valves under simulated and/or real process conditions to ensure valves operate as intended.
 - 3.4.3 Pressure test valves in conjunction with the pipes in which the valves are installed.

END OF SECTION

FULL-PORT PLUG VALVES

1.0 GENERAL

1.1 Summary

1.1.1 This Section applies to full-port eccentric plug valves provided for following commodities as identified on the *Drawings*:

(a) RAW – Raw Water

1.1.2 This section must be referenced to and interpreted simultaneously with all other sections pertinent to the *Work* described herein.

1.1.3 Operating Conditions

(a) Specific design conditions for valves installed in piping identified in the *Contract Drawings*.

1.1.4 Related Requirements

(a) Section 40 05 51: Common Requirements for Process Valves

2.0 PRODUCTS

2.1 Acceptable Valve Manufacturers: DeZURIK PEF Series, Valmatic Series 5600, or approved equal.

2.2 Valves rated to 1035kPa at 83 °C on both sides.

2.3 Valve and actuator construction to AWWA C517.

2.4 Provide valves with body seating surface aligned eccentrically from the plug shaft centreline.

2.5 Provide valves with port area minimum 100% of pipe area.

2.6 Provide valves with bi-directional bubble tight shutoff.

2.7 Valve bearings shall be accessible for visible inspection, adjustment, or replacement without disassembly of the valve or removal of the valve from the pipe.

2.8 Provide valves with permanently self-lubricating sleeve type upper and lower shaft bearings.

2.9 Provide upper and lower thrust-bearings to maintain proper plug alignment with valve seat.

2.10 Provide bearings with grit excluding seal.

2.11 Provide valve bonnet/cover which can be removed for inspecting the plug and seat while the valve is installed in the pipeline.

2.12 Provide self-adjusting seals repackable without removing the bonnet from the valve.

2.13 Provide valves as detailed below.

FULL-PORT PLUG VALVES

Component	Description
Body and Bonnet	Cast iron to ASTM A126, class B
Valve Ends	Flanged, ANSI B16.1, Class 125
Coating	Factory applied 2 part fusion bonded epoxy interior and exterior, or approved equal
Plug	NBR encapsulated ductile iron to ASTM A536 or cast iron to ASTM A126, class B
Seats	Welded in overlay min 95% nickel
Packing	NBR
Radial Bearings	316 Stainless Steel
Thrust bearings	PTFE, stainless steel
Actuator	Gear actuator with handwheel. For buried service, provide quarter turn worm gear actuator c/w totally enclosed fusion bonded epoxy cast iron housing sealed, grease packed and rated direct buried applications. Provide stainless steel shaft extension and epoxy coated neck/riser, terminate with 2" square nut within locking valve box at finished grade.
Fasteners	Stainless Steel
Riser, Stem Extension and Valve Box.	Use type 304 SS stem extension, epoxy coated carbon steel riser, Nelson Style cast iron epoxy coated locking valve box.

3.0 EXECUTION

3.1 Installation

- 3.1.1 Horizontal orientation - mount plug valves with the shaft in a horizontal orientation, unless otherwise indicated on the *Drawings*. The plug, when open, shall be at the top of the pipe. Valve shall be installed with flow against seat end.
- 3.1.2 Vertical orientation – mount plug valve shaft in a vertical orientation only when indicated on the *Drawings*. The valve seat shall be installed at the top and operating lever will be orientated for ease of use.

END OF SECTION
