CITY OF ST. JOHN'S SPECIFICATIONS BOOK

ST. JOHN'S

SPECIFICATIONS BOOK

FIFTH EDITION

JANUARY 2022

All CSA & ASTM designations or test standards shall be those shown here, or the latest revision.

The Specifications Book has received revisions, and you are encouraged to review the revisions.

SPECIFICATIONS BOOK

FIFTH EDITION

JANUARY 2022

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SPECIFICATIONS BOOK

SUMMARY OF REVISIONS – FEBRUARY 2025

This document is intended as a quick reference guide to changes to the City of St. John's Specifications Book made in February 2025 to the January 2022 City of St. John's Specifications Book.

SPECIFICATIONS BOOK - SUMMARY OF REVISIONS (FEBRUARY 2025)

- **Division 1 – Item 112 – Periods and hours of Work**
  - **Add:**
    Carpasian Road is added to the list of streets where lane reductions are prohibited during peak traffic timeframes.

- **Division 1 – Item 123 – Temporary Supply of Water to Residents**
  - **Replace:**
    Where residents have existing wells, which are used as a source of domestic water, and should loss of water occur as a result of the lowering of the groundwater table due to water and sewer installation, the Contractor will supply affected residents with water on a temporary basis until the system becomes operational.

    The Contractor shall test as required by the Engineer and make operational any newly installed valved section of water main and install service connections to affected properties as directed by the Engineer.

    With:
    Where residents have existing wells, which are used as a source of domestic water, and should loss of water occur as a result of the lowering of the groundwater table due to watermain and/or sewer main installation, the Contractor will supply affected residents with potable water on a temporary basis until the new water system becomes operational or otherwise directed by the Engineer.

    Where feasible, the temporary supply of water shall be via a temporary potable water piping system in accordance with Specification Item 250.09 Temporary Watermain Bypass System. Otherwise, the Contractor shall provide the temporary supply of water via an individual water storage and pumping system connected to each affected property. The water storage tank shall be 1000L (min.), refilled with water daily, and protected from freezing. The temporary water system shall be properly disinfected and tested as directed by the Engineer. Payment will be by Change Order in accordance with the General Terms and Conditions of the contract.

    Where properties have an existing water service connection to the City water system, the Contractor shall be responsible to maintain the existing system during construction. If it is not feasible, as determined by the Engineer, to maintain the existing water system, the Contractor shall be required to install and operate a temporary potable water piping system in accordance with

Specification Item 250.09 Temporary Watermain Bypass System. Payment will be on a Lump Sum or Unit Price basis, as specified in the Tender Form.

To minimize the amount of time residents are supplied water from a temporary water system, the Contractor shall test and make operational any newly installed valved section of water main and install service connections to affected properties, without delay and as directed by the Engineer.

- **Division 1 – Item 130 – Traffic Control**
  - Change name to **Item 130 – Traffic/Pedestrian Control**
  - **Add:**

    SIDEWALK CLOSURES

    The Engineer must approve all sidewalk closures. Where there is another sidewalk available on the opposite side of the street, pedestrians must be directed to use that sidewalk. This shall include “Sidewalk Closed Ahead” signs in advance of the work area at the closest marked or unmarked crosswalk indicating the sidewalk is closed ahead. “Sidewalk Closed” signs must be placed on either side of the work area that is closed to pedestrians. These signs must appear on traffic control plans being submitted for review.

    Where pedestrians cannot be directed to a sidewalk on the opposite side of the street (e.g. Detour too long, no crosswalks available, no sidewalk on the opposite side), the contractor shall be required to provide a temporary pedestrian route/crosswalk for pedestrian use. Any temporary surface provided must be safe for all users, firm, stable and slip resistant, a minimum of 1.5m wide clear width, unless otherwise directed by the Engineer, and wheelchair/mobility device accessible. Asphalt or a comparable surface may be acceptable for this purpose.

    Should the temporary sidewalk be part of the travelled way of a street, adequate delineation of the sidewalk space must be provided for the safety of all pedestrians. For plans which include a temporary sidewalk in the travelled way of a street, delineation of the sidewalk must be provided with continuous F-shape Barriers/channelizer unless otherwise approved by the Engineer. Temporary barriers must be continuous and cane detection ready. Parallel curb ramps may be necessary to transition to a temporary sidewalk and should include a running slope of 1 on 12, 1.2 m wide, slip resistant surface, 1.2 m2 clear landing area at transition points and high color contrast edging, unless otherwise directed by the Engineer.

    For the purposes of this document, only an improved area –asphalt or concrete –between the travelled way and the edge of the right of way shall be considered a sidewalk.

All travel paths must be safe, convenient and clearly delineated which includes all temporary pedestrian signage and directional signage.
PEDESTRIAN ACCESS TO BUSINESSES/PROPERTIES

Unless otherwise specified in the Contract, an unobstructed, hard-surfaced pedestrian walkway/ramp which is fully accessible must be provided, clearly identified, and maintained in a good state of repair to the satisfaction of the Engineer, Acceptable construction materials include steel and lumber; asphalt millings are not acceptable as a construction material for ramps. The surfaces of all ramps must be coated with an acceptable non-skid material.

- **Division 2 – Item 211.13 – Basis of Measurement**
  - **Add:**
    When grubbing is required ground surface for measurement of trench depth shall be deemed to be 150mm below original grade (ie. depth of grubbing). Grubbing will be paid under Item 311 Clearing and Grubbing.

    When street excavation is required, ground surface for measurement of trench depth shall be deemed to be the new street subgrade elevation. Material excavated above the new subgrade elevation will be paid under Item 321 Street Excavation.

- **Division 2 – Item 222.02 – Pipe & Fittings**
  - **Replace: Corrugated HDPE**
    Corrugated double walled pipe shall have a smooth inner wall. Pipes may be bell and spigot style and pipe shall be certified to CSA B182.8, have a pipe stiffness of 320 kPa, and conform to ASTM F667 for storm sewers. This pipe is no to be used for diameters less than 300mm or for catch basin leads.

    With:
    High Density Polyethylene (HDPE) pipe shall be certified to B182.8 Type 3 (Soil Tight) complete with bell and spigot and have a pipe stiffness of 320 kPa. Dual wall pipe shall have a smooth interior wall. This pipe is not to be used for diameters less than 300mm or for catch basin leads.

- **Division 2 – Item 223.03 – Precast Concrete Units**
  - **Replace:**
    Precast concrete shall be manufactured and installed in accordance with CSA A23.1 and the standard drawings.

    Where the precast plant is not CSA certified to manufacture precast units, third party verification by a professional engineer is required to ensure units are designed and manufactured to applicable standards.

Flexible gasket joints may be used in accordance with CSA 257.3 and the standard drawings.
All pipe openings shall be predrilled at the factory or on site with the proper drilling equipment. After installation of the pipe, all holes shall be grouted from the inside and outside before backfilling.

With:
Precast concrete units shall be manufactured and installed in accordance with the latest version of CSA A23.1 and CSA A257.4, and the standard drawings.

Where the precast plant is not CSA certified to manufacture precast units, third party verification by a professional engineer is required to ensure units are designed and manufactured to applicable standards.

Joints between precast sections shall be fitted with a flexible watertight rubber gasket in accordance with CSA A257.3 and the standard drawings.

All pipe openings shall be pre-formed or pre-drilled at the factory or on site with the proper drilling equipment.

Connection of Pipe to Manholes and Catch Basins

Sanitary sewer pipes shall have a watertight connection to manholes with a flexible rubber resilient connector meeting the installation and performance requirements of ASTM C923. The rubber connector can be cast-in-place during manufacture of the pre-cast concrete structure or installed into a cored or preformed hole in the finished structure. The opening in the concrete structure shall be appropriately sized for the pipe OD and rubber connector. After installation of the pipe and rubber connector, the pipe shall also be grouted in place from inside of the structure.

Storm sewer pipes shall have a watertight connection to manholes and catch basins. The pipe shall be grouted in place from inside and outside of the structure. The pipe shall be centred within the opening in the concrete structure before application of grout. The opening shall be 50mm (max.) greater than the OD of the pipe.

Grout shall completely fill the hole (void between the pipe and structure wall) around the entire outside of the pipe. Pipe connections set in benching shall also to be grouted to provide a smooth transition from pipe to manhole. Grout shall be a cementitious, non-shrinkable type, with freeze/thaw resistance and suitable for use in underground sewer systems. Mixing and application of grout shall be in accordance with manufacture recommendations.

When necessary to connect pipe to an existing structure in the field, the required hole shall be cored drilled through the structure wall using appropriate equipment.

Where the specified rubber connector and/or grouting is deemed to be not appropriate for a specific situation, provide details of an alternate watertight connection to the Engineer for approval.

- **Division 2 – Item 224.02 – Pipe & Fittings**
  - **Replace: Polyvinyl Chloride Pressure Pipe**

    Pipe: Rigid PVC shall conform to AWWA C900 and be certified to CSA B137.3 for sizes 100mm to 1500mm. Pipe shall be cast iron pipe equivalent OD's and be DR 18 (pressure class 235 psi). Pipe shall be Factory Mutual, ULC and ULI approved, and NSF 61 certified. Pipe shall be delivered to site complete with capped ends.

    Molecularly oriented PVC (PVCO) shall conform to AWWA C909 and be certified to CSA B137.3.1 for sizes 100mm to 600mm. Pipe shall be cast iron pipe equivalent OD's and be DR 18 (pressure class 235 psi) and be pressure class 235 psi. Pipe shall be Factory Mutual, ULC and ULI approved, and NSF 61 certified. Pipe shall be delivered to site complete with capped ends.

    With:

    Pipe: Rigid PVC shall conform to AWWA C900 and be certified to CSA B137.3 for sizes 100mm to 1500mm. Pipe shall be cast iron pipe equivalent OD's and be DR 18 (pressure class 235 psi). Pipe shall be Factory Mutual, ULC and ULI approved. Pipe shall be delivered to site complete with capped ends.

    Molecularly oriented PVC (PVCO) shall conform to AWWA C909 and be certified to CSA B137.3.1 for sizes 100mm to 600mm. Pipe shall be cast iron pipe equivalent OD's and be pressure class 235 psi. Pipe shall be Factory Mutual, ULC and ULI approved. Pipe shall be delivered to site complete with capped ends.

- **Division 2 – Item 224.05 – Corrosion Protection**
  - **Replace:**

    Petrolatum Tape System

    Existing Metallic Forcemains (Maintenance Applications): Petrolatum tape system not required, as sacrificial anodes are to be installed.

    New Forcemain Installations: Petrolatum tape system shall be installed at the following locations:
    - all metallic fittings (i.e. bends, couplings, etc.)
    - all joint restraints at non-metallic pipe joints

- all joint restraints and flanges at metallic fitting and valves

The petrolatum tape system shall be comprised of a primer, profiling mastic and petrolatum tape. The petrolatum tape system shall provide long-term corrosion protection and be suitable for use with underground forcemain systems.

Sufficient profiling mastic shall be used to fill all voids and provide a smooth surface for petrolatum tape installation at locations with sharp edges and irregular shape (i.e. flanges, restraints, etc.). There shall be no void space between the profiling mastic and petrolatum tape.

Petrolatum tape shall have a minimum 55% overlap to ensure a double thickness of tape at all locations and extend at least 50mm onto the connecting pipe. Smooth the tape surface to ensure a completely sealed system.

The petrolatum tape system shall be installed, including any required cleaning and preparation, in accordance with the manufacturer's instructions. Acceptable products include the Denso Petrolatum Tape System (Denso LT Tape, Denso Profiling Mastic and Denso Paste) or approved equal. The supply and installation of petrolatum tape systems shall be considered incidental to the work and no additional payment will be made.

With:

Petrolatum Tape System
Existing Metallic Forcemains (Maintenance Applications): Petrolatum tape system not required, as sacrificial anodes are to be installed.

New Forcemain Installations: Petrolatum tape system shall be installed at the following locations:
- all metallic fittings (i.e. bends, couplings, etc.)
- all joint restraints at non-metallic pipe joints
- all joint restraints and flanges at metallic fitting and valves

The petrolatum tape system shall be comprised of a paste, profiling mastic and petrolatum tape, and comply with the latest revision of AWWA C217, NACE RP0375 and CSA Z245.30. The three components shall be of the same manufacture to ensure compatibility and optimal performance. The petrolatum tape system shall provide long-term corrosion protection and be suitable for use with underground sewer forcemain systems.

Sufficient profiling mastic shall be used to fill all voids and provide a smooth surface for petrolatum tape installation at locations with sharp edges and

irregular shape (i.e. flanges, restraints, etc.). There shall be no void space between the profiling mastic and petrolatum tape.

Petrolatum tape shall have a minimum 55% overlap to ensure a double thickness of tape at all locations and extend at least 100mm onto the connecting pipe. Smooth the tape surface to ensure a completely sealed system.

The petrolatum tape system shall be installed, including any required cleaning and preparation, in accordance with the manufacturer's instructions. Installers shall be fully trained by the product manufacture or supplier, or by other previously trained and competent installers. Acceptable products include the Denso Petrolatum Tape System (Denso LT Tape, Denso Profiling Mastic and Denso Paste), Longwrap Petrolatum Tape System (Longwrap Petrolatum Tape, Longwrap LD Mastic and Longwrap Petrolatum Paste) or approved equal. The supply and installation of petrolatum tape systems shall be considered incidental to the work and no additional payment will be made.

- **Division 2 – Item 230.11 – Products – Water Services 50mm and smaller**
  - **Replace:**
    Cross linked polyethylene pipe: To conform to ASTM C904, certified to CSA B137.5, and conform to ASTM F816, F877 and F2023, NSF 14 and 61, with co-extruded UV shield to allow exposure to natural sunlight for up to one (1) year. The minimum degree of cross linking shall be 80%. Approved products: Municipex, IPEX Blue 904 Pex.

    With:
    Cross linked polyethylene pipe (PEX): To conform to ASTM C904, certified to CSA B137.5, and conform to ASTM F876, F877 and F2023, and NSF 14 and 61. Approved products: Municipex, IPEX Blue 904, LYNX-PEX.

  - **Add:**
    Couplings
    Couplings for use on direct bury plain ended watermain pipes shall be bolted sleeve type in accordance with AWWA C219. Where the length and configuration of watermain on each side of a coupling is sufficient to prevent axial movement of the watermain, a non-restraining coupling may be used. Otherwise, a restraining coupling shall be used. Contractor shall ensure the coupling is suitable for the material type and OD of watermain pipes being connected. Couplings shall be ductile iron or steel with a minimum working pressure rating of 1035kPa (150psi), fusion bonded epoxy coated to AWWA C213, with type 304 or 316 stainless steel nuts and bolts to ASTM F593/F594, and fitted with NBR or EPDM rubber gaskets to AWWA C111/A21.11-23.

Couplings shall be NSF 61 certified for use with potable water. Approved products: Non-restraining – Robar 1506 and Smith-Blair 413, Restraining – Krausz Hymax Grip and Georg Fischer Multi/Joint 3000 Plus, or approved equal.

- **Division 2 – Item 230-13 Pipe Assembly, Polyvinyl Chloride Pipe**
  - **ADD:** The Engineer shall submit a design for pipe restraints for each location where pipe restraints are proposed.

- **Division 2 – Item 230.18 – Corrosion Protection**
  - **Replace:**

    Petrolatum Tape System

    Existing Metallic Watermains (Maintenance Applications): Petrolatum tape system not required, as sacrificial anodes are to be installed.

    New Watermain Installations: Petrolatum tape system shall be installed at the following locations:
    - all metallic fittings (i.e. bends, couplings, etc.)
    - all metallic corporation stops and curb stops
    - all joint restraints at non-metallic pipe joints
    - all joint restraints and flanges at metallic fitting, valves and hydrants

    The petrolatum tape system shall be comprised of a primer, profiling mastic and petrolatum tape. The petrolatum tape system shall provide long-term corrosion protection and be suitable for use with underground potable watermain systems.

    Sufficient profiling mastic shall be used to fill all voids and provide a smooth surface for petrolatum tape installation at locations with sharp edges and irregular shape (i.e. flanges, restraints, etc.). There shall be no void space between the profiling mastic and petrolatum tape.

    Petrolatum tape shall have a minimum 55% overlap to ensure a double thickness of tape at all locations and extend at least 50mm onto the connecting pipe. Smooth the tape surface to ensure a completely sealed system.

    The petrolatum tape system shall be installed, including any required cleaning and preparation, in accordance with the manufacturer's instructions. Acceptable products include the Denso Petrolatum Tape System (Denso LT Tape, Denso Profiling Mastic and Denso Paste) or approved equal. The supply and installation of petrolatum tape systems shall be considered incidental to the work and no additional payment will be made.

With:
Petrolatum Tape System
Existing Metallic Watermains (Maintenance Applications): Petrolatum tape system not required, as sacrificial anodes are to be installed.

New Watermain Installations: Petrolatum tape system shall be installed at the following locations:

- all metallic fittings (i.e. bends, couplings, etc.)
- all metallic corporation stops and curb stops
- all joint restraints at non-metallic pipe joints
- all joint restraints and flanges at metallic fitting, valves and hydrants

The petrolatum tape system shall be comprised of a paste, profiling mastic and petrolatum tape, and comply with the latest revision of AWWA C217, NACE RP0375 and CSA Z245.30. The three components shall be of the same manufacture to ensure compatibility and optimal performance. The petrolatum tape system shall provide long-term corrosion protection and be suitable for use with underground potable watermain systems.

Sufficient profiling mastic shall be used to fill all voids and provide a smooth surface for petrolatum tape installation at locations with sharp edges and irregular shape (i.e. flanges, restraints, etc.). There shall be no void space between the profiling mastic and petrolatum tape.

Petrolatum tape shall have a minimum 55% overlap to ensure a double thickness of tape at all locations and extend at least 100mm onto the connecting pipe. Smooth the tape surface to ensure a completely sealed system.

The petrolatum tape system shall be installed, including any required cleaning and preparation, in accordance with the manufacturer's instructions. Installers shall be fully trained by the product manufacture or supplier, or by other previously trained and competent installers. Acceptable products include the Denso Petrolatum Tape System (Denso LT Tape, Denso Profiling Mastic and Denso Paste), Longwrap Petrolatum Tape System (Longwrap Petrolatum Tape, Longwrap LD Mastic and Longwrap Petrolatum Paste) or approved equal. The supply and installation of petrolatum tape systems shall be considered incidental to the work and no additional payment will be made.

- **Division 3 – Item 323-05 – Placing Gravel for Streets**
  - **REVISE: Table 1 Gradation Requirements.** Sieve sizes in Table 1 should read 0.425 mm (formerly 4.25 mm), 0.3 mm (formerly 300 mm), 0.075 mm (formerly 075 mm).

- **Division 3 – Item 330-07 – Jointing**
  - **Replace: Expansion Joints**

    Full depth expansion joints shall be constructed at right angles to the curb line, at immovable structures and at points of curvature for short radius curves. Filler material shall conform to the requirements of D-1751 and shall be furnished in a single piece for the full width of the concrete structure. They shall be flush with the surface, cut-off and trimmed to the satisfaction of the Engineer. Accepted products include Nomaflex, Reflex or approved equal.

    With:

    Full depth expansion joints shall be constructed at right angles to the curb line, at immovable structures and at points of curvature for short radius curves. Filler material shall conform to the requirements of D-1751 and shall be furnished in a single piece for the full depth and width of the concrete structure. They shall be flush with the surface, cut-off and trimmed to the satisfaction of the Engineer. Maximum spacing is 5400 mm. Accepted products include Nomaflex, Reflex or approved equal.

- **Division 3 – Item 330-10 – Reinstatement**

  Replace: Reinstatement

  Reinstatement of existing asphalt concrete driving surface adjacent to the curb or gutter shall be made in accordance with the Item 352 "Full Depth Asphalt Patch", except the cost shall be deemed to have been included by the Contractor in his bid prices for this work and no separate payment will be made for this patching.

  Where the street is stripped of all asphalt for the purpose of street reconstruction no asphalt for street reinstatement will be required.

  Reinstatement of grass or asphalt surfaces behind the curb line shall be performed and paid for in accordance with the applicable section of Item 511 “Topsoiling, Sodding and/or Hydroseeding” or Item 530 “Reinstatement” of this contract.

  With:

  Reinstatement of existing asphalt concrete driving surface adjacent to the curb or gutter shall be made in accordance with the Item 352 "Full Depth Asphalt Patch", except the cost shall be deemed to have been included by the Contractor in his bid prices for this work and no separate payment will be made for this patching. Reinstated sections must be of sufficient width to mechanically tamp and/or roll to achieve compaction requirements.

  Where the street is stripped of all asphalt for the purpose of street

reconstruction no asphalt for street reinstatement will be required.

Reinstatement of grass or asphalt surfaces behind the curb line shall be performed and paid for in accordance with the applicable section of Item 511 “Topsoiling, Sodding and/or Hydroseeding” or Item 530 “Reinstatement” of this contract.

- **Division 3 – Item 351-07 – Construction**
  Replace: Paving Season for Asphalt Surface Course

  The placing of surface course asphalt will not be permitted to be placed prior to May 24 or after September 30, of any given year unless otherwise approved by the City.

  No pavement shall be removed from a roadway that cannot meet the requirement of replacing the asphalt before the end of the paving season.

  With:

  Paving Season for Asphalt Surface Course

  The placing of surface course asphalt will not be permitted to be placed prior to May 24 or after October 15, of any given year unless otherwise approved by the City.

  No pavement shall be removed from a roadway that cannot meet the requirement of replacing the asphalt before the end of the paving season.

- **Division 3 – Item 351-07 – Construction**
  Replace: Tables 5 & 6

Table 5
Asphalt Content/Gradation Acceptance Criteria

TYPE OF TEST	ACCEPTABLE ZONE (%)	PENALTY ZONE (%)	REJECTABLE ZONE (%)
Asphalt Binder Content	± 0.25	-0.25 TO - 0.50 +0.25 TO +0.50	<-0.50 OR >+0.50
Gradation	Passing 4.75 mm (#4) - 0.00 to 5.00 Passing 75µm (#200) - 0.00 to 1.00	Passing 4.75 mm (#4) - 5.01 to 9.00 Passing 75µm (#200) – 1.01 to 2.00	Passing 4.75 mm (#4) >9.00 Passing 75µm (#200) >2

Table 6
Asphalt Content Penalty:

Penalty Zone AC Content Deviation (%)	Unit Price Payment Adjustment Factor (% Per Tonne of HMA)	Penalty Zone AC Content Deviation (%)	Unit Price Payment Adjustment Factor (% Per Tonne of HMA)	Penalty Zone AC Content Deviation (%)	Unit Price Payment Adjustment Factor (% Per Tonne of HMA)	Penalty Zone AC Content Deviation (%)	Unit Price Payment Adjustment Factor (% Per Tonne of HMA)
0.25	0.0	0.32	7	0.39	14	0.46	21
0.26	1	0.33	8	0.40	15	0.47	22
0.27	2	0.34	9	0.41	16	0.48	23
0.28	3	0.35	10	0.42	17	0.49	24
0.29	4	0.36	11	0.43	18	0.50	25
0.30	5	0.37	12	0.44	19	> 0.50	Reject
0.31	6	0.38	13	0.45	20		

With:

Table 5
Asphalt Content/Gradation Acceptance Criteria

TYPE OF TEST	ACCEPTABLE ZONE (%)	PENALTY ZONE (%)	REJECTABLE ZONE (%)
Asphalt Binder Content	± 0.30	-0.30 TO - 0.50 +0.30 TO +0.50	<-0.50 OR >+0.50
Gradation	Passing 4.75 mm (#4) - 0.00 to 5.00 Passing 75µm (#200) - 0.00 to 1.00	Passing 4.75 mm (#4) - 5.01 to 9.00 Passing 75µm (#200) – 1.01 to 2.00	Passing 4.75 mm (#4) >9.00 Passing 75µm (#200) >2

Table 6
Asphalt Content Penalty:

Penalty Zone AC Content Deviation (%)	Unit Price Payment Adjustment Factor (% Per Tonne of HMA)	Penalty Zone AC Content Deviation (%)	Unit Price Payment Adjustment Factor (% Per Tonne of HMA)	Penalty Zone AC Content Deviation (%)	Unit Price Payment Adjustment Factor (% Per Tonne of HMA)	Penalty Zone AC Content Deviation (%)	Unit Price Payment Adjustment Factor (% Per Tonne of HMA)
0.30	0.0	0.37	7	0.44	14	> 0.50	Reject
0.31	1	0.38	8	0.45	15		
0.32	2	0.39	9	0.46	16		
0.33	3	0.40	10	0.47	17		
0.34	4	0.41	11	0.48	18		

0.35	5	0.42	12	0.49	19		
0.36	6	0.43	13	0.50	20		

- **Division 3 – Item 351-09 – Payment**

  Replace:

  Payment shall be at the respective unit price bid for this item, with adjustment for penalties of 351.08 where applicable. The price bid shall be full compensation for all labour, equipment and materials necessary to complete the work in accordance with this specification.

  With:

  Payment shall be at the respective unit price bid for this item, with adjustment for penalties of 351.08 where applicable. The price bid shall be full compensation for all labour, equipment and materials necessary to complete the work in accordance with this specification. If the City determines that any rejected material may remain in the work, and the Contractor elects not to repair the affected area, payment for the rejected amount will be at 50% of the respective bid unit price.

- **Division 3 – Item 360 – Geogrid**
  - **Replace: All**

- **Division 5 – Item 530.07 – Driveway Culverts**
  - **Replace:**

    The Contractor shall supply and install corrugated polyethylene pipe certified to CSA B182.6 with a pipe stiffness of 320 kPa and smooth interior wall in sizes specified. This item covers new locations or the replacement of existing culverts which are unsuitable for reuse due to no fault of the Contractor.

    Excavation for driveway culverts shall be in accordance with and paid for under Item 221 “Trench Excavation”.

    With:

    The Contractor shall supply and install corrugated High Density Polyethylene (HDPE) pipe certified to CSA B182.8 Type 3, Soil tight with external couplers, with a pipe stiffness of 320kPa and smooth interior wall in sizes specified. This item covers new locations or the replacement of existing culverts which are unsuitable for reuse due to no fault of the Contractor.

    Excavation for driveway culverts shall be in accordance with and paid for under Item 221 “Trench Excavation”.

- **Division 6 – Item 602 – Guide Rail**
  - **Replace: All**

- **Division 10 – Standard Drawings**
  - Drawing 10-211-03 - Trench Detail Electrical Conduit: Added Note 4 re: sand bedding Item 326.
  - Drawing 10-211-05 - Trench Compaction Detail: Added Note 4 re: Streets with existing geogrid.
  - Drawing 10-223-05 – Pre-Cast Manhole – Type 1200: Revised Note 2 and added Note 10 re: rubber connections and grouting.
  - Drawing 10-223-06 – Pre-Cast Manhole – Type 1500, 1800: Revised Note 2 and added Note 10 re: rubber connections and grouting.
  - Drawing 10-223-16 – Pre-Cast Single Catch Basin: Revised Note 2 and 3 re: gasket and grouting.
  - Drawing 10-223-17 – Pre-Cast Double Catch Basin: Revised Note 2 and 3 re: gasket and grouting.
  - Drawing 10-223-28 – Catch Basin Frame and Grate with Curb Inlet: New drawing added.
  - Drawing 10-223-29 – Pre-Cast Single Curb Inlet Catch Basin: New drawing added.
  - Drawing 10-223-30 – Pre-Cast Double Curb Inlet Catch Basin: New drawing added.
  - Drawing 10-230-04 – Hydrant Connection: Revised 300mm spacing from back of sidewalk to hydrant.
  - Drawing 10-230-05 – Hydrant & Hydrant Marker: Revised 300mm spacing from back of sidewalk to hydrant and marker.
  - Drawing 10-330-07 – Standard Driveway Ramp: Revised notes and dimensions.
  - Drawing 10-330-08 – Alternate Driveway Ramp: Revised notes and dimensions.
  - Drawing 10-330-09 – Short Driveway Ramp: Revised notes and dimensions.
  - Drawing 10-330-11 – Standard Curb Ramp: Revised notes and dimensions.
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  - Drawing 10-330-13 – Minimum Curb Ramp - A: Revised notes and dimensions.
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  - Drawing 10-330-15 – Single Direction Curb Ramp: Revised notes.
  - Drawing 10-330-16 – Standard Mid-Block Curb Ramp: Revised notes and dimensions.
  - Drawing 10-330-17 – Alternate Mid-Block Curb Ramp: Revised notes.
  - Drawing 10-330-18 – Shared Use Path & Sidewalk Typical Treatment: Revised notes and dimensions.
  - Drawing 10-330-22 – Concrete Joint Notes: Added Note 11 re: Expansion Joint Spacing 5400mm.
  - Drawing 10-330-25 – Mountable Traffic Island Curb & Gutter: Revised

dimensions.

- Drawing 10-330-34 – Bus Shelter Pad with Front Accessibility: New drawing added.
- Drawing 10-330-35 – Bus Shelter Pad with Side Accessibility: New drawing added.
- Drawing 10-330-36 – Accessible Bus Stop Pad: New drawing added.
- Drawing 10-330-37 – Bus Shelter Pad at Landscaped Boulevards: New drawing added.
- Drawing 10-330-38 – Traffic Island Curb: New Drawing Added
- Drawing 10-530-01 – Parking Meter Post & Signpost Detail: Note 6 added re: signpost saver locations.
- Drawing 10-602-04 – Guide Post: New drawing added.

DIVISION 1

SPECIFICATIONS GENERAL

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ITEM 110

ENGINEER'S SITE OFFICE

When called for by a separate pay item in the Tender Form the Contractor shall supply and maintain an Engineer's Site Office, complete with utilities and furniture as detailed:

The office shall have a minimum 4.6m x 3.0 metres x 2.4 metres height, with floor 0.3 metres above grade, complete with four (4) 50% opening windows and one (1) locked door. The office shall be insulated and heated to maintain 22°C inside temperature at -20°C outside temperature. The inside walls and ceiling shall be finished with plywood, hardwood or wall board and painted in selected colours. The finished floor shall be comprised of 19mm thick plywood. The electrical lighting systems shall provide minimum 750Lx using surface mounted shielded commercial fixtures with 10% upward light component. An internet connection must also be provided.

Office furniture and equipment shall be as follows:

1 desk (1m x 2m) with lockable drawers

1 plans table

3 chairs

1 draftspersons stool

1 electrical outlet near the drafting table

1 coat rack and shelf

Eyewash kit, fire extinguisher, first aid kit in accordance with OH & S regulations

A boardroom table and chairs capable for 6-8 persons

The Contractor shall provide private washroom facilities adjacent to office complete with flush or chemical type toilet, lavatory and mirror and maintain a supply of paper towels and toilet tissue.

The Contractor shall clean, maintain, light and heat office and washroom throughout the continuance of the work.

The Engineer’s site office and equipment, if required, will be included as a pay item in the Schedule of Prices.

The Engineer’s site office must be on site, fully functional, and acceptable to the Engineer prior to the commencement of construction.

ITEM 112

PERIOD AND HOURS OF WORK/RUSH HOUR RESTRICTIONS

Notwithstanding any other provision contained in these contract documents, the Contractor shall not be permitted to work during the winter months between December 21 and March 21 of the following year unless otherwise approved or directed by the Engineer.

Hours of work for a project will be as agreed to by the Engineer. The hours of work and days of work will be incorporated in the Contractor's schedule and methodology for carrying out the said contract. Hours of work to comply with the City of St. John's Noise By-Law or any other bodies having jurisdiction.

In addition, this section regulates or prohibits construction activities on busy streets during peak traffic periods as below:

1. Non-emergency construction will not be permitted on many streets throughout the City during the peak traffic periods (rush hour) during the morning hours from 7:00am to 9:00am and the evening hours from 4:00pm to 6:00pm. The restrictions will not be in place on weekends (Saturdays and Sundays) or on days of observance for public holidays (in accordance with the Newfoundland and Labrador *Shops Closing Act*). The streets affected are mainly "arterial" classified streets, with construction activities prohibited in certain lanes during rush hour as outlined in the following list:

STREET NAME	STREET SECTION	MORNING RESTRICTION (7:00am-9:00am)	EVENING RESTRICTION (4:00pm-6:00pm)
Adams Ave.		All Lanes	All Lanes
Allandale Rd.	Outer Ring Rd. to Elizabeth Ave.	Southbound Lanes	Northbound Lanes
Barter's Hill		All Lanes	All Lanes
Bay Bulls Rd.		All Lanes	All Lanes
Blackmarsh Rd.		All Lanes	All Lanes
Bonaventure Ave.		All Lanes	All Lanes
Brookfield Rd.		All Lanes	All Lanes
Campbell Ave.	Cashin Ave. to Lemarchant Rd.	All Lanes	All Lanes
Captain Whelan Dr.		All Lanes	All Lanes
Carpasian Road		Southbound Lanes	Northbound Lanes
Cashin Ave.		All Lanes	All Lanes
Cashin Ave. Ext.		All Lanes	All Lanes

STREET NAME	STREET SECTION	MORNING RESTRICTION (7:00am-9:00am)	EVENING RESTRICTION (4:00pm-6:00pm)
Cavendish Sq		All Lanes	All Lanes
Columbus Dr.		Northbound Lanes	Southbound Lanes
Cornwall Ave.		All Lanes	All Lanes
Duckworth St.		All Lanes	All Lanes
Elizabeth Ave.		All Lanes	All Lanes
Empire Ave.	Old Pennywell Rd. to Bonaventure Ave.	All Lanes	All Lanes
Freshwater Rd.		All Lanes	All Lanes
Goldstone St.		All Lanes	All Lanes
Hamilton Ave.		All Lanes	All Lanes
Harbour Dr.		Eastbound Lanes	Westbound Lanes
Harvey Rd.		All Lanes	All Lanes
Higgins Line		All Lanes	All Lanes
Job St.		No Restriction	All Lanes
Kelsey Dr.		No Restriction	All Lanes
Kenmount Rd.		All Lanes	All Lanes
Kenna's Hill		All Lanes	All Lanes
King's Bridge Rd.		All Lanes	All Lanes
Lemarchant Rd.		All Lanes	All Lanes
Logy Bay Rd.		Southbound Lanes	Northbound Lanes
Macdonald Dr.		All Lanes	All Lanes
Main Rd.		All Lanes	All Lanes
Major's Path		All Lanes	All Lanes
Military Rd.		All Lanes	All Lanes
Monkstown Rd.		All Lanes	All Lanes
New Cove Rd.		All Lanes	All Lanes
New Gower St.		All Lanes	All Lanes
Newfoundland Dr.		All Lanes	All Lanes
O'Leary Ave.		All Lanes	All Lanes
Old Pennywell Rd.	Columbus Dr. to Empire Ave.	All Lanes	All Lanes
Ordnance St.		All Lanes	All Lanes
Pippy Pl.		All Lanes	All Lanes
Portugal Cove	City Limits to New Cove Rd.	Southbound	Northbound

STREET NAME	STREET SECTION	MORNING RESTRICTION (7:00am-9:00am)	EVENING RESTRICTION (4:00pm-6:00pm)
Rd.		Lanes	Lanes
Portugal Cove Rd.	New Cove Rd. to Rennie's Mill Rd.	All Lanes	All Lanes
Prescott St.		All Lanes	All Lanes
Prince Of Wales St.		All Lanes	All Lanes
Prince Philip Dr.		All Lanes	All Lanes
Queen's Rd.		All Lanes	All Lanes
Rennie's Mill Rd.	Portugal Cove Rd. to Military Rd.	All Lanes	All Lanes
Southern Shore Hwy.		All Lanes	All Lanes
Symonds Ave.		All Lanes	All Lanes
Thorburn Rd.	City Limits to Goldstone St.	All Lanes	All Lanes
Thorburn Rd.	Goldstone St. to Freshwater Rd.	Eastbound Lanes	Westbound Lanes
Topsail Rd.	City Limits to Cornwall Ave.	Eastbound Lanes	Westbound Lanes
Torbay Rd.		Southbound Lanes	Northbound Lanes
Waldegrave St.		All Lanes	All Lanes
Water St.	Waldegrave St. to Temperance St.	All Lanes	All Lanes
Water St. (West)	Topsail Rd. to Waldegrave St.	Eastbound Lanes	Westbound Lanes
Waterford Bridge Rd.		All Lanes	All Lanes
Westerland Rd.		All Lanes	All Lanes

2. Construction is not permitted in **any** lanes of an intersection included in the list in Section 1 of these restrictions, during the peak traffic periods, regardless of the direction of travel, unless prior approval is given by the City.

3. All efforts should be made to ensure construction activities in school zones take place on weekends or during the summer months (typically July and August) when schools are closed.

4. When construction is only restricted in certain lanes during a peak traffic period, construction may proceed in only one lane on the opposite side of the road, with the

remaining lane(s) opened to traffic. Traffic flow must be maintained at all times during the peak periods, regardless of the direction of flow.

5. Construction may be permitted on restricted streets during peak traffic hours if the work is outside of traffic lanes and does not impede traffic flow.

6. Construction on busy commercial streets (such as Kelsey Drive, Stavanger Drive, Aberdeen Avenue, Hebron Way and White Rose Drive) should be given careful consideration to avoid causing additional traffic congestion. It is recommended that road work on these streets be performed in the early morning hours before 10:00am or on days of observance for public holidays (in accordance with the Newfoundland and Labrador *Shops Closing Act*).

7. The annual Tely 10 Road Race is held on the fourth Sunday in July. Any road work on the race route must be finished and any disrupted surfaces repaved by the Friday before the race is scheduled. Contractors should take weather into consideration and pave earlier if necessary to ensure that there are not unpaved areas before the race takes place. Streets included on the route include Topsail Rd, Cornwall Ave, Hamilton Ave, Lemarchant Rd, Harvey Rd, Military Rd and Bannerman Rd. Work on the route cannot resume until after the race has finished.

8. Any emergency repairs to City infrastructure as determined by the City's Department of Public Works or Department of Planning, Engineering and Regulatory Services, will not be bound by these restrictions.

9. Upon approval by the City, these restrictions may be lifted for longer-term construction projects where a traffic detour is required, or for other extenuating circumstances.

10. "Construction" for the purposes of this specification item, not only includes work ongoing in the road right-of-way, but also any construction equipment or personnel that may be impacting traffic flow due to construction activities outside the road right-of-way or work zone.

11. The City of St. John's will monitor all construction activities throughout the city, whether on the aforementioned streets list or not, and contractors may be asked to remove equipment from the roadway at any time of day if it is deemed necessary to alleviate traffic congestion. No additional payment will be made to contractors for any delays associated with these removals.

ITEM 120

LINES & GRADES

Engineer will provide only those survey control points as necessary to define general location, alignment, and elevations of work. Give Engineer reasonable notice of requirements for such control points.

Before the commencement of any work, the accuracy of the lines, positions, elevations, and grades shown on the drawings shall be checked and agreed on the site jointly by the Contractor and Engineer.

Set grades and lay out work in detail from control points and grades established by Engineer.

Assume full responsibility for and execute complete layout of work to locations, lines and elevations indicated.

Provide devices needed to lay out and construct work.

Supply stakes and other survey markers required for laying out work.

The checking of, or setting out, of lines or levels by the Engineer shall not in any way relieve the Contractor of his responsibility for the correctness thereof and the Contractor shall carefully protect and preserve all benchmarks, profiles and other things used in setting out the Works. If at any time during the progress of the works, any error shall appear or arise in the Works, the Contractor shall at his own expense rectify such error to the satisfaction of the Engineer, unless such error is based on incorrect data supplied in writing by the Engineer.

The Contractor shall keep the Engineer informed a reasonable time in advance of the time and places at which he wishes to do the Work in order that information lines, elevations and grades may be confirmed and necessary measurements for record and payment purposes may be made with the minimum of inconvenience. No payment shall be made for the cost to the Contractor of any work or delay occasioned by establishing or checking lines and grades or making other measurements and no extensions of time shall be allowed for any delay occasioned thereby.

ITEM 121

STORAGE FACILITIES

The Contractor shall supply proper storage facilities at his own expense and shall be responsible for the care of all materials until placed in the works.

ITEM 122

NOTICE BY CONTRACTOR

All notices to the utility companies (power, communications, etc.), city departments, owners or occupants of property, or other interested parties shall be given by the Contractor at least one (1) week in advance of the work, except where the serving of such notices is the express duty of the City. Other notices as required throughout the course of the work for various activities or disruptions must be delivered a minimum of three (3) days prior to the activity or as deemed appropriate by the Engineer. The contractor must keep a record of notices delivered and provide proof of such to the Engineer upon request.

Any required coordination with the utility companies and city departments should commence immediately upon award notification.

ITEM 123

TEMPORARY SUPPLY OF WATER TO RESIDENTS

Where residents have existing wells, which are used as a source of domestic water, and should loss of water occur as a result of the lowering of the groundwater table due to watermain and/or sewer main installation, the Contractor will supply affected residents with potable water on a temporary basis until the new water system becomes operational or otherwise directed by the Engineer.

Where feasible, the temporary supply of water shall be via a temporary potable water piping system in accordance with Specification Item 250.09 Temporary Watermain Bypass System. Otherwise, the Contractor shall provide the temporary supply of water via an individual water storage and pumping system connected to each affected property. The water storage tank shall be 1000L (min.), refilled with water daily, and protected from freezing. The temporary water system shall be properly disinfected and tested as directed by the Engineer. Payment will be by Change Order in accordance with the General Terms and Conditions of the contract.

Where properties have an existing water service connection to the City water system, the Contractor shall be responsible to maintain the existing system during construction. If it is not feasible, as determined by the Engineer, to maintain the existing water system, the Contractor shall be required to install and operate a temporary potable water piping system in accordance with Specification Item 250.09 Temporary Watermain Bypass System. Payment will be on a Lump Sum or Unit Price basis, as specified in the Tender Form.

To minimize the amount of time residents are supplied water from a temporary water system, the Contractor shall test and make operational any newly installed valved section of water main and install service connections to affected properties, without delay and as directed by the Engineer.

ITEM 125

EXISTING UNDERGROUND SERVICES

Prior to commencing work, the Contractor shall establish location and extent of all existing underground services and other obstructions in area of work and notify the Engineer of findings.

Where unknown services are encountered, the Contractor shall immediately advise the Engineer and confirm findings.

ITEM 126

PRIVATE PROPERTY

The Contractor shall not enter upon or occupy with men, equipment, tools, or materials of any nature, any property other than public streets and roadways, except for the rights-of-way shown on the drawings, or other areas designated by the Engineer and required for the performance of the work.

Permission to work on private property must be obtained prior to commencement of the work.

ITEM 128

SUBSOIL INVESTIGATION

The bore hole information presented on the drawings is provided for guidance and is only accurate for the exact location where drilled.

Contractors wishing to undertake additional subsoil investigations may do so provided they have proper clearances.

ITEM 129

TREE PROTECTION

The Contractor shall adhere to the requirements of the City of St. John’s Landscape Development Policy as it relates to the protection, removing or relocating of trees.

ITEM 130

TRAFFIC/PEDESTRIAN CONTROL

The Engineer must approve all sidewalk closures. Where there is another sidewalk available on the opposite side of the street, pedestrians must be directed to use that sidewalk. This shall include “Sidewalk Closed Ahead” signs in advance of the work area at the closest marked or unmarked crosswalk indicating the sidewalk is closed ahead. “Sidewalk Closed” signs must be placed on either side of the work area that is closed to pedestrians. These signs must appear on traffic control plans being submitted for review.

Where pedestrians cannot be directed to a sidewalk on the opposite side of the street (e.g. Detour too long, no crosswalks available, no sidewalk on the opposite side), the contractor shall be required to provide a temporary pedestrian route/crosswalk for pedestrian use. Anh temporary surface provided must be safe for all users, firm, stable and slip resistant, a minimum of 1.5m wide clear width, unless otherwise directed by the Engineer, and wheelchair/mobility device accessible. Asphalt or a comparable surface may be acceptable for this purpose.

Should the temporary sidewalk be part of the travelled way of a street, adequate delineation of the sidewalk space must be provided for the safety of all pedestrians. For plans which include a temporary sidewalk in the travelled way of a street delineation of the sidewalk must be provided with continuous F-shape Barriers/channelizer unless otherwise approved by the Engineer. Temporary barriers must be continuous and cane detection ready. Parallel curb ramps may be necessary to transition to a temporary sidewalk and should include a running slope of 1 on 12, 1.2 m side, slip resistant surface, 1.2 m2 clear landing area at transition points and high colour edging, unless otherwise directed by the Engineer.

For the purpose of this document, only an improved area – asphalt or concrete between the travelled way and the edge of the right of way shall be considered a sidewalk.

All travel paths must be safe, convenient and clearly delineated which includes all temporary pedestrian signage and directional signate

The Contractor shall always carry out the work in a manner consistent with the faithful performance of the Contract, which will cause a minimum of interference with traffic and the general public.

Traffic control operations shall be carried out in conformance with the requirements of the latest revision of the Occupational Health and Safety Act and Regulations.

Procedures and equipment for traffic control shall be in accordance with the requirements of the Province of Newfoundland and Labrador Traffic Control Manual. The Contractor shall provide all required means of traffic control as detailed and to the satisfaction of the Engineer. The cost shall be borne entirely by the Contractor.

Prior to commencing work within any existing City of St. John’s Street right -of-way, and at least seven (7) days in advance of the proposed implementation of the traffic control measures, the Contractor shall submit (in AutoCAD or other formats suitable to the City)

detailed traffic plans for all proposed lanes closures, diversions, etc to the City's Transportation Division or Project Manager, that will impact upon normal traffic movements. Traffic detours shall be applicable to through traffic movements only. The Contractor shall provide adequate means whereby access is maintained to properties fronting on closed sections of streets. No work will be permitted until after the traffic plans have been submitted and approved by the City of St. John's

Once traffic plans have been approved, the Contractor shall remain in full compliance throughout the course of the work. Contractor shall review, revise and update plans as work progresses otherwise the site will be shut down until an acceptable TCP and traffic plans are in place.

To implement traffic control, the following two (2) documents must be prepared:

Traffic Control Permit – the form to be completed, after reviewing the work zone and activity, indicating a review of the required traffic control measures has been completed and the necessary traffic control devices have been chosen.

Traffic Control Plan – a drawing, sketch or use of aerial photography of the work zone indicating placement of traffic control devices.

A Traffic Control Permit/Plan is required to be completed for each activity where the movement of vehicular traffic constitutes a hazard to workers.

Information documented on the Traffic Control Permit/Plan must be in place before work activity may begin.

If multiple groups are working in the area, the principal group (those leading the work activity) must complete the Traffic Control Permit/Plan and ensure all traffic control parameters are in place and working effectively.

- Secondary groups working on this site must confirm traffic control is in place.

If site conditions change during the work activity, the task must be halted, and a new Traffic Control Permit/Plan must be completed. If this new Traffic Control Permit/Plan indicates changes to the existing traffic control procedures, the work must be halted, and the changes must be implemented.

The Traffic Control Permit/Plan must be completed based on criteria located as per the Province of Newfoundland and Labrador Traffic Control Manual:

- The correct Figure number, chosen from the Province of Newfoundland and Labrador Traffic Control Manual, must be listed on the Traffic Control Permit, indicating which model of traffic control will be used regarding the placement of devices.
- If no figure number matches the work zone, a Traffic Control Plan must be created based on similar figures.
- If no similar figures exist, a Traffic Control Plan must be submitted to the City's Transportation Division, prior to work commencing, seeking approval.
    - The Traffic Control Plan must indicate the exact location of traffic control devices.

  - The Traffic Control Plan must be based on similar Traffic Control Manual figures and must ensure full compliance with the fundamental principles outlined in the Province of Newfoundland and Labrador Traffic Control Manual.
  - Aerial photography or plan drawings may be used (in lieu of a sketch) to depict roadways.
  - Traffic Control Plan to be labelled and include:
    - Active street and neighbouring/incoming streets
    - Traffic control devices to be used and correct positioning.
    - Taper locations and distances.
    - Identification of North.
    - Other requirements based on location.
- The City Supervisor/Designate or Contractor must review the Traffic Control Permit/Plan with the applicable workers. This includes flag persons and those workers placing traffic control devices.
  - Workers must sign the Traffic Control Permit indicating they have reviewed and understand this information and will follow it accordingly.
  - The City Supervisor/Designate or Contractor who completed the Traffic Control Permit must sign the Traffic Control Permit.
- A copy of the Traffic Control Permit/Plan must be kept on site for review by:
  - Employees
  - Occupational Health and Safety

The City Supervisor/Designate or Contractor must monitor the Traffic Control Plan and ensure its continual accuracy.

Guidelines:

- A Traffic Control Permit/Plan must be completed every day.
  - If the work activity/location has not changed, the Supervisor must inspect the work zone to confirm the traffic control is still functioning properly and a new Traffic Control Permit must be completed indicating “same as previous day”.
- A Traffic Control Permit/Plan must be completed for each activity inside a work zone that impacts traffic flow differently.
  - Multiple Traffic Control Permits/Plans may be required for the same site depending on activity and location.
- Grind and patch operations require a Traffic Control Permit/Plan
  - A Traffic Control Permit/Plan is required for each street and each intersection.
- Signs, indicating a change in the speed limit, are not permitted in Traffic Control Plans unless pre-approved by a City Transportation Engineer.
- Contractors are required to use the City’s Traffic Control Permit.
- Sign spacing is essential to ensure motorists receive enough warning to allow them to slow and stop.
  - Sign spacing must comply with the information in the Province of Newfoundland and Labrador Traffic Control Manual.
    - Variances may only be allowed due to road conditions/distances.
- Flag Person Ahead signs, TC-21, must be removed/turned to the sidewalk when flag person operations are not in effect.
- All aspects of the traffic control model must be used including a taper separating the work zone from the travel zone.

- Traffic Control Persons:
    - Shall stand in the required location ahead of the work activity as directed in the Province of Newfoundland and Labrador Traffic Control Manual.
    - Shall stand a minimum 30m ahead of work activity unless circumstances or space requirements dictate otherwise.
    - Shall not stand in the travelled portion of the road. This area is more hazardous as they could get struck by a vehicle that has not slowed /stopped in time.
    - Shall not stand with their back to the vehicles they are directing… if they do not see the vehicle coming, they cannot get out of the way.
    - Shall not use cell phones/headphones or any other device that may distract them from completing their task properly.
    - Shall ensure communication methods and used and understood when working with another Traffic Control person.
- After a work activity is completed, all traffic signs shall be removed immediately.
    - Installed signs not applicable during a phase of construction shall be removed or covered.
- Poorly maintained, defaced, damaged, or dirty signs are ineffective and shall be replaced, repaired, or cleaned without delay.
    - Signs which have been defaced or damaged and are not replaced within 24 hours of notification shall be removed by the City.
    - Costs associated with sign removal, sign replacement or traffic control will be the responsibility of the contractor.
- The base of the sign supports shall not be appreciably wider than the signs. Bases which require weighting for support shall be weighted using sandbags only.
    - The use of rocks, boulders, concrete blocks as weights shall not be permitted.
    - When signs are removed from the construction zone, the sandbags must also be removed and not left along the road.
- All signs shall meet all specifications in the Manual of Uniform Traffic Control Devices for Canada and the Traffic Control Manual.

SIDEWALK CLOSURES

The Engineer must approve all sidewalk closures. Where there is another sidewalk available on the opposite side of the street, pedestrians must be directed to use that sidewalk. This shall include “Sidewalk Closed Ahead” signs in advance of the work area at the closest marked or unmarked crosswalk indicating the sidewalk is closed ahead. “Sidewalk Closed” signs must be placed on either side of the work area that is closed to pedestrians. These signs must appear on traffic control plans being submitted for review.

Where pedestrians cannot be directed to a sidewalk on the opposite side of the street (e.g. detour too long, no crosswalks available, no sidewalk on the opposite side), the contractor shall be required to provide a temporary pedestrian route/crosswalk for pedestrian use. Any temporary surface provided must be safe for all users, firm, stable and slip resistant, a minimum of 1.5m wide clear width, unless otherwise directed by the Engineer, and wheelchair/mobility device accessible. Asphalt or a comparable surface may be acceptable for this purpose.

Should the temporary sidewalk be part of the travelled way of a street, adequate delineation

of the sidewalk space must be provided for the safety of all pedestrians. For plans which include a temporary sidewalk in the travelled way of a street, delineation of the sidewalk must be provided with continuous F-shape Barriers/channelizer unless otherwise approved by the Engineer. Temporary barriers must be continuous and cane detection ready. Parallel curb ramps may be necessary to transition to a temporary sidewalk and should include a running slope of 1 on 12, 1.2 m wide, slip resistant surface, 1.2 m^2 clear landing area at transition points and high color contrast edging, unless otherwise directed by the Engineer.

For the purposes of this document, only an improved area –asphalt or concrete –between the travelled way and the edge of the right of way shall be considered a sidewalk.

All travel paths must be safe, convenient and clearly delineated which includes all temporary pedestrian signage and directional signage.

PEDESTRIAN ACCESS TO BUSINESSES/PROPERTIES

Unless otherwise specified in the Contract, an unobstructed, hard-surfaced pedestrian walkway/ramp which is fully accessible must be provided, clearly identified, and maintained in a good state of repair to the satisfaction of the Engineer, Acceptable construction materials include steel and lumber; asphalt millings are not acceptable as a construction material for ramps. The surfaces of all ramps must be coated with an acceptable non-skid material.

ITEM 131

PROTECTION OF STRUCTURES, UTILITIES AND PROPERTY

The Contractor shall provide adequate protection for all utilities (power, communication, water, sewer, etc.) and private property which may be endangered by the performance of the work of this Contract. The protection shall be as required by the Engineer or the respective owner. The Contractor shall notify the owner of his intent to work in the vicinity of the property and shall co-operate with the owner in the protection thereof.

Should the nature of the work require that existing drainage courses or sewer flows, etc., be blocked or diverted, or if new drainage courses are created, then the Contractor shall provide temporary pipes or channels. All methods employed by the Contractor shall be approved by the Engineer.

All costs associated with the protection of and repair of damage to structures, utilities and property, shall be borne by the Contractor regardless of whether the work is performed by the Contractor or the respective owner. This provision shall not apply however to the cost of:

1. Permanent removals or relocations of property which are stipulated in the Contract Documents as being performed by parties other than the Contractor.

2. Removal, relocation, protection or restoration of property and utilities for which specific payment provisions have been made in the Contract Documents or identified as being

paid for by others.

ITEM 132

DELAYS CAUSED BY UTILITIES AND PROPERTY OWNERS

Before work begins the City will make every effort to acquire all of the rights-of-way and to arrange for the moving of those utility poles, wires, cables and underground facilities that are in the way. However, should the Contractor be delayed, due to all of the rights-of-way not being acquired, or due to utility poles, wires, cables and underground facilities not being moved, then the City will not assume responsibility for such delays and the Contractor shall indemnify and save harmless the City from all suits and action for damages and costs resulting from the delay.

ITEM 133

REMOVAL OF SNOW AND ICE

During the construction period the Contractor shall remove snow and ice from any portion of the work in any of its stages whenever deemed necessary by the Engineer. No additional payment will be made for this work.

ITEM 135

EXCAVATION AND EMBANKMENTS

General - All excavation work shall be performed in accordance with the latest editions of the Occupational Health and Safety Act and Regulations of the Province of Newfoundland and Labrador and the Occupational Health and Safety Policies of the City of St. John’s and without limiting the generality of the foregoing the Contractor shall comply with the following:

Accumulation of Water - The Contractor shall provide and maintain means whereby the accumulation of water is effectively prevented. This shall apply equally to excavations, to natural depressions from which drainage has been blocked and to depressions formed by the filling of adjacent areas. If unhindered flow from the area of potential accumulation cannot be provided by drainage under the influence of gravity alone, then the Contractor shall provide a working pump of a capacity adequate to prevent water accumulation. At the end of each day's work the Contractor shall appoint a watchman to tend the pump and maintain its operation overnight. The watchman shall have means available whereby a replacement unit or other assistance can be obtained upon short notice in the event of pump failure. The Contractor shall not use existing or newly-installed pipes, catch basins or other components of the City's storm sewer system to dispose of water without first taking steps to remove silt and debris. The quality of drainage from excavations as well as all other matters shall meet the requirements of the applicable Provincial and Federal Government Departments/Agencies.

Pedestrian Protection - Where an excavation or embankment creates a grade separation

between two (2) different surfaces such that a potential hazard to pedestrians exists, the Contractor shall provide means whereby pedestrians are effectively protected from the hazard. This requirement shall apply to all excavations and embankments regardless of location or of the degree of pedestrian usage nearby. It shall be in addition to any other barricades or structures required for traffic control or other purposes.

Pre-Excavation Requirement

a. Before commencing any excavation work with power tools or equipment in any area likely to have underground conduits, cables or pipelines, the location of such services shall be accurately determined.

   Powered equipment shall not be used in a manner that will expose workers to harmful effects resulting from the damage to service facilities.

   Trees, boulders, or other matter located within 1.8 metres of the area to be excavated shall be removed prior to commencing excavation work.

b. No worker shall be permitted or required to enter any excavation over 1.2 metres in depth unless:
   (1) the sides of the excavation are sloped to a safe angle; or

   (2) the sides have been secured by the use of sheet piling, shoring and bracing; or

   (3) the workers are protected by other effective means (ie. trench boxes). Trench boxes used on this project shall be certified by a Professional Engineer.

c. If equipment or other heavy objects are located or operated close to the edge of excavations, or if excavations are adjacent to or abutting buildings or other structures, or a hazard is created by vibration from nearby equipment, or from passing vehicular traffic, the added loads shall be considered in the design of the support system.

d. Whenever there is danger of undermining adjacent foundations, excavation work shall be done in short sections, and the adjacent foundation shall be effectively shored or braced.

Access - When workers are required to enter excavations over 1.2 metres in depth, a ladder shall be provided in the immediate area where workers are employed. The ladder shall extend from the bottom of the excavation to at least 900mm above the top of the excavation.

Removal of Material - No worker shall allow excavated material to remain within 1.2 metres of the edge of any trench-type excavation, nor within 1.5 metres of any pit-type excavation.

Faces and Slopes - Where work is being carried on in excavations, the slopes shall be scaled and rimmed, or otherwise stabilized, to prevent slides of material or falls of rock. Overhanging banks, and dangerous trees or stumps, shall be removed. Means shall be provided to prevent the dangerous erosion of slopes by surface water.

Barricade and Guard – Excavations shall be guarded by effective railings or barriers to

prevent workers from falling into excavations. Applicable during work hours and after-hours to protect the public/traffic.

Excavation Permit – required to be completed by Site Supervisor prior to entry into excavation confirming all OHS hazards have been reviewed and addressed. Employees to sign indicating acknowledgement.

ITEM 136

OCCUPATIONAL HEALTH AND SAFETY

The Contractor shall comply with the latest editions of the Occupational Health and Safety Act and Regulations of the Province of Newfoundland & Labrador and the Occupational Health and Safety Policies of the City of St. John's.

The Contractor shall ensure that necessary protective clothing and devices are used for the health and safety of his workers.

The Contractor shall, prior to commencing of this project, send to the Occupational Health and Safety Division of Service NL, a "Notice of Project" form containing the name and location of the project, the mailing address to which correspondence shall be directed, the nature of the work, and the number of workers to be employed. A copy of this form shall be forwarded to the City's Project Manager and Safety Advisor.

The Contractor shall participate in a "OHS Orientation" with the City's Safety Advisor prior to the commencement of any work related to this project.

The City shall not be responsible for injury or damage occasioned by a failure of the Contractor to adhere to the OHS Act and Regulations.

ITEM 137

STREET EXCAVATION PERMIT

All Contractors and Developers shall obtain a City of St. John's Street Excavation Permit for work completed in the City R.O.W. If a project is City funded, then a Street Excavation Permit is not required.

ITEM 139

USE OF EXPLOSIVES

Transportation, handling, storage, preparation and firing of explosives, and the handling of misfires shall be in accordance with all applicable legislative requirements, including the Occupational Health and Safety Act and Regulations.
Any permits required by applicable legislation must be held and maintained in good standing

for the duration of the blasting operations and must be produced upon request. This includes the Blaster's Safety Certificate, and a permit for the transportation of explosives.

Only such explosives as are necessary for the performance of the work shall be brought to the Site.

Blasting shall be conducted in a manner which will not endanger persons or property. The Contractor shall be responsible for and shall make good any damage caused by the blasting or by accidental explosion of any explosives intended for use on the Works or stored on the Site.

Unless otherwise permitted, all blasting shall be covered or satisfactorily confined.

A pre-blast survey shall be performed on all dwellings and structures within a 150 metres radius of the blast area. A copy of this pre-blast survey shall be submitted to the Engineer prior to the commencement of blasting.

In addition, a public notice must be issued prior to blasting operations.

The contractor shall not carry out or cause to be carried out blasting that results in a particle velocity which exceeds the limits set out in the table below at the closest structure:

Frequency of Ground Vibration (Hertz)	Maximum Allowable Peak Particle Velocity in millimeters/second (mm/s)
15 or less	12.5
16 to 20	19.0
21 to 25	23.0

It will be the responsibility of the Contractor to prove to the Engineer that the blast is within the acceptable limits.

ITEM 145

PROJECT RECORD DOCUMENTS

145.01 PROJECT RECORD DOCUMENTS

.1 Engineer will provide two sets of white prints and a digital copy of the drawings for record drawing purposes.

.2 Maintain project record drawings and record accurately deviations from Contract Documents.

.3 Mark changes in red coloured ink and always keep one copy available in Contractor's site office.

.4 All record document measurements must be taken using GPS survey equipment.

.5 Record following information:

.1 Horizontal and vertical location of underground utilities and appurtenances referenced to final surface elevation. Items that must be recorded include, but are not limited to finish grades, manholes, catch basins, all inlet/outlet invert elevations, fire hydrants, gate valves, curb stops, bends, tees, reducers, start/stop points of pre-insulated pipe, centrelines of all long stretches of uninterrupted pipe, centrelines and edges of all duct banks and underground utility lines, and profile of any rock encountered.

.2 Horizontal and vertical location of all surface improvements. Items that must be recorded include, but are not limited to curb & gutter, sidewalk, road centerline (at stations shown on IFC drawings), driveways, signage, limits of reinstatement, etc.

.3 Field changes of dimension and detail.

.4 Changes made by change order or field order.

.5 Benchmarks as required by the City of St. John's.

.6 At completion of project and prior to final inspection, a digital copy of Record Documents must be submitted to the Consultant/Project Manager for review. Digital submission must include all point data as indicated in section 145.01.5 as well as applicable linework connecting these points. The data must be clear and concise, using separate layers and notes as necessary. Separate layers for linework must include, but not be limited to: water main, sanitary main, storm main, Newfoundland Power ducts, Bell Aliant ducts, Rogers Communication ducts, street lighting ducts, edge of pavement, curb line, and back of sidewalk.

.7 Missing as-constructed information will be considered a deficiency and the amount will be retained by the owner until the Project Record Documents have been received from the Contractor and approved by the Consultant.

ITEM 151

WEIGHT RESTRICTIONS

The Contractor shall be responsible for the compliance with the Provincial Department of Transportation & Infrastructure (DTI) weight restrictions, by both his own vehicles and any hired trucks hauling materials for use on this contract, or on any City or private work the Contractor may undertake.

The Engineer is empowered to take immediate action to ensure compliance with all acts and regulations.

ITEM 152

CONTINGENCY ALLOWANCE

This amount is estimated to cover expenditures for foreseeable work to be carried out by the Contractor, the cost of which is not included in the tendered unit prices for the Contract. This work will include but is not restricted to payment for such items as repairs to private property, etc. This amount will also cover payment for expenditures incurred by the Contractor which could not be foreseen when the contract was prepared such as but not limited to, increase in taxes during the life of the contract, etc. This is not a lump sum payment to Contractors. No payment will be made except if the expenses are properly invoiced.

ITEM 153

MOBILIZATION AND DEMOBILIZATION

Mobilization shall be defined as the loading, transportation, unloading, and complete set-up of all plant, materials, and equipment necessary to complete the work associated with the contract. Demobilization shall be defined as the de-commissioning, loading, transportation, unloading and mothballing of all plant, excess materials and equipment after the work associated with the contract is complete.

Where excess materials are demobilized and the City purchases these materials, demobilization shall include the loading, transportation and unloading of the same from the job site to the Municipal Depot. Demobilization does not apply to the loading, transportation to a storage site, and removing of existing materials which are to be salvaged.

The Contractor is advised that payment at the lump sum price for this item shall be compensation in full for all labour, supplies, materials, and equipment use required to mobilize and demobilize plus provision of storage and security required during the mobilization and demobilization phases of the work.

Payment for this item shall be made with each progress estimate. The amount to be paid on any given estimate will be proportional to the amount of work actually completed on that estimate compared to the estimated total amount of work in the contract.

At no time will the total amount paid to the Contractor exceed the amount bid for this item in the contract.

When the final progress estimate is completed the total amount paid to the contractor will be the lump sum price bid for this item in the contract.

Where mobilization and demobilization is not shown as a pay item in the Tender, then these costs are to be distributed to other pay items in the Contract.

ITEM 154

MATERIALS ON SITE

At the discretion of the City, a Contractor, Sub-contractor or Supplier may be paid for materials that are delivered to site, stored on property owned by the City of St. John’s, or stored on property where the area of material storage is leased to the City of St. John’s and meets the following conditions:

1) Materials must be covered by insurance against loss or damage.

2) Materials that may be damaged or deteriorated by weather or other environmental conditions must be appropriately protected.

3) The City is not liable for any additional transportation or handling costs.

4) City representative is to verify each month or more frequently, if deemed necessary, quantity and quality of materials stored.

5) Where the material storage area is not City property, the space to be leased must be located within the boundaries of the City or an adjoining municipality.

6) Where the material storage area is not City property, the space must be leased to the City by means of a formal agreement.

7) Rent, utilities, security or insurance, where applicable, must be paid for by the contractor, sub-contractor or supplier.

8) Proof of ownership of space leased, must be provided by the Lessor.

9) A plan defining the space leased must be provided.

10) Materials, not stored on City property, must be tagged to indicate ownership by the City of St. John’s.

11) Lessor must notify the City’s representative if rent is not paid by the Contractor, Sub-Contractor or Supplier.

12) If the City pays rent, insurance costs, etc. associated with the storage of materials on site, these costs will be deducted from the contract including administrative cost.

ITEM 180

UNWATERING

The term “Unwatering” shall mean the removal or keeping out of water from the site, in order that work may be carried out in accordance with the specifications.

Where unwatering is not a pay item, but is required to carry out other work, then such necessary unwatering shall be provided by the Contractor. The Contractor shall provide such temporary water-tight structures and pumps as are required for unwatering, and then after completion of the work, remove the unwatering facilities and clean-up and trim the site to sightly proportions, all at his own expense.

In an unwatering operation silt laden water containing more than 25 milligrams of suspended solids per litre shall not be disposed of directly into a watercourse or water body, and also silt laden water containing more than 350 milligrams of suspended solids per litre shall not be disposed of directly into a sewer. Silt laden water exceeding these limits shall be discharged to a vegetated area or to a sedimentation basin for removal of silt to within the appropriate limits before being disposed of into a water course or water body, or into a sewer. Where possible the vegetated areas shall be not less than 60 m from a water course or water body, unless otherwise directed by the Engineer.

Cofferdams, when used, shall be constructed with suitable materials so as to render the cofferdam non-erodible and non-polluting. Earthfill cofferdams shall be faced with plastic sheeting followed by sandbags, or equivalent if approved by the Engineer. The purpose of the plastic is to produce a dam that produces the least amount of infiltration.

Should silt fences be required in connection with unwatering, then the silt fences shall be included in the cost of unwatering.

DIVISION 2

SPECIFICATIONS FOR WATER & SEWER SERVICES

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ITEM 201

CLOSED CIRCUIT TELEVISION (CCTV) INSPECTION

201.01 SCOPE OF WORK

The work covered by this specification consists of furnishing all materials, labour, supervision, equipment, and plant necessary to perform closed-circuit television (CCTV) inspection of new and existing sewer pipes as specified.

201.02 DEFINITIONS

"CCTV" shall mean closed circuit television.

"Sewer Section" shall mean the length of pipe connecting two manholes.

"Building Service" shall mean the sewer line (lateral) extending from the building to the sewer main.

“MH” shall mean Manhole or Maintenance Hole.

"NASSCO" shall mean the National Association of Sewer Service Companies.

"PACP" shall mean Pipeline Assessment and Certification Program.

201.03 WHEN CCTV INSPECTIONS ARE REQUIRED

CCTV sewer inspection are required:

(a) for all new sewer installations (sanitary and storm).

(b) when any proposed construction project may conceivably damage, disrupt or otherwise disturb any portion (or an appurtenance) of the City’s existing sewer system. In this case, a pre-construction and post-construction inspection of the existing sewer system will be required.

(c) other sewer investigative works as required by the City.

CCTV sewer inspection requirements for proposed construction projects shall be determined based on the following criteria:

(a) Any sewer running parallel to the proposed construction area and within 5 metres of same, shall be inspected if blasting is required or anticipated.

(b) When blasting is not required, any sewer running parallel to the proposed construction area and within 3 metres of same shall be inspected.

(c) Where the Engineer may deem necessary.

In new sewers, a small stream of clear water is to flow in the pipe during the CCTV inspection to define the invert of the pipe and sags in the pipe.

201.04 ARRANGEMENT FOR INSPECTIONS

The Contractor will arrange all pre-construction and post-construction CCTV inspections.

201.05 PRE-CONSTRUCTION INSPECTION OF SEWERS

In the area of the proposed construction, all building services connected to the sewer main shall be assumed to be in reasonable structural condition if they have been functioning properly in the past.

If a malfunction of a building service is caused, then the contractor will be held responsible for any repairs.

Pre-construction inspection of existing sewers shall be completed prior to the start of any constructions works, in accordance with the requirements of Item 201.03.

As an alternate to the previously outlined pre-construction inspection requirements, the Contractor may accept the sewer pipe conditions identified in a previous CCTV Inspection report for the affected area, which may be presently on file. However, to permit utilization of a past report, the following criteria must be met:

(a) The CCTV Inspection report shall be less than three (3) years old.

(b) No major construction works shall have been undertaken in the immediate area since this inspection.

201.06 POST-CONSTRUCTION INSPECTION OF SEWERS

The post-construction inspection of new and existing sewers must be completed within thirty (30) days of completion of the works, and in any case before the work is accepted.

New sewer installations found to have deficiencies are to be re-inspected after the deficiencies have been rectified. The final CCTV inspection shall identify no deficiencies and clearly indicate the revision number.

201.07 REPAIR OF DAMAGED SEWERS

All damage incurred by any portion of the sewer system due to a construction project shall be repaired by the contractor, at the contractor's expense and in accordance with City Specifications.

Upon completion of these repairs, a subsequent verification CCTV inspection shall be undertaken to assess the quality of the repairs. Repairs that are not in accordance with the City Specifications will have to be redone and re-inspected at no cost to the City.

201.08 SITE SAFETY

The Contractor shall ensure that all aspects of the required work are, at all times, in full and complete compliance with the Occupational Health and Safety Act, as amended. The Contractor shall provide approved equipment and training to personnel who enter confined spaces as may be required. The procedures the contractor follows for Confined Space Entry must meet or exceed the requirements outlined by the Occupational Health and Safety Act

201.09 TRAFFIC CONTROL

The Contractor shall provide traffic control measures in accordance with Item 130 Traffic Control of the City of St. John's Specifications Book.

201.10 SEWER CONDITION CODING

CCTV inspections shall include sewer condition coding in accordance with the National Association of Sewer Service Companies (NASSCO), Pipeline Assessment and Certification Program (PACP) Reference Manual.

201.11 OPERATOR CERTIFICATION

CCTV inspection and defect coding shall only be completed by operators who have a current NASSCO PACP Certification. A copy of the PACP Certificate for each operator that will be performing CCTV inspections shall be provided to the Engineer prior to start of work. The operator shall be fully trained in all aspects of sewer inspection and capable of making accurate observations and recording of all conditions, which may be encountered in the sewers. Only work completed by PACP certified operators will be accepted.

201.12 CODING ACCURACY

Prior to commencement of CCTV inspections, the Contractor shall develop and implement a formal coding accuracy verification system. Coding accuracy will be a function of the number of defects or construction features not recorded or omitted and the correctness of the coding

and classification recorded. Coding accuracy will satisfy the following requirements.

- header accuracy – 95%
- detail accuracy – 85%

Verification of coding accuracy shall be completed on a random basis on a minimum of 10% of the inspection reports. A minimum of two accuracy verifications shall be completed for each operator for each week working.

Inspections not satisfying the accuracy requirements shall be re-coded to meet the accuracy requirements and the accuracy of the inspections immediately preceding and following the non-compliant inspection, shall be verified. Repeat the process until the proceeding and subsequent inspections meet the accuracy requirements.

Coding accuracy checks shall be provided with the corresponding video recording.

201.13 EQUIPMENT

Inspection equipment shall consist of inspection unit (vehicle), cameras, lighting, cables, power source, monitor(s), data acquisition system, digital recorder, and other related equipment.

Inspection Unit (Vehicle)
The inspection unit shall consist of a self-contained vehicle with an area for viewing, recording, and controlling the CCTV inspection operations and a separate area for equipment storage. The viewing and control area shall be insulated against noise and extremes in temperature. Proper seating accommodation for two people, in addition to the operator, shall be provided with a clear view of the monitor screen which displays the inspection work as it proceeds.

The equipment must be in good mechanical condition and the inspection unit shall have sufficient spare parts to ensure a minimum of downtime.

The inspection unit shall be equipped with fans and/or blowers necessary to remove any fog that may be present in the sewer during inspection.

The Contractor shall equip the inspection unit and/or crew supervisor with a cellular telephone and provide the telephone numbers to the Engineer.

The Contractor’s personnel shall not smoke within the CCTV unit when the City representative is present.

Camera
The CCTV camera shall be specifically designed and constructed for sewer inspection and shall permit viewing of the entire perimeter of the sewer. The CCTV camera shall be operative in environments with 100% humidity. The CCTV camera shall be a colour, pan, tilt and zoom view type camera physically capable of radial rotation of 360 degrees, lateral

rotation of at least 270 degrees, and of producing a continuous high-resolution picture of not less than 400 lines at the periphery of the picture. The adjustment of focus and iris shall allow optimum picture quality to be achieved and shall be remotely operated.

Lighting
The camera shall be equipped with a self-contained, adjustable, direct light source compatible with the lens angle and dispersed to create even distribution of the light around the pipe perimeter without the loss of contrast, flare out of picture or shadowing. The periphery of the pipe shall have a minimum illumination level of 100 foot-candles over a minimum distance of two (2) meters.

Camera Transporter
The camera shall be transported through the sewer by means of a self-propelled rubber tire or crawler type camera transporter capable of passing over minor amounts of debris and surface imperfections. The transporter shall permit complete inspection of the sewer from the centre of the start manhole to the centre of the finish manhole while maintaining a centreline path. The camera transporter shall be capable of moving forward and reverse at variable speeds. The mounting of the camera shall be adjustable such that the central axis of the camera lens is positioned in the center of the pipe and looking along the longitudinal axis of the pipe during the inspection of the sewer. The camera position tolerance shall be +/- 10% of the vertical dimension of the sewer.

Where conditions do not permit the use of a self-propelled camera transporter, the camera shall be float or skid mounted and towed by winch through the pipeline. The winch cable shall be of steel or an equally non-elastic material and shall be positioned in a manner that will not impede the cameras view of the sewer and ensure the float or skid is stable enough to provide a smooth progress and steady video recording.

Transport equipment and cable shall be capable of inspecting a minimum of 200 metres of sewer from a single access point.

Monitor
The monitor shall be not less than a 21-inch monitor and shall provide a colour picture of sufficient size and clarity and be positioned to be easily viewed by the City representative, and it shall clearly define the details of the interior of the sewer. The picture quality on the monitor shall provide a continuous 400 lines (or greater) resolution video picture.

Digital Video Recorder
Digital video recorders shall be able to continuously capture digital video in colour from the live video source with MPEG-4 format. Minimum recording video resolution shall be 400 lines with a NTSC size of 720 x 480 @29.97 frames per second.

Robotic Cutting Equipment
The robotic cutting (including milling) equipment shall have the following capabilities:

- self-propelled capable of driving in forward and reverse.
- capable of working in sewers with pipe diameters of 200 mm and greater.
- robotic arm capable of swivelling up and down and rotating clockwise and counter-clockwise.

- Colour camera with rotation of 270 degrees (135 degrees up and 135 degrees down)

The equipment shall have both cutting and milling heads for the following tasks:

- Milling of concrete, ceramics, organic substances, and plastics.
- Abrasive cutting of protruding obstacles such as roots, branches, sticks, etc.

201.14 SEWER AND MANHOLE MEASUREMENTS

Measure the vertical distance from the sewer invert to the top of the manhole frame (Start MH and End MH) to the nearest 0.01 of a meter with a steel tape before beginning the CCTV inspection. Pipe diameters shall also be measured for each sewer section.

Measure the distance between the center of the start and end manhole on the ground surface above the sewer to the nearest 0.10 of a meter using a steel tape or other approved methods before beginning the sewer inspection. The center of the manhole will be based on the centre of the manhole cover regardless of the manhole configuration.

Provide a remote reading counter to measure distance the CCTV camera has travelled within the sewer from the center of the start manhole during the sewer inspection. Measurement shall be recorded in metres to the nearest 0.10 of a meter.

The distance measurement by the remote reading counter within the sewer shall be accurate to within 1% of the above ground steel tape measurement between start and end manhole centers.

201.15 CCTV INSPECTION

Unless otherwise specified in the contract documents, each sewer pipe section being inspected shall be sufficiently dry to ensure total viewing of the periphery of the pipe, including the pipe invert and under no circumstances shall the sewer flow height be greater than 10 percent of the height of pipe. Where required, appropriate flow control measures shall be used to accomplish the required viewing of the pipe, as per Section 201.16 of this Specification.

The inspection shall be from the center of the start MH to the center of the end MH. The remote reading counter shall be adjusted so that zero is at the center of the start manhole.

The inspection shall provide a complete vertical view of the inside walls (base to cover) of the start MH and end MH, as well as a clear view of the pipe/MH wall interface of the start MH.

Begin CCTV inspections generally with the upstream sewer in the system and proceed downstream in a consecutive manner. Schedule inspection of downstream sewers to be done after the contributing upstream sewers have been cleaned.

CCTV inspections shall be performed in the direction of the flow and shall be continuous over

the entire length of the sewer section. When it is not possible to complete an entire inspection in one direction, the inspection of the sewer section must be completed from the opposite direction. The Contractor shall clearly document the reason for abandonment of an inspection. When a portion of the sewer section is unable to be CCTV inspected from either direction, the contractor shall immediately notify the Engineer to assess the possibility of undertaking additional steps (ie. flushing, cleaning, reaming, etc.) to complete the inspection.

The sewer section under inspection shall be free of any fog or vapour that obscures the view. Where required, appropriate ventilation equipment such as fans and blowers, or other provisions shall be used to eliminate such fog or vapour.

The inspection speed shall allow proper viewing and analysis of the sewer condition. The maximum camera travel speed shall be 9 meters/minute. The camera shall stop and pan/tilt, as necessary, to provide a clear direct view of each building service, pipe connection, infiltration, obstruction and all other defects for at least 5 seconds.

The camera lens shall be kept clean during the entire CCTV inspection.

The finished video must be clear and correctly illuminated to vividly show the object being video inspected. Unacceptable quality will be cause for rejection.

The Engineer reserves the right to view the television monitor and request digital still photographs of major items of concern, during the CCTV inspection.

201.16 FLOW CONTROL MEASURES

The Contractor shall be responsible to provide for the design, supply, installation, operation, and maintenance of appropriate flow control measures, as necessary to properly conduct the work, as specified.

Where conditions permit, flow control measures may consist solely of plugging or blocking the sewer at the manhole upstream of the sewer section to be cleaned or CCTV inspected. Plugs shall be designed such that it can release any or all of the flow, as necessary.

When adequate flow control cannot be obtained by plugging the sewer, the Contractor shall provide bypass pumping or vacuum trucks to transport the flow from upstream sewers to a downstream or adjacent sewer. The contractor shall be responsible to determine the capacity of the required bypass system.

When possible, CCTV inspections shall be conducted during periods of lower flows to lessen the required flow control measures.
The Contractor shall continuously monitor flow levels in the sewer to ensure that flow control measures do not cause back-ups or flooding of public or private property being serviced by the sewer system. Any damage due to back-ups or flooding of public or private property that is deemed a result of the Contractors operations will be remediated and repaired at the Contractors expense.

201.17 SEWER CLEANING

When specified in the contract documents or as directed by the Engineer, the Contractor shall conduct sewer cleaning operations immediately prior to CCTV inspection, as specified below.

The sewer section shall be cleaned to remove all grease, deposits, debris, roots, and other foreign materials that obscures viewing of the pipe or prevents the camera from traveling the entire length of the pipe. Sewer cleaning shall be by means of high velocity jet water propelled cleaning equipment. When necessary and as directed by the Engineer, other means of sewer cleaning, such as hydraulically propelled or mechanically powered cleaning equipment with use of reamers, cutters, or grinders, and flushed afterwards with a high-pressure water nozzle shall be utilized. Any foreign material remaining after cleaning operations must not reduce the internal diameter of the sewer by more than 25 mm or obscure the view of the pipe or prevent the camera from traveling the entire length of the pipe.

The Contractor shall plan and execute the cleaning operations to prevent damage to the sewer and service connections, and to ensure that any areas of the sewer that are structurally unsound are not further damaged. Precautions shall be taken to ensure that the cleaning operations do not cause flooding of public or private property being serviced by the sewer system. Any damage to the sewer or service connections or flood damage that is deemed to be a result of the Contractors operations shall be repaired at the Contractors expense.

The Contractor shall scour manhole walls and benching before cleaning downstream sewers. Sewers are to be cleaned in the direction of flow. Material from the cleaning operations shall be removed at the downstream manhole of the section being cleaned with vacuum pumping or other acceptable methods. Passing material from manhole section to manhole section shall not be permitted. The Contractor shall also install a screen at the outlet pipe of the downstream manhole to catch any material which may migrate downstream. The Contractor will be responsible for proper off-site disposal of all materials removed from the sewer during cleaning operations. Wastewater shall remain in the sewer system and be allowed to flow downstream during removal of material. Excessive wastewater removed from the sewer system during removal of material shall be discharged back into the sewer of origin and not removed from site. Contractor shall not be compensated for off-site disposal of wastewater, unless otherwise approved by the Engineer.

201.18 PROTRUDING SERVICE CONNECTIONS

When specified in the contract documents or as directed by the Engineer during the CCTV inspection work, service connections that protrude into the sewer section shall be cut or ground back prior to pipe cleaning operations that may damage the connection or to facilitate CCTV inspection of the pipe. The Contractor shall notify the Engineer of any protruding service connections, prior to proceeding with the work. The finish surface of the connection shall be smooth and even with no jagged edges. The extent of the protrusion left in place must not interfere with the cleaning operations and in no case, shall be more than 25 mm from the pipe wall. If an intact and sound service connection is damaged or broken by the Contractor, then the Contractor shall repair the damage at his own expense by using

excavation if necessary. The Contractor shall submit the proposed method of repair and reinstatement of damaged service connections to the Engineer for review and approval, prior to commencement of the work.

201.19 RECORDING RESOLUTION

Provide a minimum of 400 lines of resolution around the periphery of the picture for digital MPEG video playback.

Confirm recording resolution, if requested by the Engineer, by recording a RETMA type resolution chart as follows:

a) Set up camera and accessories for the recording to simulate an actual inspection, for example, video signal routed through the cable reel and video overlay system.
b) Record camera being introduced and reaching its final position for the test.
c) Resolution chart shall fill the monitor screen.
d) Resolution chart shall be illuminated evenly and uniformly without reflection and illumination source shall accurately simulate the lighting used in the sewer inspections.
e) Record test for a minimum of 30 seconds.
f) Identify the camera (make, model and serial number) on the recording.
g) Perform the test at the start of digital recording.

201.20 RECORDS

A digital inspection record shall be maintained during the sewer inspection by the Contractor. This record shall show the exact location of the camera, each pipe connection, building service, and defect. The location shall include the distance away from the reference manhole and the position as referenced to the axis of the pipe and will be clearly displayed and recorded in overlay format. Defects will be coded as per NASSCO PACP standards.

The term defect is hereinafter defined as:

(a) Any sewer pipe joint which displays a gap, separation, offset or displaced gasket.

(b) Any building service which has water entering around the junction of the lateral to the sewer pipe, or a steady flow entering the sewer section through the sewer lateral.

(c) Any building service exhibiting a protrusion into the sewer line section.

(d) Any section of the sewer which is crushed, broken, deformed or displays holes, voids, or cracks.

(e) Any section of the sewer which has active infiltration or shows signs of previous infiltration.

(f) Any variance in the grade of the sewer pipe section, including sags.

(g) Any evidence of grease, gravel, roots, debris, or other foreign materials which may impede sewer flow.

(h) Any other defect as per NASSCO PACP standards.

The CCTV Inspection Report for each section will be submitted by the Contractor in the format as noted in Item 201.21 Standards for CCTV Inspection Reports. In addition to the normal Inspection Report format, where applicable, the Contractor shall submit Inspection reports to the Engineer who in turn will submit with his comments to the City.

All measurements in the video and inspection report shall be metric.

Inspection reports shall include photographs of significant defects. Digital photographs shall have a resolution of at least 640 x 480 pixels.

All photos and video pictures shall be of excellent quality and resolution. They should present a clear picture of the condition of the pipe with a precise and distinct definition of all observations and defects.

201.21 STANDARDS FOR CCTV INSPECTION REPORTS

Within ten (10) working days following completion of a CCTV Inspection on a section of sewer, a final CCTV Inspection Report (PDF format) and the associated CCTV inspection video, shall be submitted by the Contractor to the Engineer.

The Contractor shall provide CCTV inspection videos and reports to the Engineer by way of the Internet. The Contractor shall provide the Engineer with a URL (ie. internet address) that will provide access to the CCTV inspections for viewing and downloading within the specified timeline.

The inspection report and video must be produced utilizing a commercially available and internationally recognized sewer inspection software program. Each report will bear a traceable report and revision number as well as Contractor's name, Project, Location, and Date.

The sewer inspection software must be capable of the following:

1. Digitally record each video to MPEG-4 format and suitable for proper playback on commonly used video file playing software applications.
2. Generating a text overlay on each section with a complete description including continuous distance display, observations, and defect coding throughout each section.
3. Rating deficiencies as per NASSCO PACP coding.
4. Documenting and storing data and video files together.
5. Generating written reports complete with still photographs.

6. Produce scaled drawings indicating position of service laterals, deficiencies, and other observations.
7. Interface with City sewer management software.

Clearly display the following information on the viewing monitor and video recording for a minimum of 10 seconds prior to commencing the inspection:

1. Contract Name and Number
2. Street Name
3. Start Manhole and End Manhole
4. Pipe Type or Use
5. Pipe ID Number
6. Direction of Travel
7. Pipe Material, Shape and Diameter
8. Date and Time
9. Invert depth of Start MH and End MH

Clearly display the following information on the viewing monitor and video recording throughout the inspection:

1. Street Name
2. Start Manhole and End Manhole
3. Automatic update of distance from center of the start manhole
4. Defect coding and observations

201.22 VIDEO FILE NAMING CONVENTION

File names for each digital video file shall be in accordance with the following:

Street Name_Pipe Type and ID_Start MH_End MH_DS or US<inspection direction>_<Letter designating inspection sequence>.MPG

For example: Topsail Road_San5329_MH5328_MH5350_US_A.MPG

Pipe and manhole ID numbers will be provided by the Engineer.
Use “San” for sanitary sewers, “Sto” for storm sewers and “Com” for combined sewers.
Use “A” for the initial inspection of the sewer section. Use “B” and subsequent letters for additional “partial” inspections.

201.23 QUALITY ASSURANCE

Upon submission, inspection reports, digital MPEG video recordings and coding accuracy checks shall be reviewed to ensure compliance with the Contract Documents.

Submittals shall be reviewed by the Engineer and their acceptance confirmed within 10 working days of submission. Only inspections with minimum accuracy for header information of 95% and minimum detail accuracy for defects and features of 85% will be accepted. Non-compliant submissions will be returned for correction. Corrected submissions shall be

returned to the Contract Administrator for review within 5 Working Days.

Operators failing to meet the coding accuracy requirements on two occasions shall not be permitted to code on the remainder of the Contract, unless they successfully re-attain NASSCO qualification.

Re-perform sewer inspections where the Engineer has determined the requirements of this specification have not been satisfied. Correct non-compliant inspection submissions and resubmit the corrected inspections to the Engineer within 5 Working Days. Repeat the process until the inspection submissions are accepted by the Engineer.

202.24 MEASUREMENT FOR PAYMENT

Measurement for payment purposes shall be as follows:

1) CCTV Inspections – centreline distance measured in meters (from center of start MH to center of end MH) of existing sewer pipe inspected. Unit price shall be full compensation for carrying out the specified scope of work, with exception of any separately identified pay items.

2) Flow Control – included in CCTV Inspections.

3) Sewer Cleaning – hourly rate (all inclusive). Rate shall be full compensation for carrying out the specified scope of work. The payment time shall be the duration between when the Contractor arrives on site and when the Contractor it is advised to stop work and leave the site. No payment shall be made for mobilization or demobilization. (Provisional Item).

4) Robotic Cutting - hourly rate (all inclusive). Rate shall be full compensation for carrying out the specified scope of work. The payment time shall be the duration between when the Contractor arrives on site and when the Contractor it is advised to stop work and leave the site. No payment shall be made for mobilization or demobilization. (Provisional Item).

5) Material Disposal – the weight of material in metric tonnes removed from the sewer pipes during cleaning operations and disposed of at an off-site facility approved to accept such materials for disposal and/or treatment. (Provisional Item).

201.25 PAYMENT

Payment for CCTV Inspection of new storm and sanitary sewer systems shall be included in the bid price for new storm and sanitary sewer systems.

CCTV Inspection of existing sewer systems shall be paid for under this item.

Pre inspection and post inspections of the same sewer shall be considered two separate sewers for payment purposes. There will be no additional payment for re-inspecting a sewer

after rectification of deficiencies noted in a post construction inspection, if these deficiencies were the fault of the Contractor.

Payment shall be on a unit price or hourly rate basis, as per the pay items identified in the Tender Form. The bid price shall include all labor, equipment, and materials necessary to complete the work in accordance with this specification.

Any cost associated with the required flow control measures shall be included in the Unit Price for CCTV Inspections. No additional payment will be made for flow control measures.

Payment will not be made until the required CCTV inspection report submissions are deemed acceptable by the Engineer.

Where in the Engineer’s opinion, the CCTV inspection report is not in accordance with the Contract requirements, the Contractor shall re-perform the inspection at no additional cost to the City.

ITEM 211

TRENCH EXCAVATION

211.01 SCOPE OF WORK

This item shall cover all excavation other than excavation classified as street excavation or excavation for structures. Also included are the bedding, backfilling, care and protection of existing pipes and structures and the removal of all surplus material remaining after the completion of the work, as directed by the Engineer.

211.02 CLASSIFICATION

There shall be only three (3) classes of excavation:

(a) Solid Rock (SR) which shall be solid beds or masses of igneous, sedimentary, or metamorphic rock which, prior to its removal was integral with its parent mass, and cannot normally be excavated without blasting or pneumatic hammer, and boulders or rock fragments having individual volume in excess of $0.5m^3$ determined from three (3) mutually perpendicular dimensions.

(b) Other Material (OM) which shall be all excavated material not classified as solid rock or unsuitable material.

(c) Unsuitable Material (USM) shall be excavated material not suitable for re-use as trench backfill.

211.03 DIMENSIONS AND DEPTH OF TRENCHES

All pipes shall be laid to the depth shown on the plans, except as otherwise instructed by the Engineer. Trenches shall be excavated to the dimensions specified and the grades given by the Engineer and only as far in advance of the pipe laying as specified, to a maximum of 15 metres. Trench backfilling operations shall lag no more than 6 metres from pipe installation.

211.04 PREPARATION OF TRENCH AND PIPE FOUNDATION

The foundation in the trench shall be formed to prevent any subsequent settlement.

Pipes should be carefully protected from all blasts. All excavation requiring blasting shall be completed at least 10m in advance of the laying of the pipe.

211.05 SHEATHING AND BRACING

The sides of the trenches shall be supported by suitable sheathing and bracing in accordance with agencies having jurisdiction and this contract. All sheathing shall be removed before backfilling unless otherwise specified by the Engineer. The cost of sheathing and bracing shall be covered in the price for trench excavation.

211.06 EXCAVATION BELOW GRADE

Where the ground does not afford a satisfactory foundation, the Contractor shall excavate to such increased depth as is necessary. The trench shall be backfilled with approved material. Payment for extra excavation and backfill below grade will be measured and paid as per theoretical limits for trench excavation.

211.07 BLASTING

Refer to item 139 entitled “Use of Explosives”.

211.08 UNWATERING

Perform all work in dry conditions. Control water as per the Item 135 “Excavations and Embankments” and Item 180 “Unwatering”, water shall be kept out of new and existing sanitary and water lines and electrical conduit.

211.09 BACKFILLING

Material for Bedding:

The bedding material shall be compacted beneath and around the pipe to the undisturbed trench walls and have a compacted thickness of not less than 300mm over the top of the pipe, unless otherwise indicated on the drawings.

Bedding material for watermains, forcemains, sanitary and storm sewers and services shall be material conforming to the gradation of Granular “B” found in the Item 323 "Gravel for Streets". 40mm minus crushed stone is acceptable.

Bedding material for electrical conduit shall be sand having no particle size greater than 5mm.

If imported bedding material is required, the Contractor shall supply this material. Separate payment shall be made as designated under the Schedule of Prices for Trench Excavation.

Material for Backfilling:

The remainder of the trench shall be backfilled with excavated material approved by the

Engineer containing no stone larger than 150mm. The material shall be placed in layers not exceeding 300mm in thickness and adequately compacted. Backfill material shall be of a composition that provides insulation qualities. If material of sufficient quality and quantity is not available on site, the Contractor shall import same. Any imported material required for backfilling must conform to the Item 322 “Borrow”.

All excavated trench material intended for use as backfill shall be protected by the contractor, so the moisture content is maintained within the range that allows its reuse. If the contractor does not make the necessary efforts to protect the fill, then the volume of the unprotected fill that was deemed unsuitable for reuse as backfill will be deducted from the final borrow quantity for payment. Service line trenches shall not be backfilled with all blasted rock. The trench backfill must contain a 1m deep layer of OM or be backfilled with a 50/50 mixture of blasted rock and OM.

Geogrid as per Item 360 – “Geogrid” is required for stand-alone trenches/excavations greater than one (1) meter deep and shall be placed as per Drawing No. 10-211-05. Examples include private service connections to the water or sewer mains in the street, water or sewer main repairs and other localized excavations. Geogrid may not be required for larger trenching projects at the Engineer’s discretion.

Drainage Blanket:

A drainage blanket 300mm thick or as detailed in the contract drawings and made of Granular “B” road gravel shall be placed against headwalls for the full height and width of the excavation. Payment for this drainage blanket shall be included in the unit price bid for headwalls.

Compaction:

Backfill shall be compacted to a density of at least 95% of Standard Proctor density and as per Drawing No. 10-211-05.

Moisture Content:

The moisture content of the backfill material shall be within the range of plus or minus three percent (3%) of Proctor Optimum Moisture Content.

211.10 INSPECTION

Pipes or structures shall not be backfilled until inspected.

211.11 MARKER TAPE

All trenches shall have placed approximately 1m above the pipe 150mm wide heavy gauge polyethylene marking tape indicating the service buried. Costs of supplying and installing marking tape will be included with the Unit Price Bid for Trench Excavation.

211.12 CLEAN UP

Any surplus and/or unsuitable material not needed for inclusion in the work shall become the property of the Contractor and be removed from the site at the Contractor expense.

211.13 BASIS OF MEASUREMENT

The unit of measurement shall be the cubic metre (m^3) as determined by the following:

The volume of excavated material shall be computed from measurements of the length, width, and depth of the completed excavation, in accordance with the following:

1. Trench length shall be measured for:

   (a) Sanitary, storm and water mains - from the centre of the manholes, catch basin, bends, tees or other fittings installed.

   (b) House services - from the centerline of the connecting mains to the point of termination denoted by the Engineer.

   (c) Underground conduit - the length approved by the Engineer.

2. Trench width shall be either:

   (a) Water, sanitary & storm services and underground conduit - 1000mm.

   (b) Single-pipe trenches - the greater of 1000mm or the outside diameter of the pipe plus 600mm.

   (c) Double-pipe trenches - the sum of outside diameters of the two pipes plus 1050mm.

3. Trench depth shall be the distance between the ground surface and either:

   (a) 150mm below the invert of the pipe.

   (b) The bottom of the completed trench if over-excavation is necessary for the replacement of unsuitable material below the pipe.

When grubbing is required ground surface for measurement of trench depth shall be deemed to be 150mm below original grade (ie. depth of grubbing). Grubbing will be paid under Item 311 Clearing and Grubbing.

When street excavation is required, ground surface for measurement of trench depth shall be deemed to be the new street subgrade elevation. Material excavated above the new

subgrade elevation will be paid under Item 321 Street Excavation.

No additional excavation will be paid for at manhole locations, unless the excavation is for a manhole to be constructed over an existing sewer line, or if solid rock is encountered. Measurement shall be based on a line 600mm outside the wall of the manhole and a depth measured from 300mm below the invert of the existing pipe to the top of ground or top of rock whichever is applicable.

Excavation for catch basins shall be based on a standard of $19m^3$ per single catch basin and $25m^3$ per double catch basin. If rock is encountered, excavation for rock shall be paid at the unit price for solid rock based on a line 600mm outside the wall of the catch basin and a depth measured from the average top of rock to 200mm below the bottom of the catch basin. Where rock is encountered in catch basins, the OM quantities to be measured shall be $19m^3$ minus SR for single catch basins and $25m^3$ minus SR for double catch basins.

Excavation for traffic pole bases and traffic controller bases will be based on the following: length = base length + 1200mm, width = base width + 1200mm, depth = distance from top of ground to bottom of base.

There will be no additional payment at junction box and headwall locations, unless the excavation is in solid rock, in which case, measurement for rock will be as applicable to catch basins in rock excavation.

Removal of asphalt and concrete shall be paid under Item 321 “Street Excavation”.

Imported bedding material shall be measured in cubic metres based on length of pipe requiring bedding, theoretical width of trench and theoretical depth as indicated on the plans or called for in this specification, less the volume of pipe.

Borrow used for trench backfill shall be measured as Trench Borrow in cubic metres (m^3) based on length of trench requiring borrow and theoretical width as detailed in this specification and the average depth of trench requiring backfill, or if no trench borrow item is provided, borrow shall be paid for under Item 322 “Borrow”.

Any additional excavation, as for bell recesses, side wall sloping, extra working space etc. shall not be included in measurements for payment purposes.

211.14 PAYMENT

Payment shall be made at the respective unit prices bid for each cubic metre of material excavated or supplied in each of the stipulated classifications. The unit price bid shall include full compensation for all labour, equipment, materials and supplies necessary to excavate, backfill and perform all work in accordance with these specifications.

ITEM 221

SANITARY SEWER

221.01 SCOPE OF WORK

The Contractor shall supply, transport, lay, joint, test and inspect sanitary sewer pipe as shown on the plans and do all other work necessary to make a proper connection to the existing sewer system in accordance with the following specifications.

221.02 PIPE AND FITTINGS

General

Diameter, material, strength, class and dimensional ratio of pipe and fittings: as indicated.

Polyvinyl Chloride Pipe (PVC)

Smooth wall polyvinyl pipe and fittings to ASTM D3034 and ASTM F679. Plastic pipe and fittings: certified to CSA B182.1 for 100/125/150 mm sizes, CSA B182.2 for 200 mm to 675 mm sizes. DR 35 for mains and DR 28 for service pipe, unless otherwise indicated on the contract drawings, with locked-in gasket and integral bell system.

Joints shall conform to CSA B182.1 or ASTM D3212. Rubber gaskets shall conform to ASTM D3212.

Profile wall polyvinyl chloride pipe - pipe and fittings shall be certified to CSA B182.4 and ASTM F794. Pipe stiffness to be 320 kPa. This pipe not to be used for diameters less than 300mm.

Profile Polypropylene Pipe (PP)

Polypropylene pipe and fittings shall be certified to CSA B182.13 for 300-1500 mm. Minimum pipe stiffness to be 320 kPa.

Pipe shall be joined with a gasketed integral bell and spigot joint, and the spigot shall have two gaskets meeting the requirements of ASTM F477.

Concrete

Pipe and Fittings

Non-reinforced circular concrete pipe and fittings: to CSA A257.1, designed for flexible rubber gasket joints, mortar joints to CSA A257.3.

Reinforced circular concrete pipe and fittings: to CSA 257.2, designed for flexible rubber gasket joints, mortar joints to CSA A257.3 and to ASTM C655M.

Concrete Pressure Pipe

Pipe and Fittings

Prestressed concrete pressure pipe, steel cylinder type, lined-cylinder type to A.W.W.A. C301(L).
Prestressed concrete pressure pipe, steel cylinder type, embedded-cylinder type to A.W.A.A. C301(E).
Reinforced concrete pressure pipe, non-cylinder type to A.W.W.A. C302.
Reinforced concrete pressure pipe, steel cylinder type, pre-tensioned to A.W.W.A. C303.
Joints to be sealed with non-shrink grout.

221.03 PIPE LAYING

Where a Contractor is required to install sanitary sewer mains beginning at an existing manhole or section of existing main, the Contractor shall install a temporary 6mm mesh screen over the outlet pipe of the first downstream, existing manhole to prevent silt and gravel from entering the existing system from the new work. If this location is not appropriate, the Engineer may choose a more suitable location.

All sewers shall be constructed in an open trench and laid to the lines and grades as set by the Engineer. The pipe shall be well bedded on a solid foundation along the full length of each pipe. The bottom of the trench shall be recessed at bells such that the barrel of the pipe shall be completely supported over its entire length on a solid foundation. In order to ensure adequate lateral and vertical stability of the pipe during jointing and embedding operations, a sufficient amount of bedding material to hold the pipe in rigid alignment shall be uniformly deposited, and thoroughly compacted on each side and back of the bell of each pipe.

Alignment and grade of the pipe shall be established by the Contractor using appropriate laser technology. Horizontal alignment tolerance for pipe shall be +/- 75mm.

The trench shall be kept dry and no pipe shall be laid in water or upon a wet, muddy or frozen bed. All pipes must be thoroughly cleaned and protected from dirt and no water shall be allowed to flow in any pipe during construction.

221.04 PIPE ASSEMBLY

Pipe shall be assembled in accordance with the manufacturer's instructions. All pipes shall be unloaded and handled with reasonable care. Pipe bells shall be laid on the upstream end. Sewer laying shall commence at the lowest elevation and shall terminate only at manholes, service branches or clean outs. Where a sewer ends in a stub end outside of a manhole for purposes of a future extension, the pipe shall end in a bell and plug.

221.05 CLEANING AND TEST FOR WATER TIGHTNESS OF SYSTEM

The pipes are to be flushed and cleaned prior to testing. Testing must be carried out in the presence of the Engineer. The Contractor must furnish all water, labour and appurtenances required for testing.

Infiltration or exfiltration testing will be carried out as the work progresses, before any flows enter the system, after all house services have been installed and after backfilling in the case of an infiltration test. The Engineer will decide whether the infiltration or exfiltration test will be done for each section. Each manhole to manhole section shall be tested separately unless otherwise approved by the Engineer.

Infiltration Test

Infiltration testing is an acceptable method of test only when the ground water level is above the top of the pipe throughout the length being tested. The allowable infiltration for any portion of sewer shall be measured by weir or current metre placed in the appropriate manhole and shall not exceed 4.6 litres per millimetre of internal pipe diameter per kilometre per day, including manholes.

Isolate the section of sewer to be tested at its upper limits by temporarily plugging the outlet of the upstream manhole. Construct a temporary dyke in the inlet pipe of the downstream manhole. Do not start until steady state conditions have been established to the satisfaction of the Engineer.

Exfiltration Test

Exfiltration testing is an acceptable method of test only where the ground water level is low enough to allow the test pressure to exceed the hydrostatic pressure created by the ground water. The allowable water exfiltration for any length of sewer pipe between manholes shall not exceed 4.6 litres per millimetre of internal pipe diameter per kilometre per day. During exfiltration testing the maximum internal pipe pressure at the lowest end shall not exceed 7.6m head of water or 74.5kPa and the water level inside the upstream manhole shall be 1.0m higher than the top of the pipe or 1.5m higher than ground water level, whichever is greater.

The pipe may be filled not higher than the above level, up to twenty-four (24) hours prior to time of testing, to permit the normal absorption into the pipe walls to take place.

Test by letting the water stand in a standpipe for one (1) hour and observing the drop in level at the end of the period. The drop in water level in the manholes at the end of the test will be a measure of leakage from the sewer.

Repeat Testing

If the Engineer has any reason for suspecting that any portion of the sewer has been damaged during the backfilling, or by any other cause, and that the portion of sewer would

no longer comply with the requirements of the test, then he may order the Contractor to carry out a second test. Should the length of sewer prove defective, the Contractor shall repair or make good the defects, or relay the length of sewer. No extra payment will be allowed for carrying out any such second test even though the length of sewer proves to be satisfactory.

TABLE 1
Permissible Infiltration & Exfiltration Leakages for 3-hour test

Pipe Diameter (mm)	Infiltration (l/m of pipe)	Exfiltration (l/m of pipe)
100	0.058	0.058
150	0.086	0.086
200	0.115	0.115
250	0.144	0.144
300	0.173	0.173

221.06 CCTV INSPECTION

A CCTV inspection shall be carried out on all sections of the sewer, in accordance with Item 201 Closed Circuit Television (CCTV) Inspection.

221.07 DEFLECTION TEST

All flexible thermoplastic pipe installed shall be tested for deflection. Deflection testing shall be carried out to confirm that installed pipe meets the requirements for short-term and long-term deflection limits. Deflection tests shall not be carried out sooner than thirty (30) days after installation and backfilling completion to assess deflection. The maximum allowable deflection is 5% of the pipes Base Inside Diameter. The equipment used will be as recommended by the manufacturer and may include a rigid “go-no-go” device or a laser profiling device.

Any section of pipe that exceeds the maximum allowable deflection of 5% shall be considered to have failed the deflection test. All sections of pipe that fail the deflection test shall be repaired/replaced and retested.

Laser Profiling Device
The use of a laser profiling device will require prior approval by the Engineer. Specifications for the proposed system shall be submitted for review, including details on the inspection methodology, final output format, sample test report, and software requirements.

A deflection test report shall be provided for each sewer section. The report shall be presented in a continuous graph format and identify vertical and horizontal diameters and % deflection/ovality vs. distance along the pipe length. The graph shall include access point numbers and be generated automatically by the laser profiler software package.

Contractors performing laser profile testing shall employ staff who are suitably qualified and experienced with the equipment and methods required to obtain a quality test. Laser profile equipment shall be calibrated in accordance with the manufacturer's recommendations, and evidence of satisfactory calibration shall be confirmed by the Engineer, prior to City acceptance of the laser profile results.

At the sole discretion of the Engineer, any suspect sections of pipe, or sections where the laser profile results are inconclusive, or section that exceed the maximum allowable deflection shall be tested with a “go-no-go” device. The “go-no-go” device test results shall be accepted as the definitive test.

Go-No-Go Device

If using a “go-no-go” device, all pipe up to and including 900mm diameter shall be inspected with a mandrel device as described herein and as per Drawing No. 10-221-01. Pipe larger than 900mm diameter shall be inspected with a suitable proving device to confirm that vertical deflection does not exceed the maximum allowable deflection limit of 5%.

The mandrel or proving device shall be pulled through the pipe in such a manner to ensure that excessive force is not used to advance the device through any deflection portion of the pipe.

The mandrel shall be cylindrical in shape, constructed with nine (9) evenly spaced arms and shall generally conform to the following:

The minimum diameter of the circle scribed around the outside of the mandrel arms shall be equal to the values required for each specific pipe material, within a tolerance of +/- 0.25 millimetres. The contact length of the mandrel shall be measured between the points of contact on the mandrel arm. The outside radius of the mandrel arms shall be checked for conformance with these specifications with a proving ring.

An oversized proving ring may be used, which shall be manufactured to a diameter equal to the outside diameter of the mandrel plus 1 millimetre, to facilitate undertaking measurements to confirm the size of the mandrel conforms to the dimensions and dimensional tolerances specified. The proving ring shall be manufactured to within 0.25 millimetres of the specified size. The proving ring shall be fabricated from 6mm minimum thick steel.

As an alternative, a “go-no-go” proving ring device shall be permitted in which case the proving ring shall be sized up to 0.30 millimetres less than the circle that would be scribed by the specified mandrel size. If a “go-no-go” proving ring is utilized, an acceptable mandrel will not be able to pass through the proving ring. “Go-no-go” proving rings shall not be less than 0.1mm of the specified dimension.

Mandrel dimensions shall be calculated as follows:

Mandrel O.D. = 0.95 x Base I.D.

Base Inside Diameter (I.D.) is defined in the CSA or ASTM standard to which the pipe is manufactured.

221.08 MEASUREMENT FOR PAYMENT

Pipe - shall be the centreline distance in metres from beginning to end including pipe running through manholes, or in the case of branch lines from the centre of the intersecting manhole to the end of pipe laying, for each pipe size and class described in the Schedule of Quantities and Prices.

Connection to Existing Sewer - shall be for each pipe connection made to an existing sewer.

221.09 PAYMENT

Payment shall be on a unit price basis for pipe, supplied, transported, laid, jointed, tested, inspected and connected to existing sewer systems. The bid price shall include all labour, equipment and materials necessary to complete the work in accordance with this specification.
The Contractor will only be paid to a maximum of ninety percent (90%) of the value of this item until such time as the section of work has passed all tests. This ten percent (10%) will be called the "Sanitary Test Allowance". In addition, the 10% mechanics lien holdback shall apply.

ITEM 222

STORM SEWER

222.01 SCOPE OF WORK

The Contractor shall supply, transport, lay, joint and inspect storm sewer pipe as shown on the plans and do all other work necessary to make a proper connection to the existing sewer system in accordance with the following specifications.

222.02 PIPE & FITTINGS

General

Diameter, material, strength class and dimensional ratio of pipe and fittings: as indicated.

Polyvinyl Chloride Pipe (PVC)

DR 35 Pipe - shall be certified to CSA B182.2 for 200mm to 675mm sizes. Joints shall conform to CSA B182.1 or ASTM D3212. Rubber gaskets shall conform to ASTM D3212.

Profile wall polyvinyl chloride pipe - pipe and fittings shall be certified to CSA B182.4 and ASTM F794. Pipe stiffness to be 320 kPa. This pipe not to be used for diameters less than 300mm or for catch basin leads.

Profile Polypropylene Pipe (PP)

Polypropylene pipe and fittings shall be certified to CSA B182.13 for 300-1500 mm. Minimum pipe stiffness to be 320 kPa.

Pipe shall be joined with a gasketed integral bell and spigot joint, and the spigot shall have two gaskets meeting the requirements of ASTM F477.

Corrugated HDPE

High Density Polyethylene (HDPE) pipe shall be certified to B182.8 Type 3 (Soil Tight) complete with bell and spigot and have a pipe stiffness of 320 kPa. Dual wall pipe shall have a smooth interior wall. This pipe is not to be used for diameters less than 300mm or for catch basin leads.

Concrete

Non-reinforced circular concrete pipe and fittings: certified to CSA A257.1, designed for flexible rubber gasket joints, mortar joints to CSA A257.3.

Reinforced circular concrete pipe and fittings: certified to CSA A257.2, designed for flexible rubber gasket joints, mortar joints to CSA A257.3 and to ASTM C655M.

222.03 PIPE LAYING

Where a Contractor is required to install storm sewer mains beginning at an existing manhole or section of existing main, the Contractor shall install a temporary 6mm mesh screen over the outlet pipe of the first downstream existing manhole to prevent silt and gravel from entering the existing system from the new work. If this location is not appropriate, the Engineer may choose a suitable location.

All sewers shall be constructed in an open trench and laid to the lines and grades as set by the Engineer. The pipe shall be well bedded on a solid foundation along the full length of each pipe. The bottom of the trench shall be recessed at bells such that the barrel of the pipe shall be completely supported over its entire length on a solid foundation.

In order to ensure adequate lateral and vertical stability of the pipe during jointing and embedding operations, a sufficient amount of bedding material to hold the pipe in rigid alignment shall be uniformly deposited, and thoroughly compacted on each side and back of the bell of each pipe.

Alignment and grade of the pipe shall be established by the Contractor using appropriate laser technology. Horizontal alignment tolerance for pipe shall be +/- 75 mm.

The trench shall be kept dry and no pipe shall be laid in water or upon a wet, muddy or frozen bed. All pipes must be thoroughly cleaned and protected from dirt and no water shall be allowed to flow through any pipe during construction, except as allowed for under the item "Excavations and Embankments".

222.04 PIPE ASSEMBLY

Pipe shall be assembled in accordance with the manufacturer's instructions. All pipes shall be unloaded and handled with reasonable care. Pipe bells shall be laid on the upstream end. Sewer laying shall commence at the lowest elevation and shall terminate only at manholes, service branches or clean outs. Where a sewer ends in a stub end outside of a manhole for purposes of a future extension, the pipe shall end in a bell and plug.

222.05 CLEANING

The storm sewers are to be flushed and cleaned of any debris and building material prior to the television inspection.

222.06 CATCH BASIN LEADS

Catch basin leads greater than six (6) meters in length will require a CCTV inspection and deflection test unless otherwise stated in the Contract Documents.

No formal grading plan will be provided for catch basin leads, but in no case will catch basin leads be permitted to be installed at a grade less than two percent (2%). Single catch basin

leads, and double catch basin leads shall have a minimum diameter of 300 mm.

Manhole drop requirements applicable to storm sewer mains do not apply to catch basin leads. Catch basin leads may enter the manhole at any convenient height above the invert of the outlet pipe.

222.07 CCTV INSPECTION

A CCTV inspection shall be carried out on all sections of the sewer in accordance with the Item 201 "Closed Circuit Television (CCTV) Inspection".

222.08 DEFLECTION TEST

All flexible thermoplastic pipe installed shall be tested for deflection as per Item 221.07 “Deflection Test”. Deflection testing will not be required on sewer sections (manhole to manhole) where Insert-a-Tee’s are used.

222.09 MEASUREMENT FOR PAYMENT

Pipe - shall be the centerline distance in metres from beginning to end including pipe running through manholes, or in the case of branch lines from the center of the intersecting manhole to the end of pipe laying, or the outside wall of the catch basin or headwall, for each pipe size and class described in the Schedule of Quantities and Prices.

Connection to Existing Sewers, catch basins, headwalls and pipe shall be for each pipe connection made. Connection to new sewer, catch basins, headwalls and pipe shall be included in the price bid for each unit of pipe supplied and installed.

222.10 PAYMENT

Payment shall be on a unit price basis for pipe, supplied, transported, laid, jointed, tested, inspected and connected to new and existing manholes, catch basins, headwalls and pipe. The bid price shall include all labour, equipment and materials necessary to complete the work in accordance with this specification.

The Contractor will only be paid to a maximum of ninety (90%) of the value of this item until such time as the section of work has passed all tests. This ten (10%) will be called the "Storm Test Allowance". In addition, the ten (10%) mechanics lien holdback shall apply.

ITEM 223

MANHOLES, CATCH BASINS, DITCH INLETS, HEADWALLS & CHAMBERS

223.01 SCOPE OF WORK

The Contractor shall construct manholes, catch basins, ditch inlets, headwalls and chambers. Location of structures shall be as shown on the drawings and/or as directed by the Engineer.

223.02 FORM AND DIMENSIONS

The form and dimensions of the items shall conform to contract drawings or, if not shown, the standard drawings.

223.03 PRECAST CONCRETE UNITS

Precast concrete units shall be manufactured and installed in accordance with the latest version of CSA A23.1 and CSA A257.4, and the standard drawings.

Where the precast plant is not CSA certified to manufacture precast units, third party verification by a professional engineer is required to ensure units are designed and manufactured to applicable standards.

Joints between precast sections shall be fitted with a flexible watertight rubber gasket in accordance with CSA A257.3 and the standard drawings.

All pipe openings shall be pre-formed or pre-drilled at the factory or on site with the proper drilling equipment.

Connection of Pipe to Manholes and Catch Basins

Sanitary sewer pipes shall have a watertight connection to manholes with a flexible rubber resilient connector meeting the installation and performance requirements of ASTM C923. The rubber connector can be cast-in-place during manufacture of the pre-cast concrete structure or installed into a cored or preformed hole in the finished structure. The opening in the concrete structure shall be appropriately sized for the pipe OD and rubber connector. After installation of the pipe and rubber connector, the pipe shall also be grouted in place from inside of the structure.

Storm sewer pipes shall have a watertight connection to manholes and catch basins. The pipe shall be grouted in place from inside and outside of the structure. The pipe shall be centred within the opening in the concrete structure before application of grout. The opening shall be 50mm (max.) greater than the OD of the pipe.

Grout shall completely fill the hole (void between the pipe and structure wall) around the entire outside of the pipe. Pipe connections set in benching shall also to be grouted to provide a smooth transition from pipe to manhole. Grout shall be a cementitious, non-shrinkable type, with freeze/thaw resistance and suitable for use in underground sewer systems. Mixing and application of grout shall be in accordance with manufacture recommendations.

When necessary to connect pipe to an existing structure in the field, the required hole shall be cored drilled through the structure wall using appropriate equipment.

Where the specified rubber connector and/or grouting is deemed to be not appropriate for a specific situation, provide details of an alternate watertight connection to the Engineer for approval.

223.04 FORMWORK

All formwork shall be approved by the Engineer and shall comply with CSA A23.1 - Section 11. The forms shall be erected, jointed and finished to secure uniform concrete surfaces.

Forms shall be thoroughly oiled before concrete is deposited. All mortar and dirt shall be removed from forms that have been previously used.

All form tying devices left in the concrete shall not be less than 25mm from the exposed surface.

Fittings and pipe to be built-in shall be installed at the time of pouring of the concrete structure. Boxing-out will not be permitted, unless approved by the Engineer.

The Contractor shall ensure that concrete is not damaged during and after the removal of formwork.

Formwork shall remain in place until the concrete has reached seventy (70%) of its design strength, or longer, if directed by the Engineer.

223.05 CONCRETE

General

Concrete shall conform to Item 404 “Concrete Structures”.

223.06 REINFORCEMENT

Reinforcement shall conform to Item 405 “Concrete Reinforcement”.

223.07 TRASH RACKS

Trash racks are required on all inlet headwalls unless otherwise noted. The size and shape of the trash rack shall be as shown on the standard drawings, or as modified by the Engineer. Final design of each trash rack shall be approved by the Engineer prior to fabrication.

223.08 ACCESS COVERS AND GRATINGS

Access covers or gratings shall be as shown in the standard contract drawings and shall be supplied and set to the finished grade. In asphalt streets, parking lots, etc., manhole frames shall be self-levelling and adjustable.

Adjustable manhole frames and covers shall consist of a resilient seat ductile iron upper section with a conical cast iron guide frame. Approved products are Model MC401010193 as manufactured by EJ and Model C-51MSR as manufactured by Bibby-Ste-Croix or approved equal. The diameter of the cover shall be 624 mm as per Dwg. 10-223-13A. The adjustable manhole upper section shall conform to ASTM A536 for ductile iron. The adjustable guide frame and cover shall conform to ASTM A48 Class 30 for cast iron.

In subdivision developments and other projects where top course asphalt is not to be placed until the next construction season, manhole covers located in the asphalt surface shall be set at base course grade and adjusted to finished grade during placement of the top lift of asphalt. Catch basins located at the face of curb may be placed at finished grade.

223.09 GROUTING

Where it is necessary to grout around a pipe opening, parge a concrete surface or adjust a frame and cover where there will be less than 40mm between the underside of the frame and the top of the existing concrete, a non-shrink grout is to be used.

223.10 INFILTRATION

No visible signs of infiltration will be permitted in the sanitary sewer manholes even when pipe sections pass infiltration tests. All sanitary manholes shall be inspected after construction and during the maintenance period to ensure water tightness. The Contractor shall be responsible for correcting any leakages detected.

223.11 EXFILTRATION

Each sanitary sewer manhole shall be tested as follows: Plug the inlet and outlet pipes and fill the manhole with water to within 300mm of finished grade and no further. Filling may be done up to 24 hours prior to time of testing to allow for normal water absorption into the manhole.

Test by letting the water stand in the manhole for three (3) hours and observing the drop of water level at the end of the period. The drop in water level at the end of the test will be a measure of leakage from the manhole. "Permissible Exfiltration Leakage" will be at the rate of 1.6ml/h/mm of manhole diameter/m height of test water column.

If permissible leakage is exceeded and subject to the Engineer's approval, correct defects on site in accordance with manufacturer's instructions. **Concrete mortar grouting is not acceptable.** Repeat testing until acceptable. If rejected by the Engineer, the manhole must be replaced at the Contractor's expense.

If the Engineer has any reason for suspecting that the manhole has been damaged during the backfilling of the structure or by any other cause, such that the manhole will no longer comply with the requirements of the test, then he may order the Contractor to carry out a second test, and should the manhole be defective, the Contractor shall repair or make good the defects in accordance with the manufacturer's instructions. **Concrete mortar grouting is not acceptable.** No extra payment will be allowed for carrying out any such second test, even though the manhole proves to be satisfactory.

223.12 SAFETY LANDINGS

Safety landings shall be required in all manholes having a depth of 5m measured from the top of cover to the invert of the outlet pipe.

223.13 MEASUREMENT FOR PAYMENT

Measurement for payment shall be as follows and as further detailed in the Schedule of Prices:

Manholes, Catch Basins, Ditch Inlet - the number of each kind and size/depth of unit supplied and installed.

Headwalls and Chambers - the number of headwalls or chambers supplied and installed or the theoretical volume of concrete, measured in cubic metres rounded to one decimal place, required to construct the unit.

Trash Rack - the number of trash racks of various sizes required. Sizes will be denoted by the inlet pipe size unless otherwise noted.

223.14 PAYMENT

The Contractor shall be paid at the respective unit price bid for each unit installed. The unit prices shall constitute full compensation for all labour, equipment, and materials required to complete the work as specified.

ITEM 224

SEWER FORCEMAIN

224.01 SCOPE OF WORK

The Contractor shall supply, transport, lay, joint, clean and test all forcemain pipe and fittings, in accordance with the specification and do all work necessary to make a proper connection to manholes and sewage pump stations.

224.02 PIPE & FITTINGS

General

Forcemains shall be no smaller than 100mm.

Polyvinyl Chloride Pressure Pipe

Pipe: Rigid PVC shall conform to AWWA C900 and be certified to CSA B137.3 for sizes 100mm to 1500mm. Pipe shall be cast iron pipe equivalent OD's and be DR 18 (pressure class 235 psi). Pipe shall be Factory Mutual, ULC and ULI approved. Pipe shall be delivered to site complete with capped ends.

Molecularly oriented PVC (PVCO) shall conform to AWWA C909 and be certified to CSA B137.3.1 for sizes 100mm to 600mm. Pipe shall be cast iron pipe equivalent OD's and be pressure class 235 psi. Pipe shall be Factory Mutual, ULC and ULI approved. Pipe shall be delivered to site complete with capped ends.

Molded Fittings: shall conform to AWWA C907 and certified to CSA B137.2 for sizes 100mm to 300mm. They should also be UL listed and FM approved.

Fittings greater than 300 mm: We will not accept fabricated fitting for these sizes. Fittings shall be ductile iron.

Lubricant: shall be non-toxic, water soluble and listed by the National Sanitation Foundation.

Pipe Restraints: restraints shall be same as for ductile iron but specifically designed for use on PVC pipe or PVC integral joint restraint.

Colour Coding: Pipe and fittings shall be color coded blue.

Polyethylene Pressure Pipe

In accordance with CSA B137 unless otherwise specified.

Polyethylene to polyethylene joints: to be thermal butt fusion or socket fusion in accordance with the recommendations of the manufacturer.

Polyethylene fittings in accordance with CSA B137 for pipe sizes NPS 4 and less.

Pipe Insulation and Protection

Pipe insulation to be rigid polyethylene foam factory applied, core density 32 to 48 kg/m^3, closed cell content 90% minimum, water absorption p. 024 gm/cm^3 per surface immersed forty-five (45) hours, 2.44 metre head of water, thermal conductivity 0.019 to 0.028 W/M. C, compressive strength 210 to 281 kg/m^2, tensile strength 527.3 kg/m^2, shear 2109 kg/m^2, maximum service temperature 121ºC.

Pipe metal jacket to be 0.889 mm (20ga) stainless steel formed from a continuous strip which is shaped and jointed in a spiral pattern using a pressure grooved, single lock, waterproof seam.

Adjustable steel yoke pipe roll shall be as manufactured by I.T.T. Grinnell Figure 181 size to match outside diameter of insulated pipe systems.

Insulation protection shield shall be as manufactured by I.T.T. Grinnell Figure 167 size to match outside diameter of insulated pipe system.

224.03 PIPE LAYING

Provide a minimum 2.0 metres cover unless otherwise specified.

Maintain grade and alignment of pipes. Align pipes carefully before jointing. Do not exceed maximum joint deflection recommended by pipe manufacturer unless directed in writing by the Engineer. Use special bends where necessary to avoid joint deflection. Support pipe firmly over entire length, except for clearance necessary at couplings.

Keep pipe and pipe joints free from foreign material. Avoid bumping gasket and knocking it out of position, or contaminating with dirt or other foreign material. Gaskets disturbed to be removed, cleaned, lubricated and replaced before joining is attempted. Use gasket lubricant as recommended by manufacturer.

Support pipes by means of hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.

Apply sufficient pressure in making joint to ensure that joint is complete to manufacturer's recommendations.

Apply restraint to force main to ensure that joints when completed are held in place, by tamping fill material under and alongside pipe, or otherwise as approved by the Engineer.

Block pipe as directed when any stoppage of work occurs to prevent creep during down time.

Do not lay pipe on frozen bedding. Insulated above ground high density polyethylene pipe to be installed in accordance with manufacturer's recommendations.

Upon completion of pipe laying and after the Engineer has inspected work in place, surround and cover pipes between joints with approved granular material placed to dimensions indicated or directed.

Leave joints and fittings exposed for hydrostatic testing. If it is necessary to backfill sections of the force main prior to testing, take full responsibility and bear all costs for any additional excavation and backfill to expose pipe, fittings or joints that may be necessary.

Hand place granular material in uniform layers not exceeding 150 mm thick to minimum 300 mm over top of pipe. Dumping material directly on top of pipe is not permitted.

Compact each layer to at least 95% maximum density in accordance with ASTM D698-12, Method D.

When HDPE pipe is used, butt fusion to be carried out by a qualified technician.

224.04 FORCEMAIN MARKING

All new forcemains shall be marked using 3M Ball Marker technology (programmable). Marker balls shall be supplied by the contractor and installed at the following locations:

- Bends
- Tees or Wyes
- Or a maximum spacing of 15m

Marker balls shall be green for wastewater. The balls shall be placed no deeper than 1.5 meters and located directly above the forcemain or fitting.

Prior to the start of the project, the Contractor shall contact the Water & Wastewater Division of Public Works (W & WW) and supply a copy of the construction drawings and a sufficient quantity of marker balls for the project. Upon review the drawings W & WW will program and identify the appropriate markers required for the project.

The Engineer shall ensure that the appropriate marker balls are installed in their assigned location. The Engineer shall also record the ID number and location of each marker ball on the As-Built drawings.

At completion of the project, the City will locate the markers and collect the data.

Marker balls cannot be re-programmed without re-excavation.

224.05 CORROSION PROTECTION

Cathodic Protection

Existing Metallic Forcemains (Maintenance Applications): Sacrificial anodes shall be installed at the following locations:

- At the connection point to the existing metallic forcemain
- all metallic valves
- all metallic pipe
- all metallic fittings (i.e. bends, couplings, etc.)

New Forcemain Installations: Sacrificial anodes shall be installed at the following locations:

- At the connection point between a non-metallic forcemain and the existing metallic forcemain.

Anodes shall be 24-48 Zinc (10.9kg x 1220mm casting) in accordance with ASTM B418.

Anodes shall be installed horizontally, a minimum of 600mm to the side of the forcemain and shall be backfilled with native material.

Anodes shall be installed complete with their cardboard container and enclosed selected backfill.

The anode lead wire shall connect to the forcemain, metallic fitting or valve, as shown on drawing 10-230-07. Sufficient slack shall be left in the wire to prevent any stress on either the anode or the wire-to-pipe connection during backfill and subsequent soil settlement.

Petrolatum Tape System

Existing Metallic Forcemains (Maintenance Applications): Petrolatum tape system not required, as sacrificial anodes are to be installed.

New Forcemain Installations: Petrolatum tape system shall be installed at the following locations:

- all metallic fittings (i.e. bends, couplings, etc.)
- all joint restraints at non-metallic pipe joints
- all joint restraints and flanges at metallic fitting and valves

The petrolatum tape system shall be comprised of a paste, profiling mastic and petrolatum tape, and comply with the latest revision of AWWA C217, NACE RP0375 and CSA Z245.30. The three components shall be of the same manufacture to ensure compatibility and optimal performance. The petrolatum tape system shall provide long-term corrosion protection and be suitable for use with underground sewer forcemain systems.

Sufficient profiling mastic shall be used to fill all voids and provide a smooth surface for petrolatum tape installation at locations with sharp edges and irregular shape (i.e. flanges, restraints, etc.). There shall be no void space between the profiling mastic and petrolatum tape.

Petrolatum tape shall have a minimum 55% overlap to ensure a double thickness of tape at all locations and extend at least 100mm onto the connecting pipe. Smooth the tape surface to ensure a completely sealed system.

The petrolatum tape system shall be installed, including any required cleaning and preparation, in accordance with the manufacturer's instructions. Installers shall be fully trained by the product manufacture or supplier, or by other previously trained and competent installers. Acceptable products include the Denso Petrolatum Tape System (Denso LT Tape, Denso Profiling Mastic and Denso Paste), Longwrap Petrolatum Tape System (Longwrap Petrolatum Tape, Longwrap LD Mastic and Longwrap Petrolatum Paste) or approved equal. The supply and installation of petrolatum tape systems shall be considered incidental to the work and no additional payment will be made.

Epoxy Coating Repairs

Epoxy coated components (i.e. valves, etc.) shall be free of nicks, scratched or other damage to the epoxy coating. Any damage to the epoxy coating shall be repaired as per the manufacture's recommendations prior to installation, and at no additional cost to the City of St. John's.

224.06 THRUST BLOCKS

Place concrete thrust blocks between bends, tees and fittings and undisturbed ground. Keep pipe couplings free of concrete.

Bearing area of thrust blocks to be as indicated or specified by the Engineer.

Do not backfill over concrete within twenty-four (24) hours after placing concrete.

224.07 CLEANING AND TESTING

The pipes are to be flushed and cleaned prior to testing. Testing must be carried out in the presence of the Engineer. The Contractor must furnish all water, labour and appurtenances required for testing.

224.08 FIELD TESTING OF FORCE MAIN

Expel air from force main, by slowly filling main with water. High points to be drilled and tapped and suitable cocks installed to vent air and to be shut when pressure is applied.

Remove cocks after satisfactory completion of test and seal holes with tight fitting plugs.

Apply a hydrostatic test pressure of one hundred and fifty percent (150%) of the normal working pressure based on the elevation of the lowest point in the main and corrected to elevation at the test gauge location or a minimum of 1000 kPa, whichever is greater, for a period of one hour.

Apply pressure for one (1) hour for pressure test and two (2) hours for leakage test.

Examine exposed pipe, joints and fittings while system is under pressure. Remove defective joints, pipe and fittings and replace with new sound material. Make leaking joints watertight.

Test force main in sections not exceeding 300 metres in length, unless otherwise authorized by the Engineer.

Define leakage as amount of water supplied from water storage tank in order to maintain test pressure for two (2) hours. The allowable leakage is 0.0000449 l/h/m/mm nominal pipe diameter for a working pressure of 1000 kPa. For other working pressures, test in accordance with AWWA C600.

ALLOWABLE LEAKAGE TABLE

Pipe Diameter (mm)	Forcemain (l/hr/m)
100	0.00449
150	0.00674

224.09 PIGGING

Appropriately sized poly pigs as manufactured by Gerard, or approved equal, having a minimum density of 2 lb/ft.^{3} and recommended for wiping shall be installed into the main to ensure force mains are swept when the system is first charged.

224.10 MEASUREMENT FOR PAYMENT

Sewage force main will be measured through fittings and chambers after the work is completed. Measurement will be horizontally in metres over the center line of the pipe when the grade of the pipe is less than ten percent (10%) and in metres along the slope length of the pipe when the grade of the pipe is ten percent (10%) or greater, for each size

pipe and depth class supplied and installed.

Force main connection to manholes, including grouting flange and bends, will be included in price bid for sewage force main.

Breaking into and connecting to existing manhole to be measured by the each.

224.11 PAYMENT

Payment shall be on a unit price basis per metres for pipe and fittings supplied, transported, laid, jointed, tested, and connected to manholes and sewage pumping stations. The bid price shall include all labour, equipment and materials necessary to complete the work in accordance with this specification.

The Contractor will only be paid to a maximum of ninety percent (90%) of the value of this item until such time as the section of work has passed all tests. This ten percent (10%) will be called the "Test Allowance". In addition, the ten percent (10%) mechanics lien holdback shall apply.

ITEM 225

SEWER SERVICES

225.01 SCOPE OF WORK

The Contractor shall supply and install 100mm and 150mm diameter sewer service pipe and fittings from the sewer mains to a point 3 metres beyond the future back of sidewalk or as instructed by the Engineer. The work shall be in accordance with these specifications and to the satisfaction of the Engineer. 100 mm diameter service pipe shall be a direct connection to the sewer main whereas 150 mm diameter and greater shall be connected via a manhole.

Sewer services larger than 150mm diameter shall be installed and paid under the applicable Item 221 “Sanitary Sewer” or Item 222 “Storm Sewer” and meet these requirements in all respects.

225.02 LOCATION AND GRADES

Service lines shall be installed having a grade not less than two percent (2%) and shall be installed at the center of the building lot and perpendicular to the mains, unless otherwise directed by the Engineer. The sanitary service shall be located on the left and the storm service located on the right when facing the building. The end of the sanitary lateral shall be painted red. The location of the end of the service shall be marked with a marker post, painted red and extending from the service invert to 600mm above finished grade.

Invert elevations for both the storm and sanitary services and tie-ins of the end of services to the lot boundaries or existing buildings and top of curb elevation at the centre of the lots are to be recorded by the Contractor and presented to the Engineer in tabular form as soon as this work is completed.

225.03 PIPE

Storm and sanitary sewer service pipe and fittings shall be 100mm or 150mm nominal diameter PVC pipe, certified to CAN/CSA B182.2 and conforming to ASTM D3034. Joints shall be integral-bell and spigot type, with solid rubber rings. Joints shall conform to CAN/CSA B182.1 or ASTM D3212. Rubber gaskets shall conform to ASTM D3212.Pipe shall be to SDR 28

Fittings shall be as manufactured by the pipe supplier and be of the same joint configuration as the pipe.

225.04 SEWER CONNECTIONS

The configuration of connections to the sewer mains shall conform to the Drawings and

the following:

Service Connections to Sewer Mains:

Pipe Type		Main Size	Connection Type
PVC	New	≥ 200 mm < 400 mm	In Line Tee
PVC	New	≥ 400 mm	INSERTA TEE
PVC	Existing	≥ 200 mm	INSERTA TEE
Asbestos Cement	Existing	≥ 200 mm	INSERTA TEE
Concrete	New & Existing	≥ 200 mm	INSERTA TEE
Vitrified Clay	Existing	≥ 200 mm	INSERTA TEE
Polypropylene Pipe (PP)	New & Existing	≥ 300 mm	INSERTA TEE
SRPE	New & Existing	All	INSERTA TEE
Corrugated HDPE	New & Existing	≥ 300mm	INSERTA TEE

NOTE: INSERTA TEE as manufactured by INSERTA FITTINGS Company. INSERTA TEE supplied shall be in accordance with INSERTA FITTINGS Company recommendation for size, material and thickness of sewer main.

Service Connections at Manholes (When Approved):

Service lines shall not be connected directly into manholes unless approved by the City. If approved the service must be made using proper drilling equipment. The cored invert opening must be 50mm above the existing benching. The service must be benched to the main channel and the service benching must be lined with PVC pipe. The service must enter the main channel at no greater than a 45° angle with the direction of flow. A smooth transition between the end of the PVC lining and the main channel is required.

225.05 PIPE LAYING AND ASSEMBLY

Pipe laying and assembly shall be in accordance with the sections Pipe Laying and Pipe Assembly found in the item "Sanitary Sewer" or in the item "Storm Sewer". All sewer service pipe shall end in a bell and plug.
Long radius bends or a combination of bends up to a maximum deflection of 45° are permitted. After each 45° bend or combination thereof, a cleanout is required.

When sewer service laterals are:

1. to be constructed to a proposed or existing residential building from existing sewer mains or
2. extended from the termination point at the street line,

The entire length of the service pipes must be inspected and approved by an Engineer or by the Water & Wastewater Division of Public Works prior to backfilling. The Contractor must contact the Water & Wastewater Division at 576-CITY to arrange for an inspection and give twenty-four (24) hours notice of the inspection time. Any portions of the sewer service lateral that are buried without being inspected shall be uncovered for inspection at the Contractor's expense.

225.06 TESTING

No formal tests will be made except in the case of services installed in conjunction with new sanitary sewers, which will be tested in conjunction with the sanitary sewers. However, the Engineer reserves the right to test the services. If at any time the infiltration rate exceeds 1.3ml/h/mm of pipe diameter/m of service, the service shall be repaired to the satisfaction of the Engineer.

225.07 MEASUREMENT FOR PAYMENT

Measurement for payment shall be based on:

(a) The number of service connections made to the sewer mains, including connections to building drains where an existing sewer service previously existed, or as directed by the Engineer.

(b) The length of service measured in metres from the centerline of the sewer main to the end of pipe laying as approved by the Engineer.

225.08 PAYMENT

The Contractor shall be paid at the respective unit price bid for sewer services. The unit price shall include the cost of all labour, equipment and materials necessary to complete the work in accordance with this specification.

ITEM 226

PERFORATED PIPE FOR SUB-DRAINAGE

226.01 SCOPE OF WORK

The Contractor shall supply, transport, lay, joint, excavate and backfill sub-drain system as shown on the plans and in accordance with the following specifications.

226.02 MATERIALS

Sub-Drain Pipe

Perforated polyvinyl chloride pipe, plastic pipe and fittings to be certified to CSA B 182.1, CSA B 182.2 and conform to ASTM D3212. DR 28 for sizes 100 & 150 and DR 35 for sizes 200mm and larger.

Corrugated double walled pipe to be certified to CSA B182.8 and conform to ASTMF667 for storm sewers. Pipe to have a smooth inner wall. Pipes may be bell and spigot style or plain end fastened with a coupling recommended by manufacturer. Pipe stiffness 320 kPa.

Bedding

19 mm diameter washed stone. See detail 10-226-01.

Geo-textile

Geo-textile shall be as specified, or if not, shall be nonwoven polyester P150 as manufactured by Mirafi or approved equal (when called for on the drawings).

226.03 INSTALLATION

Excavation, bedding and backfilling shall be done in accordance with the Item 211 “Trench Excavation”.

Place 100mm layer of bedding material as indicated and compact to minimum 95% standard proctor density.

Lay drains on prepared bed, true to line and grade with inverts smooth and free of sags or high points. Ensure barrel of each pipe is in contact with bed throughout full length.

Commence laying at outlet and proceed in upstream direction. Lay perforated pipes with perforations downward and symmetrical about the vertical axis. Make joints tight in accordance with manufacturer’s instructions. Make watertight connections to existing drains, new or existing manholes and catch basins where indicated. Plug upstream end of drain

with a concrete plug or end cap approved by the pipe manufacturer. Surround and cover drain with bedding material in uniform 150mm layers to an elevation of at least 150mm above top of drain.

Perforated pipe shall be laid with perforations downwards and symmetrical about the vertical axis.

226.04 MEASUREMENT FOR PAYMENT

Pipe - shall be the centre line distance in metres from the beginning to end of pipe laying, for each size of pipe described in the Schedule of Prices.

Geo-textile - shall be the centre line distance in metres from the beginning to the end of pipe laying. Excavation, bedding and backfilling will be paid for separately under the item “Trench Excavation”.

226.05 PAYMENT

Payment shall be on a unit price basis per metre of pipe supplied and installed. The unit price bid shall include all labour equipment and materials necessary to supply and install perforated sub-drain as specified.

ITEM 227

SANITARY SEWAGE LIFT STATION

227.1 SCOPE OF WORK

The work covered by this Section shall consist of furnishing all materials, labour, equipment and services for the installation of a fully functioning sewage lift station. The contractor shall include all labour, materials, equipment, incidentals, and ancillary components to make a complete system. Pumps, pump mechanical accessories, piping, valves, access frames, control panel and pump junction box are to be provided as a package by the pump supplier to ensure compatibility between components.

227.2 GENERAL

All materials and equipment supplied under this Section shall be new and designed by the manufacturer for use in municipal sewage lift station applications with a design life of twenty (20) years, minimum.

All electrical equipment installed in wet wells and/or areas not isolated from wet wells shall be approved for installation in Class I, Zone 1, Group D, hazardous locations in accordance with Section 18 and Section 22-700 to 22-710 of the latest revision of the Canadian Electrical Code, Part I (CSA C22.1).

227.3 WET WELL CHAMBER

The chamber shall be constructed and tested in accordance with Item 223 “Manholes, Catch Basins, Ditch Inlets Headwalls & Chambers.” The chamber shall have concrete benching in accordance with the pump suppliers’ recommendations to prevent sludge and debris settling in the chamber and to minimize the amount of liquid left in the chamber after pump-down. The benching shall have a smooth finish to prevent debris from adhering to the surface. Minimum probe length shall be 1.5 meters.

The chamber shall be tested for infiltration and exfiltration.

227.4 PUMPS

General

Supply two (2) submersible pumps with characteristics as indicated in Table 1 – Pump Technical Data Sheet.

Pumps shall be of a submersible design suitable for continuous operation in municipal sewage lift stations. Pumps shall be capable of handling raw unscreened sewage, storm water, and other similar solids-laden fluids without clogging. The pumps and cable assembly shall be rated for a minimum submergence depth of 20 meters.

The pumps shall be installed in a manner that will allow easy removal from the station without the need for service personnel to enter the well. The pumps shall be supplied with a mating cast iron discharge connection elbow permanently installed in the wet well and connected to

the discharge piping. The pumps shall connect to the discharge connection elbow automatically and firmly, guided by a guide rail constructed of 316 stainless steel schedule forty (40) pipe. Other grades of stainless steel are not acceptable. Systems utilizing guide cable(s) are not acceptable. No portion of the pump shall bear directly on the floor of the sump.

Major pump components shall be of gray cast iron with smooth surfaces devoid of porosity or other irregularities. All exposed nuts and bolts shall be 316 stainless steel. All metal surfaces coming in contact with the pumped media (other than the stainless-steel components) shall be protected by a factory applied coating of zinc phosphate primer with a high solids two part epoxy paint finish coat.

The pump/motor assembly shall incorporate metal to metal contact between machined surfaces. Critical mating surfaces where a watertight seal is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Sealing will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without requiring a specific torque limit. Rectangular cross sectioned gaskets requiring specific torque limits to achieve compression shall not be considered adequate or equal. No secondary sealing compounds shall be required.

Pump Types

Non-clog, solids-handling pumps are the preferred design and must be used for design flows over seven (7) liters per second.

Impellers

.1 The impeller shall be capable of passing a minimum of a 75mm spherical solid and be of gray cast iron construction. The impeller shall be dynamically balanced to prevent undue vibration during operation. The backside of the impeller shall work in conjunction with the motor housing bottom to prevent fouling of the seal by materials in the pumped media which may cause premature seal failure.

.2 The impeller shall have a slip fit onto the motor shaft and be fastened to the shaft by a stainless-steel bolt. The impeller bolt shall be equipped with a suitable locking device to prevent loosening. The impeller shall be prevented from turning on the motor shaft by a key, conical collar, or other suitable locking mechanism.

Impeller Types

.1 Non-clog impellers shall be of either the semi-open, closed or vortex design with preference in that order.

.2 Semi-open impellers shall be equipped with a wear-plate containing a spiral groove on the impeller side to shred and move fibrous materials through the pump to the discharge. Semi-open impellers shall be adjustable to compensate for wear.

.3 Closed design impellers shall be equipped with replaceable wear rings fitted to the pump volute for efficient sealing between the volute and impeller.

Pump Volute

.1 The pump volute shall be of a single piece, gray cast iron, non-concentric design with centerline discharge. Passages shall be smooth and large enough to pass any solids which may enter the impeller. Minimum discharge size shall be as specified in Table 1

– Pump Technical Datasheet.

.2 Grinder pumps are acceptable for design flows under seven (7) liters per second. Grinder pumps shall have a stationary and rotating cutting ring to shred all materials to a fine slurry capable of freely passing through a 50mm pipe. Cutting rings shall be of hardened stainless steel for long life. The impeller shall be a multiple vane centrifugal type. Pump housing and impeller shall be constructed of cast iron.

Seals

Pumps shall be equipped with a tandem mechanical shaft seal system. The seals shall operate in a lubricant reservoir to lubricate the seal faces. Seals shall not be damaged should the pump run dry. The reservoir shall be designed to prevent overfilling and to provide expansion of lubricant. The reservoir shall have an inspection and drain plug easily accessible from the exterior of the pump. The plugs shall have a positive anti-leak seal.

The lower seal serves as the primary seal between the pumped media and the pump internals and shall contain one (1) stationary ring and one (1) rotating ring constructed of silicon-carbide.

The upper seal serves as a backup seal between the pumped media and motor housing and shall contain one stationary ring and one rotating ring constructed of tungsten-carbide.

Each seal interface shall be held in place by its own spring system and shall not be dependent on the impeller to maintain contact between the seal faces. The seals shall not depend on the direction of rotation for proper sealing. The seals shall require neither maintenance nor adjustment. Shaft seals without positively driven rotating members or conventional double mechanical seals containing a common spring shared between the upper and lower units shall not be considered acceptable. Seals requiring set-screws, pins, or other mechanical locking devices to hold the seal in place are not acceptable.

Motors

The motor and motor housing shall be designed for continuous duty, completely submerged or unsubmerged. The motor housing shall be gray cast iron. The motor shall be of the squirrel-cage induction design housed in an air filled, water tight housing. Oil filled motor housings are not acceptable. The stator shall be heat-shrink fitted into the stator housing. The use of bolts, pins or other fastening devices requiring penetration of the stator housing shall not be acceptable.

The rotor bars and short circuit rings shall be made of cast aluminium. The stator windings and stator leads shall be insulated with moisture resistant Class H insulation rated for 180^{o}C. The motor shall be designed for continuous duty operation, handling pumped media with a temperature of up to 40^{o}C and capable of a minimum of ten (10) evenly spaced starts per hour. The motor shall be capable of handling an input voltage variation of ± 10% from nominal.

The pump shaft and motor shaft shall be an integral unit. Each shaft shall be of 420 or 431 stainless steel. Carbon steel or chrome plated shafts shall not be considered adequate. Multi-piece shafts or shaft sleeves shall not be acceptable. Each shaft shall have a polished finish and have accurately machined shoulders to accommodate bearings. The shaft shall be adequately designed to meet the maximum torque required at any normal start-up or operating condition in the system with maximum deflection not to exceed 0.05mm at the lower seal.

The pump shaft shall rotate on permanently lubricated, greased bearings. The upper bearing shall be a deep groove ball bearing. The lower bearings shall be a heavy-duty double row angular contact ball bearing. Bearings shall be of sufficient size and properly spaced to transfer all radial and axial loads to the pump housing and minimize shaft deflection. L-10 bearing life shall be a minimum of 50,000 hours at flows ranging from ½ of BEP flow to 1½ times BEP flow (BEP is best efficiency point).

Motor Protection

The motor shall contain a bi-metallic temperature switch in each phase of the stator windings. These thermal switches shall have normally closed contacts and be connected in series. The thermal switches shall be set to open at 140^{o}C ± 5^{o}C.

Pumps shall be equipped with an early warning system to indicate seal failure. This system shall detect moisture infiltration into the pump through leaking seals before the moisture enters the motor housing damaging the motor windings.

.1 Systems utilizing an oil reservoir shall use a probe to detect water in the oil. Float devices in the motor housing shall not be considered an early warning system.

.2 Pumps utilizing a closed loop cooling system shall have a dry inspection chamber to contain seal leakage. The dry chamber shall be equipped with a device to detect moisture collecting in the dry chamber. The chamber shall have a drain / inspection plug easily accessible from outside of the pump. The plug shall be equipped with a positive anti-leak seal.

Motor protection devices shall be wired to the control panel. Activation of any motor protection device shall shut down the pump and signal an alarm at the control.

Cooling System

The pump shall be designed with adequate cooling such that the pump can operate continuously in an unsubmerged condition without the pump overheating.

Pumps utilizing a cooling jacket with a closed loop cooling system shall employ a circulating impeller driven by the main motor shaft to circulate a glycol solution through the pump. An integrated heat exchanger in the base of the motor shall transfer excess heat from the coolant to the process liquid. Cooling systems utilizing oil within the motor chamber shall not be acceptable.

Power Cables

Power cables shall be sized and selected according to applicable NEC and CSA standards. Cables shall be of sufficient length to reach the control junction box without requiring splices. The outer jacket of the cable shall be of an oil resistant and UV stable material suitable for long-term use in municipal wastewater.

Cable Entry

The cable entry shall not require specific torque requirements to insure a watertight seal. The cable entry shall consist of one (1) or more cylindrical elastromer grommets, each flanked by stainless steel washers. A cable cap incorporating a strain relief shall mount to the cable entry boss creating a compression seal between the grommet, cable and cable entry bore.

Lifting Handle

The pump shall be fitted with a rigid handle of suitable strength to lift up to four (4) times the weight of the pump. The lifting handle shall provide a large open loop so that the handle can be easily hooked from the surface without the need for personnel to enter the wet well.

TABLE 1 - PUMP TECHNICAL DATA SHEET

Project Title: _____ Location: _____	
Pump Type	❑ Non-clog ❑ Grinder ❑ Semi-open impeller ❑ Closed impeller ❑ Vortex
Primary Duty Point	_____l/s @ _____meters
Primary Duty Point Efficiency	_____% minimum
Secondary Duty Point	_____l/s @ _____meters
Secondary Duty Point Efficiency	_____% minimum
Shut-off Head	_____meters minimum
Static Lift	_____meters
Pump discharge size	_____mm
Rotational Speed	_____rpm maximum
Power Rating	_____KW / _____HP
Supply Voltage	3 – phase □ 208 volt □ 230 volt □ 600 volt single – phase □ 230 volt
Cable Length	_____meters
Lifting Chain / Cable Length	_____meters
Internal Piping Size	_____mm
Forcemain Connection Size	_____mm
Valve Size	

227.5 MISCELLANEOUS EQUIPMENT

Access Hatches

The access hatch shall provide sufficient clearance to allow easy insertion and removal of the pump equipment without modification to the pump accessories or shortening of the guide rail. The access hatch shall be manufactured as a complete unit by a manufacturer with minimum of five (5) years experience in design and construction of access hatches. Preference is given to double-door access hatches with no intermediate support impairing access to the wet well. The access hatch shall be provided with a fall through protection system.

The hatch frame shall be fabricated using an aluminium extrusion with an integral anchor flange and door seat. The frame shall be coated with bituminous coating where it will contact concrete. The frame shall be provided with nut rails and sliding nuts to mount the upper guide rail holder of the pump guide rail assembly, level regulator hanger and cable hook.

The hatch doors shall be of aluminium construction and include a lifting handle that does not protrude above the door. The doors shall be held open automatically by stainless steel hold open arms and equipped with hydraulic or spring assisted hinges. The doors shall be supplied with tamper proof stainless steel hinges and recessed padlock staple clip with hinged lid. The doors shall have a load rating of 14.4 kPa and shall be reinforced such that the doors are not dependent on the fall through protection system to maintain their load rating.

The fall through protection system shall be a rigid aluminium grate with a safety orange finish. In its closed position, the grate shall limit access to the wet well while still allowing visible inspection of the station internals. Grate openings shall be a nominal 100mm by 150 mm or 125mm by 125mm. In its open position, the grate shall have mechanism preventing accidental closure of the grating. The grating shall have a load rating capable of supporting a 275 lb operator plus the weight of the pump. The grating shall not support the exterior doors. The grating system shall be provided with a padlock staple for locking independent of the hatch doors.

A confined space warning label shall be attached in a visible location when the door is open.

Locks

The City of St. John's utilizes a Best padlock system. The station shall be provided with sufficient locks to secure the control, junction box and access frame of the station. The station is to be properly secured until it is turned over to the City at which time the City will be responsible for re-keying of the locks.

Piping And Valves

Piping

1. The station shall be equipped with prefabricated piping of schedule forty (40) steel pipe. All internal piping shall be hot-dipped galvanized prior to installation. Spray or brush-on cold galvanizing compounds or coatings are not acceptable. Stainless steel bolts and fasteners will be used to assemble all internal piping and valves. The header pipe shall be equipped with a 100mm clean-out port opposite the forcemain flange to allow for cleaning of the forcemain. The clean-out port shall be covered by a galvanized blind flange. Where the forcemain flange internal to the lift station is not firmly attached to the

forcemain by welding, the header pipe shall be restrained from movement by a minimum of two (2) 50mm galvanized straps from the header pipe anchored securely to the chamber wall. These are to be field fabricated to ensure a secure fit.

Valves

.1 Non-clog ball check valves shall have a throughway size equal to the pump discharge pipe size to ensure full, free-flow. Ballcentric plug valves shall be installed in each pump discharge line between the check valve and header pipe.

Ventilation

The lift station shall be equipped with two (2) vent pipes. Each vent pipe shall be constructed from 100 mm schedule forty (40) hot dipped galvanized steel pipe. The top of the vent pipe shall utilize two (2) 90 degree elbows such that the vent opening will face downwards. The vent opening shall have a steel mesh screen welded over the opening to prevent birds from entering the vent pipe. Where the control panel is to be mounted at the lift station, the vent pipes may be utilized to form a mount for the control panel and junction box.

Where the site layout drawings permit, vent pipes shall be supplied with a mounting plate to be cast in the chamber top. Mounting plates shall be provided with bolts firmly welded in place. Vent pipes shall be easily installed and removed from the mounting plate. Vent pipes cast directly into the chamber top are not acceptable.

Where the vent pipes are used for control mounting, the mounting plate shall incorporate 50mm conduit nipples in quantities as listed in the control specification and drawings.

All vent pipe components and fasteners are to be hot-dipped galvanized.

Lifting Equipment

The lift station shall be provided with lifting equipment for removal of pumps. All equipment shall be of adequate strength to safely remove the pumps from the station and be rated for overhead lifting.

Where material of construction is steel, these units shall be hot-dipped galvanized. All fasteners shall be stainless steel.

Lifting davits shall be portable and supplied with a mating socket for flush-mounting in the chamber cover. Davits shall have sufficient clearance to the top of the chamber for removal of the pump. Davits shall be rotatable and adjustable in length for centering over the pump allowing a vertical lift without imposing excessive horizontal loading on the guide rails.

Pumps shall be supplied with lifting cable or lifting chain of length indicated in Table 1 – Pump Technical Datasheet. Lifting chain shall be hot-dipped galvanized. Lifting cable shall be stainless steel.

The davit shall be equipped with a mechanism to allow lifting of the pump from the chamber:

.1 Pumps with lifting chains shall be supplied with a chain hoist with a load sprocket compatible with the lifting chain.

.2 Pumps with a lifting cable shall be supplied with a winch capable of securely accepting the cable.

Valve Chamber Enclosure

The valve chamber enclosure shall contain and protect piping, valves and associated

controls. Enclosure shall incorporate the following design and service features:

1. Access door must be supplied on two sides. Location and size shall permit access for routine maintenance functions on the valves and control panel.
2. A continuous hinge and latch shall be installed on the access panels. The hinged panels shall allow easy access to the electrical controls and valves. Latch handle locks shall be match keyed, requiring only one key to open all access panels.
3. A vent in one access panel shall allow free air flow for enclosure ventilation.

Station enclosure shall be manufactured of molded reinforced orthophthalic polyester resins with a minimum of 30% fiberglass, and a maximum of 70% resin. Resin fillers or extenders shall not be used.

1. Chopped glass fibers of 32mm average length shall be sprayed and rolled. Major design consideration shall be given to structural stability, corrosion resistance, and watertight integrity. The polyester laminates shall provide a balance of mechanical, chemical, and electrical properties to insure long life. They must be impervious to micro-organisms, mildew, mold, fungus, corrosive liquids, and gases which are expected to be present in the environment surrounding the wet well.
2. All interior surfaces of the housing shall be coated with a polyester resin rich finish providing maintenance free service, abrasion resistance, and protection from sewage, greases, oils, gasoline, and other common chemicals.
3. Outside surfaces of the enclosure shall be coated with gel-coat pigmented resin to insure long maintenance free life and UV protection. Color used shall de-emphasize the presence of dirt, grease, etc.

Station Heater:

1. Pump station shall be provided with a 1300/1500 watt, 115-volt electric heater with cord and grounding plug. Ungrounded heaters shall not be acceptable. Heater shall be rated Class 1, Division 1.

Insulation Package:

1. The enclosure shall have a minimum insulation R12 rating with 38mm thick spray foam insulation, which shall be applied to the roof, doors, and corner panels.

Alarm Light (External):

1. Station manufacturer will supply one 115 VAC alarm light fixture with vapor-tight shatter resistant red globe, conduit box, and mounting base. The design must prevent rain water from collecting in the gasketed area of the fixture, between the base and globe.

Padlock: Four (4) PADLOCKS, Master Lock No. 2081 or approved equal, c/w four (4) master keys to match existing master key.

227.6 PUMP CONTROL PANEL

General

The pump control shall be properly sized to the load requirements of the supplied pumps and

other connected equipment.

The pump manufacturer shall supply a completely assembled control panel based on a PLC/RTU controller complete with graphics touch screen operator interface and remote communications using modbus protocol or option modbus TCP/IP protocol via high-speed internet access.

All parts shall be of the best industrial quality, designed for reliable operation under extreme weather conditions. Electromechanical components shall be limited to a strict minimum. The control shall be built by a CSA approved facility and receive CSA certification prior to leaving the fabrication facility as a complete assembly.

The enclosure shall be 14 gauge, 316L stainless steel construction and shall be weatherproof to NEMA / EEMAC 4X in order to provide reliable outdoor operation. Other grades of stainless steel will not be accepted. The enclosure shall be fitted with a heavy steel inner door to isolate operators from live electrical components yet allowing access to the operator interface. The exterior door shall be hinge-mounted with a 135-degree angle opening to allow easy access to the control interior. The exterior door shall be equipped with a three-point latching mechanism operated by a single handle to provide secure, weatherproof closure. The handle shall be capable of being secured by a padlock. Screw style external locking clamps, individual quarter turn fasteners or padlock staples are not acceptable.

The control panel shall be equipped with a manual transfer / disconnect switch to select between Line Power, Generator Power or Off. This switch shall be interlocked with the inner door to electrically isolate the components of the control panel when the inner door is opened. The panel shall be adequately protected by fusing or circuit breakers at the manual transfer / disconnect switch. This switch shall be rated for the full load of the panel with all equipment operating and shall have lock-out ability for servicing.

Incoming power terminals must be provided to allow for connection of a 200 amp service, minimum. All terminals over 200 volts shall be guarded against accidental contact by a protective cover. Standard of acceptance is Entrelec model CPV.

Each pump circuit shall be protected by a 3-pole current-limiting motor protector and overload relay. Tripping of the motor protector shall open all poles to avoid single-phase operation of three-phase pumps. The overload shall be rotary operated with rotary knob mounted on the inner door. The knob shall indicate ON / OFF / TRIP conditions and allow resetting of the overload without the need to open the inner door. The rotary knob shall have lock-out ability for servicing.

Each pump circuit shall be equipped with a 3-pole, fast-acting magnetic contactor. Overload conditions shall first open the overload relay followed by the contactor. Contactors shall have a twenty (20) year service design life.

The control shall be equipped with a minimum of 75-watt heat source with thermostat. Heat source shall be in the form of heat trace around the perimeter of the enclosure interior. The heat trace shall be fastened securely against detachment from the enclosure. Point heat sources requiring shields to prevent injuries are not acceptable.

The control shall be equipped with a weatherproof, exterior-mounted receptacle for connection of a portable generator. The generator receptacle and associated wiring shall be sized to suit the full load of the system with all equipment operating. The City of St. John's has a standardized generator receptacle system utilizing Techspan pin and sleeve

connectors, determined by voltage and phasing, as follows:

.1	230 volt, single-phase	Orange 100 amp, 3-pole, 4-wire
.2	208 volt to 230 volt, 3-phase	Red 125 amp, 4-pole, 5-wire
.3	600 volt, 3-phase	Black 100 amp, 3-pole, 4-wire

Control panel mounted generator receptacles shall have inlets with male pins and supplied with protective covers. Receptacles shall be weather-tight with an IP67 rating and conform to IEC 60309.

An exterior-mounted, vandal-proof, alarm light shall be provided to notify alarm conditions. The light shall be mounted to the side of the control enclosure on a stainless-steel bracket so that it is visible from 360^{o}. Alarm lights are not to be mounted to the top of the enclosure to prevent leakage into the control enclosure. Alarm light wiring shall enter only through the enclosure side or bottom.

The generator receptacle and alarm light are to be installed, wired and weather sealed by the CSA certified facility constructing the control panel. Loose supply of the generator receptacle and alarm light for field wiring will not be accepted.

The control shall be equipped with a 120 volt duplex receptacle with ground-fault interruption mounted on the inner door. Systems utilizing 208 volt or 230 volt power to the station shall include a neutral line so that this receptacle will be capable of supplying a minimum of 15 amps to a connected load. Where 600 volt systems are utilized the control shall be provided with a transformer dedicated to the duplex receptacle and capable of providing a minimum of two (2) amps. The receptacle shall be labelled indicating the load of the receptacle.

Circuits of 200 volts and below shall be protected by circuit breakers where the current load is one (1) amp or higher. These breakers shall be mounted on the inner door in a manner such that the circuit breaker can be reset and its status readily seen without the need to open the inner door. Circuits of 200 volts and below may be protected by fuses where the current load is less than one (1) amp. Fuses shall be of proper design characteristics for the circuit which it is protecting.

Three-phase stations shall be equipped with a phase monitoring device to protect against phase failure, phase reversal, or unbalance conditions. The phase monitoring device shall notify the controller of power issues, prevent operation of the pumps and signal an alarm.

The control enclosure shall have a minimum unpopulated area left on the back-plate of 300mm x 300mm to allow for future installation of communication equipment for a SCADA system.

The control shall be provided with a minimum of two (2) spare fuses of each type and rating used in the panel.

Controller Hardware

The station control panel shall be supplied with a programmable controller mounted on the back panel of the enclosure and a graphics based touch screen HMI mounted on the inner door. The HMI shall allow access to and configuration of all parameters of the programmable controller for proper operation of the lift station, display and acknowledgement of alarms and display of trends.

The HMI shall have a minimum of 125mm x 125 mm display area capable of displaying in

256 colors with a resolution of 320 x 240 pixels. Multi-line character based displays are not accepted. The HMI shall have a minimum of 64 MB of memory for logging of station operation. This memory shall be in the form of a removable memory card so that it can be removed from the unit for downloading of data logs off-site.

The programmable controller shall perform all functions of normal station operation. The controller shall contain non-volatile memory to maintain the station configuration and logged data. The controller shall have pre-programmed set-points to allow for basic lift station operation at initial start-up. The controller shall be equipped with a minimum of three serial ports; one for connection of the HMI, one (1) service port, and one (1) for remote communications. A network port is not considered to be a serial port for the purposes of this specification.

Operation

The controller shall be programmed for reliable operation of the lift station with the following functions:

.1 Start, stop and alternation of the pumps based on input from the level regulation system. Start and stop delays to be implemented based on operator configured values. The control panel shall have Hand-Off-Auto switches mounted so the operator can manually control pump operation.

.2 Should failure of the primary level regulation system occur; the controller shall endeavour to alarm the event and switch to the backup level regulation system. The programming for the backup system shall include the option of operating on a timer after being triggered by the emergency high level float of the backup system, or by the tipping of the emergency low level float of the backup system.

.3 The controller shall monitor pump health based on leakage and overtemperature sensors to determine pump condition. If the leakage and overtemperature detection functions are enabled, the controller shall not operate the pumps.

.4 The controller shall have a sump cleaning function to allow the pump to operate below its normal low level shutoff in order to remove floating debris, to agitate the chamber and to bring the water in the chamber to its minimum level so as to minimize sludge deposits. This function shall be initiated by either the number of pump cycles or time intervals, as configured by the operator. Shut off shall be determined by a drop in pump current as the pump begins to draw air and shall have a backup timer to shut the pump off after a user configured time delay after reaching the pump stop set-point.

.5 The controller shall calculate station inflows and pump flows based on operator configured wet well geometry.

All set-points and operating parameters to configure the operation of the lift station shall be entered from the HMI interface. There shall be no need to access the programmable controller via a secondary device such as a laptop to configure the system. Set-points and parameters shall include, but not be limited to:

.1 Configuration of well level transmitter.

.2 Setting of start and stop levels for pumps.

.3 Selection of alternation technique.

.4 Selection of normally open or normally closed for digital inputs.

.5 Selection of analog or digital inputs for primary level regulation system.

.6 High- and low-level alarm points for primary level regulation system.

.7 Lead, lag or alternation sequence for pumps.

.8 Start and stop delays for pumps.

.9 Enabling of leak and fault detection functions for each pump.

.10 Configuration of wet well geometry, including piping and benching, for flow calculations.

.11 Configuration of the sump auto clean settings.

.12 Configuration of recommended pump maintenance interval.

.13 Configuration of alarms sent to the external alarm light.

HMI Display

Primary Page: The HMI display primary page shall provide a graphical representation of the lift station and contain the following information:

.1 Pump run hours, both individual and combined.

.2 Pump starts.

.3 Pump current draw.

.4 Pump status.

.5 Station well level.

.6 Inflow rate.

.7 Calculated pump flow rate, both individual and combined.

.8 Indication of sump auto-clean cycle

Alarm Pages: The HMI display alarm pages shall display the active and current alarms of the lift station. The HMI shall allow the operator to acknowledge and clear alarms. Alarms which have been acknowledged but are still active shall remain on the alarm page and marked as acknowledged. The alarm will be removed from the alarm list only when the alarm fault has been cleared. The HMI shall maintain a history of a minimum of twenty-five (25) of the last alarms. The system shall recognize and display the following alarms:

.1 Primary level regulator failure.

.2 High well level.

.3 Low well level.

.4 Power fault (3-phase systems)

.5 Pump overcurrent.

.6 Pump undercurrent.

.7 Pump overload trip.

.8 Pump high temperature.

.9 Pump leakage.

Trend Page: The HMI display shall display logged data on a trend page. The display shall be capable of displaying the following operator selectable trends:

.1 Well level.

.2 Station inflow.

.3 Pump one flow.

.4 Pump two flow.

.5 Combined pump flow.

.6 Pump starts.

.7 Pump current draw.

.8 Pump operating time.

Primary Level Regulation System

The primary level regulation system shall be via a low maintenance multi-contact probe installed in the wet-well. Liquid level shall be indicated due to a conduction path created by the liquid between the probe sensors and ground. Mechanical floats, submersible pressure transmitters or ultrasonic sensors are not acceptable.

The probe shall be constructed from uPVC tubing with molded sensor units at regular intervals along the probe. Each sensor unit shall contain two (2) Avesta SMO254 stainless steel sensors mounted on opposite sides of the sensor unit. Sensor material other than Avesta SMO254 stainless steel will not be accepted. Each sensor unit shall be rotated 90^{o} to the previous sensor unit to prevent the possibility of tracking between units. The probe shall be filled with epoxy resin to form a sealed, watertight assembly.

The probe shall be mounted in a turbulent area of the wet well suspended by its own cable. A mounting bracket consisting of a stainless hook hanging from a stainless steel bracket containing a polyurethane squeegee for cleaning of the probe shall be provided. The probe shall be capable of being cleaned by simply pulling through the squeegee. The bracket shall be located such that the probe will be easily accessible via the operators without the need to enter the wet well.

The probe cable shall be provided in sufficient length to reach the control panel junction box without the need for splicing. The cable shall be installed in its own conduit separate from any power carrying conductors. The cable conductors shall be encoded with number and text along its length at intervals not greater than 200mm in order to identify the conductor. The cable shall be capable of supporting the weight of the probe and cable without extra support. The cable shall be secured to the top of the probe by a synthetic rubber compression fitting.

The probe shall have a minimum of ten (10) sensors at equal spacing and of length appropriate to station operating conditions. Probe shall be of sufficient length for control of the pumps throughout the required pumping range without excessive starting of the pumps. Minimum probe length shall be 1.5 meters.

The probe shall be provided with a minimum of a ten (10) channel intrinsically safe barrier for connection to the programmable controller. The intrinsically safe barrier shall be fully compatible with the probe. Status for all probe contacts shall be brought back to the controller for display of liquid level in wet-well.

Standard of acceptance: Multitrode Probe

Backup Level Regulation System

The station shall be equipped with a backup level regulation system consisting of two floats. The low level float shall be placed below the normal station pump stop level. The high level float shall be located above the lag pump start point. The floats shall be located in such a manner as to not impede normal operation of the station on the primary level regulation system.

Junction Box

A junction box shall be provided to allow removal and replacement of wet well equipment without the need to disturb sealed conduits to the control panel. The junction box shall be of 316L stainless steel construction with a NEMA 4X rating. The junction box shall have latching mechanisms to allow for secure closure and to maintain the NEMA 4X rating. Latching mechanisms requiring tools to open or close are not acceptable. The junction box shall be provided with a padlock staple for security.

The junction box shall be of sufficient size for easy access to contained wiring. The junction box shall be equipped with terminals of sufficient size and quantity to accept all conductors to the wet well.

The junction box shall be located immediately under the control, as close as practical, for ease of access for maintenance and mounted such that the door is hinged on the bottom.

Emergency Outputs

The station control shall have relay outputs to indicate a high well level condition as indicated by the tipping of the high level float. This output shall be normally open and close on fault or loss of power. Detection of the tipping of the float shall be independent of the programmable controller or the HMI. The relay output shall be ran to terminals for future tie-in to the City of St. John's alarm system provider.

227.7 ACCEPTABLE MANUFACTURES

Pumps

.1 ABS Pumps

.2 ITT FLYGT Pumps

Check Valves

.1 Hillen de Lelie - Ball Check Valves

Ballcentric Plug Valves

.1 Keystone F580/F583 Ballcentric Plug Valves

227.8 WARRANTY

Supplied equipment shall have minimum warranties, from date of installation, as follows:

.1 Pumps - Non-clog – five (5) year prorated.

.2 Grinder – one (1) year.

.3 Primary Level Regulation Probe – ten (10) year.

.4 Access Frames – ten (10) year.

.5 All other items shall have a minimum of one (1) year warranty.

227.9 INSPECTION, TESTING

The pump shall be tested for proper operation at rated power supply values and for electrical and mechanical integrity prior to shipment from factory.

The pump/motor assembly shall be CSA approved as one, integral unit, as per CSA standard CAN/CSA-C22.2.108-M89, LIQUID PUMPS. An approval of the motor unit only shall not be acceptable. The cable shall be CSA approved for the application at rated voltage and current.

Any equipment in the pumping station that may have been provided by another supplier shall have been tested by the original supplier.

227.10 SUBMITTALS

As soon as possible after receipt of an order, the contractor shall furnish the following:

General assembly drawings (plans, elevations, sections) depicting station components, elevations and orientation.

Outline dimension drawings, including, but not limited to:

.1 Pumping station

.2 Discharge connections

.3 Liquid level regulator

.4 Pumps

.5 Station equipment

.6 Access frames

.7 Control circuits

227.11 NAMEPLATES

Suitable nameplates shall be permanently affixed onto the pumps, control enclosure components, and other operating components. Nameplates shall contain critical information regarding the item being identified including model number, voltage, power, impeller number and other information required to fully identify the equipment. The lift station pumps and control equipment are CSA approved and the CSA logo appears on the nameplates of these components.

227.12 INSTALLATION SUPERVISION

An authorized representative of the manufacturer must be made available to:

.1 Supervise the installation of the pumps.

.2 Adjust the level regulation system and test the controls.

.3 Start, test and adjust the equipment for complete and satisfactory operation after installation. All station parameters are to be adjusted to site conditions such that all features are functioning.

.4 Explain and brief thoroughly, owner's representative on station functioning.

227.13 MAINTENANCE AND OPERATIONS MANUALS

Two (2) copies of the maintenance and operations manual shall be provided with each pumping station. These manuals shall contain the following information:

.1 General assembly drawing(s) of the station confirming locations, sizes, elevations and equipment supplied.

.2 An outline drawing of the pumps and discharge connections.

.3 A performance curve for the pumps indicating normal operating duty point.

.4 Information on the level regulation system and components.

.5 A schematic diagram of the control system.

.6 Start-up, operating and safety instructions for the system.

.7 Operators' and complete parts manual to provide complete maintenance and operation information on the station.

227.14 MEASUREMENT FOR PAYMENT

Sanitary sewage lift station shall be measured on a lump sum basis for each lift station, supply and installed complete with excavation, chamber installation, backfilling, pumping system, controls, electrical server and all other work required to provide a functioning lift station in accordance with this specification and associated drawing.

Where rock excavation is required to install this pump station, rock excavation shall be paid for at the respective price for rock excavation under Item 211 "Trench Excavation".

227.15 PAYMENT

The Contractor shall be paid at the respective lump sum prior for each sanitary sewage lift station installed. This price shall be full compensation for the cost of all labour, equipment and materials necessary to complete the work in accordance with this specification.

ITEM 230

WATERMAINS

230.01 SCOPE OF WORK

The Contractor shall supply, transport, lay, joint, clean, disinfect and test all watermain pipe, fittings, valves, hydrants, and water services in accordance with this specification, the standard drawings and do all work necessary to make a proper connection to the existing water system.

230.02 ABREVIATIONS

W & WW = Water & Wastewater Division of Public Works

230.03 ELECTRICAL GROUNDING TO WATERMAINS IS PROHIBITED

As of January 1, 2009, the grounding of electrical services to watermains and water services is prohibited.

Where an electric service is already grounded to an existing metallic watermain or service and the watermain or service is to be replaced by non-metallic piping, a new electrical grounding system is to be provided. The size and configuration of the new electrical grounding system is to be approved by the Regulatory Services Division, Department of Planning, Engineering & Regulatory Services.

230.04 WATER MAIN MARKING

All new water mains shall be marked using 3M Ball Marker technology (programmable). Marker balls shall be supplied by the contractor and installed at the following locations:

- Bends
- Tees or Wyes
- Reducers
- Corporations
- Curb Stops
- Stub ends of pipes
- Or a maximum spacing of 15m

Marker balls shall be blue for “Water”. The balls shall be placed no deeper than 1.5 metres and located directly above the water main or fitting.

For curb stops tie straps shall be used to secure the marker ball to the street side of the curb stop box.

Prior to the start of the project, the Contractor shall contact W & WW and supply a copy of the construction drawings and enough marker balls for the project. Upon review the drawings, W & WW will program and identify the appropriate markers required for the project.

The Engineer shall ensure that the appropriate marker balls are installed in their assigned location. The Engineer shall also record the ID number and location of each marker ball on the As-Built drawings.

At completion of the project, the City will locate the markers and collect the data.

Marker balls cannot be re-programmed without re-excavation.

230.05 PIPE SIZES

For new work:

Watermains and services larger than 50mm: 100mm, 150mm, 200mm, 300mm, 400mm, and as specified in larger sizes.

Domestic services: 25mm, 38mm and 50mm.

Repairs to existing: as specified by the Engineer.

230.06 SHOP DRAWINGS

For concrete pressure pipe and fittings, submit tabulated materials list and drawings indicating internal pressure rating, maximum external load, type of joints and identification mark numbers.

230.07 SCHEDULING OF WORK

Coordinate and organize work to minimize interruptions to existing services.

Notify Engineer and building occupants a minimum of 24 hours in advance of planned interruptions in service. A longer notification period may be required depending on the impacted area.

Do not interrupt water service except between 10:00 a.m. and 4:00 p.m. local time, unless otherwise authorized.

Notify 311 – Access St. John’s if any planned or accidental interruption in water service occurs.

230.08 OPERATION OF EXISTING WATERMAIN VALVES AND HYDRANTS

Existing water main valves shall only be operated by W & WW. The Contractor shall give 24 hours' notice for his request to have an existing valve opened or closed.

The City views illegal operation of City owned valves and hydrants by Contractors or others as a serious safety and Public Health matter. If a Contractor illegally operates a valve or hydrant to turn on or off the municipal water supply the City will shut down the Contractor's operation immediately. In addition, the Contractor may be fined in accordance with current City by-laws.

230.09 PROCEDURE FOR SUPPLY OF TEMPORARY MUNICIPAL WATER

The Contractor is responsible for supply of his own water for construction and testing purposes. The City will make temporary municipal water available for this purpose from a City hydrant.

Supply of temporary water does not constitute City acceptance of ownership of the water main, and the City shall not own the new water main or fittings until such time as subdivision Phase 1 works are accepted by the City or Substantial Performance for City construction contracts is reached.

Temporary Water Supply from City and Non-City Owned Hydrants

To obtain a temporary municipal water supply during construction, the Contractor shall obtain a Hydrant Permit. The contractor shall supply a valve assembly consisting of a valve, Reduced Pressure backflow preventer, reducer, pressure pipe, and a connector to a hydrant side nozzle. The Contractor will be permitted to connect to and operate his own valve assembly. The Contractor will be responsible for any street crossing that may be required for the hosing to reach the construction site, and the Contractor shall be liable to obtain all permits associated with such street crossings.

Once the backflow prevention is in place, the Contractor may connect the hose to the new water mains, in order to provide pressure for wet tapping. The only acceptable methods of connection are:

1. Connection to an end cap
2. Connection to a contractor's on-site hydrant
3. Connection to a service tee.

In certain areas of the City, discoloured water will result from sudden large volume withdrawals of water, such as operation of the Contractor's valve as described above. The Contractor will be responsible for all claims due to water quality. The City reserves the right to restrict water use at its sole discretion if the City believes the site water is affecting water quality. Should the Contractor be found to repeatedly be in violation of the temporary water supply procedure outlined here, he shall lose the privilege of access to a temporary municipal water supply, in addition to any legal remedies the City may take.

230.10 TAPPING OF EXISTING WATERMAINS

W & WW shall perform all tapping of existing watermains at the Contractors expense. The Contractor shall supply all materials and pay all applicable fees or costs. The price bid for tapping of an existing watermain shall include cost of all fees or work payable to W & WW for the tapping of existing watermains, unless otherwise specified.

For connection to existing PVC water mains, the contractor shall supply to the City a Mueller BR2S series service saddle. Direct threaded tapping of PVC pipe is not permitted.

230.11 PRODUCTS

Ductile - Iron Pipe and Fittings (Maintenance Applications Only)

Pipe: designed to AWWA C150/ANSI A21.50, manufactured to AWWA C151/ANSI A21.51, Special Thickness Class 52, cement mortar lined to AWWA C104. Pipe shall be delivered to site complete with capped ends.

Fittings: to AWWA C110, cement mortar lined to AWWA C104, minimum pressure rating 1035 kPa for cast iron, minimum pressure rating 1720 kPa for ductile iron.

Joints: mechanical or push-on to AWWA C111; flanged where indicated, to AWWA C110 with class 125 flanged ends to ANSI B16.1 with cloth-inserted rubber gasket; grooved type coupling joint with malleable iron couplings and gaskets.

Pipe Restraints: restraints must be ductile iron with twist off nuts for proper torque. Wedges shall be ductile iron. Product shall be UL or ULC listed and FM approved. The restraint shall have a working pressure of 1720 kPa (250 psi) with a 2:1 safety ratio when tested in a dead-end situation. Acceptable Products: Uni-Flange Series 1400 (mechanical joints), Uni-Flange Series 1450 (push on joints), EBAA Megalug, or approved equal.

Polyvinyl Chloride Pipe

Pipe: Rigid PVC shall conform to AWWA C900 and be certified to CSA B137.3 for sizes 100mm to 1500mm. Pipe shall be cast iron pipe equivalent OD's and be DR 18 (pressure class 235 psi). Pipe shall be Factory Mutual, ULC and ULI approved, and NSF-61 certified. Pipe shall be delivered to site complete with capped ends.

Molecularly oriented PVC (PVCO) shall conform to AWWA C909 and be certified to CSA B137.3.1 for sizes 100mm to 600mm. Pipe shall be cast iron pipe equivalent OD's and be DR 18 (pressure class 235 psi). Pipe shall be Factory Mutual, ULC and ULI approved, and NSF-61 certified. Pipe shall be delivered to site complete with capped ends.

Molded Fittings: shall conform to AWWA C907 and certified to CSA B137.2 for sizes 100mm to 300mm. They should also be UL listed and FM approved.

Fittings greater than 300 mm: We will not accept fabricated fitting for these sizes. Fittings

shall be ductile iron.

Lubricant: shall be non-toxic, water soluble and listed by the National Sanitation Foundation. Pipe Restraints: restraints shall be same as for ductile iron but specifically designed for use on PVC pipe or PVC integral joint restraint.

Colour Coding: Pipe and fittings shall be color coded blue.

Concrete Pressure Pipe and Fittings

Pipe and Fittings: steel cylinder type, pre-tensioned, concrete lined: to AWWA C303, with minimum 31mm thick cover over tension bar reinforcement using Type 50 cement to ASTM C150 containing fifteen percent (15%) fly ash.

Joints: bell and spigot, plain end, victaulic and welded with performance requirements to AWWA C303. Flanged to AWWA C207, 1 MPa rating drilled to ANSI B16.1 (flat face).

Protective Coating: (when specified).

Hydrants and Extensions

Hydrants: Dry barrel compression type per AWWA C502 and ULC-S-520 listed, and FM approved designed for 1207 kPa/175 psi working pressure, 2413 kPa/350 psi test pressure. Fire hydrants designed for cold climate with suitable operating assembly – no oil filled hydrants permitted due to climate & environment. Fire hydrants certified to ANSI/NSF 61 and 372. Each hydrant tested in factory per AWWA/ULC/FM.

Depth of bury: 2000mm unless otherwise specified.
Barrel: two-piece with safety break-away flange and stem.
Safety flange shall be installed 75-125mm above firm ground.
Type 316 or 304 stainless steel nuts and bolts, no standard steel fasteners permitted.
Main valve: compression type, 114mm or 125mm opening; Main valve shall be replaceable from the ground, main valve shall be Buna N Rubber or EPDM, upper and lower valve plates shall be independent from main valve rubber.
Inlet connection: mechanical joint per ANSI/AWWA CIII/A21.11 or integral restraint connection by hydrant manufacturer, 150mm diameter.
Nozzles: two (2) 63.5mm threaded hose outlets and one (1) 114mm steamer port per City standards unless otherwise stated; Nozzles retained into barrel must be locking screw to prevent pull out;
Hydrant to open counterclockwise; operating nut shall be bronze one-piece design only per AWWA C502with 32mm square operating nut.

Acceptable hydrant model manufacturers list include: McAvity Brigadier M67B (Clow) or CV Darling B-50-B-18 (Mueller).

Hydrant Extensions: As manufactured by the hydrant manufacturer. Multiple extensions not permitted by contractor.

Hydrant Markers: As detailed in the standard drawings.

Valves

1. Gate Valves

Gate valves 50mm to 300mm (and above when applicable): Resilient Wedge design to current AWWA C515 standard, UL/ULC listed, FM approved minimum working pressure of 1379KPa/200psi. Factory minimum 2068KPa/300psi seat (closed), 2758KPa/400psi shell (open) test pressure by manufacture per AWWA. All Gate Valves tested at manufacturer per AWWA/ULC. Gate Valves are tested and certified to ANSI/NSF 61 and 372 for potable water service. Gate Valves shall be full flow type with smooth body design only, no cavity or obstruction in flow way permitted.

Ductile iron body, Bonnet, and stuffing box, per ASTM A-536 on-rising one-piece Bronze stem only per AWWA C515, minimum yield strength of 20, 000psi. Stem nut shall be Bronze only preventing dissimilar metals for operator. Stem shall have three O-ring seal, minimum one above and under integral bronze thrust collar. O-rings shall be maintenance free. Thrust collar must be integral design per AWWA C515 latest revision. Iron Wedge shall be fully encapsulated SBR Rubber, ASTM D2000 Type 316 or 304 stainless steel nuts and bolts, no standard steel fasteners permitted. Open clockwise, aka Open Right Operating nut shall be tapered St. John's style using correct retaining screw. Nut shall be painted Red made of Ductile Iron only per ASTM A-536. Valve lifting not permitted by device under operating nut. When stated, Valve shall have cast or ductile iron hand wheel to ASTM A126 Class B or ASTM A-536, type 316 or 304 retaining screw only.

All RWGVs shall include 10 mils factory fusion-bonded epoxy resin coating to AWWA C550/ANSI/NSF 61 and 372.

End Connection: Mechanical Joint ANSI/AWWA C111/A21.11, Flanged Connection ASME B16.1 Class 125, or threaded connection permitted when stated.

2. Butterfly Valves

Butterfly Valves 350mm and larger: to AWWA C504, short body for Class 150B service, minimum pressure rating 150psi/1035 kPa. 150psi/1035KPa seat (closed), 300psi/2068KPa shell (open) test by manufacture per AWWA C504. Butterfly Valves are tested and certified to NSF 61 for potable water service. Butterfly Valves shall be seat on body design with no disc obstruction to mating pipe types used on 400mm and larger pipe type used in City of St. John's. No alteration, internal beveling or 'chamfering' to mating pipe wall permitted. Valve body must comply with AWWA C504 lay length and minimum wall thickness.

Body: cast iron ASTM A126, Seat: 400mm-500mm Rubber body seat shall be one piece-molded design bonded into recessed cavity in valve body. Seats may not be located on Disc or be retained by screws/pins or segments of any type.
600mm and above E-Lok seat shall be BUNA-N suitable for bi-direction shutoff. Seat retained in body without use of screws, retaining rings or hardware of any kind in flow stream. Seat shall be 360-degree circumference and replaceable without removal of valve from line. Disc type: 400mm-500mm lens type disc of cast iron ASTM A126 with Stainless Steel 316

disc edge. 600mm and above disc of ductile iron ASTM A536 only with Stainless Steel 316 disc edge. 750mm and above uses flow-thru design disc only for minimal pressure drop and turbulence. Stainless steel shafts Stainless type 304. "V" type Chevron packing shall be used vs O-ring or U-cup design. 600mm and above use two-piece Stainless Steel shafts type 304 per AWWA C504 thickness only. Rubber seated for positive shut-off at minimum 1 MPa differential pressure, either direction. Manual gear operated for buried service; grease packed preventing water entry. Manual gear maximum operation input torque of 300ft/lbs per AWWA C504. Manual gear stop collars shall withstand 450ft/lbs input torque.

End Connection: Mechanical Joint ANSI/AWWA C111/A21.11, Flanged Connection ASME B16.1 Class 125.

NOTE: All valves 400mm and greater shall be joint restrained

Valves 400mm in diameter and greater shall be gear operated. Valves 900mm and greater shall have an operating gear ratio of no less than 1 to 180.

3. Air and Vacuum Release Valves

Water Air and Combined Air & Vacuum Valves to AWWA C512, CSA B64-M88, heavy-duty combination air release valve employing direct acting kinetic principle using lever or compound lever design. Valves to expel air at a high rate during filling, at a low rate during operation, and to admit air while line is draining. Manufacturer must have Canadian factory representative to assist correct valve selection to ensure orifice size allows rapid air exhaust/entry.

Valve body constructed of ductile iron ASTM A536 with bronze, EPDM rubber or Stainless-Steel trim/seat. Stainless steel floats and stainless-steel levers only. Shock-proof synthetic adjustable orifice seat suitable for 2 MPa working pressure. Fasteners shall be Stainless type 316. Ends to be flanged to ANSI B16.1. Valve to be complete with a suitable removal housing plate for periodic checks.

4. Valve Boxes

Valve box to be ABS composite lower section, complete with ductile iron upper section. Design feature allows the DI upper to 'float' inside the non-corrosive ABS composite lower section. DI Upper top flange shall be raised from top of lower section using aggregate and asphalt. Once separated, full compaction accomplished with road equipment permitted.

ABS Composite Lower 2.1 meters unless otherwise stated. ABS Composite Lower standpipe cross section 146mm. ABS Composite Lower cut with hand saw minimum 150mm below final grade and maximum 450mm below final grade. Upper made of Ductile Iron ASTM A536. Upper uses minimum 600mm adjustment sleeve with beveled top flange, one piece design only permitted. Upper top flange shall include manufacturer's name, material, and model per ASTM. Minimum ABS Lower/DI Upper sleeve overlap of 150mm.
Cover shall be cast iron ASTM A126. Cover shall be marked 'WATER' with manufacturer's name. Covers intended for Hydrant isolation valve shall be marked 'HYDRANT' with manufacturer's name. Covers shall be same manufacturer as Upper and Lower sections.

5. Tapping Sleeve

Mechanical joint tapping sleeve shall include branch outlet flanged, 1379 kPa/200psi working pressure. Tapping Sleeves utilize body gaskets in recessed grooves on casting of sleeve. Split end gaskets provide 360-degree seal along circumference of host pipe. Manufacturer's instructions shall be supplied with each sleeve.

Sleeve is to be two-piece body Ductile Iron ASTM A536 with Stainless Steel type 316 fasteners, EPDM gaskets and Stainless Steel type 316 test plug.

Approved Tapping Sleeve manufacturer's model list include: H615 - Ductile Iron (Mueller) and Smith Blair Style 623.

Water Services 50mm and smaller

Copper tubing: To ASTM B88, type K, annealed for service laterals up to 50mm in diameter.

Copper Pipe Joints: To be compression type suitable for 1 MPa working pressure.

Polyethylene / Aluminum / Polyethylene composite pipe: To CSA B137.9, AWWA C903 and ASTM F1282. Compression fittings to be as per manufacturers specifications and suitable for underground service (red brass). Approved products: IPEX Q-Line.

Cross linked polyethylene pipe (PEX): To conform to ASTM C904, certified to CSA B137.5, and conform to ASTM F876, F877 and F2023, and NSF 14 and 61. Approved products: Municipex, IPEX Blue 904, LYNX-PEX.

Brass Corporation Stop: Red brass to AWWA C800/ASTM B62, compression type. For working pressures up to 690 kPa, ball style can be used. For working pressures in excess of 690 kPa, ball style must be used.

Ball Type Curb Stop (38mm and smaller): Ball type with neoprene gasket to AWWA C800/ASTM B62, compression type with drain and must have stainless steel key and cotter pin. Approved Products: Ford, Canada Brass.

Curb Case: Curb stops to have 1.5 metres to 1.8 metres adjustable bituminous coated, cast iron service box with stainless steel stem to suit depth of bury. Top of cast iron box marked "WATER".

Compression Connections: Only compression connections with a pull out resisting device and approved by the City shall be permitted to be used. Approved products: Ford Grip Joint Connection, Mueller Grip Joint Connection.

All brass fittings are to be lead free.

Couplings

Couplings for use on direct bury plain ended watermain pipes shall be bolted sleeve type in accordance with AWWA C219. Where the length and configuration of watermain on each side of a coupling is sufficient to prevent axial movement of the watermain, a non-restraining coupling may be used. Otherwise, a restraining coupling shall be used. Contractor shall ensure the coupling is suitable for the material type and OD of watermain pipes being connected. Couplings shall be ductile iron or steel with a minimum working pressure rating of 1035kPa (150psi), fusion bonded epoxy coated to AWWA C213, with type 304 or 316 stainless steel nuts and bolts to ASTM F593/F594, and fitted with NBR or EPDM rubber gaskets to AWWA C111/A21.11-23. Couplings shall be NSF 61 certified for use with potable water. Approved products: Non-restraining – Robar 1506 and Smith-Blair 413, Restraining – Krausz Hymax Grip and Georg Fischer Multi/Joint 3000 Plus, or approved equal.

Miscellaneous Items

Thrust Blocks and Anchors: 25 MPa concrete, see standard drawings.

Disinfectant: sodium hypochlorite or calcium hypochlorite: to AWWA B300.

Reducing Agent: hydrogen peroxide: 35% by weight commercial grade.

Insulation: to CAN/CGSB 51.20, Type 4 extruded polystyrene.

Paint: as specified for Item 603 “Handrail”.

Anodes: All sacrificial zinc anodes shall conform to ASTM B-418 Type II and shall be made of high-grade electrolytic zinc, 99.99% pure. The standard anode size shall be 10.9 kg. (24lb.) and 1.2 metres (48’’) in length, ZN 24-48. The anode lead wire shall be at least 3 metres of No. 10 AWG stranded copper wire having TWH blue insulation. The lead wire shall be connected to the steel core with silver solder.

230.12 PIPE LAYING

Watermain shall be constructed in an open trench and laid to the lines and grades set by the Engineer. The pipe shall be well bedded on a solid foundation along the full length of each pipe. The bottom of the trench shall be recessed at bells such that the barrel of the pipe shall be completely supported over its entire length on a solid foundation. Pipe depth to be minimum 2000mm unless otherwise noted.

In order to ensure adequate lateral and vertical stability of the pipe during jointing and embedding operations, a sufficient amount of bedding material to hold the pipe in rigid alignment shall be uniformly deposited, and thoroughly compacted on each side and back of the bell of each pipe.

The trench shall be kept dry, and no pipe shall be laid in water or upon a wet, muddy or

frozen bed. All pipes must be thoroughly cleaned and protected from dirt and no water shall be allowed to flow through any pipe during construction.

At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug. If water enters the trench, this plug shall remain in place until the trench is pumped completely dry.

Existing water service laterals that straddle the trench shall be preserved without being cut unless the engineer agrees that the works require the laterals be cut. Cut pipes shall have a temporary cap placed at each open end. The Engineer shall be present to inspect proper workmanship for reconnection of cut laterals, to guard against pull out of pipe from the couplings later due to trench settlement.

230.13 PIPE ASSEMBLY

Ductile Iron

Pipe shall be assembled in accordance with the manufacture's recommendation.

Pipe restraints are permitted in place of thrust blocks under certain conditions. The restraint distance must be in accordance with the manufacturer's recommended length. The Engineer shall submit a design for pipe restraints for each location where pipe restraints are proposed.

Polyvinyl Chloride Pipe

Pipe shall be assembled in accordance with the manufacturer's recommendations. Where PVC pipe is used, associated tees, bends and fittings are to be PVC for sizes 300 mm and smaller. Ductile iron fittings are only to be used for PVC pipe greater than 300 mm or when joining onto existing cast iron or ductile iron piping. Where ductile iron fittings are used, they shall be wrapped with a Petrolatum Tape System in accordance with Specification Item 230.18 Corrosion Protection.

Where pipe restraints are permitted, the restraint distance must be in accordance with the manufacturer's recommended length. **The Engineer shall submit a design for pipe restraints for each location where pipe restraints are proposed.**

Concrete Pressure Pipe

Pipe shall be assembled in accordance with the manufacturer's recommendations.

230.14 THRUST BLOCKS

Thrust blocks as called for in the standard drawings shall be provided with all plugs, caps, tees, reducers, bends, valves, and hydrants.

230.15 SETTING OF HYDRANTS

Hydrants shall be located as shown on the plans or as directed by the Engineer.

All hydrants shall stand plumb and shall have their nozzles parallel with the curb, with the pumper connection facing the curb. Hydrants shall be set to the established grade, with the breakaway flange approximately 75mm to 150mm above the finished sidewalk or ground elevation. Where a hydrant extension is required to bring a new hydrant to grade, the extension will be supplied, installed and paid for under "Adjusting Hydrants to Grade."

Where a hydrant is set in pervious soil, drainage shall be provided at the base of the hydrant by placing 40mm washed stone from the bottom of the trench to at least 150mm above the drain opening in the hydrant and to 300mm around the elbow.

Where a hydrant is set in clay or other impervious soil, a drainage pit 600mm in diameter and 900mm deep shall be excavated below each hydrant and filled with 40mm washed stone under and around the elbow of the hydrant and to a level of 150mm above the drain openings.

Where the bowl of the hydrant will be located below the high-water table, the drain holes of the hydrant are to be plugged and the hydrant marked, by a sign as a “Wet Hydrant”. Where this situation is encountered, further direction from EDS is required.

The bowl of each hydrant shall be well braced against undisturbed earth at the end of the trench with concrete backing, or it shall be secured to the main line using approved mechanical restraining devices. Hydrant lead valves less than 2.0m from the hydrant shall be restrained to the main using a mechanical joint restraining system. Hydrants and hydrant markers shall be painted in standard City colours or as specified. Paint and coat application shall be as specified in the Item 603 “Handrail”.

230.16 VALVES

Valves, unless otherwise shown, shall be installed in accordance with the manufacturer’s instructions and installed with a valve box and extensions to extend from the valve bonnet to the top of finished grade.

230.17 TAPPING SLEEVES AND VALVES

Tapping sleeves and valves shall be used to connect to a live municipal water supply, unless otherwise approved by the Engineer.

Prior to ordering a tapping sleeve and valve, the Contractor shall excavate at the location of the tap and measure the outer diameter (OD) of the existing water main. The Contractor shall also provide ESD an opportunity to view the location prior to backfilling the excavation.

The Contractor shall provide the tapping sleeve and valve (TS&V), fasten the sleeve to the pipe, and pressure test to prove no leakage. The Contractor then shall request ESD to

perform the tap and retrieve the coupon.

Pipe joints shall be restrained using a megaholder (or approved equal) for a branch pipe length as recommended by the pipe restraint manufacturer.

The Contractor is advised to allow for sufficient lead time between delivery and order of cast iron tapping sleeve and valve assemblies.

230.18 CORROSION PROTECTION

Cathodic Protection

Existing Metallic Watermains (Maintenance Applications): Sacrificial anodes shall be installed at the following locations:

- At the connection point to the existing metallic watermain
- all metallic valves
- all fire hydrants
- all metal services
- all metallic pipe
- all metallic fittings (i.e. bends, couplings, etc.)

New Watermain Installations: Sacrificial anodes shall be installed at the following locations:

- At the connection point between a non-metallic watermain and the existing metallic watermain
- all fire hydrants
- all existing metal services

Anodes shall be 24-48 Zinc (10.9kg x 1220mm casting) in accordance with ASTM B418.

Anodes shall be installed horizontally, a minimum of 600mm to the side of the watermain and shall be backfilled with native material.

Anodes shall be installed complete with their cardboard container and enclosed selected backfill.

The anode lead wire shall connect to the watermain, metallic fitting, valve, service, or hydrant as shown on drawing 10-230-07. Sufficient slack shall be left in the wire to prevent any stress on either the anode or the wire-to-pipe connection during backfill and subsequent soil settlement.

Petrolatum Tape System

Existing Metallic Watermains (Maintenance Applications): Petrolatum tape system not required, as sacrificial anodes are to be installed.

New Watermain Installations: Petrolatum tape system shall be installed at the following locations:

- all metallic fittings (i.e. bends, couplings, etc.)
- all metallic corporation stops and curb stops
- all joint restraints at non-metallic pipe joints
- all joint restraints and flanges at metallic fitting, valves and hydrants

The petrolatum tape system shall be comprised of a paste, profiling mastic and petrolatum tape, and comply with the latest revision of AWWA C217, NACE RP0375 and CSA Z245.30. The three components shall be of the same manufacture to ensure compatibility and optimal performance. The petrolatum tape system shall provide long-term corrosion protection and be suitable for use with underground potable watermain systems.

Sufficient profiling mastic shall be used to fill all voids and provide a smooth surface for petrolatum tape installation at locations with sharp edges and irregular shape (i.e. flanges, restraints, etc.). There shall be no void space between the profiling mastic and petrolatum tape.

Petrolatum tape shall have a minimum 55% overlap to ensure a double thickness of tape at all locations and extend at least 100mm onto the connecting pipe. Smooth the tape surface to ensure a completely sealed system.

The petrolatum tape system shall be installed, including any required cleaning and preparation, in accordance with the manufacturer's instructions. Installers shall be fully trained by the product manufacture or supplier, or by other previously trained and competent installers. Acceptable products include the Denso Petrolatum Tape System (Denso LT Tape, Denso Profiling Mastic and Denso Paste), Longwrap Petrolatum Tape System (Longwrap Petrolatum Tape, Longwrap LD Mastic and Longwrap Petrolatum Paste) or approved equal. The supply and installation of petrolatum tape systems shall be considered incidental to the work and no additional payment will be made.

Epoxy Coating Repairs

Epoxy coated components (i.e. valves, hydrants, etc.) shall be free of nicks, scratched or other damage to the epoxy coating. Any damage to the epoxy coating shall be repaired as per the manufacture's recommendations prior to installation, and at no additional cost to the City of St. John's.

230.19 WATER SERVICES INSTALLATION

Water services shall not be buried shallower than 1.8 metres and no deeper than 2.0 metres.

When new PVC mains are beings installed, service tees are to be installed for each water service. Installed on mains 400mm and smaller. Service saddles are to be used on mains

larger than 400mm. Direct tapping to connect a water service to a new main is prohibited.

Water services shall be installed at the centre of lots and 3 metres beyond the back of the future sidewalk, unless otherwise directed. If the services are to be installed in conjunction with sewer services than the water service shall be located on the right side of the sewer services. When a water service is installed by itself, then the end of the service shall be marked with a stake as detailed in Item 225.02. Each water service shall be suitably plugged or capped to prevent leakage and to prevent dirt or other harmful material from entering the pipe.

Water Service to Building

When a water service lateral is to be constructed to a proposed or existing residential building from an existing water main or extended from its termination point at the street line, the entire length of the service pipe must be inspected and approved by W & WW Division the City's representative prior to backfilling. The Contractor must contact W & WW Division to arrange for an inspection. Any portions of a water service lateral that are buried without being inspected shall be uncovered for inspection at the Contractor's expense.

The Contractor must avoid joining separate pieces of pipe with couplings, unless necessary and approved by the Engineer. A service of less than 20 metres in length shall have no coupling connections.

The service pipe shall be brought under the footing of the building in one piece prior to termination.

Size of Water Services

Specification of the diameter of a water service depends on such factors as length, building fixture units, allowance for future building expansion, internal building plumbing sizes and available street pressure. It is the responsibility of the Developer or his agent to properly specify water service sizes in order that the finished development will have a water service which is properly sized in accordance with the Canadian Plumbing Code.

The minimum water service size allowed by the City under any circumstance is 25mm.

Minimum Water Service Size for Single Family Housing:

In the case of a single-family residence the minimum water service size shall be 25mm, for a length, not to exceed 30 metres and where the where the main floor elevation of the house is within 2 metres of street elevation. For cases outside these parameters, the developer shall submit detailed calculations for review and approval of size of service.

The service length shall be measured from the watermain to the location where the service enters the building.

Provision of services to this minimum standard for single family residences does not constitute automatic compliance with the Canadian Plumbing Code, and the onus is on the

Developer or his agents to ensure compliance with the Code.

230.20 ABANDONING OF WATER SERVICE LATERALS

50mm or less

An existing water service to a property that is proposed to be abandoned shall be excavated by the Contractor at the connection to the water main and abandoned at the main.

Contractor is responsible to expose and close the corporation stop and then install an abandonment sleeve. The sleeve will be provided by the City.

W & WW or the City's representative shall inspect that the corporation stop has been closed prior to backfilling. The Contractor shall provide twenty-four (24) hour notice.

If upon excavation it is found that a corporation stop does not exist, City forces will place a repair sleeve on the pipe at the Contractor's expense.

Larger than 50mm

The City shall determine requirements depending on each circumstance. Contractor shall contact the City to obtain direction.

230.21 TIE-INS

The Contractor shall record on drawings or in tabular form "As Built" tie-ins for all valves, curb stops, bends and pipe ends. When the work is completed, this information shall be presented to the Engineer.

230.22 CONNECTION TO THE EXISTING MUNICIPAL WATER SUPPLY

No pipe shall be physically connected to the existing municipal water system, or to a tapping sleeve, prior to pigging and City acceptance of satisfactory pressure, leakage, and chlorination test results. A gap of one (1) metre minimum length shall remain in place until the City formally approves connection to the municipal water system.

The Contractor shall disinfect all existing water main end caps and pipe segments before connection of new water main pipe.

230.23 PIGGING

Appropriately sized poly pigs as manufactured by Gerard, or approved equal, having a minimum density of 2lb/ft^2 and recommended for wiping shall be installed into the main to ensure watermains are swept when the system is first charged. Hydrant leads will not be

required to be pigged.

To ensure the pigging is properly undertaken the following procedures must be used and will be rigidly enforced:

(a) Before any water main is placed, the Contractor, the Engineer and representatives of ESD shall meet and agree on the procedures and schedule for pigging, i.e. where and when the poly pigs are inserted, how they will be removed, when the pigging should be done, in what direction the poly pigs will be forced, etc...

(b) The Engineer will verify the insertion of each poly pig.

(c) Upon the request of the Contractor and Engineer, ESD will witness the removal of the poly pig and certify that the appropriate section has been properly pigged.

230.24 PRESSURE TEST

Water from the existing distribution system shall be supplied as described in the item entitled “Procedure for the Supply of Temporary Municipal Water”.

After the pipe has been laid, backfilled, thrust blocks have reached sufficient strength and after the installation of service fittings, all newly laid pipe, or valved section thereof, shall be subjected to a hydrostatic pressure of 1050kPa or 1.5 times static pressure, whichever is greater. Every valve shall be pressure tested in the closed position on either side of the valve and in the open position. Where hydrants are in the test section, the test shall be made against the closed hydrant.

Each valved section of pipe shall be slowly filled with water and the test pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer. The pump, pipe connection and all necessary apparatus shall be furnished by the Contractor.

Before applying the test pressure, all air shall be expelled from the pipe. If permanent air vents are not located at all high points the Contractor shall install corporation cocks at such points so the air can be expelled, the corporation cocks shall be closed, and the test pressure applied.

The pressure test shall be of duration of at least two (2) hours and the pressure shall not vary by more than +/- 35kPa.

Where water services are installed onto an existing main or onto a new main that has been pressure tested the service shall be pressure tested to 690kPa and visually inspected before backfilling. All faulty or leaking connections shall be corrected before backfilling.

230.25 LEAKAGE TEST

A leakage test shall be conducted concurrently with the pressure test. The Contractor shall

supply all equipment necessary for the conducting of this test.

"Leakage" shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof, to maintain pressure within 35/kPa of the test pressure after the air in the pipeline has been expelled.

No pipe installation will be accepted if the leakage is greater than the allowable leakage for joints + the allowable leakage for closed metal seated valves.

Allowable leakage for pipe is 0.0000449 l/hr/mm of pipe diameter/m of pipe for maximum test sections of 300 metres. If testing more than 300 metres, no leakage is allowed.

Allowable leakage for closed metal seated valves shall be 0.0012 l/h/mm of nominal valve size. No leakage allowance will be allowed for resilient seat valves.

ALLOWABLE LEAKAGE TABLE

Pipe Diameter (mm)	Watermain (l/hr/m)	Valves (closed) (l/hr)
150	0.00674	0.18
200	0.00898	0.24
300	0.01348	0.36
400	0.01797	0.48

If any test of pipe discloses leakage greater than the allowable, the Contractor shall, at his own expense, locate and repair the defective joints until the leakage is within the specified allowance. All visible leaks are to be repaired regardless of the amount of leakage.

230.26 DISINFECTION

Disinfection of water mains shall be done in accordance with the Continuous-Feed Method of Chlorination identified in the latest version of AWWA C651 and the following:

Other methods of water main disinfection identified in AWWA C651 may be considered on a case-by-case basis; however, shall not be used without prior approval of the Engineer.

Prior to being chlorinated the mains shall be filled with potable water to eliminate air pockets and shall be flushed and swabbed to remove particles. The flushing velocity in the mains shall be not less than 0.91m/s unless the Engineer determines that conditions do not permit the required flow to be discharged to waste.

Water from the existing distribution system shall be supplied as described in the item entitled “Procedure for the Supply of Temporary Municipal Water”. Water shall be made to flow at a constant measured rate into the newly laid water mains and hydrant leads.

At a point not more than 3 metres downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate, such that the

water will have not less than 25mg/l free chlorine. To assure that this concentration is provided, measure the chlorine concentration at regular time intervals.

Chlorine application shall not cease until the entire main is filled with heavily chlorinated water. The chlorinated water shall remain in the main for at least 24 hours, during which time all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances. At the end of this 24-hour period, the treated water in all portions of the main shall have a residual of not less than 10mg/l free chlorine, as determined by using an appropriate chlorine test kit. If the testing proves unsatisfactory, the disinfection shall be repeated until acceptable results are received.

All chlorine residual field testing shall be performed by using the DPD Drop Dilution Method or High-Range Chlorine Test Kit according to AWWA C651 Appendix A. All test kits shall be calibrated and maintained according to manufacturer's recommendations.

Upon completion of watermain chlorination and confirmation of acceptable free chlorine residuals, the main shall be flushed to remove all heavily chlorinated water. Flushing shall continue until chlorine measurements show that the concentration in the water leaving the main is no higher than the concentration entering the main from the existing distribution system.

After the final flushing and before the water main is placed in service, two (2) sets of water samples shall be collected from the water main for bacteriological testing at a certified laboratory. The second set of water samples shall only be taken after a minimum of 16 hours after collection of the initial set of samples, without any water use and from the same locations. Sample sets shall comprise only of samples that are collected consecutively on the same day. Both sets of samples shall show the absence of coli form organisms for the main to be approved for service. If the two consecutive sample sets produce any unsatisfactory bacteriological test results, or if other results indicate unacceptable water quality, disinfection and sampling of the main shall be repeated until satisfactory bacteriological test results have been obtained. Resampling without repeating proper disinfection of the main will not be acceptable.

All water mains, including branch lines greater than 6m in length, shall have water sample sets collected every 370m (maximum) of water main plus one set from the end of each main or branch line.

A copy of all laboratory bacteriological test results and a map or drawing identifying the location of each sample shall be provided to the Engineer for review and approval to place the main in service.

After disinfection, the heavily chlorinated water shall be discharged into a sanitary sewer, if available. Otherwise, the water can be discharged into a storm sewer, open ditch, or watercourse. Prior to discharge, the water shall contain a chlorine concentration of not greater than 30.0 mg/l for discharge to a sanitary sewer and 1.0 mg/l for discharge to a storm sewer, open ditch or watercourse, in accordance with the NL Environmental Control Water and Sewerage Regulations, 2003. If necessary, the water shall be de-chlorinated using a de-chlorinating (neutralizing) agent listed in AWWA C655. Otherwise, the water shall be

discharged into tanks and disposed of at an approved disposal facility. The cost associated with de-chlorinating or disposing of heavily chlorinated water shall be borne by the Contractor.

230.27 MEASUREMENT FOR PAYMENT

Measurement for payment purposes shall be:

Connection to Existing Main - a lump sum price for each connection to an existing system.

Pipe and Fittings - the centerline end to end distance of watermain installed, measured in metres. No deletions shall be made for valves or other fittings.

Valves - the number of valves of each size or classification installed.

New Hydrants - each new hydrant and hydrant marker supplied and installed.

Relocate Hydrants - each hydrant and hydrant marker relocated and adjusted to grade but not requiring a hydrant extension.

Adjust Hydrant to Grade - the number of each length installed.

Supply Hydrant Marker - each new hydrant marker supplied and installed separate from those called for in other parts of this specification.

Water Services:

(a) the number of services of each size connected to the main.

(b) the number of services of each size connected to an existing service or building plumbing.

(c) the length of service measured in metres from the centerline of the water main to the end of pipe laying, as approved by the Engineer.

Pipe Restraints - the number of each size installed.

Sacrificial Anodes – the number of sacrificial anodes installed.

230.28 PAYMENT

Payment shall be on a unit price basis per metre for pipe and fittings supplied, transported, laid, jointed, disinfected, tested, and connected to existing watermains. The bid price shall include all labor, equipment, and materials necessary to complete the work in accordance with this specification.

The Contractor will only be paid to a maximum of 90% of the value of this item until such time as the section of work has passed all tests. This 10% will be called the "Water Test Allowance". In addition, the 10% mechanics lien holdback shall apply.

ITEM 240

CURED IN PLACE PIPE LINING OF SEWERS

240.01 SCOPE OF WORK

The work to be performed shall include all labour, equipment, tools, materials, engineering design and supervision to structurally rehabilitate various manhole to manhole (MH to MH) sections of sanitary, storm or combined sewers by Cured-in-Place Pipe (CIPP) lining method in accordance with the plans and specifications.

The work also includes but is not limited to, traffic control, flow control and bypass pumping, sewer cleaning and preparation for lining, CCTV inspections, liner installation and curing, liner sampling and testing, reinstatement of service connections, reinstatement and clean-up of the work site, and all other incidental work and services necessary for completion of the scope of work.

CIPP lining means trenchless sewer rehabilitation by installation of a resin-impregnated flexible tube which when cured will form a continuous close fit liner within an existing sewer, beginning and ending at manhole inside walls.

CIPP liner thickness shall be designed in accordance with the design section of these Specifications. CIPP designs and any other necessary design works shall be approved and stamped by a licensed Professional Engineer and Permit Holder authorized to perform such work by Professional Engineers and Geoscientists of Newfoundland and Labrador (PEGNL).

240.02 REFERENCE SPECIFICATIONS

ASTM F1216 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube

ASTM F1743 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)

ASTM F2019 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place Thermosetting Resin Pipe (CIPP)

ASTM D5813 Standard Specification for Cured-In-Place Thermosetting Resin Sewer Piping Systems

ASTM D790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

ASTM D638 Standard Test Methods for Tensile Properties of Plastics

ASTM D2990 Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics

240.03 CONFINED SPACE REQUIRMENTS

The Contractor shall meet or exceed the requirements of Confined Space Entry as outlined under the Occupational Health and Safety Act. For all work in and around the sewer manholes, a person shall be qualified in Confined Space Entry. Proof that atmospheric testing of each manhole, prior to initial entry and continuously while in the manhole where work was performed, shall be submitted to the Engineer on the Confined Space Entry form, with each progress payment certificate submission.

240.04 PERMITS AND APPROVALS

The Contractor shall obtain all necessary permits, permissions and approvals for the work.

240.05 PRE-LINING SUBMISSIONS

The Contractor shall submit the following to the Engineer for review and approval at least 14 days prior to commencement of any sewer section lining, unless otherwise noted:

1) Engineering design for each size of sewer to be CIPP lined. The designs shall clearly identify the proposed CIPP liner thickness and all required design formulas, assumptions and parameters used in the design. Design parameters shall be in accordance with Section 240.19. Designs shall be approved and stamped by a Professional Engineer licensed in the Province of Newfoundland and Labrador.

2) Design calculations to confirm the hydraulic capacity of the CIPP lined sewer will be equal to or greater than the existing sewer.

3) Proposed CIPP Lining (tube and resin) information including product name, type and manufacturer.

4) Material specifications for the proposed CIPP lining (tube and resin) in sufficient detail to enable confirmation by the Engineer that the materials proposed will meet the objectives, performance requirements and design requirements of this specification.

5) A certified original copy complete with supporting literature from the resin manufacturer of the Infrared Spectrograph of the catalyzed resin mixture proposed for the Contract.

6) Independent third party test data supporting the short-term and long-term values of flexural modulus and flexural strength of the proposed CIPP liner used in the design.

7) Manufacture’s recommendations for product transportation, handling and storage, repair of damaged product, installation procedures, inversion pressures and curing schedule

(temperature and duration).

8) Contractor's proposed procedures and materials for Filling of Voids and Service Lateral Connection Grouting.

9) Contractors proposed CIPP liner installation procedures, including details of the liner wet-out and liner curing process.

10) Contractors proposed traffic control plan.

11) Contractors proposed sewer flow control and sewer by-pass plan.

12) Project schedule detailing timelines of the proposed works.

240.06 SCHEDULE OF WORKS

1) The Contractor shall submit to the Engineer for review and approval, a schedule of the proposed specifically identified works. The schedule shall be reviewed and approved by the City prior to commencement of the planned works.

2) The Contractor shall commence work within seven calendar days from the Engineer's order to commence work. The work shall be carried out on the continuous basis and all assigned work shall be completed within the contract schedule.

3) The Contractor shall notify the Engineer of specific start and finish times for all procedures in order that the Engineer's inspection staff may coordinate their schedules to ensure suitable levels of inspection. This notification shall be given a minimum of 48 hours prior to the start time.

4) The order of work is, in general, the responsibility of the Contractor and shall be as indicated in the detailed work plan. However, the City reserves the right to modify the order of work based on the City's needs and priorities.

240.07 SITE INVESTIGATION

The Contractor shall investigate each site prior to submission of Tender to determine the exiting site conditions, any obstruction, or any other problem which may affect the Tender price or completion of the proposed work. No additional payment shall be made on account of difficulties to complete the work because the Contractor failed to investigate the site prior to submission of Tender.

240.08 EXISTING CCTV SEWER INSPECTIONS

Where possible, existing CCTV sewer inspections or inspection reports will be made available during the tendering process. The Contractor shall be aware the sewer inspections may have

been completed immediately after sewer cleaning and no set amount of time before tendering; therefore, the inspections may no longer represent the condition of the sewer at the time of tendering.

If, for bidding purposes, the contractor is of the opinion further inspection is required in order to properly assess the work to be undertaken, the contractor will be responsible to perform such additional inspection at no cost to the City. Arrangements shall be made with the Engineer prior to proceeding with any further inspection.

240.09 MEASUREMENT OF EXISTING SEWER SECTIONS

It is the responsibility of the Contractor to confirm and record the necessary lengths and interior dimensions of the sewer sections to be lined by conducting the appropriate measurements. Size information provided on the drawings or in the tender documents are typically nominal sizes and are not necessarily the inside diameter pipe sizes. The Contractor shall immediately notify the Engineer of any step discrepancy (such as nominal 250mm instead of nominal 300mm) between the internal diameter measurement and the diameter identified in the contract documents.

The Contractor's method for obtaining and confirming sizes shall be suitable for proper sizing of the liners to be installed. At a minimum, inside diameter measurements of each individual section of existing sewer to be lined shall be completed at the corresponding manhole locations with a suitably accurate device. Measurement method shall take into account the possibility that the exposed sewer end is a bell and does not represent the inside diameter of the sewer pipe itself. Measurement method shall take into account any debris, encrustation, or other build up in the sewer that could result in an incorrect sizing measurement. The liner size is to be based on the internal diameter of the sewer pipe following cleaning and preparation operations.

240.10 NOTIFICATION OF SEWER USERS

The City shall provide an initial notice to all properties connected to the sewers scheduled to be lined, in advance of the start of on-site activities by the Contractor. The notice shall include a brief introduction to the upcoming sewer lining works and the applicable City contact information.

Contractor Provided Notices

The Contractor shall provide two (2) notices to all properties connected to the sewer scheduled to be lined. The first notice shall be provided at least 7 days in advance of the start of any sewer lining activities, including sewer cleaning and preparation works. The second notice shall be provided 24 hours in advance of the start of a sewer liner installation. The notices shall include a brief description of the upcoming construction work, any anticipated sewer service interruptions for the duration of the process, discussion on the potential for odours and how to alleviate odours, and names & phone numbers of the Contractor's personnel (including an after hour's local emergency number). The notices shall also indicate the need for property owners to limit the use of sewer (flushing toilets) and water (washing machine, dishwasher,

running water, etc.) during lining operations, as this could adversely affect lining installation and a cause sewer back-up. The Engineer is to receive a copy of the two notices for approval prior to delivery to the affected sewer users.

Record Log of Notifications
The Contractor shall make and maintain a log record. The log shall record the address where each notice was delivered, the date of delivery and any other information relevant to maintaining a record of notifications, such as follow-up telephone calls or property visits. The log shall be maintained in a common electronic format, such as an MS Excel document. The log shall be provided to the Engineer upon request.

240.11 SUPPLY OF TEMPORARY MUNICIPAL WATER FOR CONSTRUCTION

The Contractor is responsible for the supply of water required for construction and testing purposes. The City will make temporary municipal water available for this purpose from a City hydrant, as per Item 230 – Watermains, of the City's Specifications Book.

240.12 TRAFFIC CONTROL

The Contractor shall provide traffic control measures in accordance with Item 130 Traffic Control of the City of St. John's Specifications Book. The Contractor's Traffic Control Plan shall be submitted to the Engineer for review and approval, as per Item 240.05 Pre-Lining Submissions. The cost for traffic control shall be borne entirely by the Contractor.

240.13 FLOW CONTROL AND SEWER BYPASS

The Contractor shall be responsible for the design, supply, installation, operation and maintenance of appropriate flow control and sewer bypass measures for main line sewers and sewer services, as necessary to properly conduct the specified work in accordance with the following requirements.

The Contractor shall provide a "Flow Control and Sewer Bypass Plan" to the Engineer for review and approval as per the pre-lining submissions section of this specification.

During CCTV inspections, sewers flows shall be shut off and the sewer sufficiently dry to ensure total viewing of the periphery of the pipe, including the pipe invert.

During CIPP liner installations, sewers flows shall be shut off and the sewer sufficiently dry to ensure total viewing of the periphery of the pipe, including the pipe invert, and to permit proper installation of the liner. All areas of standing water shall be removed from the sewer, prior to liner installation.

Where conditions permit, flow control measures may consist solely of plugging or blocking the sewer directly upstream of the sewer section to be inspected or lined. Plugs shall be designed such that it can release any or all of the flow, as necessary.

When adequate flow control cannot be obtained by plugging the sewer, the Contractor shall provide bypass pumping or vacuum trucks to transport the flow from upstream sewers to a downstream or adjacent sanitary sewer.

The Contractor shall make arrangements with all property owners connected to the sewer being inspected or lined, to shut off sewer flows or provide temporary sewer service bypass, as deemed necessary to complete the work.

The contractor shall be responsible to determine the capacity of all required sewer bypass systems.

All temporary sewer bypass system materials shall and shall be capable of withstanding 860 kPa pressure and all other conditions of use.

The Contractor shall ensure that flow control measures do not cause back-ups or flooding of public or private property being served by the sewer system. Any damage due to back-ups or flooding of public or private property will be remediated and repaired at the Contractors expense.

240.14 GENERAL REQUIREMENTS FOR CIPP LINERS

The purposes for lining sections of sewer are to prevent further material deterioration, improve structural integrity, prevent root intrusion, prevent/reduce infiltration, improve flow characteristics and extend the service life of the sewer with minimal construction disturbance. Liners shall be designed in accordance with the CIPP Liner Design section of this specification.

Installation of any liner system shall provide a rehabilitated sewer section with a hydraulic capacity equal to or greater than the existing pipe. The contractor shall provide design calculations using Manning's formula with appropriate "n" values for the CIPP liner product and existing sewer pipe prior to lining.

Installation

The Contractor is responsible for the installation and curing of the CIPP liner. Procedures for liner installation are specific to the method being used and may vary with liner type, material, thickness, pipe size, pipe shape, etc. The Contractor's installations procedures shall follow the liner manufacturer's installation recommendations and be in accordance with the pre-lining submission documents approved by the Engineer. Any proposed deviation from the previously submitted procedure shall be submitted, with explanation, to the Engineer for approval and the submission shall include the approval of the lining manufacturer. Where, in the Engineer's opinion, these procedures are not in accordance with industry standard or liner manufacturer's procedures, the Engineer may require the Contractor to alter or modify the procedures.

If the liner is to be installed by pull-in-place method, the Contractor must use appropriate monitoring devices to ensure that pull-in forces do not exceed the maximum allowable tensile stress of the fabric liner tube during installation, as determined by the Manufacturer.

The Contractor shall ensure that all sewer flows are shut-off by means of appropriate flow

control measures, and sewers are cleaned and prepared for lining in accordance with applicable requirements, prior to installation of any liner. All areas of standing water must be removed from the sewer prior to lining.

Liner Wet-Out and Curing
Liners can be wet-out at the manufacturer's facility or wet-out by the Contractor on site. In any case, appropriate quality control measures and records keeping must be implemented to ensure the wet-out liner meets or exceeds the design thickness and all specifications.

Contractor shall ensure the liner curing method and process, including curing temperatures and duration from start of heating to end of cool down is completed in accordance with the manufacture's specifications. All circulating heat sources shall be equipped with suitable temperature and pressure gauges so that the curing and cooling processes can be monitored. Boiler temperatures and thermocouple readings (at suitable locations along the liner) shall be recorded at suitable time intervals after heating begins.

Contractor must ensure adequate circulation of the heat source to avoid zones of inadequate heating, which can lead to improper curing of the liner. Contractor shall employ appropriate measures to address heat sinks such as groundwater infiltration into the sewer that can cause washout of resin and improper curing of the liner. The liner shall be free of soft spots, dry spots, lifts or delamination due to inadequate wet-out, washout of resin, improper curing or any other means.

Liner Temperature and Storage
Any liner wet-out off-site shall be stored until the liner installation, at the temperature, conditions and within the allowable duration recommended by the manufacturer. It is the responsibility of the contractor to ensure the wet-out liner is stored and transported in a climate-controlled environment as per the resin manufacturer's recommendation. A temperature log (starting immediately following wet-out) during storage and transportation must be provided to the Engineer prior to the liner installation. The Contractor shall not install any liner that has expired or otherwise compromised due to transportation and storage conditions not being in accordance with the manufacture's recommendations.

Styrene and Odour Control
The Contractor shall take necessary precautions to prevent styrene odours emitted from sewer lining and curing operations from entering any property. Precautions shall include the following:

- Venting of sewer section being lined with appropriately sized exhaust blowers. Blowers shall be installed at the start MH and end MH locations immediately following curing and gaining access to the liner section to exhaust air from the sewer. If the start MH or end MH is not available, blowers shall be installed on the next MH on the sewer system. Blowers shall be kept in place until all service connections have been re-opened and styrene odour levels deemed low enough for closure of MH covers.
- Ensuring hot water used in curing of resins containing styrene is cooled to the ambient temperature of the sewer system before being released into the sanitary sewer.

The Contractor shall take necessary actions to immediately address any complaint of odours

within a property. The Contractor shall not enter any property, without permission of the owner or resident of the property. Actions to alleviate odours shall include but are not limited to the following:

- Filling of plumbing traps with water.
- Preventing air flow from any drain with a malfunctioning trap (do not hold water) or drains that do not have traps.
- Ventilation of the property by opening windows and doors.
- Ventilation of the property with appropriately sized fans or blowers.
- Other actions that are useful in alleviating the odour problem.

The Contractor shall be responsible for proper disposal of all water used for curing of resin containing styrene in accordance with applicable guidelines, laws and regulations. Under no circumstance shall curing water containing styrene be discharged into the City's storm sewer system or a body of water.

Liner Continuity

The completed CIPP liner shall be continuous over the entire length of the sewer section (MH to MH) without any breaks, cracks, separations, joints or discontinuities.

Fit and Finish

Liners shall be continuous, tight fitting and closely conforming to the shape of the existing sewer with no bridging, gaps or voids. Liners shall be in contact with the inside surface of the existing sewer to ensure the level of mechanical bonding correspond to the design and performance parameters for the liner, with no annular space between the liner and the existing sewer, except for the maximum allowable diametric shrinkage due to curing permitted in ASTM D5813.

Liners shall be free of any interior bulges, lifts, sags, wrinkles, fins, ribs, ripples, rips, tears, holes, scratches, cracks, separations, blisters, eruptions, stains or other irregularities. Exceptions to the liner fit maybe considered acceptable where these irregularities correspond with irregularities in the existing sewer and the diameter of the affected area of liner (measured along the inside surface of the liner) is not greater that one half the diameter of the existing sewer. Irregularities in the existing sewer include off set joints, protrusions, bumps or other similar irregularities that remain following acceptable cleaning and preparation of the sewer.

Liner termination points at manholes shall be tight fitting and tapered to eliminate any impediment to flow. Any annular space between the liner and existing sewer at terminations points shall be sealed by filling the space with a resin mixture or sealant compatible with the CIPP liner.

Under no circumstance shall the fit and finish of the installed CIPP liner negatively affect the flow, design requirements or long-term performance of the CIPP liner.

Hydrophilic End Seals

Contractor shall install hydrophilic end seals at each end of the CIPP liner to prevent water migrating in the annular space between the CIPP liner and host pipe from entering back into the manhole. Hydrophilic end seals shall be continuous around the circumference of the liner/host pipe and swell when in contact with water to provide a watertight seal between the

liner and host pipe. The hydrophilic end seals shall be at least 20mm wide and 5mm high prior to hydration and have a swell capacity of at least two hundred percent (200%).

240.15 SEWER CLEANING AND PREPARATION FOR LINING

The Contractor shall conduct sewer cleaning and preparation for lining operations, including the cutting back of protruding service connections, filling of voids, and service lateral connection grouting, as per the below specifications.

Sewer Cleaning

The sewer section to be lined shall be cleaned to remove all sewage and foreign materials such as sludge, debris, deposits, build-ups, grease, roots, and protrusions (including protruding service connections) by means of hydraulically propelled, high velocity jet water propelled or mechanically powered cleaning equipment with use of reamers, cutters or grinders, as necessary and flushed afterwards with a high-pressure water nozzle. Any foreign material remaining after cleaning operations must not reduce the internal diameter of the sewer by more than 13 mm and must be hard and firmly attached to the sewer.

The Contractor shall plan and execute the cleaning operations to prevent damage to the sewer and service connections, and to ensure that any areas of the sewer that are structurally unsound are not further damaged. Precautions shall be taken to ensure that the cleaning operations do not cause flooding of public or private property being serviced by the sewer system. Any damage to the sewer or service connections or flood damage will be repaired at the Contractors expense.

The Contractor shall scour manhole walls and benching before cleaning downstream sewers. Sewers are to be cleaned in the direction of flow. Foreign material from the cleaning operations shall be removed at the downstream manhole of the section being cleaned with vacuum pumping or other acceptable methods. Passing foreign material from manhole section to manhole section shall not be permitted. The Contractor shall also install a screen at the outlet pipe of the downstream manhole in order to catch any foreign material, including cut outs from service connection openings, which might migrate downstream. The Contractor will be responsible for proper off-site disposal of all foreign material removed from the sewer during cleaning and lining operations. Wastewater (including sewage) shall remain in the sewer system and be allowed to flow downstream during removal of foreign material. Excessive wastewater removed from the sewer system during removal of foreign material shall be discharged back into the sewer of origin and not removed from site. Contractor shall not be compensated for off-site disposal of wastewater.

Protruding Service Connections

Service connections that protrude into the sewer section shall be cut or ground back prior to pipe cleaning or reaming operations that may damage the connection. The finish surface of the connection shall be smooth and even (no jagged edges) to avoid damage of the liner material. The extent of the protrusion left in place must not interfere with the installation or long-term performance of the CIPP liner and in no case, shall be more than 6 mm from the pipe wall. If an intact and sound service connection is damaged or broken as a result of the Contractors operations, then the Contractor shall repair the damage at his own expense by

using excavation if necessary. The Contractor shall submit the proposed method of repair and reinstatement of damaged service connections to the Engineer for review and approval, prior to commencement of the work.

Active Infiltration
Active infiltration of water into the sewer that may cause wash-out of the uncured resin, heat sinks that will prevent proper curing or otherwise negatively affect the installation and curing of the liner shall be sealed to the satisfaction of the Engineer. No liner shall be installed in any sewer until such a time as all active water infiltration into the sewer has been stopped.

Filling of Voids
Filling of voids in the pipe and the surrounding soil shall be completed at locations specified in the contract documents or as identified upon completion of the preliminary or pre-lining CCTV inspections. Voids shall be completely filled flush with the inside wall of the pipe to prevent bridging of the liner, prevent settlement of the backfill and provide a solid backing for the liner, while ensuring the structural integrity of the pipe. Voids created due to the Contractors sewer cleaning method or operation shall be filled by the Contractor, at no cost to the City. The Contractor shall submit to the Engineer for approval, a detailed procedure outlining the process and materials to be used for filling of voids, as part of the pre-lining submission documentation.

Service Lateral Connection Grouting
Contractor shall grout sewer service lateral connections to the sewer main at locations specified in the contract documents or as identified following review of preliminary or pre-lining CCTV inspections, to fill voids around the service connection and surrounding soil, and to prevent active infiltration of water into the sewer that may cause wash-out of the uncured resin, heat sinks that will prevent proper curing or otherwise negatively affect the installation and curing of the liner.

Sewer service lateral connection grouting shall be completed using a chemical grout solution or other approved product, that is compatible with the CIPP liner system and form a smooth watertight connection. The Contractor shall submit to the Engineer for approval, a detailed procedure outlining the process and materials to be used for sewer service lateral connection grouting, as part of the pre-lining submission documentation.

240.16 CCTV INSPECTIONS

CCTV Inspections required under this contract include a Preliminary (V1), Pre-Lining (V2), Post-Lining (V2) and Warranty (V4) (Provisional) Inspection of each MH-MH section of sewer to be lined. All CCTV inspections shall be performed as per the below specifications and shall be used as part of the City's approval process of the Contractors work. Other CCTV inspections carried out by the Contractor shall be at the Contractors sole discretion and expense.

Equipment
Inspection equipment shall consist of inspection unit (vehicle), colour cameras, lighting, cables, power source, monitor(s), data acquisition system, digital recorder, and other related equipment.

The CCTV inspection unit shall consist of a self-contained vehicle with an area for viewing, recording and controlling the CCTV inspection operations and a separate area for equipment storage. The viewing and control area shall have proper seating and sufficient space to accommodate the City representative and provide a clear view of the monitor screen which displays the inspection work as it proceeds.

The inspection unit shall be equipped with fans and/or blowers necessary to remove any fog that may be present in the sewer during inspection.

The CCTV equipment shall be specifically designed and constructed for sewer inspection and shall permit viewing of the entire perimeter of the sewer, for all pipe sizes identified in the contract. The CCTV camera must be a true PAN and TILT camera physically capable of radial rotation of 360 degrees, lateral rotation of at least 270 degrees, and of producing a continuous high resolution colour picture of not less than 400 lines at the periphery of the image. The adjustment of focus and iris shall allow optimum picture quality to be achieved and shall be remotely operate.

The camera shall be transported through the sewer by means of a self-propelled rubber tire or crawler type camera transporter capable of passing over minor amounts of debris and surface imperfections. The transporter shall permit complete inspection of the sewer from the centre of the start manhole to the centre of the finish manhole while maintaining a centreline path. The camera transporter shall be capable of moving forward and reverse at variable speeds. The camera transporter must be stable and adjustable, and the centre of the lens shall be positioned in the centre of the sewer. The camera position tolerance shall be +/- 10% of the vertical dimension of the sewer. The camera shall be capable of inspecting at least 200 meters of sewer in one continuous inspection and from one point of entry.

The camera shall have a self-contained lighting system capable of providing a clear picture of the entire periphery of the pipe of a minimum illumination level of 100 foot candles over a minimum distance of two (2) meters. The lighting shall be set up in such a manner so as not to project a shadow of the body of the camera and/or transporter onto the surface of the pipe within the field of vision of the camera when aimed down the barrel of the pipe.

The monitor shall be not less than a 21inch colour monitor and shall provide a colour picture of sufficient size and clarity to be easily viewed by the Contractor’s operator and the City representative, and it shall clearly define the details of the interior of the pipe. The picture quality on the monitor shall provide a continuous 400 line (or greater) resolution video picture.

Digital video records shall be able to capture in colour from the live video source with MPEG-4 format. Minimum recording video resolution shall be 400 lines with a NTSC size of 720 x 480 @29.97 frames per second.

Inspection Requirements

The CCTV inspection shall be performed on one MH-MH sewer section at a time. The inspection shall start in the MH and provide a clear view of the pipe opening and pipe/MH wall interface. The inspection camera shall also pan vertically to provide a complete view (cover to base) of the start MH and end MH. CCTV inspections shall be continuous over the entire length of the sewer section. Each sewer section being inspected shall be sufficiently dry to

ensure total viewing of the periphery of the pipe, including the pipe invert. Appropriate flow control measures shall be used to accomplish the required viewing of the pipe, as per Section 240.13 of this Specification. The inspection shall be performed in the direction of the flow, where possible.

The sewer section under inspection shall be free of any fog or vapour that obscures the view. Where required, appropriate ventilation equipment such as fans and blowers, or other provisions shall be used to eliminate such fog or vapour.

The inspection speed shall allow proper analysis of the pipe condition. The maximum camera travel speed shall be 5 meters/minute. The camera shall stop and pan/tilt, as necessary, to provide a clear direct view of each service connection and other significant observations for at least 5 seconds.

The finished video must be clear and correctly illuminated to vividly show the object being video inspected. Unacceptable quality will be cause for rejection.

Sewer Condition Coding and Operator Qualifications

The CCTV inspection shall include sewer condition coding in accordance with the National Association of Sewer Service Companies (NASSCO), Pipeline Assessment and Certification Program (PACP) Reference Manual or an acceptable alternate program.

Only operators who have successfully attained the NASSCO PACP Level of Qualification for CCTV Operators will be permitted to operate inspection equipment. The operator shall be fully trained in all aspects of sewer inspection and capable of making accurate observations and recording of all conditions, which may be encountered in the sewers. A copy of the PACP CCTV Operators Certificate shall be submitted for each operator that will be performing this work. Only work completed by PACP certified operators will be accepted.

CCTV Inspection Video and Reports

The Contractor shall produce a CCTV inspection video and inspection report utilizing a commercially available and internationally recognized sewer inspection software program. The inspection video and report (PDF format) shall be provided to the Engineer by way of the Internet. The Contractor shall provide the Engineer with a URL (ie. internet address) that will provide access to the CCTV inspections for viewing and downloading within the specified timelines.

The sewer inspection software must be capable of the following:

1. Digitally record each video to MPEG- 4 format and suitable for proper playback on commonly used video file playing software applications.
2. Generating a text overlay on each section with a complete description including continuous distance display, observations, and defect coding throughout each section.
3. Rating deficiencies as per PACP coding.
4. Documenting and storing data and video files together.
5. Generating written reports complete with still photographs.
6. Produce scaled drawings indicating position of service laterals and noted observations.
7. Interface with City sewer management software.

Clearly display the following information on the viewing monitor and video recording for a minimum of 10 seconds prior to commencing the inspection:

1. Contract Name and Number
2. Street Name
3. Start Manhole and End Manhole
4. Pipe Type or Use
5. Pipe ID Number
6. Direction of Travel
7. Pipe Material, Shape and Diameter
8. Date and Time

Clearly display the following information on the viewing monitor and video recording throughout the inspection:

1. Street Name
2. Start Manhole and End Manhole
3. Automatic update of distance from center of the start manhole
4. Defect coding and observations

Video File Naming Convention
File names for each digital video file shall be in accordance with the following:

Street Name_Pipe Type and ID_Start MH_End MH_DS or US<inspection direction>_V1, V2, V3 or V4<Video inspection completed>.MPG

For example: Topsail Road_San5329_MH5328_MH5350_US_V1.MPG

Pipe and manhole ID numbers will be provided by the Engineer.
Use “San” for sanitary sewers, “Sto” for storm sewers and “Com” for combined sewers.

Preliminary CCTV Inspection (V1)
Before undertaking any work required for the CIPP lining of a sewer section, the Contractor shall complete a preliminary (V1) CCTV inspection of the sewer section. The V1 inspection is to determine the existing condition of the sewer section and if the sewer section is a suitable candidate for CIPP lining. The V1 inspection will also determine whether any excavated repairs or filling of voids (in the existing sewer pipe or surrounding soil) are required before lining and collect information necessary for proper design of the CIPP liner. The inspection complete with all reports shall be provided to the Engineer at least 7 days prior to the start of lining.

If the sewer section is deemed by the Contractor to be not suitable for lining, the Contractor shall immediately notify the Engineer and provide a copy of the CCTV inspection within 24 hours.

The Contractor shall complete sewer cleaning operations as necessary to provide a satisfactory CCTV inspection.

Pre-Lining CCTV Inspection (V2)
Following cleaning and preparation operations of the sewer section, a pre-lining CCTV

inspection (V2) of the sewer section shall be completed by the Contractor to determine if the cleaning and preparation operations are acceptable for CIPP lining. The V2 CCTV inspection shall also capture all information necessary for the Service Lateral Connections Report (refer to Section 240.17). The inspection complete with all reports shall be provided to the Engineer at least 2 working days prior to lining, for review and approval of the cleaning and preparation operations.

Lining shall not commence until approval of the cleaning and preparation operations has been provided by the Engineer.

If the V2 inspection identifies any deficiency in the cleaning and preparation of the sewer section that requires correction, the inspection shall be redone at the Contractors expense after the correction of the deficiency and submitted to the Engineer.

Post-Lining CCTV Inspection (V3)
Following completion of all work related to the lining of the sewer section, including reinstatement of service connections and MH benching, a post-lining CCTV inspection (V3) of the sewer section shall be completed by the Contractor. The V3 inspection complete with all reports shall be submitted to the Engineer for review and approval within 5 working days of completion of liner installation, and in all cases, prior to payment of any progress claim submission for the liner installation.

If the V3 inspection identifies any deficiency in the CIPP lined sewer section, the Contractor shall immediately notify the Engineer of the deficiency and provide a copy of the CCTV inspection within 24 hours.

Following the correction of any deficiency in the CIPP lined sewer section, the V3 inspection shall be redone at the Contractors expense and submitted to the Engineer**.**

Warranty CCTV Inspection (V4) (Provisional)
If identified in the contract documents, the Contractor shall complete a warranty CCTV inspection (V4) of the lined sewer section within the last 2 months of the warranty period. The Contractor shall complete sewer cleaning operations as necessary to provide a satisfactory V4 CCTV inspection. The V4 inspection complete with all reports shall be submitted to the Engineer prior to expiry of the warranty period for review and approval of the CIPP lined sewer section.

If the V4 inspection identifies any deficiency in the CIPP lined sewer section that requires correction, the inspection shall be redone at the Contractors expense after the correction of the deficiency and submitted to the Engineer.

240.17 IDENTIFICATION OF SERVICE CONNECTIONS

The Contractor shall identify all service connections on a sewer section, as part of the preliminary or pre-lining CCTV inspection, and submit a Service Lateral Connection Report to the Engineer at least 2 days prior lining of the section. The Service Lateral Connection Report shall contain the information listed below:

- Contract No.
- Date.
- Street Name.
- Sewer Section No.
- Start MH and End MH
- Total number of service lateral connections
- For each service lateral connection, identify the distance from the starting manhole, clock position, diameter, material type, connection status (active, inactive or undetermined), address of property serviced and general observations pertaining to the lateral.

The Service Lateral Connection Report shall be used as a control document for reinstatement of service connections into the lined watermain. Upon completion of service reinstatements, the report shall be updated to identify the reinstated service connections and submitted to the Engineer along with the post-lining CCTV inspection.

240.18 CIPP LINER MATERIALS AND STANDARDS

The CIPP lining shall be carried out in accordance with ASTM F1216 (inverted liners), ASTM F1743 (pull-in-place liners) or ASTM F2019 (reinforced pull-in-place liners). Liner material shall be in accordance with ASTM D5813 or its latest edition.

The liner shall utilize a thermosetting resin and catalyst that is compatible with the liner tube and able to cure in the presence of hot water or steam. The inner surface of the liner shall contain flexible plastic coating that is compatible with the resin. The liner shall be uniformly impregnated with the correct quantity of resin to produce a cured result that has homogeneous and uniform physical properties throughout the liner wall that meet or exceed the requirements of referenced standards or the properties used in the liner designs, whichever are higher. In this context the liner wall does not include the surface plastic coating. CIPP Liner designs shall not use properties lower than those in the reference standards. The quantity of resin used in the liners and its impregnation shall meet with the requirements of ASTM F1216-16, section 7.2.

Where, in the course of Work, the Contractor has reason to use materials that differ from the original proposed materials, either in general or for a specific installation, the proposed alternate materials shall meet the above standards and require the approval of the Engineer prior to use.

240.19 CIPP LINER DESIGN

The Contractor shall provide engineered designs for each unique liner situation, including for each size of liner. The engineered designs shall demonstrate, to the satisfaction of the Engineer, that the lining to be installed is rated to withstand the required external loads.

The thickness for CIPP liners shall be determined in accordance with the design method set out in ASTM F1216-16, Appendix X1, Design Considerations, Section X1.2.2, Fully

Deteriorated Gravity Pipe Condition. The standard design parameters are as identified in the below table.

The thickness determined by design shall be the minimum thickness of the completed CIPP liner in the sewer. Liner thickness measurements shall not include any non-structural layers, such as plastic coatings and shall be in accordance with ASTM D5813.

Engineering designs for CIPP liners shall be approved and stamped by a licensed Professional Engineer and Permit Holder authorized to perform such work by PEGNL. Engineering designs shall be submitted to the Engineer for review and approval, as per the pre-lining submissions.

Standard Liner Design Parameters
Standard Design for CIPP liners shall use the following parameters:

Parameter	**Requirement**
Design Method	ASTM F1216-16, Appendix X1, Section X1.2.2
Pipe Condition	Fully Deteriorated Gravity Pipe Condition
Pipe Size	Actual inside diameters of the existing sewer.
Ovality	3% or actual ovality, whichever is greater.
Soil Cover Over Sewer	3.0 m soil cover or actual soil cover at liner location, whichever is greater.
Water Table Location	1.5 m below ground surface
Soil Density	19.61 kN/m³ (2000 kg/m³)
Soil Modulus	6.9 MPa
Live Load	AASHTO HS-20
Enhancement Factor	7.0 for CIPP liners that are tight fitting to existing sewer
Design Life	50 years
Factor of Safety	2.0
CIPP Liner Flexural Modulus	The flexural modulus to be used in design equations X1.1 and X1.3 shall be the long-term flexural modulus in the axial direction. The flexural modulus to be used in design equation X1.4 shall be the short-term flexural modulus in the axial direction. The short-term flexural modulus testing shall be in accordance with ASTM D790. The long-term flexural modulus shall be the amount of short-term flexural modulus retained for the design life. The retention factor shall be derived from long-term testing in accordance with ASTM D2990 and be appropriate for stress and stress duration in the installed liner. Independent third-party test data is required to substantiate the short-term and long-term values used in design.

	Minimum short-term value shall be in accordance with the minimum requirement in ASTM F1216 (1724 MPa).
CIPP Liner Flexural Strength	The flexural strength to be used in design equations X1.2 shall be the long-term flexural strength in the axial direction. The short-term flexural strength testing shall be in accordance with ASTM D790. The long-term flexural strength shall be the amount of short-term flexural strength retained for the design life. The retention factor shall be derived from long-term testing in accordance with ASTM D2990 and be appropriate for stress and stress duration in the installed liner. Independent third-party test data is required to substantiate the short-term and long-term values used in design. Minimum short-term value shall be in accordance with the minimum requirement in ASTM F1216 (31 MPa).

Flexural Modulus and Flexural Strength
The flexural modulus (ASTM D790) and flexural strength (ASTM D790) short-term values shall be values that are reliably and repeatedly obtained in the installed liners, as substantiated by testing samples from installed liners. They shall not be values obtained from laboratory samples or maximum values obtained in testing. The liner designs shall identify the short-term test values of flexural modulus and flexural strength from which long-term design values are derived.

Pre-Installation Evaluation
The Contractor shall evaluate each sewer section proposed for a liner installation to determine whether the actual field conditions correspond with the Standard Liner Design Parameters. Field conditions to be checked include pipe ovality, pipe size, soil cover over top of pipe, water table location and live load. Where any field condition is in exception to the Standard Liner Design Parameters the Contractor shall notify the Engineer within 48 hours of completing the evaluation. The Contractor shall also complete a Special Design utilizing the actual field conditions to determine if the existing standard liner design is appropriate.

Where a liner thickness determined from the Standard Liner Design parameters is insufficient for the installation as determined by a Special Design, the liner thickness shall be increased to satisfy the Special Design liner thickness. Any additional cost of the increased liner thickness shall be as per the Unit Price identified in the Form of Tender, if applicable, or shall otherwise be negotiated with the City.

No liner shall be installed that does not meet the design requirements and liner thickness for the actual field conditions.

240.20 SERVICE LATERAL CONNECTIONS REINSTATEMENT

The Contractor shall commence reinstatement of all active and undetermined service lateral connections (as per the Service Lateral Connect Report) in a sewer section, immediately following the curing (including cooling) of the installed liner. Inactive service connections are not to be reinstated. The method of reinstatement shall be from the inside of the sewer using robotic equipment and without excavation.

Service connections shall be opened to at least 75 % capacity within 8 hours and fully opened and trimmed within 24 hours of completion of the liner curing process. Service connection openings in the liner shall match the size and shape of the existing service connection inside wall. Openings shall be smooth and clean. Finished openings shall be without protrusions, hanging material, shavings, lips or obstructions to sewage flow from the service connection into the interior of the liner. Over-cutting shall be avoided. Service connections, that in the Engineer's opinion, are over-cut will be deemed defective and require a CIPP spot repair followed by reinstatement of the lateral by the Contractor as a remedial action, at no cost to the City.

The existing service connections shall not be damaged. The Contractor shall repair any damage to the existing connections that occurs during the reinstatement, to the satisfaction of the Engineer, at no cost to the City.

It is the responsibility of the Contractor to make location measurements or employ alternative procedures that allow for locating and identifying service laterals after lining is complete.

Pressure Testing and Chemical Grouting of Service Lateral Connection
Following reinstatement of sewer service lateral connections and prior to completion of the post-lining CCTV inspections, the Contractor shall pressure test and grout (as necessary) service lateral connections using the pipe packer method with a chemical grout solution to fill any voids between the CIPP liner and host pipe and surrounding soils.

All service lateral connections to the sewer main shall be pressure tested; however, only the connections that fail to meet the requirements of the pressure test are required to be grouted. Grouting shall be by injection of a chemical grout solution using a lateral pipe packer. The chemical grout solution shall be compatible with the CIPP liner system and form a watertight connection.

The Contractor shall submit to the Engineer for approval, a detailed procedure outlining the process and materials to be used for sewer service lateral connection chemical grouting, as part of the pre-lining submission documentation.

240.21 MANHOLE BENCHING AND RESTORATION

Following CIPP sewer liner installation, all manholes shall be re-benched, if necessary, to conform to the dimensions and positions of the liner. Where a liner has been placed continuously through a manhole, the top half diameter of the liner shall be opened the full width of the manhole (from pipe entrance to exit) and the benching made to conform to the exterior

of the liner. Where the existing benching does not fit tightly to the portion of the liner left in place, any gaps or misfits shall be filled with a suitable concrete patching compound. The finished liner and benching in the manhole shall provide a smooth and uniform flow path from entrance to exit at a uniform grade.

Where lining work necessitated or resulted in damage to the manhole or the manhole benching, it shall be restored to equal or better than original condition and shall meet the requirements for benching as previously specified.

Material for benching work shall be Speedcrete, 20 MPa or approved equal.

240.22 CIPP LINER AND RESIN SAMPLES AND TESTING

CIPP Liner Samples

Contractor shall prepare one sample of CIPP liner for testing from each MH-MH sewer section lined, in accordance with ASTM F1216-16 Section 8 and these specifications. Where two consecutive MH-MH sewer sections are being lined with the same liner installation, only one CIPP liner sample taken at an intermediate MH is required. CIPP liner samples shall be restrained (pipe type) samples for sewer sizes up to nominal 450 mm. For sewer sizes greater than nominal 450 mm, the Contractor shall provide either a plate type sample or a restrained sample from a circular multi-piece form assembled in the MH. Plate type samples or multi-piece restrained samples for sewer sizes less than nominal 450 mm will not be accepted unless the Contractor can demonstrate to the satisfaction of the Engineer that restrained (pipe type) samples cannot be obtained for a specific installation.

Restrained samples shall be made by extending the liner through a cylindrical form held in place at the outlet of the sewer being lined. The form shall have an inside diameter as close as possible to the inside diameter of the sewer being lined and shall be sufficiently strong to prevent expansion or distortion of the sample. Sample shall be taken at an end MH or an intermediate MH that was temporarily lined through as part of the same liner installation. Contractor shall ensure sample conditions during curing are representative of the remaining sewer liner conditions during curing by such means as placing sandbags over and around the sample form during curing.

The sample form shall be of sufficient length to prevent edge effects and provide at least five test coupons for ASTM D790 testing. For non-reinforced CIPP, sample length shall be sufficient to obtain test coupons of 16 times liner thickness plus an allowance (at least100 mm) to eliminate sample end effects. For reinforced CIPP, sample length shall be sufficient to obtain test coupons of 32 times liner thickness plus an allowance (at least 100 mm) to eliminate sample end effects. Under no circumstances shall any sample be less than 300 mm in length.

Contractor shall remove the cured sample under the direct supervision of the Engineer. Restrained pipe sample is to remain in the form, while the restrained multi-piece form sample and plate sample is to be removed from the forms. After the sample is identified with appropriate information, the sample is to be turned over to the Engineer.

Before or immediately upon removal, the sample shall be clearly marked with the following Identification information:

- Contract Number.
- Installation Date.
- Street name.
- Sewer Size.
- MH numbers delineating sewer section lined.
- MH number where sample was taken.
- Crown position.

CIPP Liner Sample Testing
CIPP liner samples shall be tested for short-term flexural strength and short-term flexural modulus as per ASTM D790 and thickness as per ASTM D5813. Samples to be submitted for testing will be at the discretion of the Engineer. The Engineer will arrange and pay for delivery and testing of the liner samples at a testing laboratory designated by the Engineer. All samples and test results remain the property of the City of St. John's. Test reports will be provided to the Contractor on request.

Delamination testing shall be performed in accordance with ASTM F1216 specifications, at the City's discretion.

Resin Samples and Testing
Contractor shall arrange for sampling of uncatalyzed resin from the wet-out facility immediately before addition of the catalyst and wet-out of the liner. One representative sample is to be taken from each resin batch to be used on the project and delivered to a testing laboratory designated by the Engineer. If the liners are to be wet-out at the manufacturer's facility prior to delivery to the Contractor, the manufacture will be responsible to submit the samples directly to the testing laboratory. If the liners are to be wet-out by the Contractor, the samples must be taken under the supervision of the Engineer, and the Engineer will submit the samples to the testing laboratory. Upon request of the Engineer, additional resin samples may be required to be taken and submitted for testing. Resin samples are to be tested by infrared (IR) analysis and the resulting IR spectrographs compared to the reference spectrograph provided as part of the pre-lining submissions. The Engineer will pay for testing of the resin sample. All samples and test results remain the property of the City of St. John's. The test reports will be provided to the Contractor on request.

240.23 CIPP LINER SAMPLE TEST RESULTS

CIPP liner sample test results for short-term flexural strength and flexural modulus (ASTM D790) and thickness (ASTM D5813) will be compared to the short-term flexural strength and flexural modulus and thickness values used in the Contractors liner design. Where any of the liner sample test results do not meet or exceed the liner design values, the liner may be considered deficient pending a design review. The design review will utilize the sample test results for flexural strength and flexural modulus, while keeping all other parameters the same, to re-calculate the required CIPP liner thickness.

Upon completion of the design review, if the liner sample thickness meets the re-calculated liner design thickness, the liner shall not be deemed deficient. If the liner sample thickness does not meet the re-calculated liner design thickness, the liner shall be deemed deficient. If the liner sample test results do not meet the minimum requirements of ASTM F1216, a design review will not be conducted, and the liner will be deemed deficient.

240.24 CIPP LINER DEFICIENCIES

Where in the Engineer's opinion, the liner sample test results or CCTV inspections or any further investigation indicate the liner is not in accordance with the Contract requirements, the liner shall be deemed deficient. The Contractor shall take remedial action acceptable to the Engineer to correct any deficiency, in accordance with the Specifications and Contract requirements. Remedial actions shall ensure the liner meets the 50 year design life requirements and may include repair of any deficiency, installation of a supplemental liner, or complete removal and replacement of the deficient liner. Remedial actions must be submitted to the Engineer for review and approval prior to commencement of remedial work. Contractor will be responsible for the cost associated with all required remedial work.

240.25 EQUIPMENT RECOVERY WORKS

In the event that equipment becomes stuck or jammed in a sewer line, the Contractor shall immediately notify the Engineer. Removal of equipment, including removal by excavation, and all associated repair and restoration works, will be the responsibility of the Contractor. The Contractor shall complete any required repair and restoration works in accordance with the applicable City of St. John's specifications. No additional payment will be made for equipment recovery works.

240.26 REINSTATEMENT AND CLEANING

The Contractor shall reinstate, restore, replace, repair and make good all public and private property disturbed or damaged during performance of the work, in accordance with the applicable City of St. John's specification and to the satisfaction of the property owners and Engineer.

Following completion of all construction and reinstatement work, the Contractor shall complete a final cleaning of the site, including any public and private property disturbed, damaged or utilized during performance of the work, to remove surplus materials, equipment, tools, etc., to the satisfaction of the property owners and Engineer.

No additional payment will be made for reinstatement and cleaning works.

240.27 MEASUREMENT FOR PAYMENT

Measurement for payment purposes shall be as follows:
1) Mobilization and Demobilization – lump sum price.

2) CIPP Liner - the centreline distance of sewer main liner installed, measured in meters (from center of start MH to center of end MH), for each pipe size.

   Unit price shall be full compensation for carrying out the specified scope of work, (including but not limited to, traffic control, flow control and bypass pumping, sewer cleaning, liner installation, sampling, MH benching, reinstatement and clean-up of the work site, and all other incidental work and services necessary for completion of the scope of work), with exception of any separately identified pay items.

3) CIPP Liner (Thickness Increase) - the centreline distance of sewer main liner installed, measured in metres, for each pipe size and each increment increase in liner thickness. Unit price shall be full compensation for carrying out the additional work associated with an increased liner thickness. (Provisional Item).

4) CCTV Inspection – the centreline distance of sewer main video inspected, measured in metres, including supply of an inspection report (PDF) and inspection video.

5) Material Disposal – weight of foreign material in metric tonnes removed from the sewer system during cleaning and preparation operations and disposed of at an off-site facility approved to accept such materials for disposal and/or treatment. Wastewater shall remain in the sewer system and will not be measured for payment.

6) Cutting or Grinding of Protruding Service Connections - unit price for the number of service lateral connections cut or ground back in preparation for sewer lining.

7) Filling of Voids – based on the Contractor's invoice for Time, Materials and Equipment, and shall be as an Allowance, as specified in the Form of Tender.

8) Service Lateral Reinstatement – unit price for the number of service lateral connections reinstated following CIPP lining.

9) Service Lateral Connection Pressure Testing – unit price for the number of sewer service lateral connections pressure tested.

10) Service Lateral Connection Grouting – unit price for the number of sewer service lateral connections pressure injection grouted with chemical grout solution.

11) Chemical Grouting – unit price per Litre (L) of chemical grout solution pressure injected at sewer service lateral connections.

12) Project Sign – unit price for the number of project signs of each size supplied, installed and removed (end of project).

240.28 PAYMENT

Payment shall be on a lump sum or unit price basis, or an allowance, as per the pay items identified in the Form of Tender. The bid price shall include all design, supervision, labor,

equipment and materials necessary to complete the work in accordance with this specification.

The Contractor will only be paid to a maximum of 80% of the value of the CIPP Liner and CIPP Liner (Thickness Increase) pay items, until such time as the CIPP liner section has passed all sample testing criteria, as per the Contractors design and reference standards, and accepted by the City. This 20% holdback will be called the "Sample Test Allowance". In addition, the 10% mechanics lien holdback shall apply.

Payment for a liner thickness increase as determined by a Special Design, in which there is an increase in the nominal tube thickness shall be as per the Unit Price identified in the Form of Tender. Where there is no unit price for CIPP Liner thickness increase identified in the Form of Tender, the cost shall be negotiated with the City. Payment for a liner thickness increase will not be given without a corresponding certified design approved by the City.

Payment for Warranty CCTV Inspection shall be as an Allowance, as specified in the Form of Tender. Payment for the allowance shall be equal to the amount of work actually completed and at such a time that a satisfactory warranty inspection is provided to the City. The allowance will be adjusted to actual cost as defined under GC 51 Valuation and Certification of Changes in the Work. The allowance does not cover the cost associated with the correction of any deficiency identified by the warranty inspection.

Payment for Filling of Voids shall be as an Allowance, as specified in the Form of Tender. Payment for the allowance shall be based on the Contractor’s invoice for Time, Materials and Equipment. The allowance will be adjusted to actual cost as defined under GC 51 Valuation and Certification of Changes in the Work. The allowance does not cover the cost associated with the filing of any voids created as a result of the Contractors sewer cleaning or other operations.

ITEM 250

CURED IN PLACE PIPE LINING OF WATERMAINS

250.01 SCOPE OF WORK

The work to be performed shall include all labour, equipment, tools, materials, engineering design and supervision to structurally rehabilitate various sections and sizes of watermain by Cured-in-Place Pipe (CIPP) lining method in accordance with the plans and specifications.

The work also includes but is not limited to, traffic control, temporary watermain bypass and service connections, pavement cutting, excavation and preparation of access pits, dewatering, pipe cutting, pipe cleaning and preparation for lining, disposal of water and debris from pipe cleaning operations, CCTV inspections, liner installation and curing, liner sampling, reinstatement of service connections, removal and replacement of necessary watermain pipe, valves, fittings, and hydrants, cathodic protection, flushing, pressure and leak testing, disinfection, close-up of watermain, backfilling and restoration of excavated areas, reinstatement and clean-up of the work site, and all other incidental work and services necessary for completion of the scope of work.

CIPP lining means trenchless pipe rehabilitation by installation of a resin-impregnated flexible tube which when cured will form a continuous close fit liner within an existing watermain.

CIPP liner thickness shall be designed in accordance with the design section of these Specifications. CIPP designs and any other necessary design works shall be approved and stamped by a licensed Professional Engineer and Permit Holder authorized to perform such work by Professional Engineers and Geoscientists of Newfoundland and Labrador (PEGNL).

250.02 REFERENCE SPECIFICATIONS

ASTM F1216	Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube
ASTM F1743	Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)
ASTM F2019	Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place Thermosetting Resin Pipe (CIPP)
ASTM D5813	Standard Specification for Cured-In-Place Thermosetting Resin Sewer Piping Systems
ASTM D790	Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

ASTM D638	Standard Test Methods for Tensile Properties of Plastics
ASTM D2990	Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics
ASTM D2290	Standard Test Method for Apparent Hoop Tensile Strength of Plastic or Reinforced Plastic Pipe

250.03 CONFINED SPACE REQUIRMENTS

The Contractor shall be responsible to assess the work site to determine whether it contains a Confined Space, as per the Occupational Health and Safety Act. Where a confined space exists, the Contractor shall meet or exceed the requirements of Confined Space Entry as outlined under the Occupational Health and Safety Act.

250.04 PERMITS AND APPROVALS

The Contractor shall obtain all necessary permits, permissions and approvals for the work.

250.05 PRE-LINING SUBMISSIONS

The Contractor shall submit the following to the Engineer for review and approval at least 14 days prior to commencement of any watermain section lining, unless otherwise noted:

1) Engineering design for each size of watermain to be CIPP lined. The designs shall clearly identify the proposed CIPP liner thickness and all required design formulas, assumptions and parameters used in the design. Design parameters shall be in accordance with Section 250.25. Designs shall be approved and stamped by a Professional Engineer licensed in the Province of Newfoundland and Labrador.

2) Proposed CIPP Lining (tube and resin) information including product name, type and manufacturer.

3) Material specifications for the proposed CIPP liner (tube and resin) in sufficient detail to enable confirmation by the Engineer that the materials proposed will meet the objectives, performance requirements and design requirements of this specification.

4) A certified original copy, complete with supporting literature from the resin manufacturer, of the Infrared Spectrograph of the catalyzed resin mixture proposed for the Contract.

5) Documentation and certifications to demonstrate the CIPP Liner meets the NSF/ANSI Standard 61 for potable water.

6) Independent third-party test reports and data supporting the short-term and long-term values of flexural modulus and tensile strength of the proposed CIPP liner used in the

design.

7) Manufacture's recommendations for product transportation, handling and storage, repair of damaged product, installation procedures, inversion pressures and curing schedule (temperature and duration).

8) Contractors proposed CIPP liner installation procedures, including details of the liner wet-out process and liner curing process.

9) Contractors proposed temporary watermain bypass system plan.

10) Contractors proposed traffic control plan.

11) Access pit shoring design documents/drawings approved and stamped by an Engineer and the Contractors proposed access pit locations.

12) Project schedule detailing timelines of the proposed works.

13) Contractors procedures for performing post lining wet taps up to and including 50mm diameter on the CIPP lined watermain.

250.06 SCHEDULE OF WORKS

1) The Contractor shall submit to the Engineer for review and approval, a schedule of the proposed specifically identified works. The schedule shall be reviewed and approved by the City prior to commencement of the planned works.

2) The Contractor shall commence work within seven calendar days from the Engineer's order to commence work. The work shall be carried out on the continuous basis and all assigned work shall be completed within the contract schedule.

3) The Contractor shall notify the Engineer of specific start and finish times for all procedures in order that the Engineer's inspection staff may coordinate their schedules to ensure suitable levels of inspection. This notification shall be given a minimum of 48 hours prior to the start time.

4) The order of work is, in general, the responsibility of the Contractor and shall be as indicated in the detailed work plan. However, the City reserves the right to modify the order of work based on the City's needs and priorities.

250.07 SITE INVESTIGATION

The Contractor shall investigate each site prior to submission of Tender to determine the exiting site conditions, any obstruction, or any other problem which may affect the Tender price or completion of the proposed work. No additional payment shall be made on account of difficulties to complete the work because the Contractor failed to investigate the site prior to

submission of Tender.

250.08 NOTIFICATION OF WATER USERS

The City shall provide an initial notice to all properties connected to the watermain scheduled to be lined, in advance of the start of on-site activities by the Contractor. The notice shall include a brief introduction to the upcoming watermain lining works and the applicable City contact information.

Contractor Provided Notices
The Contractor shall provide appropriate notice(s) to all properties connected to the watermain scheduled to be lined. The first notice shall be provided 7 days in advance of the start of installation of temporary watermain bypass system or access pit excavations required for watermain lining. The notice shall include a brief description of the upcoming construction work, anticipated water service interruptions, details of the temporary watermain bypass system and activation, and names & phone numbers of the Contractor's personnel (including an after hour's local emergency number). The second notice shall be provided 24 hours in advance of the activation of the temporary water supply to affected properties. The Engineer is to receive a copy of the two notices for approval prior to delivery to the affected properties.

Delivery of notices shall be based on actual construction activity on a particular street/area; therefore, may require distribution to different streets/areas at different times.

Additional 24-hour notices shall be provided whenever there is a need to enter a property to perform work such as installation of shut-off ball valves, installation of hose bibs, activation of temporary water service and deactivation of temporary water service.

Record Log of Notifications
The Contractor shall make and maintain a log record. The log shall record the address where each notice was delivered, the date of delivery and any other information relevant to maintaining a record of notifications, such as follow-up telephone calls or property visits. The log shall also record date and description of any work performed at a property, such as installation of shut-off ball valves, installation of hose bibs, activation of temporary water service and deactivation of temporary water service. The log shall be maintained in a common electronic format, such as an MS Excel document. The log shall be provided to the Engineer upon request.

250.09 TEMPORARY WATERMAIN BYPASS SYSTEM

The Contractor shall be responsible to design, supply, install, disinfect, operate and maintain a temporary above ground watermain bypass system with service connections to all properties connected to the existing watermain scheduled for CIPP lining in accordance with the following requirements.

General Requirements
All temporary watermain bypass system materials shall conform to the NSF/ANSI Standard 61

and shall be capable of withstanding 860 kPa pressure and all other conditions of use.

The Contractor shall provide a “Temporary Watermain Bypass System Plan” to the Engineer for review and approval as per the pre-lining submissions section of this specification.

The temporary watermain bypass system shall include the bypass main line, branch lines, service connections, fire hydrants, valves, check valves and connections to the existing water supply system. The work also includes, flushing and disinfection of the bypass system, protection of the system from damage, signage and safety measures, road crossings, temporary shut off of private services, maintenance and repair of the system, removal of the system upon reinstatement of the existing watermain and restoration of the site upon completion of the work.

The temporary watermain bypass system shall be sized to provide all properties with a minimum of 1000 L per occupant per day and a minimum pressure under peak hour flow conditions of 300 kPa. In any case, the bypass main line shall have a 100 mm minimum inside diameter and any branch line shall have a 50 mm minimum inside diameter and services connects shall have a 20 mm minimum inside diameter.

The temporary bypass system materials shall be fully adequate to withstand the pressures and all other conditions of use and shall be of material which does not impart any taste or odour to the water. Pipe and fittings shall provide adequate water tightness and care shall be exercised throughout the installation of any temporary pipe and service fittings to avoid the possible pollution of any City main or property services or contamination of the temporary service pipe.

In general, the temporary watermain bypass system shall be a looped system. However, where looping is not practical, bypass piping dead ends will require the installation of a 20mm diameter temporary water service line that will serve as a continuous water bleed line to prevent stagnate water at dead ends. The bleed lines will require a check valve and will have to be drained to a catch basin or other suitable location.

Where necessary and practical, the temporary bypass main line shall be connected at each end to the existing water system. Additional connections to the existing water system may be required for larger bypass systems. Connection to existing fire hydrants will be acceptable. Where the ends of the bypass main line are connected to different pressure districts, a check valve shall also be installed. Valves shall be installed in the bypass system in the vicinity of existing main line valves on the watermain being lined and where branch lines connect into the bypass mainline or at such other locations as the Engineer may direct. The existing watermain shall not be removed from service until the Engineer has approved the installed temporary bypass system. Once activated, the temporary bypass system shall remain in service until the existing watermain is returned to service, unless otherwise directed by the Engineer.

Progress payment(s) for the temporary bypass system will be pro-rated based on the estimated quantity of watermain in the Tender Form and length of existing watermain taken out of service and only paid when temporary bypass lines are placed in service.

The Contractor shall maintain the temporary watermain bypass system in a safe operating condition and ensure an adequate water supply at all times. During normal working hours or

while on site, the Contractor shall commence repair of any leaks in the temporary bypass system immediately. During after work hours or when the Contractor is not otherwise on site, the Contractor shall respond to assess and immediately repair any leak within 2 hours of being notified of the leak. If it is necessary for the City forces to repair any portion of the bypass system as a result of the Contractor not responding within a 2-hour period, any costs incurred by the City for such repairs will be deducted from the Contractor's progress payment.

During freezing, stormy or inclement weather, no work shall be done except that which is incidental to cleaning or lining, unless otherwise directed by the Engineer. No bypass service pipe or property service connections shall be installed during freezing or inclement weather and pipes already in use shall be removed or drained and services restored when so directed by the Engineer. Removal and reinstallation of such pipes or services shall be done at the Contractors expense.

The Contractor shall maintain a sufficient supply of additional bypass pipe and service connection pipe on Site, in case of emergency. The pipe shall be chlorinated and capped at its ends to prevent contamination and stored in a suitable manner.

Temporary Water Services

All temporary water service connection materials shall conform to the NSF 61 standard. All individual property connections shall be a minimum 20 mm internal diameter, designed for a working pressure of 860 kPa and be free from defects in material and workmanship.

Each residential (single dwelling) property shall have a 20 mm temporary water service connection from the bypass main line or branch line to the private plumbing via a wye at an outside tap (hose bib). Where the dwelling does not have an existing outside tap, the Contractor shall install an outside frost-free tap. If installation of an outside tap is not possible, the Contractor shall provide the temporary water service connection by exposing and connecting to the existing water service line behind the sidewalk. The branching of wyes from a single spigot shall not be permitted; nor will connecting homes in series. Contractor shall arrange to turn off the existing water service at the house entry point prior to connecting the temporary water supply.

The size of temporary service connections to properties other than single dwelling properties shall be the diameter of the existing connection to a maximum of 100 mm, unless otherwise noted in the tender documents.

Flushing and disinfection of the temporary water service will be required prior to connecting to the private plumbing. Temporary water services shall be valved near the point of connection to the bypass line and at the private plumbing system.

Temporary Hydrants

The Contractor shall supply, install and maintain temporary fire hydrants and the necessary valves and fittings as part of the temporary watermain bypass system. Temporary hydrants shall be connected to the watermain bypass system and have a continuous run of 100 mm diameter (minimum) pipe from the hydrant to the existing water system.

Temporary hydrants shall have a male threaded nozzle with a 63.5 mm inside diameter, an

82.5 mm outside diameter and 5V-threads per 25.4 mm in accordance with the City of St. John's thread standard and compatible with the equipment of the John's Regional Fire Department. The temporary hydrants shall have a 63.5 mm minimum operating valve and a 32 mm square operating nut. (Note that most fire hose threads are blunt at the top, however, the 5V thread is cut to a sharp "V" point. To do this the depth of the thread is 1/64th of an inch deeper than the conventional 5-threads per inch (25.4 mm), as noted in the Canadian Standard fire hose thread.)

Two temporary hydrants, spaced approximately 2m apart, shall be set in close proximity to existing hydrants taken out of service and in such a manner that the St. John's Regional Fire Department will have no difficulty making a connection with a fire hose. The hydrants shall be placed where they will cause the least obstruction to vehicular and pedestrian traffic and will be least likely to be damaged. Contractor shall submit a detailed sketch of the proposed temporary hydrant as part of the Temporary Watermain Bypass System Plan. Temporary hydrants shall be tested by the Contractor to ensure they are in proper working order, prior to the bypass system being placed into operation.

Temporary hydrants shall stand in an upright position, be protected by barricades and be maintained until the existing hydrants are restored to service. All temporary hydrants must have reflective tape on the barrel for increased visibility. The existing hydrants which are out of service shall be fitted with an "Out of Service" ring on the hydrant's pumper outlet nozzle.

Water Sample Ports

The contractor shall supply, install and maintain water sampling ports on the temporary watermain bypass system. Water sampling ports shall consist of a 13mm tap or ball valve (with a copper tubing spout) attached to a standpipe extending from the temporary watermain bypass pipe. The water sampling port shall be a minimum of 600mm above grade and protected with a fiberglass enclosure that is rigidly attached to the standpipe. The enclosure shall have a solid hinged cover and latches that are lockable with a pad lock (Hoffman Type 4X - 254mm x 203mm x 152mm or approved equal).

Water sampling ports shall stand in an upright position and be placed where they will cause the least obstruction to vehicular and pedestrian traffic. All water sampling ports must have reflective tape on the standpipe and enclosure for increased visibility. Contractor shall submit a detailed sketch of the proposed water sampling port as part of the Temporary Watermain Bypass System Plan.

Water sampling ports can be incorporated into a temporary hydrant with a tee off the hydrant barrel but shall not interfere with operation of the temporary hydrant. There shall be a separation of at least 300mm between the sample port tee and the temporary hydrant nozzle.

Each temporary watermain bypass system requires a minimum of one (1) water sampling port with one (1) additional sample port required for every 1000m of temporary watermain bypass piping. The location of water sampling ports shall be as identified by the Engineer.

Placement and Protection of Temporary Bypass System

The Contractor shall be responsible to place the temporary watermain bypass lines and temporary water service connections at locations and in a manner that will cause the least

obstructions and prevent injury to vehicular and pedestrian traffic. Under no circumstance shall the temporary bypass interfere with accessible curb ramps. The Contractor shall provide appropriate warning lights, barricades, signage, markings and other necessary measures along the bypass system to ensure the safety of the public. The Contractor shall be responsible to protect the bypass system and public and private property from damage.

Where the temporary watermain bypass line and/or temporary water service crosses a sidewalk, the Contractor shall install the bypass line and/or water service in a recessed trench or shall provide a serviceable ramp at a slope not greater than 1:12. Ramps shall be prefabricated of metal, rubber or wood, or constructed using recycled (milled) asphalt.

At roadway crossings, the Contractor shall saw cut and remove asphalt and granular materials to permit burying of the temporary watermain bypass pipe. The top of the pipe shall be at least 50 mm below the surface. The pipe shall be covered with hot mix or recycled (milled) asphalt to surface and compacted.

At driveway crossings, the Contractor shall either bury the temporary watermain bypass pipe or provide acceptable ramps over the pipe. Burying of pipes requires the saw cutting and removal of asphalt and granular materials to ensure the top of the pipe is at least 50mm below the surface. Buried pipes shall be covered with hot mix or recycled asphalt to surface and compacted. Ramps shall be prefabricated of metal, rubber or wood, or constructed using recycled (milled) asphalt and have a slope not greater than 1:6.

Under no circumstance is a roadway or driveway bypass pipe crossing to remain open and unprotected from vehicular and pedestrian traffic.

Ramps constructed of recycled (milled) asphalt shall be sufficiently compacted to maintain its form and not be in a loose condition. Contractor shall use a protective barrier (felt paper or similar) underneath the recycled asphalt and ensure that all asphalt millings and any staining due to the use of the recycled asphalt are removed upon site reinstatement.

Connection to Hydrants

Where practical, temporary watermain bypass system connections to existing fire hydrants shall be made at the front steamer port; otherwise, double hose outlet connections will be required at each hydrant. Connections shall be made with an approved backflow prevention device (reduced pressure type assembly) and in such a manner that if it becomes necessary, they can be easily removed so the hydrant can be used for fire fighting purposes.

Disinfection of Temporary Bypass Lines and Service Connections

Prior to connection of the temporary watermain bypass system to the existing municipal water system or any private plumbing (including an outside tap), the Contractor shall disinfect the temporary bypass system, including all bypass pipe, water service connections, valves, fittings and hydrants in accordance with Item 230 – Watermains, of the City's Specifications Book.

The Contractor shall arrange for the testing laboratory to e-mail a copy of water quality test results to the Engineer.

Upon acceptable completion of all required bypass system disinfection and testing, all points of

connections between the bypass pipe and the existing municipal water system, and between the water service connections and the outside taps/private plumbing shall be soaked with or submerged into a 5% sodium hypochlorite solution prior to final connection.

Removal of Temporary Bypass Lines and Service Connections
Temporary water bypass lines and service connections shall remain in service until completion of CIPP watermain lining and associated works as specified, and the CIPP lined watermain and service connections are returned to service.

Once the CIPP lined watermain and service connections are returned to service the temporary bypass pipe, service lines, and associated asphalt millings or other ramps shall be promptly removed, and all disturbed areas reinstated in accordance with the City's Specifications Book.

250.10 OPERATION OF EXISTING WATERMAIN VALVES, AND HYDRANTS

The Contractor shall not operate any existing watermain valves or hydrants. In-service watermain valves and hydrants shall only be operated by the City, as per Item 230 – Watermains, of the City's Specifications Book.

250.11 SERVICE SHUT OFF VALVES AND CURB STOPS

The Contractor shall be responsible to coordinate with property owners to locate and inspect the water service shut off valve at the entry point into the building and ensure that shut off valves are in the closed position to prevent backflow of water into the existing watermain. Service shut off valves that are inoperable or do not provide a watertight seal shall be replaced prior to proceeding with lining operations. Where a service shut off valve does not exist or cannot be located, a new shut off valve shall be installed. Where it is not possible or practical to replace or install a new service shut off valve, the Contractor shall locate the existing curb stop and place in the closed position. If a curb stop is inoperable or do not provide a water-tight seal, the Contractor may be required to replace the curb stop and/or curb case (including the stainless steel key, cotter pin, extend to grade and all required excavation, backfilling and reinstatement works), prior to proceeding with lining operations. The Contractor shall ensure that any water leaking into the watermain at service connections is stopped prior to lining of the watermain. Curb stop/curb case or shut off valves shall not be replaced without prior approval of the Engineer. Replacement of any curb stop/curb case or shut off valve shall be as per Item 230 – Watermains, of the City's Specifications Book."

250.12 SUPPLY OF TEMPORARY MUNICIPAL WATER FOR CONSTRUCTION

The Contractor is responsible for the supply of water required for construction and testing purposes. The City will make temporary municipal water available for this purpose from a City hydrant, as per Item 230 – Watermains, of the City's Specifications Book.

250.13 TRAFFIC CONTROL

The Contractor shall provide traffic control measures in accordance with Item 130 Traffic Control of the City of St. John's Specifications Book. The Contractor's Traffic Control Plan shall be submitted to the Engineer for review and approval, as per Item 250.05 Pre-Lining Submissions. The cost for traffic control shall be borne entirely by the Contractor.

250.14 ACCESS PITS

The Contractor shall excavate pits for accessing the watermain for CIPP lining at locations of existing valves and fittings, such as tees, bends (that cannot be lined), crosses, and reducers, where possible. Contractor shall submit the proposed access pit locations to the Engineer for approval. Access pit work shall include all required shoring design, asphalt and concrete cutting, excavation, disposal of excess material, shoring, fencing, dewatering, backfilling, and reinstatement of access pit locations. Access pits shall be backfilled with acceptable excavated materials and/or imported materials, as directed by the Engineer. Backfilling and reinstatement works shall be in accordance with the City's Specifications Book.

The cost associated with assess pits excavated up to 2.5 meters in depth shall be included in the Unit Price for CIPP Liner as specified in the Tender Form.

Additional cost associated with the excavation of access pits beyond the 2.5 meter depth noted above and to a maximum of 300mm below the watermain, shall be as specified in the Tender Form. This cost shall be full compensation for all work associated with the additional access pit depth. No additional payment will be made for work associated with an increased access pit/excavation size due to the additional depth.

Additional access pits may be required for the CIPP lining process due to unforeseen conditions. Any such additional pits shall include all work required for a standard access pit excavated up to 2.5 meters in depth. Payment for additional access pits (up to 2.5 meters deep) and any additional access pit depth (greater than 2.5 meters deep and to a maximum of 300mm below the watermain) shall be as specified in the Tender Form.

Shoring design shall be approved and stamped by a licensed Professional Engineer and Permit Holder authorized to perform such work by PEGNL. Shoring design documents/drawings and the Contractors proposed access pit locations shall be submitted to the Engineer, as per the pre-lining submissions section.

The Contractor shall provide temporary construction fencing, signage, and other necessary measures around each access pit location to ensure the safety of pedestrians and workers. At the end of each workday or any time the Contractor is not on site, the access pit locations shall be secured to prevent entry. These measures are in addition to the required traffic control measures.

In high traffic areas or as directed by the Engineer, the Contractor shall cover the access pits with a steel roadway plate at the end of the workday or anytime the access pit is not being utilized by the Contractor. The plates shall be a minimum of 25 mm thick and extend at least 300 mm beyond the edges of the excavation. The plates shall be skid resistant and installed such that they are recessed and flush with the existing road surface, and do not vibrate, knock,

or become dislodged by traffic. Plates shall not be installed prior to completion of access pit shoring.

Where an existing water service connection located within an access pit is damaged or removed to facilitate lining operations, the Contractor shall re-establish the water service connection to the watermain prior to backfilling, at no cost to the City.

250.15 CUTTING OF PIPE

The Contractor shall cut the existing watermain and remove the valves or fittings contained within an access pit to permit access of the watermain for CIPP lining operations. The watermain shall be cut with a power operated pipe cutting saw or other approved methods. Cuts shall be perpendicular to the pipe axis, and free of fractures and jagged edges.

250.16 CAPPING OPEN PIPE ENDS

All watermain pipe ends shall be capped, plugged or bulk-headed using a mechanical joint plug/cap anytime there is no work being performed on the pipe. The bulkhead must be capable of preventing water from entering or exiting the watermain pipe. When the possibility exists that the capped watermain section could become pressurized, the bulkhead must be equipped with a relief valve and properly braced. The cost for this work shall be included in the Unit Price for CIPP Liner as specified in the Tender Form.

250.17 WATERMAIN CLEANING AND PREPARATION FOR LINING

The Contractor shall clean and prepare each section of watermain scheduled for CIPP lining in accordance with the following requirements. The cost associated with this work shall be included in the Unit Price for CIPP Liner as specified in the Tender Form.

Watermain Cleaning

The watermain section to be lined shall be cleaned to remove all rust, tubercles, deposits, loose or deteriorated remains of the original pipe and other foreign materials and flushed afterwards with a high-pressure water nozzle to the satisfaction of the Engineer. Acceptable cleaning methods include high velocity jet water propelled cleaning devices, cable pulled scrapers, mechanically powered cleaning equipment or other approved methods. The cleaned watermain shall be suitable for CIPP liner installation and achievement of its long-term performance, including any necessary bonding of the liner to the inside surface of the watermain. Any small deposit or area of foreign material that remains hard and firmly attached to the watermain after appropriate cleaning operations, and do not reduce the internal diameter of the pipe by more than 13 mm or negatively affect the installation and long-term performance of the lining may be acceptable at the discretion of the Engineer.

The Contractor shall plan and execute the cleaning operations to prevent damage to the existing watermain and water service connections. Any damage to the watermain or service connections will be repaired at the Contractors expense.

Cleaning Water and Debris
The Contractor shall be responsible for proper disposal of all cleaning water and debris generated from the watermain cleaning operations in accordance with applicable guidelines, laws and regulations. Under no circumstances shall cleaning water and debris be discharged into the City's storm sewer system. Solid debris shall not be disposed of into any sewer systems and must be removed from site to an approved disposal site or facility. Cleaning water shall be permitted to be discharged into the City's sanitary sewer system, provided that appropriate measures, such as settling tanks or filtering sump pits, have been put in place to first remove the debris and suspended solids from the cleaning water. Contractor shall ensure that any cleaning water disposed of into the sanitary sewer system complies with applicable guidelines, laws, and regulations, and shall provide appropriate third-party testing documentation to demonstrate compliance, if requested.

Protruding Water Service Connections
Water service connections that protrude into the watermain section shall be cut or ground back, if deemed necessary, such that the extent of the protrusion left in place does not interfere with cleaning operations, or the installation and long-term performance of the CIPP liner.

Water service connections that have been determined to be inactive and no longer required, shall be cut or ground back flush with the inside surface of the existing pipe wall.

The finish surface of the water service connections shall be smooth and even (no jagged edges) to avoid damage of the liner material during installation. If any active water service connection is damaged or broken by the Contractor, then the Contractor shall repair the damage at his own expense by using excavation if necessary. The Contractor shall submit the proposed method of repair and reinstatement of damaged service connections to the Engineer for review and approval, prior to commencement of the work. Cutting or grinding back of water service connections shall be completed prior to completion of the post-cleaning CCTV inspection.

Plugging of Water Service Connections
The Contractor shall install a suitable non-toxic plug in each water service connection following cleaning of the watermain section and prior to installation of the CIPP liner. The plug is intended to prevent resin from entering the water service and shall be removed during reinstatement of the water service connection. The Contractor shall ensure the plug does not prevent proper installation of the CIPP liner.

250.18 IDENTIFICATION OF WATER SERVICE CONNECTIONS

The Contractor shall identify all service connections on a watermain section, as part of the post-cleaning CCTV inspection, and submit a Water Service Connection Report to the Engineer at least 2 working days prior to lining of the section. The Water Service Connection Report shall contain the information listed below:

- Contract No.
- Date.

- Street Name.
- Watermain Section No.
- Begin Access Pit No.
- End Access Pit No.
- Total number of water service connections
- For each water service connection, identify the distance from the beginning access pit, clock position, diameter, material type, connection status (active, inactive or undetermined), address of property serviced and general observations pertaining to the water service connection.

The Water Service Connection Report shall also include services that are abandoned and ground flush to the pipe wall.

The Water Service Connection Report shall be used as a control document for reinstatement of service connections into the lined watermain. Upon completion of service reinstatements, the report shall be updated to identify the reinstated service connections and submitted to the Engineer along with the post-lining CCTV inspection.

250.19 CCTV INSPECTIONS

CCTV Inspections required under this contract include a Post-Cleaning and Post-Lining Inspection of each section of watermain to be lined. These CCTV inspections shall be performed as per the below specifications and shall be used as part of the City's approval process of the Contractors work. Other CCTV inspections carried out by the Contractor shall be at the Contractors sole discretion and expense.

Equipment
Inspection equipment shall consist of inspection unit (vehicle), colour cameras, lighting, cables, power source, monitor(s), data acquisition system, digital recorder, and other related equipment.

The CCTV inspection unit shall consist of a self-contained vehicle with an area for viewing, recording and controlling the CCTV inspection operations and a separate area for equipment storage. The viewing and control area shall have proper seating and sufficient space to accommodate the City representative and provide a clear view of the monitor screen which displays the inspection work as it proceeds.

The CCTV equipment shall be suitable for viewing the entire perimeter of the pipe for all watermain sizes identified in the contract. The CCTV camera must be a true PAN and TILT camera physically capable of radial rotation of 360 degrees, lateral rotation (tilting) of at least 270 degrees, and of producing a continuous high resolution colour picture of not less than 400 lines at the periphery of the image. The adjustment of focus and iris shall allow optimum picture quality and the focal range shall be adjustable from 100 mm to infinity.

The CCTV camera shall be self-propelled (mounted on a rubber tire or crawler type transporter) or towed by winch and cable (skid mounted) through the watermain in a smooth and stable condition. The camera shall be capable of inspecting at least 200 meters of

watermain in one continuous inspection and from one point of entry. The camera transporter or tow cable shall not prevent proper viewing of the entire perimeter of the pipe.

The camera shall have a self-contained lighting system capable of providing a clear picture of the entire periphery of the pipe of a minimum illumination level of 100 foot candles over a minimum distance of two (2) meters. The lighting shall be set up in such a manner so as not to project a shadow of the body of the camera and/or transporter onto the surface of the pipe within the field of vision of the camera when aimed down the barrel of the pipe.

The monitor shall be not less than a 21inch colour monitor and shall provide a colour picture of sufficient size and clarity to be easily viewed by the Contractor's operator and the City representative, and it shall clearly define the details of the interior of the pipe. The picture quality on the monitor shall provide a continuous 400 line (or greater) resolution video picture.

Digital video records shall be able to capture in colour from the live video source with MPEG-4 format. Minimum recording video resolution shall be 400 lines with a NTSC size of 720 x 480 @29.97 frames per second.

CCTV Equipment Dedicated to Watermains

All CCTV camera equipment including the cable, any other related equipment that enters the watermain and any external containment or operating equipment, such as the cable reel shall be equipment that is dedicated to the inspection of watermains and shall not be used and shall not have been used for other purposes, such as inspection of sewers.

All CCTV equipment used shall be kept clean and free of contamination by periodically dousing of the equipment with chlorine as needed to assure cleanliness. The City requires at a minimum the equipment be cleaned immediately prior to entering any watermain that has already been lined; however, the Contractor shall ultimately be responsible for the frequency of chlorine dousing to prevent any contamination of the watermain by the CCTV equipment.

The requirement for watermain dedicated CCTV equipment applies to any CCTV inspection of watermains and applies regardless of whether the CCTV inspections are Contract required or done for the Contractor's own purposes.

Inspection Requirements

The CCTV inspection shall be performed on one watermain section at a time. Each pipe section being inspected shall be sufficiently dry to ensure total viewing of the periphery of the pipe, including the pipe invert. The pipe section under inspection shall be free of any fog or vapour that obscures the view. Where required, appropriate ventilation equipment such as fans and blowers, or other provisions shall be used to eliminate such fog or vapour. The inspection speed shall allow proper analysis of the pipe condition. The maximum camera travel speed shall be 5 meters/minute. The camera shall stop and clearly view each service connection and other significant observations for at least 5 seconds.

Each CCTV inspection shall start at the outside of the pipe to get a clear view of the pipe opening and cut end of the pipe. CCTV inspections shall be continuous over the entire length of the watermain section. The start of each video shall clearly display all information necessary to properly identify the inspection including such things as inspection type, project name and

number, street name, start pit, end pit, pipe size, material type, operator, date and time. The video shall also show a continuous metered camera distance from the start of the watermain section.

The Contractor shall provide CCTV inspection videos to the Engineer by way of the Internet. The Contractor shall provide the Engineer with a URL (ie. internet address) that will provide access to the CCTV inspections for viewing and downloading within the specified timelines. The inspections shall be MPEG-4 format and suitable for proper playback on commonly used video file playing software applications. The CCTV video inspection shall be accompanied with an inspection report. The inspection report for each watermain section shall provide the inspection identification information (as per the start screen of the CCTV video inspection), as well as the location of each service connection, tee, bend, valve and any other significant observation.

The finished video must be clear and correctly illuminated to vividly show the object being video inspected. Unacceptable quality will be cause for rejection.

Post-Cleaning CCTV Inspection

Flowing cleaning and preparation of any watermain section, and prior to lining of the section, a CCTV inspection of the watermain section shall be completed by the Contractor. The inspection is to determine the condition of the existing watermain section; if any excavated repairs are required; if there are any valves or fittings that were not previously identified; if there are any changes in the nominal pipe size within the section (ie. change from 150mm to 200mm); if the watermain is a suitable candidate for lining; and if the cleaning and preparation operations are acceptable for CIPP lining. The CCTV inspection shall also capture all information necessary for the Water Service Connections Report (refer to Section 250.18) and for proper design of the CIPP liner. The inspection complete with all reports shall be provided to the Engineer at least 2 working days prior to lining.

Lining shall not commence until approval of the cleaning and preparation operations has been provided by the Engineer.

In the event that the post-cleaning inspection identifies any deficiency in the cleaning and preparation of the watermain section that requires correction, the inspection shall be redone at the Contractors expense after the correction of the deficiency and submitted to the Engineer.

If excavated repairs are required or the watermain is deemed to be not suitable for lining, the Contractor shall notify the Engineer within 48 hours of completing the post-cleaning inspection and await instructions of the Engineer before completing further work on the watermain section.

Post-Lining CCTV Inspection

Following completion of all work related to the lining of the watermain section, including reinstatement and back-flushing of water service connections, a CCTV inspection of the watermain section shall be completed by the Contractor. The inspection complete with all reports shall be submitted to the Engineer for review and approval within 5 working days of completion of liner installation, and in all cases, prior to payment of any progress claim submission for the liner installation.

Post-lining CCTV inspections of watermain sections shall not be completed until all water services have been back-flushed (by allowing water to flow from the buildings temporary water supply into the lined watermain) to remove debris from the service. Any debris remaining in the service or visible at the service connection will be considered a deficiency.

If the post-lining inspection identifies any deficiency in the CIPP lined watermain section, the Contractor shall immediately notify the Engineer of the deficiency and provide a copy of the CCTV inspection within 24 hours.

Following the correction of any deficiency in the CIPP lined watermain section the post-lining inspection shall be redone at the Contractors expense and submitted to the Engineer**.**

250.20 MEASUREMENT OF EXISTING WATERMAIN SECTIONS

It is the responsibility of the Contractor to confirm and record the necessary lengths and inside diameter of the watermain sections to be lined by conducting the appropriate measurements. Size information provided on the drawings or in the tender documents are typically nominal sizes and are not necessarily the actual inside diameter pipe sizes. The Contractor shall immediately notify the Engineer of any step discrepancy (such as nominal 250mm instead of nominal 300mm) between the inside diameter measurement and the diameter identified in the contract documents.

The inside diameter of the watermain to be lined shall be accurately measured throughout the length of the lining run using a suitable device, such as a laser measuring device (or equivalent method) that will travel along the inside of the existing watermain. Inside diameter measurements shall be accurate to within 1.5 mm and shall be obtained at a maximum spacing of 300 mm along the watermain. The measurements shall be for the final inside diameter before lining and therefore shall be made after the existing watermain has been fully cleaned and prepared for lining.

The results of the inside diameter measurements shall be used for sizing the liner to be used for each lining run to ensure each liner will provide the required tight fit to the inside surface of the watermain. The final installed liner shall leave no gap or annular space between the liner and the watermain at any location around the perimeter of the watermain along the full lined length. An exception to tight fit is allowed where joints in the existing watermain have a joint gap. Joint gaps are a normal and typical situation for joints in CI and DI watermain pipelines. The liner shall be permitted to bridge or partially bridge this gap and thereby may not be a tight fit to the inside surface of the existing watermain over the zone of the joint gap. A watermain liner that bridges or partially bridges a joint gap shall possess the necessary stress and strain properties such that the performance of the liner will not be degraded when joint gaps are bridged or partially bridged by the liner.

Where the measurements indicate that the proposed liner will not assure a 100 per cent tight fit over the full range of the diameters measured, the proposed liner shall not be installed, and a different sizing of liner shall be used that will assure the 100 per cent tight fit. Where the range of measurements is such that no liner sizing will assure a 100 per cent tight fit, the Contractor shall advise the Engineer of this finding within 48 hours. No lining shall take place until this

situation has been resolved to the satisfaction of the Engineer. Where no resolution is possible due to the measured size range, the watermain shall not be lined."

Documentation of Measuring & Results

Before a liner is installed in a proposed liner run, the Contractor shall provide the written results of the watermain inside diameter measurement survey for the entire length of liner run to the Engineer. The Contractor shall also report on the impact of the watermain inside diameter survey on sizing the liner for tight fit, the liner diametric size to be used to obtain a tight fit and whether a tight fit throughout the liner run can only be obtained by using an oversized liner with corresponding excess material manifesting as a fold, wrinkle or fin either localized or over the full length of the liner.

250.21 OBJECTIVES FOR CIPP WATERMAIN LINING

The objectives to be achieved by CIPP lining of a watermain are:

- Prevent leaks out of or into the lined watermain over the design life of the CIPP lining.
- Prevent deterioration in water quality in the lined watermain over the design life of the CIPP lining.
- Prevent deterioration of flow capacity in the lined watermain over the design life of the CIPP lining.
- Reinstate water service connections into the lined watermain without excavation.
- Utilize trenchless methods for the installation of the CIPP lining thereby minimizing excavation, ground surface disruption and carbon footprint due to and during construction.
- Allow for post lining wet tapping up to and including 50 mm taps. Wet taps must remain watertight with no migration of water between the liner and the host pipe for the design life of the liner.

The leaks to be prevented relate to leaks that typically develop over time in existing cast iron or ductile iron watermains due to deterioration over time of the physical condition of these watermains including their joints and connections. The CIPP lining shall achieve the leak prevention objective including in the situation that the existing watermain continues to deteriorate over the design life of the liner and therefore, without a CIPP lining, would develop leaks. Refer to section 250.22 for further detail on leak prevention requirements.

While leaks out of a watermain comprise the vast majority of watermain leaks, leaks into a watermain, while rare, are a significant issue. Leaks into a watermain can occur when the watermain is at an internal pressure lower than the surrounding ground water pressure (typically can only occur when watermain has been depressurized) or can occur when the watermain experiences a vacuum condition. A vacuum condition, while a rare and short-term event, can both cause a leak when the watermain (or lined watermain) is not rated for sufficient vacuum or expose a pre-existing leak that was not active until exposed to a vacuum situation. Therefore, one of the objectives for CIPP lining of a watermain is to prevent leaks both out of and into the lined watermain.

250.22 PERFORMANCE REQUIREMENTS FOR CIPP WATERMAIN LINING

1. Reinstatement of Water Service Connections without Excavation

The CIPP watermain lining shall allow for remote reinstatement of existing water service connections into the lined watermain of size 50 mm or less. Remote means that the reinstatement shall be done internally within the lined watermain and no excavation to the watermain shall be required to make the reinstatement. The reinstated service connection shall not leak.

The CIPP liner shall create a pressure tight seal to the existing watermain in the area of the service connection and to the service connection tap so that the service connection can be reinstated by accurately removing (by drilling or other means) the liner blocking the service connection opening. The pressure tight seal shall be sufficient to prevent any leakage at or around the reinstated service connection. The pressure tight seal shall remain sufficient over the design life of the liner to prevent any leakage at or around the reinstated service connection over the design life of the liner. The pressure tight seal shall be created by adherence or bond of the liner to the existing watermain over the area required to create the pressure tight seal to the service connection tap. The required level of adherence or bond shall be the responsibility of the Contractor and shall be compatible with the specific watermain lining product being used by the Contractor. Failure to achieve a pressure tight seal will be regarded as a failure of the Contractor to achieve the bond or adherence that was necessary for and predicated by the watermain lining product being used. The bond or adherence required is specific to the specific watermain lining product being used and therefore is not specified by the City.

2. Provide Required Capacity for External Loads

External loads on the lined watermain include loads due to groundwater hydrostatic pressure, ground cover (soil) loads, live loads (such as from surface vehicles) and an equivalent external load due to a vacuum condition within the lined watermain. The CIPP watermain liner shall provide the necessary resistance to these loads for the occasions and durations than they will come to bear on the watermain lining.

When and where the lined watermain is a normally pressurized pipe and the internal pressure is greater than twice the external load pressure, the required resistance shall be based on considering the external loads as a short-term effect. When the lined watermain will not be a normally pressurized pipe, the required resistance shall be based on considering the external loads (except for vacuum) as a long-term effect.

Required resistance to external load shall consider the situation where the existing watermain portion of the lined watermain has deteriorated into the fully deteriorated condition (see ASTM F1216 X1.1.2) and cannot support external loads. This is considered a worst-case scenario that shall be addressed in providing required resistance to external loads.

3. Provide Localized Internal Pressure Resistance Prior to Any "Failure" of Host Pipe

By "failure" in this context is meant a loss of ability of the host pipe portion of the lined watermain to carry internal pressure and/or remain watertight. The watermain liner shall have the ability to perform structurally where a gap exists between the liner and the existing watermain portion of the lined watermain. Such gaps will occur wherever the liner is not a tight fit against the inside surface of the host watermain. In these cases, the liner will experience the effect of the internal pressure even though the existing watermain portion of the lined watermain remains fully capable of carrying the full internal pressure. The prime example of such gaps is where the liner bridges or partially bridges joint gaps in the CI or DI portion of the lined watermain.

The performance mechanisms required in the watermain liner in this situation includes bending without cracking.

4. Survive Future Joint Deflections in the Host Pipe Portion of the Lined Watermain

CIPP watermain lining installed in CI and DI pipelines (or other pipeline materials as applicable) shall not fail when subject to post lining deflection than may occur in the joints of the host pipe portion of the lined watermain. Failing in this context means any loss in the structural integrity of the lining that results in a leak, a potential leak, cracking or a loss of other structurally related performance of the liner including in its ability to fully resist the internal design pressure as a stand-alone pipe.

The liner shall survive (meaning it will not fail in any way) up to and including 5 degrees joint deflection that may occur post lining in any direction regardless of the existing joint deflection in the host pipe prior to lining.

The liner shall accommodate changes in joint deflection in the host pipe portion of the lined watermain on an ongoing basis over the design life of the liner. This means if the changes in joint deflection are dynamic over time, the line shall accommodate this situation and maintain its ability to accommodate such joint deflection without failing (as defined above).

5. Prevent Watermain Leaks Due to Failure of the Host Pipe Portion of the Lined Watermain

The watermain liner shall prevent leaks that would have occurred in the unlined watermain due to a partially deteriorated or fully deterioration condition of the host pipe portion of the lined watermain occurring over the design life of the liner. This shall include the watermain liner surviving (meaning it will neither fail, nor leak) a failure in the host pipe portion of the lined watermain that results in:

- A deflection at a failure in the host pipe up to including 5 degrees in any direction.
- An offset at a failure in the host pipe up to and including 2% of pipe diameter (i.e. offset between the two separated pipe pieces up to 2% of the nominal pipe diameter (ex. for a 250mm watermain an offset of 5 mm).
- A hole in the host pipe of unlimited size or shape.
- A loss of pressure carrying capacity in the host pipe due its loss of sufficient tensile hoop wall strength.
- Any other type of failure of the host pipe that is due to deterioration of the physical condition of the host pipe.

Excluded from the required liner leak prevention performance are leaks that are caused by excavated damage to the lined watermain, catastrophic undermining of the soil support around the lined watermain (due to unrelated events) that causes excessive loads on or deflections in the lined watermain and leaks caused by deterioration of the host pipe at couplings and regressed saddle service taps.

250.23 GENERAL REQUIREMENTS FOR CIPP LINERS

The purposes for lining sections of watermain are to prevent further material degradation, improve structural integrity, improve flow characteristics and extend the service life of the watermain with minimal construction disturbance. Liners shall be designed in accordance with the CIPP Liner Design section of this specification.

Installation of any liner system shall provide a rehabilitated watermain section with a hydraulic capacity equal to or greater than the existing pipe.

Installation

The Contractor is responsible for the installation and curing of the watermain liner. The Contractor shall follow the liner manufacturer's installation recommendations to the extent that they are appropriate for specific circumstances. The Contractor's installation procedures shall be in accordance with the pre-lining submission documents approved by the Engineer. Any proposed deviation from the previously submitted procedure shall be submitted, with explanation, to the Engineer for approval and the submission shall include the approval of the lining manufacturer. Where, in the Engineer's opinion, these procedures are not in accordance with industry standard or liner manufacturer's procedures, the Engineer may require the Contractor to alter or modify the procedures.

Liner Wet Out and Curing

The Contractors equipment shall use an automated system to control the mixing and pumping of resin, including volume, ratio, speed, pressure, temperature, etc. for liner wet out. Mixing of resin and wet out of the liner by non-automated methods (ie. mixing and wet-out by hand) is not acceptable. Appropriate quality control measures and records keeping must be implemented to ensure the wet-out liner meets or exceeds the design thickness and all specifications.

Contractor shall ensure the liner curing method and process, including curing temperatures and duration from start of heating to end of cool down is completed in accordance with the manufacture's specifications. All circulating heat sources shall be equipped with suitable temperature and pressure gauges so that the curing and cooling processes can be monitored. Boiler temperatures and thermocouple readings (at suitable locations along the liner) shall be recorded at suitable time intervals after heating begins.

Contractor must ensure adequate circulation of the heat source to avoid zones of inadequate heating, which can lead to improper curing of the liner. Contractor shall employ appropriate measures to address heat sinks such as water infiltration into the watermain that can cause washout of resin and improper curing of the liner. The liner shall be free of soft spots, dry spots, lifts or delamination due to inadequate wet-out, washout of resin, improper curing or any other means.

Liner Sizing

The CIPP liner size shall be based on the internal diameter of the watermain following cleaning and preparation operations, and specific to each section of watermain to be lined. Liners shall be sized to ensure a 100 percent tight fit to the entire inside surface of the existing watermain section and the appropriate level of bonding of the liner to the watermain is achieved. Liners shall be able to meet its tight fit and bonding requirements, despite any variances in the actual inside diameter along the section of watermain.

Liners which rely on circumferential expansion to ensure a tight fit within a watermain with a varying diameter shall not exceed the manufactures allowance for circumferential expansion of the liner during installation.

Liners which rely on a longitudinal fold to ensure a tight fit within a watermain with a varying diameter shall be sized to ensure the smallest possible fold size while providing a 100 percent tight fit along the entire length of the lined watermain section.

Where the diametric range of the liner to be installed will not assure a 100 percent tight fit due a large diameter variance within the watermain, a different size liner shall be used that will assure a 100 percent tight fit. Where the range of diameter measurements is such that no liner sizing will assure a 100 percent tight fit over the entire watermain section, the Contractor shall immediately notify the Engineer and the section shall not be lined until a resolution is approved by the Engineer.

Liner Continuity

The completed CIPP watermain liner shall be continuous over the entire length of the watermain section (i.e. liner installation run). There shall be no separations, cracks or discontinuities over the length of the liner installation run.

Existing Watermain Alignments
The CIPP lining shall have the capability to be successfully installed and cured-in-place in existing watermain alignments typical for cast iron and ductile iron watermain pipelines. This requirement specifically includes:

- Through existing bends up to and including 45 degrees.
- Through existing deflected joints with deflections of up to and including 5 degrees.

Successfully means that the CIPP liner performance will not be degraded when installed and cure-in-place in these situations. For bends greater than 22.5 degrees some bunching of the liner on the inside of the deflection will be acceptable provided it does not degrade liner performance.

Fit and Finish
Liners shall be 100 percent tight fitting to the inside surface of the existing watermain and shall adhere to the inside surface of the existing watermain (in accordance with requirements for the specific product) such as to affect a pressure tight seal at and around water service connections and pipe ends. There shall be no measurable or visible gap or annular space between the liner and the watermain.

The only exception to the tight fit requirement is at normal joint gaps in the existing watermain pipe to pipe joints, where the liner may bridge or partially bridge the gap. Where a liner product bridges or partially bridges joint gaps, the liner must have the required properties to bridge the gap when under internal pressure (up to an including the design pressure) or subject to external load such that the liner does not crack or otherwise deteriorated due the bridging stress in the liner over the design life of the liner.

Where longitudinal folds occur, they shall be tightly compressed and have no void space either within the fold or behind the fold. A fold shall not result in any annular space between the liner and the inside of the watermain. Folds shall not have any of the liner tube inner membrane trapped with the fold. Folds shall not negatively affect the flow of water or long-term performance of the CIPP liner.

The liner shall be free of any interior bulges, ribs, ripples, rips, tears, holes, scratches, cracks, separations, blisters, eruptions, stains or other irregularities, except where these irregularities correspond with irregularities in the existing watermain following cleaning and preparation operations.

Where folds, ridges, ripples or wrinkles are a direct result of obtaining the required tight fit, they shall be acceptable provided the liner was properly sized for the watermain based on the inside diameter measurements and they do not negatively affect the flow of water or long-term performance of the CIPP liner.

Liner termination points shall be smooth, square, neatly cut and there shall be no separation from the inside surface of the existing watermain. Termination points shall be watertight to the requirement for external and internal hydrostatic pressure.
Under no circumstance shall the fit and finish of the installed CIPP liner negatively affect the

flow, design requirements or long-term performance of the CIPP liner. Where the liner fit or finish does not meet specifications, the liner will be considered deficient and require remediation. Where the specified liner fit or finish has not been achieved throughout the watermain section, the entire liner shall be removed and replaced with a new liner. If liner removal and replacement is not possible then a new watermain shall be installed. The Contractor shall be responsible for the costs of all required remediation, including the installation of a new watermain, if necessary.

Tapping of CIPP Lined Watermain

Following installation of a CIPP liner, the lined watermain shall permit live tapping of service connections in accordance with Item 230 – Watermains, of the City's Specifications Book. Under no circumstance shall the liner materials, physical properties, installation procedures, size, thickness, fit and finish, or any other property of the installed CIPP liner negatively affect the installation or long-term performance of a tap installation. The Contractor's and/or manufactures recommended tapping procedures shall be provided by the Contractor to the Engineer.

250.24 CIPP LINER MATERIALS AND STANDARDS

The CIPP lining shall be carried out in accordance with ASTM F1216 (inverted liners), ASTM F1743 (pull-in-place liners) or ASTM F2019 (reinforced pull-in-place liners) with exceptions made for where the watermain liner is required to differ specifically from requirements in these standards.

Liners shall be approved for potable water use and meet the requirements of NSF/ANSI Standard 61 for potable water. Documentation and certifications to demonstrate the proposed CIPP liner meets the NSF/ANSI Standard 61 shall be submitted to the Engineer for review and approval, as per the pre-lining submissions section. All materials must be delivered to the site in their appropriate containers that clearly show that the product has various agencies' approvals.

The liner shall utilize a thermally cured epoxy resin and hardener which does not rely on ambient heat for curing. The inner surface of the liner shall contain a waterproof membrane layer. The liner shall be uniformly impregnated with the correct quantity of resin to produce a cured result that has homogeneous and uniform physical properties throughout the liner wall that meet or exceed the requirements of referenced standards or the properties used in the liner designs, whichever are higher. In this context the liner wall does not include the surface waterproof membrane layer. CIPP Liner designs shall not use properties lower than those in the reference standards. The correct quantity of resin shall be determined by the Contractor and be in accordance with the specifications of the liner manufacturer.

Where, in the course of Work, the Contractor has reason to use materials that differ from the original proposed materials, either in general or for a specific installation, the proposed alternate materials shall meet the above standards and require the approval of the Engineer prior to use.

250.25 CIPP LINER DESIGN

The Contractor shall provide engineered designs for each unique liner situation, including for each size of liner. The engineered designs shall demonstrate, to the satisfaction of the Engineer, that the lining to be installed is rated to withstand the required external loads and internal pressures.

The thickness for CIPP liners shall be determined in accordance with the design method set out in ASTM F1216-16, Appendix X1, Design Considerations, Section X1.3.2, Fully Deteriorated Pressure Pipe Condition. The standard design parameters are as identified in the below table.
The thickness determined by design shall be the minimum thickness of the completed CIPP liner in the watermain. Liner thickness measurements shall not include any non-structural layers, such as waterproofing membranes or plastic coatings. Liner thickness measurements shall be in accordance with ASTM D5813.

Engineering designs for CIPP liners shall be approved and stamped by a licensed Professional Engineer and Permit Holder authorized to perform such work by PEGNL. Engineering designs shall be submitted to the Engineer for review and approval, as per the pre-lining submissions.

Standard Liner Design Parameters
Standard Design for CIPP liners shall use the following parameters:

Parameter	**Requirement**
Design Method	ASTM F1216-16, Appendix X1, Section X1.3.2
Pipe Condition	Fully Deteriorated Pressure Pipe Condition
Pipe Size	Actual inside diameters of the existing watermain.
Design Pressure	862 kPa (125 psi) internal watermain pressure.
Ovality	2% or actual ovality, whichever is greater.
Vacuum	50 kPa below atmospheric pressure.
Soil Cover	2.0 m soil cover or actual soil cover at liner location, whichever is greater.
Water Table Location	1.5 m below ground surface.
Soil Density	19.61 kN/m³ (2000 kg/m³)
Soil Modulus	6.9 MPa
Live Load	AASHTO HS-20
Enhancement Factor	7.0 for CIPP liners that are tight fitting to existing watermain.
Design Life	50 years or greater
Factor of Safety	2.0
CIPP Liner Flexural Modulus	The flexural modulus to be used in design equations X1.1 and X1.3 shall be the long-term flexural modulus in the axial direction. The flexural modulus to be used in design equation X1.4 shall be the

	short-term flexural modulus in the axial direction. The short-term flexural modulus testing shall be in accordance with ASTM D790. The long-term flexural modulus shall be the amount of short-term flexural modulus retained for the design life. The retention factor shall be derived from long-term testing in accordance with ASTM D2990 and be appropriate for stress and stress duration in the installed liner. Independent third-party test data is required to substantiate the short-term and long-term values used in design. Minimum short-term value shall be in accordance with the minimum requirement in ASTM F1216 (1724 MPa).
CIPP Liner Tensile Strength	The tensile strength used in F1216 equation X1.7 shall be the long-term tensile strength in the hoop direction. The long-term tensile strength shall be the amount of short-term tensile strength retained for the design life. The retention factor shall be derived from long-term testing in accordance with ASTM D2990 and be appropriate for stress and stress duration in the installed liner. The short-term tensile strength testing in the hoop direction shall be in accordance with ASTM D638 or ASTM D2290. Independent third-party test data is required to substantiate the short-term and long-term values used in design. Minimum short-term value shall be in accordance with the minimum requirement in ASTM F1216 (21 MPa).

Vacuum
In accordance with the ASTM F1216 design method, vacuum is treated as an equivalent external pressure. The short-term liner flexural modulus shall apply to vacuum resistance.

Flexural Modulus and Tensile Strength
The flexural modulus (ASTM D790) and tensile strength (ASTM D638) short-term values shall be values that are reliably and repeatedly obtained in the installed liners, as substantiated by testing samples from installed liners. They shall not be values obtained from laboratory samples or maximum values obtained in testing. The liner designs shall identify the short-term test values of flexural modulus and tensile strength from which long-term design values are derived.

Pre-Installation Evaluation

The Contractor shall evaluate each watermain section proposed for a liner installation to determine whether the actual field conditions correspond with the Standard Liner Design Parameters. Field conditions to be checked include pipe ovality, pipe size, soil cover over top of pipe, water table location and live load. Where any field condition is in exception to the Standard Liner Design Parameters the Contractor shall notify the Engineer within 48 hours of completing the evaluation. The Contractor shall also complete a Special Design utilizing the actual field conditions to determine if the existing standard liner design is appropriate.

Where a liner thickness determined from the Standard Liner Design parameters is insufficient for the installation as determined by a Special Design, the liner thickness shall be increased to satisfy the Special Design liner thickness. Any additional cost of the increased liner thickness shall be as per the Unit Price identified in the Tender Form, if applicable, or shall otherwise be negotiated with the City.

No liner shall be installed that does not meet the design requirements and liner thickness for the actual field conditions.

250.26 WATER SERVICE CONNECTION REINSTATEMENT

The Contractor shall reinstate all active and undetermined water service connections (as per the Water Service Connect Report) in a watermain section following the curing (including cooling) of the installed liner. Inactive service connections are not to be reinstated. The method of reinstatement for water service connections up to and including 50 mm in size shall be from the inside of the watermain using a remotely controlled robot equipped with a camera and drilling tool that allows the operator to drill a hole in the liner at the precise location of the service connection. Water service connections shall be reinstated to 100 percent of the pre-existing opening size but not greater. The cost for this work shall be as specified in the Tender Form. The Contractor shall be responsible to repair any damage to the liner (such as but not limited to mis-drills and over-cutting of service reinstatements) or existing service connections that occurs during the reinstatement, to the satisfaction of the Engineer.

Following the reinstatement of service connections and prior to completing the post-lining CCTV inspection, all water services shall be backflushed (by allowing water to flow from the buildings temporary water supply into the lined watermain) to remove debris from the service. Service connections shall be fully opened and without obstructions to water flow. The Contractor shall be responsible to remove any resin, debris or other material obstructing the flow of water at a service connection. Where the service connection cannot be fully opened or cleared of obstructions from the inside of the watermain, the Contractor shall be responsible for excavation of the water service to clear the obstructions or replace the service connection and all associated reinstatement work, at no additional cost.

It is the responsibility of the Contractor to make location measurements or employ alternative procedures that allow for locating and identifying service connections after lining is complete.

250.27 CIPP LINER AND RESIN SAMPLES AND TESTING

CIPP Liner Samples

Contractor shall provide samples of completed CIPP liners for testing. Samples shall be cylindrical pipe samples obtained by cutting a section of the CIPP lined watermain and/or flat plate samples obtained by installation of a flat plate sampling apparatus on the CIPP liner during installation. Samples shall be of a sufficient size and length to allow the required testing and shall be collected at the location of a watermain access pit/excavation identified by the Engineer.

CIPP liner samples shall be collected at a rate of one sample per day of CIPP liner installations; hence, on days with more than one CIPP liner installation, only one of the liners will require a sample to be taken.

Contractor shall ensure the sample conditions during curing are representative of the remaining watermain liner conditions during curing by such means as placing sandbags over and around the sample location during curing. The cost for sampling at access pit/excavation locations shall be included in the Unit Price for CIPP Liner as specified in the Tender Form.

Contractor shall obtain the cured CIPP sample under the direct supervision of the Engineer. The Contractor shall remove the host watermain from the CIPP sample using approved methods. Immediately upon removal, the Contractor shall give the sample into custody of the Engineer.

Before or immediately upon removal, the sample shall be clearly marked with the following Identification information:

- Contract Number.
- Installation Date.
- Street Name.
- Watermain Size.
- Access Pit numbers delineating watermain section lined.
- Access Pit number where sample was taken.
- Crown position.

CIPP Liner Sample Testing

CIPP liner samples shall be tested for short-term flexural modulus and short-term flexural strength in the axial direction in accordance with ASTM D790.

CIPP liner samples shall be tested for short-term tensile strength in the hoop direction in accordance with ASTM D638 or ASTM D2290, at the discretion of the Engineer. ASTM D638 testing in the hoop direction shall be completed on flat plate samples and ASTM D2290 testing shall be completed on full cylindrical samples.

Alternatively, the Contractor can provide an appropriate conversion factor (for each liner size) that will be used to obtain tensile strength in the hoop direction from ASTM D638 test results determined in the axial direction for approval of the Engineer. Conversion factors shall have been obtained from sufficient testing of flat plate samples whereby testing was done in both the axial and hoop directions.

Sample thickness measurements shall be completed as per ASTM D5813.

Samples will also be inspected for fit and finish within the host watermain. Samples to be submitted for testing will be at the discretion of the Engineer. The Engineer will arrange and pay for delivery and testing of the liner samples at a testing laboratory designated by the Engineer. All samples and test results remain the property of the City of St. John's. The test reports will be provided to the Contractor on request.

Delamination testing shall be performed in accordance with ASTM F1216 specifications, at the City's discretion.

Additional CIPP Liner Samples

Upon request of the Engineer, the Contractor shall obtain a sample of CIPP Liner from a location within the lined watermain that is not at an access pit location required for lining. Since the sample will not be obtained at an access pit location, an excavation specifically for collection of the sample will be required. The sample shall be obtained by cutting and removing a section of the host watermain or preparation of a flat plate sample at a location specified by the Engineer. After the sample is identified with appropriate information, the sample is to be turned over to the Engineer. Sample shall be submitted for testing and inspected for fit and finish, as noted above, at the discretion of the Engineer.

The contractor shall be responsible for all required asphalt and concrete cutting, excavation, cutting of pipe, removal of sample, close-up of the lined watermain with new pipe and fittings, cathodic protection, backfilling, reinstatement and all other incidental work in accordance with the City's Specifications Book. The cost for addition CIPP Liner samples shall be as specified in the Tender Form.

Resin Samples and Testing

Contractor shall arrange for sampling of epoxy resin from the wet-out facility immediately before addition of the hardener and wet-out of the liner. One representative sample is to be taken from each resin batch to be used on the project and delivered to a testing laboratory designated by the Engineer. If the liners are to be wet-out at the manufacturer's facility prior to delivery to the Contractor, the manufacture will be responsible to submit the samples directly to the testing laboratory. If the liners are to be wet-out by the Contractor, the samples must be taken under the supervision of the Engineer, and the Engineer will submit the samples to the testing laboratory. Upon request of the Engineer, additional resin samples may be required to be taken and submitted for testing. Resin samples are to be tested by infrared (IR) analysis and the resulting IR spectrographs compared to the reference spectrograph provided as part of the pre-lining submissions. The Engineer will pay for testing of the resin sample. All samples and test results remain the property of the City of St. John's. The test reports will be provided to the Contractor on request.

250.28 CIPP LINER SAMPLE TEST RESULTS

CIPP liner sample test results for short-term flexural modulus and flexural strength (ASTM D790), short-term tensile strength (ASTM D638 or ASTM D2290) and thickness (ASTM D5813) will be compared to the short-term values of flexural modulus, flexural strength and tensile strength, and thickness values used in the Contractors liner design. Where any of the

liner sample test results do not meet or exceed the liner design values, the liner may be considered deficient pending a design review. The design review will utilize the sample test results for flexural modulus, flexural strength and tensile strength, while keeping all other parameters the same, to re-calculate the required CIPP liner thickness.

Upon completion of the design review, if the liner sample thickness meets the re-calculated liner design thickness, the liner shall not be deemed deficient. If the liner sample thickness does not meet the re-calculated liner design thickness, the liner shall be deemed deficient. If the liner sample test results do not meet the minimum requirements of ASTM F1216, a design review will not be conducted, and the liner will be deemed deficient.

250.29 CIPP LINER DEFICIENCIES

Where in the Engineer's opinion, the liner sample test results or CCTV inspections or any further investigation indicate the liner is not in accordance with the Contract requirements, the liner shall be deemed deficient. The Contractor shall take remedial action acceptable to the Engineer to correct any deficiency, in accordance with the Specifications and Contract requirements. Remedial actions shall ensure the liner meets the 50 year design life requirements and may include repair of any deficiency, installation of a supplemental liner, complete removal and replacement of the deficient liner or installation of a new watermain. Remedial actions must be submitted to the Engineer for review and approval prior to commencement of remedial work. Contractor will be responsible for the cost associated with all required remedial work.

250.30 PRESSURE AND LEAK TESTING

The watermain shall be pressure and leak tested before the reinstatement of the water service connections. Water for this purpose shall be supplied as per Section 250.12 of this specification.

The section of watermain to be tested shall be subjected to a test pressure of 1.2 times the operating pressure or a maximum pressure of 1035 kPa, whichever is less. The Engineer will provide the operating pressure to the Contractor for the watermain section(s).

Each section of watermain shall be slowly filled with water and the test pressure shall be applied by means of a pump connected to the watermain in a manner satisfactory to the Engineer. The pump, watermain connection and all necessary apparatus shall be furnished by the Contractor. Before applying the test pressure, the Contractor shall ensure all air has been expelled from the watermain.

The test pressure shall be maintained for at least two (2) hours, during which time the pressure shall not vary by more than +/- 35 kPa. The maximum allowable water loss during the pressure test shall not exceed 0.0000449 l/hour/mm of pipe diameter/m of pipe, in accordance with Item 230 – Watermains, of the City's Specifications Book.

If any new valve, fitting, hydrant or watermain pipe used for close up of the watermain is

unable to be pressure tested, it shall be visually inspected for leaks after the lined watermain is reconnected to the existing water supply system and returned to normal operating pressure.

250.31 CLOSE UP OF WATERMAIN

Upon completion of CIPP lining operations, the Contractor shall close up the watermain, where it was accessed to facilitate lining operation, using new valves, fittings and watermain pipe, in accordance with Item 230 – Watermains, of the City's Specifications Book. Unless otherwise noted, the new valves, fittings and watermain pipe used for close up of the watermain shall be of the same or similar type as the existing. For instance, existing iron pipe (cast or ductile) and fittings shall be replaced with new ductile iron watermain pipe and fittings. The cost for this work, with the exception of the supply and installation of new valves, shall be included in the Unit Price for CIPP Liner as specified in the Tender Form.

250.32 WATERMAIN GATE VALVES

The Contractor shall supply and install a watermain gate valve and valve box at locations of all existing gate valves and at new locations identified in the contract documents or as directed by the Engineer in accordance with Item 230 – Watermains, of the City's Specifications Book.

Gate valve and box installations may be required at/near access pit locations necessary to facilitate watermain lining operations or at locations throughout the watermain not otherwise requiring an access pit.

Gate valve and box installed at/near an access pit location shall also include any other necessary items not already included with execution of the access pit. The cost of this work shall be as specified in the Tender Form. Compensation shall not include the cost of work associated with the execution of access pits (including but not limited to such things as excavation, shoring, backfilling and reinstatement) required to facilitate watermain lining, as identified in Section 250.14 Access Pits.

Gate valve and box installed at stand-alone locations throughout the watermain (not at/near an access pit location) shall also include all required asphalt and concrete cutting and disposal, excavation, cutting and removal of existing pipe or valve, cathodic protection, dewatering, pipe bedding, backfilling and reinstatement. Backfilling and reinstatement works shall be in accordance with the City's Specifications Book. The cost for this work shall be as specified in the Tender Form.

250.33 HYDRANT REPLACEMENT

At locations identified in the contract documents, the Contractor shall supply and replace existing fire hydrants or install new fire hydrants, including the hydrant lead, valve and box, cathodic protection, tee, pipe restraints and any other necessary items in accordance with Item 230 – Watermains, of the City's Specifications Book. Hydrant leads shall be Ductile Iron pipe. Hydrants shall follow the City of St. John's thread standard.

All fire hydrants, including the hydrant lead and valve shall be installed with a depth of bury of 2000mm, unless otherwise specified or directed by the Engineer, and regardless of the depth of bury of the existing hydrant.

Where necessary to decommission an existing fire hydrant in placed, the existing hydrant barrel and hydrant valve box shall be cutting at least 0.6m below grade and the upper portion removed for disposal/salvage. The section of hydrant barrel, lead, valve and valve box remaining in-ground shall be filled with concrete. The hydrant lead connection (TEE) to the watermain shall be removed and replaced with new pipe prior to CIPP lining of the watermain.

Fire hydrant installation and decommissioning works shall also include any required asphalt and concrete cutting and disposal, excavation, removal of existing hydrant (including hydrant lead and valve), dewatering, cutting of pipe, connect to the existing or lined watermain, adjust to grade, hydrant marker, pipe bedding, backfilling and reinstatement in accordance with the City's Specifications Book. The cost for this work shall be as specified in the Tender Form.

250.34 SALVAGE EXISTING MATERIALS

The Contractor shall salvage all existing hydrant barrels (upper section) and valve bonnets (main line and hydrant lead valves) that have been removed from service and deliver them to the City Depot located at 25 Blackler Avenue, St. John's, at no additional cost to the City.

The Contractor shall be responsible for the off-site disposal of any materials not identified for salvaged by the City.

250.35 CATHODIC PROTECTION

At all access pits and other locations where metallic watermain pipe, fittings, services, valves or hydrants have been exposed and accessed or replaced, sacrificial anode cathodic protection shall be installed. The Contractor shall supply and install 10.9 kg (24 lb) zinc anode with anode lead CAD welded (thermite welding) to the metallic pipe, fitting, service, valve or hydrant in accordance with Item 230 – Watermains, of the City's Specifications Book.

250.36 BALL MARKERS

At all access pits and other excavated locations where new watermain pipe or fittings (tees, bends, reducers) have been installed, the Contractor shall supply and install programmable 3M Ball Markers, as per Item 230 – Watermains, of the City's Specifications Book.

250.37 DISINFECTION

Following close up of the lined watermain sections (except at point of connection to the existing water system) and prior to reconnection of the CIPP lined watermain to the existing municipal water system or opening of water services, the Contractor shall disinfect the CIPP

lined watermain and all new valves, fittings, hydrants and watermain in accordance with Item 230 – Watermains, of the City's Specifications Book.

250.38 EQUIPMENT RECOVERY WORKS

In the event that equipment becomes stuck or jammed in a watermain, the Contractor shall immediately notify the Engineer. Removal of equipment, including removal by excavation, and all associated repair and restoration works, will be the responsibility of the Contractor. The Contractor shall complete any required repair and restoration works in accordance with the applicable City of St. John's specifications. No additional payment will be made for equipment recovery works.

250.39 REINSTATEMENT AND CLEANING

The Contractor shall reinstate, restore, replace, repair and make good all public and private property disturbed or damaged during performance of the work, in accordance with the applicable City of St. John's specification and to the satisfaction of the property owners and Engineer.

Following completion of all construction and reinstatement work, the Contractor shall complete a final cleaning of the site, including any public and private property disturbed, damaged or utilized during performance of the work, to remove surplus materials, equipment, tools, etc., to the satisfaction of the property owners and Engineer. No additional payment will be made for reinstatement and cleaning works.

250.40 MEASUREMENT FOR PAYMENT

Measurement for payment purposes shall be as follows:

1) Mobilization and Demobilization – lump sum price.

2) Temporary Watermain Bypass – lump sum price or unit price (per meter of CIPP Liner installation) for supply, installation and maintenance of a temporary bypass system.

3) Temporary Water Services – unit price for the number of temporary water services of each size.

4) Frost-Free Hose Bib - unit price for the number of frost-free hose bibs installed.

5) Water Service Shut-off Valve - unit price for the number of water service shut-off valves removed and replaced or newly installed.

6) Grinding of Inactive Service Connections – unit price for the number of inactive service connections cut or ground back flush with the inside surface of the existing pipe wall.

7) CIPP Liner - the distance of CIPP lined watermain, measured in meters (from center of start access pit to center of end access pit), for each pipe size. No deletions shall be made for watermain access pit locations, unless new pipe and fittings used to close-up the watermain are paid separately.

   Unit price shall be full compensation for carrying out the specified scope of work, (including but not limited to, traffic control, access pits, dewatering, pipe cutting, pipe cleaning and preparation for lining, liner installation, sampling, reinstatement of service connections, close-up of watermain, cathodic protection, flushing, pressure and leak testing, disinfection, reinstatement and clean-up of the work site, and all other incidental work and services necessary for completion of the scope of work), with exception of any separately identified pay items.

8) CIPP Liner (Thickness Increase) - the centreline distance of watermain liner installed, measured in metres, for each pipe size and each increment increase in liner thickness. Unit price shall be full compensation for carrying out the additional work associated with an increased liner thickness. (Provisional Item).

9) Water Service Connection Reinstatement - unit price for the number of water service connections reinstated following installation of the CIPP Liner.

10) Valves – unit price for the number of valves of each size or classification installed on the watermain at/near locations where an access pit was required to facilitate watermain lining and the number of valves installed at stand-alone locations where an access pit was not required to facilitate lining.

11) Hydrants – unit price for the number of existing hydrants (removed and replaced with new hydrants) and the number of new hydrants supplied and installed.

12) Hydrant Extensions - unit price for the number of hydrant extensions of each length installed.

13) Curb Stop and Curb Case - unit price for the number of curb stops and/or curb case of each size removed and replaced with a new curb stop and/or curb case.

14) CCTV Inspections – the centreline distance of watermain video inspected, measured in metres, including supply of an inspection report (PDF) and inspection video.

15) Additional Access Pits – unit price for the number of additional access pits required to facilitate lining operations, due to unforeseen conditions or obstructions with the existing watermain. (Provisional item).

16) Additional Access Pit Depths - the depth in meters of additional access pit excavation beyond the specified 2.5 meter depth and to a maximum of 300mm below the watermain. Unit price shall be full compensation for all work associated with the additional access pit depth. (Provisional item).

17) Additional CIPP Liner Samples – unit price for the number of additional CIPP Liner

samples. (Provisional item).

18) Project Sign - unit price for the number of project signs of each size supplied, installed and removed (end of the project).

250.41 PAYMENT

Payment shall be on a lump sum or unit price basis, as per the pay items identified in the Tender Form. The bid price shall include all design, supervision, labor, equipment and materials necessary to complete the work in accordance with this specification.

The Contractor will only be paid to a maximum of 80% of the value of CIPP Liner and CIPP Liner (Thickness Increase) pay items, until such time as the CIPP liner section has passed all sample testing criteria, as per the Contractors design and reference standards, and accepted by the City. This 20% holdback will be called the "Sample Test Allowance". In addition, the 10% mechanics lien holdback shall apply.

Payment for a liner thickness increase as determined by a Special Design, in which there is an increase in the nominal tube thickness shall be as per the Unit Price identified in the Tender Form. Where there is no unit price for CIPP Liner thickness increase identified in the Tender Form, the cost shall be negotiated with the City. Payment for a liner thickness increase will not be given without a corresponding certified design approved by the City.

DIVISION 3

SPECIFICATIONS FOR STREET RECONSTRUCTION

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ITEM 301

WEIGHING MATERIALS IN TRUCKS

301.01 SCOPE OF WORK

The Contractor shall provide weigh scales and accessories for weighing materials in trucks for those instances where payment is based on the weight of the material.

301.02 GENERAL

Where the contract includes items that require measurement for payment by weighing, the Contractor, as part of the work to be carried out under these items, shall provide, install and maintain as necessary, truck weight scales meeting the requirements of the Government of Canada Weights and Measures Act and Regulations, and also the requirements of this specification. On completion of the work the Contractor shall remove temporary scales and scale ramps and clean up and trim the site on which the scale was located.

301.03 LOCATION

Scales for weighing hot asphaltic concrete shall be located at a site convenient to the asphalt plant. Scales for weighing other materials shall be installed at locations selected by the Contractor subject to the approval of the Engineer.

When, for the above locations, in the opinion of the Engineer, there is a waste or loss of material between the point of origin and the materials intended destination on the contract, the hauling operation may be terminated by the Engineer until the Contractor has at his own expense, provided on a site approved by the Engineer, a scale which is close enough to the intended destination to preclude the possibility of waste or loss.

301.04 WEIGH SCALES

The scales shall be of such capacity to accurately weigh any single loaded truck arriving on the site.

The scales shall be equipped with a portable scale house complete with furniture and adequate provision for heat and light.

The scale house shall enclose the mass indicator and be large enough for the Engineer representative to perform his work and maintain records as required by the Engineer.

The scale house shall be waterproof and have a minimum of 750 luxes of illumination, one sliding window facing the scale platform, one other window for cross ventilation, a shelf desk

at least 0.6 x 1.8 metres and heat enough to maintain inside temperature at 20°C. Entrance door to scale house shall not face onto scale platform.

The Contractor shall supply enough approved weigh tickets, in triplicate, with consecutive serial numbers.

Scales may not be used for weighing materials on the contract until the scale house heater and lights are in working order.

The Contractor shall always periodically clean the scale house and maintain all lights and heating in good working condition when the scales are in use. The lights should provide adequate lighting for general office work and the heater most be able to maintain the temperature in the scale house at 20°C.

In order to minimize the effect of impact loads on the scale adjustment and to reduce the effect of vehicle braking and kickback on the scale platform and scale adjustments, the approach ramp shall be constructed on a straight and level grade at the same elevation as the scale platform, for a distance at least equal to the length of the scale platform. Vehicles shall enter and leave the platform at a speed not exceeding 8km/h.
The scale platform and mechanism shall always be maintained, clean and free from encumbrances such as gravel, asphalt, snow, and ice.

Scale houses must be equipped with suitable washroom facilities that meet the latest the OHS Act and Regulations under Sections 61 and 62 of the Regulations. These facilities must be located within 100 metres of the scale house.

These facilities must be provided for use by the Engineer only for the duration of the project while scales are being used. Other accommodations must be provided for contractors/subcontractor’s personnel.

The sanitary provisions shall be in accordance with Regulatory Authorities.

If portable toilets are used, they must be a minimum of 2 metres (height) X 1 metre X 1 metre and must be approved by the Regulatory Authority. The Contractor shall transport the waste from these units, using a collection company (whenever possible) licensed by the Regulatory Authority.

Toilet facilities must be approved by the Engineer. These facilities must be cleaned twice (2) weekly and in the case of a portable toilet, emptied of sewage as well. Contractor must also supply toiletries for the facility. Also, adequate and suitable provisions for washing (hot and cold water, soap, towels OR ample supply of hand sanitizer liquid) must be included in the facility. The door to the facility must contain a lock and key and shall be provided to the Resident Engineer.

301.05 TESTING AND CERTIFICATION

The Contractor shall engage an independent company to test and certify the weigh scales in accordance with the current acts and regulations of Measurement Canada.

All scales shall be tested by the proper authority at the Contractor's expense after each set-up and prior to use on every contract. After certification, the Contractor must provide, to the Engineer, a certificate of compliance from the scale testing company before the scales may be used.

When considered necessary by the Engineer, the Contractor shall have the scales re-tested and re-certified.

The re-testing shall be at the Contractor's own expense.

301.06 DETERMINING TRUCK TARES

When scales are being used on the contract the tares of the hauling vehicle will be determined randomly at least once daily, and more frequently if required by the Engineer. Vehicles which are being weighed for the tare shall contain normal hauling complement of driver and accessories such as spare tires and tools.

301.07 WEIGHING COSTS

The Contractor shall supply a scale operator to take measurements for weights. However, City's representative may also operate the scales and take measurement for weights whenever the Engineer sees fit during weighing operations.

Should the Contractor use a scale with electronic controls and readings, the Engineer may forgo the requirement for the Contractor to provide a scale operator.

All costs of providing, installing, maintaining and finally removing weigh scales complete with scales and furniture, together with all costs of testing and certification in accordance with this specification shall be borne by the Contractor as part of the work to be carried out at the contract price for items which are measured by weighing.

The City shall not be liable for claims caused by delays in testing or certification of the scales.

301.08 USE OF SCALES BY CITY OFFICIALS

Weigh scales, during weigh scale operating hours, shall be at the disposal of City Officials for the purpose of checking the various weights of vehicles hauling materials for use on this contract or on any City or private work the Contractor may undertake.

301.09 VERIFICATION OF WEIGHTS

The City reserves the right to have any vehicles hauling material for the City or its Contractor and/or its cargo re-weighed at the Robin Hood Bay Sanitary Landfill site scales or at other authorized scales. No compensation will be paid to the Contractor for verification of weights of trucks and their load.

ITEM 302

STREET SWEEPING

302.01 SCOPE OF WORK

The Contractor shall sweep street surfaces and gutters as directed by the Engineer. Sweeping shall be enough to remove all gravel and other debris from the swept area to the satisfaction of the Engineer.

302.02 EQUIPMENT

Street sweeping shall be accomplished by using standardized mechanical street sweeping equipment. Both vacuum truck and loader attachment types are acceptable.

The street sweeping equipment shall be a self-driven, self-contained unit equipped with a sweeper broom, collection hopper, gutter brush and water sprinkler system. The sweeper broom shall be a floating broom design to allow for continuous full broom-to-surface contact over uneven terrain with a minimum broom width of 1220 mm (48 inches). The collection hopper shall be automatically loaded by the equipment during operation. The gutter brush shall be hydraulically driven and shall have provisions for manual adjustment. The water sprinkler system shall have a minimum storage capacity of 250 litres (55 imperial gallons) and shall be equipped with adequate spray nozzles to satisfactorily control the dust created by the sweeping operation.

302.03 PROCEDURE

Gravel and debris shall be removed to the satisfaction of the Engineer and within the limits specified by the Engineer. In areas where the street sweeping equipment cannot remove the gravel and debris as required, such gravel and debris shall be removed using other means acceptable to the Engineer.

All gravel and debris collected during the street sweeping operation shall be legally disposed of offsite at a pit provided by the Contractor.

Street sweeping following asphalt crack sealing shall be performed no earlier than 12 hours after the crack sealing operation has finished. The Engineer shall determine the scheduling for the sweeping of each street, noting that it is recommended that street sweeping be conducted within 24 hours of crack sealing.

302.04 MEASUREMENT FOR PAYMENT

The Quality to be measured shall be the number of on-site hours of operation of the

equipment, rounded to the nearest 0.5 hours. Payment will not be made for any equipment downtime.

Additionally, payment shall be made for each call-out requested by the Engineer. This shall cover the cost of mobilizing and demobilizing for each day that the street sweeper is used. Once the street sweeper is mobilized, payment for traveling to subsequent streets shall be paid for at the hourly rate. No payment will be made for disposal of the collected material or for the travel time associated with disposal.

302.05 PAYMENT

Payment shall be made at the unit prices bid for street sweeping and street sweeper call-out. The price bid shall be full compensation for all labour, equipment and materials necessary to complete the work as specified.

ITEM 311

CLEARING AND GRUBBING

311.01 DESCRIPTION

Clearing and Grubbing shall consist of the removal and disposal of all trees, brush, logs, surface boulders, stumps, roots, matted roots and other vegetation from within areas selected by the Engineer.

311.02 PERMITS AND AUTHORIZATION

Should the Contractor wish to burn brush, then prior permission must first be obtained from applicable authorities.

311.03 CLEARING AND GRUBBING OPERATIONS

Areas in which clearing and grubbing are to be carried out will be marked on the ground beforehand by the Engineer.

The Contractor shall not proceed with any burning operations during the fire season without securing the permission of applicable authorities. The Contractor shall take all necessary precautions to guard against damage to surrounding timber and shall assume all liability for claims which may arise from any such damage.

All surface boulders shall be removed and disposed of along with the other clearing and grubbing debris.

Clearing and Grubbing debris shall be legally disposed of offsite at a pit provided by the Contractor.

311.04 MEASUREMENT FOR PAYMENT

Measurements will be made of the horizontal area cleared and grubbed, to a depth of 150mm, from within the area staked out by the Engineer. These measurements shall be computed to obtain the area in hectares, measured to three decimal places.

Clearing and grubbing beyond the limits staked will not be measured for payment.

Surface boulders less than 0.5m³ shall be considered as part of clearing and grubbing. Surface boulders 0.5m³ and larger shall be measured as Solid Rock under Item 321 “Street Excavation”. Grubbing to a depth more than 150mm will be paid as Unsuitable Material (USM) under Item 321 “Street Excavation”.

311.05 PAYMENT

Payment shall be on a unit price basis per hectare of land cleared and grubbed. Payment shall be full compensation for all labour, equipment and materials necessary to clear and grub as specified.

ITEM 321

STREET EXCAVATION

321.01 SCOPE OF WORK

The work to be done consists of the construction of subgrade for the street. The bottom of all excavation and the top of all fill, when completed shall be known as the subgrade and shall be true to lines and grades as set by the Engineer. Excavation and fill is to be made in all cases to such a depth that the compacted subgrade shall be at the required depth below the elevation of the finished roadway.

321.02 CLASSIFICATION

These are the classifications of excavation unless otherwise noted:

(a) Solid Rock (SR) which shall be solid beds or masses of igneous, sedimentary or metamorphic rock which, prior to its removal was integral with its parent mass, and cannot normally be excavated without blasting or pneumatic hammer, and boulders or rock fragments having individual volume in excess of 0.5 m^3 determined from three mutually perpendicular dimensions.

(b) Other Material (OM) - which shall include all excavated material not classified as Solid Rock or Unsuitable Material.

(c) Unsuitable Material (USM) - shall be all excavated material other than Solid Rock or OM which is unsuitable to be placed in the subgrade.

(d) Concrete (CON) - shall be all non reinforced and reinforced concrete and rock and concrete composite structures.

(e) Asphalt (ASP) - shall be asphalt concrete.

321.03 STRIPPING

All topsoil on the streets and the area which will be cut or filled shall be removed and stockpiled on the site for use in landscaping or as otherwise directed by the Engineer.

321.04 BLASTING

The Contractor shall design a blasting pattern for solid rock so that the blasted rock will meet the requirements of Item 322.02 (b) “Rock Borrow”.

321.05 OTHER MATERIAL CUTS

Where the work is in a cut area the Contractor will be generally expected to excavate material to the true surface of the subgrade. Should the Contractor excavate below the true surface of the subgrade he shall place and compact other material as necessary to restore the excavation to subgrade. There shall be no payment for this work except where unsuitable material is excavated below the subgrade.

The Contractor shall remove stones larger than 150mm in greatest dimension from the top 300mm of sub-grade.

321.06 ROCK CUTS

All rock cuts shall be excavated and mucked out fully to 300mm below sub-grade.

In rock cuts where pockets that will not drain are formed below the sub-grade by blasting, the contractor shall, at his own expense, provide drainage by ditching to a free outlet, as ordered, and then backfill and compact to 95% of Proctor Density both the pockets and the trench to an elevation 300mm below subgrade. Backfill material shall be broken rock or coarse gravel.

Back slopes shall be carefully scaled down and all rock and fragments, liable to slide or roll down the slopes, removed to the satisfaction of the Engineer.

321.07 FILL

Where fill material is required to raise the embankment to the proper subgrade elevation such material shall be obtained from surplus excavation and excavated rock meeting requirements of Item 322.02.

The Contractor shall remove unsuitable material as directed by the Engineer. No fill material shall be placed until the area to be filled has been approved by the Engineer.

All excavated excess material to used later in fill locations shall be protected by the contractor so the moisture content is maintained within the range that allows its reuse. If the contractor does not make the necessary efforts to protect the fill, then the volume of the unprotected fill will be deducted from the final borrow quantity for payment.

On no account will the Contractor be allowed to construct a core through the fill and complete the fill area by side dumping.

Fill material shall be deposited and spread in uncompacted layers not exceeding 500mm for the full width of the fill, except that the Engineer may order this thickness reduced, if such thickness does not respond to compaction methods.

The thickness of each successive layer shall be maintained uniform for the full width of the fill.

All stones larger than 150mm in greatest dimension shall be removed from the material comprising the top 300mm of the fill.

The moisture content of the material in the embankment shall be controlled at all stages of construction by ensuring that the top surface of each layer of fill material is suitably compacted and sloped with a cross-fall not to exceed 5% in order to shed surplus rain water.

Material shall be compacted to 95% Standard Proctor Density.

If the moisture content of the material is deficient, the Contractor shall add sufficient water to obtain the necessary compaction. The water shall be placed in controlled amounts and added uniformly. The placing of water shall be considered as included in the unit price bid for "Street Excavation".

321.08 DISPOSAL OF SURPLUS MATERIAL

All surplus material to be legally disposed off the site and at a pit provided by the Contractor.

321.09 REMOVAL OF OBJECTS ABOVE GROUND LEVEL

Unless otherwise provided for by a separate pay item, the Contractor shall be deemed to have included in his bid price for Street Excavation the removal and disposal of trees, shrubs, hedges, fences, signs, boulders, and other objects that rise above the original ground level.

321.10 REMOVAL OF EXISTING ASPHALT AND CONCRETE WORKS

Unless otherwise provided for by a separate pay item, existing asphalt and concrete works which are to be removed shall be classified as "Street Excavation (USM)".

321.11 FILL ADJACENT TO STEEP SLOPES

Where new fill is to be placed adjacent to an existing steep slope or embankment, the Contractor shall, concurrent with the placement of new fill, bench the existing slope as described herein to provide proper bonding of new work to existing.

Each bench shall be 2 metres in width, and at the same height above original ground (or above the next bench below it) as the thickness of the adjacent layer of new fill, such that the bench forms a 2 metres wide extension of the new fill layer into the existing slope.

Material cut out of the existing slope shall be placed in the fill area and compacted.

321.12 MEASUREMENT FOR PAYMENT

The quantity to be measured shall be the number of cubic metres of material excavated, rounded to the nearest whole number, and as shown on the cross-section sheets, between the original ground lines and the completed and accepted embankment lines. On areas where clearing and grubbing is required, cross-sectioning for excavation quantities will be done after clearing and before grubbing operations. A depth of grubbing of 150mm will be assumed and deducted from the excavation quantities. Material placed or removed outside the lines of the Contract and beyond the toe of slope or top of slope, for fill and cut sections respectively, shall not be included in the calculations for pay quantities.

The volume of fill shall be computed by the average end area method of computation.

During excavation operations whenever the character of material changes from one type to another, the Contractor shall notify the Engineer in order that proper measurements or cross-sections shall be made. No allowance will be made for material excavated before such measurements or cross-sections have been made.

In areas where rock excavation is required for street excavation, rock shall be cross sectioned after removal of overburden; shattering to 300mm below road subgrade shall be paid for as excavation.

321.13 PAYMENT

Payment shall be made at the respective unit price bid for each cubic metre of material excavated. Payment for placing and compacting materials into fill areas shall be considered included in the unit price bid for excavation.

Payment shall be full compensation for all labour, equipment, and material necessary to excavate, fill, compact, and remove surplus material in accordance with this specification.

ITEM 322

BORROW

322.01 SCOPE OF WORK

The Contractor shall supply and transport material suitable to the Engineer as may be required to bring the street or other surfaces to the necessary sub-grade in excess of that obtained from street or other excavation on site. This item shall also include Borrow required for Trench Excavation.

322.02 BORROW MATERIALS

Borrow material incorporated into the work shall be:

(a) **Gravel Borrow** - Gravel borrow shall consist of firm well graded granular materials as approved by the Engineer. Approved materials shall not contain any organic soils, vegetation, frozen materials nor excessive amounts of water.

(b) **Rock Borrow** - Rock borrow shall consist of well graded pieces of hard durable solid rock formations, as approved by the Engineer. Approved materials shall not contain any organic soils, vegetation, frozen materials or stones larger than 500mm in greatest dimension.

TABLE 1 - GRADATION REQUIREMENTS GRAVEL BORROW

Sieve Sizes	Percent Passing by Dry Weight			
	Gravel Borrow	100mm Minus Rock	150mm Minus Rock	Rock Borrow
500mm				100
150mm			100	
101.6mm		100		
90.6mm	100			
63.0mm	80-100			
31.5mm	60 - 90			
16.0mm	43 - 77			
8.00mm	33 - 65			
4.00mm	23 - 52			
2.00mm	15 - 40			
1.00mm	9 - 32			
0.500mm	7 - 25			
0.250mm	5 - 19			
0.075mm	0 - 12			

The gradation shall not show marked fluctuations from opposite extremes of the limiting sizes, and the plotted curve shall flow in a manner free from acute changes in directions.

Materials shall be considered unsuitable even though particle sizes are within the specified gradation limits if particle shape or any other characteristic precludes satisfactory compaction.

(c) **Unshrinkable Fill** - The materials for and the production of unshrinkable fill shall be according to the following:

1) Cement type Normal Portland GU Portland limestone GUL
2) Maximum 28-day cylinder compressive strength 0.7 MPa
3) Class of exposure N/A
4) Maximum nominal size of coarse aggregate 25 mm
5) Minimum slump at point of discharge 150 mm
6) Minimum cement content 25 kg/m3

Supplementary cementing materials, for example fly ash, silica fume and/or slag cement may

be used to meet the requirements of this specification.

The material shall flow into the excavation so that it fills the entire space without vibration and segregation. Care shall be taken that no air is trapped beneath horizontal projections or in other locations in the excavation. Unshrinkable fill shall not be placed in direct contact with plastic pipe. A layer of carefully compacted granular material shall be
placed to ensure a separation of 300 mm between the unshrinkable fill and the plastic pipes.

322.03 APPROVAL OF BORROW

At least seven (7) days prior to the commencement of placing the borrow materials, the Contractor shall notify the Engineer of the location of his proposed source or sources of borrow material, so that the Engineer may inspect and , if necessary, test the material and decide on its suitability. The Contractor shall supply material only from approved sites.

322.04 PLACEMENT OF BORROW

Placing of borrow material shall be in accordance with the section "Fill" as specified in Item 321 "Street Excavation" or the section "Backfilling" as specified in Item 211 "Trench Excavation".

322.05 MEASUREMENT FOR PAYMENT

(a) The unit of measure for payment for Gravel Borrow shall be the cubic metre rounded to the nearest whole number. The payment quantity shall be the volume in cubic metres of acceptable gravel borrow material placed to the required lines, grades and cross-sections. The volume of gravel borrow shall be computed using the cross-sectional area between the original ground position, or the position of material of other classifications (as determined by survey cross-sections) and the required lines and grades. For embankment borrow the volume shall be computed using the average end area method and for trench borrow the profile method, using theoretical measurements.

(b) The unit of measurement for payment for Rock Borrow shall be by:

(i) the tonne, rounded to the nearest whole number. The payment quantity shall be the weight in tonnes of acceptable Rock Borrow material placed to the required lines, grades and cross-sections. The weight of rock borrow shall be computed from weigh scale tickets as delivered to the site and signed by the City representative upon the delivery of each load of material.

(ii) the cubic metre, rounded to the nearest whole number. Measurement shall be made in the same manner as that specified for Gravel Borrow.

(c) During fill operations, when the character of material being placed changes, the Contractor shall notify the Engineer in order that proper measurements or cross-sections may be made. No allowance will be made for borrow placed before such measurements or cross-sections have been made, nor for material placed beyond the established pay lines.

322.06 PAYMENT

Payment shall be on a unit price basis per cubic metre, or tonne, and shall be full compensation for all labour, equipment, and materials necessary to excavate, transport, place, and compact borrow material as specified.

ITEM 323

GRAVEL FOR STREETS

323.01 SCOPE OF WORK

The Contractor shall supply and place on a prepared sub-grade Gravel for Streets Granular "A", Granular "B", Maintenance Grade No. 1 and Quarter Minus Materials in accordance with this specification.

323.02 PHYSICAL AND GRADATION REQUIREMENTS

Gravel for streets shall be composed of clean, hard, un-coated particles and shall be free from organic matter, clay lumps and deleterious materials such as shale, ochre and schists.

Materials shall be considered unsuitable even though particle sizes are within the specified gradation limits if particle shape or any other characteristic precludes satisfactory compaction or fails to provide a street suitable for traffic.

Materials shall conform to the gradation requirements given in Table 1 and to the physical requirements given in Table 2. The gradation shall not show marked fluctuations from opposite extremes of the limiting sizes, and the plotted curve shall flow in a manner free from acute changes in direction.

Granular "A", Granular "B", Maintenance Grade No. 1 and Quarter Minus Materials shall be processed by crushing and, when necessary to eliminate surplus fines passing the 4.76mm sieve, shall be screened and washed.

323.03 SAMPLING AND APPROVAL

Samples of material will require testing and approval before placement. A testing laboratory approved by the Engineer must certify the material as being suitable before any gravel is placed on the street. This applies to all projects including subdivisions being completed by developers. Samples may also be tested at the City’s Asphalt and Soils Laboratory. Additional tests may be required during the work if deemed necessary by the Engineer.

No gravel other than that which conforms to this Specification will be acceptable and the Contractor shall satisfy himself as to the availability of such materials before tendering.

323.04 PREPARATION OF SUB-GRADE

The Contractor shall prepare the road surface to the satisfaction of the Engineer before

commencing placement of any gravel for streets. Such work shall be carried out in accordance with Item 321"Street Excavation".

323.05 PLACING GRAVEL FOR STREETS

The Contractor shall place all granular base in such a manner as to prevent contamination by other materials and to prevent segregation.

All gravel for streets shall be placed in uniform layers such that the thickness of the compacted layer does not exceed 150mm. This requirement may be waived if the Contractor can demonstrate to the satisfaction of the Engineer, a method of placing and compacting thicker layers of material such that the specified density is uniformly attained.

The materials shall be sprayed with water when and as directed by the Engineer, either to aid compaction or reduce dust nuisance or both. When water is added to aid compaction, it shall be applied immediately ahead of the compacting unit.

Each layer of gravel for streets shall be bladed, shaped and compacted as necessary to produce the required profile and cross-section. The finished surface shall not deviate at any place on a 3m straight edge by more than 20mm for Granular "B", and 10mm for Granular "A" and Maintenance Grade No. 1 and Quarter Minus Materials. The upper layer shall be maintained to these tolerances and to the specified density until completion of the contract, or until the surface is paved. This may require keeping the moisture content at the appropriate value during periods of dry weather in addition to regrading and recompacting as frequently as may be deemed necessary by the Engineer.

Calcium chloride shall be applied uniformly by mechanical means when and as directed by the Engineer.

TABLE 1 GRADATION REQUIREMENTS				
Sieve Sizes	**Percent Passing by Dry Weight**			
	Granular "A"	**Granular "B"**	**Maintenance Grade No. 1**	**Quarter Minus**
38.1mm		100		
25.4mm		60 - 90		
19.0mm	100		100	
15.9mm		45 - 80`		
9.51mm	55 - 80		55 - 80	
6.30mm				100
4.76mm	35 - 60	25 - 55	35 - 60	55-80
2.00mm				35-55
1.20mm	17 - 35	12 - 35	17 - 35	
0.425mm				12-30
0.3mm	7 - 20	7 - 20	7 - 20	
0.075mm	3-6 (Pit Source) 3-8 (Rock Source)	3-6 (Pit Source) 3-8 (Rock Source)	6 - 12	4-10

1. The percentage of material finer than the 0.075mm sieve shall be determined by ASTM C117-80.
2. Where Granular "A" and Granular "B" materials are produced from natural gravel deposits, a maximum of six percent (6%) passing the 0.075mm sieve will be allowed.
3. Where forty percent (40%) or more of Other Material is blended to a rock source for the production of granular materials it shall then be treated as a pit source.

323.06 COMPACTION

All gravel for streets shall be compacted to not less than 100% of the Standard Proctor Density (ASTM D698-78).

Compaction operations shall be carried out as closely as possible behind the placing and spreading operations. At the end of each day, all material placed shall have been compacted to the specified density.

Each layer of material shall be graded and compacted as specified before the next layer is placed.

Where necessary to obtain the required compaction, the Contractor shall supply sufficient water by means of an approved distributor.

TABLE II PHYSICAL REQUIREMENTS				
Physical Test	**ASTM Designation**	**Granular "A"**	**Granular "B"**	**Maintenance Grade No. 1**
Los Angeles* Abrasion (loss % Maximum)	C131-89 C-535-89	35	35	35
Percent** Crushed (Minimum)	D5821	50	50	50
Plasticity Index	D424-84	0	0	0
Petrographic Number (Maximum)	(CSA 23.2-M90)	150	150	150
Micro - Deval Test for Fine Aggregate (% Maximum)	(CSA A23.2-23A)	30	30	
Micro-Deval Test for Coarse Aggregate (% Maximum)	MTO LS.618	25	25	

* For Granular “A” & “B”, the rate of the loss after 100 revolutions to the loss after 500 revolutions shall not exceed 0.280.

** The percent of crushed particles will be determined by examining the fraction on the 4.76mm sieve and dividing the weight of the crushed particles by the total weight retained on the 4.76mm sieve. Pieces having one or more freshly fractured faces will only be considered as crushed material. Pieces with only small chips removed will not be considered as crushed.

323.07 MEASUREMENT FOR PAYMENT

Measurement for payment will only be made for those materials accepted for use under this specification.

Measurement for payment for Gravel for Streets shall be by the weight of material placed in the works as weighed on scales.

The scales shall be provided by the contractor and shall conform with the requirements of

Item 301 "Weighing Materials in Trucks". Scale Checkers shall be supplied by the Engineer as necessary. Only loads certified by the City representatives being placed in the works at the required locations shall be considered for payment.

The weight shall be computed in tonnes, rounded to one decimal place.

323.08 PAYMENT

Payment shall be on a unit price basis per tonne and shall be full compensation for all labour, equipment and material necessary to supply and place material in accordance with this specification. The contractor shall not be paid more than 110 % of the calculated quantities based on theoretical limits and approved tickets.

ITEM 324

EXCAVATION OF DITCHES

324.01 SCOPE OF WORK

The Contractor shall construct new or reconstruct existing ditches to the lines and grades established on the drawings or established by the Engineer in the field.

324.02 CLASSIFICATION

There shall be three classifications of excavation unless otherwise noted:

(a) Solid Rock (SR) which shall be solid beds or masses of igneous, sedimentary or metamorphic rock which, prior to its removal was integral with its parent mass, and cannot normally be excavated without blasting or pneumatic hammer, and boulders or rock fragments having individual volume in excess of 0.5 m^3 determined from three (3) mutually perpendicular dimensions.

(b) Other Material (OM) - which shall include all excavated material not classified as Solid Rock or Unsuitable Material.

(c) Unsuitable Material (USM) - shall be all excavated material other than Solid Rock which is unsuitable to be placed in the subgrade.

324.03 CONSTRUCTION

The width and side slopes of all roadside ditches shall be made true to the required cross-sections and trimmed to the satisfaction of the Engineer.

To reduce siltation resulting from roadside drainage, the Contractor shall, if possible, terminate roadside ditches a minimum of 30 metres from any watercourse or water body or at a point designated by the Engineer. This will allow roadside drainage water to filter through a vegetated area prior to entering a watercourse or water body.

Where the quantity of excavation exceeds that required to construct the sub-base as directed by the Engineer, the surplus shall be used to widen the fills or otherwise disposed of.

All surplus material to be legally disposed of off the site and at a pit provided by the Contractor.

Fill material required to be compacted into ditch cross-sections shall be compacted to 95% standard proctor density.

324.04 MEASUREMENT FOR PAYMENT

The quantity to be measured shall be the number of cubic metres of material excavated, rounded to the nearest whole number, and as shown on the cross-section sheets, between the original ground lines as cross-sectioned before construction, clearing and/or after grubbing where applicable, and the completed and accepted ditch lines. Material placed or removed outside the lines of the Contract and beyond the established ditch limits, for fill and cut sections respectively, shall not be included in the calculations for pay quantities.

The volume of fill shall be computed by the average end area method of computation.

During excavation operations whenever the character of material changes from one type to another, the Contractor shall notify the Engineer in order that proper measurements or cross-sections shall be made. No allowance will be made for material excavated before such measurements or cross-sections have been made.

324.05 PAYMENT

Payment shall be made at the respective unit price bid for each cubic metre of material excavated. Payment for placing and compacting materials into fill areas shall be considered included in the unit price bid for excavation.

Payment shall be full compensation for all labour, equipment and material necessary to excavate, fill, compact, and remove surplus material in accordance with this specification.

ITEM 325

SCARIFYING AND RESHAPING GRAVEL SURFACES

325.01 SCOPE OF WORK

This specification covers the requirements for the scarifying and reshaping of a road surface prior to the application of Selected Granular Base Course or Asphaltic Pavement.

325.02 OPERATIONS

Where directed by the Engineer the Contractor shall scarify and reshape a road surface prior to the application of Selected Granular Base Course or Asphaltic Pavement. The scarifying and reshaping shall be carried out within the lengths designated by the Engineer and within the width to be covered by the proposed pavement plus 0.3 metre on each side, or to such other width as the Engineer may designate.

Where the road surface consists of Selected Granular Base Course of a particular type, then the scarifying shall be to the full depth of the base course of that type or to a depth of 300mm, whichever is less.

Where the subgrade consists of subgrade consisting of Other Material, then the scarifying shall be to a depth of not less than 300mm.

Where the road surface consists of subgrade consisting of rock, then scarifying as such will not be required, and scarifying and reshaping operations shall simply consist of just reshaping the road surface.

Unsuitable roadbed materials, as determined by the Engineer, which are encountered during the scarifying operation shall be excavated to the lateral limits and depth directed by the Engineer and shall be disposed of as directed. Such work shall be carried out in accordance with Item 321 "Street Excavation".

No boulders greater than 150mm in diameter shall be left within 300mm of the top of subgrade composed of Other Material. Such boulders over 150mm in diameter which cannot be removed by the scarifying operation shall be removed by hand excavation, blasting or any other suitable method. All excavated boulders shall be removed from the subgrade and ditches and then disposed of.

Excavations resulting from the removal of boulders or Unsuitable Material shall be backfilled with approved material to the specified grades, in accordance with Item 321 "Street Excavation".

Whenever the materials incorporated in the existing subgrade are insufficient to provide the required profile and cross-section, the Contractor shall add additional approved material as directed by the Engineer. Such work to be carried out in accordance with

Item 321 "Street Excavation".

The maximum variation from the specified profile and cross-section of the compacted, scarified and reshaped road surface shall be 30mm, except in those instances where paving is to take place directly on top of the scarified and reshaped material, in which case the finished surface shall not deviate at any place on a 3m straight edge by more than 10mm.

Where due to traffic use, or for whatever other reason, the scarified and reshaped road surface no longer lies within the required tolerance, then before placing the next materials, the Contractor shall scarify and reshape the affected area again, at his own expense.

325.03 COMPACTION

Road materials disturbed by the scarifying and reshaping shall be compacted.

Where subgrade is scarified and reshaped the disturbed materials shall be compacted to not less than 95% of the maximum Standard Proctor Dry Density (ASTMD698-78).

Where select granular base course is scarified and reshaped the disturbed materials shall be compacted to not less than 100% of the maximum Standard Proctor Dry Density.

325.04 MEASUREMENT FOR PAYMENT

.01 Measurement for Payment where subgrade and Select Granular Base Course are in the same contract.

Where subgrade was constructed under the same contract which also calls for the placing of selected granular base course, then any required scarifying and reshaping of the subgrade prior to placing granular will not be measured for payment and no payment for the scarifying and reshaping will be made.

Boulders removed from the top 300mm of Other Material fill subgrade will not be measured for payment. However, boulders removed from the top 300mm of subgrade in Other Material cuts will be measured and paid for in accordance with Item 321 "Street Excavation".

Additional fill material shall be measured and paid for in accordance with the provisions of Item 321 "Street Excavation" or Item 322 "Borrow", as appropriate.

.02 Measurement for Payment where road surface was constructed under a previous contract.

Where subgrade was constructed, or some selected granular were placed under a previous contract, then such scarifying and reshaping of the road surface as the Engineer requires shall be carried out and measured for payment. This measurement for payment

shall be of the horizontal area actually scarified and reshaped from within the limits of length and width as designated by the Engineer, and will be measured in square metres, rounded to the nearest whole number.

Boulders removed from the top 300mm of Other Material subgrade, on a job where subgrade was constructed on a previous contract will be measured and paid for in accordance with Item 321 "Street Excavation". The measurement for payment will be done in this case regardless of whether the boulders were from a cut or a fill.

The excavation of Unsuitable Material in the roadbed shall be measured and paid for in accordance with the provisions of Item 321 "Street Excavation".

Additional fill material shall be measured and paid for in accordance with the provisions of Item 321 "Street Excavation" or Item 322 "Borrow", as appropriate.

325.05 PAYMENT

Payment shall be on a unit price basis per square metre and shall be full compensation for all labour, equipment and material necessary to complete the work as specified.

ITEM 326

SAND

326.01 SCOPE OF WORK

This specification covers the requirements for the supply and delivery of sand.

326.02 PHYSICAL AND GRADATION REQUIREMENTS

Materials shall be natural or manufactured from natural aggregates and consist of sound and durable predominately angular particles completely resistant to breakdown under traffic or freezing conditions.

Materials shall conform to CAN/CSA A82.56 be composed of clean, hard, uncoated, particles and shall be free from organic matter, clay lumps, and deleterious materials such as shale, salts, ochre and schists.

Materials shall conform to the gradation requirements as given in Table 1. The gradation shall not show marked fluctuations from opposite extremes of the limiting sizes and the plotted curve shall flow in a manner free from acute changes in direction.

Materials shall be considered unsuitable even though particle sizes are within the specified gradation limits if particle shape or any other characteristic does not lend itself well for the identified specific end use of the product. (Example; material that is sharp will be unsuitable and cause many unnecessary injuries to persons playing softball.)

TABLE No. 1 GRADATION REQUIREMENTS						
Sieve Sizes	**Percent Passing by Dry Weight**					**9.51 mm (3/8") Washed Stone (Natural Gravel)**
	Winter Sand	**Baseball Field Sand**	**Paving Stone Bedding Sand**	**Washed Sand**	**Trench Bedding Sand**	
9.51 mm	100	100	100		100	100
4.76 mm	90-100	90-93	95-100	100	90-100	40-0
2.34 mm			80-100			10-0
2.00 mm		65-67				
1.18 mm	50-85		50-85		50-85	
0.595 mm			25-60			
0.425 mm		30-33				
0.300 mm	10-30				10-30	
0.297 mm			10-30			
0.149 mm			2-10			
0.075 mm	0-5	8-10	0-3	0	0-5	0

326.03 SAMPLING AND INSPECTION

Materials shall be sampled and inspected by the City prior to stockpiling at the designated locations. This acceptance shall not preclude further stockpile sampling, which may or may not lead to material rejection.

The quantity of these tests shall be determined by the Engineer. They shall be sufficient in number to provide an acceptable product.

326.04 MEASUREMENT FOR PAYMENT

The measurement for payment will only be for those materials accepted for use under this specification.

.01 Volume Measurement for Payment

Where the contract unit price table states that Sand is to be stockpiled and the unit of

measurement is stated in cubic metres, then such stockpiles shall be cross sectioned and the volume computed in cubic metres rounded to the nearest whole number.

The quantity to be measured shall be the number of cubic metres of stockpiled Sand as shown on the cross section sheets between the graded base of the stockpile as cross sectioned before stockpiling begins and the cross sections made over the completed stockpile. The volume of this stockpile being computed by the average end area method of computation or as wedges or pyramids, as the case may be when terminating at grade points.

.02 Weight Measurement for Payment

Where the contract price table states that Sand is to be stockpiled and the unit of measurement is stated in tonnes, then the material shall be weighed on scales.

The scales shall be provided by the Contractor and they shall conform with the requirements of Item 301 "Weighing Materials in Trucks". Only loads certified by the City Road Checker as being placed in the works at the required locations shall be included in measurement for payment.

The weight shall be computed in tonnes, rounded to one decimal place.

For quantities of Sand less than or equal to 10,000 tonnes, the City will measure the material in stockpile by cross sectioning, calculating the number of cubic metres and converting the quantities to tonnes if the contractor so desires. A standard conversion factor of 1.8 t/m^3 will be applied for Sand measured in stockpile.

For quantities of Sand greater than 10,000 tonnes, the Contractor must provide weight scales.

326.05 PAYMENT

Payment at the contract price per cubic metre for Sand shall be full compensation for all labour, equipment-use, materials and any other expenses to; provide a pit, obtain environmental approval, provide and transport pit samples to the City's Asphalt and Soils Laboratory, clear, grub and strip the pit, process pit material to the required gradation and physical requirements, transport and place the material in the stockpile, clean up the pit, pay any royalties for the material, and provide such other restoration to the pit as may be required, together with the provision of scales if required.

ITEM 330

CONCRETE CURB, GUTTER AND/OR

SIDEWALK WORKS

330.01 SCOPE OF WORK

The Contractor shall remove and replace existing and/or construct new concrete structures as directed by the Engineer. The Contractor shall excavate as required, compact sub-base, place a crushed gravel base, supply, place, finish and cure concrete work in accordance with these specifications and those contained in CSA A23.1, “Concrete Materials and Methods of Concrete Construction”.

The Contractor shall form and pour paraplegic ramps, driveway lowbacks etc. into the concrete structure as required by the Engineer.

330.02 DEFINITIONS

For the purpose of this specification the following terms shall have the following meaning:

(a) **Remove and Replace** - Work removed and reinstalled at the same place, grade and alignment.

(b) **New** - Work installed where no similar structure previously existed or where the new structure is installed at a different grade and/or alignment.

330.03 EXCAVATION AND BORROW

The Contractor shall excavate or provide acceptable borrow material as required to provide a suitable sub-grade for replacement structures, unless a suitable sub-grade remains undisturbed upon removal of existing structures. Such excavation shall also provide sufficient working room for formwork, etc.

330.04 BASE

The Contractor shall supply and place material consisting of Granular "B" road gravel, as specified in the Item 323 “Gravel for Streets” to bring the existing base up to grade or to construct a new consolidated base. The base shall be placed on a uniform dense sub-grade. The sub-base shall be compacted to 95% Standard Proctor Density and the base shall be compacted to 100% Standard Proctor Density. All soft, yielding or otherwise unsuitable material shall be removed and replaced with suitable material. The base shall have a minimum thickness of 100mm or thicker if specified and shall be true to the lines and grades

set by the Engineer, and in accordance with the dimensions outlined in the standard drawings.

330.05 FORM AND DIMENSIONS

The form and dimensions of the concrete work shall conform to the contract drawings or the Standard Drawings.

330.06 FORMS

Forms shall be free from warp and of sufficient strength to keep from springing out of shape. All forms shall be approved by the Engineer and shall comply with CSA A23.1 Section 6.

The forms shall be staked or otherwise held to the established lines and grades and upper edges shall conform to the grade of the top-of-curb established by the Engineer.
All forms shall be thoroughly wetted, oiled or coated with soap or whitewash before depositing any concrete against them. All mortar and dirt shall be removed from the forms that have been previously used.

Face of curb forms shall be lowered 100mm at all lowbacks so that proper screeding and compaction can be carried out.

330.07 JOINTING

Control Joints

Transverse weakened - plane contraction joints shall be constructed at right angles to the curb line at a spacing of 1800mm maximum for sidewalk and combined curb and sidewalk, and 6300mm maximum for curb and curb and gutter. The depth of this joint shall be at least one quarter (1/4) of the depth of the curb section and shall continue through the combined sidewalk section where applicable, to a depth of one quarter (1/4) the sidewalk thickness. ***If the joint is tooled, it shall not include the depressed edges.***

Expansion Joints

Full depth expansion joints shall be constructed at right angles to the curb line, at immovable structures and at points of curvature for short radius curves. Filler material shall conform to the requirements of D-1751 and shall be furnished in a single piece for the full depth and width of the concrete structure (pieces cut in half which results in concrete abutting against existing concrete is not acceptable and will result in removal of the concrete at the contractor's cost). They shall be flush with the surface, cut-off and trimmed to the satisfaction of the Engineer. Maximum spacing is 5400 mm. Accepted products include Nomaflex, Reflex or approved equal.

Construction Joints

Construction joints shall be built at convenient stopping places in the placement of the concrete. They may be either butt-type or expansion type joints and shall be full depth and width of the sidewalk section. They shall be built when there is a delay in the supply of concrete and cold joints might develop, especially during hot weather. When the joint is left until the next day, it shall be treated as an isolation joint.

Isolation Joints

Isolation joints shall be located adjacent to existing structures (i.e. existing sidewalk/slabs, poles, walls, hydrants, buildings, curb and gutter, etc.) Isolation joints shall also be located before and after curve sections and at intersections. Filler material shall conform to the requirements of D-1751 and shall be furnished in a single piece for the full depth and width of the concrete structure (pieces cut in half which results in concrete abutting against existing concrete is not acceptable and will result in removal of the concrete at the contractor's cost). They shall be flush with the surface, cut-off and trimmed to the satisfaction of the Engineer. Accepted products include Nomaflex, Reflex or approved equal.

330.08 CONCRETE

Concrete production, quality, delivery and placing as per Item 404 "Concrete Structures" unless otherwise stated.

Placement and Consolidation

Concrete may be placed by the "formed" or "slipform" method:

Formed Method - The concrete shall be placed in the forms without segregation and then it shall be tamped or mechanically vibrated for thorough consolidation. When face forms are used, they shall be removed as soon as possible to permit finishing. Front and back forms shall be removed without damage to the concrete after it has set.

Slipform Method - The slipform method will be permitted for curb and gutter, combined curb and sidewalk and sidewalk construction, with the following maximum tolerances, 25mm in 3m for both horizontal and vertical alignment. Expansion and contraction joints are to be saw cut.

Surface Finishing

As soon as the concrete has been placed and consolidated, it shall be struck off and screeded to the established grade. The surface shall be immediately floated with a magnesium or wood float to remove ridges and fill the voids remaining on the surface following screening. The concrete shall not be worked when bleed water (or free water) is present on the surface. The surface shall not be permanently worked or subsequently overworked to cause excessive fines and water to be forced to the surface. Floating and

edging of the surface shall be performed in such a manner that leaves a surface free of tool marks, elevations and depressions. Final surface texture shall be given by using a coarse broom to produce regular corrugation not over 3mm in depth. Concrete adjacent forms and formed joints shall be edged with a suitable edging tool having a radius of 25mm.

In addition to the above, for street grades greater than 12%, a 150mm O.C. non skid ribbed surface shall be edged on the sidewalk perpendicular to the curb.

Curing and Protection

Concrete shall be cured in accordance with the requirements of Section 404 "Concrete Structures". Proper curing will be considered 15% of the associated unit price bid for concrete payment purposes.

Freshly deposited concrete shall be protected from premature drying and extremes of temperature and kept at a relatively constant temperature for the period necessary to hydrate the cement and allow proper hardening of the concrete.

In cold weather the Contractor shall, at his own expense, and by approved means, ensure to the satisfaction of the Engineer that all concrete is maintained at a temperature of not less than $10^{o}C$ for 96 hours after placing.

The method and materials used to cure and protect the concrete shall be in accordance with the provisions of CSA A23.1 Section 7.

When membrane curing compounds are used on concrete which will probably receive application of de-icer chemicals during the first winter of exposure, a minimum of thirty (30) days air drying following the curing period shall pass before de-icer salts are applied.

Following the last finishing operation of the surface, two (2) spray coats, one at 90^{O} to the other, of Sternson Ritecure (white pigmented) ASTM C-309, Type II or approved equivalent, shall be applied to the surface at the manufacturer's recommended rate of coverage.

The Contractor shall by barricades, security, or other means, protect all curb gutter and/or sidewalk from harm by vehicular traffic or pedestrians, until the Engineer authorizes the curb gutter and/or sidewalk open to vehicular traffic or pedestrians.

Time Limitations

No concrete work installed under this specification shall be placed after November 15^{th} of each year or before May 1^{st} of the following year unless otherwise approved by the City.

330.09 REINFORCEMENT

The Contractor shall furnish and place steel reinforcement for concrete to conform to the Standard Drawings and shall do all cutting, bending, fastening, and any special work

necessary to hold the reinforcement in place and protect it from injury and corrosion.

Steel reinforcing bars or rods to be embedded in concrete shall be deformed bars of 400MPa strength. They shall be free from kinks or defects and from bends that cannot be readily and /fully straightened in the field. Bars shall conform to CSA A23.1 Section 6. All bars shall be stored in a clean, dry place until incorporated in the work.

330.10 REINSTATEMENT

Reinstatement of existing asphalt concrete driving surface adjacent to the curb or gutter shall be made in accordance with the Item 352 "Full Depth Asphalt Patch", except the cost shall be deemed to have been included by the Contractor in his bid prices for this work and no separate payment will be made for this patching. Reinstated sections must be of sufficient width to mechanically tamp and/or roll to achieve compaction requirements.

Where the street is stripped of all asphalt for the purpose of street reconstruction no asphalt for street reinstatement will be required.

Reinstatement of grass or asphalt surfaces behind the curb line shall be performed and paid for in accordance with the applicable section of Item 511 “Topsoiling, Sodding and/or Hydroseeding” or Item 530 “Reinstatement” of this contract.

330.11 DAMAGED WORK

Where concrete curb, gutter and sidewalk works are damaged and are designated by the Engineer to be replaced, the repairs shall be as follows:

(a) For Curb & Curb & Gutter - the length of the damaged section.

(b) For Sidewalk and Combined Curb and Sidewalk - the number of existing whole blocks having been damaged.

330.12 MEASUREMENT FOR PAYMENT

Work performed under this item shall be paid for in accordance with the following:

(a) Curb, Curb and Gutter, Combined Curb and Sidewalk and similar structures - the length of structure, in metres, rounded to one decimal place, measured along the exposed curb face, with no deduction for gutter inlets, frames, grates, etc.

(b) Sidewalk - the surface area of the structure in square metres, rounded to one decimal place, with no deduction for manholes or other similar structures.

330.13 PAYMENT

The Contractor shall be paid at the respective unit price bid for each unit of work performed in accordance with this specification. The unit prices shall constitute full compensation for all labour, equipment, and materials required to complete the work in accordance with this Specification and the following:

(a) N**ew Structures**: The unit price shall include placing of granular bed and forming, placing and curing the concrete.

(b) **Remove and Replace Structures**: The unit price shall include excavating the existing structure, placing a granular bed and forming, placing and curing the concrete.

ITEM 331

UNIT PAVERS

331.01 SCOPE OF WORK

The Contractor shall remove and replace existing and/or construct new unit paving surfaces. The Contractor shall excavate as required, compact sub-base, place a crushed gravel, filter fabric and sand base, supply and place unit pavers.

The Contractor shall form paraplegic ramps, driveway low backs etc., into the paver surface as required.

331.02 DEFINITIONS

For the purpose of this specification the following terms shall have the following meaning:

(a) **Remove and Replace** - Work removed and reinstated at the original grade and alignment.

(b) **New** - Work installed where no similar paver surface previously existed or when a new paver surface is to be installed at a different grade and/or alignment.

331.03 EXCAVATION AND BORROW

The Contractor shall excavate or provide acceptable borrow material as required to provide a suitable sub-grade for replacement surfaces, unless a suitable sub-grade remains undisturbed upon removal of existing paver surfaces. Such excavation shall also provide sufficient working room for formwork, etc.

331.04 BASE

The Contractor shall supply and place material consisting of Class "A" road gravel, as specified in the Item 323 "Gravel for Streets" to bring the existing base up to grade or to construct a new consolidated base. The base shall be placed on a uniform dense sub-grade. The sub-base shall be compacted to 95% Standard Proctor Density and the base shall be compacted to 100% Standard Proctor Density. All soft, yielding or otherwise unsuitable material shall be removed and replaced with suitable material. The base shall have a minimum thickness of 100mm or thicker if called for on the contract drawings and shall be true to the lines and grades set by the Engineer, and in accordance with the dimensions outlined in the drawings.

331.05 FILTER FABRIC AND SAND

Filter fabric shall conform to Terrafix 270R as manufactured by Terrafix Geosynthetics Inc. or approved equal and be placed at the interface between the Class “A” road gravel and the sand.

Sand shall conform to Paving Stone bedding Sand as detailed in Item 326 “Sand”.

331.06 UNIT PAVERS

Unit pavers can be precast concrete pavers, brick, flagstone (natural slate) or other units defined in the specifications.

Precast Concrete Pavers: shall conform to CSA3-A321.2 and be in shapes, sizes and colours specified. If not specified, the unit shall be the Holland type having dimensions of 105mm X 215mm X 50mm for sidewalks and 105mm X 215mm X 60mm for streets. The colour shall be 70% red and 30% brown. Pattern shall be "double basket".

Flagstone (natural slate): shall be shaped to fit design details, rectangular and 25mm thick.

New Work

For each project the unit pavers shall be supplied from one manufacturing source to ensure uniform texture and colour.

Damaged or soiled unit pavers shall not be used in the work.

Unit pavers stored on the site shall be stored off the ground on wood pallets or platforms.

Remove & Replace Work

Where unit pavers have been removed to facilitate repairs or construction of curbs and sidewalks or other reasons, the Contractor shall reinstate same with existing materials and where necessary, supply new material of similar shape and colour to match existing.

331.07 INSTALLATION

Place bedding sand to the specified depth, approximately 25mm. Sand shall be levelled and lightly compacted.

Paving units shall be laid in the pattern specified, by hand, on top of the uncompacted sand. Partial units used for detailing shall be neatly cut to the desired shape and placed on the uncompacted sand bed.

Vibrate the pavers, using a plate vibrator, into the uncompacted bedding to seat the units. After seating of pavers is complete, sand shall be broadcast on the surface and swept into the joints.

Vibrate sand into place between the pavers, then sweep off the excess sand.

Surface of finished pavement shall be free from depressions exceeding 3mm as measured with a 3-metre straight edge.

331.08 MEASUREMENT FOR PAYMENT

The quantity to be measured shall be the area of unit pavers measured to one (1) decimal place in square metres.

331.09 PAYMENT

The Contractor shall be paid at the respective unit price bid for each unit of work performed in accordance with this specification. The unit price bid shall constitute full compensation for all labour, equipment, and materials required to complete the work in accordance with this specification.

Payment for new work shall include the supply and installation of unit pavers, sand and Class "A" bedding.

Payment for removal and replacement work shall include the salvaging and re-use of existing precast concrete pavers, supply and installation of additional new precast concrete pavers, sand and Class "A" bedding.

Excavation for unit pavers shall be paid for under Item 321 "Street Excavation".

ITEM 341

RECONSTRUCT AND ADJUST UTILITIES TO GRADE AND ALIGNMENT

341.01 SCOPE OF WORK

The Contractor shall adjust to finished grade, manholes, catch basins, valve boxes and curb cases and others specified in the bid form. The work may also include the replacement of certain structures or portions there of and reinstatement of disturbed areas.

341.02 FORM AND DIMENSION

The form and dimension shall be in accordance with the standard drawings or as detailed by the Engineer.

341.03 CONCRETE

Concrete shall conform to "Concrete" as detailed in Item 223 "Manholes, Catch Basins, Ditch Inlets, Headwalls & Chambers".

341.04 FORMWORK

Formwork shall conform to "Formwork" as detailed in the Item 223 "Manholes, Catch Basins, Ditch Inlets, Headwalls & Chambers".

341.05 REINFORCEMENT

Reinforcement shall conform to "Reinforcement" as detailed in the Item 223 "Manholes, Catch Basins, Ditch Inlets, Headwalls & Chambers".

341.06 BONDING AGENT

Bonding agent shall be Sternson ST-432 or approved equal and shall be applied at joints between old and new concrete in compliance with the manufacturer’s instructions.

341.07 UTILITY CASTINGS

Utility castings shall be those shown in the contract or standard drawings and from manufacturers approved by the City.

Adjustable manhole frames and covers shall consist of a resilient seat ductile iron upper section with a conical cast iron guide frame. Approved products are Model MC401010193 as manufactured by EJ and Model C-51MSR as manufactured by Bibby-Ste-Croix or approved equal. The diameter of the cover shall be 624 mm as per Dwg. 10-223-13A. The Adjustable manhole upper section shall conform to ASTM A536 for ductile iron. The Adjustable guide frame and cover shall conform to ASTM A48 Class 30 for cast iron.

341.08 PROCEDURE

Cutting of Asphalt and Concrete

Where utilities are in areas where the existing asphalt and concrete is to remain, the Contractor shall remove asphalt or concrete in square or rectangular areas for a minimum distance of **900mm** from the edge of the structure. Cut edges shall be straight, smooth, and vertical to provide for proper bonding of replacement material.

Adjusting manholes (adjustable manholes)

The Contractor shall:

a) remove sufficient concrete to remove existing frame and cover plus remove any unsound concrete and reinforcement, that may exist as to leave only sound concrete and reinforcement in the manhole. Removal of existing asphalt, concrete and/or backfill material shall provide adequate space for the installation or adjustment of the manhole frame and cover.

b) clean and prepare existing concrete deck for manhole installation.

c) measure the distance from the finished asphalt surface to the top of the existing concrete deck to select the proper guide frame height, as per the guidelines listed below:

   i) 400mm or greater clearance from finished asphalt surface to concrete deck = 100mm concrete adjustment ring or greater with 200mm conical Guide Frame used with adjustable frame & cover.
   ii) 275mm to 375mm clearance from finished asphalt surface to concrete deck = 200mm conical Guide Frame used with adjustable frame & cover.
   iii) 225mm to 275mm clearance from finished asphalt surface to concrete deck = 150mm straight Guide Frame used with adjustable frame & cover.
   iv) Less than 225mm clearance from finished asphalt surface to concrete deck = 100mm straight Guide Frame used with adjustable frame & cover.

d) install adjustable manhole guide frame with EZ-STIK butyl rubber rope, as

manufactured by Press –Seal Gasket Corporation or approved equal, between guide frame and concrete and/or concrete grade rings.

Adjustment Rings

In locations where the existing support structure is determined by the City or Engineer to be in excellent condition, Contractor shall be permitted to use adjustment rings to accomplish final grade. These rings shall have an outside diameter of 1054mm to match the bottom diameter of the Guide Frame.

PVC grade rings may be substituted for concrete grade rings. If multiple rings are required, a sealant recommended by the manufacturer of the grade rings shall be applied between each ring.

Adjusting manholes, catch basins and constructing catch basin chutes (cast-in-place concrete)

The Contractor shall:

(a) remove sufficient concrete to remove frame and cover plus remove any unsound concrete and reinforcement, that may exist to leave only sound concrete and reinforcement in the manhole or catch basin, and

(b) supply, erect, apply and/or place formwork, bonding agent and concrete such that the casting is re-bedded to the proper grade in the manner shown in the standard drawings. After sufficient curing time, strip and remove all formwork from the structure.

Backfilling

The Contractor shall backfill the excavation and compact (in lifts not exceeding 150mm) to 100% Standard Proctor Density above sub-grade and 95% Standard Proctor Density below sub-grade. Backfill material shall consist of Class “A” gravel.

Adjusting valve boxes and curb cases

The Contractor shall adjust valve boxes, curb cases and similar direct bury structures to proper grade in accordance with the manner intended for the structure by screw or slide adjustment or replacement of components or complete replacement.

341.09 REINSTATEMENT

New and reconstructed streets

In new and reconstructed streets, reinstatement shall conform to the requirements specified in the contract for the particular location and shall be paid for separately from this item.

Resurfacing streets

In existing streets where utilities are required to be adjusted for purposes of resurfacing the Contractor shall reinstate each asphalt cut with 300mm of Class "A" road gravel and 50mm of asphalt prior to resurfacing. This work shall be done in accordance with Item 352 "Full Depth Asphalt Patching". Payment for reinstatement shall be considered included in the price bid for this item.

Existing Streets not to be resurfaced

For existing streets where utilities are required to be adjusted but the street is not to be resurfaced, the Contractor shall reinstate each asphalt cut to meet the existing conditions or a minimum thickness of 80mm. This work shall be done in accordance with item 352 Full Depth Asphalt Patch and Dwg. 10-352-01 (Asphalt Damage Repairs). The asphalt shall be compacted using a vibratory style compaction roller with a drum width no less than 1000mm. Payment for reinstatement shall be considered included in the price bid for this item.

Curbs and behind curbs

Where utilities must be adjusted in the curb or behind the curb, reinstatement shall conform to requirements specified in the contract for the location and shall be paid for separately from this item.

341.10 REPLACEMENT OF CASTINGS

The Contractor shall carefully preserve and re-use existing castings if specified. However, if the casting is damaged or unsuitable for re-use a new casting shall be used. If the castings unsuitability was a result of the Contractors actions, the replacement casting shall be supplied at the contractor’s expense. If the castings unsuitability was not caused by the contractor, then the supply of a new casting shall be paid for separately under this item.

341.11 CLEANING AND STRIPPING OF MANHOLES AND CATCH BASINS

When adjusting manholes and catch basins by means of breaking out the frame and cover and resetting it in concrete, the contractor shall remove old formwork as an incidental to the contract. Where no adjustment is made, or adjustment is by means of riser rings, cleaning and stripping of manholes shall be paid for on a force account basis unless a specific pay item is provided.

Cleaning of manholes and catch basins may be performed by hand or vacuum truck.

341.12 MEASUREMENT FOR PAYMENT

The quantity to be measured shall be as follows:

(a) Adjusting manholes or catch basins: For each existing or new manhole (adjustable or regular) or catch basin raised or lowered and concrete and reinforcement removed and/or replaced for a depth of 300mm from the casting's bottom.

(b) Reconstruction

For each m^3, rounded to one decimal place of concrete,

(i) removed and/or replaced beyond that paid for in (a), and

(ii) supplied and formed into a catch basin chute. Volume shall be determined by theoretical measurements of length width and height.

(c) Reinforcing Steel: For each metre of reinforcing steel supplied and installed in each diameter size.

(d) Adjustment Rings: For each adjustment ring installed. Shall include supply and installation of adjustment ring including EZ-Stik gasket or sealant.

(e) Valve Box

(i) Adjust only: For each valve box adjusted to grade.

(ii) Replace top section and adjust: For each new valve box top section supplied and installed to grade and old valve box section removed.

(iii) Replace complete and adjust: For each new valve box supplied and installed to grade and old valve box removed.

(f) Case

(i) Adjust only: For each curb case adjusted to grade.

(ii) Adjust with new set cap: For each curb case adjusted to grade requiring a new cap.

(ii) Extend and adjust: For each curb case cut and extension supplied and installed, and curb case adjusted to grade.

(iii) Extend and adjust with new set cap: For each curb case cut and extension supplied and installed, and curb case adjusted to grade requiring a new cap.

(iv)

(iii) Replace complete and adjust: For each new curb case supplied and installed to grade and old curb case removed.

(g) Supply manhole or catch basin castings: For each new manhole or catch basin frame

and cover supplied.

(h) Cleaning and stripping of manholes and catch basins: For each manhole or catch basin stripped of existing internal formwork or each unit cleaned.

341.13 PAYMENT

The Contractor shall be paid at the respective unit price bid for each unit of work performed in accordance with this specification. The unit price bid shall constitute full compensation for all labour, equipment, and materials necessary to complete the work as specified.

ITEM 351

HOT MIX ASPHALTIC CONCRETE

351.01 SCOPE OF WORK

This specification covers the City's requirement for the production, placing and compaction of hot mix, hot laid asphaltic base course and asphaltic surface course asphaltic concrete for pavement construction. Also covered are the requirements for Asphaltic levelling course to fill pavement depressions.

The base, surface and levelling course asphaltic concrete pavement shall consist of asphaltic cement, coarse and fine mineral aggregate, blending sand, plus mineral filler if required, combined as hereinafter specified, placed, and compacted on a prepared base in conformity with the lines, grades, dimensions and cross sections, as staked by the Engineer.

The paving of bridge decks and approach slabs shall be in accordance with Section 422 "Asphaltic Paving of Bridge Decks".

351.02 MATERIALS

Asphalt Cement

Unless otherwise specified, the asphalt cement (binder) shall conform to the latest edition of AASHTO M320 entitled Standard Specification for Performance Graded Asphalt Binder. The Performance Grade (PG) of asphalt binder shall be PG 58-28 and shall conform to the requirements of Table 1 in the AASHTO Specification. Other PG Binders may be specified in individual contracts when warranted. Irrespective of the PG binder specified the ash content of any binder must be less than 0.50% following AASHTO T111.

All PG asphalt binders will be subject to testing for acceptance prior to and during use.

Prior to the start of and throughout pavement production current copies of certification of all project asphalt binders shall be provided to the City. Safety Data Sheets for the Asphalt cement and any chemical additives must also be submitted.

Any asphalt binder other than the asphalt binder specified must be removed from the Contractor’s tanks to prevent contamination. Binders meeting the performance specifications but obtained from different sources cannot be stored in the same tank unless approved by the asphalt suppliers.

Performance Graded Asphalt Binder (PGAB) Sampling

The Contractor shall collect samples of asphalt cement as required by the Engineer. At least one sample shall be collected per project and per additional 5000 T of hot mix asphalt produced. The Engineer may opt to request one random sample per day. Samples shall be taken from the Contractor’s storage tank in accordance with ASTMD140 Standard Practice for Sampling Bituminous Materials. The sample size shall be at least two litres placed in one

litre containers. The sample shall be appropriately identified including the time and date of samples, grade and type of binder, supplier, refinery and the name and proportions of any additives added.

It shall be the City's responsibility to submit PGAB samples for quality assurance testing.

Anti-Stripping Additive

An anti-stripping additive will be required for all Hot Mix Asphaltic Concrete. Liquid anti-stripping additives and/or hydrated lime ($Ca(OH)_2$) can be utilized as an anti-strip additive.

Contractors may choose to use an approved liquid anti-stripping additive in order to meet the AASHTO T283 requirements below. The liquid anti-stripping additive application rate added to the hot mix asphaltic concrete shall be the greater of 0.5% of additive by weight of asphalt cement, or the recommended percentage as determined from Lottman test results. Approved liquid anti-stripping additives include the products AD-here LOF 65-00 (ARR-MAZ Custom Chemicals), AD-here 77-00 (ARR-MAZ Custom Chemicals), Evotherm M1 (Meadwestvaco Corp.), Evotherm P25 (Meadwestvaco Corp.), Redicote C-3082 (Akzo Nobel Chemicals), Rediset LQ-1102C (Akzo Nobel Chemicals), and Warmgrip N1 (ARR-MAZ Custom Chemicals). All other products must be approved by the City's Engineering Department.

Modified Lottman tests in accordance with AASHTO T 283 Resistance of Compacted Hot Mix Asphalt (HMA) to Moisture-Induced Damage shall be completed within the mix design procedure, to determine the required amount of anti-stripping additive. An additional rate of liquid anti-stripping additive and/or an alternate anti-stripping additive will be required if one of the following conditions occurs as determined by AASHTO T 283:

- The tensile strength ratio of the hot mix asphalt concrete is less than 0.80
- There is visual evidence of stripping. Acceptable specimens shall have a visual stripping rating of 1.0 or lower based on a scale from 0 to 10 (with 0 being no visual stripping and 10 being fully stripped).
- The results of the mix utilizing neat hot mix asphalt concrete (or with no anti-stripping additive) significantly exceed the performance of the mix with the anti-stripping additive.

Suppliers of the asphalt cement and liquid anti-stripping additives shall provide in writing all mixing requirements and proof of product compatibility. The treated asphalt PG binders must meet the relevant performance grade specifications. Some of the additives noted above at various dosage rates are understood to lower the required mixing and compaction temperature of the asphalt mixture. All information in this regard shall be provided 10 days prior to mix design. This information shall also be made available for proper production, laydown and field testing.

Contractors must inform the Engineer and advise workers of the proper procedures, use of protective clothing and equipment when handling anti-stripping additives. Hot mix asphaltic concrete with liquid anti-strip additives is known to produce strong odors. Contractors must ensure the mix materials are used under proper environmental conditions to guarantee the safety and comfort of construction personnel and the public.

In addition to AASHTO T 283 requirements, the asphalt hot mix containing liquid anti-stripping additive shall pass a boiling water test in accordance with ASTM D3625 Standard Practice for the Effect of Water on Bituminous-Coated Aggregate Using Boiling Water within the mix design procedure. The pass criterion for ASTM D 3625 is 95% or greater retained bitumen coating of aggregate.

An additional rate of liquid anti-strip and/or an alternate anti-stripping additive will also be required if the aggregate is known to be prone to stripping from past performance and the minimum application rate was insufficient.

Modified Lottman Tests (AASHTO T 283) and Boiling Water Tests (ASTM D3625) shall also be conducted on field produced samples of hot mix. All field produced samples shall also pass the requirements above.

Hydrated lime ($Ca(OH)_2$) can also be utilized as an anti-strip additive. Where hydrated lime is used as an anti-strip additive the dosage requirement shall be the greater of one half (1/2) percent by mass of total dry aggregate, or the recommended percentage as determined from Lottman and Boiling Water test results.

Where hydrated lime is utilized, the hydrated lime shall be added to all aggregates by either of the following methods:

(a) Hydrated lime slurry shall be homogeneously mixed with the aggregate in a pug-mill or tumble mixer prior to entering the asphalt plant (the hydrated lime slurry shall be produced at the approximate rate of 1 part lime to 3-4 parts water).

(b) Dry hydrated lime shall be homogeneously mixed with wetted aggregate in a pug-mill or tumble mixer prior to entering the asphalt plant. The wetted aggregate shall have a minimum moisture content of 2% by weight for coarse aggregate and 3% by weight for fine aggregate.

Hydrated lime shall be mixed with the aggregate al least 4 hours prior to entering the asphalt plant. Aggregate treated with hydrated lime shall be used within the same construction season. Treatment shall include both coarse and fine aggregate components of the asphalt aggregate.

Where hydrated lime is to be utilized, the Contractor shall provide the City with complete information on how the Hydrated lime to be used in the treatment of aggregates. Hot mix produced containing hydrated lime, shall conform to all requirements of the contract before acceptance. The design amount of hydrated lime will be added as a percentage of the total dry aggregate weight.

The cost of all anti-stripping additives (including hydrated lime) will be borne by the Contractor no separate or additional payment will be made.

If an anti-stripping additive or additional/alternative anti-stripping additives are required, a further 10 working days will be required after the Contractor has advised the City of its new anti-strip proposal and all materials have been received by the Engineering Division. The Contractor and his supplier shall provide sample materials, any technical information and

manufacturer's recommended application rates.

Coarse Aggregate

Coarse Aggregate shall consist of hard, durable crushed stone or crushed gravel particles, reasonably uniform in quality and free from soft or disintegrated pieces. The portion of material retained on the 4.75 mm sieve shall be known as coarse aggregate. The coarse aggregate stockpile shall contain no more than 20% passing the 4.75 mm screen.

Coarse Aggregates shall be washed if necessary, to have clean surfaces free from coatings of foreign matter. Coarse Aggregates shall conform to the physical requirements shown in Table 1.

Irrespective of compliance with the physical requirements of Tables 1, any coarse aggregate may be accepted or rejected on the basis of past field performance at the discretion of the City.

TABLE 1

Physical Requirements for Coarse Aggregates

TEST METHOD	TEST NO.	ALL COURSES
Los Angles Abrasion - % Maximum (A)	ASTM C131	35
Absorption - % Maximum	ASTM C127	2
Magnesium Sulfate – Soundness – 5 cycles - % Maximum	ASTM C88	12
Petrographic Number – Maximum	CSA A23.2 – 15A	135
Freeze - Thaw Test - 5 cycles- % Maximum	CSA A23.2 - 24A	10
Crushed Particles - % Maximum (B)	ASTM D5821	90
Flat & Elongated Particles - % Maximum (C)	MTO LS608	10
Loss by Washing - % Maximum Passing (D)	ASTM C117	1.75
Micro Deval (% Max.)	ASTM 6928	20
Clay Lumps (% Max.)	CSA A23.2 – 3A	1
Low Density Particles (% Max.)	CSA A23.2 – 4A	1
Friable or Slatey Siltstone (% Max.)	CSA A23.2 – 15A	1

Notes:

(a) The ratio of the loss after 100 revolutions to the loss after 500 revolutions shall not exceed 0.265.
(b) Pieces having two (2) or more freshly fractured faces only will be considered as crushed material. Pieces with only small chips removed will not be considered as crushed.
(c) Flat and elongated pieces are those whose greatest dimension exceeds four (4) times

their least dimension.

(d) When only quarried rock is used as a source of coarse aggregate, a maximum of two percent (2%) passing the 75µm sieve shall be permitted.

Fine Aggregate (Crushed Fines)

The portion of the material passing the 4.75mm sieve shall be known as fine aggregate.

Fine aggregate shall conform to the physical requirements shown in Table 2.

In any fine aggregate, not more than twenty percent (20 %) of the material passing the 75µm sieve shall be finer than 2µm in size.

Fine aggregate shall consist of clean, tough, rough-surfaced grains, free from clay, loam and other foreign matter. The fine aggregate stockpile shall contain no more than 20% retained on the 4.75 mm screen.

The maximum allowable percentage of non-crushed fine aggregate in the total combined aggregate shall be 20% inclusive of all-natural occurring fines and blending sands.

For all base course mixes the fine aggregates maximum percentage passing the 75 µm sieve is limited to 8% prior to mix production at the asphalt plant. For all surface and levelling course mixes the fine aggregates maximum percentage passing the 75 µm sieve is limited to 8 % prior to mix production at the asphalt plant.

Irrespective of compliance with the physical requirements of Table 2 any fine aggregate may be accepted or rejected based on past field performance at the discretion of the City.

Natural Fines and Imported Blend Sand

Blending sand shall consist of clean, tough, rough surfaced grains, free from clay, loam, or any other foreign matter. Blending sand is considered as a fine aggregate and thus must meet the requirements of Table 2. Blending sand may be either a naturally occurring screened sand or a manufactured sand added to the mix for the purposes of enhancing mix properties.

The gradation of the blending sand shall be such that when used in the asphalt mix, the resulting mix shall meet the requirements of Tables 2 and 3 of this section. In any case, the blending sand shall have 100% (by dry weight) passing of the 9.5 mm sieve and at least 80% (by dry weight) passing the 4.75mm sieve. The combined total of blending sand and naturally occurring find aggregate shall not exceed 20% (by dry weight) of the total combined dry aggregate.

Mineral Filler

Mineral Filler shall meet the requirements of ASTM D242 Standard Specification for Mineral Filler for Bituminous Paving Mixtures. Where filler is required, it shall be supplied by the contractor:

Passing 600µm Sieve	97% - 100%
Passing 75µm Sieve - not less than	70% - 100%

TABLE 2

Physical Requirements for Fine Aggregates

Test Method	Test No.	All Courses
Micro-Deval Test for Fine Aggregate % Maximum (See note 1)	CSA A23.2-23A	20
Plasticity Index	ASTM D4318	0
Sand Equivalent (minimum)*	ASTM D2419	50
Fine Aggregate Angularity (% min)**	ASTM 1252	45

* Sand Equivalent testing to be conducted on each individual fine aggregate component. When combined in accordance with the Marshall Mix design the minimum value SE shall be 50.

** FAA tests shall be conducted on a representative sample of the total find aggregate inclusive of all fine aggregate materials as indicated in the mix design including blending sand. The test will be conducted in accordance with Standard Graded Sample Method A.

Note 1If equipment for Test Method CSA A23.2-23A is not available, the magnesium sulfate soundness test, as detailed in ASTM C88, is acceptable, providing the limit does not exceed 15% for Surface, Base or Leveling courses.

Recycled Asphalt Pavement (RAP)

If the Contractor wishes, the Contractor will be permitted to use Recycled Asphalt Pavement (RAP) in leveling or base course asphalt. The amount of RAP in the pavement mixture will be limited to 20% and subject to the following conditions:

Preparation and submission of a Marshall Asphalt Design Mix Formula (including all supporting documentation) for the asphalt mixture containing RAP, for the City's approval, is the responsibility of the Contractor. The Contractor shall use professional engineering services and a qualified testing laboratory to assess the aggregate materials, asphalt binders, blending sands, mineral filters, anti-stripping agents and asphalt cement rejuvenation agents proposed for use and to carry out the design of the asphalt concrete mix. No compensation will be provided to the Contractor, to produce the asphalt design mix formula for the asphalt mixture containing RAP.
The asphalt mixture containing RAP shall be designed in accordance with the Ontario

Ministry of Transportation, Design Procedure for Recycled Hot Mix Asphalt, latest edition, except that all test methods referred to shall be replaced with the appropriate ASTM Standards. Copies of this document are available from the City's Engineering Department.

RAP percentages may require the use of asphalt cement rejuvenation agents to ensure the overall asphalt cement characteristics meet the specified Performance Grade. Testing to confirm the rheological characteristics of the combined Performance Graded Asphalt Cement and the RAP asphalt cement shall be supplied as part of the Marshall Mix Design. In all cases the Performance Grade of the asphalt cement shall meet the project specifications.

RAP shall be comprised of asphalt millings and be free of uncoated particles. The use of non-milled reclaimed asphalt pavement is subject to the approval of the City of St. John's.

The quality of the aggregate in the RAP and the quality of the final pavement mixture shall meet all requirements set forth in this specification.

Where RAP is included in base or leveling course mixes that following process will be followed:

- RAP shall be fractionated into a minimum of three separate sizes.
- The gradation of the individual fractionated RAP shall be:
    - 9.5mm and above
    - 4.75mm to 9.5mm
    - minus 4.75mm
- The asphalt plant must be equipped with a metering system that allows the fractionated RAP to be added in a controlled manner acceptable to the City.

The Contractor shall provide the City with a minimum 30 day notice of his intention to use RAP. The City reserves the right to accept or reject any particular source of RAP, irrespective of its quality.

351.03 COMPOSITION OF MIXTURE

General Requirements for Asphalt Pavement Mixture

All aggregate stockpiles are to be tested by an independent third party materials testing laboratory and the results are to be submitted to the City for record and field verification purposes.

Designation of Mixture

The composition of the asphalt pavement mixture shall be the responsibility of the contractor, subject to review and acceptance by the owner. The mix designs shall be conducted within the current work season and be reflective of existing stockpiled materials. New mix designs shall be conducted representative of each "major quarry blast". The mixture shall consist of uniformly graded fine and coarse aggregate mixed with asphalt cement as specified. The pavement mixture shall be designed using the Marshall Method of Mix Design as specified by the Asphalt Institute Manual Series No. 4, Item 4.3, Asphalt Hot Mix Design Methods. A Marshall Mix design shall be completed complementary to the processing of

coarse or fine aggregates or with changes in the asphalt cement. The Marshall mix designs shall be submitted to the owner for review a minimum of ten (10) working days prior to the start of paving operations. Unless otherwise specified, the aggregates shall be combined in such proportions to produce a mixture conforming to the grading and asphalt content requirements of Table 3.

TABLE 3
ASPHALT AGGREGATE MIXTURES

Sieve Size (mm)	Percent Passing by Dry Weight		
	Base Course	**Surface Course**	**Leveling Course**
22.0mm	100	100	100
19.0mm	100	100	100
12.5 mm	80-100	93-100	93-100
9.5mm	65-95	75-95	75-95
4.75 mm	35-75	55-75	55-75
2.00mm	20-55	35-55	35-55
425µm	10-25	16-25	16-25
150µm	5-12	5-12	5-12
75µm (note 1)	2-7	2-7	2-7
Asphalt Cement (% by weight of total mixture)	5.0-7.0	5.0-7.0	5.0-7.0

Note 1: The dust/effective asphalt ratio of all mixes shall be between 0.6 and 1.2. Dust is defined as material passing the 75µm sieve .

After notification of acceptance of the Marshall Mix Design the contractor shall produce a 'Plant Batched Trial Samples' of any asphalt pavement types proposed for the project. The 'Trial Samples' shall be blended in accordance with the aggregate and asphalt cement proportions described in the approved 'Marshall Mix Design' report. Trial samples shall be tested to determine the volumetric and physical properties of the pavement mixture as identified in Table 4. Dependent upon the resultant Marshall mix properties the composition of the pavement mixture may require adjustments. In this occurrence a second 'Trial Mix' shall be conducted to confirm the properties of the adjusted pavement mixture. Upon review and acceptance of the 'Trial Mix' properties by the owner the approved pavement mixture shall be known as the 'Job Mix Formula' and utilized throughout the project. Aggregate and asphalt cement components of the approved 'Job Mix Formula (JMF)' shall be regulated as follows:

Aggregate passing 19.0mm sieve	+ 5%
Aggregate passing 12.5mm sieve	+ 5%
Aggregate passing 9.5mm sieve	+ 5%
Aggregate passing 4.75mm sieve	+ 5%
Aggregate passing 2.0mm sieve	± 4%
Aggregate passing 425µm sieve	± 3%
Aggregate passing 150µm sieve	+ 2%
Aggregate passing 75µm sieve	± 1%
Asphalt Cement content	± 0.25%

In all cases the asphalt/aggregate combination may be adjusted at the owner's discretion.

Physical and volumetric properties of all asphalt pavements shall meet the specifications provided in Table 4.

Physical Requirements for Mixture

The aggregates and the asphalt cement shall be mixed in such proportions as to satisfy the criteria contained in Table 4. These criteria are based on the Standard Marshall Test Procedures and using a compactive effort of 75 blows on each face of the specimen.

All test procedures used hall be the latest versions of ASTM or AASHTO standards, except where indicated.

TABLE 4

Physical Requirements for Asphaltic Concrete Mixture (All Courses)

	Minimum	Maximum
Marshall Stability N. At 60º C (i) Local Streets (ii) Collector & Arterial Streets	 5400 8000	 - -
Marshall Flow Index MM	2.0	4.0
% Air Voids (A)	2.0	4.0
% Voids in Compacted Mineral Aggregates (i) Leveling & Base Course (ii) Surface Course	 14.0 15.0	 - -
Modified Lottman AASHTO T283 - Tensile Strength Ratio (plus visual)	0.8	---
% Retained Coating of Aggregate - Boiling Water Test ASTM D3625	95	---
Moisture Content of Hot Mix Asphalt by Oven Method, AASHTO T329 (as percent of HMA)	---	0.3
Immersion Marshall MTO LS-283 & Retained Stability (B)	70	-

Notes:
(a) The test method, ASTM 2041 “Theoretical Maximum Specific Gravity and density of Bituminous Paving Mixture”, shall be modified as follows: the uncompacted test specimens shall be oven cured at 143°C for at least four (4) hours, in order to account for maximum absorption of asphalt cement in porous aggregates.
(b) The residual pressure in the vacuum cell shall be 27.5mm ± 2.5mm.
(c) Asphaltic Leveling Course shall have the same mix composition as Asphalt Surface Course except where there is no item for Asphalt Surface Course, in which case Asphalt Base Course may be used instead.

351.04 USE OF PITS, QUARRIES AND STOCKPILES

Should the Contractor intend to use a Drum Mix Asphalt Mixing Plant, then the designated aggregates shall be split on the 4.75mm screen and each material shall be stockpiled separately such that intermixing of each size and type does not occur. The coarse aggregate stockpile shall contain no more than fifteen percent (15%) passing the 4.75mm screen.

351.05 PLANT INSPECTION

All manufacturing of asphalt concrete shall be conducted using batch, drum or continuous mixing plants. All plants shall conform to the requirements of ASTM D995 Standard Specification for Mixing Plants for Hot-Mixed, Hot Laid Bituminous Paving Mixtures and as specified herein.

351.05.01 Mixing Plants

351.05.01.01 General Requirements and Equipment for Storage of Asphalt Cement

Tanks for storage of asphalt cement shall be capable of heating and maintaining the temperature of the asphalt cement at a constant temperature range between 120oC and 160oC. The actual working temperature shall not vary by more than + 5o C when the amount of asphalt cement added to the mixture is measured volumetrically. Heating shall be by steam or oil coils, electricity, or other means such that no flame shall contact the heating tank.

A circulating system for the asphalt cement shall be of adequate capacity to thoroughly mix the asphalt cement and provide continuous circulation between the storage tank and proportioning units during the entire operation period. All pipelines and fittings shall be steam or oil jacketed and properly insulated to prevent heat loss. Storage tank capacity shall be such as to ensure continuous operation of the plant and uniform temperature of the asphalt cement when it is introduced into the mixing unit. Tanks shall be accessible for measuring the volume of asphalt cement at any time.

A sampling outlet shall be provided in the asphalt cement feed lines connecting the plant storage tanks to the weighing system or spray bar. The outlet shall consist of a valve installed in such a manner that samples may be withdrawn from the line slowly at any time during plant operation. The sampling outlet shall be installed between the pump and the return line discharge in a location that is readily accessible and free from obstruction. A drainage receptacle shall be provided for flushing the outlet prior to sampling.

351.05.01.02 Cold Bins

All plant types shall be equipped with operational cold bins capable of being calibrated.

Cold bins shall be divided into not less than three compartments, each to be equipped with individual gate controls, so as to enable accurate and positive proportioning of each aggregate size. Partitions of sufficient height to eliminate intermingling of the aggregate shall be provided between adjoining bins, if the bins are being fed with a front-end loader the width of each bin must be at least 500 mm wider than the width of the loader bucket.

351.05.01.03 Dryer

A rotary dryer, of satisfactory design, for drying and heating the aggregate shall be provided. Dryer units shall be of sufficient capacity to uniformly heat the aggregate and reduce the moisture content to the specified level. Upon request the asphalt contractor shall make available to the Engineer the following information.

a) The specified rate of production in tonnes per hour versus aggregate moisture content.
b) Within drum plants the specified location and length of the of the asphalt cement delivery pipe.

351.05.01.04 Screens

Plant screens on batch and continuous mix plants shall have adequate capacity and size range to properly separate all of the aggregate into the sizes required for proportioning so that they may be recombined consistently within the specification limits.

All screens shall have square openings and be free any rips or holes. Screen decks shall be stacked in such a manner that cross contamination of aggregates is prevented.

351.05.01.05 Hot Aggregate Storage Bins

Batch and continuous mix plants shall have hot bin storage of sufficient capacity to ensure uniform and continuous operation. Bins shall be divided into compartments arranged to ensure separate and adequate storage of appropriate fractions of the aggregate. Each compartment shall be provided with an overflow pipe of such size and at such a location to prevent any backing up of material into other bins or into contact with the screen. Adequate and convenient facilities shall be provided for obtaining aggregate samples from each hot bin.

351.05.01.06 Asphalt Cement Control Unit

Satisfactory means, either by weight, metering or volumetric measurements, shall be provided to obtain the proper amount of asphalt cement. All measuring devices shall prove accurate to within + 2.0% when tested for accuracy.

351.05.01.07 Thermometric Equipment

An armoured thermometer of suitable range shall be fixed in the asphalt cement feed line at a convenient location near the discharge of the mixer unit. The plant shall be further equipped with approved recording thermometers, pyrometers, or other approved recording thermometric instruments at the discharge chute of the dryer and in the hot fines bin to register and record automatically the temperature of the heated aggregate.

351.05.01.08 Dust Collectors

Dust collectors shall be provided where required.

351.05.01.09 Safety Requirements

Adequate and safe stairways to the mixer platform shall be provided, and guarded ladders to other plant units shall be located where requested.

All gears, pulleys, chains, sprockets, and other dangerous moving parts shall be thoroughly protected. Ample unobstructed passage shall be always maintained in and around the truck-

loading space. This space shall be kept free of drippings from the mixing platform. A ladder or platform shall be located at the truck-loading space to permit easy and safe inspection of the mixture as it is delivered into the trucks.

A suitable sampling platform with stairs or ramp access including railing shall be provided for sampling material in the truck bed. The height of the platform shall be adequate to prevent the inspector from having to climb up on to the truck in order to obtain a sample. The platform shall be constructed such that the truck is able to park on either side. If it is not possible for the platform to be constructed in such a manner, then two separate platforms shall be provided, or the truck will be required to reverse direction so that a sample may be obtained. Overhead protection shall be provided where necessary.

351.05.01.10 Capacity

Unless indicated otherwise asphalt mixing plants must have a minimum rated capacity of 120 tonnes per hour delivered to the spreader, with a production history to support this requirement.

351.05.02 Special Requirements for Batching Plants

351.05.02.01 Weigh Box or Hopper

The equipment shall include a means for weighing each bin size of aggregate into a weigh box or hopper, suspended on scales, and ample in size to hold a full batch without running over. The weigh box or hopper shall be supported on fulcrums and knife edges that will not easily be thrown out of alignment or adjustment. Gates both on the bins and the hopper shall be constructed to prevent leakage when closed.

351.05.02.02 Plant Scales

Scales shall be of the dial or digital type and of a standard make and design. Scales for weighing aggregates shall be accurate and sensitive to 0.5% of the maximum loading required. All scales shall provide a positive means of balancing the tare weight of the hopper or asphalt bucket. After each plant set-up and prior to batching any materials, and whenever deemed necessary by the Engineer, the Contractor shall, at his own expense, have the plant scales tested to the satisfaction of the Engineer.

351.05.02.03 Mixer Unit

The plant shall include a batch mixer of an approved twin shaft pug mill type capable of producing a uniform mixture within the permissible job mix tolerances. The clearance between the mixer blades and liner plates shall not exceed 20mm. The mixer shall be constructed to prevent leakage of the contents. Mixer discharge shall not cause appreciable segregation. The mixer shall be fitted with separate dry and wet mixing cycle timers and locking devices so that asphalt cement cannot be discharged, and the pug mill gate cannot be opened until the desired mixing times have elapsed.

351.05.03 Special Requirements for Continuous Mixer Plants

351.05.03.01 Gradation Control Unit

The plant shall include means for accurately proportioning by volumetric measurement the aggregate discharged from each hot bin. The unit shall include a feeder, mounted under the compartment bins. Each bin shall have an accurately controlled individual gate to form an orifice for volumetrically measuring the material drawn from each respective bin compartment. The orifice shall be rectangular with dimension adjustable by positive mechanical means. Indicators shall be provided on each gate to show the gate opening in millimetres. Each gate will be provided with a lock.

351.05.03.02 Weight Calibration of Material Feed

The plant shall include a means for calibration of gate openings by weighted test samples. The equipment shall include a method of obtaining hot aggregates from the bins fully representative of the flow from the specific gate openings. It shall also include platform scales capable of accurately weighing test samples of aggregates and asphalt cement.

All calibration equipment, including revolution counters, shall be always kept in good operating order and shall be available whenever required.

351.05.03.03 Synchronization of Aggregate and Asphalt Feed

In order to ensure the correct flow of aggregate from the bins and the flow of asphalt from the meter or other proportioning sources, satisfactory means shall be provided to afford positive interlocking control between the flow of aggregate from the bins and the flow of asphalt from the meter or other proportioning sources. In order to ensure the correct flow of asphalt cement to the mixer at all times, the plant shall be equipped with means of maintaining a constant head of asphalt cement to the metering device. A satisfactory pressure gauge shall be installed on the asphalt line between the metering device and the spray bar.

351.05.03.04 Mixer Unit

The plant shall include a continuous mixer of an approved twin shaft pug mill type that shall be capable of producing a uniform mixture within the specified tolerances. The clearance of the blades from the inner surfaces of the pug mill liners shall not exceed 20 mm. The paddles shall be of a type adjustable for angular position on the shafts and reversible to retard the flow of the mixture. The mixer shall be equipped with an adjustable dam gate at the discharge end to control the level of the material. The mixer shall carry a manufacturer's plate giving the net volumetric contents of the mixer at several heights.

Unless otherwise required, determination of mixing time shall be by weight method under the following formula. The weights shall be determined for the job by tests made by the Engineer.

$$\text{Mixing time in seconds} = \frac{\text{Pug mill capacity in kg}}{\text{Pug mill output in kg/s}}$$

351.05.03.05 Discharge Hopper

All continuous mix plants shall be equipped with a controlled discharge storage hopper. The minimum capacity of the hopper in tonnes shall be equal to 1.5% of the hourly production rate of the plant but shall not be less than one tonne. This hopper shall be always kept in satisfactory operating condition and operated to prevent segregation of the mixture.

351.05.03.06 Material Level Indicators

Material level indicators shall be installed in each hot aggregate bin at the one-third full level and at the two-thirds full level and they shall be connected to remote high-low indicator lights mounted at the operator's station. Operation of the mixer shall not be permitted when the low-level indicator shows any bin to be less than one-third full.

351.05.04 Special Requirements for Drum Mixer Plants

351.05.04.01 Aggregate Feed

Aggregates shall be fed to the dryer drum by means of a multi bin (minimum 3 or 4 bins) cold feed unit and shall be blended to meet the design mix proportions by adjustment of variable speed feed belts and gates on each bin. There shall be no overflow from one bin to another.

A reliable moisture probe shall be installed in the fine aggregate cold feed bin with a meter mounted in the plant control panel.

The total flow of aggregate shall be metered by an electronic weigh belt system with an indicator that can be monitored by the plant operator and which is interlocked with a variable speed asphalt pump so that the proportions of aggregate and asphalt entering the mixer remain constant.

Cold feed calibration and asphalt cement pump calibration shall be performed at the start of each contract and whenever deemed necessary by the Engineer. The calibration shall be done in the presence of the plant inspector. The cold feed shall be recalibrated whenever the weighing conveyor is moved.

A positive interlocked automatic shut off shall be provided so that the plant shuts down automatically if there is any disruption in the flow of aggregate or asphalt cement.

A vibrating screen of adequate capacity shall be provided to remove oversize from the combined cold feed. An aggregate sampling device shall be provided which will divert a representative combined aggregate sample of adequate size into a container or hopper for the purposes of gradation testing. The sampling device shall be located after the cold feed aggregates have passed through the vibrating screen and prior to mixing with asphalt cement.

351.05.04.02 Asphalt Cement Feed

The asphalt cement feed system shall be equipped with a calibration system which will enable approximately 200 litres of asphalt cement to be by-passed into a container which can be weighed. Adequate scales shall be provided by the Contractor.

A temperature gauge, showing the temperature of the asphalt cement at the metering pump, shall be provided in the control trailer. The gauge shall be graduated to cover at least the range 100oC to 200oC with increments of not more than 2.5oC.

A temperature compensating system shall be installed in the asphalt cement metering system designed to provide a volume of asphalt cement which will be constant when referenced to 15oC of regardless of variations in the temperature of the asphalt cement from the storage tank.

351.05.04.03 Asphalt Cement Mixing

The heating, coating, and mixing of the asphalt mix shall be accomplished in an approved parallel flow dryer-mixer. The aggregate and asphalt shall enter the drum at the burner end and travel parallel to the flame and exhaust gas stream. Heating shall be controlled to prevent fracture of the aggregate or excessive oxidization of the asphalt. The system shall be equipped with automatic burner controls and shall provide for continuous temperature sensing of the bituminous mixture of discharge, with a printing recorder that can be monitored by the plant operator. The printed record of mix temperatures shall be available to the Engineer for inspection.

The method used to transfer the mixture from the drum mixer to the haulage units shall be designed, constructed, and operated so that there shall be no segregation of, or damage to, the mix.

A system for wasting unacceptable asphalt aggregate mixture shall be provided between the drum mixers discharge and holding bin.

The plant shall not be operated below 50% of the rated capacity of the belt scale.

351.06 EQUIPMENT

Haulage Equipment

Trucks for hauling asphaltic mix shall be of the metal box type and their use shall be approved by the Engineer. The metal box shall be treated with an approved release agent and be in smooth condition with no rust scales or foreign material. Wherever possible trucks shall be loaded such that the front and back of the truck body are loaded prior to placement of asphalt in the middle section.

Vehicles shall be equipped with tarpaulins of water repellent material (no open mesh types) of sufficient size to completely cover the truck box and overhang the box on all sides by a minimum of 150 mm. The tarpaulins shall have enough tie-down points so that they can be properly secured and shall be in good condition and be free of holes and tears. They shall be securely tied down as an effective barrier against rain infiltration and air flow over the HMA mixture.

Tarpaulins are to be used at all times for protection of the load of Hot Mix Asphalt. Tarpaulins shall be rolled back to uncover the hot mix for inspection immediately prior to dumping into

the paver. Trucks will stop ahead of the paver and allow the paver to smoothly pick up the truck.

Spreading Equipment

Mechanical self-powered pavers shall be used which can spread the mixture true to line, grade and crown as specified by the Engineer.

Pavers shall be equipped with hoppers and distributing screws to place the mixture evenly in front of the screeds. The distributor screws shall always be kept 1/3 to 2/3 covered.

Asphalt concrete shall be dumped into the middle of the paver hopper. The hopper shall not be emptied to less than 25% of its capacity when moving except when the spreading operation is suspended. All cold or segregated asphalt must be shoveled out and wasted. In no case shall cold asphalt be allowed in the pavement mix.

Pavers shall be equipped with screeds and shall be capable of spreading the mixture, without segregation, in thickness of from 10mm to 200mm and in widths of from 2500mm to 4000mm in increments of 150mm.

The Contractor shall provide on each paver a 3 metre straight edge with a level recessed in its upper surface parallel to the lower face and capable of detecting a variation from the horizontal of 3mm in 1000mm.

The term “screed” shall mean any strike-off device operating by cutting, crowding, or other practical action which is effective on the mixture and which produces a finished surface of the evenness and texture required. The screed shall be adjustable as to level and crown and shall be heated in an approved manner.

Pavers shall be equipped with automatic screed controls, as recommended by the paver manufacturer, for the control of longitudinal grade and transverse slope. The longitudinal grade control shall be equipped to operate from a joint matching shoe when required. The transverse slope control shall be capable of operating from either side of the paver.

Rollers

All rollers shall be of the types specifically designed for asphalt compaction.

All rollers shall be in good condition and capable of reversing without backlash. They should be always operated by competent and experienced operators.

All rollers shall be weighed in the presence of the Engineer and ballasted, if required, immediately before commencing work and whenever subsequently required by the Engineer.

Steel drum rollers shall be equipped with satisfactory means to supply water to the drum to prevent adhesion of asphalt mixture. The rear wheels of combination rollers shall each be not less than 450mm in width. Drums of the tandem rollers shall each be not less than 1250mm in width. Steel drum rollers shall weigh at least 12 tonnes and shall exert a load on the compression roll of at least 6 tonnes per metre of wheel width.

All pneumatic tired rollers shall be self-propelled and shall have not less than nine (9) wheels revolving on two (2) axles. The tires on the front and rear axles shall be staggered to cover the entire area over which the roller travels with a minimum overlap of 15mm. Under working conditions, the roller shall exert a load of not less than 5 tonnes per metre of tire width on the asphalt surface. The tires shall be inflated to an air pressure of not less than 400kPa. The roller shall be equipped with an adequate scraping or cleaning device on each tire to prevent the bituminous mixture from accumulating on the tires. The roller shall be equipped with a water system which will keep all tires uniformly wet, and which will have a capacity that will provide not less than two hours continuous operation without refilling.

351.07 CONSTRUCTION

Preparation of Gravel Road Surface

Where paving is to take place directly on top of a gravel surface, then the Contractor shall prepare the road to the satisfaction of the Engineer before paving. Not less than 300m of prepared grade shall be always maintained in front of the paver, except at the end of the paving operation for that day.

Where the top layer of Granular “A” was placed under the same contract as the paving, then the preparation of the Granular “A” prior to paving shall be carried out in accordance with the Item 323 “Gravel for Streets”. Where the paving is to take place directly on top of materials that were not placed in the paving contract, then such preparation prior to paving as the Engineer may require shall be carried out in accordance with Section 325 "Scarifying and Reshaping Gravel Surfaces".

Preparation of Paved Surface

When required by the Engineer, paved surfaces shall be treated with Tack Coat prior to repaving with asphaltic concrete.

Such treatment with Tack Coat as may be required shall be carried out in accordance with the Item 354 “Tack Coat”.

Placing of Asphaltic Courses

The base on which paving is to take place shall be cleaned of all loose or foreign material before paving may take place.

The asphaltic mixture shall be laid only upon a base which is dry or at least free from standing water, and when weather conditions are suitable. No paving shall take place during rain.

No course shall be placed upon a previously laid course less than twelve (12) hours after final compaction of the latter, except with the permission of the Engineer in circumstances where in his opinion this requirement would be impractical.

No hot mix shall be placed unless the air temperature at the surface of the road is 7ºC or above without the written permission of the Engineer.

The temperature of the mixture immediately after spreading and prior to initial rolling shall not be less than 135ºC or greater than 160ºC. At no time over the life of the mix shall the mixture be hotter than 175°C.

The width of succeeding courses shall be adjusted by an offset of width of from 150mm to 300mm so that longitudinal joints do not coincide.

The longitudinal joints in the surface course shall correspond to the demarcation between driving lanes, speed change lanes, tapers, etc. indicated in the contract or as directed by the Engineer.

Immediately after any course is laid and before roller compaction is started the surface and edges shall be checked and any irregularities adjusted by the addition or removal of mixture.

Pavers must be equipped with heated vibratory screeds. There should be no allowance for pavers with non-vibratory screeds. All pavers which are equipped with a tamping device or other mechanical apparatus designed to aid compaction of the mixture shall have such devices operating continuously when the mixture is being placed unless otherwise directed. Where screed extensions are used, such extensions shall be designed so that the tamping or vibratory action of the screed is effectively transferred to the extensions in such manner as to provide a uniform degree of initial compaction across the full width of the freshly laid mat.

To ensure continuous operation of the pavers they shall operate at whatever speed necessary to match the output of the plant provided that a consistent and satisfactory mat is being laid. However, in no case shall the speed of the paver exceed 0.7km/h.

Mixtures may be spread by hand only in places inaccessible to the paver. Hand placing shall be from a steel dump board by means of hot shovels. Hand spreading shall be with rakes of suitable design. The mixture shall be spread to the depth required to give the compacted design thickness after rolling.

No loads of mixture shall leave the plant so late in the day as to preclude the spreading and compacting of the mixture during daylight.

Paving Season for Asphalt Surface Course

The placing of surface course asphalt will not be permitted to be placed prior to May 24 or after October 15, of any given year unless otherwise approved by the City.

No pavement shall be removed from a roadway that cannot meet the requirement of replacing the asphalt before the end of the paving season.

Joints

All joints shall be made in such a manner as to ensure a thorough and continuous bond and to provide a smooth riding surface.

For the purposes of this specification, there are two types of cold joints: (1) Transverse or

longitudinal joints that are created between the asphalt being placed and the pre-existing asphalt and (2) Transverse or longitudinal joints in the new asphalt being placed itself.

For joints between new and old asphalt, all foreign material and all loose material shall be removed from all faces against which joints are to be made and the joint shall be cut back to expose a fresh vertical face. For the paving of the base course, apply tack coat to the vertical edge. The surface course joint is then to be offset by milling a minimum of 300 mm outside the base course edge and a Hot Asphalt Joint Sealing System applied to the vertical asphalt edges as per the manufacturer's instructions prior to paving. The Hot Asphalt Joint Sealing System shall be in accordance with specification Item 352 Full Depth Asphalt Patch.

For joints in the new asphalt itself, prior to placing the adjacent mat, or extending the existing hot mat, the exposed longitudinal/transverse joints must be coated with Emulsified Asphalt (Tack Coat). The joint shall be rolled immediately upon placement of the fresh mixture and before the adjacent strip has completely cooled. The joint shall be set-up with the back of a rake or lute at proper height and grade to receive the required compression under rolling.

Asphalt mat edges having companion longitudinal joints shall be matched within the maximum allotted time period as determined by the engineer. The maximum allotted time period shall be restricted to a lower limit of one hour with an upper limit of two and one half hours. The allotted time limit will be proportioned on the paving lay-down conditions; with the lower time limit applied to least favorable placement conditions and the upper time limit applied to favorable placement conditions. Lay-down conditions considered by the engineer in establishing the time limit will include ground surface temperature, hot mix lay-down temperature, placement capacity, ultraviolet intensity, wind speed and air temperature. Longitudinal joints shall be matched by the end of each day's operations to the extent possible. Unmatched longitudinal/transverse asphalt joints left exposed at the end of the day, exposed to moisture, or exceeding the allotted time periods above shall be cut back (150 mm Min.) to full depth to expose a fresh vertical face, and then coated with Emulsified Asphalt (Tack Coat) prior to placement of additional asphalt.

All joints shall be constructed such that any excess material is not scattered on the surface of the freshly laid mat. Such excess material shall be carefully removed and disposed of as directed.

The width of succeeding courses shall be adjusted by an offset of 150 mm to 300 mm so that longitudinal joints do not coincide.

Transverse joints shall be checked with a straight edge immediately after initial rolling. Any irregularity in the pavement surface at the joint shall immediately be corrected by the addition of or removal of mixture. When possible, the transverse joints shall be initially rolled in a direction perpendicular to the direction of paving.

The depth of the newly laid mat shall be adjusted to allow for compaction. The paver shall overlap the existing mat by at least 50mm.

General Requirements for Compaction

The mixture shall be compacted to a density of 97% of the Bulk Relative Density of the

comparative laboratory Marshall mixture based on the criteria given in item 351.03 “Physical Requirements for Mixture”.

It is an express condition of this specification that all mixtures be compacted to the density immediately following placement. If, during the paving operation, measured in-site densities fall below the specified minimum, the Contractor shall revise his compaction process by (a) increasing the number of passes of the compaction equipment; (b) adjusting the frequency amplitude or tire pressure of individual rollers; or (c) by adding additional rollers to the compaction operation, or by any other means necessary to achieve the specified degree of compaction.

Steel drum rollers should operate with the drive wheel forward in the direction of paving. In all cases, the production and placing of pavement mixture shall be controlled so that all rolling shall be completed before the pavement mat temperature falls below 80 degrees Celsius. The compaction process shall be completed before sunset.

Compacting Asphaltic Base and Surface Courses with Static Wheel Rollers

Where the Contractor elects to compact the mixture using static wheel rollers, a minimum of two (2) steel wheel and one (1) pneumatic tired rollers will be required to operate with each paver used.

The initial breakdown rolling by a steel wheel roller shall commence as soon after placing as the mixture will bear the roller without checking or undue displacement. Rolling shall start longitudinally at the lower edge and proceed toward the higher edge of the course, overlapping on successive passes. Alternate passes of the roller shall be staggered.

Intermediate rolling, using a pneumatic tired roller, shall follow the breakdown roller as closely as possible. Passes shall be so arranged as to ensure overlapping successive tire paths. The Contractor shall be responsible for ensuring that the tires are in proper condition at all times to prevent pick-up of the mixture.

Finishing rolling, using a steel wheel roller, shall be accomplished with the minimum number of passes required to produce a satisfactory surface. Rolling shall start longitudinally at the higher edge and proceed towards the lower edge. The operating speed of static steel rollers shall not exceed 5 km/h and shall be slow enough to avoid displacement of the mix.

While rolling longitudinal joints, steel drums or rubber tires shall extend 150 mm over the previously placed mat.

Compacting Asphaltic Base and Surface Courses with Vibratory Rollers

Where the Contractor elects to compact the mixture using vibratory rollers, a minimum of one vibratory roller and one pneumatic tired roller will be required to operate with each paver used.

The required compaction shall be obtained by the vibratory roller followed by the pneumatic tired roller. Rolling shall commence as soon after placing as the mixture will bear the roller without checking or undue displacement.

In areas where a vibratory roller proves ineffective (i.e. intersections and bridge decks) compaction shall be obtained using a suitable static steel wheel or oscillatory roller.

Compacting Asphaltic Leveling Course

Where the Contractor elects to compact leveling course using a static steel wheel roller, or a double steel wheel vibratory roller, then a pneumatic tired roller shall be used following the steel wheel roller.

However, where the Contractor elects to compact leveling course using a vibratory roller of the type consisting of two or more pneumatic tires and a vibratory steel drum, then a separate pneumatic tired roller will not be required.

Requirement for Asphaltic Leveling Course

Asphaltic Leveling Course shall be used to fill surface depression on old pavement to restore the surface to the original profile and cross-section.

Patching and leveling shall not be carried out simultaneously at the same place. The patch, consisting of asphaltic base course, shall be placed and fully compacted before leveling operations may proceed over the patch.

Requirements for Completed Asphaltic Base and Surface Courses

Each course after final compaction shall be smooth and true to the established crown and grade, shall have the average thickness specified, and shall at no point vary more than 6mm from the specified thickness. The surface of each course shall be free from deviations exceeding 3mm as measured with a 3-metre straight edge paralleling the centre line of the roadway.

Any low or defective places shall immediately be remedied by cutting out the course as required and replacing it with fresh hot mixture which shall be immediately compacted to conform with the surrounding area and shall be thoroughly bonded to it.

Segregation and Other Surface Defects

The finished surface of any Pavement Course shall have a uniform texture and be free of visible signs of poor workmanship.

Any obvious defects, as determined by the Engineer, will be cause for rejection of the pavement course. Such defects shall include but not necessarily be limited to the following:

1. Segregated Areas
2. Areas of Excess or Insufficient Asphalt Cement Patches
3. Roller Marks
4. Cracking or Tearing
5. Improper Matching of Longitudinal and Transverse Joints.
6. Tire Marks
7. Improperly Constructed
8. Improper Cross Slope
9. Fuel Spills on the Mat.

Segregation is defined here as areas with predominantly coarser texture than that of the surrounding pavement and will normally be first identified visually.

Severe Segregation:

Area appears very stony, with stone against stone and little or no matrix. All areas of severe segregation in any pavement course will require removal and repair across the full lane width.

Medium Segregation:

Area has significantly more stone than the surrounding acceptable mat and usually exhibits some lack of surface matrix. Medium segregation in surface-courses will be subject to a penalty of $25/m2 for the area in question, but for base-courses will normally be left in place with no price reduction. However, any areas of medium segregation that deteriorate prior to being overlaid by another pavement course must be repaired at the Contractor's cost.

Slight Segregation:

Area where the matrix is in place between the stones but there is slightly more stone in comparison with the surrounding acceptable mix. Slight segregation will normally be left in place without price adjustment. The severity of segregation can be determined through several test methods, as specified by the Engineer.

Defects as determined by the Engineer, which occur in the finished surface of any pavement course during the one-year warrantee period resulting from poor workmanship, shall be repaired by the Contractor. The Contractor's method of repair shall be approved by the Engineer and performed according to specifications.

351.08 MEASUREMENT FOR PAYMENT

Measurement for payment will only be made for those materials accepted for use under this specification and then only when incorporated into the work at the grades, lines and location specified by the Engineer.

The material shall be weighed by means of the truck scales. Only loads certified by the City Representative as being placed in the works at the required locations shall be considered for inclusion in the measurement for payment.

Payment for joint sealing compound (DensoBand or approved equal) shall be in linear metres at the respective unit price bid.

Payment Adjustment Factors:

Based on individual samples collected, adjustments as per the tables below will be made to the unit price of HMA for both the Asphalt Binder Content (Table 6) and Gradation (Table 7) if applicable.

If the test results representing the individual sample for asphalt cement content and gradation

falls into the “Penalty Zone” stated in Table 5, the payments for Hot Mix Asphalt shall be adjusted by deducting a percentage from the unit price as per Table 6 for the asphalt cement content and the gradation as per Table 7. These adjustments shall apply to the quantities of asphalt represented by these samples.

If the test results representing the individual sample fall into the above-stated “Rejectable Zone”, then no payment will be made for the hot mix asphalt represented by those samples.

The Sample frequency of hot mix asphalt shall be taken randomly, throughout each day of production (one sample per 500 tonnes or one sample per mix/per day/per street). The sample collected is to be tested to ensure conformance with the specifications stated herein. Sampling and testing shall be performed in accordance with ASTM D979 and ASTM D6307. Additional samples may also be taken and tested in accordance with ASTM D6307, for verification purposes.

Any or all samples are to be collected and tested by the City of St. John's or a certified testing company. The samples are to be collected near one another but not in the same immediate area. A minimum of 2 additional samples will be considered and labelled as a re-check as well as a contractor appeal sample. If the initial sample falls into the penalty or rejectable zones, the City of St. John's at its own expense will test the re-check sample. If the appeal sample is required, then this will be the responsibility of the contractor. The results of all tested samples will be averaged to determine the results used for payment adjustments.

Acceptance Criteria

The following acceptance criteria shall apply for all mixes:

Table 5
Asphalt Content/Gradation Acceptance Criteria

TYPE OF TEST	ACCEPTABLE ZONE (%)	PENALTY ZONE (%)	REJECTABLE ZONE (%)
Asphalt Binder Content	± 0.30	-0.30 TO - 0.50 +0.30 TO +0.50	<-0.50 OR >+0.50
Gradation	Passing 4.75 mm (#4) - 0.00 to 5.00 Passing 75µm (#200) - 0.00 to 1.00	Passing 4.75 mm (#4) - 5.01 to 9.00 Passing 75µm (#200) - 1.01 to 2.00	Passing 4.75 mm (#4) >9.00 Passing 75µm (#200) >2

Table 6
Asphalt Content Penalty:

Penalty Zone AC Content Deviation (%)	Unit Price Payment Adjustment Factor (% Per Tonne of HMA)	Penalty Zone AC Content Deviation (%)	Unit Price Payment Adjustment Factor (% Per Tonne of HMA)	Penalty Zone AC Content Deviation (%)	Unit Price Payment Adjustment Factor (% Per Tonne of HMA)	Penalty Zone AC Content Deviation (%)	Unit Price Payment Adjustment Factor (% Per Tonne of HMA)
0.30	0.0	0.37	7	0.44	14	> 0.50	Reject
0.31	1	0.38	8	0.45	15		
0.32	2	0.39	9	0.46	16		
0.33	3	0.40	10	0.47	17		
0.34	4	0.41	11	0.48	18		
0.35	5	0.42	12	0.49	19		
0.36	6	0.43	13	0.50	20		

Table 7
Gradation Penalty:

Sieve Size (Designation)	Gradation Deviation from the Job Mix Formula	Unit Price Adjustment (% Per Tonne of HMA)
Passing 4.75 mm (#4)	0.00 to 5.00	0
	5.01 to 5.20	1
	5.21 to 5.40	2
	5.41 to 5.60	3
	5.61 to 5.80	4
	5.81 to 6.00	5
	6.01 to 6.20	6
	6.21 to 6.40	7
	6.41 to 6.60	8
	6.61 to 6.80	9
	6.81 to 7.00	10
	7.01 to 8.00	11
	8.01 to 9.00	12
	>9.00	REJECT
Passing 75µm (#200)	0.00 to 1.00	0
	1.01 to 1.10	1
	1.11 to 1.20	2
	1.21 to 1.30	3
	1.31 to 1.50	5
	1.51 to 1.75	7.50
	1.76 to 2.00	10
	>2.00	REJECT

In addition to the acceptance/rejection requirements for gradation above, the following shall apply:

1. The results must fall within the gradation limits as specified in Table 3 and will be rejected if they fall outside regardless of if they are still within the gradation deviations noted in Table 7.

351.09 PAYMENT

Payment shall be at the respective unit price bid for this item, with adjustment for penalties of 351.08 where applicable. The price bid shall be full compensation for all labour, equipment and materials necessary to complete the work in accordance with this specification. If the City determines that any rejected material may remain in the work, and the Contractor elects not to repair the affected area, payment for the rejected amount will be at 50% of the respective bid unit price.

ITEM 352

FULL DEPTH ASPHALT PATCH

352.01 SCOPE OF WORK

The Contractor shall cut out asphalt surfaces as marked out in the field by the Engineer and replace to match existing or a minimum 80mm. Each lift shall not exceed 50 mm and the minimum lift thickness shall not be less than 40 mm. The second (2^{nd}) lift and subsequent lifts cannot be placed any earlier than twelve (12) hours after the previous lift to allow time for proper curing. This does not include asphalt areas called for on the Contract Drawings to be removed, or where the asphalt is required to be removed because of grade changes, unless it is specifically shown on the drawings to be included.

352.02 MATERIALS

Asphalt shall be asphalt as specified in the Item 351 "Hot Mix Asphaltic Concrete".

Tack coat shall be tack coat as specified in the Item 354 "Tack Coat".

Road gravel shall be road gravel as specified in the Item 323 "Gravel for Streets".

352.03 PROCEDURE

Refer to Drawing No. 10-352-01 for examples of typical repairs and applicable procedure. The Contractor shall cut the asphalt in clean straight lines. Transverse joints shall be perpendicular to the curb line with longitudinal joints parallel to the curb line. The area of asphalt to be removed shall extend at least 300mm outside the distressed area.

The Contractor shall remove distressed asphalt and where a firm base is not present, the base and sub-base shall be removed to such depths as required to establish a solid foundation. Where base and sub-base are required to be removed and reconstructed, payment shall be paid at the respective unit prices for "Street Excavation" and "Gravel for Streets".

The thickness of Granular “A” and Granular “B” layers shall be the thickness of the existing granular layers but in no case less than 100mm and 200mm, respectively.

Using a self-propelled mechanical routing machine the contractor must ensure the surface course asphalt joint is a minimum 300 mm outside of the base asphalt joint around the entire perimeter of the cut. Asphalt shall be laid from the edges of the cut and proceed to the centre. Asphalt shall not be laid in layers greater than 50mm thick and when the smallest dimension of a patch exceeds 2.5 metres, a mechanical asphalt spreader shall be used to lay the patch.

The thickness of the asphalt patch shall be the thickness of the existing asphalt mat but in no case less than 80mm.

Asphalt shall be compacted to 97% of the Standard Marshall Test. Base shall be compacted to 100% Standard Proctor Density and sub-base shall be compacted to 95% Standard Proctor Density.

The finished surface shall be smooth and at the same level as the surrounding existing asphalt.

Hot Asphalt Joint Sealing System

The Contractor shall apply a hot asphalt joint sealing system to the vertical edges around the entire perimeter of the surface asphalt cut, prior to placement of the surface course hot asphalt patch as per Drawing No. 10-352-01.

The hot asphalt joint sealing system shall consist of a primer and a polymer modified bitumen strip used for sealing cold joints between existing asphalt and hot asphalt. The primer and polymer modified bitumen strip shall be from the same manufacture to ensure compatibility. The joint sealing system shall bond to the surfaces of the asphalt joint and form a flexible watertight seal.

The applicable hot asphalt joint sealing system shall comply with the following street classifications:

- Residential (RES)
  - 2mm thick x 50mm wide cold applied polymer modified bitumen strip. Approved products: Denso Reinstatement Tape or approved equal.

- Collector (COLL) and Arterial (ART)
  - 8mm thick x 45mm wide hot applied polymer modified bitumen strip. Approved products: DensoBand or approved equal.

The hot asphalt joint sealing system shall be installed, including any required cleaning, preparation and priming, in accordance with the manufacturer's instructions. The supply and installation of the hot asphalt joint sealing system shall be considered incidental to the work and no additional payment will be made.

352.04 PAYMENT

Payment shall be made at the unit price bid per square metre (surface course area) for thickness specified. The unit price bid shall be full compensation for all labour, equipment, and materials necessary to remove distressed asphalt, compact and bring base to grade, apply a hot asphalt joint sealing system, and place an asphalt patch, all in accordance with this specification.

ITEM 353

CHANNEL CUTS

353.01 SCOPE OF WORK

The Contractor shall construct channel cuts in designated locations and replace with asphalt as a continuous mat at start and finish of asphalt resurfacing. Channel cuts will only apply for tying new asphalt into the existing street section and shall not include tie-ins for residential/commercial access points. This is to be considered reprofiling and will be paid for under that item.

353.02 FORM AND DIMENSION

The form and dimension of the channel cut shall conform to the standard drawings.

353.03 PROCEDURE

The Contractor shall construct channel cuts in locations and lengths approved by the Engineer. Channel cuts may be constructed using a self-propelled mechanical routing machine or, by cutting out a minimum 1000mm wide strip of existing asphalt. All channel cuts shall be straight line cuts and have a uniform cross-section.

353.04 MEASUREMENT FOR PAYMENT

Measurement for payment shall be in square meters of total channel cut area, rounded to one decimal place.

353.05 PAYMENT

Payment shall be on a unit price basis per square meter of channel cut area made in accordance with the standard drawings. The bid price shall include all labour, equipment and materials necessary to complete the work in accordance with this specification.

ITEM 354

TACK COAT

354.01 SCOPE OF WORK

This section covers the requirements for the supply and application of Tack Coat to pavement surfaces prior to repaving with asphaltic concrete. All surfaces to be paved shall receive tack coat regardless of when the original receiving surface was paved.

354.02 MATERIALS

Tack Coat shall consist of RS-1 emulsified asphalt conforming to ASTM D977 "Standard Specifications for Emulsified Asphalt", CRS-1 emulsified asphalt conforming to ASTM D2397 "Standard Specifications for Cationic Emulsified Asphalt" or a non-tracking emulsion. The non-tracking emulsion shall be a Clean Bond Coat, or equivalent, applied un-diluted or diluted with a maximum of 40% water and shall meet the requirements of **Table 1** and **Table 2.** Dilution of the emulsion shall be permitted provided the Manufacturer's dilution process is followed.

Table 1: Non-Tracking Emulsion Requirements (Prior to Dilute)

Test Type	**Specification Range**	
	Minimum	Maximum
Tests on Emulsions		
SF Viscosity, 25ºC, SFs	20	-
Sieve Test, 850µm, %	-	0.1
Residue by Distillation, 260ºC, %	55	-
Oil Portion of Distillate, %	-	Trace
Particle Charge	(-) or (+)	
Test on Residue		
Penetration, 25ºC, dmm	20	55
Ash Content, %	-	1.0

Table 2: Non-Tracking Emulsion Requirements (Diluted)

Test Type	**Specification Range**	
	Minimum	Maximum
Tests on Emulsions		
Residue by Distillation, 260ºC, %	39.3	-
Test on Residue		
Penetration, 25ºC, dmm	20	55
Ash Content, %	-	1.0

Should the Contractor wish to use an alternate product, then prior written approval of the Engineer must first be obtained. A written request must be submitted to the Engineer a

minimum of 14 days prior to the intended use of the alternate product. The Contractor's request must include reasons for the use of the alternate product, manufacturer's product literature and required application rates as well as applicable Safety Data Sheets.

The Contractor shall collect samples of emulsified asphalt as required by the Engineer. The Engineer may opt to request one random sample per day. Samples shall be taken from the Contractor's storage tank in accordance with ASTM D140 "Standard Practice for Sampling Bituminous Materials". The sample size shall be at least eight litres placed in two separate four litre containers. Collection of the asphalt binder sample shall be witnessed by the Engineer. The sample shall be appropriately identified including the time and date of samples, type of emulsified asphalt, manufacturer, and refiner. If the sample is Clear Bond Coat it should also be recorded if the sample is un-diluted or diluted and the percentage of water added. The sample shall be immediately forwarded to the witnessing Engineer.

354.03 EQUIPMENT

Tack Coat shall be applied by means of an approved pressure distributor designed and equipped so that the emulsion may be applied uniformly at even heat on variable widths at easily determined and controlled application rates under uniform pressure. The distributor shall maintain a constant height of the spray bar as the tank is unloaded.

The distributor shall be equipped with a suitable thermometer with a minimum range from 10°C to 150°C placed to accurately show the temperature of the contents. The approved pressure distributor shall be equipped with a tachometer measuring speeds in meters per minute that is visible to the truck driver so as to maintain constant application speeds at specified rates. The distributor's pump shall be equipped with a tachometer registering liters per minute that is visible to the truck driver. The distributor shall be equipped with a hose and nozzle attachment to be used for spraying by hand, areas inaccessible to the spray bar.

All spray nozzles shall be in good condition and of the same type, orifice size and manufacturer and capable of producing a uniform fog-type spray without streaking. Prior to spraying the Contractor shall check with the Manufacturer to ensure the correct spray nozzles are being utilized. Clogged nozzles shall be removed and cleaned with solvent. The slot of each nozzle shall be set at 30 degrees to the axis of the spray bar and the spray bar shall be set at a height above the existing pavement that will permit the fan from each nozzle to overlap its neighbouring fan by exactly half. The spray bar shall be provided with a positive shut-off to prevent dribbling.

354.04 APPLICATION

Tack Coat shall only be placed on surfaces that are clean and dry, with no threat of precipitation or fog and then only when the atmospheric temperature is 10°C, or greater. The emulsion shall not be applied to a prepared surface when the surface temperature is less than 2°C.

Should the surface to be treated be dirty, then the Contractor shall thoroughly clean the surface by means of a power broom, or equivalent to ensure bonding of the Tack Coat.

Tack Coat shall only be placed on surfaces that have been approved by the Engineer.

The Contractor shall plan his work so that no more Tack Coat than is necessary for the day's paving operation is applied at one (1) time.

The spraying temperature shall be between 20°C and 70°C for RS-1 and Clean Bond Coat, 60°C and 80°C for CRS-1, or the temperature recommended by the manufacturer. This recommendation from the manufacturer shall be provided in writing to the Engineer. Application rates shall meet the requirements of Table 3. On pavement, which was placed during the previous construction season, the rate of application shall be as directed by the Engineer. This rate will not exceed the rates provided in Table 3.

Table 3: Tack Coat Application Rates

Emulsion Type	Application Range
RS-1	0.15 to 0.25 l/m2*
CRS-1	
Clean Bond Coat Un-diluted	0.15 to 0.25 l/m2*
Clean Bond Coat diluted (40%)	0.25 to 0.35 l/m2*

* Or the application rate as recommended by the Manufacturer and approved by the Engineer.

Tack Coat application shall be visually uniform. Areas of insufficient or non-uniform Tack Coat coverage shall be re-sprayed by the Contractor at no additional cost.

354.05 CURING

No hot mix shall be placed upon the Tack Coat until it has dried to a proper condition of tackiness, as determined by the Engineer. The Contractor is advised that the period required for such drying will depend upon weather conditions; generally, it can be 1 hour or more.

Where appropriate, the Contractor shall keep traffic off the Tack Coat to maximize product performance.

354.06 MEASUREMENT FOR PAYMENT

Measurement for payment shall be by means of the horizontal area treated with tack coat lying within the area designated by the Engineer for treatment. The area shall be computed in square meters, rounded to one decimal place.

354.07 PAYMENT

Payment at the contract price for Tack Coat shall be compensation in full for all labour, materials, and equipment-use to; clean the existing surface, supply and apply the tack coat.

ITEM 355

RE-PROFILING

355.01 SCOPE OF WORK

The Contractor shall re-profile existing street surfaces as directed by the Engineer. Re-profiling shall expose sufficient curb or gutter face to allow full curb height restoration after resurfacing and shall extend to a width sufficient to restore an acceptable cross-section. Residential/commercial access points where tie-ins are required will also be considered under this scope of work and will not be considered a channel cut.

355.02 EQUIPMENT

Re-profiling will be accomplished by cold-milling.

A cold-milling machine shall be a self-driven rotating drum type, capable of removing asphalt 100mm thick in a single pass. Cutting depth shall be adjustable from 0mm to 100mm over the length of the drum. The machine shall have automatic grade control and be able to load milled material directly into trucks or be able to windrow the material for subsequent pick-up by other equipment.

355.03 PROCEDURE

Existing asphalt shall be removed to depths specified. Removal may be required across the full width of the street, or in tapered strips along the curb face, depending upon suitability of the resulting cross-section. In areas where the re-profiling equipment cannot remove the asphalt to the depths required, such asphalt shall be removed to the required grade using other means acceptable to the Engineer.

All residue left by the re-profiling process is to be removed immediately from the street and disposed of off site. Mechanical sweeping shall be performed at the end of each day's operations.

355.04 MEASUREMENT FOR PAYMENT

The quantity to be measured shall be the number of cubic meters of asphalt removed, rounded to one decimal place.

355.05 PAYMENT

Payment shall be made at the unit price bid for re-profiling of existing asphalt. The price bid

shall be full compensation for all labour, equipment and materials necessary to complete the work as specified.

ITEM 356

HEATER-SCARIFICATION OF ASPHALT

356.01 SCOPE OF WORK

The Contractor shall preheat, heat, scarify add rejuvenator (when requested), mix, spread and compact the scarified asphalt street surface.

356.02 EQUIPMENT

Preheater

The preheater shall be a separate independently operated self-propelled heating unit. The preheater shall meet the heater requirements as specified for the heater-scarifier.

Heater-Scarifier

The heater-scarifier shall be a self-propelled machine capable of heating, scarifying, adding rejuvenator, mixing, and screeding the scarified asphalt street surface.

The heating system shall be propane, fuel oil, or butane fuelled, capable of being turned on or off instantly and have a range of width to heat 1.0 to 4.0 metres depending on the surface scarified. Heating of the asphalt street surface shall be accomplished in such a manner that adequate heat penetration is provided without excessive oxidation, or direct flame contact with the asphalt street.

The machine shall be equipped with a minimum of two rows of spring-mounted scarification teeth. Teeth shall be evenly spaced at a maximum spacing of 38mm over a minimum operating width of 3 metres, with the rows offset by an amount equal to one-half of the tooth spacing. Teeth shall be capable of vertical movement, such that the rows of teeth will follow any contours in the street profile to scarify to the required depth regardless of depression or high areas. Self-regulating controls shall be used to exert pressure from the weight of the machine onto the tooth mounting system, and to control the depth of scarification.

The machine shall be capable of adding rejuvenator (when required) uniformly over the area to be scarified at a uniform rate per distance travelled.

The machine shall be capable of agitating 100% of the material being scarified by spinning and tumbling to provide for the filling of cracks and turning the worn and dried faces of exposed aggregate.

The machine shall be capable of lateral movement of the scarified material as required, by using a reversible auger and/or adjustable blades. This system shall be capable of maintaining a uniform supply of scarified material distributed as required across the face of

the spreader screed.

The heater-scarifier shall be equipped with a heated vibratory screed for the re-spreading of scarified material. This screed shall be fully adjustable for width, mat thickness, cross slope, crown, and shall be automatically controlled to provide a smooth uniform finish surface.

Compaction Equipment

Compaction of asphalt shall be by means of a double drum static wheel roller conforming to the specifications and performance requirements stipulated in Item 351 "Hot Mix Asphalt Concrete".

356.03 MATERIALS

Rejuvenator

Shall be "rejuvenate" as manufactured by McAsphalt Industries Ltd., 8800 Sheppard Avenue East, West Hill, Ontario, M1E 4R2, or approved equal.

356.04 PROCEDURE

(a) Prior to commencing heater-scarifying, the Contractor shall sweep the asphalt surface with a power broom to ensure that the street is clean and free of any dirt, debris or other material which would be detrimental to the quality of the work.

(b) The asphalt surface shall be uniformly heated to a depth sufficient to accommodate scarification of the material. The temperature of the scarified material shall be a minimum of 105°C when measured with a stick thermometer immediately behind the scarifier. The asphalt binder shall not be charred in excess of 0.1 of 1%.

(c) The rejuvenator shall be uniformly applied to the street surface immediately following the heat application process and prior to the scarification process. The rate of application shall be established by the engineer in the field and vary from street segment to street segment.

(d) The scarification teeth shall be regulated and adjusted to provide for scarification to an average depth of 25mm across the operating face. Teeth shall follow the contours of the existing surface such that the minimum depth of scarification at any point is 12mm. Scarified material shall be thoroughly tumbled and mixed by the action of the teeth, augers or blades, and deposited in front of the spreader in a manner conducive to proper respreading.

The scarified surface shall be 150mm wider than the screed following, and each successive pass shall overlap the previous scarified adjacent surface by a minimum of 300mm.

The scarification process, or subsequent work by hand, if necessary, shall ensure that the street surface is evenly scarified to the edges and on all sides of manholes, catch basins, valve boxes and similar structures. The Contractor shall not leave unscarified areas surrounding such structures, nor taper the depth of scarification to the surface at the edge of the structures.

The Contractor shall ensure that no scarified material is permitted to enter catch basins, manholes or valve boxes.

Scarification will be deemed acceptable when the average of three (3) consecutive random depth tests immediately behind the scarifier and in three different locations indicate that the required depth has been scarified.

(e) The spreader screed shall be adjusted and regulated so as to deposit the scarified material across the street surface. Unless otherwise directed, the Contractor shall re-spread the material to a uniform thickness, except where ruts, depressions or other surface irregularities require localized variations in mat thickness.

In certain instances, the Engineer may direct that the street cross-section be altered slightly to make allowances at the curb line for the additional thickness of the finish lift of asphalt. In this event, the Contractor shall adjust and regulate the screed to provide for a redistribution of the scarified material to the new cross-sectional shape required.

In either event the screed shall be adjusted to fully re-use all scarified material without either surplus or deficiency. The screed shall be automatically controlled (as from a pavement ski or other method) to provide uniformity of grades both longitudinally and transversely, thus eliminating any localized irregularities.

(f) Immediately upon spreading of the mixture, the Contractor shall compact the surface in conformance with the methods and standards outlined for the compaction of new material as contained in the item "Hot Mix Asphaltic Concrete". Compacted density shall be not less than 97% of the density of a Marshall Test Specimen prepared (using 75 blows) from a sample of scarified material.

356.05 TIMING OF HEATER SCARIFICATION

Heater Scarification of existing asphalt will not be permitted to be done until ten (10) calendar days prior to the placement of top course asphalt, unless otherwise approved by the Engineer.

356.06 MEASUREMENT FOR PAYMENT

Measurement for payment shall be:

(a) Heater Scarified - in square metres, rounded to the nearest metre of area preheated and

heater scarified.

(b) Rejuvenator - in litres, rounded to the nearest litre of rejuvenator applied to the street surface.

356.07 PAYMENT

The Contractor shall be paid at the respective unit prices bid for this item. The bid prices shall include all labour, equipment and materials necessary to preheat, scarify, add rejuvenator, mix, spread and compact asphalt street surface in accordance with this specification.

ITEM 357

ASPHALT CRACK SEALING

357.01 SCOPE OF WORK

This specification covers the work of sealing pavement cracks with a crack sealant compound. The purpose of crack sealing is to prevent moisture from penetrating the roadway structure, to prevent the intrusion of incompressible material into the cracks and to prevent the spalling of material from the edges of the cracks.

This specification covers two methods of sealing pavement cracks. A Blow & Go method involving no routing will be conducted during the spring (April 01 to May 31) and fall (September 15 to November 30). During the summer months (June 01 to September 14), crack sealing work will include a combination of Blow & Go method and a Rout & Seal method whereby cracks are cut using a router and sealed.

357.02 MATERIALS

.01 General

The hot-poured, rubberized joint and crack sealing compound shall be MacSeal 6690-4 or an approved equivalent.

The crack sealing material shall meet Type IV classification conforming to ASTM D6690 Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements or an approved equivalent, capable of maintaining an effective seal in climates experiencing very cold temperatures. Crack sealing material having a lower resilience modulus may be acceptable if it can be shown that the product has been used successfully in similar climatic conditions. Final approval and acceptance of the crack sealing material will be at the City's discretion.

Portland cement or agricultural lime will be required to sprinkle over sealed cracks to prevent tacking.

The use of any controlled products must be in accordance with the Workplace Hazardous Material Information (WHMIS). Workers should become familiar with Material Safety Data Sheets for these products.

.02 Samples

The Contractor shall be prepared to submit a 1 kilogram or a 1 litre sample of crack sealing material to the City and at least two (2) weeks prior to commencing work.

During the process of placing, the Engineer may require the Contractor to take samples of the crack sealing material directly from the heating kettle.

357.03 EQUIPMENT

All equipment shall be safety approved.

.01 Router

Routing equipment shall consist of mechanical routers capable of continually creating well-defined right-angle routs. The routing equipment shall be sufficiently portable and flexible to accurately follow wandering cracks without tearing, chipping or spalling the crack edges. Equipment must produce a clean, neat square cut with vertical sidewalls.

The router shall be guided so that the crack lies entirely within the routed channel. Vertical sides of the cut shall be perpendicular to the pavement surface. The router must be capable of cutting a grove as shown on Dwg. 10-357-01 “Asphalt Crack Sealing Detail”. Open “V” shaped groves are not permitted.

Bits used to rout the cracks must be kept sharp and replaced promptly when dull.

.02 Compressor

Compressed air equipment is required to effectively clean the cracks. The compressor, which may be attached to the hot air lance, shall provide a clean oil-free air jet of a minimum flow of 4 m^3/min, a minimum velocity of 990 m/s and a minimum pressure of 600 kPa.

.03 Hot Air Lance

A hot air lance is required to dry and pre-heat cracks prior tot applying crack sealing material. The hot air lance must be used at all times to warm the crack and remove moisture. It is acceptable to use the compressor and air lance simultaneously. Tiger torches are not permitted**.**

.04 Heating Kettle

The heating kettle shall be a double-jacketed melting boiler capable of providing indirect heating and constant agitation of the crack sealing material. The kettle must be equipped with positive thermostatic temperature controls that will prevent overheating of the crack sealing material and heat transfer oil.

A calibrated thermometer capable of +/-5^{o}C from 100^o to 400^{o}C will be located so that the workers may safely and frequently check and record the crack seal material temperature.

A heated sealant applicator wand shall be attached to a heated hose and attached to a heated sealant chamber. Temperature controls will be capable of maintaining the temperature of the sealant within manufacturer’s tolerances.

357.04 TRAFFIC CONTROL

The Contractor shall be responsible for the maintenance and directing of traffic during crack sealing in accordance with Division 7, Specifications for Temporary Signs & Devices.

Treated areas shall be protected from vehicle traffic for either thirty (30) minutes after the crack sealing material has been poured or in accordance with the manufacturer's specifications, whichever is longer.

Where traffic is to be maintained during crack sealing, the surface of the crack sealing material shall be dusted with Portland cement or agricultural lime prior to allowing traffic on the sealed areas.

Each vehicle used by the Contractor for the application of crack sealing material shall be equipped with a clearly visible rotating amber light.

357.05 PREPARATION OF UNCUT CRACKS (BLOW & GO METHOD, NO ROUTING)

Crack sealing shall be limited to sealing uncut cracks (Blow & Go Method) during the periods of spring and fall. Pavement surfaces and crack edges must be dry, and the air temperature must be above 2^{o}C.

Crack sealing will include cleaning and sealing open cracks greater than 3mm wide and less than 25mm wide during the spring and fall seasons.

The cleaning operation shall consist of high compressed air free of oil to rid cracks of debris and/or moisture. The hot air lance will be used to warm the cracks and to remove any remaining moisture. The operation of the compressed air and hot air lance maybe conducted in combination or separately. All cracks shall be dry (exhibiting no evidence of moisture) prior to sealing.

The Contractor shall remove all dirt, dust and debris from the pavement, and this shall be considered as incidental to the work.

357.06 PREPARATION OF CUT CRACKS (ROUT AND SEAL METHOD INCLUDES ROUTING)

During the summer season, all cracks greater that 3 mm wide and less than 10 mm wide will be routed and cleaned. All cracks greater than 10mm wide and less that 25mm wide shall be sealed according to the Blow & Go method. The standard dimension of the cut crack (rout) is 20mm wide by 20mm deep or as directed by the Engineer.

The cracks will be routed taking care to follow the crack precisely. Avoid leaving small islands of pavement, which are or could be broken loose. Two (2) or more cracks shall not be joined by routing through uncracked pavement or routed in areas where a crack does not exist.

Following routing, the pavement surface and the routed crack shall be cleaned with high compressed air free of oil to rid cracks of debris and/or moisture. Ensure that no debris or moisture enters the routed crack before sealing. All routed cracks shall be sealed within four

(4) hours of routing.

The hot air lance will be used to warm the cracks and to remove any remaining moisture. All cracks shall be dry (exhibiting no evidence of moisture) prior to sealing.

The routing operation shall be periodically checked for cleanliness using duct tape by pressing 1 metre of the adhesive surface of the tape into the rout and inspecting it. After proper cleaning, there should be very little, if any residue on the tape.

The Contractor shall remove all dirt, dust and debris from the pavement. This shall be considered as incidental to the work.

357.07 MELTING AND PREPARING HOT CRACK SEALING MATERIAL

The Contractor shall fully comply with the crack sealing material manufacturer's instructions for heating and preparing sealant for application using the specified equipment.

The crack sealing material shall be heated and melted in the melting kettle. The kettle should be charged by adding a few units of crack sealing material at a time. When the compound has reached a fluid condition, additional material can be added until the kettle is full.

The crack sealing material shall be subjected to continuous and positive agitation. The temperature used in the melting the compound will be in accordance with the manufacturer's recommendation. Overheated, burned or under heated material shall not be used. If applied, it shall be removed and replaced at the Contractor's expense, as directed by the Engineer.

When the pouring temperature has been reached, the crack sealing material shall be maintained at this temperature until it is placed in the crack. In no case, shall the material be held at fluid temperatures for more than three (3) hours.

The Contractor shall ensure that crack sealing material packaging or other foreign material does not get into the melting unit.

357.08 HOT SEALANT APPLICATION

All cracks shall be thoroughly dried and cleaned of all residual dust and debris with high compressed air followed by the heating of the crack or rout with the hot air lance. The compressor and hot air lance may be used in combination or separately.

The hot air lance should always be used and kept moving at a pace that will avoid burning the surrounding pavement. A qualified operator should be used to adjust the cleaning speed, flame size and the distance of the heat lance tip from the road.

All cracks shall be carefully inspected prior to sealing to ensure they are thoroughly dry, clean and free from dust and debris. Adjacent pavement surface must also be clean and dry. The sealant compound shall not be applied with evidence of any dampness on or within the pavement or in the pavement pores. No salt residue shall be present on the pavement while

crack sealing.

The crack sealing material shall not be applied when the ambient temperature is below 2^{O}C or according to the sealant manufacturer's instructions.

No sealant shall proceed under unfavourable conditions having regard to the foregoing stipulations, until same have been rectified to the satisfaction of the Engineer.

The crack sealing material shall be applied by the heated sealant applicator wand. The crack sealing material shall be placed within two (2) minutes after heating of the crack with the hot compressed air lance. Care should be taken to avoid spillage of the material on the pavement. Should spillage occur, then the contractor shall clean it up at his own expense.

Pour pots shall not be allowed unless they are used to seal cracks or routs which were previously sealed by the heater kettle and only need a second application to be topped up.

The crack sealing material is placed into the prepared crack or rout, and the material is spread over the crack with a squeegee or with the wand. The crack sealing material centered over the crack or rout shall be shaped with a squeegee or wand as thin as possible into an overband approximately 50mm wide.

Following the application of the crack sealing material and before the area is open to traffic; all treated areas will be thoroughly checked for areas exhibiting adhesion failure, damage to the sealant, missed cracks, foreign objects in the sealant or other problems. All areas not meeting the acceptable criteria shall be prepared and resealed until satisfactory.

To prevent tacking prior to curing, the Contractor shall sprinkle the sealant with agricultural lime as traffic warrants.

357.09 WARRANTY

The Contractor shall guarantee that subject to normal wear and tear, all work performed under this contract will remain in acceptable condition for a period of twelve (12) months from the date of acceptance of all work by the Contractor

An acceptable condition would be when 95% of the crack seal performs as required over the twelve (12) month period. If the less than 95% of the crack sealant performs as required, the Contractor will have to repair all failed areas within the contract at the Contractor's expense. All material, haul, traffic control and related works shall be paid by the Contractor.

The Contractor shall, within fourteen (14) days after receiving written notice from the Engineer (or an agreed upon date), make good at his expense, in a manner satisfactory to the Engineer, any imperfections due to faulty materials or workmanship discovered in the work.

357.10 MEASUREMENT FOR PAYMENT

Measurement for payment for crack sealing will be by means of the required completed and accepted crack seal, measured in metres rounded to one decimal place. The crack sealing of cracks which the Engineer did not required to be treated, will not be included in measurement for payment.

357.11 PAYMENT

Payment at the contract price for crack sealing shall be compensation in full for all labour, materials and equipment-use to: supply samples of sealant to the City, clean out and/or rout the cracks that the Engineer requires to be treated, clean the routed cracks, dry the cracks, supply and apply sealant to the required depth, clean up all sealant spillage on the pavement, supply and apply cement or lime to the treated cracks to prevent tacking, together with the cost of providing the required traffic control.

ITEM 358

REPROFILING AND ASPHALT PATCHING

358.01 SCOPE OF WORK

The Contractor shall reprofile distressed or irregular asphalt surfaces, tack coat and patch or resurface with new asphalt to provide a smooth finished surface at the same level as the surrounding existing asphalt.

358.02 EQUIPMENT

Reprofiler shall conform to the requirements of Item 355 "Reprofiling".

358.03 MATERIALS

Asphalt shall be asphaltic concrete as specified in Item 351 "Hot Mix Asphaltic Concrete".

Tack coat shall be tack coat as specified in Item 354 "Tack Coat".

358.04 PROCEDURE

The Contractor shall reprofile the asphalt in clean straight lines. Transverse joints shall be perpendicular to the curb line with longitudinal joints parallel to the curb line. The area of asphalt to be reprofiled shall extend at least 300mm outside the distressed area. The depth of reprofiling shall be to a depth sufficient to provide for a minimum 40mm lift of asphalt patching.

The Contractor shall apply tack coat to the horizontal and vertical surfaces of the reprofiled area. Asphalt shall be laid from the edge of the cut and processed to the centre. Asphalt shall not be laid in layers greater than 50mm thick and when the smallest dimension of a patch exceeds 2.5 metres, a mechanical asphalt spreader shall be used to lay the patch.

Asphalt shall be compacted to 97% of the Standard Marshall Test.

The finished surface shall be smooth and at the same level as the surrounding existing asphalt.

358.05 PAYMENT

Payment shall be made at the unit price bid per square metre of Reprofiling and Asphalt Patching. The unit price bid shall be full compensation for all labour, equipment, and materials necessary to reprofile asphalt surfaces, clean reprofiled surface, tack coat, and

patch with asphalt, all in accordance with this specification.

ITEM 359

PULVERIZE EXISTING ASPHALT

359.01 SCOPE

Pulverizing is a process by which the existing asphalt pavement is crushed in place into small size particles and mixed with part of the existing granular base to total depth equivalent to twice the old asphalt thickness. This is accomplished in one operation with a pulvi-mixer type of equipment.

The pulverized mixture is re-levelled and re-profiled prior to compaction.

359.02 PROCEDURE

The Contractor shall pulverize the existing asphalt pavement (asphalt and granulars) to a depth as provided by the Engineer, up to a total maximum depth of 160mm unless noted otherwise in the unit price table. The pulverized material shall have 100% passing a 40mm sieve and shall be blended uniformly. This process shall be performed using a Caterpillar Reclaimer or equivalent.

After the pulverizing operation has been completed the Contractor shall prepare the roadway for Hot Mix Asphalt Paving or other applicable surface treatment as directed by the Engineer. This shall include saw cutting the asphalt, rough grading, addition of new Granular “A” as directed by the Engineer, fine grading and compaction. If the Engineer requires the gradation of the pulverized material to be adjusted, thorough mixing of new Granular “A” with the pulverized material will be required. The profile and cross section shall be restored to the satisfaction of the Engineer.

The grading and compaction shall be in accordance with Item 323 “Gravel for Streets” of the Specifications Book.

The Contractor shall be responsible for maintaining the gravel surface in a condition acceptable to the Engineer until the Hot Mix Asphalt Paving or other surface treatment is complete. The roadway shall not be left unpaved more than one week after pulverization of the old asphalt and the pulverized or unpaved work area shall not be greater than 4km in road length.

359.03 MEASUREMENT FOR PAYMENT

Measurement for payment shall be in square meters of actual area of roadway pulverized. The measurement calculations shall be based on actual existing asphalt width determined from field measurements and the length of the actual horizontal distance covered as determined by the Engineer.

359.04 PAYMENT

Payment at the contract price for Pulverization of Existing Asphalt will be considered compensation in full for all plant, labour and material use to: saw cut asphalt at the limits of pulverizing, pulverize the existing asphalt and granular materials to a depth as directed by the Engineer, to a maximum depth of 160mm or as specified in the Unit Price Table, rough grading, fine grading including blending of new Granular “A” and compaction, and dust control as deemed necessary by the engineer.

Payment for the new Granular “A” will be made according to Item 323 “Gravel for Streets”.

ITEM 360

GEOGRID

360.01 SCOPE OF WORK

The work to be performed includes the supply and placement of a structural geogrid for the purpose of creating a mechanically stabilized aggregate layer beneath or within the aggregate base course of the road structure. The goal of this application is to reduce the depth of excavation into the existing road structure and still provide a pavement section that will satisfy the service life requirements of the road.

360.02 MATERIALS

The geogrid shall be integrally formed through punching and drawing of extruded sheets of polypropylene. The geogrid shall be oriented in three substantially equilateral directions, so the resulting ribs have a high degree of molecular orientation which continues at least in part through the mass of the integral node.

The resulting geogrid structure shall have apertures that are triangular and shall have ribs with depth-to-width ratios greater than 1.0.

The geogrid shall be certified in writing by the manufacturer to meet the following characteristics:

Properties	**Longitudinal**	**Diagonal**	**Transverse**	**General**
Rib Pitch(2), mm (in)	40 (1.60)	40 (1.60)	-	
Mid-rib depth(2), mm (in)	-	1.4 (0.06)	1.6 (0.06)	
Mid-rib width(2), mm (in)	-	1.2 (0.05)	1.0 (0.04)	
Rib shape				rectangular
Aperture shape				triangular
Junction Efficiency(3), %				93
Aperture stability(4), kg-cm/deg @ 5.0 kg-cm				3.0
Radial stiffness at low strain(5), kN/m @ 0.5% strain (lb/ft @ 0.5% strain)				300 (20,580)

Resistance to chemical degradation(6)	100%
Resistance to ultra-violet light and weathering(7)	70%

1. Unless indicated otherwise, values shown are minimum average roll values (MARVs) determined in accordance with ASTM D4759-02. Brief descriptions of test procedures are given in the following notes.

2. Nominal dimensions.

3. Load transfer capability determined in accordance with ASTM D6637-10 and ASTM D7737-11 and expressed as a percentage of ultimate tensile strength.

4. In-plane torsional rigidity measured by applying a moment to the central junction of a 225mm x 225mm specimen restrained at its perimeter in accordance with GRI-GG9 modified.

5. Radial stiffness is determined from tensile stiffness measured in any in-plane axis from testing in accordance with ASTM D6637-10.

6. Resistance to loss of load capacity or structural integrity when subjected to chemically aggressive environments in accordance with EPA 9090 immersion testing.

7. Resistance to loss of load capacity or structural integrity when subjected to 500 hours of ultraviolet light and aggressive weathering in accordance with ASTM D4355-05.

360.03 STORAGE AND HANDLING

1. Geogrid rolls shall be elevated off the ground and adequately covered to protect them from site construction damage, precipitation, any contamination of dirt, dust any other deleterious materials.

2. Geogrid rolls shall be protected from extended ultraviolet radiation including sunlight, chemicals that are strong acids or strong bases, flames including welding sparks, excess temperatures, and any other environmental conditions that may damage the physical properties of the geotextile.

3. Store and handle the geogrid in accordance with the manufacturer's recommendations.

360.04 PLACEMENT

1. Geogrid shall not be placed when weather conditions, in the opinion of the Engineer, are not suitable for installation including heavy rainfall, extreme cold or frost conditions, or extreme heat.

2. The geogrid shall be laid smooth without wrinkles or folds on the prepared sub-grade in the direction of construction traffic. The geogrid shall be free from any tension or stress.

3. Adjacent geogrid rolls should be overlapped along their sides and ends as a function of subgrade strength as per the manufacturer's instructions.

4. Cut geogrid to conform to curves.

5. Place piles of base or sub-base material as required to hold geogrid in place. Pins and washers are not permitted.

6. Install geogrid to the limits of the roadway sub-grade including intersections and turning lanes or as directed by the Contract Administrator.

7. Prior to covering, the geogrid shall be inspected by the Contract Administrator for damage during installation.

8. Cover the damaged area with a geogrid patch that extends an amount equal to the required overlap beyond the damaged area.

9. Remove and replace geogrid that is improperly installed or damaged as directed by the Engineer.

10. Construction vehicles are not permitted directly on the geogrid. Turning of vehicles shall not be permitted on the first lift above the geogrid.

11. Avoid sudden stops or sharp turns by construction equipment during placement of sub-base materials.

12. Geogrid shall not remain uncovered for longer than 7 days after installation.

13. Install geogrid in accordance with this specification and the manufacturer's recommendations.

360.39 PAYMENT

Payment shall be on a lump sum or unit price basis, as per the pay items identified in the Form of Tender. The bid price shall include all labor, equipment, and materials necessary to complete the work in accordance with this specification. No measurement or payment will be made for the overlapped area.

DIVISION 4

SPECIFICATIONS FOR STRUCTURES

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ITEM 401

REMOVAL OF EXISTING STRUCTURE

401.01 SCOPE OF WORK

The scope of the work involves the demolition, removal, salvage and disposal of an existing structure, structural components and debris.

The intention of this specification is to cover both rehabilitation and complete removal and disposal works. For rehabilitation type projects, a supplementary general condition shall describe which structural components are to be removed, salvaged and disposed of.

Debris shall be defined as pieces of timber, concrete, steel, wood, sticks, branches, bushes, garbage and the like including that above and below the water level. Also included is the accumulation of debris from the time of tender closing up to and including the date of substantial completion.

Structural components and related debris shall include that related to the superstructure, railings, bearings, abutments, piers, footings and wingwalls.

All work shall be carried out in accordance with CSA S350 “Code of Practice for Safety in Demolition of Structures”.

401.02 GENERAL

The demolition, removal, disposal and salvage of an existing structure shall be carried out under the following conditions:

Division 9, Environmental Requirements.

The Structure shall be removed to 0.6 metres below grade or stream bed with as little disturbance to the area or riverbed as possible. The bending down of reinforcing steel to meet the above 0.6 metre criteria shall not be permitted. Reinforcing steel shall be cut off flush with the concrete remaining in the works. The area or stream bed will be restored to as near original condition as possible and to the satisfaction of the Engineer.

Where unwatering is required, it shall be provided for under Item 180 of the Specifications Book.

When all activity is complete, the affected work area must be restored to its natural condition acceptable to the Engineer. This shall include the backfilling of holes left after the existing foundation has been removed with material compatible with the natural environment.

The Contractor is advised the indiscriminate disturbance of the general area or stream bed

will not be permitted.

401.03 DEMOLITION, REMOVAL, SALVAGE AND DISPOSAL

The Contractor shall provide a disposal site satisfactory to all municipal, provincial and federal agencies having jurisdiction. Such disposal site shall be specifically approved by the Engineer.

Demolition, removal, salvage and disposal shall include the excavation, disassembly, breaking into pieces, handling, transportation from the job to disposal or storage site, and disposal or storage of bridge components and debris including burial and trimming of the disposal site to neat contours as required.

Demolition, salvage and removal operations shall be conducted in a workmanlike manner as approved by the Engineer. Debris which moves downstream during the work shall be recovered. Debris with a larger dimension of 500mm shall be removed from streams and rivers.

The use of explosives will only be permitted where they are authorized for use by the Engineer. The use of explosives will not be permitted where any part of the structure is intended for salvage or to remain in future work.

401.04 SALVAGE

Where structural components, regardless of material type are destined to be salvaged, the contract shall contain a supplementary general condition indicating which components are to be salvaged, how and where they are to be stored and whatever other pertinent requirements must be fulfilled by the Contractor.

Where the removal of aluminum railing, steel guiderail and any related components is required, it shall be salvaged by the Contractor. This shall include loading, transportation to the Public Works Depot, off-loading and storage in a manner acceptable to the Engineer. Storage shall include the provision for wooden spacers to separate the various items from the ground and from each other. Provision for suitable watertight containers necessary to store components which may become lost or scattered is also required.

401.05 MEASUREMENT FOR PAYMENT

Measurement for payment purposes shall be lump sum for the demolition, removal, disposal and salvage if so required, of the existing structure, structural components and debris as outlined above.

401.06 PAYMENT

Payment at the contract price for “Removal of Existing Structure” shall be full compensation for all labour, materials and equipment-use to demolish, remove, salvage and dispose of an existing structure, structural components and related debris as outlined above.

Also included in the basis of payment is the cost to the Contractor of selecting and providing the disposal site, cost of all permits, fees and royalties in addition to all necessary backfilling, grading and trimming of both the job and disposal site to neat and sightly contours.

ITEM 402

EXCAVATION FOR FOUNDATION, UNWATERING AND EXTRA BACKFILL FOR STRUCTURES

402.01 DESCRIPTION OF EXCAVATION

Excavation shall include the removal of all material necessary for the construction of foundations, substructures and the backfilling of the same in accordance with the plans or as directed by the Engineer.

All rock or other hard foundations shall have all loose or soft material removed to present a clean firm surface.

When a footing is to rest on an excavated surface other than rock, special care shall be taken not to disturb the bottom of the excavation. This shall include excavation by hand where so required or the use of excavator attachments which do not project below the final footing elevation. Alternatively, for footings excavated in the dry where the soil at or below the foundation elevation is disturbed as a result of construction operations; the foundation soil must be recompacted to yield a bearing capacity equal to or greater than that specified for the footing as approved by the Engineer.

In soft conditions, the final removal of material to foundation level shall not be made until the Contractor is ready to proceed with the construction of the footing. When material at the foundation elevation is Other Material and has been over excavated, the elevation shall be re-established by replacing with suitable material and compacting it to the bearing capacity indicated on the contract drawings as approved by the Engineer. When the founding material is Solid Rock and has been over excavated, the foundation elevation shall be re-established to the original elevation with mass concrete. First, all loose and compressible material shall be removed from the excavation to the satisfaction of the Engineer. Next, concrete shall be placed to the foundation elevation and shall fill the entire volume of the over excavation. Concrete shall be of a quality compatible with that used in the footing.

Footing elevation shall be considered as approximate only and may be ordered to be changed by the Engineer on evaluation of conditions as the excavation proceeds.

Unless otherwise specified no excavation shall be made outside of that required for constructing substructure and the natural stream bed adjacent to the structure shall not be disturbed without permission from the Engineer. The Contractor shall ensure that the channel is brought back to its original condition unless otherwise authorized.

After each excavation is completed, the Contractor shall notify the Engineer and no concrete or other backfill shall be placed until the depths of excavation and the nature of the foundation material has been affirmed as satisfactory.

Materials excavated as excavation for foundations will be used for backfill if the material is deemed suitable by the Engineer.

Suitable excavated material beyond the requirements for backfilling the excavation will be incorporated into fill construction in accordance with Item 321 Street Excavation. Excavation for foundation materials not required or unsuitable for backfilling excavation or for fill construction, will become the property of the Contractor. No overhaul will be paid for the removal and disposal of these materials. The use and classification of all excavation foundation materials will be as directed by the Engineer.

402.02 CLASSIFICATION

Excavation shall be measured and classified as solid rock and other material. Provided that whenever the classes of material excavated cannot be separately measured on an accurate basis, the material will be classified on a percentage basis.

(a) Solid Rock - shall include all rock in masses or ledges in their original or stratified bed or position and all boulders and detached pieces of rock exceeding 0.50m^3.

(b) Other Material - shall include all solid material other than solid rock as defined above including boulders less than 0.50m^3.

402.03 PROTECTION

All substructure work shall be adequately shored, braced or otherwise adequately protected in a rigid fashion in accordance with Item 407 “Formwork and Falsework”.

Where the stability, safety or function of an existing roadway, railway or other works can be impaired by an excavation or temporary slope, the Contractor shall provide such protection as may be required including sheeting, shoring and driving of piles where necessary to prevent damage to such works.

Where any excavation may endanger physical facilities, public safety or that of workmen, or the face of the excavation is less than two (2.0) metres from the edge of traveled lane or asphaltic pavement, whichever is nearest, or the excavation is more than one (1.0) metre deep, the Contractor shall submit scaled drawings detailing the method of protection, physical dimensions and grades of sub sheeting, shoring, bracing and piling. These drawings shall be prepared, signed and stamped by a Professional Engineer licensed to practice in the Province of Newfoundland.

All work must conform to the latest revision of the Occupational Health and Safety Act, including all amendments.

Unless otherwise specified, any materials used for protection shall remain the property of the Contractor and shall be removed from the job site when no longer required.

402.04 UNWATERING FOR BRIDGE FOUNDATIONS

The Contractor shall carry out all work necessary to prevent disturbance to the foundation and unless otherwise specified, he shall place all the concrete in the dry.

Where the term “unwatering” is used in this specification, it shall mean the removal of all water that would impede the placing of concrete for the foundations of the permanent structures by means of temporary water-tight structures and pumps.

The Contractor shall submit plans and descriptions outlining the methods of unwatering that he intends to use. These plans shall be approved by the Engineer before construction is started; approval will not relieve the Contractor of his responsibility for unwatering the foundations to the satisfaction of the Engineer.

Any damage to the permanent structure due to any failure of the temporary structure used in the unwatering operations shall be remedied at the expense of the Contractor to the satisfaction of the Engineer, even to the extent of removal and reconstruction of said permanent structure.

Unwatering for bridge foundations shall include the supply of all equipment, materials and labour for the construction of the necessary water-tight temporary structures, their pumping out and subsequent removal.

Earthfill cofferdams shall be faced with a layer of plastic sheeting followed by sandbags. The purpose is to produce a dam that permits the least amount of infiltration and therefore requires the minimum amount of unwatering.

Effluent from an unwatering operation shall not be disposed of directly into a watercourse or water body. Effluent shall be discharged to a vegetated area or to a sedimentation basin for silt removal before being returned to a watercourse. Where possible, the vegetated area shall be not less than 60m from a water course or water body unless otherwise directed by the Engineer.

If for any reason, all water cannot be removed from the forms so as to permit concrete to be placed in the dry, the Engineer may authorize upon receipt of a written request from the Contractor, the placing of a concrete seal by means of a tremie pipe or some other method. When a concrete seal is so authorized, the Contractor shall supply at his own expense all equipment, materials and labour necessary for such tremie concrete and no payment will be made for tremie concrete so placed other than under the lump sum bid for “Unwatering”.

Unless otherwise specified, all temporary unwatering and support structures shall remain the property of the Contractor and shall be removed from the job site when no longer required.

402.05 EXTRA BACKFILL

All backfilling and compaction work shall be conducted in the dry and under controlled conditions as approved by the Engineer.

The use of large vibratory compactors of the type used in roadway projects is prohibited adjacent to wingwall legs and abutments.

Select Material Compacted

The grubbing and excavation of all unsuitable material, and unwatering operations shall be completed before any select material is placed.

The quality of select material compacted shall be non-frost-susceptible, free draining, granular material complying with Item 323 “Gravel for Streets” - Granular “B”. The physical and gradation requirements shall be in accordance with Section 323.02. The location of a source of sufficient suitable material is solely the responsibility of the Contractor.

The percentage of crushed materials is to be minimum of 70%. This will be determined by examining the fraction retained on the 4.76mm sieve and dividing the weight of the crushed particles by the total weight retained on the 4.76mm sieve. Only pieces having one or more freshly fractured faces will be counted as crushed material. Pieces with only small chips removed will not be considered as crushed.

French drains comprised of washed well-graded stone including filter fabric and perforated pipe if indicated shall be placed at weep holes and wherever else required on the contract drawings.

The limits for placing select material compacted shall be as defined on the contract drawings or in the tender documents. Where select material is to be placed below abutment or pier footings, the limits shall be defined as that extending 1.0 metre beyond all sides and ends of the footing(s) and extending to the original ground elevation or bottom of excavation whichever is more pertinent from the bottom of the footing elevation at a side slope of 1.5:1(min.). The limits of placing shall be stakes on the ground before placing operations begin.

Select material placed below abutment and pier footings, behind abutments, retaining walls, wing walls, and similar structural components shall be placed in horizontal layers having a maximum loose thickness of 250mm before compaction. Where permission is given in writing by the Engineer or so indicated on the contract drawings, the maximum lift thickness can be increased to 500mm where select material is being placed in non-structural applications. The backfill can be spread with a bulldozer and after each layer is spread, a vibratory compactor must be used as directed by the Engineer.

The Contractor shall compact the backfill behind abutments to a minimum of 95% of the maximum Standard Proctor Dry Density and to a minimum of 100% of the maximum Standard Proctor Dry Density below all footings, i.e. as per (ASTM D698). When directed by the Engineer, water may be added to assist the compaction effort, but the amount of

water added should not bring the moisture content above the optimum for the compactive effort used.

The Contractor shall provide the Engineer with sufficient notice to perform Proctor and density testing. Acceptance shall be determined based upon samples taken from the point of final acceptance. The bottom layer must be spread, thoroughly compacted and tested before the next layer is placed.

No backfill shall be placed below a footing, against an abutment, wingwall or retaining wall until permission has been obtained from the Engineer.

Backfilling around arches, rigid frames, abutments and piers shall proceed simultaneously and evenly on both sides so as to avoid differential surface elevation in excess of 500mm.

Compacted Ordinary Fill

All material and placing shall be in accordance with Item 321 “Street Excavation”. However, location of the source will be the responsibility of the Contractor.

402.06 MEASUREMENT FOR PAYMENT

Excavation shall be measured in cubic metres in the original position of material excavated in conformity with the plans or as directed by the Engineer. Ordinarily no volume shall be included in the measurement for payment which is outside the volume bounded by vertical planes parallel to and beyond the neat lines of the footings unless such excavation is indicated on the contract drawings or specifically requested by the Engineer. The volume measured shall not include water or other liquids but shall include mud. The top limit for payment volume is original ground or new road subgrade elevation. Material removed above road subgrade elevation will be paid under Item 321 Street Excavation of the General Specifications. The bottom limit is the completed bottom of footing. Measurement for payment for over excavation will not be made.

The volume of boulders in excavation shall be determined on the basis of the three maximum rectilinear dimensions.

Unwatering shall be paid as lump sum as bid in the Unit Price Table.

Compacted ordinary fill and select material compacted shall be paid by the number of cubic metres in place to the nearest one decimal place and the volume measured shall be that between the theoretical or final grades and the original grades or lines as shown on the drawings, or as indicated herein.

402.07 PAYMENT

Excavation for Foundations

Payment at the contract price for “Excavation for Foundations” (a) Solid Rock and (b) Other Material, shall be full compensation for all labour, services, equipment and materials for all excavation required, protection of the excavation, protection of adjacent works, stockpiling of excavated material for backfilling, placing and compaction of excavated material and disposal of any surplus or unsuitable excavated material.

Unwatering

Payment at the contract price for the item “Unwatering” in the Unit Price Table shall be full compensation for all labour, service equipment and material to do the work according to the specifications.

Extra Backfill Select Material Compacted

Payment at the contract price for Extra Backfill Select Material Compacted shall be full compensation for all labour, equipment, plant and materials involved in the cost of locating, obtaining approval, providing a pit or quarry, sampling, clearing, grubbing, producing, loading, hauling, placing of granular backfill to the structure, the granular material at weep hole drains, french drains, perforated subdrain, weeping tile and filter fabric where so indicated on the contract drawings, for compacting the material and all other work required to place, spread and ensure compaction of the material according to the specifications including the payment of royalties.

Extra Backfill Compacted Ordinary Fill

Payment at the contract price for Extra Backfill Compacted Ordinary Fill shall be full compensation for all labour, equipment and material, locating, obtaining approvals, clearing, grubbing, hauling, loading, placing and compacting the fill and all other work necessary to comply with specifications in Item 321 “Street Excavation”.

Over excavation

Payment will not be made for over excavating due either to the Contractor’s method of operation or his negligence. Neither will compensation be provided for the cost of remedial measures required by the Engineer as a result of over excavation by the Contractor.

ITEM 403

CONSTRUCTION SPECIFICATION FOR PILING

403.01 SCOPE OF WORK

The scope of this specification is to cover the supply and driving of piles, sheet piles and associated work, in steel or timber.

403.02 MATERIALS

All materials shall be new and previously unused. The Contractor shall provide Mill Certificates and a Letter of Compliance for all piling and piling related materials used in the project.

.01 Vacant

.02 Steel Sheet Piles and H-Piles

Steel sheet piles and steel H-piles shall comply with the requirements of CSA G40.21 300W or ASTM A328. The straightness tolerance shall be 25mm in 20 metres.

Two copies of the mill certificates, indicating that the steel meets the requirements of the appropriate standards for Sheet and H piles shall be submitted to the Engineer prior to shipment to the job site.

Where mill test certificates originate from a mill outside of Canada or the United States of America the Contractor shall have the information on the mill certificates verified by testing by a Canadian laboratory. The laboratory shall be certified by an organization accredited by the Standards Council of Canada to comply to comply with the requirements of ISO/IEC 17025 for the specific tests or type of tests required by the material standard specified on the mill test certificate. The mill test certificates shall be stamped with the name of the Canadian testing laboratory and appropriate wording stating that the material conforms to the specified material requirements. The stamp shall include the appropriate material specification number, the date (i.e., yyyy-mm-dd), and the signature of an authorized officer of the Canadian testing laboratory.

.03 Steel Tube Piles

Steel tube piles shall be welded or seamless tube piles and shall comply with the requirements of ASTM Specification A252 Grade 2 or Grade 3. If welded they shall be welded by the Electric Arc method in accordance with CSA W59.

The straightness tolerance shall be 25mm in 20 metres.

Two copies of the mill certificates, indicating that the steel meets the requirements of the appropriate shall be submitted to the Engineer prior to shipment to the job site.

Where mill test certificates originate from a mill outside of Canada or the United States of America the Contractor shall have the information on the mill certificates verified by testing by a Canadian laboratory. The laboratory shall be certified by an organization accredited by the Standards Council of Canada to comply to comply with the requirements of ISO/IEC 17025 for the specific tests or type of tests required by the material standard specified on the mill test certificate. The mill test certificates shall be stamped with the name of the Canadian testing laboratory and appropriate wording stating that the material conforms to the specified material requirements. The stamp shall include the appropriate material specification number, the date (i.e., yyyy-mm-dd), and the signature of an authorized officer of the Canadian testing laboratory.

.04 Pile Tips

As per contract specifications.

.05 Concrete and Reinforcement for Steel Tube Piles

Concrete and reinforcement shall be in accordance with Item 404 “Concrete Structures” and Item 405 “Concrete Reinforcement”, respectively.

.06 Storage and Handling

All piles shall be stored and handled in such a manner that damage is prevented and that design strengths will not be affected by deterioration or deformation.

403.03 PILE DRIVING

.01 General Requirements and Restrictions

Piles shall not be driven until other excavation is completed to below cut-off level. Any material forced up between the piles shall be removed to the correct elevation. Any fill material shall be placed to the underside of the footing before driving piles.

Piles shall not be driven within 15m of concrete placed during the preceding seven days.

The Contractor shall not drive piles in such a manner that the piles are subjected to excessive or undue abuse. Forcing piles into their proper position by the use of excessive manipulation is prohibited.

The Contractor’s driving operation shall not cause vibration sufficient to harm the construction or adjacent property.

.02 Tolerances

Piles shall be driven as nearly as possible in the exact position specified on the drawings. After driving, piles at the cut-off elevation shall not be more than 75mm from the location shown on the drawings.

Deviation from the vertical or required batter shall not be more than 20mm per lineal metre of pile. Any pile so out of line or plumb as to impair its usefulness shall be pulled and redriven or an additional pile shall be driven as required by the Engineer. The piles shall not be jacked or pulled laterally to bring their tops into correct location.

.03 Driving Equipment

All piles shall be driven with a hammer developing an energy per blow of not less than that shown in the Contract Document. The energy should be capable of remote regulation to prevent damage to the piles. The piles and hammer shall be held securely in the correct alignment by rigid leads extending down to the lowest point the hammer must reach.

.04 Jetting

Jetting shall not be used unless written permission has been given by the Engineer. Appropriate Special Conditions will be given should jetting be authorized.

.05 Helmets

Pile heads shall be protected by helmets having adequate cushioning material next to the pile head. The helmet shall distribute the blow of the hammer evenly throughout the pile cross-section.

Timber piles shall be prevented from splitting by collars.

.06 Records

The Contractor shall not commence driving piles in the absence of the Engineer.

Blows per 300mm for each 300mm shall be recorded. For the final 300mm, the blows per 25mm shall be recorded.

When driving is interrupted before final penetration is reached, the final record of penetration shall not be taken until, on resumption of driving, a further penetration of 300mm has been obtained.

.07 Redriving

Piles pushed up by driving or loosened by jetting of adjacent piles shall be redriven to comply with the requirements of the contract. Similarly, if a pile(s) is suspected to have hung up on a boulder, the Contractor shall re-drive the pile(s) in question as well as others in the immediate vicinity.

After all piling is complete and all piles are driven to meet project criteria, the contractor shall return to each footing and re-drive at least ten (10) percent of the piles in each footing rounded to the next highest number of piles plus one. The piles selected for redriving shall be randomly selected by the Engineer. If movement exists on one or more piles, additional piles shall be re-driven until the Engineer is satisfied that all piles have met the design criteria as established on the contract drawings or in the specifications.

The contractor is advised that piling shall not be cut-off until all re-driving is complete.

.08 Driving of Tube And H-Piles When Boulders Are Anticipated or Driving to Bedrock

When boulders are anticipated, pile tips should be fitted. Driving shall be carried out until the pile tips make contact with rock. Driving energy shall be decreased to about a quarter and the pile shall be subjected to twenty blows. Energy can be
increased with approval from the Engineer by about a quarter at twenty blows for each interval until the Engineer is satisfied that the requirements of the contract are complied with. Adjacent piles should then be redriven.

When steel tube and H-piles are to be driven to and chipped or socketed into bedrock, rock injector pile tips shall be fitted to the ends of the piles. The piles shall be chipped into the bedrock using low energy. When the piles are firmly seated the energy shall be increased in stages or intervals and eventually driven to refusal at the rated energy as stipulated in the contract documents.

403.04 SPLICES

.01 Vacant

.02 Steel Piles

No splices will be permitted for steel piles except where allowed for in the contract or as authorized by the Engineer in exceptional circumstances. In no event will more than two splices per pile be allowed.

Welding shall meet the requirements of CSA W59 and shall be done by a welder qualified according to CSA W47.1, Division 1 or Division 2.1. Welding details shall be submitted to and approved by the Engineer.

If splices are within 5.0 meters of the pile cut off elevation specified, then they shall be made with complete penetration welds as per the details on the contract plans and all welds shall receive 100% ultrasonic or radiographic inspection.

Pile splices specified as part of the design specifications which are below 5.0 meters from the pile cut off elevation shall be made with complete penetration welds as per the details on the contract plans. All piles shall receive visual Inspection with 20% of the piles rounded to

the next highest number receiving 100% ultrasonic or radiographic inspection. Piles chosen for testing shall be determined by the resident engineer.

The Contractor shall employ an independent testing company with no corporate affiliation to carry out the visual inspection and non-destructive testing of welds. The independent testing company shall be certified by the Canadian Welding Bureau to the requirements of CSA W178.1 for bridge structures by radiographic or ultrasonic test methods. The welding inspector shall have documented evidence of training, professional knowledge, skill and experience in visual inspection of structural steel welds and material, and have a valid certificate showing qualification to a Level II or III according to CSA W178.2.

403.05 CONCRETE FILL IN TUBULAR STEEL PILES

After acceptance by the Engineer, the pile shells including rejected shells left in the ground shall be cut off at the required elevation and shall be filled with concrete.

Prior to filling each pile, the inside shall be inspected with an electric lamp attached to a drop cord of sufficient length to reach the bottom of the pile. Any debris and water shall be removed before placing the concrete.

Reinforcing steel shall be installed in the concrete fill at the top of all the piles as shown on the drawings.

No concrete shall be placed until all driving within a radius of 15m has been completed. If this cannot be done, driving within these limits shall be stopped until the concrete in the last pile has set for at least seven days.

Concrete shall be poured continuously until the shell is filled.

The concrete shall be worked thoroughly down into place and compacted with a vibrator to the lowest extent of the reinforcement.

After placing, the concrete shall be protected from frost for at least three days.

403.06 MEASUREMENT FOR PAYMENT

.01 Sheet Piles

The measurement for sheet piles will be in square metres to the nearest one decimal place, based on the driving lines as shown on the drawings and the length of piling left in place after cut-off as approved by the Engineer.

.02 Piles Other Than Sheet Piles

The measurement for piles other than sheet piles will be in linear metres to the nearest one

decimal place left in place after cut-off and required for the work, all as approved by the Engineer. For piles driven this measurement shall include the pile tip.

.03 Pile Tips and Splices

These will be measured according to the actual number used, authorized and accepted by the Engineer.

.04 Rejection

Any piles or tips which are rejected for reasons of improper driving, positioning or damage shall not be included in the above measurements.

.05 Vertical Piles

All piles shown on the plans vertically or with a batter angle up to and including 10° will be considered as vertical piles.

.06 Battered Piles

All piles shown on the plans with a batter angle exceeding 10° will be considered and paid for as battered piles.

403.07 PAYMENT

.01 Piles Supplied by The Contractor

Payment at the contract price for this item, “Piles Supplied By the Contractor” shall be full compensation for all labour, materials, supplies and equipment required to complete the work associated with the supply of piling, loading and transportation to the jobsite, unloading, handling and storage of piling materials and pile driving equipment plus assembling and subsequent disassembly and removal from the job site of pile driving equipment and piling.

Payment at the contract unit price will be made for the actual quantity of pile driven provided this quantity equals or exceeds the quantity estimated. If the actual quantity driven is less than the quantity estimated, payment will be made for supplying the quantity driven plus the total length of unused piles (that is uncut piles in lengths originally supplied to the Contractor and, if necessary, cut-off piles 3m or longer) but not exceeding the estimated quantity.

The unused piles shall be loaded, transported and off-loaded by the Contractor to a designated area at the Municipal Depot as part of the demobilization item as per section 153 of the Specifications Book. When the Contractor transports the unused piles, he shall present a receipt for the piles, signed by the Depot security to the Engineer.

The quantity of wastage (defined as the quantity supplied to the site less the pay quantity) shall be the Contractor's responsibility and payment will not be made for such. The Engineer

shall determine the quantity of wastage.

.02 Piles Driven

Payment at the contract price for this item shall be full compensation for positioning, driving, cleaning, painting, protecting and cut-off.

The re-driving of piles shall be considered incidental to the work and extra payment will not be made for the same. However, where the contractor succeeds in increasing the length of piling in the works he shall be compensated for the supply and driving in accordance with the contract specifications.

Where pile capacity is established by dynamic analysis and relaxation occurs the Contractor shall have the pile capacity re-evaluated. Piles are defined to have relaxed when more than 125mm average movement occurs in those piles subject to re-driving as defined in Item 403.03.07 above. Dynamic analysis re-evaluation shall be conducted by an agency approved the Engineer. The cost of the dynamic analysis re-evaluation shall be paid for by the City. All other costs including, but not limited to, the cost of delay shall be considered incidental to the tendered price for piles driven. No payment will be made for false work piling.

All costs involved in filling tube piles with concrete and reinforcing shall be included in the contract price for piles driven.

Payment for pile template(s) shall be considered incidental to the work and payment will not be made for such.

.03 Pile Splices

Payment at the contract price shall be full compensation for all labour, equipment, materials and services necessary to supply and install the pile splices where approved.

.04 Pile Tips, Supply and Install

Payment at the contract price, shall be full compensation for all labour, equipment and materials necessary to supply and install the pile tips.

.05 Jetting

No additional payment shall be made for jetting, if authorized.

ITEM 404

CONCRETE STRUCTURES

404.01 SCOPE

The scope of this specification is to cover the supply of materials for concrete structures, production, delivery, placement, sampling and testing of concrete, curing, and the subsequent protection. All work, plant, equipment and materials shall be in strict accordance with CSA A23.1.

The plant from which the ready-mix concrete is supplied shall be certified in accordance with the requirements for certification as published by the Atlantic Concrete Association or equivalent. A copy of the certification of conformance shall be provided to the Engineer prior to the start of delivery under the proposed contract.

A job meeting shall be held prior to the deck concrete placement to discuss all aspects of the concrete work including production, supply, delivery, placing, curing and any other related items. This meeting is to be called by the Engineer; the Contractor and all others deemed necessary by the Engineer shall be in attendance.

404.02 MATERIALS

All concrete materials shall be in accordance with CSA-A23.1.

Cement

All cementing materials shall be in accordance with CAN/CSA-A3000.

Cement for Superstructure, Substructure, MSE Panels and Reinforced Wharf Deck Concrete (with the exception of Pile, Mass and Tremie Concrete) shall be a blended Portland, fly ash or slag, silica fume cement, Type GUb F/SF or GUb S/SF. Contractors are advised that the minimum proportion by mass of the total cementing materials for silica fume shall be 5% and a maximum of 8%. Contractors are advised that the maximum proportion by mass of the total cementing materials for fly ash or slag is 15%. The total mass of SCMs should not exceed 30% of the total weight of Portland cement.

Cement for deck and curb resurfacing in Section 419 “Rehabilitation of Concrete Structures” shall be Type GU unless otherwise specified.

Cement for all other concrete shall be Portland cement Type GU, a portion of which may be replaced by fly ash up to 25%; by mass of the total cementing material.

Aggregate

The source of the aggregate will be determined by the Contractor, but all aggregate shall meet the requirement of CAN/CSA-A23.1-M. The maximum petrographic number will be 135.

Concrete aggregate shall consist of natural sands and gravels, crushed rock or other inert materials having clean, uncoated grains of strong and durable minerals.

Fine and coarse aggregate shall be stored in separate stockpiles sufficiently removed from each other to prevent the materials at the edges of the piles from becoming intermixed.

Aggregate shall be free from alkali, organic matter or other deleterious substances and shall not contain soft, friable, thin, flaky, elongated or laminated particles totaling more than three percent (3%) nor contain shale in excess of one and half percent (1½%), nor silt and crusher dust finer than 75µm sieve size, in excess of two percent (2%). The percentages shall be based on the weight of the combined aggregate as used in the concrete. When all three (3) groups of these deleterious materials are present, the combined amounts shall not exceed five percent (5%) by weight of the combined aggregate.

The maximum size of stone to be used for the different thickness of concrete shall be 20mm unless otherwise ordered by the Engineer. In no case shall the maximum size of stone used be greater than either 2/3 the clear distance between the reinforcement or 2/3 the clear distance between the exterior bars and the face of the structure except for girders where the latter criteria shall be 0.8 times the clear distance between the exterior bars and the face of the structure.

Stockpiles of approved fine and coarse aggregate, in amounts of one quarter to one half of that required for the job, shall be placed on the site of the work at least one month previous to concrete placing operations. The stockpiles shall be protected by tarpaulins or plastic sheeting against formations of ice and accumulation of snow.

The Contractor shall provide with the concrete mix design relevant test data for all aggregate material indicating conformance to the requirements of CSA-A23.1 and this specification. The sources and test results of all aggregate materials shall be clearly identified. The aggregate tests shall be conducted by a testing laboratory CCIL or CSA Certified in accordance with CSA Standard A-283-06 or latest edition. Test results are only considered valid for up to two years in advance of the date of the project mix design submission. The test data required but not be limited to shall include:

- Sieve Analysis of Fine and Coarse aggregate CSA-A23.2-2A
- Amount of Material Finer than 75 µm in Aggregate CSA-A23.2-5A
- Bulk Relative Density and Absorption of Fine and Coarse Aggregate (SSD basis) CSA-A23.2-6A
- Fineness Modulus of Fine Aggregate CSA-A23.2-2A
- Clay Lumps and Light Weight Pieces CSA-A23.2-3A
- Test for Organic Impurities in Fine Aggregate CSA-A23.2-7A
- Flat and Elongated Particles in Coarse Aggregates CSA-A23.2-13A
- Petrographic Analysis of Coarse Aggregate CSA-A23.2-15A
- Resistance to Degradation of Coarse Aggregate by Abrasion and Impact in the Los Angeles machine CSA-A23.2-16A
- Micro-Deval test for Coarse and fine Aggregate CSA-A23.2-23A and 29A
- Soundness of Coarse & Fine Aggregate by Use of Magnesium Sulphate CSA-A23.2-9A
- Test for Detection of Alkali-Aggregate Reactivity (AAR) on Coarse and Fine Aggregate CSAA23.2-25A
- Unconfined Freeze Thaw test CSA-A23.2-24A

Water

All water shall be clear and free from injurious substances and shall be potable.

All water used for curing shall be clean and free of any material which would cause staining or discoloration of the concrete. The contractor shall not use water from shallow, stagnant or marshy sources.

Air Entraining Agent

All concrete shall be air entrained with the air entraining agent conforming to CSA Standard CAN3-A266.1-M.

Admixtures

Any other admixture must be approved by the Engineer and shall conform to CSA Standard CAN3-A266.2-M.

Reinforcement

Reinforcement shall conform to Item 405 “Concrete Reinforcement”.

Formwork and Falsework

Formwork and falsework shall conform to Item 407 “Formwork and Falsework”.

Burlap

Burlap shall conform to AASHO M182 “Specification for Burlap Cloth made from Jute or Kenaf”.

Filter Fabric

Filter fabric shall be a, non-woven geotextile with a minimum mass of 340gm/m^2 and a minimum thickness of 3.3mm; all properties tested in accordance with C.G.S.B. CAN 24.2-M77 test methods.

Filter fabric or non-woven geotextile may be used for curing on flat horizontal surfaces but not on vertical surfaces. Vertical surfaces, i.e. abutments shall be cured using saturated burlap only.

Moisture Barrier

Moisture barrier shall conform to ASTM C171, “Sheeting Materials for Curing Concrete”.

Miscellaneous Materials

The supply and installation of miscellaneous materials shown on the drawings or mentioned in the Supplementary General Conditions, but which have not been listed on the Unit Price

Table, are considered incidental to the work and no separate payment will be made.

This shall include, but not necessarily be limited to, all miscellaneous concrete accessories, confilm evaporation retardant, abutment weep holes, drip grooves and guide rail modified end shoes.

Membrane Curing Compounds

Membrane curing compounds shall meet the requirements of ASTM C309, and shall only be used with the approval of the Engineer.

404.03 EQUIPMENT

The Contractor shall supply the Engineer before commencement of the project with adequate details of all equipment to be used. The intention is not to limit the Contractor's operation but to ensure adequate planning is undertaken.

The contractor shall maintain all equipment used for handling, mixing, transporting, depositing, compacting, curing and finishing the concrete in a clean condition and in proper working order.

Pumping equipment may be utilized by the Contractor. Details of the pumping equipment and operation must be approved by the Engineer. The contractor shall submit to the Engineer, manufacturer's specifications detailing pumping capacity and pressure at the required elevations. Aluminum pipelines shall not be used. The Contractor shall be prepared in the event of a breakdown in pumping operations. These emergency preparations shall be discussed with and approved by the Engineer prior to the commencement of concrete placement utilizing pumping equipment.

Compaction equipment shall be capable of giving dense concrete in accordance with specification requirements. Internal vibrators shall have a frequency of 160 Hz.

An approved self-propelled mechanical bridge deck finisher shall be used to strike off and finish concrete decks as per specifications. The approved machine shall travel on guides or rails supported so that they are completely clear of the finished surface. The guide or rail supports that extend through the roadway areas of the deck shall be such that they can be removed to at least 50mm below the top of concrete. Two (2) work platforms shall be used for finishing and curing operations.

Batching equipment shall be as defined in Section 404.04, "Mixing Concrete".

The equipment required for heating materials for Cold Weather Concreting shall be of adequate capacity and be approved by the Engineer, it shall be available, installed and tested ready for use before it is proposed to place concrete. Heating equipment shall be ready for use between September 1 and April 30 when so required by the Engineer. Alternative methods of keeping concrete temperatures at acceptable levels may be approved. Where the heating equipment is to be used for heating the housing as well as the materials at the same time, the term adequate capacity means that the equipment shall have adequate capacity to heat both materials and housing simultaneously to the required temperature.

Boilers used for heating materials or housing shall meet the inspection requirements and operating conditions laid down by Provincial Acts and Regulations.

404.04 CONCRETE PRODUCTION, DELIVERY AND PLACING

Measurement of Materials

Materials shall be measured by weighing. Other methods shall be used only if specifically, authorized, in writing, by the Engineer.

The apparatus provided for weighing the aggregate shall be suitably designed and constructed for this purpose. Each size of aggregate shall be weighed separately with a required accuracy of two per cent.

Cement in standard bags need not be weighed.

The mixing water **shall be measured** by volume or by weight.

All measuring devices shall be subject to approval of the Engineer.

Concrete Quality

Concrete strength shall be as shown on the drawings unless specifications require higher strength.

Concrete mixes shall be designed in accordance with CSA-A23.1. Note that ACI standard 211.1 should be used as a guide for determining mix proportions for normal and mass concrete. Verification of the following specified properties through trial batching will be a requirement as a prerequisite to approval of the mix design. In addition, test cylinders may be requested by the Engineer prior to approval of the concrete mix design.

Parameters	**45MPa (1,4)**	**40MPa (1,4)**	**35 MPa**	**32 MPa**	**25 MPa**	**20 MPa**
Cement Type	GUb	GUb	GU	GU	GU	GU
Water/Cement Ratio	0.35 max.	0.37 max.	0.39 max.	0.45 max.	0.45 max.	0.55 max.
Slump	As per approved mix design	As per approved mix design	60mm+20mm*	80mm+30mm*	100 ± 30mm*	100 ±30mm*
Rapid Chloride Permeability (ASTM C1202)	<1000 coulombs	<1000 coulombs	N/A	N/A	N/A	N/A
Air Content (3)	5-8%*	5-8%*	5-8%*	5-8%*	4-7%*	4-7%*
Air Void Spacing Factor (Average)	250 µm max.	230 µm max.	230 µm max.	N/A	N/A	N/A
Concrete Use	Superstructures	Substructure	Retaining Walls, Manholes & Catch Basins.	Curb, Gutter and Sidewalk	Pile Concrete	Mass & Tremie Concrete (2)

*****The above specified tolerances apply to concrete mix production and not to concrete mix design.
N/A = Not applicable

Notes: (1) The cementitious material content for 40 and 45 MPa concrete is 480 kg/m^3 maximum.
(2) Tremie concrete shall require additional 10 % cement and slump shall be 180± 30 mm.
(3) Concrete for severe exposure conditions (decks, curbs, end blocks, barriers and grade separation columns) and which contains superplasticizer as an admixture to produce flowable concrete, shall have an air content of 7± 1%.
(4) The above mix design do not include required adjustments for prestressed girder concrete.
(5) For concrete with a water-to-cementing materials ratio of 0.36 or less, the average air void spacing factor shall not exceed 250 µm.

The Contractor will be responsible for the mix design and quality control of concrete production.

The City will review and approve mix designs and provide quality assurance about concrete testing. All concrete mix design proportioning including the mix quality control operations shall be performed by a Laboratory CCIL or CSA Certified in accordance with CSA Standard A-283. All testing shall be as conducted as stated in CAN.CSA-A-23.1 and A23.2 latest edition. The proposed mixture design shall be signed by a Professional Engineer registered to practice in Newfoundland and Labrador. The Professional Engineer shall attest to the validity of the material test data. Proposed mix designs and test results are only considered valid for up to two (2) years in advance of the date of the project mix design submission. The Contractor shall provide with the proposed mix design the following information based on actual trial mixes at least two (2) weeks in advance of concrete placement:

- Slump CSA A23.2-5C
- Air Content of Plastic Concrete by Pressure Method CSA A23.2-4C
- Mass Density and Yield CSA A23.2-6C
- Compressive Strength Testing CSA A23.2.9C
- Air Void Analysis on Hardened Concrete tested at seven (7) days ASTM C457
- Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration tested at fifty-

six (56) days ASTM C1202
- Alkali Reactivity Test Results A23.2-25A

Also to be included with each mix design submission is the following necessary information:

- Project number and title description
- Contractor company name with contact information
- Ready mix supplier
- Certifying laboratory with signing Engineer
- Type of concrete, intended use, approximate quantity and method of placement
- Mix slump and air entraining agent range plus all admixtures with dosage rates
- Aggregate test information as per requirements of 404.02 Aggregates

No concrete shall be placed until approval of the mix design has been obtained from the Engineer. The Contractor shall submit copies of the concrete mix design fourteen (14) days in advance of any concrete placement operation.

Once approved, no adjustments shall be made to the concrete mix design without the approval of the Engineer. If material characteristics change after the original mix design approval a revised mix design shall be submitted for approval.

Acceptance by the Engineer of the Contractor's concrete mix design does not relieve the Contractor of the responsibility for providing concrete which meets the specifications.

High range water reducing agents (superplasticizers) may be used at the Contractor's request, if so indicated when the mix design is submitted. The Contractor must demonstrate competence and experience in their use and specific approval must be obtained. The Contractor shall state his method of concrete placement when submitting his concrete mix design

Where 40 and 45 MPa concrete is specified on the contract drawings, a trial batch consisting of a minimum of $20m^3$ of Superstructure Concrete shall be placed in the Substructure, i.e. abutments and footings, at least twenty-eight (28) days prior to the placement of any 40 or 45 MPa Superstructure Concrete. The purpose of this exercise is to allow for fine tuning of the mix to achieve proper air and slump, and to obtain an early indication of the expected compressive strength. The additional cost of this trial batch and fine tuning of the mix design shall be considered incidental to the works.

If superplasticizers are used, the maximum concrete slump in a superplasticized condition shall be 230 mm. The mix design shall state the design slump before and after the addition of superplasticizers along with the appropriate tolerances. Note that the slump in the above table may not be applicable when using superplasticizers.

Samples for concrete testing quality assurance purposes will normally be taken from concrete as delivered to the site (at the point of discharge from the delivery equipment). However, depending on the method of placement, random sampling of the concrete as incorporated into the structure may also be performed to verity the above specified properties. This process shall entail the sampling of fresh concrete as close to the point of deposit in the structure as is practicable. Coring of the in-place hardened concrete may also

be performed to verity the specified air void system. The Engineer reserves the right to designate the point of acceptance, with prior notice given to the Contractor.

Mixing Concrete

Dry batching will not normally be permitted.
The use of ready-mix concrete is encouraged. Where ready mix concrete is to be used, details of scheduling and procedure must be approved by the Engineer.

The Contractor will be given permission to add cement on site if it is not feasible to have the concrete deposited in the forms within 120 minutes after charging the mixer at the plant. When cement is being added at the site, the total volume of concrete being batched or mixed shall not exceed eighty-five percent (85%) of the manufacturer's rated drum capacity. Cement shall be added in four equal increments with mixing to be carried out after the addition of each portion of cement added. All equipment, materials and procedure must be approved by the Engineer.

The mixing of concrete, unless otherwise authorized by the Engineer, shall be done in a batch mixer of an approved type. The mixer shall be equipped with a suitable charging hopper, water storage and water measuring device. It shall be cleaned at frequent intervals when in use and maintained in such a condition that the mixing will be unimpaired.

The mixing of each batch shall continue not less than one (1) minute after all the materials are in the mixer, during which time the mixer shall rotate at a speed from 14 to 20 revolutions per minute, unless otherwise rated by the manufacturer or directed by the Engineer. The Contractor may mix small quantities of concrete by hand when and as directed by the Engineer.

Concrete transported in a truck mixer, agitator, or other transportation device shall be discharged at the job and placed in its final position in the forms within 120 minutes of the introduction of the mixing water to the cement and aggregate, or the cement to the aggregate, except in hot weather or under other conditions contributing to quick stiffening of the concrete. The maximum volume of mixed concrete transported in an agitator shall be in accordance with the specified rating. Time of charging the truck shall be clearly indicated and excess time in the mixer shall be cause for rejection of a load. Each batch slip shall have the time of batching clearly clock stamped onto each such slip.

Aggregates shall be separated into fine and coarse. The coarse aggregates shall be graded for mass concrete from 40mm to 5mm and for reinforced sections from 20mm to 5mm. The equipment for batching on site shall have the capacity to produce at such a rate as to preclude cold joints in the concrete placement. It shall be capable of being charged to the operating capacity of a 16S mixer with one discharge of the batcher. In any event, the equipment is subject to the approval of the Engineer.

The water and approved admixture(s) shall be proportioned separately by weight or volume (i.e. metering devices(s) to an accuracy of one percent at the mixer). Metering devices which measure the volume of water discharged into the truck shall be in place both at the batch plant and on the truck if water is to be added on site. Alternatively, the water must be manually weighed or measured by volume before being placed into the mixer.

The Contractor shall provide standard certified test weights and/or devices for checking the accuracy of the controls. Checks shall be made just prior to the first concrete placement and at 150m^3 intervals thereafter. If the batching plant is moved, a check shall be made prior to batching any more concrete. The Contractor shall carry out all tests in the presence of the Engineer and shall supply him with results of all tests and make any and all alterations, repairs or replacements required to the equipment before authorization will be given to place concrete.

Placing Concrete

Concrete shall not be placed if the temperature is less than 5ºC or greater than 25ºC without the written permission of the Engineer.

The pumping of concrete from the delivery vehicle to its place of final deposition will be permitted as approved by the Engineer.

Before concrete is placed, forms, reinforcement and placing procedure shall be approved by the Engineer. The contractor shall give twenty-four (24) hours notice (not including Sundays or holidays) of his intention to place concrete.

In preparation for the placing of concrete all sawdust, chips, and other construction debris and extraneous material shall be removed from the interior of the forms. Struts, stays, and braces shall be removed when the concrete placing has reached an elevation rendering their services unnecessary. These temporary members shall be entirely removed from the forms and not buried in the concrete.

Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement. The use of long troughs, chutes and pipes for conveying from the mixer to the forms shall be permitted only on written authority of the Engineer. In case an inferior quality of concrete is produced by the use of such conveyers, the Engineer may order discontinuance of their use and the substitutions of a satisfactory method of placing.

Dewatering will not be permitted during the placing of concrete or for a period of at least twenty-four (24) hours thereafter, unless it is done from a suitable sump separated from the concrete work by a watertight wall or other effective means.

Pumping to unwater a sealed cofferdam shall not commence until the seal has set sufficiently to withstand the hydrostatic pressure.

Concrete shall not be placed with a free fall greater than 1500mm.

When placing operations would involve dropping the concrete more than 1500mm, it shall be deposited through sheet metal or other approved pipes. The pipe shall be kept full of concrete during placing and their lower ends shall be kept buried in the newly placed concrete. After initial set of the concrete the forms shall not be jarred, and no strain shall be placed on the ends of reinforcing bars which project.

Concrete, during and immediately after depositing, shall be thoroughly compacted by mechanical vibration.

The vibration shall be internal, and the intensity of vibration shall visibly affect concrete over a radius of 500mm.

The Contractor shall provide enough vibrators and they shall be manipulated to thoroughly work the concrete around the reinforcement, embedded fixtures and into the corners and angles of the forms.

Vibration shall be applied at the point of deposit and in the area of freshly deposited concrete. The vibrators shall be inserted vertically and withdrawn out of the concrete slowly. The vibration shall be of sufficient duration and intensity to thoroughly compact the concrete, until the air bubbles stop breaking on the surface. Vibration shall not be continued at any one point to the extent that localized areas of grout are formed.

Vibration shall not be used to make concrete flow into place. Application of vibrators shall be at points uniformly spaced and not farther apart than twice the radius over which vibration is visible.

Vibration shall not be applied directly or through the reinforcement to concrete which has hardened. Vibration shall be supplemented by such spading as is necessary to ensure smooth surfaces and dense concrete along form surfaces. Concrete shall be placed in horizontal layers not more than 300mm thick except as hereinafter provided. When less than a complete layer is placed in one operation it shall be terminated in a vertical bulkhead. Each layer shall be placed and compacted before the preceding batch has set to protect green concrete and avoid surfaces of separation. Vibrators shall project into preceding layer to avoid construction joint formation.

When the placing of concrete is temporarily discontinued, the concrete, after becoming firm enough to retain its form, shall be cleaned of laitance and other objectionable material to a sufficient depth to expose sound concrete.

In the construction of box culverts more than 1200mm in height, the concrete in the walls shall be placed and allowed to set before the top slab is placed. In this case, appropriate keys shall be left in the sidewall for anchoring the cover slab.

Concrete for beams and girders shall be deposited uniformly for the full length of the beam (or between vertical construction joints authorized by the Engineer) and brought up evenly in horizontal layers. Efforts shall be made to eliminate segregation as may be evident by flow lines. In this regard, concrete must be deposited in place and thoroughly consolidated rather than be permitted to flow in place.

Concrete in beams and slabs shall be placed in one continuous operation.

Beams, girders and haunches shall be placed monolithically.

During wet weather, concrete must not be placed unless suitable means, approved by the Engineer, have been provided to prevent washing of freshly deposited concrete or marring of the exposed surface.

Depositing Concrete Under Water

Concrete shall not be deposited in water except with the approval of the Engineer and under his immediate supervision.

Concrete deposited in water shall contain ten percent (10%) excess cement prepared with a mix design approved as if concrete was not under water. Slump for tremie concrete shall be 180 ± 30mm. To prevent segregation, it shall be carefully placed in a compact mass, in its final position, by means of a tremie tube or other approved method. Still water shall be maintained at the point of deposit and the forms underwater shall be watertight.

The tremie tube shall have a minimum diameter of 250mm, constructed in sections having flanged couplings fitted with gaskets.

The discharge end shall be closed at the start of the work to prevent water entering. The tremie tube shall be filled to the bottom of the hopper and the flow of concrete shall be induced by slightly raising the discharge end, always keeping it in the deposited concrete. The flow shall be continuous until the work is completed.

No concrete shall be spread at any greater distance than 3 metres from the discharge end of the tremie tube. When large areas are to be covered tremie tubes at maximum 6m centres shall be used and concrete placed simultaneously.

If the tremie operation is unavoidably interrupted below water level, the surface laitance shall be removed by jetting one (1) day after placing and removed by pumping.

Mass Concrete

Mass concrete shall conform to the specifications outlined herein and be placed where indicated on the contract drawings as approved by the Engineer. Where mass concrete exceeds 300mm thickness at any footing edge, the design authority shall be contacted. Mass concrete shall be placed after all unwatering operations have been made effective in maintaining dry and controlled conditions as approved by the Engineer.

Construction Joints

Construction joints in concrete shall be positioned at the location shown on the drawings or where otherwise approved by the Engineer.

The Contractor shall attach the appropriate horizontal and/or vertical strips to the face(s) of the formwork where all construction joints are planned or occur for reasons beyond the Contractor’s control. The concrete shall be worked such that the finished appearance will resemble narrow, neat and straight horizontal and/or vertical line(s) at all construction and cold joints. Forms shall be kept tight throughout the entire concrete placing operation.

At the bottom of curb - top of deck interface along the longitudinal sides of all decks, construction joints shall be neat, straight and properly formed as a 20mm Vee groove and shall be straight and true to line and grade.

Where construction or cold joints are planned or occur for reasons beyond the Contractor’s control, the concrete interface shall be rough, clean and free of laitance, with a full roughness

amplitude of 6mm or more. One exception to this would be at prestress steel box out locations, see Item 406, “Prestressed Concrete Members”.

Prior to butting the new concrete against previously hardened concrete, the joint face shall be cleaned of all debris and dirt.

In addition, the surface film of laitance and mortar shall be removed from the joint face to present a clean sound concrete face that has the aggregate particles exposed.

Contraction Joints

A contraction joint is a control joint to control volume change mainly (shrinkage). Bonding of the new and existing concrete is not required, but provisions to make the joint watertight are necessary.

Joints in concrete members shall be formed in location as shown on the plans.

Contraction joints shall extend to a depth equal to one-quarter of the member thickness. As soon as feasible the joint shall be thoroughly flushed out with compressed air and an approved flexible joint filler compound utilized to fill the joint. The joint filler compound shall be flexible over the extreme temperature conditions in the local area and must be approved by the Engineer.

Concrete Beam Seats and Bearing Surfaces

Concrete beam seats shall be magnesium floated to a level plane varying not more than 2mm from a straight edge placed in any direction across the area. The finished level plane shall not vary more than 3mm from the elevation given by the Engineer in the field.

Concrete surfaces which are used as bearing surfaces are to be finished in accordance with the bearing manufacturer’s recommendations.

Tolerances

All tolerances shall conform to Clause 10 "Tolerances" of CSA Standard CAN/CSA-A23.1-M.

Confilm

Immediately after the straight edge requirements have been met for the deck and curb concrete and the broom finish applied, the fresh concrete shall be coated with an evaporation retardant “Confilm” to preclude rapid evaporation of the bleed water. When all bleed water is gone, the concrete shall be cured as per Item 404.05, “Curing”. The supply and application of “Confilm” is deemed incidental to the placement of the deck concrete and as such, no separate payment will be made by the City.

Caulking of Joints

Caulking shall be applied to all control and expansion joint locations.

The caulking or sealant and the substrate material must have a temperature greater than 5ºC. Under no circumstances should sealant be applied to any surface which contains moisture, condensation or frost. Joint surfaces are to be clean, dry and free of foreign matter before application of primer and sealant.

The work shall be performed by an approved caulking applicator. Otherwise, the Contractor must designate a person for the caulking operation and that person should receive training acceptable to the Manufacturer and Engineer.

The Contractor shall supply a written guarantee of all workmanship and materials for a period of two (2) years following the date of final completion.

Sealant shall be a three component Type 1 - Dymeric (epoxidized polyurethane terpolymer) sealant as manufactured by Tremco (Canada) Limited or an approved equal, selected to most closely match the concrete colour. Primers are to be those specified by Tremco (Canada) Limited, specifically Primer #1 or an approved equal. Joint backing shall be a closed-cell non gaseous backer rod, such as Softrod specified by Tremco (Canada) Limited or an approved equal.

All work shall be in strict accordance with the Manufacturer's recommendations.

Payment shall be considered incidental to the works associated with concrete work pay items.

404.05 CURING

Fog Misting of Bridge Decks

Prior to the commencement of curing operations, a fog mist shall be applied to bridge decks. Misting shall be conducted using a pressure washer capable of sustaining a minimum 14 MPa pressure. A continuous fog mist shall commence immediately behind the screeding operation until concrete has hardened sufficiently to permit covering with burlap or a non-woven geotextile fabric. The fog mist will maintain a high relative humidity above the concrete and prevent surface drying prior to curing operations. Water shall not be allowed to drip, flow or puddle on the concrete surface during fog misting at any time before concrete has reached final set.

Payment

Payment shall be considered incidental to the placement of Concrete in Superstructures.

Moist Curing

Proper curing will be considered fifteen percent (15%) of the associated unit price bid for concrete payment purposes.
Concrete shall be **continuously** kept in a damp moist condition for at least seven (7) days after placing and the temperature of the concrete shall not be less than 10ºC, during this period. If ambient temperatures are at or anticipated to be:

(a) Greater than 25°C, then the provision of Item 404.06, “Hot Weather Concreting”, shall be followed.

(b) Less than 5ºC, then the provision of Item 404.07, “Cold Weather Concreting”, shall be followed.

Curing shall be applied to all surfaces.

Curing shall take place as soon as possible after the finishing operation without damaging the surface.

Concrete in the deck portion of all superstructure concrete, including barriers, approach slabs, expansion joint dams, end blocks, curbs and sidewalks must be cured by means of burlap and water.

All burlap must be pre-soaked by immersing it in water for a period of at least twenty-four (24) hours immediately prior to placing. Two (2) layers of burlap must be applied to the surface of the concrete. Strips must overlap by 150mm and must be held in place without marring the surface of the concrete.

The bridge decks burlap must be applied immediately after finishing of the concrete surface within 2 metres to 4 metres of the pan or screed of the finishing machine.

Curing with burlap and water must be maintained for a minimum period of seven (7) days. The burlap must be maintained in a continuously wet condition throughout the curing period by means of a soaker hose. The burlap must be covered with a layer of moisture vapour barrier within twelve (12) hours of placing the concrete, in a manner which will prevent deformation of the surface of the concrete.

Air flow in the space between the moisture vapour barrier and the burlap must be prevented.

Regardless of ambient temperature, moist curing with burlap and water must be always provided. During cold weather, burlap must be prevented from freezing.

In addition to the burlap and water method as described above certain other concretes may be cured by either:

a) **Continuous Steam Curing**

Continuous steam shall not exceed 80°C and shall follow CSA-A23-4 Precast Concrete-Materials and Construction.

b) **Curing with Filter Fabric and Water**

One (1) layer of filter fabric shall be laid on the surface of the concrete. Sheets or strips of filter fabric shall overlap by a minimum of 150mm and shall be held down, as required, against displacement by wind, etc. The fabric shall be kept wet at all time. Filter fabric shall conform to Section 404.02, “Filter Fabric”. Filter fabric or non-woven geotextile may be used for curing on flat horizontal surfaces but not on vertical surfaces. Vertical surfaces, i.e. abutments shall be cured using two (2) saturated layers of burlap only.

Air Drying

Under normal circumstances curing time required for deck concrete is moist curing for seven (7) days in accordance with this specification and a further thirty (30) days for air drying. Also, the specified design strength must be obtained.

Until the above conditions are satisfied, the application of waterproofing and the opening of the bridge to traffic will not be permitted.

If it is not practical to achieve this, the above curing times may be reduced only at the discretion of the Engineer, but in no case will the application of waterproofing and opening of the bridge to traffic be permitted until seven (7) days of wet curing and an additional seven (7) days of air drying have elapsed.

Plastic Shrinkage

Where excessive shrinkage stresses may occur, e.g., in a large expanse of concrete such as a bridge deck, more than one method of curing may be required.

If shrinkage cracks occur, the Contractor shall grout any cracks and repair by an approved method at his own expense.

All methods and materials employed in concrete curing must be approved by the Engineer.

Liquid Membrane Curing

At the discretion of the Engineer, liquid membrane curing compounds meeting the requirements of Section 404.02, may be used in place of moist curing on pier columns only. Liquid membrane curing shall not be permitted on other areas including bridge decks.

404.06 HOT WEATHER CONCRETING

When the air temperature is at 25ºC or greater or is expected to rise to this limit, according to meteorological forecasts, then special measures shall be taken by the Contractor to protect the concrete. Surface moisture evaporation must not exceed 0.75kg/m^2/hr.

Concrete placed in the forms shall be maintained at or below 27ºC and the Contractor shall obtain from the Engineer approval for his measures to ensure this.

Curing shall be by moisture and except for pier columns as per Section 404.05 “Air Drying”, curing compounds will not be permitted.

404.07 COLD WEATHER CONCRETING

General

When the air temperature is at or below +5ºC or when, according to meteorological forecasts, it is likely to fall below this limit within the next 24 hours, then the Contractor shall take special precautions to protect the concrete placed. The Contractor shall obtain approval from the Engineer for this method of protection.

Under normal circumstances no concrete for the superstructure (or approach slabs) shall be placed between November 1 and April 1.

The following table shall apply for determining degree of protection requested by the Engineer:

PROTECTIVE CLASS	PROTECTIVE MEASURE	OUTSIDE AIR TEMPERATURE FOR LEAST DIMENSION OF SECTION	
		Less than 1m	More than 1m
A	Suitable housing plus supplementary heat or adequate insulation	Below 0ºC	Below -5ºC
B	Suitable covering plus adequate insulation	0ºC to 5ºC	0ºC to -5ºC
C	Normal curing - no temperature protection required	5ºC to 25ºC	5ºC to 20ºC

Any concrete damaged by freezing or by inadequate protection or curing shall be removed and replaced by the Contractor at no cost to the City.

For guidance on adequate insulation, refer to the Canadian Portland Cement Association publication “Design and Control of Concrete Mixtures”, Chapter 11.

Placing

Concrete to be placed during cold weather shall be within the following temperature limits.

LEAST DIMENSION OF SECTION	CONCRETE TEMPERATURE MINIMUM ºC	ºC MAXIMUM
Less than 0.3 metres	10	27
0.3 metres to 1 metres	10	27
1 to 2 metres	10	25
More than 2 metres	5	20

This temperature can be obtained by heating the water or the aggregate or both; water and aggregate shall then be combined in the mixer first and the temperature of the mixture shall not exceed 38°C when the cement is added.

When the air temperature is below 0ºC the water shall be heated to not greater than 66ºC. The aggregates shall be uniformly heated in the stockpiles and/or bins by steam, either injected live or circulated in coils, or by using dry heat before the aggregates are placed in the mixer. Whatever system is used, it shall be designed to give uniform heating that will avoid local overheating which may be injurious to the materials.

No frozen lump of aggregate will be allowed in the concrete mix and shall be discarded before batching.

The use of salt, calcium chloride or other chemicals to lower the freezing point or accelerate the set is prohibited.
The ground, formwork, existing concrete and steel against which concrete is to be placed shall be free from ice and snow before the Engineer will authorize placing to commence. The Contractor shall preheat the area in which the concrete is to be placed, with live steam or moist hot air, this shall also remove snow and ice and heat the contact material to prevent the formation of a cold joint.

Concrete shall not be placed on a frozen subgrade or against frozen ground. The Contractor shall protect excavations prepared for footings, etc., with covers prior to opening for placing concrete.

The concrete shall be placed rapidly and evenly, as near to its final position as possible to reduce the risk of segregation, flow lines and cold joints.

The concrete shall be covered, as quickly as possible after placing.

Surface moisture evaporation must be kept below 0.75kg/m^2/h. Concrete surfaces shall be protected by housing. Protective housing must be wind and weather tight and constructed of suitable materials on a substantial framework. The framework must be such as to keep the housing at all points 300mm from the concrete and forms. The housing must have suitable openings to let the concrete be placed and these openings shall be so designed that they may be fully covered and closed as soon as the concrete is placed. The use of “roll back” sheeting or tarpaulins supported on stools is permitted on horizontal surfaces, such as a bridge deck provided the concrete is covered progressively as soon as placed. The housing must be so constructed as to allow a uniform circulation of heat to all parts of the work. This shall include the underside of the bridge deck and beams unless the Engineer has authorized the protection of these areas by fully insulated formwork.

When mineral fiber is used as insulation, a layer of polyethylene having a minimum thickness of 6 mils shall be placed between the surface of the concrete or formwork and the insulation. This insulation is to be always protected from moisture.

Protecting Placed Concrete

For concrete to be placed between September 1 and April 30, the Contractor shall supply a steam jenny, fully operational and fully capable of adequately protecting all concrete to be placed, when specifically requested by the Engineer.

Heating the Protective Housing

The contractor shall have available, tested and approved, adequate equipment for the heating of the protective housing. Heating will be used to establish and maintain the required curing conditions.

For decks and curbs, sidewalks, parapet walks, the Contractor shall on the day prior to placing concrete, conduct a trial run to verify his equipment, methods and workmanship meet the specifications.

Live wet steam shall be used for heating unless other methods are permitted in writing by the Engineer. Hot air blowers and the like may be used to supplement the steam heating if fine water or steam spray into the stream of hot air is provided. The humidity as measured by a wet and dry bulb thermometer shall at no time be less than ninety-five percent (95%) and the air temperature shall be not less than 13ºC.

The use of salamanders, coke stoves, oil or gas burners and similar spot heaters which have an open flame and intense local heat are prohibited. In the event of any fire of the formwork or housing, the Engineer must be immediately notified.

The system of heating and positioning of steam outlets to give the most uniform distribution possible of the heat is subject to the approval of the Engineer. The Contractor shall make suitable arrangements to stoke boilers outside normal working hours where required. A breakdown in heating is regarded as very serious especially in the early life of the concrete.

The concrete must be cured in a moist condition and its temperature shall be at least 10ºC for seven days after the day of placing.

Protection shall be withdrawn in such a manner as not to introduce thermal shock stresses in the concrete.

The temperature of the concrete shall be gradually reduced at a rate not exceeding 17ºC per day to that of the surrounding air. To achieve this in a heated housing, the heat shall be slowly reduced and then shut off and the whole housing allowed to cool to within 12ºC of the air temperature before the housing itself for the formwork is removed. Where work is to proceed within the same housing on the next stage of the work, the formwork may be removed as soon as the prescribed curing period is over. With fully insulated formwork, the forms themselves may be slackened and some insulation removed if needed. The forms themselves shall not be removed until the temperature of the concrete has fallen to within 12ºC of the outside air temperature.

404.08 SURFACE FINISHING

General

All concrete surfaces that will be visible on completion of the work shall conform to surface

finish Class 2, except for the deck, curbs and/or sidewalks which shall be Class 6 finish.

The Contractor shall take special care during the planning, forming, concrete placing, curing and stripping phases to ensure defect-free surfaces. Should remedial measures be required, they shall be carried out by personnel expert in this aspect of concrete work. The surfaces shall be uniform in colour and texture when viewed from 15 metres and shall be attained as follows.

Class 2 Rubbed Finish

Immediately following the removal of forms, all fins and irregular projections shall be removed from all surfaces except from those which are not to be exposed or are not to be waterproofed. On all surfaces, the cavities produced by form ties and all other holes, honeycombs spots, broken corners or edges and other defects shall be cut back to sound concrete and thoroughly cleaned. No feather edging is permissible. If reinforcing steel is exposed, concrete shall be cut back for at least 50mm around the reinforcement.

After having been kept saturated with water for a period of not less than three hours, the cavities shall be carefully pointed and trued with a mortar of cement and fine aggregate mixed in the proportions used in the grade of the concrete being finished. Mortar used in pointing shall not be more than one hour old. The mortar patches shall be cured as specified under Item 404.05 “Concrete Curing”. No mortar shall be placed when the air temperature is forecasted to fall below 5ºC within twenty-four (24) hours. All construction and expansion joints in the completed work shall be left carefully tooled and free of all mortar and concrete. The joint filler shall be left exposed for its full length with clean and true edges. The resulting surfaces shall be true and uniform.

After removal of forms, the rubbing of concrete shall be started as soon as its condition will permit. However, before starting this work the concrete shall be kept thoroughly saturated with water for a minimum period of three hours but sufficient time shall have elapsed before the wetting down to allow the mortar used in the pointing of rod holes and defects to thoroughly set. Surfaces to be finished shall be rubbed with a medium coarse carborundum stone, using a small amount of mortar on its face.

The mortar shall be composed of extra cement and fine sand mixed in proportions such as to match existing concrete verified by a test patch. Rubbing shall be continued until all form marks, projections and irregularities have been removed, all voids filled, and a uniform surface has been obtained. The paste produced by this rubbing shall be left in place at this time.

After all concrete above the surface being treated has been cast, the final finish shall be obtained by rubbing with a fine carborundum stone and water. This rubbing shall be continued until the entire surface is of a smooth texture and uniform colour. After the final rubbing is completed and the surface has dried, it shall be rubbed with burlap to remove loose powder and shall be left free from all unsound patches, paste, powder and objectionable marks.

Class 6 Floated Surface Finish

The provision of an approved self-propelled Bridge Deck Finishing Machine capable of striking off and providing the required surface finish is mandatory for all structures not covered by fill.

For new bridge decks and rehabilitated bridge decks where the total deck length is greater than 15 metres, the deck shall be finished with a GOMACO 450 bridge deck finishing machine with a vibrating screed and movable work bridge or approved equal.

For (a) decks less than 15.0 metres in length, (b) thin overlay strips wider than 2.0 metres and (c) wharf decks, finishing shall be achieved with a Razorback 12HD Air Operated Vibrating Allen Screed or approved equal.

All finishing equipment shall be utilized as outlined above, shall be equipped and operated in accordance with the manufacturer's literature for the particular concrete and work being performed.

For thin overlays less than 2.0 metres wide, spotty or patchy deck repairs and corners of decks, a hand float finish is adequate.

A dry run of the finishing machine covering the entire area requiring finishing shall be made to ensure the design deck thickness and profiles will be attained. The run shall be completed at least twenty –four (24) hours prior to commencing the deck concrete placement.

The finishing machine must be accompanied by a working platform with two (2) qualified cement finishers always assigned to the platform. The Contractor shall submit letters to the Engineer for his approval stating the qualifications of the finisher. The Contractor shall supply enough double railing to support the finishing machine equal to the overall length of the deck. This will enable the Engineer to check the adjustment of the railing and the finishing machine prior to any concrete being placed.

Proper allowance shall be made for camber of pre-stressed channels or girders. Concrete placement shall be at a rate to provide satisfactory progress with the finishing machine or the cement finisher.

After the deck surface has been floated and any bleed water evaporated, but while the concrete is still plastic, the Contractor shall furnish and use a 3m straight edge swung from handles half the width of the slab.

The straight edge shall be held in successive positions parallel to the road centre line and in contact with the surface and the whole area gone over from one side of the slab to the other as necessary. Advancement along the deck shall be in successive stages of not more than one-half the length of the straight edge. Any depressions found shall be immediately filled with freshly mixed concrete, stuck off, consolidated and refinished. The straight edge testing and refloating shall continue until the entire surface is found to be free from observable departures from the straight edge and the slab has the required grade and contour, until there are no deviations of more than 8mm under the 3 metres straight edge.

The concrete deck surface shall be given a broom finish when the concrete has hardened sufficiently. Exposed concrete bridge decks shall be given a coarse broom finish. Treated or waterproofed bridge decks shall be given a fine broom finish. The broom shall be of an

approved type. The strikes shall be square across the slab, from edge to edge, with adjacent strokes slightly overlapped and shall be made by drawing the broom without tearing the concrete but so as to produce regular corrugations not over 3mm in depth for the coarse broom finish. The fine broom finish shall have corrugations not exceeding 1mm in depth. The surface as thus finished shall be free from porous spots, irregularities, depressions and small pockets or rough spots such as may be caused by accidental disturbance during the final brooming of particles of coarse aggregate embedded near the surface. The Engineer may decide to delete the broom finish requirements, but tolerances previously stated will still apply.

404.09 SAMPLING AND TESTING

Normal field quality control testing will be carried out by the Engineer in accordance with current City requirements. These will normally be in accordance with CSA-A23.2 “Methods of Test for Concrete”.

Normal quality control tests carried out by the City shall conform to the following requirements.

SUPERSTRUCTURE

Air & Slump Tests	Each load until satisfactory control is established. Then test every second load thereafter.
Strength & Temperature Tests	At least one set of lab cylinders per 100 cubic meters, minimum one (1) set per day plus one (1) set of field cures per category of concrete. A set is defined as three cylinders.

SUBSTRUCTURE, REINFORCED WHARF DECK CONCRETE, PILE, CURB, GUTTER, SIDEWALK, MANHOLES, CATCH BASINS, MASS AND TREMIE CONCRETE

Air Slump Tests	Each load until satisfactory control is established. Then test every third (3rd) load thereafter.
Strength & Temperature Tests	At least one set of lab cylinders per 100 cubic meters, minimum one set per day per category of concrete. Field cures generally only required

A category of concrete shall be defined as concrete pertaining to one specific design strength, e.g., 35MPa concrete**.**

Satisfactory control is considered to have been established when tests on five (5) consecutive truck loads or batches of concrete are within specification requirements. If either

the measured slump, air content or temperature fall outside the limits specified, a repeat test shall be made. Failure to meet the contract requirements shall result in rejection of the concrete.

Additional strength tests will be required when early indications of strength are required such as before prestressing, girder transport, removal of falsework, backfilling structure, etc.
The Contractor shall co-operate fully with the Engineer in enabling quality control and quality assurance tests to be carried out. Samples for quality testing purposes will normally be taken from concrete as delivered to the site (at the point of discharge from the delivery equipment). However, depending on the method of placement, random sampling of the concrete as incorporated into the structure shall also be performed to verify the above specified properties. This process shall entail the sampling of fresh concrete as close to the point of deposit in the structure as is practicable. Coring of the in-place hardened concrete may also be performed to verify the specified air void system. The City reserves the right to designate the point of acceptance, with prior notice given to the Contractor.

Acceptance of the concrete will depend on the results and consistency of all of the above test's results being satisfactory.

404.10 MEASUREMENT FOR PAYMENT

Measurement for Payment for concrete work where the Unit Price Table states the unit to be cubic metres

For those concrete work contract items, except mass and tremie concrete, where the unit of measurement on the Unit Price Table is stated as m^3, then measurement for payment will be by the volume of concrete placed, measured in cubic metres rounded to two decimal places, based on the neat lines called for in the plans.

Measurement for payment purposes for mass concrete shall be based upon cross sections measured in cubic metres to the nearest one decimal place. Prior to concrete placing and forming operations, the Engineer shall establish the lateral and vertical limits for mass concrete.

Measurement for payment purposes for tremie concrete shall be made based upon the number of cubic metres of batched concrete rounded to the nearest one decimal place and incorporated into the works as approved by the Engineer. Every precaution must be taken to prevent waste of concrete, i.e. carelessness resulting in escape of concrete from within the confines of the forms or inaccuracy in placing. In the event of such occurrence(s) an estimate of the wastage will be made by the Engineer and an appropriate deduction from the batch quantity will be made. All additional concrete required to be placed above the estimated quantity, must be approved by the Engineer.

No deductions will be made from the volume of concrete for:

(1) Volume of reinforcement, prestressing steel or prestressing ducts.

(2) Inserts of cross-sectional area of less than $0.1m^2$. When it is specified that concrete is to be placed against undisturbed soil or set in rock, and where the excavation is

made wider than the neat lines of the footings, the excess amount of concrete will not be measured for payment quantities.

Where the concrete footings are placed lower than that authorized by the Engineer, any excess amount of concrete will not be measured for payment quantities.

Unless otherwise defined by the Contract Documents, the following will be the definitions for the structure and Unit Price Table:

Substructure concrete shall be that concrete used for slope paving, footings, abutments, backwall, bearing seats and pedestals, wingwalls and piers. Wingwall concrete shall be all concrete behind the back face of the abutment, i.e. including the cleat excluding curb (superstructure) concrete.

Where integral curbs and wingwalls exist, a horizontal surface at the bottom of the curb including the beveled portion thereof if any, and horizontal surface at the top of the vertical portion of the wingwall shall constitute the dividing line between substructure and superstructure concrete.

Retaining wall concrete shall be all concrete used in retaining walls and footings which are not cast integrally with the abutments.

Superstructure concrete will be all concrete used in beams, columns, sidewalks, barriers, expansion joint dams and diaphragms, decks, haunches, curbs, end blocks, including those curbs and end blocks integral with the wing walls.

All concrete in rigid frames used in deck, curbs, barriers, sidewalks, end blocks, vertical or inclined legs and wing walls shall be classified as superstructure concrete.

All concrete for rigid frame footings shall be classified as substructure concrete. All approach slab concrete shall be classified as superstructure concrete.

Not included are AASHTO or CPCI girders, double tees, and any other superstructure work paid for separately.

Not more than ninety percent (90%) of the units will be certified until such time as the surface finish meets the specifications and is completed to the satisfaction of the Engineer.

Measurement for Payment for concrete work where the Unit Price Table states the unit to be a unit other than cubic metres

For those concrete work contract items where the unit of measurement on the Unit Price Table is stated in some unit other than m^3, then the measurement for payment shall be in accordance with that stated in the appropriate specification for the item.

Not more than ninety percent (90%) of the units will be certified until such time as the surface finish meets the specifications and is completed to the satisfaction of the Engineer.

404.11 PAYMENT

Payment for concrete work where the Unit Price Table states the unit to be cubic metres

For those concrete work items where the unit of measurement in the Unit Price Table is stated as m^3;, then payment at the contract price shall be full compensation for all materials, labour, equipment, plant and services necessary to complete the concrete work as outlined herein. This applies to "Concrete in Substructures", "Concrete in Retaining Walls", "Concrete in Superstructures", "Reinforced Wharf Deck Concrete", "Concrete in Rigid Frames", "Concrete in Approach Slabs", "Mass Concrete" and "Tremie Concrete".

No separate payment will be made for:

(a) Supply of cement, aggregates and other materials, plant and equipment-use required for producing the concrete.

(b) Mix design, production, mixing, transportation, placing, consolidation, curing and quality control during production.

(c) Formwork and falsework.

(d) Precautions to be taken for hot weather.

(e) Precautions to be taken for cold weather.

(f) Provisions of shipping crates for concrete test specimens.

No payment shall be made for any concrete required for normal testing procedures.

Where excessive camber in girders is permitted by the Engineer, the extra concrete due to the camber in excess of the specifications will not be paid for.

Concrete not placed in accordance with the provisions of Item 404.07, "Cold Weather Concreting", when the appropriate weather conditions prevail will not be paid for unless and until it can be established to the satisfaction of the Engineer that there has been no harmful effect to the concrete. The onus for establishing this will belong to the Contractor.

Basis of Payment for concrete work where the Unit Price Table states the unit to be a unit other than cubic metres

For those concrete work contract items where the unit of measurement in the Unit Price Table is stated in some unit other than m^3, then the basis of payment shall be in accordance with that stated in the appropriate specification for the item.

Concrete not placed in accordance with the provisions of Item 404.07 "Cold Weather Concreting", when the appropriate weather conditions prevail will not be paid for unless and until it can be established for the satisfaction of the Engineer that there has been no harmful effect to the concrete. The onus for establishing this will belong to the Contractor.

Concrete Acceptance and Reduced Payment Criteria on Concrete Located in New Structures

Concrete on a project of a certain class, as defined by its specified strength at twenty-eight (28) days, must have an average tested strength at twenty-eight (28) days equal or greater than specified for payment at the bid price.

Concrete of a certain class having an average strength of less than that specified will be accepted into the job at a reduced payment, provided the difference between specified strength and tested strength is not greater than 5MPa. If the average of tests in a particular predefined portion of concrete is less than that specified by more then 5MPa that concrete shall be rejected.

When concrete is rejected, those provisions outlined in CSA-A23.1 shall be followed to determine whether the concrete may remain in the work. Such work will be done at the Contractors cost. Notwithstanding the above, should the concrete remain in the work it will be subject to a reduction, as outlined below, for having a strength less than that specified.

Concrete of a specific class and otherwise acceptable but having an average strength deficiency as tested of less than 5MPa compared with that specified, will be accepted but the bid price of all concrete in the predefined portion will be reduced according to the following procedure:

For concrete work where the Unit Price Table states the unit to be in cubic metres, the adjusted concrete price shall be calculated as follows:

$(Adjusted Concrete Unit Price) = Tested Strength / Specified Strength * $(Bid Concrete Unit Price).

Division of the structure into predefined portions will be done by the Engineer when the concrete placement sequence is outlined by the Contractor at the pre-job meeting. A predefined portion shall generally be established as that concrete placed within one operation.

There will be no bonus payment under the contract when the average strength is in excess of the specified strength.

Concrete Acceptance and Reduced Payment Criteria on Concrete Located in Rehabilitated Structures

Concrete on a rehabilitation project in a certain repair class, as defined by its specified strength at twenty-eight (28) days, must have an average tested strength at twenty-eight (28) days equal to or greater than that specified for payment at the bid price.

Concrete of a certain repair class having an average strength of less than that specified will be accepted into the job at a reduced payment, provided the difference between specified strength and tested strength is no greater the 5MPa. If the average of tests in a particular predefined portion of concrete is less than that specified by more than 5MPa then that concrete shall be rejected.

When concrete is rejected, those provisions outlined in CSA-A23.1 shall be followed to determine whether or not the concrete may remain in the work. Such work will be done at the Contractors cost. Notwithstanding the above, should the concrete remain in the work it will be subject to a reduction, as outlined below, for having a strength less than that specified.

Concrete of a specific class of repair and otherwise acceptable but having an average strength deficiency as tested of less than 5MPa compared with that specified, will be accepted but the bid price for **all concrete** in the predefined portion will be reduced according to the following procedure:

For concrete work where the Unit Price Table states the unit to be square metres or cubic metres the adjusted price shall be calculated as follows:

$(Adjusted Concrete Price) = (Tested Strength/Specified Strength) x ($(Unit Bid Price)

Division of the structure into predefined portions will be done by the Engineer when the concrete placement sequence is outlined by the Contractor at the pre-job meeting. A predefined portion shall generally be established as that concrete placed within one operation.

There will be no bonus payment under the contract when the average strength is in excess of the specified strength.

ITEM 405

CONCRETE REINFORCEMENT

405.01 SCOPE OF WORK

The scope of this section is to cover the supply, material, fabrication and placement of all reinforcing steel in concrete structures.

405.02 MATERIAL

The Contractor shall supply all the reinforcing steel to be incorporated in the work.

All reinforcing steel supplied shall be new and previously unused billet deformed bars having a yield point of 400 MPa and shall conform to CSA-A23.1 and CSA G30.18.

Where the contractor utilizes concrete blocks to support the reinforcing steel, the quality of the concrete blocks shall conform to Item 404 “Concrete Structures” and be of a quality similar to that being used in the member. The Contractor shall supply test results to verify the same.

Reinforcing accessories such as supports for reinforcing steel shall be continuous, plastic coated or stainless-steel chairs. Richmond BB bolster shall be utilized for the lower mat steel support and Richmond BBY beam bolster shall be utilized for the upper mat steel support. Equivalent types of reinforcing steel supports may be approved by the Engineer. Reinforcing accessories such as chairs shall be corrosion resistant within 25mm of all exposed surfaces.

Reinforcing steel shall be free of excessive rust and any reinforcing steel reduced in cross section area due to rust shall be rejected.

405.03 FABRICATION, TRANSPORT AND STORAGE

All properties including laps, splices, hooks and bends in reinforcement, etc. shall be as per CSA-S6; Design of Highway Bridges.

The Contractor shall submit six copies of a detailed reinforcing steel bar schedule to the Engineer. The schedule shall show all dimensions and bending diagrams for all the reinforcing steel in accordance with AC1315 Manual of Standard Practice for Detailing Reinforced Concrete structures. The Contractor retains responsibility for correctly detailing reinforcement, but the schedule must be approved for conformity with the design. Fabrication of reinforcing steel should not proceed until approval of the schedule has been obtained.

The Contractor shall transport the reinforcing steel to the site and shall store it on racks or

platforms with adequate identification.

All dirt, grease or other foreign materials shall be removed from the steel prior to the placement.

405.04 PLACING OF REINFORCING STEEL

Field bending shall not be carried out unless authorized by the Engineer and heat shall not be used for this purpose. Any bends developing cracks or splits shall be rejected.

No welding shall be carried out unless specifically authorized by the Engineer and if authorized it shall be carried out in accordance with CSA-W186, Welding of Reinforcing Bars.

Substitutions of different size bars must have the approval of the Engineer. Splicing at locations other than those specified on the drawings must be approved by the Engineer. All Contractor's requests for splices other than those detailed on the contract drawings will be at the Contractor's expense.

Reinforcing steel shall be supported and firmly held in the required positions at all times. Only approved supports, chairs and ties of strong, durable and non-corrodible material shall be used.

Stainless steel, plastic, or corrosion resistant chairs, concrete blocks or other devices may be used if they satisfy the above requirements.

If reinforcement is in position for a considerable time prior to concrete being placed, then the reinforcing steel shall be reinspected and where necessary cleaned.

Bursting and spalling reinforcement shall be placed at nominal cover.

All reinforcement to be placed at nominal cover as per CSA-S6 unless otherwise stated on the contract drawings.

405.05 MEASUREMENT FOR PAYMENT

.01 Measurement for Payment for Reinforcing Steel Used in those Contract Items where the Unit of Measurement is Stated in Tonnes

For those contract items where the unit of measurement in the Unit Price Table is stated in tonnes, then the total length of reinforcing steel used in the construction will be measured for payment. The payment of quantity shall be determined by multiplying the lengths of reinforcing bars actually placed in the structure by its weight per metre according to the following table:

Bar Designation	Mass Weight kg/m
10M	0.785
15M	1.570
20M	2.355
25M	3.925
30M	5.495
35M	7.850

The total value will be converted to tonnes, calculated to three decimal places. Where substitution has occurred the theoretical value will apply. Only that steel required by the contract drawing will be measured.

No allowance will be made for clips, wire, chairs or other material used to fasten or support reinforcing steel in place. Measurement for payment purposes shall not be made for diaphragm inserts.

That reinforcing placed in AASHTO or CCPI girders and double tees shall not be included in the measurement for payment. Payment for this steel will be included with supply of prestressed girders.

Measurement for payment purposes will not be made for lap lengths if the bars are less than 15 metres long unless the lap is specifically indicated on the contract drawings or it is not physically possible to use the 15 metre lengths.

.02 Measurement for Payment for Reinforcing Steel Used in Conjunction with those Contract Items where Reinforcement is Considered Incidental to the Work

Where reinforcement is considered incidental to the work, no reinforcing steel will be measured for payment purposes. Items where reinforcing steel is considered incidental are catch basins, manholes, toe walls, headwalls for culverts not greater than 1,500mm diameter, footings for stairs, encasements for pipes not greater than 600mm diameter, collars for pipes or other items as defined in the contract.

Where reinforced concrete is specified, no separate payment will be made for reinforcing steel.

405.06 PAYMENT

Payment at the contract price per tonne for " Reinforcing Steel except in Prestressed Girders" shall be full compensation for supplying all materials at the work site, for storing, protecting and cleaning the reinforcing steel as required, for bending, cutting and welding the reinforcing steel, for placing the reinforcing steel in the work, for supporting the reinforcing steel during the placing, compacting and setting of concrete and for such other work as may be required to complete the supply and placing of reinforcing steel.

The supply of reinforcing steel at the work site properly stored and protected and in proper condition for incorporation into the work shall be deemed for progress payment purposes to constitute 75 percent of the work to be carried out under the item "Reinforcing Steel Except in Prestressed Girders”.

ITEM 406

PRESTRESSED CONCRETE MEMBERS

406.01 SCOPE OF WORK

The Contractor shall furnish all labour, materials, equipment, plant and services specified, indicated or required to manufacture, transport, store and install the prestressed concrete and/or prestressed steel components in accordance with the plans and specifications.

406.02 GENERAL

Post-tensioning in general, post-tensioning materials, grouting, preparations for post-tensioning, application and measurement of prestressing force shall conform with CSA Standard CAN/CSA-A23.1-M09. Cast in place concrete or optionally precast at the site is normally covered by CSA Standard CAN/CSA-A23.1-M09. Precast concrete and pre-tensioning operations should conform to CSA Standard CAN3-A23.4-M latest edition.

Welding will not be permitted within 3.0 metres of any tendon without adequate protection of the prestressing steel from welding sparks. Under no circumstances shall prestressing steel be used to ground welding equipment.

.01 Approvals and Casting

The Contractor shall clearly indicate in his bid his intention with regard to casting the prestressed concrete members on site or at an approved plant. Prior to construction, the Contractor shall submit to the Engineer for approval the name of the plant from which it is intended to order the members. Only members supplied from an approved plant will be accepted.

.02 Prestressing Method

The method of prestressing to be used shall be either pre-tensioning or post-tensioning as detailed on the drawings unless otherwise approved.

Prior to casting any concrete to be prestressed, the Contractor shall submit to the Engineer for approval six complete sets of metric drawings and one set of metric design calculations. These details shall outline the method and sequence of stressing and shall include complete specifications and details of the prestressing steel and anchoring devices, eg. anchorage block out dimensions and angles, anchoring stresses, elongation calculations, type of enclosures, and all other data pertaining to the prestressing steel in the members, pressure grouting materials and equipment, size and spacing of diaphragm and end block reinforcement, where applicable.

The prestress supplier shall determine through design or experience the prestress anchorage bearing plate/casting as well as the spiral steel directly behind and adjacent to

the same.

.03 Inspection and Testing

At all times the Engineer shall have the right to inspect and approve all methods, plants and materials involved. This shall include the right to momentarily stop jacking in order to measure the elongation and jacking pressure from initial to final load on as many cables as deemed appropriate by the Engineer.

.04 Member Top Flanges

Members whose top flanges become the bottom form for the deck slab shall have the flange designated to safely accommodate all temporary construction loads.

.05 Falsework

Sound, adjustable falsework in accordance with Item 407 “Formwork & Falsework”, shall be required to compensate for any settlement such that the structure, particularly the soffit, is constructed true to line and grade. The prestressed concrete is not self-supporting until stressing, anchoring and proper curing have been carried out. Except as noted on the contract drawings or outlined in the specifications, falsework may be removed only after these operations have been completed. The prestressing ducts, strands and anchorages must be accurately and rigidly fixed in position before any concrete is placed.

406.03 MATERIALS

.01 Concrete

All concrete work shall conform to the requirements of Item 404 "Concrete Structures", unless otherwise stated herein.

The minimum ultimate compressive strength of the concrete shall be as shown on the plans and the time of tensioning shall be verified by the Engineer from the results of the field cured test cylinders.

Care must be taken to ensure that the test cylinders are compacted and cured under conditions similar to the conditions acting on the concrete in place. At least three specimens shall be tested from each batch prior to tensioning the cables and at least three specimens at 28 days.

No concrete shall be deposited in the forms until the placing of reinforcing steel, enclosures, anchorages and prestressing steel has been inspected and approved by the Engineer.

An inspection and testing company may be appointed by the Engineer to inspect and control quality of materials. If so, separate payment will be arranged for by the Engineer. The Contractor shall provide, without charge, all materials required for test purposes and give all necessary co-operation.

.02 Prestressing Steel

All prestressing steel shall be protected against damage, rust and other corrosion and shall be free of all dirt, oil, grease and other deleterious substances when finally grouted in the deck. Splicing of prestressing steel bars only shall be permitted to manufacturers' specifications. Splicing of strands or wires is not permitted.

All prestressing steel from each manufactured reel of wire, strand or mill heat or bar to be shipped to the site, shall be assigned an individual lot number and shall be tagged in such a manner that each such lot can be accurately identified at the job site. All unidentified prestressing steel received at the site will be rejected.

The Contractor shall furnish one sample, 1500mm long from each manufactured reel of wire, strand or mill heat of bar prestressing steel for testing purposes. The Engineer will select the samples of prestressing steel from the job site and all materials for testing shall be furnished by the Contractor at his own expense.

The Contractor shall have no claim for additional compensation in the event his work is delayed awaiting approval of the materials.

The approval of any material by the Engineer shall not preclude subsequent rejection if the material is damaged in transit or later damaged or found to be defective. Storage of the material on site shall be in accordance with Prestressing steel shall be high tensile strength 7-wire strand or bar as shown on the contract drawings, fabricated, sampled and tested in accordance with the requirements of ASTMA 416/A 416M-02 and ASTMA421/A 421M-02 and to the satisfaction of the Engineer. Longer term storage of prestress steel and components, i.e. storage over the winter, shall be in accordance with ASTMA 416/A 416M-02 and ASTMA 421/A 421M-02 and the environment shall not be wet, humid or subject to the accumulation of moisture.

Two (2) copies of the mill certificate and two copies of the stress-strain curves representative of the actual lots to be used shall be submitted to the Engineer with samples.

Prestressing steel shall be high tensile strength 7-wire strand or bar as shown on the contract drawings, fabricated, sampled and tested in accordance with the requirements of ASTM A 416/A 416M-02 and ASTM A 421/A 421M-02.

Tendons shall consist of parallel wires or strands composed of the required number of high tensile, cold-drawn, stress relieved steel or low-relaxation (stabilized) strands. Positive end anchorage shall be provided on each end of the tendon after threading through the terminal hardware. The tendon shall be enclosed in mortar-tight flexible metal conduit.

The pre-assembled connection between the conduit and the end bearing assemblies shall be adequate to ensure a mortar tight enclosure from terminal to terminal. The anchor shall provide for grout passage into the tendon. The supplier of the tendons shall furnish grout fittings for attachment to the terminal hardware.

High tensile strength steel shall be from steel made by the open hearth, electric furnace or

basic oxygen process to produce the desired high tensile strength. Strand shall have a nominal diameter of 15.24mm, minimum ultimate tensile strength of 260.6 kN and a nominal end area of 140.0 mm² per strand, or as otherwise indicated on the contract drawings.

Steel grade shall be 1860 MPa unless otherwise specified on the contract drawings.

Oil tempered steel shall not be employed for use in prestressed concrete construction.

The complete stress-strain curve for the steel shall be obtained for each heat or lot of steel used in the entire project and shall be used as data for stressing of the steel of that particular heat or lot. Care shall be taken that the steel so defined is correctly identified.

The Contractor shall furnish one entire tendon complete with anchorages, one complete coupling device and all hardware for testing and evaluation purposes, if so indicated in the Contract Documents. If the tendon and/or associated hardware has not been previously used in Newfoundland, the Engineer may request a sample for evaluation and testing purposes. Any components which in the opinion of the Engineer, fall below the quality of the sample provided shall not be used in the works.

.03 Ducts

Ducts for prestressing steel shall be made of approved bright metal rigid or semi-rigid corrugated steel tubing with mechanical joint connections of the diameter as shown on the drawings. Rigid ducts shall have a minimum wall thickness of 0.60 mm and be capable of being bent to a minimum inside radius of 9 metres without distress. Semi-rigid ducts shall have a minimum wall thickness of 0.25mm and be capable of being bent to a minimum inside radius of 3.5 metres without distress. The wobble friction coefficient (k) shall not exceed 0.0023 per metre and 0.0033 per metre for rigid and semi-rigid ducts respectively. The curvature friction coefficient (μ) shall not exceed 0.20 for both duct types. Rigid ducts shall be used for longitudinal tendons and semi-rigid ducts used for transverse tendons unless otherwise specified in the contract documents.

Ducts shall be watertight and of sufficient strength to withstand all forces imposed upon them during placing of concrete without denting, sagging or leaking. All ducts and anchorage assemblies shall be provided with any necessary air vents and pipes for the injection of grout after prestressing. Grouting ducts and vents shall be located at all high points and at both ends of all longitudinal tendons. For transverse tendons, grouting ducts and venting shall be located at both ends of all tendons and at all high points when the vertical distance between the lowest and highest point in the duct exceeds 400mm.

.04 Anchorage Assemblies

The anchorages shall be of an approved type as indicated on the contract drawings for the size of tendons shown on the drawings complete with all required spiral reinforcement.

Anchoring hardware shall meet the minimum requirements set forth in CAN/CSA-A23.1-M09. Moreover, the anchorage components, i.e. the bearing plate, wedges, anchor head and/or casting to develop at least 100% of the ultimate tendon capacity, but the prestressing steel

as anchored is permitted to fail at 95% of the ultimate tendon capacity.

All reinforcement, duck work, cones and/or anchorages shall be fastened firmly so that no movement can occur when concrete is placed. Anchorages shall be held tight to the end forms so that no laitance can leak down the face of the cone or bearing plates. Enclosures shall be protected against the entrance of foreign matter prior to grouting particularly in cold weather.

The anchorages shall be placed in the position shown on the contract drawings. The axis of the anchorage must coincide with the axis of the cable passing through it. Details of end anchorages i.e. block out dimensions and angles shall be determined by the prestress supplier in coordination with the Engineer.

.05 Round Void Forms

When required the type of round void form used shall be in accordance with the following table:

Outside Diameter of Void	Type of Round Void Form
Over 930mm	1.2mm corrugated metal pipe
630mm to 930mm	1.0mm corrugated metal pipe
Under 630mm	1.0mm corrugated metal pipe or sonovoid tubes, Type D, 100% Duroboard or approved equal.

Metal void forms shall have outside diameter (top of corrugation to top of corrugation) equal to the diameter of the voids shown on the drawings.

Void tubes made of fibrous material shall be protected against damage during storage and handling and shall be always protected from moisture and water. Adequate ventilation shall be provided to prevent damage due to humidity. The void tubes shall not be stored on the site for more than seven days before installation.

The void tubes shall be designed to withstand the forces imposed on them during concreting and until the concrete has set up, without deformation such as bulging, sagging or collapse.

Damaged tubes shall not be used.

All void tubes must be accurately placed and rigidly fixed in position before any concrete is placed. The Contractor shall pay particular attention to the buoyancy of the voids and adequate measures shall be taken to counteract the same. No concrete shall be placed until the installation of the tubes has been inspected and approved by the Engineer.

406.04 DIMENSIONAL TOLERANCES

The following dimensional tolerances will be allowed:

Length	= ± 10mm
Cross Section	= ± 3mm from each dim. (not cumulative)
Alignment	= ± 3mm max. in any 3m length
Camber Differential between adjacent prestressed members	= 20mm max.

In addition, camber in the prestressed members immediately after stressing or de-tensioning shall not vary more than 50% of the calculated value. Camber due to member dead load only, at the time of placing the deck slab, shall not be more than 20mm greater than the initial camber.

Deck slab surface under full dead load shall be to the grades indicated on the drawings. The deck slab thickness shall be constant between the top flanges of adjacent members. In order to meet these criteria, the Contractor shall haunch the deck slab over the member or protrude the member a maximum of 20mm into the deck slab or both, as indicated on the drawings.

For prestressed slab superstructures the deck slab surface and soffit shall be to the grades indicated on the drawings immediately after stressing, unless otherwise indicated in the contract documents.

406.05 PLACING CONCRETE, STRESSING AND GROUTING TENDONS

The minimum concrete strength at stressing shall be 30 MPa unless otherwise specified on the contract drawings.

.01 Placing

Concrete must not be deposited in the forms until the Engineer has inspected the placing of the reinforcement, ducts, anchorages, prestressing steel and has given his approval thereof.

Bar reinforcing steel and prestressing steel shall be placed accurately at the locations shown on the drawings or approved by the Engineer. The distance from the forms shall be maintained by plastic bar chairs, spacers, hangers or hold-down devices. Within a 5.0 metre longitudinal distance from support locations i.e. piers and abutments, a tolerane of ± 6mm will be permitted in the placing of prestressing ducts. At all locations a tolerance of ± 12mm will be permitted.

Post-tensioning ducts must be held securely at intervals of 500mm or less against vertical or

horizontal displacement from true alignment during the placing of concrete.

Holes shall be provided for anchor dowels and for diaphragm dowels which pass through the member; openings for connection rods, recesses for grout and holes for railing bolts in the members shall be provided in accordance with the details shown on the drawings.

Where diaphragm dowels do not pass through the member, the dowels shall be anchored in the member by embedment in the concrete or by means of approved threaded inserts.

Where openings for diaphragm dowels are provided, these dowels shall be grouted in place after the installation of the member in the structure.

Where continuous prestressed concrete slab type construction is required, the deck shall be cast in one continuous concrete placing operation commencing at the lower end of the structure.

The concrete must be vibrated internally or externally or both as required to consolidate the concrete. The vibrating shall be done with care and in such a manner that reinforcing steel ducts and prestressing steel will not be displaced. Vibrators shall operate at a minimum frequency of 160 Hz for the internal type and 60 Hz for the external type.

The contractor shall pay particular attention to concrete placing details, external vibration shall be used when casting CPCI girders.

All curing methods shall be subject to the Engineer's approval. Curing shall be in accordance with Item 404.05.

.02 Prestressing Technician

The Contractor shall provide at his own expense a technician familiar with the type of prestressing involved, approved by the Engineer, to supervise all prestressing work. This technician shall be present at the completion of the steel installation and just prior to concreting operations, at stressing and grouting operations.

The prestressing supplier shall formally certify in writing that the stressing technician being employed on the works has sufficient knowledge and experience to undertake and successfully complete the prestressing, grouting and associated work.

.03 Stressing

All prestressing steel shall be stressed by means of hydraulic jacks which shall be equipped with accurately calibrated hydraulic pressure gauges, damped from vibration, with a dial not less than 150mm in diameter, to permit the stress to be computed at any time. A certified calibration curve shall accompany each jack, showing the relationship between gauge readings and stress in the ram for both ascending and descending movements of the ram. In general, monostrand jacks shall not be used for stressing multi-strand tendons unless specifically approved by the Designer. A monostrand jack shall be present on site during stressing operations. No stressing will be permitted without the presence of a monostrand

jack on site.

A load cell attached to the jack will be accepted, as an alternative to the above, as a means of obtaining the force in the tendon provided the accuracy of the load cell is attested to by an authority acceptable to the Engineer.

The stressing operation shall be conducted in a manner recommended by the manufacturer of prestressing material and only in the presence of the Engineer or designated representative.

The supervisor in charge of the tensioning shall be provided with the required extension of the tendons and the jack pressure. The extension shall be carried out at an even rate, jack pressure and extension shall coincide with the required extension and pressure at the time of anchoring, due allowance being made for anchorage slippage at both ends of the tendons. The permissible variation in specified prestress shall not be more than 95% to 100% of the theoretical jacking force or pressure for both longitudinal and transverse tendons. Moreover, the permissible variation in specified elongation shall not be more than $\pm$ 5% of the theoretical elongation for longitudinal tendons. For transverse tendons the permissible variation in specified elongation shall not be more than $\pm$ 5% of the theoretical elongation or $\pm$ 10mm whichever is greater.

The stress in the tendons shall be measured by means of the extension of the tendons and shall be continuously checked by means of the pressure gauge on the jack. The accuracy of the jack pressure gauge shall be checked periodically. The zero error in the jack pressure shall be determined by plotting a few straight pressure readings against jack extension and extending the straight line back to determine the zero intercept.

The stressing shall be carried out as shown on the contract drawings. The tensioning shall not be commenced until the tests on the concrete cylinders, manufactured and cured under the same conditions as the prestressed member, indicate that the concrete of the member has attained the required compressive strength as shown on the contract drawings.

After the concrete is placed, no tensioning will be permitted until it is demonstrated, to the satisfaction of the Engineer, that the prestressing steel is free and unbonded in the enclosure.

Any tendon in which the accuracy of the extension is doubted shall be destressed and restressed in the presence of the Engineer.

Records of elongation, calibrated jack force readings and slippages shall be kept by the Engineer. Until such approval is obtained in writing, no tendons shall be grouted.

The prestressed steel shall be anchored at a stress that will result in the ultimate retention of working forces of stresses of not less than those shown on the plans, but in no case shall the steel be tensioned above 80% of the ultimate strength. Losses in stress due to creep, plastic flow, elastic flow and shrinkage of concrete plus creep of steel and sequence stressing, shall be computed in accordance with CSA-S6-06 latest edition.

Prestressed strands which have been stressed and meet project criteria shall be cut off with

a saw; a torch is not acceptable. The Contractor shall leave 25-50mm of strand protruding beyond the visible end of the wedge.

.04 Bonding and Grouting

The Contractor shall sandblast all concrete surfaces in anchorage boxout areas and fill the boxout with concrete of a quality similar to that used in the member. For anchorages without the tendon end cap, anchorage recesses or boxouts are to be sandblasted and filled with concrete before grouting operations commence.

Post-tensioned prestressing steel shall be bonded to the concrete by pressure grouting the ducts or openings. All stressing shall be complete before grouting begins. All areas around post-tensioned cables, strands, tendons or rods shall be completely filled with high early strength non-shrink grout.

The grouting procedure shall be approved by the Engineer.

Generally this work shall be done as soon as the prestressing steel has been stressed and approved and in no case shall any prestressing steel be left ungrouted for more than seven days after prestressing.

In the case of post-tensioned slabs which contain both longitudinal and transverse pre-stressing steel the maximum time permitted between the beginning of the stressing sequence and the grouting of the last cable shall not exceed two weeks.

Stressing and grouting sequences of longitudinal and transverse tendons shall be as outlined in the contract documents. The maximum time permitted between the beginning of stressing and grouting of the last cable shall not exceed two weeks.

All ducts or openings shall be clean and free of all foreign materials that would impair bonding of the grout. Each duct or opening shall be thoroughly blown out with compressed air immediately prior to grouting. Where it is found necessary, in the opinion of the Engineer, the duct or opening shall be flushed out with water, prior to the use of compressed air. Steam shall not be used for cleaning out. The concrete shall have a temperature of at least 5°C at the time of grouting and shall be maintained at this temperature or higher for a period of at least 48 hours. If necessary, this may include preheating the structure and maintaining protection for a period of three days after the grout is placed. The temperature of the grout at the time of injection shall be not less than 16° C not more that 27°C.

All grouts used for grouting of post-tensioning cables shall be pre-packaged products and intended for that purpose. The grout shall be mixed and placed as per the manufacturer's instructions and under the supervision of the Engineer.

Grout shall have a maximum water cement ratio of not more than 0.36, not contain any trace amounts of chlorides, contain at least 6% silica fume by weight, contain an approved superplasticizer and an approved expansive agent. Masterflow 816 Cable and Anchor grout manufactured by BASF and In-Pakt PT Grout manufactured by KING are two grouts which meet the above criteria. Approved equivalent grouts as determined by the Engineer may

also be utilized.

The compressive strength of the grout shall be at least 40MPa in four (4) days. Strength tests shall be performed on 50mm cubes, stored and tested in accordance with ASTM- C109.

The Contractor shall be responsible for all mix design and quality control of grout production and placing. Quality control and assurance of the grout from a testing viewpoint shall be provided by the Engineer.

When allowed to stand for 15 minutes, the grout shall not bleed or segregate. At the time of initial set, the grout shall exhibit an expansion of 8% (plus or minus 2%) of its original volume.

Grouting equipment shall be capable of grouting to a pressure of 1.5 MPa with a 19mm minimum inside diameter grout hose, maximum pressure 1.7 MPa.

Alternatively, the grouting equipment shall be specifically designed for the job and approved by the Engineer.

Grout shall be mixed in an approved mechanical mixer, that provides for straining and reagitating the grout before it is used. Time between mixing and pumping the grout shall not exceed 40 minutes.

Retempering the grout is prohibited.

The grout shall completely fill the duct or opening and shall be allowed to flow continuously and freely for 5 seconds at the outlet end of the duct or opening. In case the continuity of grouting is interrupted, the duct or opening shall be immediately cleaned out. A dependable high pressure air and water supply shall be on hand during grouting.

After grout has set, all exposed vents and hoses, in finished concrete surfaces are to be removed 50mm from the finished surface. The resulting void or cavity must have all debris removed and be thoroughly cleaned. The void or cavity should be filled with SET 45, manufactured by Master Builders or an approved equal. The Contractor shall follow the Manufacturer’s recommendations and specifications in the mixing and placing of SET 45.

406.06 HANDLING AND INSTALLATION OF PRESTRESSED MEMBERS

At least seven days before starting work, the Engineer shall be fully informed as to the method of handling, installation and the amount and kind of equipment proposed for use. The Contractor shall comply with the provisions of the Highway Traffic Act and make all necessary arrangements with the authorities for permission to transport.

The Contractor shall exercise extreme care in handling, storing, moving and erecting precast prestressed concrete members to avoid twisting, racking or other distortion that would result in cracking or damage to the members. The Contractor shall handle, transport and erect precast prestressed members in an upright position and keep the points of support during lifting, storing, transportation and erection within 600mm of the points of support in the final

structure. The Contractor must not allow the reactions of the lifting devices to be inclined to the vertical at an angle greater than thirty degrees. Holes provided for lifting shall be filled with mortar when members have been placed.

The Contractor must decide upon the method by which he plans to lift the prestressed girders and submit design calculations signed and stamped by a Professional Engineer licensed to practice in the Province of Newfoundland.

The Contractor is responsible for the stability of the prestressed girders during placing and until the diaphragms are in place regardless of the loading conditions.

Prestressed concrete girders shall not be moved or transported until the grout has attained 30 MPa. Falsework shall not be removed from continuous prestressed concrete structures until the grout has attained 30 MPa. Loads in addition to member self-weight shall not be placed on the prestressed concrete members until the grout has attained 30 MPa. Grout samples shall be taken, field cured and tested to establish the appropriate time to move or transport girders, remove falsework or apply loads to prestressed concrete structures. Grout samples shall also be obtained and tested for acceptance purposes.

406.07 MEASUREMENT FOR PAYMENT

.01 Prestressed Concrete Members

The quantity of prestressed members supplied and erected for which payment shall be made shall be the total number of members required as shown on the plans.

01.01 Supply of Prestressing Steel and Accessories

Prestressing tendons including anchorage will be measured as a lump sum for the total number required by the contract. Payment for the Supply of Prestressing Steel and Accessories will not be made where the prestress steel and/or components are held in longer term storage, i.e. over the winter.

.02 Prestressed Concrete in Post-Tensioned Slab Superstructures

02.01 Concrete

Measurement for payment will be by cubic metre of concrete placed based on neat lines shown on the plans. No deductions will be made from the volume of concrete for reinforcing or prestressing steel, anchorages or inserts. Deductions for any design voids will be made. The quantity shall include the volume of concrete in curbs, sidewalks, medians, parapets, including those on the wingwalls or as otherwise shown on the plans.

02.02 Supply of Prestressing Steel and Accessories

The quantity of prestressing tendons including anchorages for which payment shall be made shall be the total number of tendons required as shown on the plans. This will be considered

as a lump sum and includes both transverse and longitudinal tendons as indicated on the contract drawings.

02.03 Concrete Surface Finish

Measurement for payment for surface finish shall be in accordance with Item 404 "Concrete Structures".

406.08 PAYMENT

.01 Prestressed Concrete-Members and Post-Tensioned Slabs

Payment at the contract price shall be full compensation for all materials, labour, equipment, plant and services necessary to complete the prestressed concrete work in accordance with the plans and as described herein. In particular, no separate payment will be made for:

a) Supply of cement, aggregates and other materials plant or equipment for producing the concrete.

b) Supply and placement of grout.

c) Formwork and falsework.

d) Supply and installation of void tubes including all drain tubes, air vents, bracing, non-corrosive chair supports, splices and end closures.

e) Sandblasting the construction joints.

f) Supply and apply approved bonding adhesive.

g) Supply and installation of reinforcing steel except that in post-tensioned slabs.

h) Transporting and storing prestressed concrete members.

i) Any post-construction jacking of the superstructure.

Payment for post-tensioned slab concrete will be under Item 404 "Concrete Structures".

Payment for prestressed concrete members, such as AASHTO or CPCI Girders and double tees, will be under “Prestressed Girders” (a) supplied, (b) installed as appropriate.

.02 Supply of Prestressing Steel and Accessories

Payment at the contract unit price for "Supply of Prestressing Steel and Accessories" shall be full compensation for all materials, labour, services, plant and equipment necessary for the supply, delivery, installation and stressing of the tendons including all anchorages, bursting and spalling or end block steel and grouting as required in accordance with the

contract drawings and this specification.

For post-tensioned slab structures the materials, fabrication and placing cost of bursting and spalling or end block steel shall be paid Item 405 “Concrete Reinforcement”.

.03 Concrete Surface Finish

Payment for concrete surface finish shall be in accordance with Item 404 "Concrete Structures".

.04 Rejection

Excessive honeycombing, distortion, warping, cracking, improper grouting or other evidence of inferior workmanship or failure to meet the requirements of these specifications shall be cause for rejection of any member.

Minor surface cavities or irregularities which are satisfactorily repaired shall not constitute cause for rejection. Repairs shall not be made until the Engineer has inspected the extent of the irregularities and has determined whether or not the concrete will be rejected.

Final acceptance of members will not be made until they have been installed in the structure. Members that have been tentatively accepted at the manufacturing plant but are damaged in transit shall be replaced by the Contractor at his own expense.

Erection by a non-approved method may be cause for rejection.

ITEM 407

FORMWORK AND FALSEWORK

407.01 SCOPE OF WORK

The scope of this section is to cover the design and construction of formwork and falsework used in connection with the work.

Falsework is defined as structural supports, load carrying members and the necessary bracing required for the support of temporary loads during construction.

Formwork is defined as the mould into which concrete is placed.

Other definitions are as per CSA S269.1, Falsework for Construction Purposes.

407.02 SUBMISSION OF SHOP DRAWINGS

The Contractor shall prepare and submit to the Engineer for approval copies of detailed shop drawings and calculations for all falsework in the project. Falsework drawings shall be signed and sealed by a Professional Engineer licensed in the Province of Newfoundland and Labrador.

Six (6) copies of drawings will be required and four (4) weeks will be required for approval. No falsework shall be placed prior to the design being approved by the Engineer.

Approval of these drawings will be for conformance with the design and shall not relieve the Contractor of any responsibility for the safe design and installation of the falsework.

Shop drawings for formwork shall be submitted if required by the Engineer.

Falsework drawings shall indicate:

1) Design to be in accordance with "Limit States" principles.

2) Longitudinal, lateral and vertical, dead, live and impact loads used in design. Horizontal loads shall be designed for clause 5.2.2 of CSA S269.1; specifically, the greater part (a)(i) or (a) (ii), plus (b) plus (c).

   Fresh concrete shall normally be taken as a dead load with a minimum load factor equal to 1.25 unless unusual conditions require a higher value.

3) Bearing capacity of soil beneath mudsill and falsework support reactions

4) Deflections

5) Grade of steel or concrete size and shape

6) Species, grading, size of timber

7) Connection details

8) Type and weight of equipment to be supported

9) Sequence, method and rate of concrete placement

10) For prestress concrete slab type structures, the falsework submission shall have a side falsework design provided, the effects of the same shall be considered in the exterior leg load and load on exterior stringers.

11) Any propriety equipment (with specification).

For prestressed concrete decks, the Contractor must submit deck falsework drawings including mudsills, side and end falsework for approval. He shall obtain approved drawings before the construction of deck superstructure falsework is permitted. Submission of these drawings will not necessarily exclude the requirement to provide falsework drawings for other structural components.

The Contractor shall supply, erect and maintain standard guide rail as per drawing 10-602-01 at all traffic openings in the falsework. The Contractor shall place additional posts at mid-span. The minimum length of installation before and after the opening is at least five and one standard lengths respectively. Guide rail shall be continuous from beginning to end with the minimum installed length at least 34 metres per installed section. The supply and installation of guide rail shall conform to item 602 “Guide Rail”.

407.03 DESIGN

.01 General

All falsework and formwork shall be designed to give the necessary rigidity and to support loads without appreciable settlement or deformation.

.02 Stresses

All falsework to be designed to CSA S269.1, Falsework for Construction Purposes.

All timber design shall be in accordance with CSA 086.1 Engineering Design in Wood.

Where structural steel or concrete is used, the design shall be in accordance with CSA-S6.

Any scaffolding, fabricated shoring or patented accessories shall be used in accordance with manufacturers' recommendations.

.03 Loadings and Deflections

Normal concrete shall be considered as a liquid of mass 2400 kg/m³ with an additional construction loading of 2.4 kPa.

Horizontal loadings shall take into account environmental factors, the rate of placing, the temperature of the concrete, the effect and type of vibration and impact.

Deflection shall be limited to span/360 but final tolerances for concrete members shall also be conformed with.

407.04 MATERIALS

Wood used in forms and falsework shall comply with CSA 086.1 and shall be sound wood and free of strength reducing defects.

Steel shall meet the requirements of CSA G40.21 and be in good condition.

Other materials may be used as long as manufacturers' recommendations are strictly complied with and their suitability can be confirmed by previous satisfactory use elsewhere.

Void tubes made of fibrous material shall be protected from damage and water attack at all times.

Materials rejected shall be removed from the job site immediately, as directed by the Engineer.

407.05 FORMWORK CONSTRUCTION

For concrete pours above 3.0 metres in height or if so requested by the Engineer, Shop Drawings of form work shall be provided. Form Work drawings shall be signed and sealed by a Professional Engineer licenced in the Province of Newfoundland and Labrador.

Form Work Shop drawings shall account for the following:

1. Design to be in accordance with limit state principles;

2. Pour pressures exerted by the liquid head of concrete;

3. Sequence method and rate of concrete placement;

4. Species and grade of timber;

5. Concrete admixtures and dosage rates (i.e. placticizers and set retarders).

Forms shall be smooth, clean, free from warps, splits, holes, bulges and shall be constructed

and maintained mortar tight. Plywood shall be used on all exposed faces.

Non-staining form release oil shall be applied to the faces of forms prior to reinforcement placement.

For buried, non-exposed surfaces formwork ties, tie wire, bolts and rods shall have no metal within 25mm of the exposed concrete surface after form removal. The 25 mm cover shall be provided by means of plastic cones adjacent to the exposed concrete surface. In no case will the cutting back of metal ties or tie wire be permitted after the concrete has cured. In no case will the use of tubing be permitted to allow the recovery of ties. Cavities left as a result of ties shall be filled with a cement mortar and the surface left sound, smooth, even and uniform in color.

Fibreglass ties shall be used on the exposed surfaces.

On concrete Jersey barriers where form liner has been attached to one side, a tapered rod system may be utilized. The void remaining after the tapered rod has been removed from the concrete shall be filled with grout.

The grout and grouting procedure must be consistent throughout the project and be approved by the Engineer. The grout shall blend in with the finished concrete surface and the finished appearance shall be uniform.

All exposed corners on concrete work shall be chamfered 25mm.

Stay-in-place forms shall be used only when detailed in the contract or if approved by the Engineer.

Void tubes shall be accurately and rigidly fixed in position and carefully restrained from flotation.

Studs and joints shall be at centres not exceeding 400mm. Edges of abutting sheets shall be nailed to the same stud or joint with 50mm nails at centres not exceeding 200mm. Jointing shall be regular and flush.

Supply and Installation of Form Liner

Where indicated in contract documents the Contractor shall supply and install a form liner. The form liner pattern shall be as identified in the Contract drawings.

The material type may be SPS or ABS plastic depending upon how the Contractor schedules the work, as approved by the Engineer and anticipated future requirements.

The form liner shall be approximately 610 mm high and be located such that approximately 140 mm of untextured concrete barrier wall surface is located above and below the form liner. The horizontal distance from the end of the barrier to the beginning of the form liner shall be 150 mm. The 150 mm dimension shall also be applied at expansion joint locations.

The Contractor shall verify lines, levels and centres before proceeding with the formwork and ensure that dimensions agree with drawings. The form liner shall be strictly installed in accordance with the Manufacturer's application guide to achieve design requirements. The Contractor shall arrange and assemble formwork to permit dismantling and stripping. No damage is permitted to concrete surfaces during stripping. The form release agent shall be applied on the liner in accordance with the Manufacturer's recommendation. The form release agent shall be applied prior to placing reinforcing steel, anchoring devices and embedded items. The forms are to be loosened carefully. The Contractor shall not wedge pry bars, hammers, or tools against concrete surfaces scheduled for exposure to view.

The Contractor shall plan ahead for details such as: concrete mix design, concrete placing practices, attaching liners and sealing the joints, tie selection and tie-hole treatment, reinforcing positioning, release agents and stripping in addition to cleaning and storage of form liners and forms.

The Contractor shall use one concrete supplier, one source of aggregates and cement. An elephant trunk shall be used to prevent spattered concrete if the form is not completely filled in the first concrete operation. Falling concrete shall not be permitted to cause abrasion to the form liner. The rate of concrete placing shall not exceed the allowable pressure on the form liner.

The Contractor is reminded to use adequate vibration to avoid lift lines and reduce bugholes. Extra vibration is needed when using plastic liners because they have two or three times as much surface area as flat form panels. Vibrators shall be inserted vertically, penetrating at least 150 mm into the previous lift. Vibrators shall not touch the liner surfaces.

The Contractor shall consider temperature effects when cutting and installing liner materials. Form liner should not be exposed to direct sun in order to reduce buckling effects.

The Contractor shall give close attention to tight-fitting tie holes, reinforcing bar supports and spacers. Bar supports should be co-ordinated with the repeat pattern of the liner.

Cover shall be measured from the deepest indentation in the concrete surface to the nearest face of the bar.

Release agents and form liners shall be checked for compatibility before use.

Form liner stripping shall be recommended by the Manufacturer and approved by the Engineer. Stripping shall be kept uniform throughout the entire job.

Form liners shall be clean and should be stored in shaded or covered areas.

Construction practice and materials must be consistent throughout the entire concrete placing operation where form liners are utilized.

Measurement for Payment

Measurement for Payment shall be in square metres rounded to the nearest one (1) decimal

place. Measurement for payment shall be surface length treated or covered with form liner times the nominal height of 0.610 metres. Deductions will not be made for trimming the form liner in order to conform to the ends of the barrier wall, but deductions will be made for the length not treated with form liner such as at expansion joint locations.

Basis of Payment

The basis of payment shall be full compensation for all plant, labour, materials and equipment to supply, transport to the job site and install and remove form liner as described above.

407.06 FALSEWORK CONSTRUCTION

The Contractor shall build sound adjustable falsework to enable a structure true to line and grade to be built.

Foundation material shall either be piled or mudsills depending on bearing capacity. Mudsills shall be of minimum dimension 235mm x 89mm.

Care shall be taken to prevent reduction of bearing capacity due to environmental, construction or any other reasons.

Should, despite every precaution, reduction of bearing capacity occur, the Contractor shall take appropriate measures to eliminate subsidence or collapse.

All shoring shall conform to CSA S269.1.

All wood posts shall be of solid material, free from splits, warps, chips and any other defects that will impair strength. Splicing will not normally be permitted. Bracing material shall be at least 38mm x 89mm lumber and a minimum of two 100mm nails will be required for connecting bracing to posts.

407.07 REMOVAL OF FORMWORK AND FALSEWORK

All formwork and falsework shall be removed from the job unless specified otherwise.

If authorized by the Engineer, piles used for falsework may be cut off to 1.2m below finished grade or ground level or to 0.6m below stream bed.

Method and sequence of removal of formwork and falsework shall be subject to the approval of the Engineer and shall be such that it will permit the concrete to take up the stresses gradually.

The Engineer's approval shall be obtained prior to removal of any formwork or falsework. Timing for formwork and falsework removal will be determined by strength and curing requirements.

The minimum time required before the removal of formwork and falsework excluding those days when the temperature is below + 5°C, shall be 24 hours for girders and 48 hours for all other concrete provided all stipulations with regard to casting and curing have been and continue to be complied with in both the letter and intent of Item 404 for Curing and Cold Weather Concrete. Concrete directly exposed to moving freshwater will require a minimum 7 days and 70 percent of the 28 day design strength prior to formwork removal. Concrete directly exposed to seawater will require a minimum 14 days and 70 percent of the 28 day design strength prior to formwork removal.

The Contractor will also be required to comply with Item 406.06 “Handling and Installation of Prestressed Members”.

The wingwalls are to remain propped during construction until backfill has been placed and compacted.

407.08 HANDRAIL END BLOCK RECESSES

The City shall supply two (2) 800 x 450 x 19 plywood panels, C/W numerals attached at the Municipal Depot.

The Contractor shall install the panels on diagonally opposite handrail end blocks, as directed by the Engineer.

The Contractor shall supply and install two (2) 800 x 450 x 19 plywood panels without numerals on the remaining two (2) handrail end blocks.

The panels shall be secured to the formwork and when removed, surface finishing shall be as per Specification Book.
Installation of plywood panels supplied by the City and supply and installation of the plywood panels by the Contractor shall be considered incidental to the work and no separate payment shall be made.

407.09 PAYMENT

All costs for formwork and falsework shall be included in the contract price for the appropriate concrete or other appropriate item in the Schedule of Quantities. No separate payment shall be made for formwork and falsework.

ITEM 408

DOWELS

408.01 SCOPE OF WORK

The scope of this section is to cover the supply, material, fabrication and placement of dowels in substructure and superstructure where drilling and grouting of rock or existing structure is required.

408.02 MATERIAL

The Contractor shall supply all the reinforcing steel used as dowels and dowel pins to be incorporated in the work. All reinforcing steel for dowels shall be in accordance with Item 405 “Concrete Reinforcement”.

408.03 FABRICATION, TRANSPORTATION AND STORAGE

All steel shall be fabricated to sizes and shapes as shown on the drawings.

The Contractor shall transport the reinforcing steel and dowel pins to the site and shall store in an accessible place where identification checking can take place prior to placement.

All dirt, grease or other foreign materials shall be removed from the steel prior to placement.

408.04 PLACEMENT

Diaphragm dowels shall be placed in locations as shown on the contract drawings.

Where dowels are to be placed in rock, holes shall be drilled to the required depth and size. Hole diameter shall be two times the nominal diameter of the dowel. Each hole shall be cleaned out, grouted and the dowel set in place. The grout shall be a low slump, expansive type neat grout with a minimum compressive strength of 25 MPa in 28 days.

If the hole contains water, the contractor shall remove the water otherwise a tremie procedure approved by the Engineer shall be used to completely fill the hole with grout. The dowel shall be forced into the hole after the grout has been placed and while it is still fresh.

Where dowels are to be grouted into structures or structural components, all the holes may be drilled before any grouting is done if approved by the Engineer. Hole diameter shall be two times the nominal diameter of the dowel. The holes shall be flushed out, saturated with water and blown out with oil free compressed air immediately before the grout is injected.

The grout shall be a low slump, expansive type neat grout with a minimum compressive strength of 30 MPa in 28 days.

408.05 MEASUREMENT FOR PAYMENT

The quantity of dowels for which payment shall be made shall be the total number of dowels in the (a) substructure and the (b) superstructure which require drilling and grouting as shown on the drawings.

408.06 PAYMENT

Payment at the contract unit price for dowels in the substructure and the superstructure shall be full compensation for furnishing all labour, tools, equipment, materials and incidental items required to supply, install, drill holes, and grout the dowels as shown on the drawings or as directed herein. Where dowel pins are projecting through elastomeric bearing pads, the cost associated with these dowels shall be considered incidental to the supply and installation of bearing pads and separate payment will not be made for the same.

SECTION 412

BEARINGS

412.01 SCOPE OF WORK

The scope of this specification is to cover the supply, fabrication and installation of all plain and steel reinforced elastomeric bearings and pot bearings in structures. Pot bearings shall be defined as free sliding, constrained sliding and/or fixed structural bearings consisting of a metal piston supported by a single molded disc of unreinforced elastomer that is confined within a metal cylinder.

Bearing materials, manufacture, fabrication and installation shall comply with the latest edition of CSA-S6 or OPSS 1202/1203 for elastomeric and pot bearing respectively. In the event of a conflict between the two, the more severe criteria shall control.

412.02 MATERIALS

All materials shall be new and unused with no reclaimed material incorporated in the finished bearing.

.01 Elastomeric Bearings

Bearings shall be fabricated from elastomeric materials. Virgin natural polyisoprene (natural rubber) or virgin polychloroprene (neoprene) shall be the only raw polymer permitted.

Internal steel plates shall be not less than 3mm thick nor greater than 5mm. Plates shall be mild steel and conform to CSA-G40.21.

The elastomer compound shall exhibit grade 5 low temperature behavior. Both natural rubber and neoprene shall be either 50 $\pm$ 5 or 60 $\pm$ 5 durometer as stated on the contract drawings. The shop drawings shall indicate the low temperature behavior grade and durometer number.

.02 Pot Bearings

The Contractor shall furnish a manufacturer's certification that materials proposed for use on the project have been pretested and will meet the requirements as set forth in the manufacturer's current literature.

Elastomer and rubber components shall meet Grade 5 classification as per CSA-S6.

Sliding pot bearings shall have a PTFE and stainless-steel interface.

412.03 MANUFACTURE AND APPROVAL

.01 Elastomeric Bearings

.01 Manufacture

All pads shall have a smooth finish. Any steel plates shall be free from burrs and sharp edges; all laminations shall have a uniform thickness.

Steel laminated bearings shall be molded as a single unit under pressure and heat, steel plates shall be completely bonded on all surfaces.

.02 Approval

Bridge bearings shall be as designated in the contract or from an approved source. Bearings shall be approved by shop drawings or the manufacturer shall supply the Engineer with a catalogue.

Six (6) copies of drawings shall be forwarded for approval and three (3) weeks is necessary for this approval.

The following information is needed:

(1) Dimensions

(2) ULS/SLS Load capacity in compression

(3) Compression stiffness

(4) Maximum movement capacity in shear

(5) Shear stiffness

(6) Rotation capacity

.03 Identification

All bearings shall be indelibly marked with the name of the manufacturer, the part number, bearing identification number, elastomer type, elastomer grade and the date of manufacture on the side visible after erection.

.04 Quality Assurance

The manufacturer shall submit a certificate of compliance to the Engineer prior to installation. The certificate of compliance shall contain the material properties, grades and relevant standards of all bearing materials. The manufacturer shall certify the bearing(s) meet the design requirements.

.02 Pot Bearings

.01 Fabrication and Manufacture

This work shall consist of the fabrication, manufacture and finishing of pot type structural bearing devices of the type shown on the plans for the locations as shown on the plans. These structural bearings shall adequately provide for all movements, loads, forces and rotations of structural members where applicable.

Bearings shall be factory set and clamped for equal expansion and contraction and plant assembled. Temporary connections shall not be removed until the bearings are set in their final positions.

The stainless-steel sliding surface interface sheet shall conform to ASTM A167 Type 304 with a bright annealed mirror Number 8 finish on one side and continuously welded to the top plate.

All pot bearings shall have a minimum rotational capacity of $\pm$ 0.02 radians. All elements shall be capable of maintaining its initial uniform contact at $\pm$ 0.02 radians rotation. The coefficient of friction between the PTFE and stainless-steel plates at maximum permissible bearing load shall be 0.03 or less. Pot bearings are to be lubricated and unfilled. Exposed steel surface shall be coated with cold galvanizing compound (2 coats).

The bearing device manufacturer shall be pre-qualified with a five-year proven history of successful product manufacture.

All welding shall be in accordance with CSA W59-M. The company undertaking welding fabrication shall be certified in Division 1 or Division 2.1 of CSA W47.1.

Unidirectional or constrained sliding bearings should be manufactured with a gap tolerance at the guides of 0.5mm. All
bearing surfaces of steel plates shall be finished flat within 0.25mm. Overall manufacturing height tolerance shall be $\pm$ 3mm.

Anchorage pins, studs and connections shall be designed and supplied by the fabricator for the maximum horizontal force and minimum/maximum vertical force indicated on the drawings.

.02 Approval

The pot bearing manufacturer shall be as designated in the contract documents or an approval equal. Bearings shall be approved by shop drawings and the manufacturer shall supply the Engineer with a catalogue.

Six (6) copies of drawings shall be forwarded for approval and three (3) weeks is necessary for this approval.

The following information is needed:

(1) Dimensions of each component including top plate, sliding surface, bearing surface, piston, elastomeric disc, base pot, anchor pins, anchor studs and welds and the overall dimensions of the finished bearing. Dimensions refer to length, width, diameter and thickness.

(2) Minimum and maximum horizontal and vertical load capacity, both SLS and ULS.

(3) Longitudinal and transverse movement capacity.

(4) Bearing rotation capacity in radians.

(5) Sketch indicating bearing locations, orientation and movement.

(6) The shop drawings shall contain a detailed bill of materials.

.03 Identification

All bearings shall be indelibly marked with the name of the manufacturer, the part number, bearing identification number, elastomer type, elastomer grade and the date of manufacture on the side visible after erection.

.04 Quality Assurance

The manufacturer shall submit a certificate of compliance to the Engineer prior to installation. The certificate of compliance shall contain the material properties, grades and relevant standards of all bearing materials. The manufacturer shall certify the bearing(s) meet the design requirements.

412.04 INSTALLATION

All welding within three (3) metres of any bearing shall be specifically prohibited unless written approval is obtained from the Engineer. Such approval will require specific measures to protect the bearings where so required by the Engineer.

.01 Elastomeric Bearings

Bearings when received on site shall be stored in a location and under conditions approved by the Engineer.

The bearings shall be installed in the exact location as called for in the contract.

Tolerances of installation (including manufacturing tolerances) shall be $\pm$ 5mm.

Variation from a parallel plane shall not exceed 1mm in 50mm.

Any abnormal appearance of the bearings shall be cause for rejection.

.02 Pot Bearings

The manufacturer shall ship each bearing fully assembled. The bearings are not to be disassembled prior to final installation without the knowledge of the design authority and manufacturer.
Bearings when received on site shall be unloaded and stored in accordance with the

manufacturer's recommendations. The Engineer shall approve the same.

The bearings shall be installed in the location and orientation as indicated on the contract drawings. Constrained sliding or unidirectional bearings shall be properly aligned to allow for the movement of the structure as indicated on the contract drawings. The bearings shall not be installed in the field prior to the Engineer's approval.

Where the bearings are of a guided or constrained type, the Contractor shall establish the bearing alignment using surveying instruments. The tolerance for variation in alignment, i.e. plan view, is $\pm$ 0.0067 radians (0.382 degrees) where the bearing is required to move 75mm or less. The bearings shall have dead level bearing surfaces, i.e. top and bottom plates. Dead level shall be defined as $\pm$ 0.001745 radians (0.10 degrees), i.e. $\pm$ 1.745mm in 1000mm.

In positioning, the bearing centre of the base should correspond to the centre of the support. Rotation of the bearing should not be permitted to occur during concrete placing operations. The top plate shall be supported on all sides to prevent deflection of the same during the concrete placing operations.

The base plate shall be bedded by the Contractor on non-shrink grout. It is of extreme importance that the final bedding be free from high or hard spots, voids, etc. The Contractor shall supply durable load bearing wedges to support all bearings when they are placed on the non-shrink grout pad. Wooden wedges are not acceptable. The bearing base plate shall be set in position using a flowable non-shrink grout unless otherwise indicated on the shop drawings. For uni-directional and multi-directional bearings, adjust the upper plate to proper setting as instructed by the field Engineer prior to affixing to the structure. Ensure formwork is well sealed to prevent concrete from flowing onto the bearing prior to placing deck construction.

Installation requirements shall be written on the shop drawings. Bearings are to be installed as per the manufacturer's recommendations.

412.05 MEASUREMENT FOR PAYMENT

Each individual bearing fully assembled shall be considered as one (1) unit regardless of the bearing type, kind, size, capacity, function, location of installation in the structure or source of manufacture. Measurement for payment purposes shall be the total number of such units installed.

Bearings used against concrete creep blocks and concrete corbels shall not be included in measurement for payment and are incidental to the works.

412.06 PAYMENT

Payment at the contract price for "Bearings" shall be full compensation for all labour, equipment, materials, plant and services required to supply, fabricate, transport to the job site, store on site, handle and install the bearings in the specified locations. Any anchorages,

grout and dowel pins required are considered incidental and no separate payments will be made.

The tendered price per each unit for “Bearings” shall be the average price per unit regardless of the bearing type, kind, size, capacity, function, location of installation in the structure or source of manufacture excluding bearings used against creep blocks and concrete corbels which are incidental to the works.

Any necessary engineering and adjustment shall be considered incidental to the work.

No payment will be made until a certificate of compliance has been received by the Engineer.

ITEM 413

EXPANSION JOINTS

413.01 SCOPE OF WORK

The scope of this specification is to cover the design, supply, material, fabrication and installation of expansion joint assemblies of the type as shown in the contract documents.

Expansion joint design, materials, fabrication and installation shall comply with the latest edition of CSA-S6; Design of Highway Bridges.

413.02 MATERIALS

.01 Seal

The seal shall be a neoprene seal conforming to OPSS 1210.

.02 Lubricant

The Contractor shall supply a suitable lubricant to facilitate the installation of the seal into the expansion joint rail. The lubricant shall be compatible with the neoprene seal.

.03 Steel

All steel used in the expansion joint assembly shall conform to the latest edition of CSA G40.21. The steel grade shall be 300 W.

413.03 FABRICATION AND DRAWING APPROVAL

.01 General

The expansion joint assembly shall be a mechanically locked joint of the type shown on the contract drawings or an approved equivalent. It shall be capable of satisfactory operation between -35°C and 40°C.

.02 Approval of Drawings

Prior to any fabrication, shop drawings must be approved by the Engineer.

Normally six copies of drawings will be required, and three weeks will be required for approval.

The shop drawings shall show:

(1) Movement chart showing total rated movement.

(2) The required setting width for temperatures in increments of 5°C within the normal setting range.

(3) Grade, type and dimension of all material used.

(4) Location and full details of all splices and welds.

(5) Full details of anchors, clamping devices and curb details.

(6) Preset shipping dimensions.

(7) Site storage and installation procedures.

(8) Relationship of expansion joint assembly to deck, approach slab, roadway and all adjacent reinforcement.

.03 Fabrication

The steel extrusion shall be zinc metallized in accordance with CSA G189 providing a minimum metallized coating of 200 µm.

All cut edges shall be smooth, regular and free of slag.

All holes shall be drilled, and bleed holes shall be 12mm diameter.

All welding shall be in accordance with CSA W59. The company undertaking welded fabrication shall be certified in division 1 or division 2.1 of CSA W47.1.

The neoprene seal shall be continuous.

The roadway part of the expansion joint shall be bent up to 150mm at a 45-degree angle into the curb, the neoprene seal shall extend 25mm beyond the end of the joint.

Where the expansion joint being supplied contains snow plow deflection plates, the same shall be placed parallel to the centreline of the roadway.

413.04 TRANSPORT AND STORAGE

The joint assembly shall be shipped with the preset dimension of 50mm for 10°C unless otherwise indicated on the drawings. Care shall be taken in the shipping to prevent bending, warping or other damage.

The joint assembly shall be stored such that it is protected from rusting, dirt and distortion.

413.05 INSTALLATION

The Contractor shall provide a technician, approved by the Engineer, familiar with the expansion joint assembly being installed, to supervise all works involved with its installation.

Before the placement of the expansion joint assembly, all deck concrete shall have been placed and cured for a minimum period of three days with enough area for the proper placement of the expansion joint assembly boxed-out as per detail on contract drawings.

The expansion joint installation sequence is outlined as follows:

(a) Install steel expansion joint assembly. Adjustments for the prevailing temperature shall be made and clamps re-tightened.

(b) Erect formwork prepare concrete surfaces, place expansion joint and dam concrete; this concrete is to be cast separately from the deck concrete. Clams shall be removed shortly after the concrete has set.

(c) Remove formwork, polystyrene and debris, request inspection and approval to install seal from the Engineer. The use of heat, fire, gasoline or the application of corrosive chemicals is not an acceptable means of polystyrene removal.

(d) Install the seal in the expansion joint.

Concrete the same as that specified for the deck in accordance with Item 404, “Concrete Structures”, shall be placed around the expansion joint in the previously boxed-out area with great care being taken during consolidation that no voids are left under the steel components. The joint assembly shall be placed precisely as called for in the drawings and such that it will remain true to elevation and grade and remain firm after the concrete has hardened. Deviation from the grade or elevation shall be cause for rejection. Rejection would mean the complete removal of the expansion joint assembly and its subsequent replacement.

After the concrete has hardened, the exposed face of the seal and structural steel shapes shall be cleaned of deleterious material. Bleeder holes and bolt holes shall be cleaned and filled with an approved epoxy grout and any scratches in the metalizing shall be touched-up with zinc rich touch-up paint.

413.06 MEASUREMENT FOR PAYMENT

Measurement for payment will be made for each expansion joint assembly installed in the works as accepted by the Engineer. The assembly shall include the expansion joint and all related components with the boxed-out area or zone.

For new construction, measurement for payment for concrete and reinforcing steel shall be made in accordance with Item 404 and 405 of the Specifications Book for “Concrete Structures” and “Concrete Reinforcement”, respectively.

413.07 PAYMENT

Payment at the contract price for "Supply and Install Expansion Joints" shall be full compensation for all labour, equipment, materials, plant and services required for the design, supply, fabrication, transportation to the job site, storage, handling, satisfactory preparation and installation for the expansion joint assembly of the type as indicated on the contract drawings.

The removal of all polystyrene, form work and debris between the back face of the deck and the front face of the stem shall be considered incidental to the works.

The supply and application of all lubricants, bonding agents, grouts, sealants, epoxy, PVC foam with adhesive and backer rods shall be considered incidental to the work and payment will not be made for such.

Expansion joints constructed where the average tested 28 day strength of the concrete in the expansion joint dam is less than the specified strength but otherwise meets the specifications will be accepted at a reduced payment provided the difference between the specified strength and the average tested 29 day strength is no greater than 1-MPa. If the difference is greater then 10 MPa than the expansion joint shall be rejected. The Contractor shall remove the expansion joint dam and repour the concrete.

When concrete is rejected, those provisions outlined in CSA-A23.1-04 shall be followed to determine whether or not the concrete may remain in the work. Such work shall be done at the Contractors expense. Not withstanding the above, should the concrete remain in the work it shall be subject to a reduction as outlined below, for having a strength less than that specified.

If the concrete in any portion of the expansion joint is found to have a strength deficiency of less than 10 MPa than the lump sum bid price for the expansion joint will be adjusted in accordance with the following:

$$ALSP = BLSP – BLSP *.02*(SS-TS)*(LJDC/LJ)$$

Where:

ALSP = Adjusted Lump Sum Price for the Expansion Joint
BLSP = Bid Lump Sum Price per Expansion Joint
SS = Specified 28 day strength (MPa)
TS = Tested Average 28 day strength (MPa)
LJDC = Length of Joint with Deficient Concrete (m)
LJ = Length of Joint (m)

Full payment shall not be made until the final acceptance of the work upon satisfactory completion at the end of a three (3) month period starting with the installation of the expansion joint. If during this period, it is ascertained that the joint is leaking, the Contractor shall make good this leak to the complete satisfaction of the Engineer.

A holdback in the amount of 25% of the total payment for "Supply and Install Expansion Joints" shall be retained for the minimum three (3) month period from the latter of (a) the time of the installation of the expansion joint or (b) for a three (3) month period from the date the last repair work was completed.

The removal of all polystyrene, formwork and debris between the back face of the deck and the front face of the stem shall be considered incidental to the works.

ITEM 414

BRIDGE DECK WATERPROOFING

414.01 SCOPE OF WORK

The scope of this specification is the preparation and treatment of the concrete bridge deck, as shown on the plans and where designated by the Engineer, with a hot applied rubberized asphalt membrane such as Hydrotech No. 6125 flexible membrane waterproofing system or another approved equivalent.

414.02 PROCEDURE

The treatment procedure for bridge deck waterproofing is outlined as follows:

1. The Contractor shall submit for approval to the Engineer a list of the application rates of the following materials:

   surface conditioner
   asphalt membrane
   CRS-1 or RS-1 diluted emulsion

   The submission shall contain the project name and number, name of the product manufacturer, product identification, proposed date of application, specific gravity and the weight or mass per drum of the asphalt membrane, and any special procedures required.

   All waterproofing work shall be performed by an applicator approved by the membrane manufacturer. The applicator shall provide such evidence satisfactory to the Engineer.

2. Inspection, surface preparation and cleaning of the concrete bridge deck.

3. Application of surface conditioner for asphaltic membrane.

4. Application of rubber membrane, as required, to the concrete bridge deck where cracks in the concrete are evident, at control or construction joints and at the interface of all horizontal and vertical surfaces such as curbs and expansion joint dams.

5. Where rubber membrane is applied a thin layer of surface conditioner and asphaltic membrane respectively shall be applied below the rubber membrane. Then the rubber membrane shall be put in place.

6. Next, the layer of asphalt membrane shall be hot applied to the entire deck surface area including the rubber membrane placed previously, including all vertical faces at curbs and expansion joint dams.

7. Immediately following the application of the asphalt membrane, a layer of asphalt impregnated protection board shall be placed onto the hot applied rubberized asphalt membrane.

8. After the protection board is placed a layer of tack coat shall be applied to the protection board. The tack coat shall be CRS-1 or RS-1 emulsion diluted with an equal volume of water. The protection board is not designed for exposure and should be tack coated and paved as soon as practical.

9. At the vertical faces of all curbs a 15mm by 20mm asphalt impregnated strip shall be placed such that the top of the strip is flush with the top of the proposed asphaltic pavement.

10. Paving of the bridge deck shall begin within 24 hours after the bridge deck waterproofing is complete.

11. After the paving and compacting operations are complete, the 15mm by 20mm asphalt impregnated strip shall be removed and the joint filled with a hot applied joint sealing compound.

12. Finally, the surface adjacent to curbs and dams shall be sealed with hot applied SS-1h or RS-1K undiluted asphalt emulsion. The sealant shall overlay the concrete surface by 25mm.

All concrete surfaces shall be cured in accordance with item 404.05 “Curing” and be in a dry condition before waterproofing operations may begin. Waterproofing work shall not be performed during rainy or inclement weather or on frost covered surfaces.

The Contractor shall give the Engineer a minimum of 48 hours notice prior to commencing the waterproofing application; in addition, the prepared bridge deck shall be specifically approved by the Engineer.

The Contractor shall be aware of Section 920.02 “Spill Reporting” and the required procedures.

414.03 MATERIALS

.01 Surface Conditioner for Asphalt Membrane

The surface conditioner shall conform to the requirements of CGSB 37-GP-9Ma. Where the drying period will be only two (2) hours, Hydrotech No. 56170 Surface Conditioner or approved equivalent shall be used.

.02 Asphalt Membrane

The asphalt membrane shall be Hydrotech No. 6125 hot applied rubberized asphalt or an approved equivalent.

.03 Rubber Membrane

The rubber membrane shall be Elastosheet 6147 or an approved equivalent.

.04 Protection Board

The protection boards shall be 3mm x 900mm x 1500mm asphalt impregnated waterproofing protection boards and shall be approved by the Engineer.

.05 Tack Coat for Protection Board

The tack coat used in conjunction with the protection board shall be CRS-1 or RS-1 emulsion diluted with an equal volume of water. The CRS-1/RS-1 emulsion shall meet the requirements of the Ontario Provincial Standard Specification 1103.

.06 Joint Sealing Compound

Joint sealing compound shall be Hydrotech hot poured sealant number 6125 or approved equivalent.

.07 Hot Mix Asphaltic Concrete Sealant

The hot mix asphaltic concrete sealant shall be an undiluted CRS-1/RS-1 emulsion as in Section 414.03.05, Tack Coat for Protection Board.

414.04 INSTALLATION

.01 Concrete Surface Preparation

The existing surface of the concrete shall be treated by sand blasting, bushhammering or other such methods as the Engineer may approve, so as to expose solid, laitance-free concrete. All dirt and debris shall be swept off and disposed of to leave a prepared surface satisfactory to the Engineer before tack coating. Immediately prior to the application of the tack coat, the concrete surface shall be cleaned with a jet of oil-free compressed air to remove all dust and any other foreign material. Waterproofing shall not commence until the Engineer has approved all preparation work.

Without limiting the generality thereof, in the preparation of new concrete decks the following can be anticipated: removal of concrete and grout spills, small depressions must be filled with Portland Cement mixture, areas of heavy laitance require removal, sharp projections must be ground off and honeycombed concrete requires patching.

Old decks will generally require the removal of larger expanses of old hot mix pavement and waterproofing which is not well bonded; scaled or spalled concrete must be removed and replaced with Portland cement concrete. This will generally be considered as rehabilitation work and will be paid for separately under Item 419 for Rehabilitation of Concrete Structures.

Never use hot mix asphaltic patching to level up a deck prior to waterproofing.

.02 Surface Conditioner for Asphalt Membrane

Surface conditioner such as Hydrotech No. 56170 shall be applied at a rate of 0.1 to 0.2 l/m². Where acceptable alternatives are used, they shall be applied at a rate approved by the Engineer. Surface conditioner shall be applied with approved equipment which will provide a uniform application at the required rate. The surface conditioner shall be applied only when the concrete is dry, clean and when the air and concrete surface temperature are above 5°C. No traffic shall be permitted upon the surface conditioner until it has fully cured.

The surface conditioner shall be applied to the entire deck surface including those vertical surfaces which are to be treated with waterproofing such as the vertical faces at curbs and expansion joint dams.

Surface conditioner shall be applied in accordance with CGSB 37-GB-15M.

.03 Application of Asphalt Membrane

Application of hot applied, rubberized asphalt membranes for bridge deck waterproofing shall generally comply with CGSB 37-GP-51M.

Cakes of hot applied rubberized asphalt membranes shall be melted in an approved, indirect heating or double boiler type mechanically agitated heating and mixing unit which shall keep the contents continuously agitated until the material can be drawn free flowing and lump free from the mixing unit at a temperature not exceeding that recommended by the manufacturer. The kettle shall be equipped with a thermometer to measure membrane temperature.

No membrane shall be applied until the surface conditioner has cured completely. The hot applied rubberized asphalt membrane shall be applied at the temperature recommended by the manufacturer, to the clean, conditioner coated concrete deck, to form a uniform single coat having a minimum thickness of 4mm and a maximum thickness of 5mm. The average thickness shall not be less than 4.5mm.

The operation shall be such that discontinuities in the membrane are avoided and any joints lapped 150mm. The membrane shall extend up the face of curbs, dams at expansion joints and deck drains to the height of the top of the hot mix asphaltic surface course and into the chase where this has been provided.

Membrane application temperature shall be not less than 175°C and not greater than 212°C. Overheated material may gel or become stringy and shall be rejected. The membrane shall be applied in such a manner as to eliminate entrapped air, be of uniform thickness and essentially free of pinholes and blisters.

.04 Application of Rubber Membranes

In the areas indicated on the drawings, at all cracks and construction joints the rubber membrane shall be placed directly over the hot applied rubberized asphalt membrane while

it is still tacky. The rubber membrane shall extend up the face of the curbs or barrier walls to the top of the hot mix asphaltic pavement, or into the chase where this has been provided. The rubber membrane shall then be covered with a 3mm thick layer of hot applied rubberized asphalt membrane as shown on the plans. At the horizontal and vertical surfaces, the rubber membrane shall be shaped to fit the interface ensuring that air is not entrapped, fish mouths shall be eliminated.

.05 Application of Protection Board

Protection boards shall be laid on the asphalt membrane while the surface is still warm and tacky. Materials or substances shall not be applied to either the membrane surface or the protection board to remove the tackiness prior to installation of the protection board. Protection boards may be butt jointed if the asphaltic paving immediately follows completion of waterproofing operations. Otherwise, protection boards shall be placed with edges overlapping a maximum of 25mm both longitudinally and transversely. The overlap pattern shall be consistently applied in one direction such that the quality of paving will not be reduced. The overlap pattern shall be such as to facilitate paving operations in the downgrade direction. The protection board edge shall be within 6mm of all curbs, drain verticals, and expansion joint verticals.

No traffic or equipment shall be permitted upon the hot applied rubberized asphalt membrane until the protection board has been placed and the membrane has cooled to ambient temperature. The membrane, when wet, presents a surface which is hazardous to traffic.

.06 Application of Protection Board Tack Coat

The diluted CRS-1/RS-1 emulsion tack coat material shall be applied at the rate of 0.5 litre per square metre.

Tack coat material shall be applied to the protection board cover with approved equipment which will provide a uniform application at the required rate. The tack coat shall be applied only when the protection board cover is dry, clean and when the air temperature is above 5°C. The tack coat on the protection board cover shall be placed just sufficiently ahead of paving to allow for adequate curing.

.07 Paving Operations

The Contractor shall schedule his operations so that hot mix paving shall be carried out as soon as the membrane has cooled to ambient temperature. Hot mix asphalt concrete shall be placed within 24 hours after waterproofing is complete. Paving equipment shall not be permitted upon the tack coat until it has fully cured. Asphaltic paving of bridge decks shall be in accordance with Item 422 "Asphaltic Paving of Bridge Decks".

.08 Forming and Filling Grooves with Joint Sealing Compound

Along each curb and for the full length of each curb and barrier wall, or where indicated in the contract drawings, the Contractor shall form a rectangular groove 15mm wide and 20mm deep. This groove shall be made using 20mm asphalt impregnated strips placed against the

curb prior to the placing of the hot mix asphaltic concrete.

The boards shall be coated with an approved bond breaker and shall be removed after the mix has been fully compacted. The Contractor may use an alternative method of forming the grooves with the approval of the Engineer.

Immediately prior to pouring this compound, the groove shall be dry and then cleaned of any dust or debris by an oil-free compressed air jet.

The joint sealing compound shall be poured in place after the asphaltic pavement reaches ambient air temperature.

The joint sealing compound shall be heated in a kettle of the indirect heating or double boiler type with a built-in agitator and equipped with an indicating thermometer to measure the temperature of the melted compound. The compound shall be cut into small pieces to facilitate uniform melting and shall be melted slowly with a constant stirring. The compound shall not be heated in excess of the pouring temperature recommended by the manufacturer. The Contractor may be required to demonstrate with the equipment proposed for use that it will consistently produce a joint sealing compound of proper pouring consistency.

Pouring shall be done by the use of hand pouring pots, mechanical methods, or any other method which will give satisfactory results. The pouring equipment shall be designed such that a minimum of time will elapse during pouring operations so the compound will be placed in a workmanlike manner. Shields shall be provided to prevent the compound from being spilled on the concrete curb and on the newly placed bituminous surface.

Sufficient compound shall be poured into the groove so that upon completion of the work the surface of the compound will be flush with the surface of the pavement when the air temperature at time of pouring is 27°C or over, or 5mm below the surface of the pavement when the temperature is below 27°C. If the compound subsides to a level below the surface of the pavement, a second pouring will be required. When more than one pouring is required to fill the groove, succeeding pours will be made immediately.

Damage such as stones embedded in the joint sealing compound by construction traffic and Contractor's operation shall be repaired by the Contractor at his expense.

Traffic will not be permitted upon the surface course during the operation of forming and filling the grooves.

.09 Sealing Surface of Asphaltic Concrete Adjacent to Curbs

After the grooves at curbs have been filled and before it has become contaminated with dirt or debris, the surface shall be spray-or-brush-painted with a uniform continuous, liberal application of undiluted SS-1h/RS-1K emulsion at the rate as per manufacturer's instructions or as directed by the Engineer, for a width of 600mm adjacent to all curbs, or barrier walls or where otherwise specified, to completely seal the surface.

414.05 SAMPLING

The Engineer may at his discretion require that enough of the surface conditioner, hot poured rubberized asphalt membrane, joint sealing compound, or CRS-1/RS-1 emulsion be obtained from the materials being used on the project as might be required for immediate analysis or future testing purposes.

414.06 MEASUREMENT FOR PAYMENT

The area treated with hot applied rubberized asphalt membrane will be measured in square meters and will for payment purposes be considered the product of the width of the bridge deck measured perpendicular to faces of curb and sidewalk and the length of the bridge measured in plan between center lines of abutment bearings. No allowance will be made in the measurement for the turnup at the curb-line or for any overlaps.

414.07 PAYMENT

Payment for bridge deck waterproofing with hot applied rubberized asphalt membrane shall be made at the contract unit price per square meter and shall be full compensation for the preparation of the concrete deck surface, the supply and application of surface conditioner, hot applied rubberized asphalt membrane, rubber membrane, protection boards, tack coat for protection boards, joint sealing compound, the forming and filling of the grooves, the supply and application of undiluted CRS-1/RS-1 emulsion seal coat, for the handling and controlling of traffic and for all other items incidental to the satisfactory completion of work as determined by the Engineer.

ITEM 415

ALUMINUM BRIDGE RAILING

415.01 SCOPE OF WORK

The Contractor shall supply and install aluminum bridge railings in locations as shown on the contract drawings and in accordance with this specification.

415.02 MATERIALS

(1) The posts shall be permanent-mould cast from Alcan Alloy A444-2-T4 or equal.

(2) The rails shall be extruded from Alcan Alloy 6351-T6 or equal.

(3) The rail plugs shall be cast from Alcan Alloy 356.0F or equal.

(4) Type A307 or A325 connecting bolts, nuts and washers shall be of hot dipped galvanized steel in accordance with CSA G164.

(5) The set screws shall be of stainless steel.

(6) Type A325 anchor bolts, nuts and washers shall be of hot dipped galvanized steel in accordance with CSA G164.

(7) Miscellaneous materials shall be as noted on the contract drawings.

415.03 FABRICATION

The railing shall be fabricated strictly to the requirements given in the latest edition of the brochure "Alcan Highway Railings" published by the Extrusion Division of the Aluminum Company of Canada Limited. The type of and general arrangement for railing shall be defined in the contract. Fabrication of the railing shall be to CSA-S6.

Before starting any work on the railing, the Contractor shall submit six copies of shop drawings including Bill of Materials to the Engineer for approval, showing full details of the fabrication and erection of the railing.

415.04 INSTALLATION

Rail and posts shall be erected true to line and levels as shown on the drawings or as directed by the Engineer. Rails are to be parallel to the top of the concrete, and the posts are to be perpendicular to the concrete.

Where shims are required for the alignment of the posts, they shall be made from fully annealed alloy known commercially as Alcan AA1100 or equivalent.

Surfaces of aluminum in contact with concrete shall be given a heavy coat of alkali-resistant bituminous paint prior to the installation. The paint shall be applied as it is received from the manufacturer without the addition of any thinner.

A neoprene gasket shall be placed between the aluminum post and concrete. The 4mm thick gasket shall have pre-punched holes enabling it to properly fit over the anchors.

Prefabricated anchor inserts of the type shown on the drawings or an approved equal, shall be used to secure the bridge railing posts to the concrete.

If chemical anchors are used to secure the bridge rail posts then the anchor is to be approved by the Engineer. All chemical anchors shall be installed as per the manufacturer's specifications.

Nylon bushings shall be used to prevent any electro-chemical reaction occurring between the aluminum posts and the bolts. For accurately positioning the insert with the form, a setting template shall be furnished with the insert.

Railing shall be installed as indicated on the contract and shop drawings. Snug-tight bolts for slip joints shall be extra long and have double nuts which shall be torqued up against each other while still maintaining the slip joint.

The aluminum bridge railing shall be thoroughly cleaned of all discoloration by approved methods and all marks and scratches occurring during fabrication shall be removed. The Contractor may at his own expense, apply a thin coat of clear non-yellowing lacquer to the cleaned surfaces, but he shall in any case ensure that the railings, when erected, have a clear surface of uniform appearance and texture.

415.05 MEASUREMENT FOR PAYMENT

The quantity of aluminum bridge railing for which payment shall be made shall be all that railing as shown on the contract drawings as approved by the Engineer.

Measurement for payment shall be on a lump sum basis.

415.06 PAYMENT

Payment at the contract price for "Aluminum Bridge Railing" shall be full compensation for all labour, equipment, plant and materials required to fabricate, supply, deliver and install the railings, including posts, rails, rail sleeves, rail plugs, anchor inserts, nuts, bolts and washers, to clean and coat the above where so required and any other incidental items.

Payment will be made on delivery of all materials in good condition and with adequate storage on site up to the cost of material supplied as substantiated by invoices.

The remaining payment will be made when the Engineer is satisfied that installation in accordance with the contract has been carried out.

ITEM 416

WATERSTOPS

416.01 SCOPE OF WORK

This specification covers waterstops for joints in concrete structures.

416.02 MATERIAL

The waterstop shall be extruded from a polyvinyl chloride compound to meet the performance requirements given in this specification.

416.03 MANUFACTURE

The waterstops shall be of the shape and dimensions specified on the drawings. The extruded material shall be dense, homogeneous, of smooth surface, free from porosity and other imperfections. The cross section of the waterstop shall be uniform along its length and shall be symmetrical transversely so that the thickness at any given distance from either edge of the waterstop will be uniform.

416.04 TEST CERTIFICATE

The supplier shall provide the City with certified copies of the manufacturer's test results and a certificate of compliance is required prior to installation of the waterstops.

416.05 PACKAGING

The waterstop shall be shipped as coils in container so constructed as to ensure safe delivery to the site. The waterstop in the coil shall be of continuous length.

416.06 INSTALLATION

Waterstop shall be installed in the exact location as called for in the contract drawing. They shall be thoroughly cleared of foreign material prior to concrete being poured around item. The material shall not be installed in such a way that stress is imparted to the waterstops.

416.07 REJECTION

All waterstops failing to meet any of the requirements of this specification shall be

rejected. Rejected materials shall be expeditiously removed and replaced with acceptable materials at no expense to the City.

416.08 MEASUREMENT FOR PAYMENT

Waterstops of the type specified shall be measured in linear metre of the length actually installed in the finished structure.

416.09 PAYMENT

Payment for waterstops shall be made at the bid price per linear metre. Such payment shall constitute full compensation for the supply, packaging, delivery, and installation. If unscheduled construction joints are required because of Contractor's negligence, the Contractor shall supply and install waterstop at no additional cost.

ITEM 417

HYDRAULIC RIP-RAP

417.01 SCOPE OF WORK

This specification covers the construction of hydraulic rip-rap protective covering placed to protect causeway and structures.

417.02 MATERIALS AND GRADING

The quality of rock shall be approved by the Engineer. Rock subject to deterioration by water or weather will not be accepted. Field stones and boulders may be used where acceptable to the Engineer.

Rip-rap shall consist of clean hard durable rock having a density of not less than 2.6t/m^3. The rock material when subjected to the Los Angeles Abrasion Test CSA-A23.2-17a shall have a loss not greater than 35%.

When tested for soundness according to CSA-A23.2-9A, the rock material shall have a loss not greater than fifteen (15%) after five (5) cycles.

The following classes of hydraulic rip-rap will be used graded as follows (Taken from "Guide to Bridge Hydraulics" published by RTAC):

Class I

Nominal 300mm diameter or 40 kg mass Allowable local velocity up to 3m/sec. Grading Specification:

One hundred percent (100%) smaller than 450mm or 130 kg
at least twenty percent (20%) larger than 350mm or 70 kg
at least fifty percent (50%) larger than 300mm or 40 kg
at least eighty percent (80%) larger than 200mm or 10 kg

Class II

Nominal 500mm diameter or 200 kg mass Allowable local velocity up to 4m/sec. Grading Specification:

One hundred percent (100%) smaller than 800mm or 700 kg
at least twenty percent (20%) larger than 600mm or 300 kg
at least fifty percent (50%) larger than 500mm or 200 kg
at least eighty percent (80%) larger than 300mm or 40 kg

Class III

Nominal 800mm diameter or 700 kg mass Allowable local velocity up to 5m/sec. Grading Specification:

One hundred percent (100%) smaller than 1200mm or 2300 kg
at least twenty (20%) larger than 900mm or 1100 kg
at least fifty percent (50%) larger than 800mm or 700 kg
at least eight percent (80%) larger than 500mm or 200 kg

The class of rip-rap to be used will be designated in the contract documents.

Location of a suitable source for the hydraulic rip-rap shall be the responsibility of the Contractor.

417.03 PLACING

Where and as directed by the Engineer excavation shall be performed to provide a shelf or ledge to provide adequate foundation for the bottom of the hydraulic rip-rap.

Material shall be placed as shown on the plans or as otherwise directed by the Engineer.

Material may be dumped into position to completely cover the area to be protected to the depth specified. In some locations it may be necessary to place the hydraulic rip-rap by crane.

Placing shall be done in such a manner that the surface of the finished rip-rap shall have a uniform appearance.

The Engineer shall be the final and sole judge of the quantity of hydraulic rip-rap required.

417.04 MEASUREMENT FOR PAYMENT

Rip-rap shall be measured in cubic metres in place to the nearest one decimal place and only that material placed as directed by the Engineer shall be included.

Where measurement is impractical due to placement under water an estimate of that rip-rap correctly placed will be made by converting the truck load into cubic metres.

Measurement for any excavation requested by the Engineer will be in accordance with Item 402 “Excavation for Foundation, Unwatering and Extra Backfill for Structures”.

417.05 PAYMENT

Payment will be made at the unit price per cubic metres as specified in the contract.

Payment shall constitute full compensation for supply of all materials, labour, equipment necessary for installing hydraulic rip-rap protection as required under the contract.

Where excavation for foundation is required, the basis of payment for the same shall be as per section 402.07 “Excavation for Foundations”.

ITEM 418

DECK DRAINS

418.01 SCOPE OF WORK

The scope of this specification is to cover the supply and installation of all deck drainage equipment.

418.02 MATERIALS AND FABRICATION

The catch basin shall be of material supplied in accordance with CSA G40.21 Grade 300W. The drains shall be hot dip galvanized after fabrication. Galvanizing shall be to CSA G164.

The outlet pipe is to be supplied in accordance with ASTM Specification A120.

418.03 INSTALLATION

Drains are to be installed in the locations shown on the plans or as otherwise approved by the Engineer.

For new deck construction, the deck drain(s) where required shall be put in place before the deck is cast.

For rehabilitation type projects, the hole for the deck drain downspout shall be drilled through the concrete deck with a core bit. Breaking through the deck with a jackhammer is not permitted. The core bit shall be capable of drilling a hole of sufficient size to easily accommodate the outside diameter of the downspout. Any gap between the drilled hole and the outside of the drain downspout shall be grouted in a neat workmanlike manner.

Care shall be taken that the top of the drain is slightly below the surrounding finished surface.

Care shall also be taken that the bottom of the downspout extends below the adjacent structure.

Incorrectly placed drains shall be cause for rejection and shall be replaced in accordance with Engineers' instructions.

The grating shall be tack welded to the catch basin.

418.04 MEASUREMENT FOR PAYMENT

Each individual drain shall be considered one unit. Only deck drains will be measured for

payment.

418.05 PAYMENT

Payment at the contract unit price for "Deck Drains" shall be considered full compensation for all labour, equipment, plant and materials required to supply and install deck drains, including both catch basins and drainage downspouts.

All removal of concrete and asphalt and any additional concrete and asphalt required shall be considered as incidental to the work.

Any work associated with rectifying incorrectly placed drains shall not be paid for.

ITEM 419

REHABILITATION OF CONCRETE STRUCTURES

419.01 SCOPE OF WORK

The scope of this specification is to cover the supply of materials for concrete repair, methods of repair including concrete removal, surface preparation and the placement, finishing and curing of repair materials. All work, equipment and materials shall be in strict accordance with CSA A23.1 and Item 404, "Concrete Structures".

419.02 CONTRACTOR'S OUTLINE OF REPAIR PROCEDURES

The Contractor shall complete the form, "Contractor's Outline of Repair Procedures", and submit as part of the required contract documents with the tender. Failure to complete the form may constitute rejection of the tender. The Contractor must be specific when completing this form. The intention of the completed form is to determine details of the Contractor's proposed equipment, methods, materials and key personnel to ensure general acceptability and that important aspects of work have been fully understood.

419.03 ACCESS TO WORK SITE

The Contractor shall supply, erect, maintain and dismantle scaffolding, swing staging, barges and/or portable lifts at all repair locations. The scaffolding, staging, barges or lifts shall be erected in such a manner that all areas that require repairs are accessible. All equipment used for access shall conform to the latest edition of the Occupational Health and Safety Act including all amendments.

Payment

Measurement for payment for "access to work site" shall be made as lump sum under the appropriate item in the Form of Tender.

Basis of payment shall cover all aspects of the work including full compensation for all labour, equipment and material considered necessary.

419.04 MAINTENANCE OF TRAFFIC

General

The Contractor shall pay particular attention to the flow of traffic through the construction zone. Any damage incurred to vehicles or their cargo or injury sustained to their occupants as direct or indirect result of the Contractor's actions, procedures or

negligence, shall be the sole responsibility of the Contractor.

The Contractor shall indemnify and save harmless the City about claims arising from damages or injury.

The Contractor shall maintain at least one lane of traffic through the construction zone for the duration of the project.

The Contractor shall be responsible for the placement and maintenance of all traffic signs, barricades and other traffic control devices deemed necessary as per Division 7 "Specifications for Temporary Signs and Devices".

Three (3) copies of a detailed drawing shall be submitted by the Contractor for approval showing the following:

1. The sign and barricade layout.
2. The structure across the river.

Temporary By-pass

For certain projects, a temporary by-pass will be required, and it shall be stated in the Supplementary General Conditions detailing span and load carrying capacity.

The Contractor shall be responsible for the location and route of the by-pass, the hydrological, hydraulic and structural design of the river crossing, the maintenance and upkeep, the placement and maintenance of all traffic control devices as stated above.

Division 9, "Environmental Requirements" shall be adhered to by the Contractor.

Three copies of a detailed drawing, signed and sealed by a Professional Engineer, licensed to practice in the Province of Newfoundland, shall be submitted by the Contractor for approval to the Engineer showing the following:

1. The proposed route of the by-pass.
2. The structure.
3. The sign and barricade layout.
4. Design and speed through the construction zone.

All repairs to the by-pass deemed necessary by the City shall be implemented by the Contractor immediately after written notification by the Engineer. If after notification the Contractor fails to initiate repairs, repairs will be done by others. The cost of such repairs will be deducted from progress payments.

Traffic Resumption

Under normal circumstances curing time required for deck concrete is wet curing for seven (7) days and a further thirty (30) days for air drying. Also, the specified design strength must be obtained.

Until the above conditions are satisfied, no traffic will be permitted on a new deck or overlay.

If it is not practical to achieve this, as there is no temporary by-pass, the above curing times may be reduced only at the discretion of the Engineer but in no case will traffic be allowed onto a new deck or overlay until seven (7) days of wet curing and an additional seven (7) days of air drying have elapsed.

The area used as a route for the by-pass must be returned to its original condition.

Payment

Measurement of payment covering all aspects of the work shall be made lump sum under the appropriate item in the Tender Form to cover the cost of maintenance of traffic. Basis of payment shall represent full compensation for all labour, equipment and material necessary to carry out all the work described herein.

419.05 UNASSIGNED

419.06 SUPPLY OF PORTLAND CEMENT, BONDING AGENTS AND OTHER SPECIALTY ITEMS

The Contractor is required to supply all cement, bonding agents, and other specialty items to be incorporated in the work.

All cement required shall be in accordance with Item 404, "Concrete Structures".

The supply and use of all specialty items shall conform to manufacturer's instructions and recommendations, applicable governing standards and shall be subject to approval by the Engineer. The Contractor shall also supply the Engineer with copies of the relevant specifications for the above items.

The supply of these materials shall be considered incidental to the performance of the work and no separate payment will be made for the same.

419.07 SUPPLY AND REPLACEMENT OF REINFORCING STEEL DUE TO DAMAGE OR DETERIORATION

The following shall be considered additions or exceptions to Item 405, "Concrete Reinforcement", of the Specifications Book.

All reinforcing steel bars which are damaged by jackhammering or have deteriorated and cannot be re-used shall be replaced with an equivalent area of steel.

The extent and exact nature of the work shall be determined by the Engineer in the field.

Payment for replacement of existing deteriorated or damaged steel shall be made in accordance with GC 51 Valuation and Certification of Changes in the Work.

Any reinforcing steel, which in the opinion of the Engineer, has been damaged due to negligence of the Contractor, shall not be paid for.

419.08 REHABILITATION OF ABUTMENTS AND PIERS

General

The abutments, piers, creep blocks, and wingwalls have some degree of deterioration and may require reconstruction. Those parts to be repaired will be identified in the contract documents and are subject to review by the Engineer.

Any creep block dowels or reinforcement which is damaged through negligence and cannot be reused as determined by the Engineer, shall be reinstated at the Contractor's expense.

Removal and Surface Preparation

All existing formwork remaining from previous work at the abutments along with any accumulated debris on the beam seats shall be removed and disposed of to the Engineer's satisfaction.

This work shall entail the removal of deteriorated concrete and surface preparation. All loose, deteriorated and chloride contaminated concrete shall be removed to a minimum depth of 50mm beyond original lines or further until sound concrete as determined by the Engineer is encountered. If any rebar is corroded, presently exposed or exposed by concrete removal, then the concrete surrounding the rebar shall be removed to a clear distance of 25mm beyond the steel. Concrete removal shall be as detailed on the drawings and as directed by the Engineer.

Prior to restoration of the deteriorated areas, all exposed reinforcing steel shall be satisfactorily sand-blasted until the steel is free of all rust. Fine particles of cement or sand shall be removed by vacuum or with jets of oil-free compressed air.

Where fresh concrete will meet hardened concrete, a 30mm deep sawcut shall be used to obtain straight clean lines and to preclude feather-edging.

Concrete Supply and Placement

The Contractor shall inform the engineer of areas ready for new concrete or mortar placement at least 24 hours in advance of placement to allow for inspection and measurement. No concrete shall be placed until the prepared surface to be restored is inspected and approval in writing is given by the Engineer.

These areas shall then be restored to the original lines using a latex modified concrete, having a 28 day compressive strength of 35MPa, maximum water:cement ratio of 0.37, 3% to 6% entrained air, 125mm ± 30mm slump and maximum size aggregate of 10mm, or an approved equal repair mortar. The latex emulsion used in the mix shall have a 46% - 49**%** solids content and the latex content (solids) in the concrete shall be 15 percent by weight of cement.

All aspects of concrete supply and placement are subject to approval by the Engineer.

The use of superplasticizers to ensure the proper consolidation of concrete will be permitted subject to the Engineer's approval of the concrete mix design, however, the Contractor must demonstrate competence and experience in their use and specific approval must be obtained.

Latex modified concrete shall be mixed by mechanical mixer and placed within twenty minutes of batching.

Concrete for beam seats or bearing pad pedestals shall conform to Item 404.04, "Concrete Beam Seats and Bearing Surfaces", of the Specifications Book.

The employment of a pneumatically applied concrete "shotcrete" is a completely acceptable alternative. The work, using this method, will be performed in accordance with Item 419.16, "Rehabilitation with Shotcrete", of the Specifications Book.

Curing

All aspects of curing shall be in accordance with Item 404, "Concrete Structures", of the Specifications Book.

Payment

The unit upon which payment will be based shall be the volume in place measured in cubic metres of newly-built concrete bounded by lines pre-approved by the Engineer.

The volume shall be the difference between sections of the remaining sound concrete and the face of the new concrete or mortar. The volume shall be calculated by the average end area method. Sections shall be taken at regular intervals of not more than 500mm apart. Readings at each section shall be taken to best describe the profile of the concrete surface at that section. Representatives of the Engineer and the Contractor shall be present when the section readings are taken.

Payment shall be made at the unit price bid per cubic metre as per the Unit Price Table. This shall represent full compensation for all labour, equipment and materials necessary to carry out all the work described herein.

419.09 SUPPLY AND REPLACE BEARING PADS

General

The existing bearing pads, at one or more of the abutments and piers, are to be replaced under this contract if so indicated within the Unit Price Table of the Contract Documents. The work entails jacking up the superstructure, the removal of the existing bearing pads, the supply and placement of new bearing pads to the specifications herein and as shown on the drawings.

Procedure

The jacking procedure shall be such that all girders at a particular bearing seat location, i.e. abutment or pier, are raised simultaneously.

The Contractor shall submit detailed drawings supplemented by detailed calculations supporting his proposed method of jacking. Such drawings and calculations shall be stamped by a Professional Engineer licensed to practise in the Province of Newfoundland & Labrador.

Supply and Installation

The supply and installation of bearing pads shall be in accordance with Item 412, “Bearings”, of the Specifications Book and as shown on the drawings.

Payment

Both the measurement for and basis of payment shall be in accordance with Item 412, “Bearings”, of the Specifications Book.

Jacking of the structure, removal and disposal of the existing bearings, setting the superstructure down on the new bearings and all other labour, equipment-use, materials and services required to successfully complete the work specified herein shall be considered incidental.

419.10 REPAIR OF CONCRETE DECK BY OVERLAY

General

The Engineer shall designate all areas to be repaired.

The perimeter of the designated areas shall be sawcut to a depth of 30mm or to the level of the rebar if less than 30mm or as shown on the drawings. Deteriorated concrete within the area shall be removed.

Removal

Concrete shall be removed to a minimum depth of 50mm below the existing deck

elevation or until sound concrete is encountered, whichever is greater. If concrete is to be removed by jackhammer, the maximum hammer mass permitted is 13kg. A **higher hammer size** up to a maximum of 23kg may be used if the concrete is extremely hard provided approval is given by the Engineer.

All tools used in concrete removal shall be pointed to avoid damage to the existing substrate. If any reinforcing steel is found to be exposed, the concrete shall be removed to a clear distance of 25mm below the underside of the reinforcement. If any concrete is required to be removed around reinforcing steel, then the maximum hammer size permitted shall be 7kg. The Contractor shall take care not to damage any existing steel.

During the concrete removal and placing operations care should be taken to keep contaminants off newly exposed surfaces.

All machinery that might leak oil should be kept off this area of deck when possible. If machinery, such as compressor, has to be on this portion of the deck, plastic polyethylene sheets should be placed under it and extreme care should be taken when refuelling. Air compressors must be equipped with a functioning oil trap.

Forty-eight (48) hours of good curing shall have elapsed prior to scarifying and/or chipping an adjacent concrete within 2 metres of a newly placed overlay.

If a spill does occur, the Contractor at his own expense shall have it wiped up and the contaminated concrete chipped away immediately. The deck shall be kept cleaned on a daily basis.

The exposed reinforcing steel and the remaining sound concrete must be protected when mixer trucks and other vehicles are routed over them.

Surface Preparation

Prior to restoration of the deck, all exposed reinforcing steel and concrete substrate shall be satisfactorily sandblasted until the substrate and the steel is free of all rust and loose particles. If the steel is not exposed, the sandblasting may be waived provided that the surface is cleaned with **high pressure** water producing a minimum pressure of 13 MPa. Fine particles of concrete, sand or rust shall be removed by vacuum or jets of oil-free compressed air or water. If substrate is wet only high-pressure water shall be used.

Joints shall be located as shown on the plans. If not shown on the plans, joints shall be located as approved and/or directed by the Engineer. Longitudinal joints shall be located so as to avoid as much as practical their placement in the wheel paths.

At transverse and longitudinal joints, the concrete overlay course previously placed shall be sawed to a straight and vertical edge to a depth of 30mm before the placement of the adjacent course.

At the discretion of the Engineer the concrete overlay thickness may be increased beyond the thickness of the concrete which has been removed so as to maintain the required

concrete cover on the reinforcing steel.

No concrete shall be placed until the prepared surface to be restored is inspected and approval to proceed is given in writing by the Engineer.

In areas where a substantial amount of concrete is removed in excess of 100mm, the excess space shall be filled with concrete as per specification prior to the placement of the overlay.

For a 24-hour period, the substrate including all vertical joints shall be kept damp. Any pools of water which have collected on the concrete shall be blown away with oil free compressed air before application of the bond grout. The bond grout shall be a rich mixture of cement with only sufficient water added to give a consistency such that the imprint remains when indented by the finger. The maximum thickness of bond grout is limited to 3mm. It is important the mixture is not permitted to set before placing the new concrete. If the mixture has set before the concrete has been placed, it shall be mechanically removed, and a fresh coat applied under the direction of the Engineer.

Concrete Supply and Placement

All aspects of concrete supply and placement are subject to approval by the Engineer. High range water reducing agents (superplasticizers) may be used at the Contractor's request if so indicated when the mix
design is submitted. The Contractor must demonstrate competence and experience in their use and specific approval must be obtained.

Cement shall be Type 10 and the water/cement ratio shall not exceed 0.39. The concrete mix design shall be in accordance with Item 404.04., of the Specifications Book.

Maximum aggregate size shall be 20mm, and the aggregate must be sound with a Petrographic Number not greater than 135 and an abrasion loss not greater than 35%.

If superplasticizers are used the maximum slump permitted will be 90mm.

Concrete strength shall be a minimum 20MPa in 48 hours.

Finishing

Finishing with a vibrating bridge deck finishing machine is mandatory. The machine and its operator must receive approval prior to its use. The machine shall be of the vibrating screed type designed to consolidate the concrete by high frequency, low amplitude vibration. Vibration frequency shall be variable with positive control and shall be maintained at a frequency which will remove entrapped air without causing undue lateral flow, "pumping" of mortar or reduction of entrained air. The bottom face of the screeds shall not be less than 100mm wide and be metal. The screeds shall be provided with positive control of the vertical position. When more than one lane of overlay is being placed at one time a moveable work bridge shall be supplied.

Ridges or depressions in the surface shall be removed by using a magnesium bullfloat. Areas around curbs, drains and expansion joints shall be finished with a magnesium hand float. The surface shall not be overworked. The Contractor shall supply a 3m straight edge and the surface shall not deviate from the design grade by more than 8mm. Two qualified concrete finishers approved by the Engineer shall be supplied to perform float and broom finishing operations.

All concrete must be broom finished. Exposed concrete bridge decks shall be given a coarse broom finish. Treated or waterproofed bridge decks shall be given a fine broom finish. The concrete deck surface shall be given a broom finish when the concrete has hardened sufficiently. The broom shall be of an approved type. The strokes shall be square across the slab, from edge to edge, with adjacent strokes slightly overlapped, and shall be made by drawing the broom without tearing the concrete but so as to produce regular corrugations not over 3mm in depth for the coarse broom finish. Fine broom finish shall have corrugations not exceeding 1mm in depth. The surface as thus finished shall be free from porous spots, irregularities, depressions and small pockets or rough spots such as may be caused by accidental disturbance during the final brooming of particles of coarse aggregate embedded near the surface. The Engineer may decide to delete the broom finish requirements, but tolerances previously stated will still apply.

Curing

Immediately after the straight edge requirements have been met the fresh concrete shall be coated with an evaporation retardant "Confilm" to preclude rapid evaporation of the bleed water. All aspects of curing shall be in accordance with Item 404.05 of the Specifications Book for "Curing".

All traffic or loads of any kind must be kept off the new concrete for the entire curing period.

Payment

Measurement for payment for repair to the deck shall be made on a per square metre basis as per the appropriate item in the Tender Form.

Payment for supply and application of the evaporation retardant is considered incidental to the work and no separate payment shall be made for the same.

In all areas of over 0.5m² where additional deteriorated concrete is to be removed below a depth of 50mm, written approval must be obtained from the Engineer before any work is carried out. If this is the case then measurement for payment will be made on a prorate basis, eg., if the removal of concrete over a certain area is required to be removed to a total average depth of 75mm then the area for payment will be adjusted by a factor of 1.5.

If the Engineer requires that the concrete overlay thickness be increased beyond the thickness of the concrete which has been removed, then payment will be made for the additional concrete material as supported by invoices plus 10%. No extra payment will be made for labour, material or equipment associated with placing this additional

concrete.

Any crack sealing required due to cracking occurring up to one month from concrete placement date will be considered incidental to the work and no separate payment will be made. Method of sealing and materials utilized must receive prior approval by the Engineer.

The basis of payment shall be considered complete compensation for all labour, equipment, plant and materials necessary to carry out all the work described herein.

Formwork required due to breaking through the deck shall be considered incidental to the works.

419.11 RESURFACING OF CURBS

General

The Engineer shall designate all areas to be repaired.

The curb concrete shall be resurfaced by the removal of all deteriorated and contaminated concrete and its replacement by a 50mm minimum thickness of 35 MPa air entrained concrete.

Removal

All edges of concrete removal shall be saw cut to a depth of 30mm. Concrete shall be removed to a minimum depth of 50mm below original lines or further until sound concrete is encountered. If concrete is to be removed by a jackhammer, the maximum hammer mass permitted is 13kg. All tools used in concrete removal shall be pointed. If any reinforcing steel is found to be exposed, the concrete shall be removed to a clear distance of 25mm below the underside of the reinforcement. If any concrete is required to be removed around reinforcing steel, then the maximum hammer size permitted shall be 7kg. The Contractor shall take care not to damage any existing steel. The Engineer shall be the sole judge of the extent of removal required.

Surface Preparation

The Concrete substrate and all exposed reinforcing steel shall be satisfactorily sandblasted until the steel is free of all rust and all loose concrete particles have been dislodged. Fine particles of concrete and sand shall be removed using jets of oil-free compressed air or water producing a minimum pressure of 6 MPa. If the substrate is wet at the time of cleaning, then high pressure water jets shall be used to remove these particles. Air compressors must be equipped with a functional oil trap.

The curbs shall be restored as per the drawings. However, no concrete shall be placed until the prepared surface to be restored is inspected and approval in writing is given by the Engineer.

At the discretion of the Engineer the curb resurfacing concrete thickness may be increased beyond the thickness of the concrete which has been removed so as to maintain the required concrete cover on the curb reinforcing steel or to provide a constant curb profile for rail mounting.

Concrete shall be kept damp for a minimum of 24 hours prior to placement of new material. Excess water shall be removed with compressed air. This shall be followed by a rich mixture of cement and water. The bonding mixture shall be cement with only sufficient water added to give a consistency such that the imprint remains when indented by the finger. The maximum thickness of bond grout is limited to 3mm. It is important that the mixture not be permitted to set before placing the new concrete. If the mixture has set before the concrete has been placed, it shall be mechanically removed, and a fresh coat applied under the direction of the Engineer.

Supply and Placement of Concrete

All aspects of concrete supply and placement are subject to approval by the Engineer. High range water reducing agents (superplasticizers) may be used at the Contractor's request if so indicated when the mix design is submitted. The Contractor must demonstrate competence and experience in their use and specific approval must be obtained.

Cement shall be Type 10 and the water/cement ratio shall not exceed 0.39. The concrete mix design shall be in accordance with Item 404.04, of the Specifications Book.

Nominal maximum aggregate size shall be 20mm, and the aggregate must be sound with a Petrographic Number not greater than 135 and an abrasion loss not greater than 35%.

If superplasticizers are used, then the maximum slump shall be 90mm.

Concrete strength shall be at least 20 Mpa in 48 hours.

Finishing

The concrete shall be finished immediately after strike-off and before the appearance of bleed water using a magnesium float.

The surface shall not be overworked or sealed. All concrete shall be broom finished. The Contractor shall supply a 3m straight edge and the surface shall not deviate from the design grade by more than 8mm.

Two qualified concrete finishers approved by the Engineer shall be supplied to perform float and broom finishing.

Curing

Immediately after finishing, the Contractor shall apply an evaporation retardant and finishing aid called "Confilm" manufactured by Master Builders Company Ltd. or equivalent. The product shall be applied as per manufacturer's instructions and recommendations.

All aspects of curing shall be in accordance with Item 404.05 of the Specifications Book for "Curing".

Payment

Any crack sealing required due to cracking, occurring up to one month from concrete placement date, will be considered incidental to the work and no separate payment will be made. Method of sealing must receive prior approval.

In all areas of over 0.5m² where additional deteriorated concrete is to be removed below a depth of 50mm, written approval must be obtained from the Engineer before any work is carried out. If this is the case, then the payment will be made on a reduced prorate basis (25% of bid price for each additional 25mm) eg., if concrete is required to be removed to a total average depth of 75mm, then the area for payment will be adjusted by a factor of 1.25.

Measurement for payment for repair to curbs shall be made per square metre, including both plan and vertical faces. In some cases the existing outside face of curb is an inclined surface and the rehabilitated curb has a vertical face. All measurements for payment will be on the inclined surface as indicated on the drawing. Additional concrete required to create a vertical outside face, anchors and additional reinforcing steel is considered incidental to the work. Payment shall be for a 50mm depth of overlay as per the appropriate item of the Schedule of Quantities and Prices.

If the Engineer requires that the curb resurfacing concrete thickness be increased beyond the thickness of the concrete which has been removed than payment will be made for the additional concrete material as supported by invoices plus 10%. No extra payment will be made for labour, material or equipment associated with placing this additional concrete.

Payment for supply and application of the evaporation retardant is considered incidental to the work and no separate payment shall be made for the same.

The basis of payment shall be considered complete compensation for all labour, equipment, plant and materials used to carry out this work.

419.12 REPLACEMENT OF EXPANSION JOINT SYSTEMS AND ASSOCIATED WORK

General

Where expansion joints on the structure(s) are to be replaced by a new sealant system, the expansion joint shall be in accordance with Item 413, "Expansion Joints". Areas of deck adjacent to the expansion joints may have an undetermined degree of deterioration. It is also necessary to remove sections of the deck and backwall to accommodate the new joint system. All concrete to asphalt joints must be sawcut, a space provided and filled with an approved sealant, as described on the drawings.

It will be the Contractor's responsibility to ensure that exact dimensions of the replacement joint are correct.

All deck repairs adjacent to joints and overlays must be complete prior to the installation of concrete in expansion joint dams and asphaltic plug joints.

Removal

The work shall entail the removal of concrete, existing sealants, joint fillers and water stops. The work shall be performed as detailed on the drawings. All existing formwork remaining from the original construction along with any accumulated debris on the beam seats shall be removed and disposed of to the Engineer's satisfaction.

Concrete shall be removed to 300mm each side of the joint centerline in plan view and removal shall be to a depth of 200mm in the deck and 300mm in the backwall. If concrete is to be removed by jackhammer, the maximum hammer mass permitted is 13kg. All tools used in concrete removal should be pointed.

If any reinforcing steel is found to be exposed, the concrete shall be removed to a clear distance of 25mm below the underside of the reinforcement.

If any concrete is required to be removed around reinforcing steel, then the maximum hammer size permitted shall be 7kg. The Contractor shall take care not to damage any existing steel.

Surface Preparation

At the edge of areas to be repaired, a neat line shall be sawcut, a minimum of 30mm, to preclude featheredges. Prior to restoration of these areas, the concrete substrate and all exposed reinforcing steel shall be satisfactorily sandblasted until the steel is free of all rust, all loose particles of concrete and sand shall be removed with oil-free jets of compressed air or water producing a minimum pressure of 6 MPa. If the substrate is wet at the time of cleaning, then it shall be cleaned with high pressure jets of water. A pressure gauge shall be installed in the water or air lines in order to verify the specified pressure.

The deck and backwall shall then be restored as per the drawings. However, no concrete shall be placed until the prepared surface to be restored is inspected and approval in writing is given by the Engineer.

Concrete substrate shall be kept damp for a minimum of 24 hours prior to placement of concrete.

Any excess water shall be removed with compressed air. This should be followed by a rich mixture of cement and water. The bonding mixture shall be cement with only sufficient water added to give a consistency such that the imprint remains when indented by the finger. The maximum thickness of bond grout is limited to 3mm. It is important that the mixture not be permitted to set before placing the new concrete. If the mixture has set before the concrete has been placed, it shall be mechanically removed, and a fresh coat applied under the direction of the Engineer.

Supply and Placement of Concrete

All aspects of concrete supply and placement are subject to approval of the Engineer. High range water reducing agents (superplasticizers) may be used at the Contractor's request if so indicated when the mix design is submitted. The Contractor must demonstrate competence and experience in their use and specific approval must be obtained.

Concrete strength shall be at least 20MPa within 48 hours, and the maximum water/cement ratio shall not exceed 0.39. The concrete mix design shall be in accordance with Item 404.04. Maximum aggregate size shall be 20mm, and the aggregate must be sound with a Petrographic Number not greater than 135 and an abrasion loss not greater than 35%.

If superplasticizers are used, the maximum slump permitted will be 90 mm.

Finishing

Concrete must be finished using a magnesium float immediately after strike-off and before the appearance of bleed water. All concrete must be broom finished. The surface shall not be overworked. The Contractor shall supply a 3m straight edge and the surface shall not deviate from the design grade by more than 8mm.

Curing

Immediately after the concrete has been placed and finished, the Contractor shall apply an evaporation retardant and finishing aid called "Confilm" manufactured by Master Builders Company Ltd. or approved equivalent. The product shall be applied as per manufacturer's instructions and recommendations.

All aspects of curing shall be in accordance with Item 404.05 of the Specifications Book for "Curing".

Payment

Measurement for payment on a lump sum basis shall be made for each expansion joint system as bid in the appropriate

item of the Schedule of Quantities and Prices.

An expansion joint system shall be defined as all items, materials and work within the physical bounds defined by the length of the expansion joint, 300mm on each side of the joint centerline, 200mm deep in the concrete deck and 300mm deep in the backwall.

The basis of payment for "Replacement Of Expansion Joint System And Associated Work", shall represent full compensation for all labour, equipment, plant and materials necessary to remove existing concrete, expansion joint(s), sealants(s), joint filler(s), and waterstop(s), surface preparation, restoration of the deck and backwall, addition of a bonding mixture, supply and installation of a new expansion joint, supply, placement, finishing and curing of concrete in addition to all other items necessary to complete the work as outlined in this specification.

Any work required in the adjacent roadway surface to maintain grade, eg., asphalt saw cutting, replacement and sealing of joints shall be carried out neatly and its cost shall be considered incidental.

Expansion joints constructed where the average tested 28 day strength of the concrete in the expansion joint dam is less than the specified strength but otherwise meets the specifications will be accepted at a reduced payment provided the difference between the specified strength and the average tested 28 day is no greater than 10MPa. If the difference is greater then 10MPa than the expansion joint shall be rejected. The Contractor shall remove the expansion joint dam and repour the concrete.

When concrete is rejected, those provisions outlined in CSA-A23.1 shall be followed to determine whether or not the concrete may remain in the work. Suck work shall be done at the contractor’s expense. Not withstanding the above, should the concrete remain in the work it shall be subject to a reduction as outlined below, for having a strength less than that specified.

If the concrete in any portion of the expansion joint is found to have a strength deficiency of less than 10MPa than the lump sum bid price for the expansion joint will be adjusted in accordance with the following:

$$ALSP = BLSP – BLSP*.02*(SS-TS)*(LJDC/LJ)$$

Where:

ALSP = Adjusted Lump Sum Price for the Expansion Joint
BLSP = Bid Lump Sum Price for Expansion Joint
SS = Specified 28 day strength (MPa)
TS = Tested Average 28 day strength (MPa)
LJDC = Length of Joint with Deficient Concrete (m)
LJ = Length of Joint (m)

419.13 REMOVAL AND REPLACEMENT OF ALUMINUM BRIDGERAIL AND ANCHOR BLOCKS

General

The work will entail the complete removal of all existing bridgerail and anchor blocks, the removal and replacement of concrete in designated areas large enough to accommodate Richmond Anchors, the supply and installation of aluminum bridgerail system and the replacement of new anchor blocks. All bridgerail to be in accordance with Item 415 “Aluminum Bridge Railings”.

Removal

If concrete is to be removed by jackhammer, the maximum hammer mass permitted is 13kg. If any reinforcing steel is found to be exposed, the concrete shall be removed to a clear distance of 25mm below the underside of the reinforcement. The Contractor shall take care not to damage any existing steel.

Surface Preparation

The work shall be performed as per the drawings and under the direction of the Engineer. However, no concrete shall be placed until the prepared surface to be restored is inspected and approval in writing is given by the Engineer.

For a 24 hour period the substrate shall be dampened with water and followed by a rich mixture of cement and water. Excess and ponded water shall be removed before the application of the cement and water mixture.

Supply and Placement of Concrete

All aspects of concrete supply and placement are subject to approval by the Engineer. High range water reducing agents (superplasticizers) may be used at the Contractor's request if so indicated when the mix design is submitted. The Contractor must demonstrate competence and experience in their use and specific approval must be obtained.

Cement shall be Type GU and water/cement ratio shall not exceed 0.39. The concrete mix design shall be in accordance with Item 404.04., of the Specifications Book.

Maximum aggregate size shall be 20mm, the aggregate must be sound with a Petrographic Number not greater than 135 and an abrasion loss not greater than 35%.

Curing

Immediately after the straight edge requirements have been met the fresh concrete shall be shielded from solar radiation and wind to preclude rapid evaporation of the bleed water.

All aspects of curing shall be in accordance with Item 404.05 of the Specifications Book

for "Curing".

Payment

Measurement for payment for this work shall be made lump sum as per the appropriate item of the Schedule of Quantities and Prices.

The basis of payment shall represent full compensation for all labour, equipment, plant and materials necessary to carry out all the work described herein.

The supply and placement including drilling and grouting of rebar in anchor blocks is considered incidental. Payment for supply of aluminum rail shall be made upon receipt of invoice and material on site.

In the event that the Contractor does not receive delivery of the aluminum handrail by the scheduled completion date for the project, then he shall erect a suitable temporary protective railing, acceptable to the Engineer. This shall be considered incidental.

No payment for installation of rail or posts shall be made until all rail is in place and accepted by the Engineer.

419.14 REPLACEMENT OF DECK DRAINS AND ASSOCIATED WORK

General

The work shall entail the removal of existing drains, the supply and installation of new drains at the location shown on the drawings and the reinstatement of concrete surrounding them. The holes left by the existing drains shall be filled with new concrete. All aspects of concrete work shall be as directed in Item 419.10 "Repair of Concrete Deck By Overlay".

For rehabilitation type projects, the hole for the deck drain downspout shall be drilled through the concrete deck with a core bit. Breaking through the deck with a jackhammer is not permitted. The core bit shall be capable of drilling a hole of sufficient size to easily accommodate the outside diameter of the downspout.

Any gap between the drilled hole and the outside of the drain downspout shall be grouted to the satisfaction of the Engineer.

The new drains shall be fabricated and installed as per the drawings. The drains must be installed before placement of the surrounding deck and curb concrete. Drains shall be in accordance with Item 418, "Deck Drains".

Payment

Measurement for payment shall be made for each deck drain replaced as per the appropriate item of the Schedule of Quantities and Prices.

The basis of payment shall represent full compensation for all labour, equipment and materials required to complete the work described herein.

419.15 REMOVAL AND DISPOSAL OF OLD ASPHALT

General

The existing asphalt shall be sawcut transversely across the roadway at a point located 15 metres from each expansion joint on both approaches to the bridge as approved by the Engineer.

The old asphaltic pavement and granulars as required shall be excavated from within the limits as described above, removed, loaded, transported and disposed of at a site approved by the Engineer.

Mechanical scarifiers or pneumatic hammers having maximum rating of 28kg and equipped with chisel bits shall be used. The use of graders or backhoes for the removal of any bituminous materials from the bridge deck will **NOT** be permitted. Front end loaders may be permitted if approved by the Engineer.

The cutting of old asphaltic pavement to be excavated shall be as outlined in accordance with Item 352, “Full Depth Asphalt Patch”.

Care shall be taken in excavating the pavement on the approaches so as not to contaminate or over excavate the underlying granular base course.

The waste disposal area shall be provided by the Contractor and approved by the Engineer. The Contractor shall be aware of Division 9 General Environmental Requirements.

The Contractor shall transport the pavement debris to the waste disposal area then place and trim the debris to sightly proportions.

When traffic is maintained on the structure during repair, only one lane of asphalt shall be removed at a time until the concrete in the adjoining lane has been satisfactorily restored and cured.

Payment

Measurement for payment for the removal and disposal of old asphaltic pavement shall be in square metres rounded to one decimal place. Measurements shall be made before removal and shall be the plan area of the pavement surface actually removed. Measurement for payment regarding the cutting of old asphaltic pavement will not be made.

The basis of payment at the contract unit price for the removal and disposal of old

asphaltic pavement under the appropriate item of the Schedule of Quantities and Prices shall be full compensation for all labour, materials and equipment use for: sawcutting, excavation, removal, loading and transporting the old asphalt and waste from the job to disposal site, off loading, placing the debris and trimming to sightly proportions. Also included in the tendered unit price is the obtaining of an approved waste disposal area. The excavation, removal, transportation, disposal, and trimming of contaminated granular material shall be considered incidental to the work.

419.16 REHABILITATION WITH SHOTCRETE

General

The work will require the complete removal of old concrete, surface preparation, reinforcement and the application of shotcrete. This work shall be carried out in accordance with ACI Standard 506.2-77 "Specifications for Materials Proportioning and Application of Shotcrete", except as modified by the requirements of this project.

Removal of Deteriorated Concrete

Existing concrete shall be removed to a minimum depth of 50mm beyond original lines or as shown on the drawings. If sound concrete is not encountered, then the removal shall continue beyond the specified depth as determined by the Engineer.

Approval to proceed beyond the specified depth must be obtained from the Engineer.

If concrete is to be removed by jackhammer, the maximum hammer mass permitted will be 13kg. All tools used in concrete removal shall be pointed. If any reinforcing steel is found to be exposed, the concrete shall be removed to a clear distance of 25mm beyond the reinforcement. If any concrete is required to be removed around reinforcing steel, then the maximum hammer size permitted shall be 7kg. The Contractor shall take care not to damage any existing steel. All edges of concrete removal should be tapered to a 1/1 slope, to the full depth of removal, to prevent the entrapment of rebound. The Engineer shall be the sole judge of the extent of removal required.

Reinforcing steel which is found to be deteriorated or damaged shall be removed and replaced as determined by the Engineer.

Surface Preparation

Prior to restoration of the sections, the concrete substrate and all exposed reinforcing steel shall be satisfactorily sandblasted until the steel is free of all rust and all loose particles of concrete have been dislodged. Fine particles of concrete and sand shall be removed with oil-free jets of compressed air or water producing a minimum pressure of 6 MPa. If the substrate is wet at the time of cleaning, then it shall be cleaned with high pressure jets of water. Air compressors must be equipped with a functioning oil trap.

The Contractor shall inform the Engineer of areas ready for shooting at least 24 hours in advance of shooting to allow for inspection and measurement.

The concrete substrate shall be kept damp for a minimum of 24 hours prior to shooting. Any excess water shall be removed with compressed air.

Materials

Materials shall comply with latest requirements of the following CSA Standards:

Cement CSA A5.1 Portland Cement - Type GU/GUb
Sand CSA A23.1 Section 5.3 Fine Aggregate
Water CSA A23.1 Clause 5.2 Water

The Engineer may require samples of the materials to be used before work starts and periodically during the work to ensure quality and consistency.

Mix Design

The proportion of cement to sand shall be based on dry and loose volumes and shall be one part of cement to not more than 3½ parts of sand. The sand shall contain not less than 3% and not more than 5% moisture by weight. The water content of the final mixture shall be maintained at a practical minimum, but not more than 0.35kg of water per kg of cement. The moisture content of the sand will be checked from time to time during the course of the work. The shotcrete shall have a minimum compressive strength of 30 MPa at 28 days.

The dry mix process only is deemed to be acceptable as described in ACI 506-66.

Measurements of sand and cement by shovel, wheelbarrow or similar haphazard means will not be acceptable. No premixed material shall stand for more than 45 minutes prior to delivery through the hose.

Welded Wire Mesh

A welded, plain, WGW steel mesh with a wire spacing of 51mm (2") in each direction of 14-gauge wire shall be attached to the area to be repaired. This mesh shall be placed so that:

(i) the cover to the mesh is 40mm minimum.

(ii) the space between the mesh and existing concrete is not less than 10mm. The mesh shall be securely fastened by approved concrete anchors embedded in the concrete on a 450mm square grid with tie wire. Wire mesh shall be lapped 1½ squares in all directions.

Application of Shotcrete

No shotcrete shall be applied at an air temperature lower than 8°C. Prior to the application a test panel shall be shot in the presence of the Engineer to ensure competency of the

nozzleman.

The test panel will be approximately 3 square metres, with one-half vertical and the other half horizontal, in order for the nozzleman to demonstrate horizontal and overhead shooting on the same panel unit. Short reinforcing bars and wire mesh will be attached to the test panel as directed by the Engineer. This requirement may be waived if reliable references who attest to the nozzleman's ability are supplied.

Before application of the shotcrete the cleaned surfaces shall be washed down with water and all loose material such as rebound, or overspray removed by a water or air blast. The concrete substrate at the time of shooting should be damp with no free moisture on the surface.

The shotcrete shall be pneumatically applied by a suitable apparatus, operated only by experienced and competent persons who fulfill the requirements as set out in chapter 5 of ACI Standard "Recommended Practice for Shotcreting (ACI 506.66)". The Contractor shall submit letters to the Engineer stating the qualifications and experience of the nozzleman and the shotcrete pump operator. It is necessary to obtain approval from the Engineer before any nozzleman is employed on the site.

The pressures applied to the materials shall be such that the water is thoroughly mixed with the sand-cement mixture with the water pressure being "0.1 MPa higher". The air and water pressures shall be uniform so that a steady continuous flow of shotcrete is applied with no surging.

The velocity of the shotcrete as it leaves the nozzle shall be maintained uniform at a rate determined for the given job conditions to produce the minimum rebound. The nozzle shall be held perpendicular to the surface at distance between 600 and 1500mm. The rate of application and the depth of build-up of the shotcrete shall be adjusted to avoid sag or separation. In general, the maximum thickness of a single layer shall be 50mm on vertical surfaces and 25mm on overhead surfaces. Rebound or accumulated loose material shall be removed from any surface prior to the placing of additional layers of mortar. This rebound or loose material shall not be reused. The Contactor shall supply and install ground wires to control thickness and to assist the Engineer's and Contractor's representatives in making the necessary measurements for payment purposes. The maximum thickness of a single vertical or horizontal layer may be increased if sagging or separation can be avoided, with approval from the Engineer.

Forms shall be structurally sufficient and of such design that rebound or accumulated loose material can freely escape or can be readily removed. Shooting strips shall be used wherever necessary to form chamfers, corners, edges, and/or surfaces where it is necessary to obtain true lines, proper thickness and cover over steel. Cold joints shall be avoided wherever possible.

At the end of any period of placing shotcrete, the material shall be sloped to a thin edge. Before placing an adjacent section, this sloped portion shall be thoroughly cleaned by sandblasting or water blasting and wetting. This shall also apply when placing an additional lift atop a previously placed layer, where the shotcrete has taken final set.

For curing and subsequent testing purposes the Contractor shall supply the Engineer with test panels of the shotcrete approximately 400mm x 400mm x 100mm in size. The panels shall be supplied whenever required by the Engineer throughout the project, with at least one panel supplied per 8-hour shift.

Finishing

The shotcrete shall have a natural gun finish unless otherwise specified. Any roughness around the edges or overspray shall be removed with a trowel.

Curing

All areas shall be cured first using a fog spray on the surface of the shotcrete.

After the shotcrete has set, curing with wet burlap, or wet, white non-woven filter fabric as per Item 404.05., “Moist Curing”, with a continuous sprinkling system shall begin and continue for seven days.

Measurement for Payment

Measurement for payment will be based upon the volume measured in place in cubic metres to the nearest one decimal place of newly built shotcrete as per the appropriate item in the Tender Form. No payment shall be made for concrete removed or replaced beyond the specified depth or lines, unless the Engineer has instructed the removal or replacement in writing.

If the Engineer has instructed further removal the following shall apply.

The volume shall be the difference between sections of the remaining concrete and the face of the new shotcrete. The volumes shall be calculated by the average end area method. Sections shall be taken at regular intervals of not more than 500mm, readings at each section shall be taken to best describe the profile of the concrete surface at that location.

Representatives of the Contractor and the Engineer shall be present when the section readings are taken.

Payment

Payment shall represent full compensation for all labour, equipment and materials necessary to carry out all the work described herein.

419.17 SUPPLY AND PLACE TREMIE CONCRETE

The supply of concrete materials, supply, mixing, transportation, placing and curing of concrete, measurement for and basis of payment shall be as outlined in Item 404 “Concrete Structures”.

ITEM 422

ASPHALTIC PAVING OF BRIDGE DECKS

422.01 SCOPE OF WORK

This specification applies to both existing or rehabilitated and new concrete bridge decks where asphaltic paving is being undertaken.

The scope of the work covers the requirements for the asphaltic paving of both treated and waterproofed new concrete bridge decks and concrete approach slabs with hot mix asphaltic surface course concrete. The paving of rehabilitated bridges and their approaches, in addition to the supply, transportation, placing and compaction of selected granular base course is also part of this work.

If paving items are contained in a current or ongoing road contract, the approaches including the approach slab where appropriate will be paved under the road contract. Otherwise, granular and paving operations up to 15 metres from the abutment backwall shall be included in the bridge contract.

Treating of rehabilitated bridge decks and some new bridge decks is also included. Waterproofing of all remaining bridge decks is provided for elsewhere.

The paving of bridge decks is not permitted without the specific approval of the Construction Division, Department of Planning, Engineering and Regulatory Services.

422.02 MATERIALS

.01 Tack Coat for Treated Bridge Decks

The material shall conform to Item 354 for Tack Coat.

.02 Selected Granular Base Course

Selected granular base course shall be of Granular "A" or Granular "B" gradation as required. This material shall conform to Item 323 Gravel for Streets.

.03 Hot Mix Asphaltic Concrete

Materials which comprise hot mix asphaltic concrete for paving bridge decks shall be of surface course gradation and quality. Item 351 Hot Mix Asphaltic Concrete shall govern.

.04 Joint Sealing Compound

Joint sealing compound shall conform to Item 414.03.06 Joint Sealing Compound.

.05 Hot Mix Asphaltic Concrete Sealant

This material shall conform to Item 414.03.07 Hot Mix Asphaltic Concrete Sealant.

422.03 EQUIPMENT

For treated bridge decks only, an approved pressure distributor may be utilized to place tack coat on the concrete deck. The distributor shall strictly conform to Item 354 Tack Coat. Overspray along curbs and expansion joint dams will not be permitted, soil or gravel will not be tracked onto the bridge and approval is required from the Engineer stating the conditions of use. Alternatively, the following equipment must be utilized if so required by the Engineer.

Equipment for applying tack coat on bridge decks to be waterproofed shall be limited to a manually operated spray rod which shall produce a uniform fog-type spray. The lower part of the spray rod shall be bent 30 degrees to form a section of rod parallel to the deck. The pressurized container which holds the tack coat shall be equipped with a thermometer and pressure gauge.

All plant and equipment required to supply, produce, transport, place, spread and compact granulars shall conform to Item 323 Gravel for Streets.

All paving equipment and plant shall conform to Item 351 for Hot Mix Asphaltic Concrete.

The equipment used for filling the grooves and sealing the surface adjacent to the curbs and transverse joint filling with sealant at each expansion joint dam shall be approved by the Engineer.

422.04 CONSTRUCTION PROCEDURES

.01 General

All concrete surfaces shall be cured in accordance with Item 404.05 for "Curing" and be in a dry condition before the work as described herein may commence. Work shall not be performed during rainy or inclement weather or on wet, snow or frost covered surfaces.

.02 Treated Bridge Decks

Treated bridge deck construction procedures shall apply to all bridge decks where waterproofing is not carried out. The treatment procedure shall be as outlined herein. The process shall apply to both the suspended deck and the concrete approach slab.

02.01 Deck Cleaning and Preparation

First, the Contractor shall sweep the bridge deck and approach slabs either manually or with a power broom. This shall be followed by a cleaning of the deck and approach slabs with oil-free compressed air. Tack coat shall be applied in accordance with Item 354 for Tack Coat.

Removal and disposal of old asphaltic pavement and deck rehabilitation shall be covered in Item 419 Rehabilitation of Concrete Structures.

02.02 Granulars

Work under this classification is generally related to selected granular base course operations on rehabilitation type projects.

Contaminated granular material shall be excavated and disposed of as directed by the Engineer.

Suitable existing selected granular base course shall be reshaped and recompacted (one hundred percent (100%) maximum standard proctor dry density, ASTM D698) to grade as established by the Engineer.

Additional granular material shall be produced, supplied, transported, stored, placed, graded and compacted in accordance with Item 323 Gravel for Streets. The width and thickness of the granular base course and granular shoulders shall be in conformance with the bridge approaches and the standard of roadway to which it is being applied as per the typical cross section. The length shall be in accordance with the length of existing pavement removed and disposed of as determined by the Engineer, generally 15m from the abutment back wall.

02.03 Paving

All construction procedures related to paving shall conform to Item 351 for Hot Mix Asphalt Concrete except as outlined herein.

Paving shall proceed downgrade.

Paving shall commence as soon as practical when the tack coat has adequately cured.

Compaction using vibration is not permitted on bridge decks and approach slabs.

The deck, concrete approach slabs and bridge approaches where applicable on rehabilitation type projects shall be paved with hot mix, hot laid asphaltic surface course concrete.

On approaches to rehabilitation type projects, i.e., generally 15 m from the abutment

backwalls, new asphaltic surface course concrete shall be placed in two 40mm lifts. The deck and concrete approach slabs shall be paved with one 50mm lift and the new asphalt grades shall match the elevations of the concrete expansion joint dams. The thickness of paving on new concrete decks and approach slabs shall be in accordance with the contract drawings.

The approaches to the bridge shall be paved first thus avoiding the transfer of foreign particles on the deck so as to preclude damage to the treated deck.

Prior to commencing deck paving operations, the Contractor shall cover all deck drains to prevent the entry of hot mix asphalt. The covers shall be secured to the deck drains. After breakdown rolling is complete, covers shall be removed from all deck drains. In addition, the Contractor shall place a removable filler strip in each expansion joint gap and for the full length of each joint. The purpose of the expansion joint filler strip is to preclude the hot mix asphalt from entering the flexible expansion joint gap(s). After paving operations are complete, the filler strip shall be removed. The Contractor shall clean both the deck drains and expansion joints and dispose of waste material.

02.04 Forming and Filling Grooves with Joint Sealing Compound

This operation applies to the joints created adjacent to and for the full length of each curb. The work shall be carried out in accordance with Item 414.04.08 for Forming and filling Grooves with Joint Sealing Compound.

02.05 Sealing Surface of Asphaltic Concrete Adjacent to Curbs

This work shall be carried out in accordance with Item 414.04.09 of the Specifications Book, Sealing Surface of Asphaltic Concrete Adjacent to Curbs.

02.06 Transverse Joint Filling

The groove may be formed by placing a 10mm by 10mm vee shaped wooden strip across the width of the deck and against each concrete face at each expansion joint dam. The wooden strip shall be coated with an approved bond breaker. The strip shall be removed after the hot mix asphalt has been fully compacted. The vee groove shall be blown out with oil-free compressed air and filled with Cold Applied Sealant or Joint Sealing Compound.

The application of sealant or compound shall be carried out when the temperature is at or above 5°C and the joint is dry. Traffic shall be kept off the transverse joint until the Sealant is set-up which should take from two (2) to five (5) hours for the cold applied sealant.

.03 Waterproofed Bridge Decks

03.01 Waterproofing

The materials and treatment procedure for the concrete surface preparation, surface conditioner for asphaltic membrane, application of asphalt and rubber membranes, protection boards and protection board tack coat, the forming and filling of grooves with joint sealing compound and sealing of the asphaltic surface adjacent to the concrete curbs shall be as outlined in accordance with Item 414 “Bridge Deck Waterproofing”.

Bridge decks that are waterproofed shall have their concrete approach slabs treated as per Item 422.04.02 “Treated Bridge Decks”.

03.02 Paving

All construction procedures relating to paving shall be as outlined in Item 422.04.02.03 for paving, except as outlined herein.

The thickness of paving on waterproofed decks and treated approach slabs shall be in accordance with the contract documents.

Paving of the bridge deck should commence as soon as practical after waterproofing operations described in Item 414 for Bridge Deck Waterproofing have been completed. Care should be taken so as to not damage the installed waterproofing system. Displacement or puncturing of the protection board is not acceptable. Turning of vehicles on the bridge deck is prohibited.

Paving operations shall be conducted downgrade in the direction of protection board overlap.

The trucks should dump part of their load into the paver and then move down the deck away from the paver, so that the paver does not have to push the truck. Care must be taken to remove any hot mix material from the deck that may have spilled in front of the paver tracks or tires so that it does not perforate the membrane.

The speed of the asphalt spreader should be kept down in the range of three (3) to four (4) metres per minute in order to provide maximum traction.

The temperature of the asphalt should cool to 115°C before breakdown rolling begins with a suitable static steel wheel roller. The protection boards may squirm under the roller and crack the hot mix around the protection board perimeter if breakdown rolling is attempted too soon. The breakdown roller should make only one pass over the mat. The mat should then be rolled with a rubber-tired roller. Starting and stopping on the newly paved deck is not permitted.

03.03 Transverse Joint Filling

Transverse joint filling shall be carried out as described previously in this specification. However, only hot applied joint sealing compound is to be utilized.

422.05 MEASUREMENT FOR PAYMENT

.01 Treated Bridge Decks

Measurement for payment for the asphaltic paving of bridge decks, shall be outlined in Item 351 for Hot Mix Asphaltic Concrete.

Measurement for payment for the asphaltic paving of new bridge decks shall be confined to the actual tonnage of hot mix asphaltic concrete placed on the bridge deck and concrete approach slabs as directed by the Engineer. On rehabilitation type projects, measurement for payment shall include the actual tonnage placed on the deck, concrete approach slabs and approaches within the limits as directed by the Engineer.

Measurement for payment for bridge deck and concrete approach slab sweeping, cleaning, preparation, tack coating, forming and filling grooves with sealant or joint sealing compound, sealing the surface of asphaltic concrete adjacent to curbs, transverse joint forming and filling, the provision for deck drain cover plates and expansion joint filler strips will not be made.

Payment for the production, supply, storage, transportation, placing, grading and compaction of Selected Granular Base Course will not be made for rehabilitation type projects.

Measurement for payment for the production, supply, storage, transportation, placing, grading and compaction of selected granular base course material on new construction projects shall be in accordance with Item 323 Gravel for Streets.

Payment for cutting existing asphaltic pavement, removal, transportation and disposal of old asphaltic pavement will be made in accordance with Item 419 “Rehabilitation of Concrete Structures”.

.02 Waterproofed Bridge Decks

Measurement for payment for deck waterproofing shall be paid for under Item 414 “Bridge Deck Waterproofing”.

Payment for concrete approach slab sweeping, cleaning, preparation, tack coating, forming and filling grooves with joint sealing compound, sealing the surface of asphaltic concrete adjacent to curbs, transverse joint forming and filling, the provision for deck drain cover plates and expansion joint filler strips will not be made.

Measurement for payment for the Asphaltic Paving of Bridge Decks shall be as outlined

in Item 351 “Hot Mix Asphaltic Concrete”.

Measurement for payment for the asphaltic paving of waterproofed bridge decks shall be confined to the actual tonnage of hot mix asphaltic concrete placed on the bridge deck and concrete approach slabs as directed by the Engineer.
No separate payment will be made for liquid asphaltic cement or blending sand.

Measurement for payment for the production, supply, storage, transportation, placing, grading and compaction of selected granular base course material on new construction projects shall be in accordance with Item 323 “Gravel for Streets”.

422.06 PAYMENT

.01 General

The item in the Schedule of Quantity & Price for "Asphaltic Paving of Bridge Decks" shall contain either one of the following two phrases, (a) **"Treated Bridge Decks"** or (b) "**Waterproofed Bridge Decks"** whichever is applicable to the project being tendered.

The basis of payment for the asphaltic paving of bridge decks shall be as outlined in Item 351 “Hot Mix Asphaltic Concrete”.

.02 Treated Bridge Decks

The basis of payment at the contract unit price for the asphaltic paving of bridge decks shall include full compensation for all equipment, labour, materials and plant necessary to prepare, sweep and clean the deck, supply and apply tack coat, pave the bridge deck, concrete approach slabs and approaches on rehabilitation type projects, form and fill grooves with joint sealing compound, sealing the surface of asphaltic concrete adjacent to curbs and transverse joint forming and filling as described above. Also included is the supply and transportation of all blending sand and asphaltic cement from the source to the mixing plant.
For rehabilitation type projects the excavation, removal transportation and disposal of contaminated granulars, the reshaping and recompacting of suitable existing granulars and the production, supply, storage, transportation, placing, grading and compaction of additional selected granular base course shall be considered incidental to the work.

For new projects the production, supply, storage, transportation, placing, grading and compaction of selected granular base course shall be paid for separately under Item 323 Gravel for Streets.

The basis of payment for cutting existing asphalt, removal, transportation and disposal of old asphaltic pavement on rehabilitation type projects shall be made in accordance with terms outlined elsewhere in Item 419 “Rehabilitation of Concrete Structures”.

The covering of deck drains and expansion joints to prevent the entry of hot mix asphaltic concrete, the removal of the cover plates and filler strips, clean up and disposal of waste material shall be considered incidental to the work.

.03 Waterproofed Bridge Decks

Payment for the waterproofing of bridge decks and all related work shall be as outlined in Item 414 “Bridge Deck Waterproofing”.

The basis of payment at the contract unit price for the asphaltic paving of waterproofed bridge decks shall include full compensation for all equipment, labour, materials and plant necessary to prepare, sweep, clean and tack coat the concrete approach slabs, pave the bridge deck and concrete approach slabs. Included is the forming and filling of approach slab grooves with joint sealing compound and sealing the asphaltic surface adjacent to the concrete curbs, form and complete transverse joint filling as described above. Also included in the basis of payment is the supply and transportation of all blending sand and asphaltic cement from the source to the mixing plant.

The basis of payment for the production, supply, storage, transportation, placing, grading and compaction of selected granular base course shall be provided for separately under Item 323 Gravel for Streets.

The covering of deck drains and expansion joints to prevent the entry of hot mix asphaltic concrete, the removal of the cover plates and filler strips, clean up and disposal of waste material shall be considered incidental to the work.

ITEM 424

APPLICATION OF CONCRETE SEALER

424.01 SCOPE OF WORK

Contractors are advised that all concrete which is placed after September 1st. and before April 30th, and exposed to weather, water and/or de-icing chemicals shall receive at least one (1) application of concrete sealer prior to traffic opening or exposure to salt, whichever comes first.

This shall apply to all superstructure concrete as defined in 404, “Concrete Structures”, of the Specifications Book, Approach Slab Concrete, and those parts of the substructure included herein: (a) front and sides of abutment stem, (b) front, rear and sides of the back wall, (c) top, sides and bottom of the corbel, (d) bearing seat and pedestals, (e) parts of the wing wall concrete which is placed with the curb concrete, (f) pier or column concrete and (g) as directed by the Engineer. If part of a wingwall or abutment surface requires an application of concrete sealer and another part does not, the Contractor shall apply to the additional visible portion thereof.

424.02 MATERIALS

The penetrating sealer shall be a clear siloxane solution designed to provide maximum protection of concrete surfaces. Silanes with at least forty percent (40%) silanes by weight or concentration are considered acceptable.

The durability and abrasion resistance of penetrating sealer shall make it suitable for protecting horizontal and vertical surfaces. Penetrating sealer shall have excellent breath ability, i.e. be permeable to water vapour, and provide protection against chloride-laden water.

The material should not significantly darken or discolour concrete.

It should be suitable for application on new concrete which is twenty-eight (28) days old and existing concrete.

The material and application shall suit the requirements for severe/extreme environmental conditions where frequent exposure to de-icing salts is anticipated.

Penetrating sealer shall exceed the performance criteria of the National Cooperative Highway Research Program (NCHRP) Report #244 for protection of concrete against the intrusion of chlorides. In accordance with NCHRP Report #244, the concrete sealer should provide a minimum seventy-five percent (75%) reduction in weight gain and chloride ion content.

Penetrating sealer shall comply with ASTM C-572 reflecting a rating of 9, i.e. no scaling

after fifty (50) cycles, the highest rating.

The VOC must comply with all federal and provincial regulations.

424.03 APPLICATION

.01 Surface Preparation

All surfaces to be treated with penetrating sealer must be clean and structurally sound. New concrete and/or restoration work should be allowed to reach full 28-day cure strength prior to application.

.02 Application Procedure

Sealer shall be applied strictly in accordance with the manufacture's instructions and guidelines as approved by the Engineer.

Surface cleanliness is critical to final appearance of penetrating sealer treated walls. All oil, form release, parting agents, air pollution deposits and graffiti must be removed from substrate.

Any Dymeric sealant shall be put in place and cured before application of the penetrating sealer. The Dymeric sealant shall be covered during the application of penetrating sealer.

Alternatively, where sealants or caulks must be installed following application of the concrete sealer, the sealant or caulk must be compatible with the concrete sealer used.

.03 Sealing of Concrete Barriers, Curbs and Pier Columns

Concrete barriers, curbs and pier columns shall receive one (1) application of concrete sealer. The columns shall be sealed before any backfill is placed against the concrete columns. The sealer shall be applied to all chamfered, textured, flat and cylindrical surfaces.

The Contractor shall overlap all adjoining concrete surfaces with a 50mm wide application of sealer. Where holes are drilled, cuts are made, or the concrete surface is damaged after the sealer has been applied, these damaged areas shall receive a fresh coat of penetrating sealer. Application of sealer to textured surfaces shall be by means of a pressure spray unless the Contractor shall take special care to ensure all control and contraction joint locations are saturated with sealer and obvious runs or stains do not exist which would be noticeable at a distance of three (3) metres of or more.

Measurements for payment purposes shall be the surface area treated as approved by the Engineer in square metres rounded to the nearest one (1) decimal place. For purposes of measurement for payment, textured surfaces shall be measured as flat

surfaces. Inclined surfaces shall be measured on the incline. Measurements for overlap will not be made.

424.04 MEASUREMENT FOR PAYMENT

Measurement for payment purposes will not be made.

424.05 PAYMENT

The basis of payment for this work and items directly related thereto shall be considered incidental to the works and associated with concrete work pay items.

DIVISION 5
SPECIFICATIONS FOR REINSTATEMENT

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ITEM 511

TOPSOILING, SODDING AND/OR HYDROSEEDING

511.01 SCOPE OF WORK

The Contractor shall supply and place topsoil and sod or supply and place topsoil and hydroseed on areas designated by the Engineer in the field and in accordance with this specification.

Topsoil supplied and placed under this item shall be for sodding and hydroseeding application. Topsoil required for other applications such as trees, shrubs, flower beds, etc, shall conform to Item 512 “Topsoil and Finish Grading”.

511.02 APPROVAL

The Contractor shall receive approval from the Division of Parks and Open Spaces, Public Works for all materials incorporated in the work (Topsoil, Lime, Fertilizer, Sod, Seed, etc.).

511.03 MATERIALS

Topsoil

Topsoil shall be a “Loamy Sand” to “Sandy Loam” as classified by the Canadian System of Soil Classification. Topsoil shall be friable, fertile and free of roots, vegetation, debris and stones greater than 40 mm in diameter. The pH range shall be such that not more than 0.5 kg/m² (110 lbs./1000 sq. ft.) of dolomite lime must be added to reach the required pH level of 6.8. The soil must have a 3-7% range in organic matter by dry weight. Prior to approval the contractor shall provide a soil test analysis of proposed topsoil. The Contractor shall guarantee that the soil submitted for laboratory testing is a representative sample taken from the soil that will be delivered to the site. The Contractor shall include in the tender price the cost of amending the soil to meet the required soil properties for the intended use.

Lime

Lime shall be dolomite lime, supplied on site in sealed manufacturers packaging. Rate of application shall be as recommended by the laboratory soil analysis for the intended use.

Fertilizer

- Fertilizers shall be standard commercial brands, meeting the requirements of the Canada Fertilizer Act.
- All fertilizers shall be granular, pelleted or pill form, and shall be dry and free flowing.
- The fertilizers shall have a guaranteed N-P-K analysis.

- Fertilizer shall be packed in standard waterproof packaging, clearly marked with the name of the manufacturer, weight and analysis.
- The types, formulations, and rates of application for fertilizers shall be as recommended by the laboratory soil analysis for the growing medium.
- Substitutions or variations in fertilizers and methods shall be made only upon pre-approval by the Parks and Open Spaces Division reviewer.
- Receipts and empty fertilizer bags should be retained until reviewed by the Parks and Open Spaces Division reviewer as verification that the required fertilizer has been supplied.**Sod**

This specification manual classifies sod into the following quality grades:

1. Cultivated Turfgrass Sod
   - Premium Grade #1
   - Standard Grade #2
   - Speciality Grade #3

2. Field Sod
   - Grade #4

Cultivated Turfgrass Sod

Shall be planted on cultivated agricultural land and grown specifically for sod purposes. It shall be mowed regularly and maintained to obtain reasonable quality and uniformity. The City has the authority to specify growing medium (i.e. mineral, soil, peat, sand, etc.

Sod grade requirements:

Grade #1 & #3

Premium and Speciality Grade turfgrass shall contain only the species and varieties of grasses as specified in the tender document. Sod of this quality may contain 1 broadleaf weed per 40 m² and up to one percent (1%) native grasses. Sod should be of sufficient shoot density that no surface soil will be visible from a standing position when mowed to a height of 40 mm. Creeping bentgrass sod is exempted as mowing height is determined by end use.

Grade #2

At the time of sale, sod of this grade should be in healthy condition with no obvious patches of foreign grasses. Sod of this quality may contain up to five (5) broadleaf weeds per 40 m² and up to ten percent (10%) native grasses. Sod should be of sufficient shoot density so that no surface soil will be visible from a standing position when mowed to a height of 40 mm.

Field Sod

Grade #4

Field sod is all sod that does not meet requirements of cultivated sod. It may consist of sod lifted from pastures or meadows. It may be composed of grasses from non-certified seed, or of unknown origin. Sod is suitable for erosion control, roadside and minimum maintenance areas.

Seed

Seed shall be packed and delivered in original containers clearly showing:

- Name of supplier
- Analysis of seed mixture
- Percentage of pure seed
- Year of production
- Net weight
- Date and location of bagging

Seed shall have a minimum germination rate of seventy-five percent (75%) and a minimum purity of ninety-seven percent (97%), except where otherwise required for a specialty mixture. Seed shall have proven track record for the Newfoundland climate and be Certified Canada No. 1 seed. Seed shall have the following seed mixture or similar unless otherwise specified in the tender document.

Kentucky Blue Grass	50-60%
Creeping Red Fescue	20-30%
Perennial Rye	10-20%

Hydraulic Mulch

Hydraulic mulch, when used, shall consist of fibre or other material designed for hydraulic seeding and dyed for ease of monitoring application. Hydraulic mulch shall be capable of dispersing rapidly in water to form a homogeneous slurry and remaining in such a state when agitated or mixed with other specified materials when applied, the mulch shall be capable of forming an absorptive mat, which will allow moisture to percolate into the underlying soil. It shall contain no growth or germination inhibiting factors. The mulch shall be dry, free of weeds and all other foreign material and shall be supplied in packages bearing the manufacturers label clearly indicating weight and product name.

The mulch may contain a colloidal polythacuride (or equivalent) tackifier, that shall be adhered to the mulch to prevent separation during shipment and to avoid chemical agglomeration during mixing in hydroseeding equipment.

Binder

Binder shall be capable of joining seeds mulch and soil particles together on slopes and erodible surfaces until plant growth has been established. The binder must not form an impervious seal which would prevent the penetration of moisture to the underlying soil.

511.04 PREPARATION

Prior to the placement of topsoil, the ground shall be levelled, sloped, and graded to the desired shape and grade. The surface shall be cleaned of stones, stumps or other objects larger than 100mm in thickness or diameter, and roots, brush, wire or other objects that might be a hindrance in placing the topsoil.

Grading shall be such as to prevent the ponding of water.

511.05 PLACING OF TOPSOIL

The topsoil shall be uniformly distributed on the designated areas and evenly spread to an average thickness of 150mm with a minimum thickness of 100mm. The spreading shall be performed in such a manner that planting can proceed requiring little additional soil preparation or tillage. Irregularities in the surface resulting from topsoiling or other operations shall be corrected to prevent the formation of depressions where water will stand. Topsoil shall not be placed where the subgrade is frozen, excessively wet, extremely dry, or in a condition otherwise detrimental to the proposed planting or to proper grading.

After the topsoil has been spread and graded as required and lime added and roto tilled, then the surface shall be cleared of stone, stumps or other objects larger than 50mm in thickness or diameter, and of roots, brush, wire or other objects that might be a hindrance to placing or maintenance operations.

511.06 APPLICATION OF LIME

Prior to the placing of sod or hydroseed, lime shall be uniformly distributed over the topsoil at the rate specified in the laboratory soil sample analysis. The lime shall then be incorporated into the soil to a depth of at least 100mm by disking, harrowing or other acceptable methods. Lime may be placed up to three weeks ahead of the placing of sod or hydroseeding

511.07 SODDING

Sod shall be laid on the prepared growing medium within 3 days after cutting. Sod may be stored in stacks or piles, grass to grass or roots to roots. Sod shall be protected against drying from sun or wind and from freezing as necessary. The moving and laying of sod shall, as far as possible, be done when weather conditions and soil moisture are favourable.

Sod shall be laid staggered, closely knit together in such a manner that no open joins wider than 2mm are visible, and no pieces are stretched or overlapped.

Sod shall be laid smooth and flush with adjoining grass and paving and top surface of curbs unless shown otherwise on the drawings.

On slopes with a slope angle of 20° or greater, sod shall be laid lengthwise up the slope and each sod shall be pegged at a spacing not exceeding 600 mm. All pegs shall be driven flush with the top of sod.

Prior to placing of sods, the soil shall be fertilized at the rate as specified in the soil test analysis. Fertilizers shall be spread evenly over the growing medium with a suitable mechanical spreader. Fertilizers shall be raked into the growing medium to a minimum depth of 25mm. There should be at least three weeks separation between application of lime and fertilizers. Following the placing of sods, sods shall be rolled with a 70 - 80 kg lawn roller and then thoroughly soaked with water. If conditions warrant, more water may be required from time to time to establish and maintain growth until the sod is established and accepted.

511.08 HYDROSEEDING

Two (2) operations shall be employed in the hydroseeding of designated areas. The first operation shall consist of the distribution of lime as specified in the soil sample analysis.

The second operation shall consist of the distribution of a slurry composed of mulch, seed, fertilizer plus binder. The rate of application of these ingredients shall be as follows:

Mulch (cellulose)	1250 kg/ha
Seed Mixture	225 kg/ha
Fertilizer	As per soil analysis
Binder	25 kg/ha

The Contractor shall measure the quantities of each of the materials to be charged into the hydroseeder, either by mass or by a system of mass-calibrated volume measurements approved by the Engineer. The Contractor shall provide all equipment required for this purpose.

Both operations require that the ingredients be thoroughly mixed with water in a hydroseeding tank. The mix must be continuously agitated during the hydroseeding operation to ensure that a homogeneous slurry is produced.

The distribution of the slurry shall be by means of an approved hydroseeder and shall be applied uniformly and in such a manner as to prevent puddling and movement of the soil surface.

Work shall proceed only in calm weather and on ground free of frost, snow, ice or standing water and when weather and seasonal conditions are suitable. Hydroseeding shall not be carried out during periods of rainfall.

511.09 SECOND FERTILIZATION

The Contractor shall apply a maintenance application of fertilizer to areas sodded or hydroseeded. Fertilizer shall have an N-P-K analysis ratio of 8-2-1. The fertilizer shall be

applied at a ratio of 0.5 kg of actual nitrogen per 100 m² and shall be applied approximately two (2) months after the initial placing.

511.10 PROTECTION AND REPAIR

The area shall be protected against traffic or other use by erecting barricades immediately after sodding or hydroseeding is completed and by placing warning signs of an approved type on the various areas. If at any time before completion and acceptance of the entire work covered by this contract, any portion of the surface becomes gullied or otherwise damaged following sodding or hydroseeding, or the seedlings or grass have been winter-killed or otherwise destroyed, the affected portion shall be repaired to re-establish the condition and grade of the soil prior to sodding or hydroseeding and shall then be re-sodded or hydroseeded.

511.11 ACCEPTANCE

Sods, hydroseeding or other turf installation placed in the FALL will not be accepted until the following June when it can be determined whether or not the vegetation has established and will survive.

511.12 CUT OFF DATES

No topsoil or turf grass shall be placed before May 1st or after November 1st of any year.

511.13 MEASUREMENT FOR PAYMENT

The quantity to be measured shall be the area in square metres, measured to one decimal place, between the limits set by the Engineer that has been landscaped in accordance with this specification.

511.14 PAYMENT

Payment shall be at the unit price bid for each square metre of topsoil, seed, sod and/or hydroseed placed in accordance with this specification. Such payment shall be full compensation for the cost of all labour, materials, tools and equipment necessary to supply and place topsoil, sod, and/or hydroseed.

ITEM 512

TOPSOIL AND FINISH GRADING

512.01 SCOPE OF WORK

The Contractor shall prepare the existing grade, supply and place topsoil and perform finish grading as detailed on the drawings and specified as follows.

Topsoil supplied and placed under this item shall be for trees, shrubs, flower beds, etc. Topsoil required for sodding and hydroseeding application shall conform to Item 511 “Topsoiling, Sodding and/or Hydroseeding”.

512.02 SOURCE QUALITY CONTROL

Inform Engineer of proposed source of topsoil to be supplied and provide access for sampling. Acceptance of topsoil subject to inspection and/or soil analysis test results. Do not commence work until topsoil is accepted by the Engineer.

Inspection and testing of topsoil will be carried out by testing laboratory designated by Engineer. The Contractor will pay for costs of tests.

Test topsoil from source prior to stripping and stockpiling, for clay, sand and silt, NPK, Mg, soluble salt content, pH value, growth inhibitors and soil sterilants.

Use 25mm diameter sampling tube or spade and in presence of Engineer take twenty-five (25) samples per hectare to full depth of topsoil at random across entire area to be stripped. Mix samples together thoroughly before submitting for testing.

Submit 0.5 kg sample of topsoil to testing laboratory and indicate present use, intended use, type of subsoil and quality of drainage. Prepare and ship sample in accordance with provincial regulations and testing laboratory requirements.

Determine required limestone treatment to bring pH value of soil as recommended by soil testing laboratory.

Submit two (2) copies of soil analysis and recommendations for corrections to Engineer.

512.03 APPROVAL

The Contractor shall receive the approval from the Division of Parks and Open Spaces, Public Works for all materials incorporated in the work (Topsoil, Lime, Fertilizer, etc.).

512.04 SCHEDULING OF WORK

Schedule placing of topsoil and finish grading to permit planting under optimum conditions.

512.05 MATERIALS

Planting soil for planting of trees, shrubs and ground covers

Mix 9 parts topsoil with 1-part peatmoss. Incorporate bonemeal into planting soil at rate of 3 kg/m³ of soil mixture.

Peatmoss

Derived from partially decomposed fibrous or cellular stems and leaves of species of Sphagnum Mosses.

Elastic and homogeneous, brown in colour.
Free of wood and deleterious material which could prohibit growth.

Shredded particle minimum size: 5mm.

Fertilizer

Complete commercial synthetic fertilizer with minimum sixty-five percent (65%) insoluble nitrogen.

Formulation ratio: as determined by soil testing laboratory.

Bonemeal

Finely ground with a minimum analysis of twenty percent (20%) phosphoric acid.

Limestone

Ground horticultural limestone containing minimum eighty-five percent (85%) of total carbonates.

Gradation requirements: percentage passing by weight, ninety percent (90%) passing 1.0mm sieve, fifty percent (50%) passing 0.125mm sieve.

512.06 PREPARATION OF EXISTING GRADE

Prevent damage to existing buildings, curbs, sidewalks, and utilities. Make good any damage.

Grade subsoil, eliminating uneven areas and low spots, ensuring positive drainage. Remove soil contaminated with toxic materials. Dispose of removed materials as directed by

Engineer.

Cultivate entire area which is to receive topsoil to depth of 100mm. Repeat cultivation in those areas where equipment used for hauling and spreading has compacted soil.

Remove surface debris, roots, vegetation branches and stones in excess of 40mm diameter.

Cultivate soil to depth of minimum 25mm.

512.07 SPREADING OF PLANTING SOIL

Spread topsoil after Engineer has inspected and approved subgrade.

Spread topsoil with adequate moisture in uniform layers over approved, unfrozen subgrade, where planting is indicated.

Apply planting soil as indicated.

Manually spread planting soil around trees, shrubs and obstacles.

512.08 SOIL AMENDMENTS

Apply soil amendments at rate as specified and as determined from soil sample test.

Mix soil amendments into full depth of topsoil prior to application of fertilizer.

512.09 APPLICATION OF FERTILIZER

Apply fertilizer at least one week after limestone application.

Spread fertilizer uniformly over entire area of topsoil at rate determined on basis of soil sample test.

Mix fertilizer thoroughly to full depth of topsoil.

512.10 FINISH GRADING

Fine grade and loosen topsoil. Eliminate rough spots and low areas to ensure positive drainage. Prepare loose friable bed by means of cultivation and subsequent raking.

512.11 SURPLUS MATERIAL

Dispose of materials not required off site.

512.12 CUT OFF DATES

No topsoil shall be placed before May 1st or after November 1st of any year.

512.13 MEASUREMENT FOR PAYMENT

Supply and placing topsoil shall be included in the lump sum price and shall include preparation of subgrade and all material specified herein.

512.14 PAYMENT

Payment shall be on a lump sum basis for all subsurface preparation, supply and installation of drainage material, fabrics, topsoil, etc. The price bid shall include all labour, equipment, and materials necessary to complete the work in accordance with this specification and the contract drawings.

ITEM 513

TREES, SHRUBS AND GROUND COVERS

513.01 SCOPE OF WORK

The Contractor shall supply and install trees, shrubs and ground covers as detailed on the drawings and specified as follows. Additional information can be found in the City of St. John's Development Design Manual, Section 8 - Landscaping.

513.02 MUNICIPAL ARBORIST

Prior to the ordering of any trees, shrubs and/or ground cover, the contractor, in addition to the meeting of the requirements of the contract, shall obtain a permit from the Municipal Arborist and receive his approval of the final plant selection, placement, and final acceptance.

513.03 SOURCE QUALITY CONTROL

Obtain approval of plant material at source.

Notify Engineer of source of material at least seven (7) days in advance of shipment. No work under this Item is to proceed without approval.

Acceptance of plant material at its source does not prevent rejection on site prior to or after planting operations.

Imported plant material must be accompanied with necessary permits and import licences. Conform to federal and provincial regulations.

All plant material shall be nursery stock unless otherwise approved by the Municipal Arborist.

513.04 SHIPMENT AND PRE-PLANTING CARE

Co-ordinate shipping of plants and excavation of holes to ensure minimum time lapse between digging and planting.

Tie branches of trees and shrubs securely and protect plant material against abrasion, exposure and extreme temperature change during transit. Avoid binding of planting stock with rope or wire which would damage bark, break branches or destroy natural shape of plant. Give full support to root ball of large trees during lifting.

Cover plant foliage with tarpaulin, and protect bare roots by means of dampened straw, peatmoss, saw dust or other acceptable material to prevent loss of moisture during transit and storage.

Remove broken and damaged roots with sharp pruning shears. Make a clean cut.

Keep roots moist and protected from sun and wind. Heel-in trees and shrubs, which cannot be planted immediately, in shaded areas and water wells.

513.05 GUARANTEE

The Contractor hereby warrants that plant material as itemized on plant list will remain free of defects in accordance with GC13 Warranty, but for twenty-four (24) months.

End-of-warranty inspection will be conducted.

Engineer reserves the right to extend Contractor's warranty responsibilities for an additional one year if, at end of initial warranty period, leaf development and growth is not sufficient to ensure future survival.

513.06 REPLACEMENTS

During warranty period, remove from site any plant material that has died or failed to grow satisfactorily as determined by Engineer.

Replace plant material in next planting season.

Extend warranty on replacement plant material for a period equal to the original warranty period.

Continue such replacement and warranty until plant material is acceptable.

513.07 MATERIALS

Water - Potable and free of minerals which may be detrimental to plant growth.

Stakes - T-bar steel stakes 40 x 40 x 5 x 2440mm.

Tree Rings - Fabricated from 3mm galvanized wire encased in two ply reinforced 12mm diameter rubber garden hose or equivalent.

Fibreglass fabric - Tight woven, min 2.5 kg/m² mass, 1m wide.

Root ball burlap - 150 g Hessian burlap.

Chip mulch - Chips from deciduous or coniferous trees, varying in size from 25mm to 50mm dia.

Anti-desiccant - Wax-like emulsion to provide film over plant surfaces reducing evaporation

but permeable enough to permit transpiration.

513.08 PLANT MATERIAL

Quality and source

Comply with Landscape Canada Nursery Guide Specifications. Trees and shrubs shall be selected from the City's Street Tree Planting Standard or those species hardy to Canadian Plant Hardiness Zone 5B, salt tolerant, adapted to environmental conditions at the site, with a proven local history. Measure plants when branches are in their natural position. Height and spread dimensions refer to main body of plant and not from branch tip to branch tip. Use trees and shrubs of No. 1 grade.

Additional plant material qualifications

Plant material obtained from areas with milder climatic conditions from those of site acceptable only when moved to site prior to the breaking of buds in their original location and heeled-in, in a protected area until conditions suitable for planting.

Use trees and shrubs with strong fibrous root system free of disease, insects, defects or injuries and structurally sound. Use trees with straight trunks, well and characteristically branched for species. Plants must have been root pruned regularly, but not later than one growing season prior to arrival on site.

Large trees must have been half root pruned during each of two (2) successive growing seasons, the latter at least one (1) growing season prior to arrival on site.

Plant material that has come out of dormant stage and is too far advanced will not be accepted unless prior approval obtained.

Cold Storage

Approval required for plant material which has been held in cold storage.

Container-grown stock

Acceptable if containers large enough for root development. Trees and shrubs must have grown in container for minimum of one growing season but not longer than two. Root system must be able to "hold" soil when removed from container.

Plants that have become root bound are not acceptable. Container stock must have been fertilized with slow releasing fertilizer.

Balled and burlapped

Coniferous and broad-leafed evergreens over 500mm tall must be dug with soil ball. Deciduous trees in excess of 3 metre height must have been dug with large firm ball. Root

balls must include seventy-five percent (75%) of fibrous and feeder root system.

Substitutions to plant material as indicated on planting plan are not permitted unless written approval has been obtained as to type, variety and size. Plant substitutions must be of similar species and of equal size as those originally specified.

513.09 WORKMANSHIP

Stake out location of trees and planting beds as per planting plan. Obtain approval prior to excavating.

Apply anti-desiccant in accordance with material manufacturer's instructions.

Co-ordinate operations. Keep site clean and planting holes drained. Immediately remove soil or debris spilled onto pavement. Do not leave open holes on site overnight, unless covered with suitable coverings.

513.10 PLANTING TIME

Plant deciduous plant material during dormant period before buds have broken. Plant material noted for spring planting only, must be planted in dormant period.

Plant material imported from region with warmer climatic conditions may only be planted in early spring.

When permission has been obtained to plant deciduous plant material after buds have broken, spray plants with anti-desiccant to slow down transpiration prior to transplanting.

Plant evergreens in spring before bud break.

When permission has been obtained, trees, shrubs and ground covers growing in containers may be planted throughout growing season.

Plant only under conditions that are conducive to health and physical conditions of plants.

Provide planting schedule. Extending planting operations over long period using limited crew will not be acceptable.

513.11 EXCAVATION

Shrub beds

Excavate to minimum depth of 500mm.

Individual shrubs

Excavate planting holes 500mm deep and at least 500mm wide.

Small trees (up to 3.0 metres)

Excavate holes 600mm deep with diameter of 300mm greater than root spread or root ball.

Large trees

Excavate to depth of rootball, with width of 750 mm greater than diameter of rootball.

The transition of the tree planting area to shallower growing medium shall have a shallow angle.

Excavation of the subgrade below the rootballs of trees shall only be necessary to permit the bottom of the rootball to sit on undisturbed material or compacted fill such that the top of the rootball remains at the proper finished grade. Disturbed subgrade below the rootball shall be compacted to prevent settlement of the tree after planting. Excess excavated material shall be removed from the site.

Planting pits or areas excavated in fine soils or by mechanical means shall have all bottoms and sides scarified to ensure that they do not have glazed surfaces. Where the growing medium in a planting pit or area is different in texture, structure or organic content from the surrounding soil (such as when the pit is filled with imported prepared growing medium) the sides and bottom shall be scarified and the two material thoroughly mixed to avoid an abrupt interface. Growing medium shall be free from interfaces or textural differences that could impede root development.

513.12 PLANTING

Planting shall be such that after settlement the level of the adjacent growing medium surface matches the level of the original growing medium surface in the nursery. The soil mark on the stem is an indication of this, and it shall be maintained on the finished level, allowing for settling of the growing medium after planting. Total depth of rootballs shall be planted in growing medium.

- Plants shall be set plumb in the planting beds or in the center of the pits, except where the plant's character requires variation from this. Orientate plant material to give best appearance in relation to structure, roads or walkways.

- Growing medium as per Item 512.05 shall be placed in layers around the roots or ball, preferably by hand. Each layer shall be carefully tamped to avoid injuring the roots or ball or disturbing the position of the plant.

- When growing medium is at two-thirds of the rootball height, ties shall be cut and the top one-third of burlap on B & B plants shall be folded back carefully, not disturbing the rootball integrity. No burlap shall show above grade. In addition, wire baskets if present should be cut back to this level without disturbing rootball.

- Growing medium should be moist in tree pits and beds at this stage and allowed to settle around the roots. After the water has been absorbed, the backfilling shall be completed and tamped lightly. Any settling shall be brought up to the intended grade with growing medium.

- Plant material deemed unacceptable by the Municipal Arborist/Engineer shall not be planted.

513.13 TREE SUPPORT

Immediately following planting, trees shall be stabilized using appropriate methods such that the crown of each tree is permitted free movement but normal forces such as wind, snow loading or forces applied by human hands will not disturb the buttress root system or cause the rootball to shift in the growing medium. Securing methods include staking, guying, soil anchors and deadmen.

A tree may not need to be stabilized if the subsoil and growing medium are stable and can hold the rootball in place and if the rootball is solid, contained in a wire basket, and shaped such that it can be expected to resist shifting.

All tree stabilization methods shall be such that they do not damage the tree.

Attachment to the tree shall be no higher than necessary to stabilize the rootball while permitting free movement of the tree's crown.

Ties shall be secured to the stakes or placed in the tree such that they will not slide down or otherwise be displaced.

Stakes, anchors, etc. shall be set deep enough that they will not move in the soil when subjected to wind and other normal forces.

Stakes or anchors for guy wires shall be set below or flush with the soil surface so that they do not present a hazard, and guy wires shall be used only where they do not present a hazard. Guy wires shall be marked with flagging tape for visibility.

Stakes shall not be driven through the rootball.

513.14 PRUNING

Pruning at the time of planting shall be limited to the minimum necessary to remove dead or injured branches. Pruning shall be done in such a manner as to preserve the natural character of the plants. Only clean, sharp tools shall be used. Tools should be sterilized between cuts of different plants. All cuts shall be clean and cut to the branch collar, leaving no stubs. Cuts, bruises or scars on the bark shall be traced back to living tissue and removed. The affected areas shall be shaped so as not to retain water.

513.15 MULCHING

Obtain approval of planting before mulching material is applied. Loosen soil in planting beds and pits and remove debris and weeks. Spread mulch to minimum thickness of 50mm. Mulch material susceptible to blowing must be moistened and mixed with topsoil before applying. When mulching is placed in fall, place immediately after planting. When mulch is placed in spring, wait until soil has warmed up.

513.16 MAINTENANCE

Water once a week for first four (4) weeks and then sufficiently thereafter to maintain optimum growing conditions. Ensure adequate moisture in root zone at freeze-up.

Keep soil within confines of planting saucer around trees and planting beds, shallowly cultivated and free from weeds.

Keep tree stakes in proper repair.

Provide adequate protection against winter damage.

Maintain plant material from date of planting up to end of warranty period.

Remove tree stakes at end of warranty.

513.17 CUT OFF DATES

No trees, shrubs or ground cover shall be placed before May 1st or after November 1st of any year.

513.18 MEASUREMENT FOR PAYMENT

Measurement for payment shall be the number of each plant type supplied and installed.

513.19 PAYMENT

The Contractor shall be paid at the respective unit price bid for each plant type supplied and installed. The unit price shall constitute full compensation for all labour, equipment and materials required to complete the work as specified.

ITEM 521

PARK SIGNAGE AND BARRIERS

521.01 SCOPE OF WORK

The Contractor shall construct park signage and barriers as detailed in the Standard Drawings and specified as follows.

521.02 MATERIALS

Where new material is required it shall conform to the following:

Chain: 9.5mm galvanized.

Wood: select pressure treated structural #1 Spruce or Jack Pine.

Preservative: Pressure treated wood preservative.

Nails:150mm long, hot dipped galvanized.

521.03 WOOD POST PREPARATION

The Contractor shall cut wood to required length, chamfer all exposed edges and drill all holes as detailed. Following the completion of the above the wood shall be emersed in a bath of preservative for thirty (30) minutes, removed and allowed to dry prior to constructing.

521.04 INSTALLATION

The Contractor shall set posts as detailed and as laid out by the Engineer in the field. Chain required to be joined shall be connected using a galvanized missing link.

521.05 MEASUREMENT FOR PAYMENT

The quantity to be measured for payment shall be:

a) number of posts installed
b) linear metres of chain installed
c) park signs installed

521.06 PAYMENT

Payment shall be the unit price bid per unit installed and shall be full compensation for all

labour, equipment, and material required to complete the work as specified.

ITEM 522

CHAIN LINK FENCING

522.01 SCOPE OF WORK

Work includes the supply and erection of chain link fencing in heights specified.

The fence shall be located approximately as shown on the drawings. The exact locations and grades of the fence shall be established by the Engineer.

522.02 SPECIFICATIONS FOR MATERIALS

Fabric shall consist of No. 9 gauge steel wire woven in a chain link pattern with a 50mm mesh size. Both top and bottom edges shall have a knuckled finish. The fabric shall be hot dip galvanized after weaving and shall retain a minimum average of 488 grams of zinc per square metre of surface area.

Line posts shall be 60mm outside diameter standard continuous weld, schedule 40 galvanized pipe. The length shall be 840mm longer than the height of fabric.

Terminal posts to be used at all ends, corners, gates, and at joints between fabric of two (2) different heights shall be 90mm outside diameter standard continuous weld schedule 40 galvanized pipe. The length shall be 1870mm longer than the heights of fabric.

Top rail and brace shall be 43mm outside diameter standard continuous weld schedule 40 galvanized pipe or high strength hollow structural section, 2.5mm wall thickness with mechanical properties like ASTM A-36.

All fittings shall be either wire suitably tied, or prefabricated clips. Ties shall be galvanized steel, aluminum, or other approved non-rusting material and so attached as to maintain tension on the fabric without sagging and shall present no protruding ends or edges to injure pedestrians who may contact same.

Tension wire shall be installed along and tied to the bottom edge of the fabric. The wire shall be single strand No 6-gauge steel wire, galvanized with a minimum zinc retention of 600 grams per square metre of surface area.

522.03 CONSTRUCTION SPECIFICATIONS

All fencing shall be constructed in a workmanlike manner to the following Specification:

All posts shall be set in a foundation of 14 MPa concrete. The top of the concrete shall be troweled smooth 50mm above grade, to shed water away from the post. The concrete shall be poured in place, in holes excavated to the dimensions indicated hereafter. Prior to

pouring, any sediment or other loose material which may have washed or fallen into the hole shall be removed, and the post shall be set in the fresh concrete to the correct grade, immediately after pouring, so that the concrete forms a plug in the bottom of the pipe to prevent the entry of water from below.

Foundations for line posts shall have a top diameter of 250mm, a bottom diameter of 350mm and an overall depth of 900mm. Foundations for all other posts shall have a top diameter of 300mm, a bottom diameter of 400mm and an overall depth of 1125mm. The bottom of each post shall be set 75mm above the bottom of the foundation.

Post lengths shall be as specified, and posts shall not be cut to facilitate erection. Posts which are too long shall be set in deeper foundations, so that the tops come to the required grade.

Line posts shall be erected with a spacing between the posts of 2400mm. Terminal posts shall be installed at each fence termination, corner, gate and at every junction between fence sections of two (2) different heights.

The top rail shall run continuously through the line post tops to form a continuous brace along the top edge of the fence. Splices shall be made using splice sleeves of a minimum length of 175mm. The rails shall be secured to terminal posts with receptacle type fittings.

Horizontal braces shall be placed one-halfway between the top and bottom edges of the fabric. These braces shall run from each terminal post to the first adjacent line post each side of the terminal post. Braces shall be connected at each end with receptacle type fittings.

Where fences are erected along a street line, the fabric shall be placed on the street side of the posts. Where the fence marks a boundary between City property and that of another party, the fabric shall be installed on the City side of the posts.

Fabric shall be attached to the first terminal posts, and tension shall be applied to the fabric before tying. This tension shall be sufficient to ensure true alignment of the fabric without kinks or sagging, but not so great as to cause bending or displacement of posts or supports. The tension shall be applied by jacks, hoists, pulleys, or other means at suitable intervals along the fence line and shall not be released until the fabric is properly tied in place. The jack or other device shall be attached to the fabric by a tension bar threaded through the mesh, and such bars shall remain in place where the fabric is terminated at a post. Where posts are used to support the tensioning apparatus, they shall be temporarily braced, if necessary, to prevent displacement.

Cutting of fabric, where necessary, shall be accomplished by removing one (1) entire strand of wire, to separate the fabric into two (2) separate pieces. No cut ends shall remain on the finished side.

Joining of fabric shall be done by weaving an individual strand of wire through the two edges to be joined. This strand shall be knuckled into existing strands at the top and bottom, so that a finish surface is created. In no case will tying with wire pieces or overlapping of the fabric be permitted.

The fabric shall be securely tied to each post to the top rail, to braces and to the bottom tension wire. Attachment to terminal posts shall be made by using suitable bands around the posts and connected to the tension bars. Wire ties or clips shall also be used along the following members at the indicated (maximum) spacing.

Line Posts	300mm
Top Rail	450mm
Braces	450mm
Tension Wire	450mm

Tying shall be performed such that adequate tension is maintained on the fabric after the tensioning apparatus is removed.

522.04 GATE DETAILS

The Contractor shall construct pedestrian access ports and swing-type gates in locations and manner as specified on the drawings, or as directed by the Engineer.

Swing-type gates shall be installed between, and hinged upon, gate posts, placed at the required spacing.

Gate frames shall be fabricated of material as specified above for top rails, but with welded connections, galvanized after fabrication. All gates shall have one horizontal brace, and gates with a width of 1800mm or more shall have one additional vertical brace.

Double gates shall be equipped with a foot bolt and suitable center rest of concrete. All gates shall be equipped with a drop latch which can be padlocked from either side.

Measurement of fence length for payment purposes will include the length of all fence sections surrounding pedestrian access ports, and payment, therefore will be at the unit price bid. Payment for swing-type gates shall be included in the unit price bid per unit length of fence.

522.05 CLEANING OF SITE

Upon completion of the fence erection, the Contractor shall restore all disturbed surfaces to their original condition. All excess fill, spilled concrete, excess material, and any other matter shall be removed to an approved disposal site.

522.06 DESCRIPTIVE LITERATURE

Bidders must submit with their Tenders complete manufacturers descriptive literature, including material specifications and construction details. The City reserves the right to require, and the Contractor shall be bound to incorporate, any deviations from the

Manufacturer's Specifications or details required because of non-conformance with the foregoing specifications.

522.07 PAYMENT

Payment for this item shall be at the respective unit price bid per linear metre of chain link fencing supplied and installed. The unit price bid shall be full compensation for all labour, equipment and material necessary to complete this item in accordance with this specification.

ITEM 523

TENNIS COURTS AND ALL-PURPOSE COURTS

523.01 GENERAL

The Contractor shall supply all labour, plant and materials for the construction of asphalt paved tennis courts and all-purpose courts as detailed on the drawings and specified herein.

523.02 CLEARING AND GRUBBING

Clearing and grubbing shall be carried out as detailed in Item 311 of these specifications. The limits for the clearing and grubbing shall be the minimum required to carry out the work.

523.03 EXCAVATION AND BACKFILLING

Excavation and backfill shall be carried out as detailed in Items 321 and 322, respectively.

Where fill material is required to construct the subgrade, such material shall be obtained from excess common material resulting from other areas of the site, or from common borrow. Fill material shall be placed in layers not greater than 150mm in depth and shall be compacted to a minimum of ninety-five percent (95%) of the maximum density as determined by A.A.S.H.T.O. Method T99-774.

Granular "A" and "B" materials for granular sub-base and base for asphalt shall be as specified in Item 323 of these specifications.

523.04 DRAINAGE PIPE

When called for on the drawings the Contractor shall install 150mm CSA B 182.1 approved perforated plastic drainage pipe. The pipe shall be graded at a minimum of one percent (1%) to drain to the edge of a fill embankment or to a rock sump having minimum dimensions of 1.5 metres x 1.5 metres x 1.5 metres. The rock sump shall be located a minimum of 3 metres from the tennis court fencing. The drainage pipe shall be bedded in Class "B" road gravel.

523.05 BITUMINOUS PAVEMENT

The Contractor shall construct one 50mm layer of surface course hot mix asphalt concrete as detailed on the drawings and as specified in Item 351 of these specifications.

523.06 CHAIN LINK FENCING

The Contractor shall supply all labour, plant and materials for the construction of chain link fencing in heights as indicated on the drawings complete with gates as detailed on the drawings and in accordance with Item 522.

523.07 APPLIED COATINGS

When called for, following completion of the pavement, the Contractor shall apply a Truflex pavement coating as manufactured by Uniroyal Industrial Products or approved equal. The Truflex pavement coating shall be applied in five coats as follows:

one (1) coat filler
one (1) coat cushion
two (2) coats finish
one (1) coat line paint

This coating shall be applied in accordance with the manufacturer's instructions. Colors to be selected by Engineer.

523.08 COURT LAYOUT LINES

Court layout lines as detailed on the drawing shall be spray painted on the asphalt or applied coating surfaces using white Alkyd Traffic Paint where paint is applied directly to the asphalt surface.

523.09 EQUIPMENT

The Contractor shall supply and install complete the following equipment:

(a) Tennis court net posts shall be Edwards "Classic" tennis posts as manufactured by Gourock Industries Limited or approved equal.

(b) Tennis court nets shall be Edwards Net as manufactured by Gourock Industries Limited or approved equal.

(c) Basketball net assembly shall be of the Cantilever upright support design with steel backboard, spring back rim, double ring hoop and net as manufactured by Paris Playground Equipment or approved equal.

523.10 PAYMENT

Payment for construction of tennis courts and all purpose courts complete with drainage

pipe, granulars, bedding, asphalt, chain link fencing, applied coatings (when called for), court layout lines and equipment shall be on a lump sum basis for each tennis court or all purpose court installed.

Payment for Clearing and Grubbing and excavation of common and/or unsuitable material and supply and placing of common borrow material or blasted rock shall be in accordance with the following respective specification. Item 311 - Clearing and Grubbing, Item 321 - Street Excavation and Item 322 - Borrow.

ITEM 530

REINSTATEMENT

530.01 SCOPE OF WORK

The Contractor shall reinstate all areas, surfaces, and features necessarily disturbed by the work of this Contract. This item does not include payment for restoration type work which is required by other items of the Contract, nor restoration work required due to unnecessary damage by the Contractor.

530.02 GRAVEL REINSTATEMENT

All gravel reinstatement shall be performed using Granular “A” road gravel and placed to a thickness of 100mm. Such material shall conform to and be placed in accordance with Item 323 “Gravel for Streets”.

The unit price bid shall include supplying and installing a 100mm thick layer of Granular “A” road gravel.

530.03 ASPHALT REINSTATEMENT

The Contractor shall reinstate such asphalt surfaces as driveways, walks, parking areas, etc., with a 100mm thick layer of Granular “A” road gravel and a 50mm thick layer of asphalt concrete pavement. Asphalt concrete pavement and road gravel shall be in accordance with the Item 351 “Hot Mix Asphaltic Concrete” and Item 323 "Gravel for Streets" respectively.

The unit price bid shall include removal of the existing asphalt and OM, supplying and installing a 50mm thick layer of asphalt and a 100mm thick layer of Granular “A” road gravel.

530.04 CONCRETE REINSTATEMENT

The Contractor shall reinstate such concrete surfaces as walks and driveways, etc., with a 100mm thick layer of Granular “B” road gravel and 100mm thick layer of concrete. Road gravel and concrete shall be supplied and placed in accordance with Item 323 "Gravel for Streets" and Item 330 “Concrete, Curb, Gutter, and/or Sidewalk Works”.

The unit price bid shall include supplying and installing a 100mm thick layer of Granular “B” road gravel and a 100mm thick layer of concrete.

530.05 MISCELLANEOUS CONCRETE

The Contractor shall form and place concrete in sizes and shapes as directed by the

Engineer in the field. Concrete shall be 30MPa strength and conform to concrete as specified in Item 330 “Concrete, Curb, Gutter, and/or Sidewalk Works”.

The unit price bid shall include supplying and installing all formwork and concrete necessary to complete the work.

530.06 RELOCATION OF HYDRANT MARKERS AND TRAFFIC POSTS

The Contractor shall relocate hydrant markers and traffic posts or supply and install traffic signposts in accordance with the contract drawing or as directed by the Engineer in the field. Each marker or sign shall be placed and set with fresh concrete in accordance with the signpost detail. Signposts in areas susceptible to frequent damage may require the installation of a breakaway device such as “Signpost Savers” or approved equal.

The unit price bid shall include relocating marker or post and supplying and installing a new concrete footing or supplying and installing new traffic posts complete with footings.

530.07 DRIVEWAY CULVERTS

The Contractor shall supply and install corrugated High Density Polyethylene (HDPE) pipe certified to CSA B182.8 Type 3, Soil tight with external couplers, with a pipe stiffness of 320kPa and smooth interior wall in sizes specified. This item covers new locations or the replacement of existing culverts which are unsuitable for reuse due to no fault of the Contractor.

Excavation for driveway culverts shall be in accordance with and paid for under Item 221 “Trench Excavation”.

530.08 MEASUREMENT FOR PAYMENT

Gravel reinstatement - the quantity to be measured shall be the area in square metres, measured to one decimal place.

Asphalt reinstatement - the quantity to be measured shall be the area in square metres, measured to one decimal place.

Concrete reinstatement - the quantity to be measured shall be the area in square metres, measured to one decimal place.

Miscellaneous concrete - the quantity to be measured shall be the volume in cubic metres, measured to one decimal place.

Relocation of hydrant markers and signposts - the quantity to be measured shall be the number of each kind of markers and posts relocated.

Driveway Culverts - the quantity to be measured shall be the length in metres, measured to one decimal place.

530.09 PAYMENT

Payment shall be at the applicable unit price or lump sum price bid for each of the items listed. Payment shall be full compensation for all labour, equipment, and material necessary to complete the work as specified.

ITEM 541

RIP-RAP TREATMENT

541.01 SCOPE OF WORK

The Contractor shall construct a protective covering of approved stone, with or without mortar or sod as required on an earth bed; at the ends of culverts, on the sides of slopes or in the bed of channels or at other places as directed by the Engineer. The work shall also include such fine grading and tamping of slopes to be rip-rapped, and backfilling and tamping of foundation trenches, as may be required.

541.02 MATERIALS

Rip-Rap shall consist of clean, hard, durable rock, having a density not less than 2.6t/m³. The rock material, if subjected to the Los Angeles Abrasion Test (ASTM C131-81), shall have a loss not greater than thirty-five percent (35%). When tested for soundness, five (5) cycles of magnesium sulphate, ASTM C88-76, the rock material shall have a loss not greater than fifteen percent (15%).

Rock

Stones for use in rip-rap shall consist of clean, hard durable rock, free of cracks. Rock subject to marked deterioration by water or weather will not be accepted. Only those stones approved by the Engineer shall be used.

The largest rocks procurable shall be supplied and in no case shall any fragment measure less than 0.0035m³. In hand laid dry wall rip-rap, spalls shall be supplied to fill open joints. Field stones or boulders may be used when approved by the Engineer.

Sod

Sod shall consist of a dense well rooted growth of permanent and desirable grasses. When sod is lifted it shall be covered with grass recently mowed to a length not more than 75mm. Sod shall be in widths not less than 300mm nor more than 450mm, in thickness not less than the depth of the fibrous roots and in no case less than 25mm.

All sod shall be taken from good loamy soil. It shall be well permeated with roots; be uniform in texture and free from weeds; be in a good healthy condition with no sign of decay and contain sufficient moisture to maintain its vitality during transportation and placing.

Sod to conform to sod detailed in the item "Topsoiling, Sodding and/or Hydroseeding".

Grout

Grout shall consist of a cement mortar compound of one (1) part Portland Cement and three

(3) parts fine aggregate.

541.03 EXCAVATION

Should the Engineer require that excavation be carried out to prepare a foundation for the rip-rap, then the work shall be carried out in accordance with Item 324 “Excavation of Ditches”.

(a) **Rip-Rap - Hand Laid Dry Wall**

On slopes to be rip-rapped, the slopes shall be fine graded to a uniform surface. Depressions shall be filled and thoroughly compacted.

(b) **Rip-Rap - Hand Laid With Sod**

Same as for (a) above.

(c) **Rip-Rap - Grouted**

Same as for (a) above.

(d) **Rip-Rap - Random**

Where directed by the Engineer, excavation for foundation shall be performed to provide a shelf or ledge to retain the rock so dumped as permitted under the paragraph “Placing Random Rip-Rap”.

541.04 PLACING

Rip-Rap shall be placed to the grades and within the lines set by the Engineer.

(a) **Rip-Rap - Hand Laid Dry Wall**

Unless laid to form a flat apron, the rip-rap shall commence in a trench below the toe of the slope. Stones shall be set normal to the slope and placed so that the large dimension is perpendicular to the face of the wall, unless such dimension is greater than the specified thickness of the wall.

The required thickness of rip-rap is dependent on the proposed height and slope of the rip-rap and on the expected force of the stream flow.

The Contractor shall construct the rip-rap to the thickness required by the Engineer.

The largest stones shall be placed in the bottom courses and for use as headers through subsequent courses. No shaping of stones will be required; but the Contractor shall build a reasonable semblance of courses with stones laid closely and voids chinked with spalls.

Stones shall be placed in the wall in such a way that the rear of each stone shall be embedded into the slope of the embankment.

On the completion of laying of rip-rap operations any open foundation trenches bordering the rip-rap shall be backfilled and tamped.

(b) **Rip-Rap Hand Laid with Sod**

The placing of stones and the backfilling and tamping of trenches shall be as required under (a) above.

However, as the placing of stones proceeds sod shall be placed so that sod separates the stones from each other, both horizontally and vertically. The sod shall be placed so that there are no voids between stones.

Sod shall not be placed upside-down.

The sodding shall be trimmed so that the exposed edges of the sods are flush with the exposed face of the rip-rap.

(c) **Rip-Rap - Grouted**

The placing of stones shall be as required under (a) above. Before applying mortar, the surfaces of the stones shall be amply wetted. The spaces between the stones shall be filled with mortar, starting from the bottom, and working to the top. The mortar shall be worked with suitable tools to completely fill all voids except that the outer face of the stones shall be exposed. Excess mortar shall be removed with a stiff brush. Grouted rip-rap shall be cured in accordance with the requirements for curing concrete sidewalks as set forth in the item "Concrete, Curb, Gutter and/or Sidewalk Works".

After the mortar has set any foundation trenches bordering the rip-rap shall be backfilled and tamped.

(d) **Rip-Rap - Random**

Rock material may be placed by dumping it into position over the surface to be rip-rapped.

The Engineer will indicate whether the larger stones should be placed near the bottom of the slope, or near the top of the treated area to protect against scour. The Contractor shall make a reasonable effort to dump the larger stones where required. Placing shall be done in such a manner that the surface of the finished rip-rap shall have a uniform appearance.

541.05 MEASUREMENT FOR PAYMENT

Measurement for Payment for rip-rap will only include measurement of materials which meet

the specifications for the type of rip-rap treatment in question. Materials placed outside of the limits as staked by the Engineer will not be included in measurement for payment.

Measurement for Payment by Volume

For rip-rap for which the contract unit price is stated in terms of the price per cubic metre, then such rip-rap shall be measured for payment in terms of the net nominal volume of the rip-rap structure comprising rip-rap of the type in question. This net nominal volume shall be computed in cubic metres rounded to one decimal place.

The net nominal volume of the rip-rap structure shall be calculated as the product of the net surface area of the rip-rap structure, times the mean thickness of the rip-rap structure.

The net surface area of the rip-rap structure shall be defined as the net area given by mean length of the rip-rap structure times the mean width of the rip-rap structure; less the area of such objects as culvert ends around which the rip-rap is placed.

Measurement for Payment by Weight

For rip-rap for which the contract unit price is stated in terms of the price per tonne, then only the stones to be used in the rip-rap treatment shall be weighted on scales. The weight shall be computed in tonnes rounded to one decimal place.

541.06 PAYMENT

Payment of the Contract Unit Price per cubic metre, or per tonne, for the type of rip-rap specified shall be compensation for all labour, materials and equipment-use to supply stones and sod or mortar as required, haul the materials to the site, provide such necessary unwatering as may be required, trim and tamp ground that is to receive rip-rap treatment, construct the required rip-rap treatment according to these specifications, cure mortar if used, backfill and tamp any open foundation trenches, together with the provision for weighing (if appropriate).

Excavation shall be paid for in accordance with Item 324 “Excavation of Ditches”, but the additional requirements for the fine grading and the tamping of depressions in slopes to be rip-rapped, together with the backfilling and tamping of any foundation trenches, shall be considered compensated for in the contract price for rip-rap treatment.

The occasional manual handling of rocks or stones which may occur during placing Random Rip-Rap shall in no manner be constructed as transforming the classification of Random Rip-Rap to that of Hand Laid Dry Wall Rip-Rap.

ITEM 542

GABIONS

542.01 SCOPE OF WORK

The Contractor shall supply and install gabions in accordance with this specification and the contract drawings.

542.02 MATERIALS

Gabion baskets shall be of various sizes and consist of either galvanized or vinyl coated wire mesh as specified in the unit price table and as detailed in the standard and contract drawings.

Tie-wire to secure the baskets shall be galvanized or vinyl coated depending on whether galvanized or vinyl coated mesh is specified.

Stones used in the construction of gabions shall be clean, hard and durable, and shall be either boulder, broken rock, quarry stone, broken concrete or gravel screenings. The least dimension of any stone shall not be less than one and one half (1½) the mesh size. The greatest dimension shall not exceed 300mm.

Stones shall be of such dimensions that no less than two layers of overlapping stone are required to fill the gabion. The Contractor shall supply the stones to fill the gabion.

The Contractor shall supply gabion baskets, tie-wire and wood or metal pegs to anchor the gabion baskets, should anchoring be necessary during construction.

542.03 INSTALLATION

Gabions shall be installed to the lines and grades as set by the Engineer.

Should excavation be required to install the gabions at the required grade then excavation shall be carried out in accordance with the Item 402 “Excavation for Foundation, Unwatering and Extra Backfill for Structures". The foundation shall be excavated to an even finish and to the required grade.

The Contractor shall assemble gabions according to the manufacturer's recommendations.

The Contractor shall unfold each gabion to the open position. The four (4) corner edges shall be wired to secure the gabion shape. The edges of the diaphragms shall be wired to the gabion walls in the correct position.

Each assembled gabion shall be securely wired to the adjacent gabions along the top and

the vertical edges prior to placing of stone.

All wiring of gabions shall be carried out using the tie-wire provided and using the following method of connection by looping. The tie-wire shall be looped around the edges to be joined. Loops shall be separated by a distance not greater than 100mm. Single loops shall alternate with double loops. A single loop is one which wraps around the edges being joined once. A double loop is one which wraps around the edges being joined twice.

To achieve better alignment and finish, the Contractor shall stretch gabions before filling.

Stone on exposed areas shall be carefully hand-picked to minimize voids and to present an attractive and pleasing appearance.

Gabions shall be filled keeping voids to a minimum, to a depth of 300mm in each cell, after which connecting wires shall be placed one in each direction, with these wires looped around two meshes at each end.

For gabions of height greater than 600mm, then the operation shall be repeated and a further 200mm of rock shall be placed, and then two (2) more connecting wires shall be installed in each cell.

When filling of each gabion has been completed the top shall be folded shut and wired to the ends, sides and diaphragms.

When placing gabions on top of each other, fill placing and compaction operations as specified in the Item 402 "Excavation for Foundation, Unwatering and Extra Backfill for Structures" shall be carried out behind each row of completed gabions before a successive row may be placed.

Empty gabions placed on top of a completed row of gabions shall be wired to the filled gabions at the front and at the back of a row before filling commences.

542.04 MEASUREMENT FOR PAYMENT

Measurement for payment for gabions will be based on the number of each size and type of required gabion placed to the required alignment.

542.05 PAYMENT

Payment at the contract price for the type and size of gabion specified shall be compensation in full for all labour, materials and equipment-use required to supply the gabion baskets and tie-wire, assemble and place the gabion baskets, tie together the gabion baskets, place connecting wires, together with the supply and placing of stones and also the supply and placing of anchors, if anchor pegs should be needed.

ITEM 543

ARMOUR STONE

543.01 SCOPE OF WORK

This specification covers the requirements for the supply of armour stone of various minimum sizes and minimum weights, together with the preparation of a foundation seat for the base of the armour stone treatment and the placing of the armour stones for a thickness not less than that stated on the Unit Price Table for the type of armour stone under construction.

543.02 MATERIALS

Armour stone shall consist of clean, hard, durable rock having a density not less than 2.6 t/m^3. The rock material if subjected to the Los Angeles Abrasion Test (ASTM C131-81), shall have a loss not greater than thirty-five percent (35%). When tested for soundness, five (5) cycles of magnesium sulphate, ASTM C88-76, the rock material shall have a loss not greater than fifteen percent (15%).

Armour stones shall be of an angular shape and be of a uniform gradation. The least dimension of any stone shall not be less than one quarter of the greatest dimension.

Individual armour stones shall be of a weight, or of a volume that is not less than that specified in the contract item in the Unit Price Table.

Armour stones shall be supplied by the Contractor.

543.03 PLACING

Armour stones shall be placed within the limits required by the Engineer.

The Contractor shall prepare a foundation for the armour stone by excavating a seat in the existing ground.

Excavation shall be by means of a backhoe, or a clam as required, to carry out the excavation for the seat at the required location and to sufficient depth to provide a proper footing for the armour stone.

Stones shall be placed by a crane, or similar equipment, starting at the bottom of the slope and working upwards.

No pushing or dumping of the stones by bulldozers or other equipment will be allowed.

The Contractor shall choose the stones and place them in such a way that the whole structure will be bound and consolidated to as great an extent as the nature of the rock will allow.

Placing shall be done in such a manner that the surface of the armour stone treated slope shall have a uniform appearance. The thickness of the treated slope shall not be less than that specified in the contract item on the Unit Price Table.

Care shall be taken by the Contractor to ensure that no stones are placed outside of the lines as staked by the Engineer.

If any armour stones are placed outside of the area to be treated or are washed out of place during construction, then they shall be removed or replaced by the Contractor at his own expense.

543.04 MEASUREMENT FOR PAYMENT

Stones placed outside of the limits required by the Engineer will not be included in measurement for payment.

.01 Measurement for Payment by Volume

For armour stone for which the contract unit price is stated in terms of the price per cubic metre, then such armour stone shall be measured for payment in terms of the net nominal volume of the armour stone treated slope comprising armour stone of the size in question. This net nominal volume shall be computed in cubic metres rounded to one decimal place.

The net nominal volume of the armour stone treated slope shall be calculated as the product of: the net surface area of the armour stone treated slope, times the nominal thickness of the armour stone treated slope, as specified in the contract item.

The net surface area of the armour stone treated slope shall be defined as the net area given by the mean length of the armour stone treated slope, times the mean width of the armour stone treated slope, measured along the face of the slope; less the area of objects around which the armour stone is placed.

.02 Measurement for Payment by Weight

For armour stone for which the contract unit price is stated in terms of the price per tonne, then such armour stone shall be measured for payment by weighing the stones which are to comprise the treated slope. The weight shall be computed in tonnes rounded to one decimal place. The armour stone shall be weighed on scales provided by the Contractor. The scales shall conform to the requirements of Item 301 “Weighing Materials in Trucks”. Only armour stones certified by the rock Checker as being placed within the limits, as staked by the Engineer, will be included in measurement for payment.

543.05 PAYMENT

Payment at the contract unit price per cubic metre, or per tonne, for the size of armour stone

specified, shall be compensation in full for all labour, materials, and equipment-use: to supply the required armour stones to excavate a foundation seat for the bottom armour stones, to provide all haulage to transport the armour stones from the source to the place where the stones are to be placed, together with the provision for weighing (if applicable).

ITEM 544

SEGMENTAL BLOCK WALL

544.01 SECTION INCLUDES

The Contractor shall supply and install segmental block wall in accordance with this specification and the contract drawings.

Materials and installation of segmental retaining wall.

Related Sections: Section 402 – “Excavation for Foundation, Unwatering and Extra Backfill for Structures”.

544.02 REFERENCES

Precast Modular Block Units:
ASTM C-33 Specification for Concrete Aggregates
ASTM C-39 Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C-94 Specification for Ready-Mixed Concrete
ASTM C-138 Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C-143 Test Method for Slump of Hydraulic-Cement Concrete
ASTM C-172 Standard Practice of Sampling Freshly Mixed Concrete
ASTM C-260 Specification for Air-Entraining Admixtures for Concrete
ASTM C-494 Specification for Chemical Admixtures for Concrete
ASTM C1611 Test Method for Slump Flow of Self-Consolidating Concrete
ASTM C-1776 Standard Specification for Wet-Cast Precast Modular Block Retaining Wall Units

Drain Pipe:
ASTM D-3034 Standard Specification for Type PSM (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM F-2648 Standard Specification for 2 to 60 inch [50 to 1500 mm] Annular Corrugated Profile Wall Polyethylene (PE) Pipe and Fittings for Land Drainage Applications

Geosynthetics:
ASTM D-4595 Tensile Properties of Geotextiles - Wide Width Strip
ASTM D-4873 Standard Guide for Identification, Storage and Handling of Geosynthetics
ASTM D-5262 Unconfined Tension Creep Behavior of Geosynthetics
ASTM D-5321 Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Ge-osynthetic and Geosynthetic Friction by the Direct Shear Method
ASTM D-5818 Standard Practice for Obtaining Samples of Geosynthetics from a Test Section for Assessment of Installation Damage
ASTM D-5970 Standard Test Method for Deterioration of Geotextiles from Outdoor Exposure
ASTM D-6637 Standard Test Method for Determining Tensile Properties of Geogrids by the

Single- or Multi-Rib Tensile Method
ASTM D-6638 Standard Test Method for Determining Connection Strength Between Geosynthetic Reinforcement and Segmental Concrete Units
ASTM D-6706 Standard Test Method for Measuring Geosynthetic Pullout Resistance in Soil

Engineering Design:
NCMA Design Manual for Segmental Retaining Walls, Current Edition
AASHTO LRFD Bridge Design Specifications, Current Edition
International Building Code (IBC), Current Edition
Minimum Design Loads for Buildings and Structures, ASCE 7, Current Edition

Soils:
ASTM D-422 Standard Test Method for Particle-Size Analysis of Soils
ASTM D-448 Standard Classification for Sizes of Aggregates for Road and Bridge Construction

ASTM D-698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Stand-ard Effort (12,400 ft-lbf/f3) (600 kN-m/m3)
ASTM D-1241 Standard Specification for Materials for Soil-Aggregate Subbase, Base and Surface Courses
ASTM D-1556 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method
ASTM D-1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modi-fied Effort (56,000 ft-lbf/f3) (2700 kN-m/m3)
ASTM D-2487 Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D-3080 Standard Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions
ASTM D-4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils ASTM D-4767 Test Method for Consolidated-Undrained Triaxial Compression Test for Cohesive Soils
ASTM D-6938 Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D-G51 Standard Test Method for Measuring pH of Soil for Use in Corrosion Testing

544.03 DEFINITIONS

Segmental Block Wall Unit: Concrete, segmental facing block provided by an authorized manufacturer. Standard of acceptance: ReCon Retaining Wall Systems, Inc. (or approved equal).

Geogrid: A geosynthetic material manufactured of high tensile materials specifically for the purpose of rein-forcing and creating a structural soil mass.

Drainage Aggregate: Clean, crushed rock located within and immediately behind segmental block units to facilitate drainage and avoid compaction in close proximity to segmental block wall units.

Reinforced Soil: Soil zone extending from the drainage aggregate zone to the back of the embedded geogrid.

Foundation Soil: Soil zone immediately beneath the retaining wall facing units, the wall leveling pad and the reinforced soil zone.

Retained Soil: Soil immediately behind retaining wall facing and drainage aggregate or behind the reinforced soil for walls that utilize geogrid.

544.04 SUBMITTALS

Contractor shall submit Manufacturer's test reports certifying that the segmental block wall units manufactured at their production facility meet the requirements of this specification and the requirements of the construction drawings.

If geogrid reinforcement is required, submit manufacturer's product literature, product testing reports and a 300mmx300mm or larger sample of each type to be used in wall construction.

Submit gradation reports for aggregates used for the wall leveling pad, unit / drainage fill and for select reinforced fill if required in the final engineered wall design.

All submittals must be provided and reviewed prior to the start of retaining wall construction.

544.05 DELIVERY, STORAGE, AND HANDLING

Contractor shall inspect all products at delivery to determine that the proper materials have been delivered and are useable. Damaged material shall not be incorporated into the work.

Segmental block retaining wall units shall be stored in a location and manner that protects against excessive weathering and damage.

Contractor shall prevent segmental block wall units from excessive soiling and coming in contact with substances which may stain or adhere to the finished visual surfaces of the unit. Faces of the segmental block wall units shall be free of excessive chipping, cracking and stains.

544.06 QUALITY ASSURANCE

Installer Qualifications: Contractor shall have successfully installed at least three projects similar to that of this project within the last five years. Contractor shall maintain at least one representative on site at all times that worked on one or more of these previous installations.

Owner shall employ the services of an independent geotechnical or materials engineering firm to provide soil testing and quality assurance inspection for wall construction and soils work. Contractor shall provide any quality control testing or inspection not provided by the Owner.

544.07 MATERIALS

Segmental block retaining wall units:

The block unit shall consist of concrete with average 28-day compressive strength of no less than 28 MPa.

Concrete shall have 4.5 – 7.5 percent air entrainment by volume.

Weight of concrete shall be a minimum of 2,320 kilograms per cubic meter.

Exterior dimension at the face shall be 1220mm by 405mm for full and corner unit, and 610mm by 405mm for half unit.

Depth of unit should be as per Construction Drawings and is available in 610mm, 1000mm, 1140mm 1520mm, 1680mm, 1830mm, 1980mm, or 2134mm depths.

Segmental block wall units used shall maintain tolerances of:
a. Height: +/- 5mm.
b. Width: =/- 13mm unless field cut for fitting purposes.
c. Depth: No less than the unit design depth (i.e. 610mm, 1,000mm, 1,140mm or 1,520mm, 1680mm, 1830mm, 1980mm, or 2134mm).

Special shape units should be obtained and used where indicated on the final engineered construction drawings.

Segmental block unit face texture: Shall be “LeSueur County Limestone” by ReCon Retaining Wall Systems, Inc. (or approved equal).

Geogrid Reinforcement (where applicable): Geosynthetic reinforcement shall be high tensile geogrid or geotextile manufactured specifically for soil reinforcement applications. The geosynthetic manufacturer shall provide all relevant testing and shall be included in the submittal. No substitutions of geosynthetic shall be allowed.

Base Leveling Pad: The wall base leveling pad material shall consist of a compacted crushed stone base or non-reinforced concrete as indicated in the drawings.

Drainage Aggregate: Drainage aggregate shall consist of clean 25mm minus crushed stone or gravel meeting the requirements of the drawings.

Backfill material: all backfill material, borrow or imported, shall meet all requirements of the drawings.

Drainage Pipe: Drainage pipe shall be perforated PVC pipe manufactured in accordance with ASTM D-3034. Drainage pipe may also be covered with a geotextile filter fabric.

Unit adhesive: Adhesive shall be a premium, construction grade suitable for concrete and exterior applications.

544.08 FINISHES

Segmental block retaining wall colour: Finished wall shall be left in natural (as-cast) colour.

544.09 EXAMINATION

Verify locations of utilities and existing structures prior to excavation.

Examine the Project site and evaluate conditions where the segmental block retaining wall will be constructed. Notify the proper supervising authority in writing of any conditions that may interfere with the proper construction of the segmental block wall or delay completion.

Promptly notify the wall design engineer of site conditions which may affect wall performance, soil conditions observed other than those assumed, or other conditions that may require a re-evaluation of the wall design.

544.10 EXCAVATION

Contractor shall excavate to the lines and grades shown on the construction drawings. The contractor shall be careful not to disturb base beyond the lines indicated.

Foundation soil shall be excavated as required for footing or base / leveling pad dimensions shown on the construction drawings, or as directed by the wall engineer.

Over-excavated areas shall be filled with suitable base or backfill material and compacted to 95% standard proctor.

544.11 FOUNDATION SOILS PREPARATION

Foundation soil shall be evaluated by a Geotechnical Engineer or Owners Representative to ensure that the bearing soils meet or exceed the design conditions or assumptions.

Compact foundation soil zone to 95% standard proctor prior to installing base / leveling pad.

544.12 BASE / LEVELING PAD

Base shall be located and constructed to thickness as indicated on the construction. Base materials shall be as specified.

Width of the base pad must extend a minimum of 150mm in front and 150mm in back of the segmental block wall base unit footprint.

Base material shall be compacted so s to provide a smooth, hard surface on which to place the first course of units.

Compact base / leveling pad material to 95% of standard proctor.

Prepared base to ensure full contact of the wall unit with base material and there will be no voids beneath or between units.

Contractor may elect to substitute a portion of the specified granular base materials with a lean, unreinforced concrete topping.

544.13 UNIT INSTALLATION

Units shall be placed in full contact with base / leveling pad material.

Check units for level from site-to-side and maintain unit batter front-to-back.

Place unit faces in contact end to end and avoid any gaps 13mm or greater.

Fill and compact fill to grade in front of embedded units prior to compaction behind the wall units.

Fill voids between segmental block wall units with 20 mm clean crushed rock to 300mm behind the unit depth unless otherwise instructed.

Sweep and clean the top of each course before setting additional courses.
Lay each successive course making sure that the bottom recess is in full contact with the unit locators of the course below. Pull unit forward as far as possible. Backfill and compact soil behind the units.

Check and maintain level and wall batter by use of shims when necessary.

Follow manufacturers recommended procedures to maintain acceptable running bond when constructing curved walls and / or corners. Build in accordance with drawings or manufacturers recommendations.

Handle units with proper lifting devices that have been certified for the loads associated with the weights of the units. Avoid applying forces to the lifting loops more than the normal force associated with the weight of the unit (i.e., avoid dynamic loads from bouncing or swinging of a unit). If the unit is to be transported over a significant distance in the field, it is recommended that a cable be used in lieu of a chain.

544.14 GEOGRID INSTALLATION

Install geosynthetic reinforcement, where applicable, in accordance with manufacturer’s recommendations and the construction drawings.

Locate geosynthetic reinforcement at elevations and to the lengths shown on the construction drawings.

Prior to installation of geosynthetic reinforcement, level and compact backfill material to the level of the reinforcement layer.

Reinforcement design strength direction must be oriented perpendicular to wall face.

Position reinforcement on segmental block wall units over the tongue and groove and to within 50mm of the front ex-posed face. The next course of units shall be placed such that the geogrid is deformed over the tongue and groove. The next course of units must be slid forward such that the back edge of the groove on this unit is up against the back edge of the tongue on the lower unit with the geogrid pinched between the tongue and groove. Hold in place by installing the next course of units.

Remove all wrinkles or folds in reinforcement by pulling taut prior to backfill placement. Secure using soil staples, stakes or hand tension until reinforcement is covered with sufficient fill to maintain tensioned position.

Reinforcement shall be continuous throughout the embedment length. Splicing along reinforcement strength direction is not allowed.

Position reinforcement sections side-by-side to provide 100 percent coverage along wall face.

Where curved wall sections cause overlap areas in reinforcement, maintain at least 75mm of soil between layers where overlap occurs.

544.15 REINFORCED BACKFILL PLACEMENT

Wall fill material shall be placed in lifts no greater than 200mm in depth and shall be less if necessary, to achieve necessary compaction.

Compact backfill material to 95 percent of standard proctor.

Only hand-operated compaction equipment shall be used within 1000mm of the back of the segmental block wall units. Heavy-duty compaction equipment should be kept a minimum of 1500mm from the back of the segmental block wall units to avoid wall rotation.

Wherever possible, backfill should be placed beginning at the face of the wall. Backfill shall be placed, spread, and
compacted in a manner that minimizes the development of wrinkles, folds, or movement of geogrid.

Tracked construction equipment shall not be operated directly on the geogrid. A minimum backfill thickness of 150mm is

required prior to operation of tracked vehicles over the geogrid. Turning of tracked vehicles should be kept to a minimum to prevent tracks from displacing the fill and damaging the geogrid.

Rubber tired equipment may pass over the geogrid reinforcement at slow speeds, (less than 15km/h). Avoid sudden braking and sharp turning.

At the conclusion of each day's work, slope backfill at both the crest and bottom of wall away from wall face to prevent surface drainage from scouring or ponding.

During wall construction, the General Contractor shall be responsible for coordination of other project site operations so as to avoid adjacent construction site drainage from affecting wall construction area.

Upon completion of wall construction work, the General Contractor shall:

Ensure finished grading directs normal drainage away from the finished wall.

Ensure other trades do not operate heavy equipment or excavate near the wall and reinforced soil zone.

544.16 SITE TOLERANCES

Straight walls:
Vertical alignment: +/- 40mm over any 3600mm distance and no more than +/- 75mm over entire length of wall.

Horizontal Alignment Control:
Corners and radius location: +/- 305mm to theoretical location indicated on the Grading Plan.
Radii: +/- 610mm from theoretical lines indicated on the Grading Plan.

Wall Batter at Completion of Work: +/- 2 degrees from the design batter and no batter less than 2 degrees.

544.17 FIELD QUALITY CONTROL

Contractor shall be responsible for proper installation and quality control of all segmental block wall components and appurtenant materials.

544.18 CLEANING

After completion of wall installation, remove construction debris and restore any adjacent finished areas affected by wall construction to their pre-construction state.

Wash wall face to remove soiling and stains. Do not use acid or detergents that may burn or discolour face.

544.19 MEASUREMENT FOR PAYMENT

Measurement for payment for segmental block walls will be based on the number of each size and type of required block placed to the required alignment.

544.20 PAYMENT

Payment at the contract price for the type and size of segmental block specified shall be compensation in full for all labour, materials and equipment required for supply and

installation according to this specification.

DIVISION 6

SPECIFICATIONS FOR MISCELLANEOUS ITEMS

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ITEM 602

GUIDE RAIL

602.01 SCOPE OF WORK

The Contractor shall supply and place steel guide rails in accordance with the plans and standard drawings or as directed by the Engineer.

602.02 ENVIRONMENTAL REQUIREMENTS

Guide rail posts located in Protected Water Supply areas shall only be chromated copper arsenate (CCA) treated type.

602.03 MATERIALS

Rail Sections

The rail elements shall consist of a corrugated steel w-beam with corrugations symmetrical about the horizontal axis and such that the edges and centre of the rail element may contact each post.

The individual rail elements shall be of the Standard Type w-beam consisting of 2.75mm thick (12 gauge) rail of length not less than 4125mm, having post bolt slots 3810mm apart centre to centre; unless indicated elsewhere on a drawing or supplementary general condition in which case one (1) additional post bolt slot will be placed at midspan.

The rail metal shall be open hearth oxygen furnace or electric furnace steel having an elongation of not less than 12% in 50mm and shall withstand a cold bend, without cracking, of 180° around a mandrel of a diameter equal to 2 1/2 times the thickness of the plate.

The rail elements shall be hot-dip galvanized before or after fabrication, in accordance with the specifications of ASTM Designation A-515 (Class 2 1/2 oz.) or A-123.

Rail element joints shall be capable of withstanding a tensile load of not less than 350kN without failure. The rail element shall not deflect more than 140mm when tested as a simple beam with the traffic face up and with an 8.9kN load applied at the centre of a 3650mm span through a 76mm wide flat bearing.

Workmanship shall be equivalent to good commercial practice and all edges, bolt holes and surfaces shall be free of torn metal, burns, sharp edges and protrusions.

Two (2) certified copies of mill test reports of each batch from which the rail element is formed, shall be furnished to the Engineer, if so requested.

Angled Rail Sections

Angled rail sections shall be manufactured to meet the dimensions as shown in the drawings. The sections shall be shop fabricated from rail sections conforming to the requirements of Section 602.03.

The weld shall be cleaned, pre-treated and coated with cold galvanizing compound as outlined.

Where corrugated steal beam is cut with a saw, drilled, or welded, the beam shall be thoroughly cleaned with a wire brush to remove scale, rust, slag residue, weld splatter, etc. And wiped clean. The cleaned surface shall receive at least one (1) application of metal conditioner to de-oxidize, de-grease and phosphatize the metal surface to be treated if the surface is oily. Pre-mixed, ready-to-apply, liquid-zinc compound shall be applied to the prepared, clean, dry metal surface. The cold-galvanizing compound must be of a type that imparts cathodic action against corrosion. The cold-galvanizing compound shall have a minimum 50mm overlap of the surrounding undamaged galvanized metal.

Both metal conditioner and cold-galvanizing compound must be approved by Underwriters Laboratories Inc. for component coatings-organic and meet or exceed Canadian Government specifications 1-GP-181A. All materials must be applied in accordance with the manufacture's instructions.

No punching, cutting or welding will be permitted in the field.

Rail Terminal Sections

Rail terminal sections shall be as illustrated in the standard drawings. The metal and galvanizing shall be of the same thickness and quality as is stipulated for the rail sections in Section 602.03.

Bolts, Nuts, Washers and Spikes

All bolts, nuts and washers shall conform to the specifications of ASTM Designation A-307 or A-325, except that rail splice bolts shall be button headed.

Post bolts and splice bolts shall have shoulders of such shape and size that they fit into the bolt slots in the rails and thus prevent the bolt from turning.

Post bolts shall be 16mm diameter and 200mm long. Post bolt washers for the back of the post shall be 45mm round and 4mm thick.

Bolts for anchors shall be 16mm diameter and 350mm long and washers shall be 45mm round 4mm thick.

Spikes for anchors shall be 125mm galvanized spikes.

Bolts, nuts, washers and other fittings shall be hot-dip galvanized, in accordance with the

specification of ASTM Designation A-153.

Signal Reflectors

Silver signal reflectors and yellow signal reflectors shall be of size 75mm x 100mm.

Nails for Reflectors

Nails for securing signal reflectors, shall be supplied by the Contractor and shall consist of 30mm galvanized flat head nails.

Posts and Anchors

Timber for posts and anchors shall be sound, well seasoned structural grade lumber.

Post shall have minimum dimensions of 150mm x 150mm x 2300mm.

Anchors shall consist of either one (1) piece of 150mm x 150mm x 450mm timber, or two (2) pieces of 38mm x 140mm x 450mm lumber.

Posts and anchors shall be pressure treated with an acceptable wood preservative.

The minimum required depth of penetration of wood preservative shall be 13mm. To determine penetration, a borer core shall be taken from twenty (20) pieces in each charge. If eighty percent (80%) of the borings meet the penetration requirements, the charge shall be accepted.

The minimum retention of preservative shall be as follows:

PRESERVATIVE	MINIMUM RETENTION	METHOD OF DETERMINATION
PENTACHLOROPHENOL	6.4 kg.m³	BY ASSAY
CHROMATED COPPER ARSENATE	6.4 kg.m³	BY ASSAY
OTHER	IN ACCORDANCE WITH CSA 080	

Incising will normally be required. However, this requirement will be waived if specifications for both penetration and retention are satisfied.

If requested by the Engineer, the Contractor shall provide penetration and retention test reports for the guide posts and guide rail posts supplied for the project.

Wood preservative for use in treating field cut ends of posts shall be of the same type and chemical composition as that used in the original treatment.

602.04 DISMANTLING OF EXISTING GUIDE RAIL

The Contractor shall exercise care in dismantling and removing rails and terminal sections

so that they are not damaged and remain suitable for re-use. The rails and terminal sections shall be transported to, and stored at, a secure storage site provided by the Contractor at this own expense, pending their reassembly at a new location.

Should any material, designated for reinstallation, be damaged or lost by the Contractor, then the Contractor shall be charged with the costs of replacement with equivalent new material. Damaged material shall become the property of the Contractor and shall be disposed of.

602.05 REMOVAL AND SALVAGE OF EXISTING POSTS

The Contractor shall exercise care in excavating posts so that they are not damaged and remain suitable for re-use. Where the contract item is given as, "Salvage and Reinstallation of Guide Rail with New Posts" then, the salvaged posts shall be transported to, and stored at, the Depot. However, should the contract item be given as, "Salvage and Reinstallation of Guide Rail with Salvaged Posts" then, the posts shall be transported to and stored at, a secure storage site provided by the Contractor at his own expense pending their re-use at a new location. Should any post designated for salvage, be damaged or lost by the Contractor, then the Contractor shall be charged with the cost of replacement. Damaged posts shall become the property of the Contractor and shall be disposed of.

602.06 INSTALLATION

Galvanized materials shall be loaded, hauled and handled in such manner that the galvanizing will not be damaged. All bare, abraded and damaged surfaces shall be cleaned pretreated if required and coated with cold galvanizing compound as outlined above.

Guide rail shall be placed to the lengths, lines and grades set by the Engineer. The guide rail shall be installed in accordance with the requirements of the Standard Drawing, except where directed otherwise by the Engineer.

An angled railed section shall be placed at the approaching traffic end of a run of guide rail, and a terminal section shall be placed at the other end, unless directed otherwise by the Engineer.

The end post at an angled rail section shall have an anchor secured to the bottom of the post.

Where a 150mm x 150mm x 450mm timber anchor is used, it shall be secured to the post by means of a galvanized nut and 16mm diameter bolt 350mm long together with two (2) 45mm round 4mm thick galvanized washers.

Where a double 38mm x 140mm x 450mm lumber anchor is used, it shall be secured to the post by means of four (4) 125mm galvanized spikes.

Field boring and cutting to length of anchors will be permitted, provided that the hole is treated with two (2) coats of wood preservative before driving the bolts and provided that the cut end

is treated with two (2) coats of wood preservative before burying.

The Contractor shall excavate holes for the posts such that when placed in the holes the bottom of the posts is at least 1500mm below the ground surface.

Posts shall be set plumb and to the established lines and grades and shall be placed at 3810mm intervals, unless directed otherwise by the Engineer.

The posts shall be firmly backfilled with selected material, free of large rock, placed in layers of thickness not greater than 100mm. Each layer shall be thoroughly compacted before the next layer is placed. Should the backfill be dry then each layer shall be moistened before tamping.

All backfill shall be compacted to ninety-five percent (95%) of Standard Proctor Density (ASTM D698).

All Surplus excavated material shall be disposed of along the sides of fill, or in other locations as directed by the Engineer.

The rails shall be secured to even lines such that the centre of the rail is 635mm above the top of the sidewalk or edge of asphalt.

The Contractor shall bore holes in the posts for the post bolts and treat the holes with two coats of hot creosote before driving the bolts.

Rail elements and terminal sections shall be lapped so that the exposed ends will not face approaching traffic.

The bolted connections of the rail element to the post shall be capable of withstanding a 22.5kN pull at right angles to the lines of the railing.

When the attachment of the rail elements to the posts has been completed, the tops of the posts shall be cut to a point 75mm above the top of the rail as shown by the Drawing "Typical Guide Rail Standard Installation". The tops of the posts shall be treated with two (2) coats of wood preservative after cutting.

Signal reflectors shall be attached to posts at terminal sections, posts at the weld at angled sections, and to every fourth post in a length of guide rail. Silver reflectors shall be placed facing on-coming traffic and yellow reflectors shall be placed on the opposite side.

The Contractor shall drill nail holes in the reflectors, bend the reflectors to the required shape and secure the reflectors with 30mm galvanized flat head nails.

602.07 MEASUREMENT FOR PAYMENT

Measurement for payment for the supply and installation of Standard Type Guide Rail, guide

rail with additional posts or Type “A” Guide Rail shall be the length of guide rail placed within the limits marked by the Engineer, measured in metres, rounded to one (1) decimal place, measured end to end along the face of the railing and terminal sections.

Measurement for payment for the supply and installation of Type “B” Guide Rail shall be the length of rail and terminal sections placed within the limits designated by the Engineer, measured in metres, rounded to one (1) decimal place, measured end to end alone one (1) side only.

Where the guide rail structure is a composite of more than one (1) type of guide rail installation, then measurement for payment shall be by the length of each type of guide rail installation making up the composite.

Measurement for payment for buried end sections will be by means of the number of buried end sections placed as directed by the Engineer.

602.08 PAYMENT

Payment for this item shall be at the unit price bid for each quantity of guide rail supplied and installed and shall be full compensation for all labour, equipment, materials, necessary to supply and install guide rail in accordance with this Specification.

ITEM 603

HANDRAIL

603.01 SCOPE OF WORK

The Contractor shall fabricate, and erect pedestrian handrailing constructed of steel pipe posts. Locations shall be as shown on the drawings or as directed by the Engineer.

603.02 FORM AND DIMENSIONS

The form and dimensions of the handrail shall conform to those given in the drawings, and the length shall be as required to suit the site conditions where necessary. The Contractor shall vary the spacing of the posts such that the spacing is uniform throughout the length of the rail.

603.03 MATERIALS AND FABRICATION

Steel posts and rails for use with steps and ramp handrails shall consist of 43mm outside diameter galvanized schedule 40 pipe conforming to ASTM Standard A53. Steel posts and rails for use with headwall and retaining wall guards shall consist of 50mm inside diameter galvanized schedule 40 pipe conforming to ASTM Standard A53. Balustrades shall consist of 16mm diameter solid galvanized steel with a maximum spacing of 116mm on center (maximum clear opening of 100mm between balusters). Weld ends to top and bottom rails. The railing shall be pre fabricated before erection, and joints between rails and posts shall be made by proper cutting and fitting to insure complete contact. The joints shall then be welded, and the welds and surrounding heat damaged areas shall be galvanized after fabrication or otherwise suitably protected from corrosion using a zinc-based coating. The railing shall be delivered to the site complete and ready for erection.

603.04 INSTALLATION AND FINISH

Posts shall be bedded in cement grouts in accordance with the bedding detail in the drawings. Holes shall be either drilled or formed in the concrete walls, walks, steps, or sidewalks as required.

After installation, the posts and rails shall be prepared and painted as follows:

1. Clean galvanized railing with a metal conditioner recommended for paint type below.

2. Prime (one (1) coat) Zinc Dust - Zinc Oxide primer recommended for paint type below.

3. Paint (two (2) coats) with Bright Green Pantone 369 or Dupont 42-766076 enamel or approved equal in colour selected by the Engineer. Depending on location of handrail, black enamel may be preferred.

603.05 MEASUREMENT FOR PAYMENT

The unit of measurement shall be the linear metre. The length of rail installed shall be measured along the top rail between the centres of the posts.

603.06 PAYMENT

The Contractor shall be paid at the respective unit price bid for each linear metre of handrail supplied and installed. The unit price shall include full compensation for all labour, equipment, materials and supplies necessary to complete the work in accordance with these Specifications.

ITEM 610

SIGN AND SIGNPOST INSTALLATIONS

610.01 SCOPE OF WORK

This specification covers the requirements for the supply and installation of various types of signposts and the actual placing of signs on those signposts.

610.02 CLASSIFICATION OF SIGNPOST INSTALLATIONS

Basic types of signpost installations are:

Type C, Type D and Type E

Type C and Type D signpost installations are of various dimensions, but all are intended to support signs which require two wooden vertical members for support. Type C installations are intended for signs of width less than or equal to 2440mm and a height of less than or equal to 1220mm. Type D installations are intended for signs wider than 2440mm but less than 4880mm and/or higher than 1220mm but less than 2440mm.

For Type C and Type D signpost installations, the upper number following the letter denotes the required height of the sign board in millimetres, and the lower number denotes the length of the sign board in millimetres.

Type E signpost installations will be of various dimensions and are intended to support signs less than or equal to 2440 mm in height and between 4880mm and 6096mm in length which require three wooden vertical members for support. For Type E signpost installation, the upper number following the letter denotes the height of the signboard in millimetres and the lower number denotes the length of the signboard in millimetres. Reference standard drawings 10-610-01 through 10-610-03 for details.

610.03 MATERIALS

The Contractor shall supply all materials required to complete sign and signpost installations in accordance with these specifications.

All posts, footings, and braces for Types C & D shall be pressure treated eastern hemlock, western hemlock, or BC fir and be of the size specified for each post type.

Nails shall be galvanized with a length of 100mm.

Lag bolts shall be galvanized with a length of 80mm and a diameter of 10mm and with Hex or Square Head only (carriage type head is not to be used on signs).

Washers shall be galvanized flat washers to fit 10mm diameter lag bolts.

Materials Used for the Installation of Signs

Signs designated to be supplied by the City will be made available to the Contractor at the Municipal Depot.

Signs will be placed on wooden signposts with 80mm x 10mm lag bolts and washers in accordance with the Standard Drawings.

610.04 ASSEMBLY

Should any piece of lumber become split or cracked during nailing or installing the sign, then the Contractor shall replace the damaged piece with sound lumber at his own expense.

610.05 INSTALLATION

The Engineer will stake the locations where signpost installations are to be installed and designate the sign number of the signpost installation that is required for each location.

The Contractor shall excavate holes for the footings, such that when installed the installation is at least the required minimum depth in the ground.

Footings shall be backfilled with selected fill which meets with the Engineer's approval. Backfill materials shall not contain stones larger than 150mm in either dimension.

Backfill material shall be placed in layers of thickness not greater than 150mm. Each layer shall be thoroughly compacted before the successive layer is placed. Dry granular backfill shall be moistened before tamping.

Backfill material around the signpost installations shall be brought up level with the surrounding ground and surplus excavated material together with surplus backfill material shall be disposed of on the sides of fills, or as directed by the Engineer.

The Contractor shall be responsible for placing each sign on the correct posts, and at the location as set by the Engineer, taking care to ensure that each sign is placed undamaged, horizontally levelled, and attached to the posts and cross members with 80mm x 10mm galvanized lag bolts and galvanized washers. Nails cannot be substituted for this job.

Sign board size, signpost type, and the location of each will be specified on drawings as set by the Engineer.

610.06 MEASUREMENT FOR PAYMENT

Measurement for payment will be by means of the number of each type of signpost installation placed at the required locations.

Should excavation of solid rock be required to complete the installation of a signpost, payment for the rock excavation will be made according to item 211 “Trench Excavation”, or item 321 “Street Excavation”.

610.07 PAYMENT

Payment at the contract price for sign and signpost installation of a particular type shall be compensation in full for all labour handling, materials, and equipment use to supply all materials, handling of signs from city Depot, assemble the installation, excavate a hole for the footings, install the signposts, backfill the hole, compact the backfill, install the sign board and dispose of all surplus materials, all in accordance with this specification.

DIVISION 7

SPECIFICATIONS FOR TEMPORARY SIGNS & DEVICES

Division 7 is deleted in its entirety. Refer to Item 130 in the City of St. John's Specifications Book and the Province of Newfoundland and Labrador's Traffic Control Manual for Traffic Control Requirements.

DIVISION 8

TRAFFIC

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ITEM 801

UNDERGROUND ELECTRICAL CONDUIT

801.01 SCOPE OF WORK

The contractor shall supply and install all electrical conduit, bends and fittings in sizes specified in the unit price table and in accordance with the following.

801.02 MATERIAL

The conduit shall be P.V.C., gray in colour and meet the requirements of CSA C22.2 No. 211.2 or CSA C22.2 No. 211.0FT4 for 1/2" - 6".

801.03 INSTALLATION

The conduit shall be set in trenches excavated to undisturbed soil or in previously constructed subgrade.

Conduit shall be jointed to give a firm but not water tight fit and care shall be taken to insure the pipe or fittings do not become damaged.

Unless otherwise directed by the Engineer the conduit shall be installed at a positive slope from junction boxes with a minimum slope of two percent (2%). The top of the conduit shall not be less than 900mm below finished grade.

Where the conduit is to be installed across a street for connection to pole bases or other work at a future date, the conduit shall extend 1000mm beyond the back of sidewalk.

After the pipe has been properly laid and backfilled, a mandrel not less than 300mm long and having a diameter of 6mm less than the diameter of the conduit shall be pulled through each run to ensure that it is not blocked. A stiff bristle brush shall then be pulled through each duct to remove all sand and other foreign matter. The ends of the conduit shall then be capped with appropriate P.V.C. end caps.

A "fish line" or wire shall also be placed in each conduit as an aid in pulling the permanent lines. If the pulling of permanent wires is not part of the contract, then the Contractor shall install a minimum twelve (12) gauge galvanized steel wire in the conduit for the purpose of pulling the permanent wires.

801.04 MEASUREMENT FOR PAYMENT

Measurement for payment shall be the actual in place end to end length, measured in metres to one decimal place, along the centreline of the conduit including long radius bonds, but not

including conduits placed in pole bases on traffic controller pads.

801.05 PAYMENT

Payment shall be at the respective unit price bid for each diameter of conduit. The unit price bid shall be full compensation for all labour, equipment and materials required to supply and install underground electrical conduit in accordance with this specification.

ITEM 802

POLE BASES, JUNCTION BOXES & CONTROLLER PADS

802.01 SCOPE OF WORK

The Contractor shall construct concrete pole bases, junction boxes, and controller pads in accordance with this specification.

802.02 FORM AND DIMENSION

The form and dimension of items shall conform to those detailed in the contract drawings or, if not shown, as supplied by the Engineer.

802.03 FORMWORK

Formwork shall conform to formwork as specified in Item 407 “Formwork & Falsework”.

802.04 CONCRETE

Concrete shall conform to concrete as specified in Item 404 “Concrete Structures”.

802.05 REINFORCEMENT

Reinforcement shall conform to reinforcement as specified in Item 405 “Concrete Reinforcement”.

802.06 ANCHOR BOLTS

Anchor bolts and templates for bases and controller pads shall be supplied by the pole or equipment supplier and installed by the Contractor. The Contractor shall be responsible for ensuring the anchor bolts are installed at the proper orientation to the street. The angle of orientation shall be perpendicular to the centreline of the street unless otherwise directed. Anchor bolts to be tack welded and securely braced to maintain proper alignment during pouring of concrete. Exposed threads to be protected to prevent contact with fresh concrete.

802.07 PREFAB JUNCTION BOXES

Prefab junction boxes 330 x 600 (13" x 24") as detailed on the drawing and as manufactured by Quazite or Synertech are acceptable. Prefab junction boxes shall have the word “Traffic” printed on its cover. The junction box shall be heavy duty and able to withstand a minimum wheel load of 10,000 kg.

802.08 MEASUREMENT FOR PAYMENT

For each unit of each type supplied and installed as described in the Unit Price Table.

802.09 PAYMENT

Payment shall be at the respective unit price bid for each item described in the tender form. The price bid shall be full compensation for all labour, equipment, and materials necessary to complete the work as specified.

ITEM 803

POLES

803.01 SCOPE OF WORK

The work covered by this specification shall cover the supply and installation of traffic and light poles, anchor bolts, mounting arms and associated hardware.

803.02 MATERIALS

Unless otherwise specified poles shall be:

Traffic Pole

Traffic poles shall be hot dipped galvanized steel having offsets and mounting heights as specified on the contract drawings.

Acceptable manufacturers:	Pole Systems (Barber) TC Series (Pedestal) Valmont Structures or approved equal	TD 6000 Series (Davit)

Street Lights

Street lights shall be as specified on the contract drawings and documents.

803.03 BASES AND FOUNDATIONS

The Contractor shall supply under separate pay items concrete bases and foundations for the installations of poles, however, the supplying and placing of anchor bolts for these bases and foundations shall be considered included in the price bid for supplying and installing poles.

Where poles are of the direct bury type then excavation to the required grade and backfilling shall be included in the price bid for supply and installation of poles.

803.04 MEASUREMENT FOR PAYMENT

For each unit of each type supplied and installed as described in the unit price table.

803.05 PAYMENT

Payment shall be at the unit price or lump sum price for each pole or item supplied and installed complete with anchor bolts, template and incidentals.

ITEM 806

PREFORMED PAVEMENT MARKINGS

806.01 SCOPE OF WORK

This work shall consist of furnishing and installing retroreflective preformed patterned pavement markings in accordance with this provision and in conformance to the dimensions and lines shown on the plans or established by the Engineer.

Preformed pavement markings shall be used for all pre-marks, arrows, crosswalk zebra marks and speed hump/speed table warnings, or as indicated in the contract documents.

806.02 MATERIALS

The preformed patterned markings shall consist of white or yellow films with clear microcrystalline ceramic beads incorporated to provide immediate and continuing retroreflection during both wet and dry conditions. This film shall be manufactured without any intentional use of lead chromate pigments or other similar, lead-containing chemicals.

Preformed words and symbols shall conform to the applicable shapes and sizes as outlined in the latest edition of the Transportation Association of Canada's "Manual of Uniform Traffic Control Devices for Canada" (MUTCD).

The preformed markings shall have a pre-coated pressure sensitive adhesive and shall be capable of being adhered to properly prepared asphalt surfaces. The preformed markings shall conform to pavement contours by the action of compaction equipment and traffic. After application, the markings shall be immediately ready for traffic.

The markings shall be highly durable and be constructed of retroreflective pliant polymer materials designed for longitudinal and word/symbol markings subjected to high traffic volumes and severe wear conditions such as shear action from crossover or encroachment on typical longitudinal configurations such as edge lines and lane lines. The markings shall be capable of providing retroreflection during both wet and dry conditions.

806.03 MATERIAL REQUIREMENTS

Composition

The retroreflective pliant polymer pavement markings shall consist of a mixture of high-quality polymeric materials, pigments and glass beads distributed throughout its base cross-sectional area, with a reflective layer of microcrystalline ceramic beads bonded to a durable polyurethane topcoat surface. The patterned surface shall have approximately

40% ± 15% of the surface area raised, or 40% +/- 10% of the total pavement marking volume raised and presenting a near vertical face (ß angle of 0° to 60°) to traffic from any direction. The channels between the raised areas shall be substantially free of exposed beads or particles.

Retroreflectance

The white and yellow markings shall have the initial expected retroreflectance values as shown in the table below under dry, wet, and rainy conditions. Retroreflectance, measured as the coefficient of retroreflected luminance (RL), shall be expressed as millicandelas per square meter per lux [mcd/m^2/lx].

Retroreflectance values shall be measured under dry conditions in accordance with the testing procedures of ASTM E1710, and under wet conditions in accordance with ASTM E2832-12 or ASTM E2177 prior to installation. Wet retroreflectance values measured under a “condition of continuous wetting” (simulated rain) shall be in accordance with ASTM E2832-12. Wet retroreflectance values measured under a “condition of wetness” (wet recovery) shall be in accordance with ASTM E2177. To reduce variability between measurements, the test method shall be performed in a controlled laboratory environment while the marking is positioned with a 3 to 5-degree lateral slope. A wetting agent shall be used to improve wetting of the pavement marking by the water. It is required that a 0.1% by volume liquid soap solution be used.

Measurements shall be reported as an average for each roll tested, in a minimum of three locations. In-service wet retroreflectance values measured under a standard condition of continuous wetting shall be in accordance with ASTM E2832-12, and the test may be performed with the marking installed on the road. Measurements in the field shall not be made where both the cross slope and grade are less than 0.5 percent, or where the water submerges the test specimen. Newly installed markings shall be tested using a wetting agent, as previously described.

Color	White		Yellow	
Condition/Test	Dry ASTM E1710	Wet & Rainy ASTM E2832-12 or ASTM E2177	Dry ASTM E1710	Wet & Rainy ASTM E2832-12 or ASTM E2177
Entrance Angle	88.76º	88.76º	88.76º	88.76º
Observation Angle	1.05º	1.05º	1.05º	1.05º
Coefficient of Retroreflected Luminance [mcd/m^2/lux]	500	250	300	200

Notes: Coefficients of retroreflected luminance when measured under ASTM E2177 will be higher than when measured under ASTM E2832-12. Stated minimum values shall be met using either test method.

Beads

Index of Refraction: All “dry-performing” microcrystalline ceramic beads bonded to the polyurethane-coated, patterned surface of the material shall have a minimum index of refraction of 1.70 when tested using the liquid oil immersion method. All “wet-performing” microcrystalline ceramic beads bonded to the polyurethane-coated, patterned surface of the material shall have a minimum index of refraction of 2.30 when tested using the liquid oil immersion method. The glass beads mixed into the pliant polymer shall have a minimum index of refraction of 1.5 when tested by the liquid oil immersion method.

Acid Resistance

The beads shall show resistance to corrosion of their surface after exposure to a 1% solution (by weight) of sulfuric acid. Microscopic examination (20x) shall show no more than 15% of the beads having a formation of a very distinct opaque white (corroded) layer on their entire surface.

Color

The preformed markings shall conform to ASTM D6628, Standard Specification for Color of Pavement Marking Materials, and shall consist of white and yellow films with pigments selected and blended to conform to standard highway colors.

Skid Resistance

The patterned surface of the retroreflective pliant polymer shall provide an initial average skid resistance value of 45 BPN when tested according to ASTM E303 except values shall be taken in one direction and then at a 45° angle from that direction. These two values shall then be averaged to find the skid resistance of the patterned surface.

Thickness

The patterned material without adhesive shall have a minimum caliper of 2.159mm at the thickest portion of the patterned cross-section and a minimum caliper of 0.508mm at the thinnest portion of the cross-section.

806.04 INSTALLATION

The markings shall be applied in accordance with the manufacturer’s “Hot Inlay Application” installation instructions, unless directed otherwise by Engineer. Hot inlaying is the process of embedding pavement marking tape into fresh surface asphalt during final rolling of the mat. This is done by rolling over the applied tape with a steel-drum

finishing roller while the asphalt is still warm. The asphalt surface temperature shall be between 54 and 71 degrees Celsius.

Marking configurations shall be placed as per the MUTCD.

806.05 PRE-MARKING PLACEMENT

Pre-markings, while not included in the MUTCD, shall be installed for all lane (skip) lines and directional dividing lines and at all stop bars, or as instructed by the Engineer.

Longitudinal line pre-marks shall be die-cut into a 100mm diameter circle. Pre-marks for directional dividing lanes and lane lines shall be spaced at every 9 meters. Pre-marks for continuity lines in merging and diverging areas and tapers for left-turn and right-turn lanes shall be spaced at every 6 meters.

806.06 MEASUREMENT FOR PAYMENT

Work performed under this item shall be paid for as follows, and as further detailed in the Schedule of Quantities:

a) 100mm diameter circular pre-marks – the number of each unit supplied and installed.

b) Speed hump warnings – the number of each 1.5m x 0.6m triangular marking supplied and installed.

c) Arrows – the number of each type of arrow supplied and installed, including but are not limited to:

   i. Through arrows

   ii. Left or right turn arrows

   iii. Through-left or through-right option arrows

d) Crosswalk zebra markings – the number in linear meters, of 600mm wide preformed pavement markings supplied and installed.

e) Any other pre-cut symbols required in the drawings or contract documents (such as roundabout arrows, bicycle symbols, diamond symbols, letters, etc.) - the number of each unit supplied and installed.

f) Any other longitudinal or transverse markings required in the drawings or contract documents – the number in linear meters, supplied and installed for the width specified.

806.07 PAYMENT

Payment for this item shall be at the respective unit price bid. The unit prices shall constitute full compensation for furnishing and placing all materials, and for all materials, labor, tools, equipment, and incidentals necessary to complete the work in accordance with the manufacturer's recommendations.

ITEM 807

PAVEMENT MARKINGS

807.01 SCOPE OF WORK

This work shall consist of furnishing and installing all painted pavement markings and lines in accordance with this provision and in conformance to the dimensions and lines shown on the plans or established by the Engineer.

807.02 MATERIALS

All traffic paint shall be solvent-based (alkyd) traffic paint conforming to CAN/CGSB-1.220. Any traffic paint installed during the periods of May 1 and October 15 shall be Low-VOC paint and have a VOC count less than 150 g/L.

Glass Beads must be installed with the traffic paint to achieve the required retro reflectivity. Glass beads shall be in accordance with the latest version of AASHTO M247 and shall be installed at a rate of 0.85 to 1.0 pounds per square meter. Glass beads should be imbedded into the paint immediately after application and prior to the paint drying.

807.04 INSTALLATION

The Contractor will be responsible for installing pavement markings and lines subsequent to road resurfacing. Layout and pre-marking must be completed within two hours of paving operations, and first coat of permanent pavement markings must be installed within 24 hours of asphalt installation. If markings cannot be placed within 24 hours due to weather conditions the contractor must install and maintain temporary traffic control to delineate the traffic lanes until markings can be installed.

All street markings, with the exception of edge lines, cross hatching and parking stalls, will require two applications. The second application should be installed at least 24 hours after the first coat.

All street markings shall be uniform in design and size and shall conform to the specifications outlined in the drawings and shall be compliant with the Manual of Uniform Traffic Control Devices (MUTCD) latest edition. Any accessible parking stalls shall conform to the Accessible Parking guidelines as outlined by Service NL.

Paint shall only be applied when the asphalt surface is free of water, frost, dew, ice or other foreign materials and pavement temperature is at or above 8°C. Removal of foreign material or street sweeping is the responsibility of the Contractor. Painting is not permitted during periods of poor visibility or when the ambient air temperature is below 8°C.

Paint for all markings will be applied at a thickness of 15 mil ± 1 mil thickness (each application). The City may test the thickness of applied paint at random. Any street markings applied to a substandard thickness must be re-applied at the Contractor's expense.

Pure un-thinned paint must be used and applied to the street using airless application equipment.

The Contractor (or Subcontractor) must have a minimum of two years' experience in the application of street markings. References from Municipal and/or Provincial jurisdictions confirming experience and qualifications must be submitted upon request.

807.06 MEASUREMENT FOR PAYMENT

Work performed under this item shall be paid on a Lump Sum basis for application on each street or area where it is required, and as further detailed in the Schedule of Quantities:

807.07 PAYMENT

Payment for this item shall be at the respective unit price bid. The unit prices shall constitute full compensation for furnishing and placing all materials, and for all materials, labor, tools, equipment, and incidentals necessary to complete the work.

ITEM 810

ELECTRICAL - GENERAL PROVISIONS

810.01 SCOPE OF WORK

The work covered by this specification shall cover all electrical - general provisions necessary to furnish operating traffic control stations, traffic control equipment and street lighting.

810.02 CODES AND STANDARDS

1) Do complete installation in accordance with CSA C22.1 except where specified otherwise.

2) Comply with CSA Certification Standards and Electrical Bulletins in force at time of tender submission.

3) Do overhead and underground systems in accordance with CAN C22.3 No. 1 except where specified otherwise.

4) Do underground systems in accordance with CAN3. C22.3 No. 7.

5) Abbreviations for electrical terms: to CSA Z85.

810.03 PERMITS AND FEES

Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.

Pay associated fees.

Engineer will provide three (3) sets of drawings at no cost.

Furnish Certificates of Acceptance from electrical inspection department to Engineer on completion of work.

810.04 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

Submit shop drawings, product data and samples in accordance with City of St. John's Specifications Book.

Indicate details of construction, dimensions, capacities, weight and electrical performance characteristics of equipment or material.

Where applicable indicate wiring, single line and schematic diagrams.

Include wiring drawings or diagrams showing interconnection with work of other sections.

Each shop drawing will be stamped and signed by the Contractor before submitting, stating that he has checked the drawings against the requirements as called for in the Contract Documents and also in the case where the equipment is attached to or connects to other equipment, that it has been properly co-ordinated with this equipment.

Each shop drawing for non-catalogue items shall be prepared specifically for this project. If brochures are submitted for catalogue items, the brochures shall be marked indicating the item or items to be supplied.

810.05 CARE, OPERATION AND START-UP

Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance, and calibrate components.

Provide these services for such period and for as many visits as necessary to put equipment in operation and ensure that operating personnel are conversant with aspects of its care and operation.

810.06 VOLTAGE RATINGS

Operating voltages: to CAN3-C235.

Control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

810.07 INSPECTION

Furnish Certificates of Acceptance from authorities having jurisdiction on completion of work.

Pay charges for any changes required by inspection authorities.

810.08 MATERIALS AND EQUIPMENT

Provide materials and equipment in accordance with the City of St. John's Specifications Book.

Equipment and material to be CSA certified and manufactured to standard quoted.

Where there is no alternative to supplying equipment, which is not CSA certified, and

manufactured to standard quoted.

Where there is no alternative to supply equipment which is not CSA certified, obtain special approval from inspection department.

Factory assemble control panels and component assemblies.

Traffic controllers to be CSA certified under SA 1500-11383 tests.

810.09 DRAWINGS, CHANGES, ACCESSIBILITY

The drawings shall be considered to show the general character and scope of the work and not the exact details of the installation.

The installation shall be complete with all supports and accessories required for a complete operative and satisfactory installation.

The location, arrangement and connection of equipment and material as shown on the drawings represents a close approximation to the intent and requirements of the Contract.

The right is reserved by the Engineer to make reasonable changes required to accommodate conditions arising during the progress of the work. Such changes shall be done at no extra cost to the owner unless the location, arrangement or connection is more than 3.0 metres from that shown. Any changes shall be marked on drawings and label drawing “As Built”.

Actual location of existing services shall be verified in the field where necessary before work is commenced.

Changes and modifications necessary to ensure co-ordination and to avoid interference or conflicts with other trades, or to accommodate existing conditions, shall be made at no extra cost to the City.

810.10 TESTING, ACCEPTANCE AND GUARANTEE

The work of the Contract shall be tested and installed and any defects in operation shall be remedied immediately. Test required by local authorities shall be the responsibility of the Contractor, not withstanding Item 810.03. When the work is completed, it shall be tested in its entirety and shall be in good working order before the Owner’s Certificate of Acceptance shall be issued.

A written guarantee shall be supplied to the City by the Contractor covering the prompt making good of any and all defects in material and workmanship for the period of one (1) year from the date of acceptance and making good of any such defects shall be completely the responsibility of the Contractor.

810.11 WIRE IDENTIFICATION

Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes on both ends of phase conductors of feeders and branch circuit wiring.

Maintain phased sequence and colour coding throughout.

Colour code: to CSA C22.1.

Use colour coded wires in communication cables, matched throughout system.

810.12 PROTECTION

Protect exposed live equipment during construction for personnel safety.

Shield and mark live parts “LIVE 120 VOLTS” or with appropriate voltage in English.

810.13 EXISTING EQUIPMENT

All existing traffic equipment not reused shall be delivered to the Traffic Department.

810.14 PAYMENT

All labour, equipment and material costs associated with Electrical - General Provisions shall be appropriately spread over the items bid in the unit price table for related work specified under this division. No specific pay item for Electrical - General Provisions will be provided.

ITEM 811

INSTALLATION OF CABLES IN TRENCHES AND CONDUITS

811.01 SCOPE OF WORK

The work covered by this specification shall cover all installation of cables in trenches and conduits necessary to furnish operating traffic control stations, traffic control equipment and street lighting.

811.02 CABLE INSTALLATION IN CONDUITS

1) Ensure all conduits are clean before installing cables.

2) Install cables as indicated in conduits.

3) Do not pull spliced cables inside conduits.

4) Install multiple cables in conduit simultaneously.

5) Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.

6) Before pulling cable into conduits and until cables properly terminated, seal ends of cables with moisture seal tape.

7) After installation of cables, seal conduits ends with conduit sealing compound.

811.03 TESTING

1) Perform tests in accordance with Item 810.10.

2) Perform tests using qualified personnel. Provide necessary instruments and equipment.

811.04 PAYMENT

All labour, equipment and material costs associated with Installation of Cables in trenches and in conduits shall be appropriately spread over the items bid in the unit price table for related work specified under this division. No specific pay item for Installation of Cables in Trenches and in Conduits will be provided.

ITEM 812

WIRES & CABLES 0 - 1000 V

812.01 SCOPE OF WORK

The work covered by this specification shall cover all wires and cables 0 - 1000 V necessary to furnish operating traffic control stations, traffic control equipment and street lighting.

812.02 PRODUCT DATA

1) Submit product data in accordance with Item 810.04.

812.03 PRODUCTS

Inductive Traffic Loop Lead-In Cable

1) Sixteen (16) AWG stranded copper conductor twisted and shielded cable. Provide a minimum of seventeen (17) twists per meter.

2) High density polyethylene insulation.

3) Polyvinyl chloride jacketed.

4) Non-metallic, moisture resistant fillers shall be used to make a round cable.

5) The conductor assembly shall be covered with a wrapping of a moisture-resistant tape applied so as to lap at least 10 percent (10%) of its width.

Traffic Light Control Cable

1) Fourteen (14) AWG copper conductor, with polyethylene insulation.

2) Fifteen (15) conductor cable.

3) Each wire to be colour coded.

4) Non-metallic, moisture resistant fillers shall be used as required.

5) Overall PVC jacket suitable for use in underground conduit and extreme temperature fluctuations.

6) Manufactured to IMSA 19.1.

Power Supply Cable

1) Stranded and sized as indicated.

2) Copper conductors with 1000 V insulation of chemically cross-linked thermosetting polyethylene material rated RW/90.

812.04 EXECUTION

.01 Installation of Wires

Install wiring as follows:

1) In conduit systems in accordance with Item 811.

2) In underground conduits in accordance with Item 812.03.

3) Where required, colour code wires using tape applied for a minimum of 50mm at all boxes and terminations. Do not paint wire.

.02 Installation Loop Lead-In Cable

1) Install cables as indicated.

2) Ground cable shield and one leg in accordance with traffic controller manufacturer's instructions.

3) Terminate cables in accordance with controller manufacturer's recommendations.

4) Splice only at junction box.

.03 Installation of Traffic Light Control Cable

1) Install cable in conduits in accordance with Item 812.03.

2) Make cable terminations by using methods required by the equipment manufacturer.

3) At cable terminations, use thermoplastic sleeving over bare conductors.

4) Splice shall only be at the pole hand hole locations.

812.05 PAYMENT

All labour, equipment and material costs associated with Wire & Cables 0 - 1000 V shall be appropriately spread over the items bid in the unit price table for related work specified under

this division. No specific pay item for Wires & Cables 0 - 1000 V will be provided.

ITEM 813

WIRE & BOX CONNECTORS 0 - 1000 V

813.01 SCOPE OF WORK

The work covered by this specification shall cover all wire and box connectors 0 - 1000 V necessary to furnish operating traffic control stations, traffic control equipment and street lighting.

813.02 PRODUCTS

.01 Materials

Fixture type splicing connectors: with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

Acceptable Manufacturer: 3M Scotchlok.

813.03 EXECUTION

.01 Installation

Remove insulation carefully from ends of conductors, twist wire firmly together and install suitable solderless connector.

All wire splices between control loops and lead-in wires shall be soldered and insulated with 3M heat shrink material. All splices shall then be waterproofed with RTV sealant and placed within a section of supported PVC pipe.

813.04 PAYMENT

All labour, equipment and material costs associated with Wire & Box Connectors 0 - 1000 V shall be appropriately spread over the items bid in the unit price table for related work specified under this division. No specific pay item for Wire & Box Connectors 0 - 1000 V will be provided.

ITEM 814

GROUNDING - SECONDARY

814.01 SCOPE OF WORK

The work covered by this specification shall cover all grounding - secondary necessary to furnish operating traffic control stations, traffic control equipment and street lighting.

814.02 PRODUCTS

Materials

Grounding equipment: to CSA C22.2 No.41

Copper grounding conductors: to ASA G7.1

Equipment

Clamps for grounding of conductor shall be suitable for direct bury; size for conductor and secured to ground.

Rod electrodes, galvanized steel 19mm diameter by 3 metres long.

System and circuit, equipment, grounding conductors, bare stranded copper, untinned, soft annealed, unarmoured, size as indicated.

Insulated grounding conductors: type TW

Manufacturers

Acceptable manufacturers: Burndy Corp. Erico Inc., Cadweld Division or approved equal.

814.03 EXECUTION

Installation General

Install complete permanent, continuous, system and circuit, equipment, grounding system including electrodes, conductors, connectors, accessories as indicated to conform to requirements of Engineer and local authority having jurisdiction over installation. Where EMT is used, run grounding wire in conduit.

Electrodes

Install rod, electrodes and making grounding connections as indicated.

Bond separate, multiple electrodes together.

Use size 3/0 AWG copper conductors for connections to electrodes.

System and Circuit Grounding

Install system and circuit grounding connections to neutral of primary and secondary systems as indicated.

814.04 PAYMENT

All labour, equipment and material costs associated with Grounding - Secondary shall be appropriately spread over the items bid in the unit price table for related work specified under this division. No specific pay item for Grounding - Secondary will be provided.

ITEM 815

TRAFFIC CONTROL EQUIPMENT

815.01 SCOPE OF WORK

The work covered by this specification shall cover all traffic control equipment necessary to furnish operating traffic control stations, and traffic control equipment and street lighting.

815.02 GENERAL

That the contractor shall install equipment, supports and interconnections to provide fully operational traffic control systems.

That, the installation must be completed in accordance with manufacturer's recommendation and to the City of St. John's specifications and contract drawings.

That, the traffic controller programming, and system commissioning to be completed by the City of St. John's Traffic Division.

815.03 PRODUCTS

Signal Heads - Standard Three (3) Section

All standard signal heads to be yellow polycarbonate, consisting of three (3) 30cm x 30cm sections, one (1) red LED, one (1) amber LED, and one (1) green LED, complete with reinforcing plates, with the terminal block located in the second section from the top. Acceptable manufacturers: Econolite, Fortran, Eagle or approved equal.

Signal Head with Flashing Arrow – Four (4) section

As specified above except there will be four (4) sections. The fourth (4^{th}) section to be a dual LED amber and green flashing arrow. Four (4)-section signals are also required to have a reinforcing bracket secured to the back of the signal as specified by the City Traffic Division.

Signal Head Installation

Outboard signals are to be installed on an Astro-bracket. Inboard signals are to be installed on an Astro-bracket. All signal heads on the overhead davits are also to be secured with a safety chain.

Top-mounted signals are to be installed on the TCM poles on a single post top mount assembly or double mount on two 1200mm sentinel arms with plumbizers or as specified on the contract drawings.

Arrow Lens

All arrow lens to be LED type bi-model amber and green arrows. Acceptable manufacturers: Diolux, Dialight, or approved equal.

Pedestrian Signals

Pedestrian signal heads to be yellow polycarbonate, consisting of one 30cm x 30cm LED Bi-Modal display capable fof displaying the “Walk” symbol (walking man) alternating with a “Don’t Walk” symbol (hand) and one 30cm x 30cm LED square countdown module.

Acceptable manufactures: Econolite, Fortran, Eagle, or approved.

Pedestrian heads are to be installed on a spring cushion hanger and sentinel arm assembly unless otherwise specified on the contract drawings.

Signal Hangers

Spring Cushion Hangers - acceptable manufacturers: Sentinel Pole and Traffic Equipment, Fortran, Econolite or approved equal.

Astro-bracket – fitted with cables and able to rotate 360 degrees. Acceptable manufacturers: Pelco, Fortran, Econolite, Electromega or approved equal.

Balance Adjusters - Iron type - acceptable manufacturers: Pelco, Eagle, or approved equal.

Mid-Span Hangers - Iron type with signal closure kit and adjustable set-screws - acceptable manufacturers: Pelco, Eagle, or approved equal.

Post-top Assemblies - Iron type with signal closure kit- one-way post top and bracket assembly for single signal head installations and a two-way post top and bracket assembly for double signal head installations as specified on contract drawings. Acceptable post top manufacturers: Fortran, Pelco, or approved equal.

Sentinel Arms – 600mm or 1200mm mast arm assembly - to be used to install pedestrian signal heads unless otherwise specified. Also to be used for side-mounted signal heads as specified on contract drawings. Acceptable manufacturer: Sentinel Pole and Traffic Equipment or approved equal.

Plumbizer – acceptable manufacturers: Pelco, Fortran, Econolite, Electromega or approved equal.

Other Equipment

Pedestrian Push Buttons - push buttons to be yellow, freezeproof and waterproof. Acceptable manufacturers: Econolite model #E3951G2 or Polara Bull Dog soft-touch or approved equal.

APS Pedestrian Push Buttons – yellow, freezeproof and waterproof. Acceptable manufacturers: Camphill, Polara, Pelco, or approved equal.

Traffic Controllers - As specified on contract drawings. Acceptable manufacturer: Econolite, no substitutes.

Safety Chain - chain shall be 6.4mm hot dipped galvanized chain fastened around the davit pole and to each signal head section independent of the hanger.

Inductive Traffic Loops

Loop Wire - shall be 16 AWG stranded - DS1-116 loop wire for preformed and asphalt cut installations. The wire shall be of sufficient length to make four (4) continuous turns of the loop, or more if specified and run continuously to the traffic junction box where it will be soldered spliced to the loop lead in cable. There will no twisting of wires in the loop. When the loop wires leave the loop, the wires shall be tightly twisted around each other at a minimum rate of seventeen (17) turns per metre. All splices shall be soldered, covered with heat shrink tubing and waterproofed with RTV or equal sealant.

Preformed Loops - loops shall be prefabricated and spaced not less than 75mm and not more than 120mm from the finished road surface. The loop shall be constructed of 20mm PVC pipe meeting the specifications of CSA C22.2 No. 211.2. The wire within the loop shall be installed such that there will no movement of individual conductors with respect to each other and no movement of the bundle of the wires within the conduit. This shall be accomplished by injecting the loop with a polyurethane compound that will, when set, remain flexible.

Asphalt Cut - saw slots shall be cut to the dimensions shown on the drawings and have no sharp corners. Loop slots shall be 4.8mm wide and 63mm deep. Slots running from the loop to the junction box shall be 9.6mm wide and 63mm deep. Saw cuts shall be made with diamond blade cutting tools to provide a clean uniform depth throughout. Prior to placing loop wire the cuts shall be thoroughly washed out and dried. Loop wire shall be intermittently secured to the bottom of the asphalt cut by means of sections of backer rod intermittently spaced. The placement of the backer rod shall be such to allow the flowing of traffic loop sealant under the backer rod and to completely encase the wires. Traffic loop sealant shall be poured into the slots to ensure complete encasement of the loop wires and the backer rod and to fill the slot level with the street surface. Traffic loop sealant shall be approved by the City Traffic Division.

815.04 MEASUREMENT OF PAYMENT

The unit of measurement shall be as follows:

Power Supply - for each power supply installed to the traffic controller including weather head, ground cables, connectors, etc.

Signal Head - for each signal head unit including safety chain, hanger and LED units.

Pedestrian Head and Assemblies - for each pedestrian head and pole mounting assemblies supplied and installed.

Signal Head Hangers and Assemblies - for each unit type of signal head hanger and assemblies supplied and installed.

Pedestrian Push Button - each unit of each type of push button and sign supplied and installed.

Traffic Controller - for each unit of each type of traffic controller supplied, installed and operational.

Inductive Traffic Loops - for each unit of each type of inductive traffic loop supplied and installed.

815.05 PAYMENT

Payment shall be at the applicable unit price or lump sum price bid for each of the items listed. Payment shall be full compensation for all labour, equipment, and material necessary to complete the work as specified.

DIVISION 9

ENVIRONMENTAL REQUIREMENTS

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ITEM 901

OWNER'S POLICY

901.1 OWNER'S POLICY

It is Owner's policy to protect the environment of the area where the project is located. To ensure protection of the environment, the work always shall be subject to inspection by the staff of relevant municipal, provincial and federal agencies. Normally, all inspections other than by the Engineer will be arranged in advance through the Engineer. Any specific matters relating to environmental protection will be dealt with between Contractor and Engineer.

Any violations of environmental permits or authorizations or any environmental related incidents which are observed by inspectors representing regulatory agencies are to be reported by them prior to leaving the site to the Engineer. Except in emergency situations, environmental protection measures required by other agencies must be approved by the Engineer prior to implementation by the Contractor.

ITEM 915

PROTECTION OF WATERCOURSES AND WATERBODIES

915.01 SCOPE

This specification covers the environmental requirements for work being carried out at watercourses and waterbodies. It includes references to Federal and Provincial Legislation and prescribed methods and procedures to employ when carrying out such work as culvert or bridge installations, stream diversions, fording, fill placements at waterbodies, and any other work which may alter or impact any watercourse or waterbody, or the quality of the water therein.

915.02 LEGISLATIVE REQUIREMENTS

The Contractor shall be aware of all Federal and Provincial Legislation governing the protection of watercourses and waterbodies and all revisions and amendments to this legislation.

.01 PROTECTION OF INLAND FISHERIES ENVIRONMENT

All permanent or temporary works or undertakings which are proposed for watercourses or waterbodies constituting fish habitat require authorization from the Federal Department of Fisheries and Oceans at least two (2) weeks prior to the commencement of any work. The Contractor is required to obtain such approval and provide the Engineer with a copy prior to any work

Contractors are referred to the Department of Fisheries and Oceans publication entitled “Resource Road Construction - Environmental Guidelines and Design Criteria”, latest edition, (and to other technical information). The DFO “Factsheets” contain recommended guidelines for culvert installations, road and bridge construction, and other works. They include mitigative measures and procedures intended to assist Contractors in minimizing impacts on fish and fish habitat.

Contractors are advised that Environmental and Fisheries regulations require that any work done in or near a watercourse, deemed to be viable fish habitat, must be restricted to the minimum of disturbance. The establishment of temporary and permanent buffer zones are required. Great care must be taken during construction not to harmfully alter, disrupt, or destroy fish habitat or to deposit any substance which may be harmful to fish habitat in or near any watercourse where it may enter the watercourse. Culvert pipes must be constructed, according to the requirements of the applicable permits, to allow free movement of fish.

Contractors are advised to refer to the Fisheries Act with particular attention to:

Section 35 - Outlines required authorization for work or undertaking which may affect fish

habitat.

Section 36 - Prohibits the deposit of a harmful substance of any type into water frequented by fish.

Section 37 - Powers of the Minister for the provision of information such as plans, specifications, studies, etc., and to require any modifications to such plans and/or related information.

Section 38 - Powers of a Ministerial Inspection.

Section 40-42 - Enforcement and Penalties.

.02 THE ENVIRONMENTAL CONTROL (WATER AND SEWAGE) REGULATIONS

Contractors shall maintain compliance with the Environmental Control (Water and Sewage) Regulations.

.03 THE WATER RESOURCES ACT, DEPARTMENT OF ENVIRONMENT

Where the Contractor must carry out any alteration of a body of water **which is not required specifically as part of the contractual work,** the Contractor must obtain a Certificate of Approval from the Department of Environment, Climate Change and Municipalities (ECCM) before carrying out the work. Alterations to watercourses and waterbodies such as culvert installations, bridges, stream diversions, rock fill placement in waterbodies, etc., which are typically required as part of the contractual work are authorized and administered by Department of Transportation and Infrastructure (DTI) and do not require separate approval from the ECCM. All such alternations to bodies of water must be carried out according to established procedures of the regulatory agencies to prevent pollution or damage to the environment.

The Contractor is referred to the following **Environmental Guidelines** of the DECCM, Water Resources Division, regarding construction procedures at watercourses:

CHAPTER	TITLE	CHAPTER	TITLE
3	Watercourse Crossings	7	Diversions, New Channels & Major Alterations
4	Bridges	9	Pipe Crossings
5	Culverts	13	General Construction Practices
6	Fording	7	Diversions, New Channels & Major Alterations

915.03 FORDING OF WATERCOURSES

The use of equipment or machinery in a watercourse or waterbody is generally not permitted. Should it be necessary for equipment to ford a watercourse, then the approval of the

Engineer is required for the specified equipment only and at a designated location. The same crossing point shall be used each time that a fording is required. When extensive or frequent crossing of a watercourse is necessary, temporary culvert or bridge installation may be required instead of fording. The Contractor is referred to the Environmental Guidelines Chapter 6, "Fording" of the ECCM, regarding the selection, site preparation, and use of fording sites. The Contractor shall discuss all proposed fording sites with DT&W a minimum of five (5) working days before any fording activity. Site selections require the written approval of the Engineer.

915.04 CLEARING & GRUBBING ADJACENT TO WATERCOURSES

The Engineer shall mark limits for clearing and grubbing adjacent to watercourses. Buffer zones of undisturbed vegetation shall be maintained at watercourse crossings as marked in the field. A permanent buffer zone shall be maintained both sides of the construction zone at watercourse crossings, wherein, no disturbance or cutting of vegetation is to take place. A temporary ungrubbed buffer zone shall be maintained on both sides of the watercourse, unless otherwise directed by the Engineer, within the construction zone at watercourse crossings until such time as the installation of the crossing is to be carried out. The Contractor shall use appropriate mitigative measures such as the use of silt fencing, sedimentation basins and take-off ditches to control sediment laden runoff from entering watercourses.

915.05 GENERAL PROCEDURES FOR INSTALLING WATERCOURSE CROSSINGS

The Contractor shall present to the Engineer for approval, a plan for the construction of unwatering systems including diversion systems, pumping systems, settling and/or filtration systems, a minimum of **three (3) working days** prior to the start of any work at the site for the approval of the Engineer.

A pre-construction meeting shall be convened on-site between the Contractor and the Engineer to review environmental protection measures and associated contract details pertaining to the watercourse crossing, prior to any work being carried out at the proposed crossing site.

All work carried out at watercourses shall be performed in the dry and with due care and caution so as to prevent unnecessary disturbance or impact on adjacent land or downstream areas. Where watercourses are deemed fish habitat, work within the channel is generally prohibited between September 15 and June 1, on the island portion of the province, and between September 1 and June 30 for Labrador, unless otherwise approved by DFO and the Engineer. The Contractor shall carry out all work in and around watercourses in accordance with all Federal and Provincial permits and requirements, the relevant sections of this Specification Book, and the contract drawings.

The Contractor shall give **three (3) working days**' notice prior to any instream or near stream grubbing or excavation.

Buffer zones shall be established and maintained as described in section 915.04.

An approved cofferdam shall be installed at the low end of the construction zone to collect all site water which is to be disposed of in an approved manner. (See Section 915.07 Treatment of Silted Water).

The operation of heavy equipment shall be confined to dry stable areas in order to prevent the generation of mud and silted water. All flow shall be diverted or pumped around or through the work area by means acceptable to the Engineer to maintain flow in the watercourse immediately below the site, prevent erosion, and maintain acceptable water quality.

The flow diversion system shall have sufficient freeboard to be capable of accommodating rain events or provision shall be made to safely discharge elevated flows without causing washouts of constructed works, erosion, or siltation in downstream areas. The discharge location of the pumping or diversion system shall be stabilized to prevent erosion. All unwatering operations shall be constantly monitored by the Contractor.

Work should be carried out from the downstream section of the work area and progress to the upstream.

The Contractor shall ensure that fish are not left stranded in the work area at the time the diversion system is made operational. All stranded fish shall be removed by appropriate means and quickly returned to the watercourse below the construction area to prevent mortalities.

An impermeable cofferdam of non-erodible material, such as sandbags and sheet plastic, shall be constructed at the outlet area of the construction zone to prevent any silted water from entering downstream areas and to assist in unwatering operations.

The location, size, construction, and operation of sedimentation basins shall be carried out according to City specifications or as directed by the Engineer and so as to achieve adequate settling parameters within the basins and ensure that discharged water from the basins, which is entering any watercourse, meets the water quality standards set forth in the Environmental Control (Water and Sewage) Regulations, (See Section 915.02.02).

Operation of the sedimentation basins shall be continuously monitored by the Contractor to ensure proper functioning and maintenance.

Excavation material shall be carried out to the limits marked in the field by the Engineer. All excavations shall be carried out using a tracked excavator which will operate within the limits of the work area or as directed by the Engineer.

Excavated material shall be removed from the site and stockpiled at an approved location where it will not enter any watercourse.

When corrugated steel pipes are installed, impervious material shall be placed under the invert of the pipe and around the haunches of the pipe at the inlet area so as to ensure that

all flow is confined within the pipe, particularly during low flow conditions, and not lost into the porous fill zones outside the pipe.

All sections of newly constructed channel shall be adequately stabilized to prevent destabilization, erosion, or scouring of the channel and fill embankments. Rip-rap on road slopes shall be placed concurrently with backfilling operations on the pipe so that inlet and outlet areas are protected as directed by the City Representative.

Any disturbed areas or exposed soils within the high-water zone of the watercourse shall be stabilized by such means as placing rip-rap or well staked sodding within 48 hours of completion of backfilling operations. Other adjacent disturbed areas shall be rehabilitated by sodding or seeding, or as directed by the Engineer.

Where baffles are required as part of a culvert installation all activities associated with the baffle pipe installation including the diversion of all water flow from the natural watercourse into the baffled pipe, abandonment of any temporary stream diversion system and rehabilitation of the surrounding disturbed area shall be carried out efficiently without delay so as to not interfere with fish migration.

Upon completion of the work, flow shall be introduced slowly into the new channel or watercourse crossing. Any silted water generated as a result shall be prevented from entering downstream areas of the watercourse and pumped or treated as required.

All construction related waste material shall be removed from the work site(s).

Sedimentation basins shall be pumped dry and backfilled with the original excavated material and compacted. Hand seeding, hydroseeding, and/or sodding of disturbed areas shall be carried out as directed by the Engineer. Additional rehabilitation may be required by the Engineer.

915.06 USE OF FRESH CONCRETE IN OR NEAR BODIES OF WATER

When concrete is poured in or adjacent to a watercourse or waterbody, all necessary precautions shall be taken to prevent the concrete from adversely affecting water quality. Whenever possible, fresh concrete should not come in contact directly with the waters of a watercourse. Standing water zones should be drawn down prior to placing fresh concrete. All formwork shall be well secured and made tight to prevent leakage of fresh concrete into any adjacent waters. Where tremie concrete is required, the work shall be carried out under the specific directions of the Engineer. The washing of concrete delivery trucks or chutes is not permitted within 100 metres of any watercourse or waterbody. All necessary precautions shall be taken when handling related substances such as form coatings and concrete admixtures to prevent any spill or leakage of these substances.

915.07 CONTROL AND TREATMENT OF SILTED WATER

Silted or muddy water is not permitted to be released into any watercourse or waterbody or

into any ditch or area that leads directly to a watercourse or waterbody. Runoff from adjacent areas shall be channeled, piped, diverted, or confined to prevent the water from entering construction zones and becoming polluted. Where due to rain events, runoff from construction zones and areas of exposed soils contains mud or silt, appropriate measures shall be taken by the Contractor to confine, settle, or channel such water so that adjacent watercourses or waterbodies are not adversely affected. Such measures may include the provision of mud basins, settling basins, ditch blocks, silt fencing, temporary ditching, or other means necessary to prevent pollution. Silted runoff water or water released or pumped from construction zones may be discharged to an approved vegetated area where ground absorption will occur or to an approved settling area or to a settling basin constructed in accordance with contract drawings or as directed by the Engineer.

915.08 FILL PLACEMENT AT WATERBODIES

Fill material placed in or at waterbodies shall be clean blasted rock. Where in the opinion of the Engineer, significant silty bottom sediments will disperse with potential of creating water quality problems, the fill zone shall be isolated from the remainder of the waterbody by such means as a silt curtain as approved by the Engineer. Rock shall be placed into the water zone so as to create the least amount of disturbance of bottom sediments. Rock shall be placed along the outer edge of the fill zone to close off and isolate the fill zone from the rest of the waterbody. Fill placement shall proceed with runs of rock along the inside of the first outer run of fill. Successive runs of rock fill shall be placed in this manner until the zone if filled back to the inner fill limits. Height of the placed rock fill shall be maintained a minimum of 300 mm above water level during fill operations. Equipment shall not operate in standing water zones. Removal of displaced sediments and/or bog shall be carried out as directed by the Owner. Pumping of water from the fill zone to a designated area may be required by the Owner to reduce water levels in the fill zone and prevent movement of silted water through the rock fill back into the waterbody.

ITEM 920

STORAGE AND HANDLING OF FUELS AND OTHER HAZARDOUS, TOXIC, OR DANGEROUS MATERIAL

920.01 STORAGE TANK REGISTRATION, INSPECTION, AND REMOVAL

All storage tank systems must be registered under and in compliance with Newfoundland Regulation 58/03, The Storage and Handling of Gasoline and Associated Products Regulations 2003 before commencing operation. Registration does not apply to storage tank systems of a capacity less than 2500 litres that are connected to a heating appliance. Contractors shall supply verification of storage tank registration to the Engineer prior to the Commencement of work.

Storage tank systems shall be inspected on a regular basis as per Section 18 of Newfoundland Regulation 58/03 Storage and Handling of Gasoline and Associated Products. This involves, but is not limited to, gauging or dipping, reconciliation of the records, and the proper maintenance of reconciliation records for a period of two (2) years. Records shall be maintained for inspection by the Engineer, ESO and/or Government Service Centre Inspectors.

The owner of a storage tank system shall, within thirty (30) days of known abandonment, empty the system of all products, remove the tank and associated piping from the ground, remove any contaminated soil, clean the area and restore the site to the satisfaction of the Engineer and in accordance with the criteria of the Government Services Centre.

920.02 SPILL REPORTING & CLEANUP PROCEDURES

The Contractor, Subcontractors, and their personnel shall take all necessary precautions to prevent the spillage, misplacement, or loss of fuels and other hazardous material. Contractor and Subcontractors shall abide by the following measure in the event of the detection of a fuel or hazardous material spill of **70** litres or more:

i) make every effort to stop leakage and contain contaminant flow;

ii) **immediately** upon detection, report spill location and size to the Canadian Coast Guard spill report number **772-2083,** Pesticides Control Section **729-3395** and to the Owner; follow up with a full written report containing information on the cause of the spill, remedial action taken, damage or contamination estimate, and any further action to be taken;

iii) remove contaminant from spill site by absorbent, pumping, burning, or whatever method is appropriate and acceptable to Owner. Clean-up the affected area in accordance with the requirements of the Government Services Centre and then dispose of contaminated debris at an approved waste disposal site.

iv) take all necessary action to ensure the incident does not recur.

Contractor shall apply the following criteria in reaching decisions on contaminant and clean-up procedures:

i) minimize danger to persons;
ii) minimize pollution to watercourses and wetlands;
iii) minimize the size of the area affected by a spill; and
iv) minimize the degree of disturbance to the area and watercourses during clean-up.

Any spillage of hydrocarbons less than 70 litres shall be immediately cleaned up by the Contractor and reported promptly to the Engineer.

The Contractor shall dispose of any soil contaminated by small leaks of oil or lubricating fluids from equipment in a manner approved by the Engineer and in accordance with the criteria of the Government Services Centre.

The Contractor shall have on site a suitable quantity of absorbent material such as "Oclansorb" or similar product which can be accessed quickly and effectively in the event of any hydrocarbon spill. The Contractor shall advise fuel handling staff of its location and application.

920.03 FUEL STORAGE & HANDLING PROCEDURES

Contractor shall ensure that fuels and hazardous materials are handled only by personnel who are trained and qualified in handling these materials in accordance with manufacturers' instructions and government regulations. The Contractor will be required to verify personnel qualifications as they pertain to this item and provide written confirmation of same to the Engineer. The Contractor shall supply a copy of the product safety data sheet to the Engineer of all hazardous, toxic or dangerous materials or substances which will be used during the course of the contract. Refueling operations shall be supervised at all times. Under no circumstances shall any refueling procedure be left unattended by the operator. Handling and fueling procedures shall be carried out to prevent the contamination of soil or water. Smoking shall be prohibited within **10 metres** of a fuel storage area or during refueling operations. Equipment shall not be fueled within **30 metres** of a watercourse, wetland or groundwater source (private well). Oils, greases, gasoline, diesel, hydraulic and transmission fluids or other fuels shall be stored at least **100 metres** (horizontal distance) from any water course, water body, or designated wetland unless otherwise approved by the Engineer.

Any above ground fuel containers, except for those exempted under Newfoundland Regulation 58/03, shall be self dyked units that are in compliance with the terms and conditions of the approval of the Government Services Centre. Fuel storage areas and non-portable transfer lines shall be clearly marked or barricaded to ensure that they are not damaged by moving vehicles. The markers shall be visible under all weather conditions. The storage, handling and disposal of **used oils** shall be in accordance with the Used Oil Control Regulation (82-02) under the NL Environmental Protection Act.

920.04 EQUIPMENT SERVICING PROCEDURES

All heavy equipment maintenance shall be carried out by using suitable fluid collection equipment and in a manner which ensures all waste material is collected and suitably disposed of. The Contractor shall ensure that all equipment is mechanically sound to avoid leaks of grease, oil, diesel, gasoline, and hydraulic and transmission fluids. The Contractor shall ensure that no servicing or washing of heavy equipment occurs adjacent to watercourses and designated wetlands. Fueling, servicing or washing of equipment shall not be allowed within **100 metres** of a watercourse except within a refueling site approved by the Engineer where conditions allow for containment of accidentally spilled fuels. The Contractor shall remove from the work area and properly dispose of all waste oil, filters, containers of other such debris at an approved waste disposal site.

920.05 USE OF HAZARDOUS, TOXIC OR DANGEROUS MATERIAL

Toxic construction material e.g., creosote treated timber, shall be stored at least **100 metres** away from all areas where drainage is directed into any watercourse or wetlands.

Toxic or dangerous substances such as form release agents, fuels, concrete additives (including superplasticizers), and other substances, shall be transported, stored and handled with all necessary precautions so as to prevent any spillage from occurring. Drip pans shall be used at locations where such liquids are being drawn off in order to contain any minor spills, and as a safety measure for containment of a significant spillage.

ITEM 925

WASTE MANAGEMENT

925.01 SOLID WASTE DISPOSAL

Contractor shall collect and dispose of all waste produced by its employees and those of its Subcontractors in a manner approved by the Engineer, and in accordance with the Government of Newfoundland and Labrador, Waste Disposal Guidance Document (November 2014 or latest edition) and Newfoundland and Labrador Environmental Protection Act. Through the placement of suitable containers at the site, the Contractor shall collect and dispose of rubbish and domestic garbage generated by employees. During the progress of the work, the Contractor shall keep the areas occupied by it and access to such areas in a neat, clean, and safe condition, and free from the accumulation of all waste materials including crating materials, rubbish, drink containers, cigarette cartons, and all other waste. All solid waste shall be removed from the job site and recycled or disposed of at an Approved Waste Disposal Site, with the permission of the City. No waste material shall be deposited in any watercourse or wetland.

Upon completion of the work the Contractor shall, at its own expense, and to the satisfaction of the Engineer, dispose of or remove from the jobsite all construction plant, rubbish, unused material, including concrete forms, filter fabric material, sediment fencing, sand bags, and other equipment and material belonging to it or used under its direction during the performance of the work. The site shall be left in a neat and clean condition.

In the event of the Contractor's failure to comply with any of the foregoing, the same may be accomplished by the owner within **thirty** (**30) days** of the completion of the work and the cost of same may be deducted from any money due or owing to the Contractor whether under this or any other contract.

925.02 SANITARY FACILITIES / SEWAGE DISPOSAL

The Contractor shall maintain portable latrines on site or systems approved by Service NL. The sanitary facilities shall be used by all Contractor employees and those of subcontractors. The Contractor shall transport the waste from these units, using a collection company (whenever possible) licensed by Service NL. Otherwise, transportation and disposal shall be by a means and at a facility or location as approved by the Government Services Centre.

ITEM 940

DUST CONTROL

940.01 DUST CONTROL

The Contractor shall ensure that dust does not become a problem for adjacent property owners or construction site personnel or a hazard to vehicular traffic. When required, or as directed by the Engineer, water, or an acceptable dust suppressant such as calcium chloride shall be used by the Contractor on haul routes or other locations on the project to control dust.

All costs associated with dust control for the measures above and any other materials or methods as deemed necessary for the work shall be borne by the Contractor.

ITEM 945

EQUIPMENT OPERATION & PREVENTION OF EROSION & SEDIMENTATION

945.01 STORMWATER MANAGEMENT

The Contractor is responsible for stormwater and drainage management during the period of the contract. This includes the collection, channeling, containment, settling, discharge, and any other operation to effectively control storm runoff and prevent problems of erosion or siltation of adjacent or downstream areas. (See Section 915.07 Control and Treatment of Silted Water).

945.02 TEMPORARY TRAVEL ROUTES

Linear travel along the right of way by vehicles and equipment shall be restricted to one (1) track or travel route, particularly during the early stages of opening access along the route, unless otherwise approved by the Engineer. The route shall be maintained by the Contractor free of standing water. Surface drainage will not be permitted to run along the route which can generate extensive mud and silt, and adversely affect material to be excavated such as grubbing, unsuitable material, and overburden. Surface drainage shall be vented off the route at frequent intervals. Where drainage courses are encountered, and frequent crossings are required, temporary pipes (CSP or iron) shall be installed to permit passage of equipment and vehicles in the dry, without causing erosion and siltation. At certain locations fording may be permitted by the Engineer. (See Section 915.03 Fording of Watercourses).

945.03 EROSION & SEDIMENT CONTROL MEASURES

945.03.01 GENERAL PROTECTION MEASURES

The Contractor shall minimize terrain disturbance and erosion resulting from its activities. The Contractor shall, as part of its work, prepare an Erosion and Sediment Control Plan (ESCP) and implement erosion and silt control measures where construction activities result in a blockage of natural drainage, the diversion of natural drainage, or the exposure of soil or subsoil to potential erosion. Some common erosion and sediment control measures are included in Division 9 of the City of St. John's Development Design Manual. Additional measures may be required depending on the particular project.

945.04 LIMITATION OF OPERATION

During periods of heavy rain, where in the opinion of the Engineer, the movement of excavated material and equipment may give rise to extensive mud conditions, or the potential to seriously impact watercourses, or adjacent land, the Contractor may be required to suspend operations until such time as site conditions allow operations to resume. The Contractor shall not be paid for such downtime.

ITEM 950

PROTECTION OF VEGETATION AND WETLANDS

950.01 MAINTAIN NATURAL DRAINAGE PATTERN

Drainage is to be maintained in its natural state wherever possible, with provision being made for spring flooding. Where existing drainage patterns cannot be maintained, alternate drainage will be installed to approximate normal conditions with the approval of the Engineer.

950.02 PROTECTION OF TREES & SHRUBS

Some trees, shrubs and plants within the clearing limits may be required for use by the Owner or other groups. Where necessary, and as directed by the Engineer, such trees, shrubs, and plants shall be flagged for removal. Also see Section 955.02 (Planting of Trees and Shrubs) and Section 8 – City of St. John's Development Design Manual for additional information.

Where branches of trees are to be removed as a result of damage or where roots **2.5 cm** in diameter or larger are exposed as a result of contractors excavation work, the stumps shall be cut cleanly using a saw or lopping tool. The roots shall be cut back level to the surface of the cut slope within 24 hours following their exposure.

The Contractor shall adhere to the following protection measures:

i) No unnecessary cutting of trees is to be conducted. Care will be taken during construction to prevent damage to trees and shrubs adjacent to the flagged clearing limits which are to remain after construction.

ii) Care shall be taken when sloping embankments not to expose roots of trees, or put the soil at the base of such trees in danger of future erosion or extensive downslope drainage.

iii) The Contractor shall not use living trees as survey marks and shall not cut blazes or otherwise mark live trees except with removable surveyor's tape and/or tags.

iv) Where cutting is necessitated, the Contractor shall stockpile and remove all merchantable timber not required by the Owner. Other wood waste and slash remaining near the uncut zone shall be disposed of by chipping, burning, or removal, as acceptable to the Engineer.

950.03 OFF RIGHT OF WAY TRAVEL

The Contractor shall limit equipment travel to the surveyed right-of-way and existing municipal and provincial roads. Use of equipment of any type is not permitted outside the

clearing limits of the right of way without prior approval. To obtain approval for additional or

new travel routes, the Contractor shall notify the Engineer a minimum of five working days in advance of such requirements and not commence work until written approval is given by the Engineer.

950.04 BOGS AND WETLANDS

Bogs and wetlands are considered sensitive terrain because of their high disturbance potential. Travel by machinery across bogs and wetlands shall be avoided whenever possible. When such travel is necessary it shall be carried out as directed by the Engineer. Bog excavation shall conform with good construction practices and be carried out in accordance with other relevant sections of these specifications.

ITEM 955

REVEGETATION

955.01 REVEGATATION FOR SURFACE STABILIZATION

Immediately following and during some construction activities, the Engineer will identify areas requiring seeding/sodding or stabilization by a method to prevent erosion. These will include:

(i) Extensive cuts in overburden material. These areas shall be hydro seeded with **three (3)** calendar days of a cut being prepared and work shall be carried out as directed by the Engineer.
(ii) Stream crossing sites. Topsail placement, sodding, and shrub or tree plantings may be required as directed by the Engineer.
(iii) All remaining disturbed areas, designated, will be hydro seeded or sodded as soon as possible.

Where the potential for erosion exists, as on steep slopes, long slopes, or soft erodible type material, an appropriate erosion control material shall be applied to the surface. This can be in the form of an erosion control fabric or a sprayed on erosion control product which is approved by the Engineer and which will be in addition to hydroseeding as indicated in the contract documents or as directed by the Engineer. Also see Section 945.03 (Erosion and Silt Control Measures).

The Engineer will inspect all revegetated areas periodically to ensure that adequate results have been achieved. During adverse dry conditions watering of revegetated areas shall be carried out as directed by the Engineer. Additional revegetation work will be undertaken upon direction from the Engineer if the desired results are not achieved.

955.02 PLANTING OF TREES & SHRUBS

955.02.01 GENERAL INSTRUCTION

The planting of trees will be carried out in those areas identified in the contract documents. The types of species, quantity, size, and exact location will be either specified in the contract documents or otherwise found in Division 8 (Landscaping) – City of St. John's Development Design Manual.

955.02.02 PLANTING METHODS & MAINTENANCE

The Contractor is referred to Division 8 (Landscaping) – City of St. John's Development Design Manual for general information and recommended practices for the removal of trees and shrubs for either planting out directly or holding over for subsequent planting, and other aspects of care and maintenance.

All trees and shrubs do best when planted in early spring prior to the buds opening but may

also be successfully planted in late fall during their dormancy period. While it is possible to plant trees and shrubs at any time of the year, a regular watering program prepared by the Contractor and approved by the Engineer to reduce or prevent mortalities is required during the active growing period. A watering program is required for all planted stock (nursery stock or site stock) in the first year. This should commence as soon as active growth begins, and as determined by the prevailing weather conditions and dryness of the soil throughout the growth season. Watering and other necessary maintenance such as the provision of staking or supports, pruning, mulching, etc. is responsibility of the Contractor and not extra compensation will be paid for these items.

955.02.03 PAYMENT & WARRANTY

Measurement for payment shall be by the number of individual trees of the specified species and size planted. The Contractor is responsible for preventing mortalities in planted stock. Trees and shrubs which die within twenty-four (24) months of being planted shall be replaced by the Contractor at not additional cost to the Owner.

ITEM 960

PROTECTION OF HISTORIC RESOURCES

960.01 PROTECTION OF HISTORIC RESOURCES

The Contractor shall be aware that the Historic Resources Act (1990) requires the protection of archaeological sites and artifacts and sets forth procedures to be followed if either are found. The Contractor shall be aware of the following sections of the Act:

Section 10 (1) A person who discovers an archaeological object in, on, or forming part of the land within the province shall report the discovery forthwith to the Minister stating the nature of the object, the location where it was discovered and the date of the discovery.

Section 10 (2) No person, other than the one to whom a permit has been issued under this Act, who discovers an archaeological object shall move, destroy, damage, deface or obliterate, alter, add to, mark or in any other way interfere with, remove or cause to be removed from the province that object.

Section 11(1) The property in all archaeological objects found in, on or taken from the land within the province, whether or not these objects are in the possession of Her Majesty is vested in Her Majesty.

Should any archaeological remains be encountered, such as stone, bone or iron tools, concentrations of bone, fireplaces, house pits and/or foundations, work in the area of the find should cease immediately. The Contractor shall immediately notify the Owner through the Engineer, immediately upon discovery of any historic resources. The Owner shall immediately notify the Historic Resources Division.

DIVISION 10

STANDARD DRAWINGS

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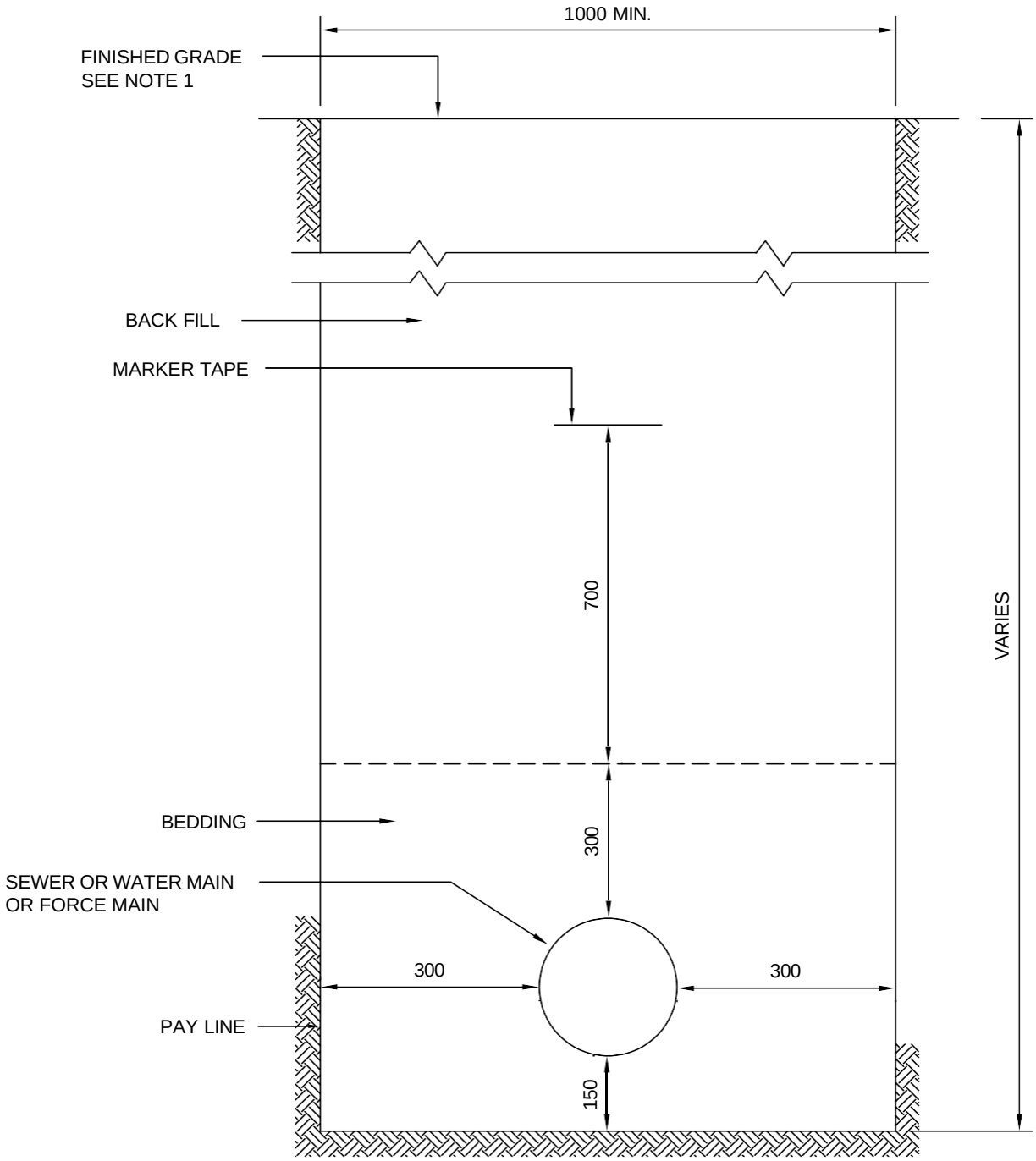
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10-223-22 Miscellaneous Pre-cast Details
10-223-23 Pre-Cast Ditch Inlet Catch Basins
10-223-24 Typical Ditch Inlet Grating Detail
10-223-25 Swing Grate for Storm Outlets 1350Ø to 3650Ø
10-223-26 Swing Grate for Storm Inlet 1350Ø to 3650Ø
10-223-27 Cut Off Berm – Intake Sump Details
10-223-28 Catch Basin Frame and Grate with Curb Inlet
10-223-29 Pre-Cast Single Curb Inlet Catch Basin
10-223-30 Pre-Cast Double Curb Inlet Catch Basin
10-224-01 Forcemain Crossing
10-225-01 Building Service Connections (Deep Sewer)
10-225-02 House Services
10-225-03 Clean Out Details
10-225-04 House Services (Inside Property Boundaries)
10-225-05 House Services Ex. House New Water & Sewer
10-225-06 House Services (Infill Properties Only)
10-226-01 Sub-Drain Pipe (With & without Geo-Textile)
10-226-02 French Drain
10-230-01 Water Main Thrust Blocks “A”
10-230-02 Water Main Thrust Blocks “B”
10-230-02A Water Main Valve Thrust Blocks
10-230-03 Standard Valve Operating Nut
10-230-04 Hydrant Connection
10-230-05 Hydrant & Hydrant Marker
10-230-06 25mm, 38mm & 50mm Water Services
10-230-07 Typical Cathodic Protection
10-230-08 Hydrant Lead Under Ditch
10-230-09 50mm Watermain Looping in Cul-De-Sacs

10-230-10 Post Hydrant/Water Sampling Station
10-324-01 Cut Off Berm – Typical Cross Section
10-324-02 Cut Off Berm – Intake Channel
10-330-01 Curb
10-330-02 Curb & Gutter
10-330-03 Curb, Gutter & Sidewalk
10-330-05 Combined Curb & Sidewalk
10-330-06 Dish Gutter
10-330-07 Standard Driveway Ramp
10-330-08 Alternate Driveway Ramp
10-330-09 Short Driveway Ramp
10-330-11 Standard Curb Ramp
10-330-12 Alternate Curb Ramp
10-330-13 Minimum Curb Ramp-A
10-330-14 Minimum Curb Ramp-B
10-330-15 Single Direction Curb Ramp
10-330-16 Standard Mid-Block Curb Ramp
10-330-17 Alternate Mid-Block Curb Ramp
10-330-18 Shared Use Path & Sidewalk Typical Treatment
10-330-19 Detectable Warning Surface Placement
10-330-20 Truncated Dome Detectable Warning Surface Plate
10-330-21 Curb Ramp Transition
10-322-22 Concrete Joint Notes
10-330-23 70º Entry Channel & Median End Treatment
10-330-24 Standard Curb/Sidewalk Repair - Bridge Deck
10-330-25 Mountable Traffic Island Curb & Gutter
10-330-34 Bus Shelter Pad with Front Accessibility
10-330-35 Bus Shelter Pad with Side Accessibility
10-330-36 Accessible Bus Stop Pad
10-330-37 Bus Shelter Pad at Landscaped Boulevards
10-330-38 Traffic Island Curb
10-331-01 Pre-cast Concrete Paver Sidewalk

10-331-02 Pre-cast Concrete Paver Ribbon
10-352-01 Types of Asphalt Damage and Examples of Repairs Required
10-353-01 Channel Cut
10-354-01 Tack Coat Spray Bar
10-357-01 Asphalt Crack Sealing Detail
10-521-01 Wood Post & Chain Barrier
10-521-02 Sign Detail Parks
10-530-01 Parking Meter Post & Signpost Detail
10-530-02 Parking Meter Post Attached to Handrail
10-530-03 Granular Walk
10-530-05 Standard Speed Cushion Local Street
10-530-06 Standard Speed Cushion Collector Street
10-542-01 Gabions
10-542-02 Rip Rap Treatment - Storm Sewer Outlet
10-602-01 Guide Rail Standard Installation
10-602-02 Typical Guide Rail Installation Types
10-602-03 Signal Reflectors on Guide Rail Posts
10-602-04 Guide Post
10-603-01 Handrail
10-610-01 Signpost Installation Type “C”
10-610-02 Signpost Installation Type “D”
10-610-03 Signpost Installation Details Type “E”
10-802-01 Electrical Junction Box
10-802-02 Davit Traffic Pole Bases
10-802-03 Lamp Post & TCM Traffic Pole Base
10-802-04 Traffic Controller Base
10-802-05 Traffic Control Prefab Junction Box-Quazite Composolite
10-815-01 Type 1 Installation of Pre-formed Inductive Loop Placement in New Road
10-815-02 Type 2 Installatioon of Pre-formed Inductive Loop Placement in Existing Road
10-815-03 Asphalt Cut Inductive Loop
10-945-01 Sediment Fence



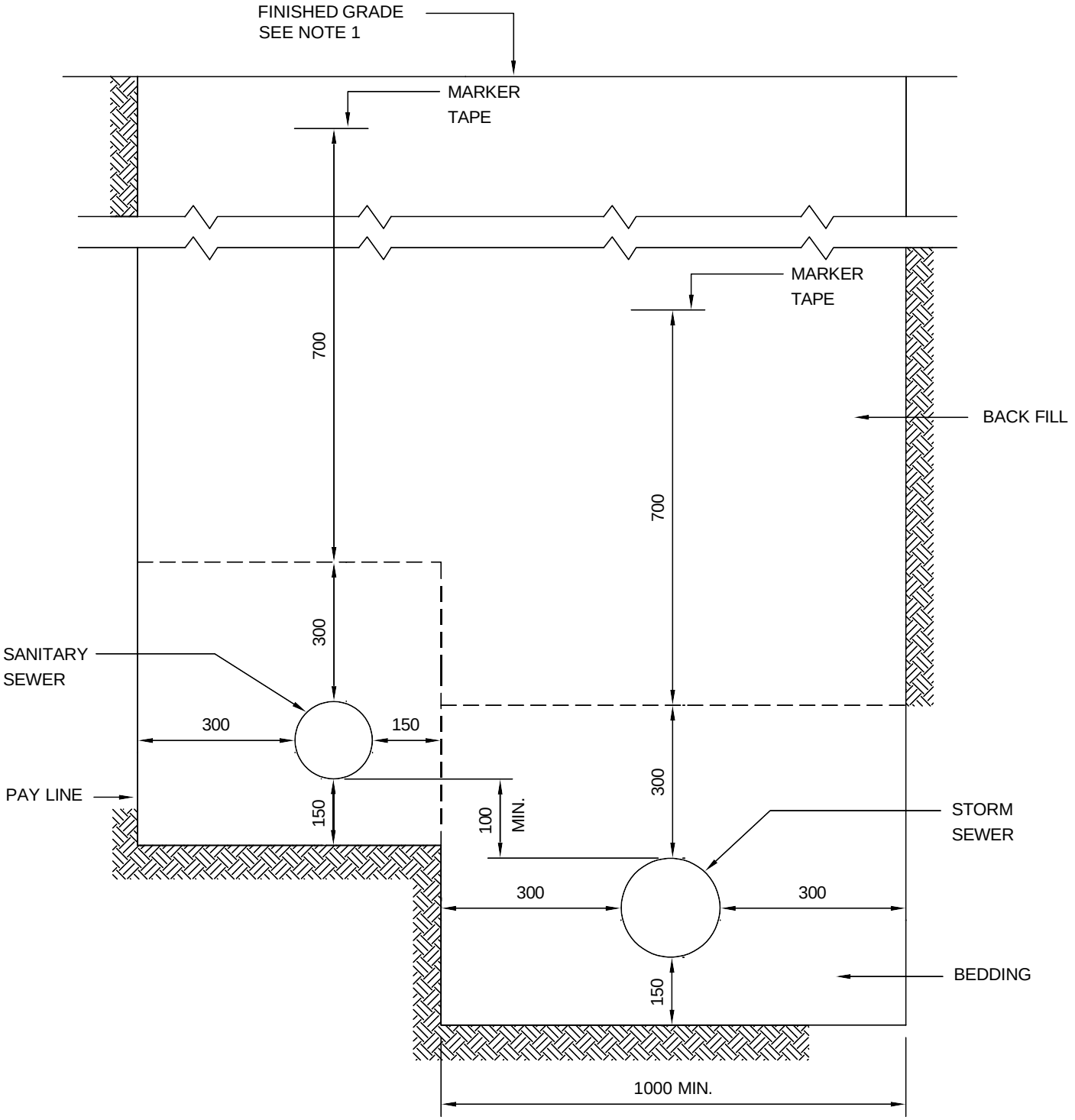
NOTES:

1. STREET EXCAVATION PAID IN ACCORDANCE WITH ITEM 321.
2. BEDDING IN ACCORDANCE WITH ITEM 211.

ST. JOHN'S
DEPARTMENT OF ENGINEERING

TRENCH DETAIL SINGLE PIPE

DRAWN BY: R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-211-01



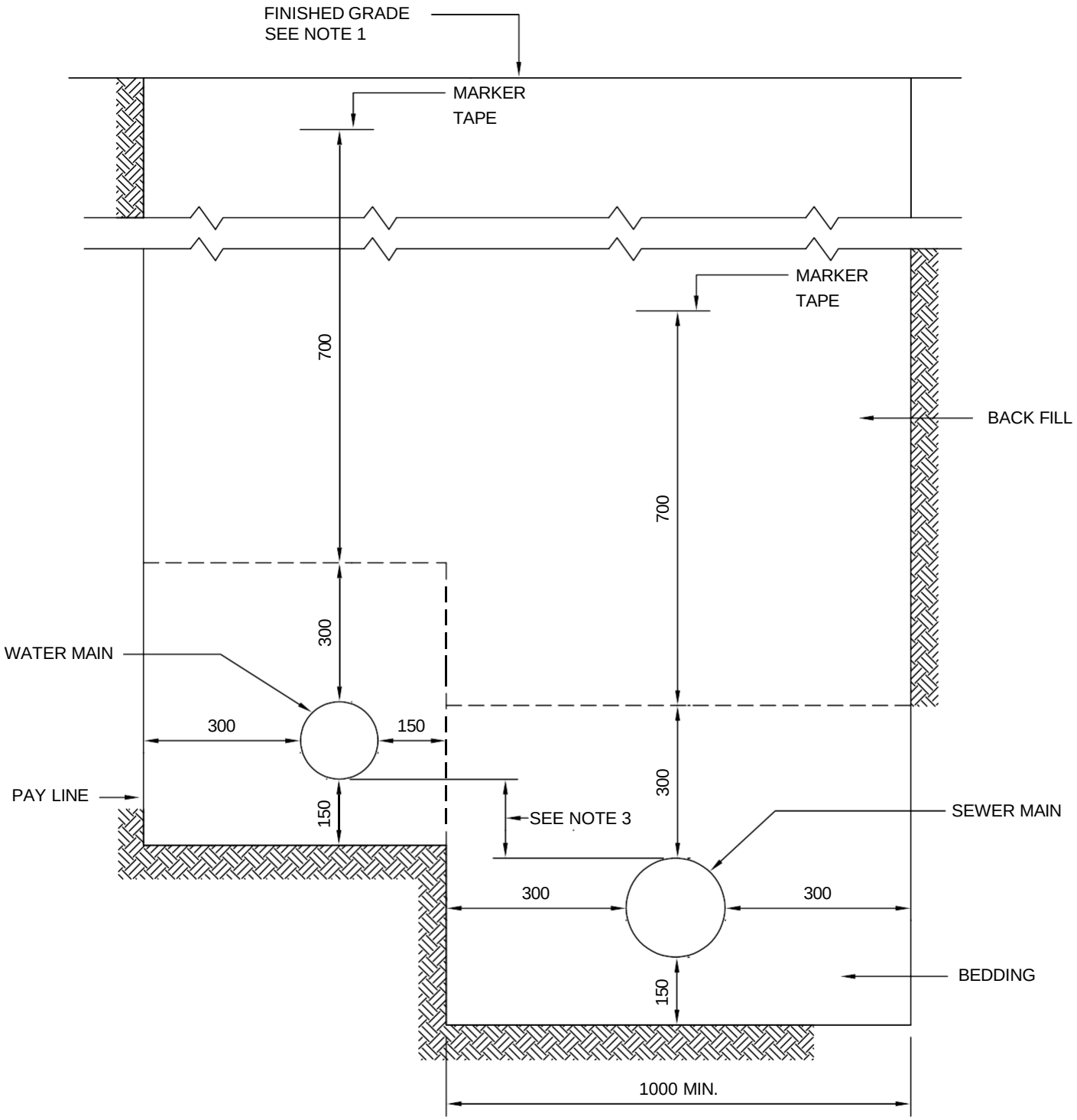
NOTES:

1. STREET EXCAVATION PAID IN ACCORDANCE WITH ITEM 321.
2. BEDDING IN ACCORDANCE WITH ITEM 211.

ST. JOHN'S
DEPARTMENT OF ENGINEERING

TRENCH DETAIL COMMON SEWER

DRAWN BY: C.S. / R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-211-02



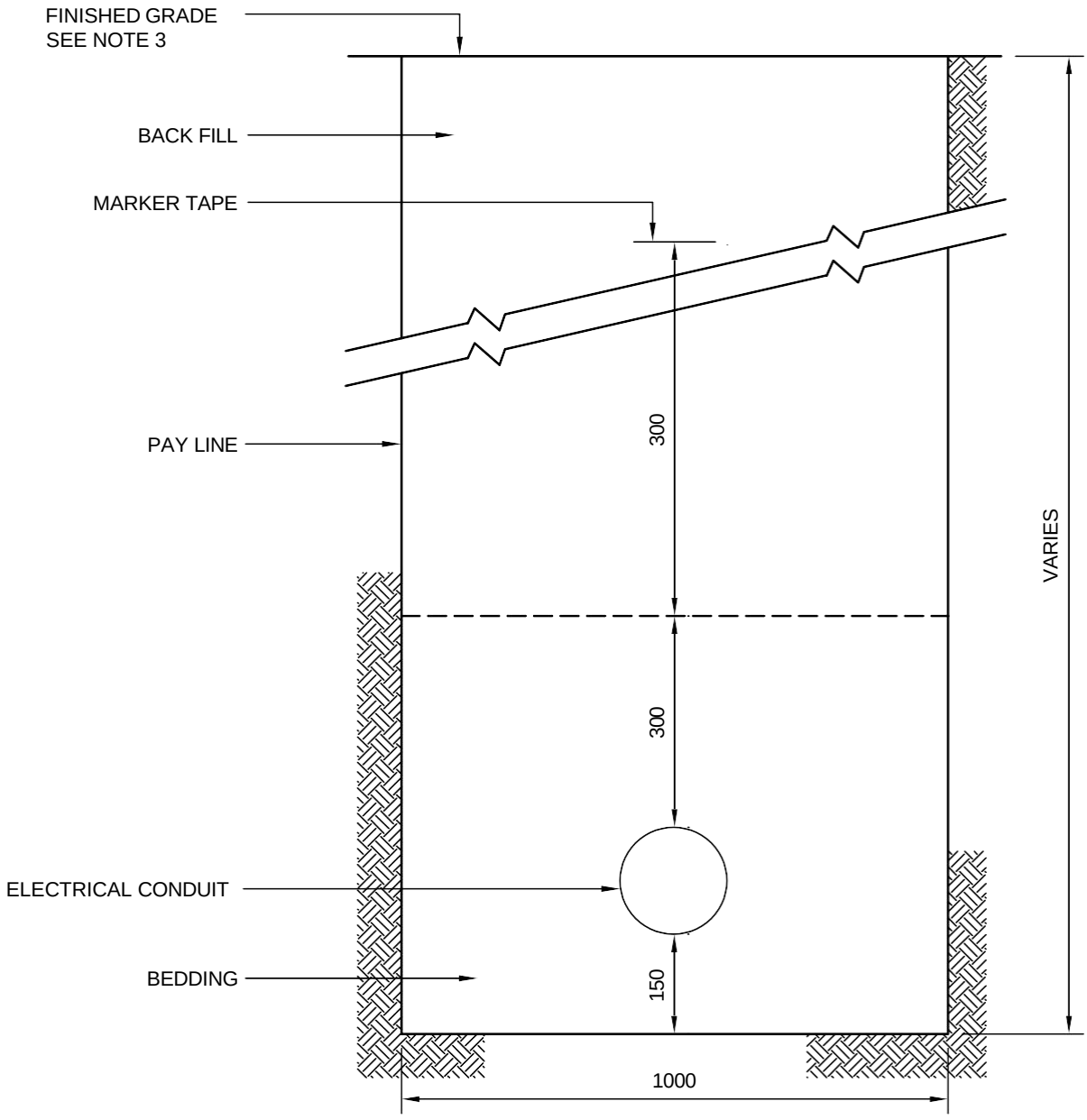
NOTES:

1. STREET EXCAVATION PAID IN ACCORDANCE WITH ITEM 321.
2. BEDDING IN ACCORDANCE WITH ITEM 211.
3. MAINTAIN MINIMUM HORIZONTAL SEPARATION BETWEEN SEWER AND WATER MAIN. WHERE NOT ACHIEVABLE, MAINTAIN MINIMUM VERTICAL SEPARATION OF 0.45m FROM CROWN OF SEWER MAIN.

ST. JOHN'S
DEPARTMENT OF ENGINEERING

TRENCH DETAIL WATER AND SEWER

DRAWN BY: C.S. / R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-211-02A



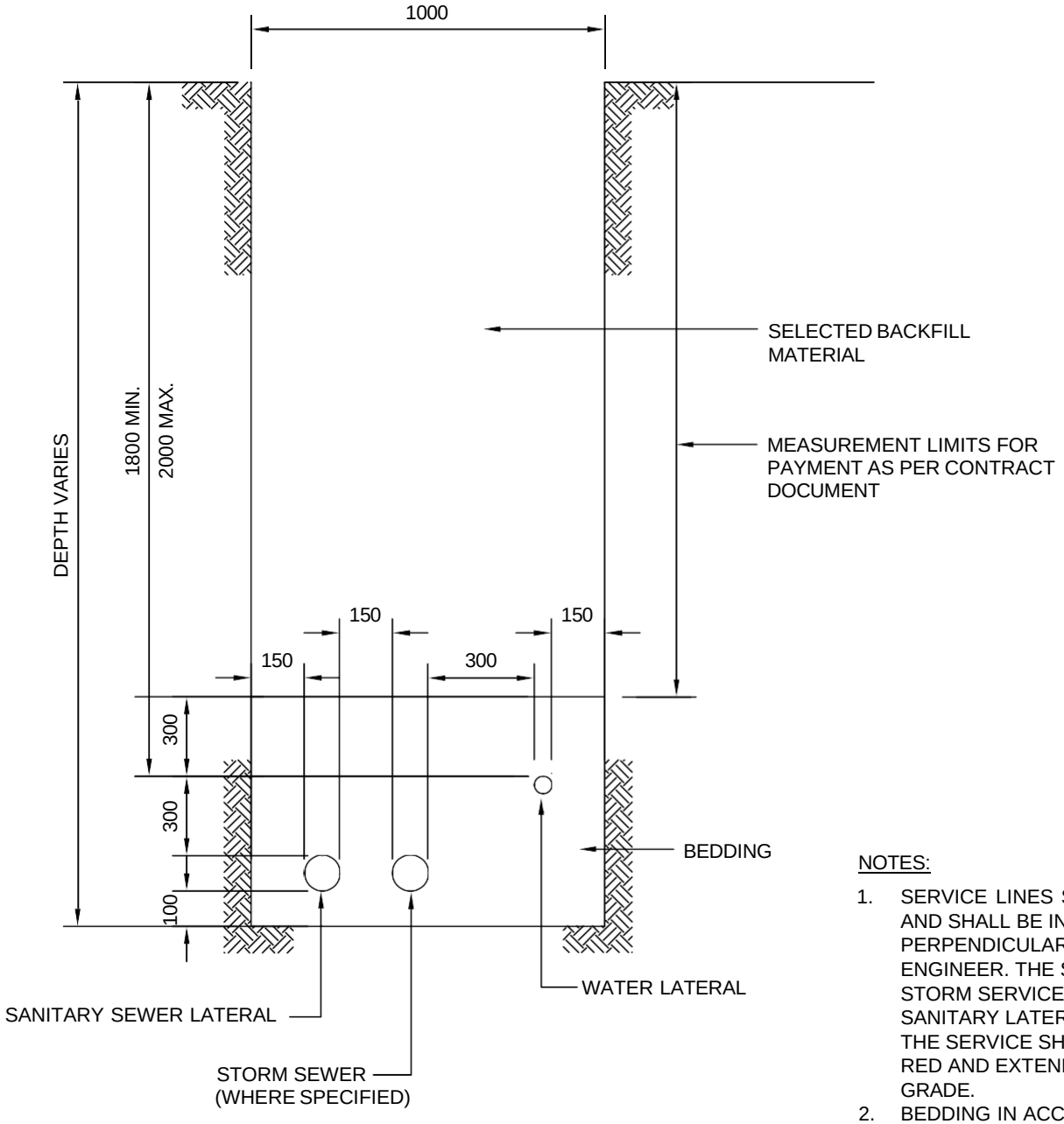
NOTES:

1. MINIMUM DEPTH OF BURY 900mm TO TOP OF CONDUIT.
2. MINIMUM SLOPE OF CONDUIT 2%.
3. STREET EXCAVATION PAID IN ACCORDANCE WITH ITEM 321.
4. BEDDING IN ACCORDANCE WITH ITEM 326.

ST. JOHN'S
DEPARTMENT OF ENGINEERING

TRENCH DETAIL ELECTRICAL CONDUIT

DRAWN BY: C.S. / R.W.	DATE: FEB. 2025	SCALE: N.T.S.	DRAWING No. 10-211-03



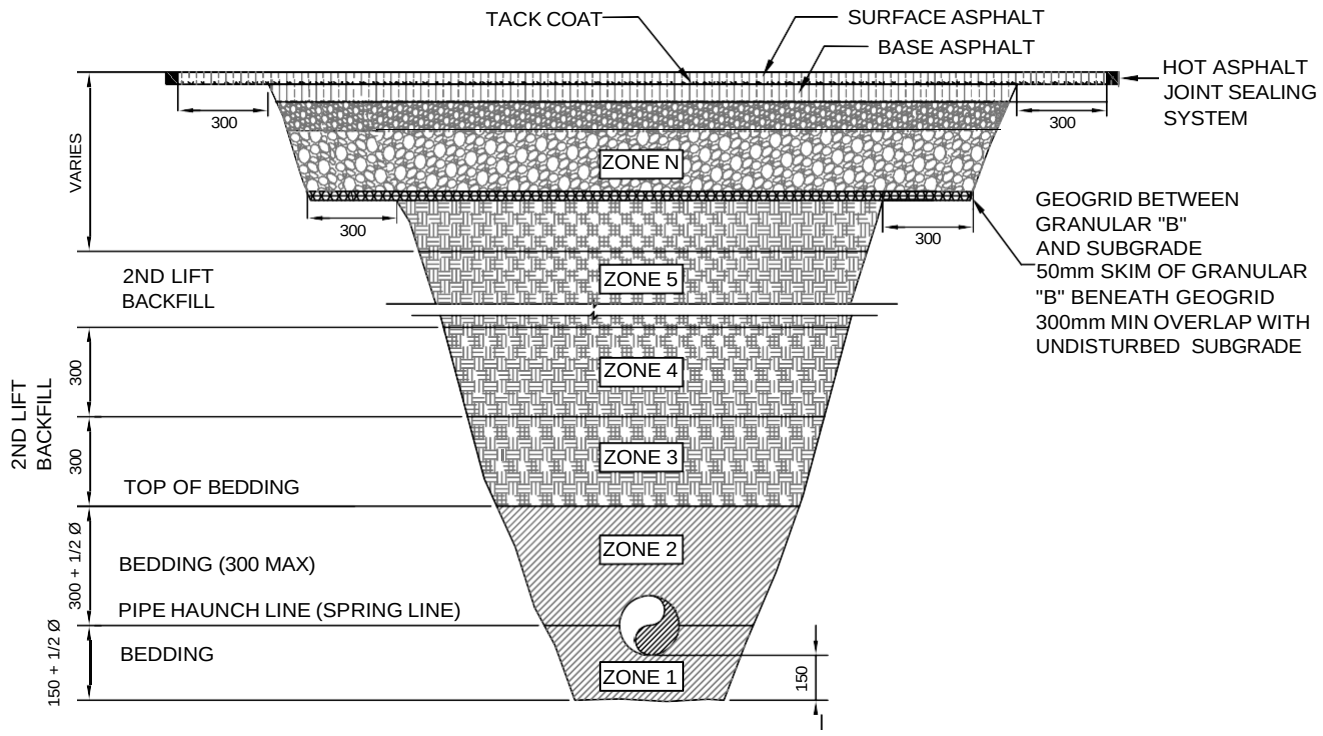
NOTES:

1. SERVICE LINES SHALL BE INSTALLED HAVING A GRADE NOT LESS THAN 2% AND SHALL BE INSTALLED AT THE CENTER OF THE BUILDING LOT AND PERPENDICULAR TO THE MAINS, UNLESS OTHERWISE DIRECTED BY THE ENGINEER. THE SANITARY SERVICE SHALL BE LOCATED ON THE LEFT AND THE STORM SERVICE ON THE RIGHT WHEN FACING THE BUILDING. THE END OF THE SANITARY LATERAL SHALL BE PAINTED RED. THE LOCATION OF THE END OF THE SERVICE SHALL BE MARKED WITH A 90mm x 40mm MARKER POST, PAINTED RED AND EXTENDING FROM THE SERVICE INVERT TO 600mm ABOVE FINISHED GRADE.
2. BEDDING IN ACCORDANCE WITH ITEM 211.

ST. JOHN'S
DEPARTMENT OF ENGINEERING

TRENCH DETAIL HOUSE SERVICE

DRAWN BY: C.S. / R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-211-04



COMPACTION MINIMUM REQUIREMENTS				
ZONE	THICKNESS(mm)	COMPACTOR TYPE	MIN. WEIGHT	MIN. No. OF PASSES
1	150 + $\frac{1}{2}$ PIPE Ø	VIBRATORY PLATE	66 KG	6
2	300 + $\frac{1}{2}$ PIPE Ø	VIBRATORY PLATE	74 KG	6
3	300	VIBRATORY PLATE	74 KG	8
4	300	VIBRATORY PLATE	74 KG	8
5	300	REVERSIBLE VIBRATORY PLATE COMPACTOR	830 KG	8
6	300	REVERSIBLE VIBRATORY PLATE COMPACTOR	830 KG	8
7	300	REVERSIBLE VIBRATORY PLATE COMPACTOR	830 KG	8
N	600	VIBRATORY ROLLER	5000 KG	8

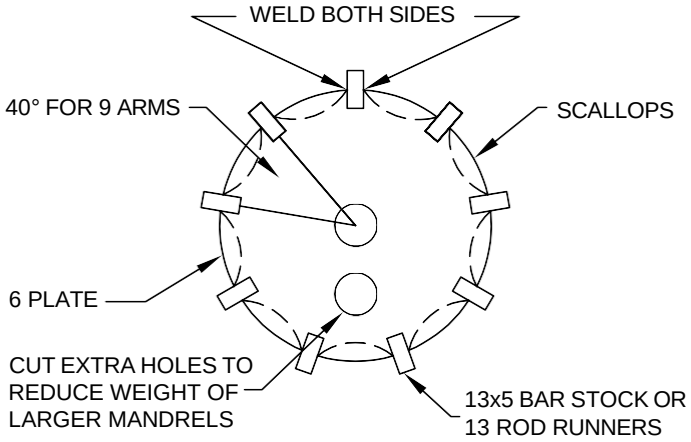
NOTES:

1. COMPACTION EFFORT TO BE VERIFIED BY MATERIALS TESTING LABORATORY. MINIMUM NUMBER OF PASSES TO BE ADJUSTED IF NECESSARY TO ENSURE 95% STANDARD PROCTOR DENSITY IS ACHIEVED.
2. REFER TO DETAIL 10-352-01 FOR TYPES OF ASPHALT CUTS AND EXAMPLES OF REPAIRS REQUIRED.
3. COMPACT TO UNDISTURBED TRENCH WALLS.
4. STREETS WITH EXISTING GEOGRID, OVERLAP NEW GEOGRID BY 300mm WITH EXISTING, COMPLETE WITH 5mm ZIP TIES SPACED 600mm TO SECURE NEW GEOGRID TO EXISTING.

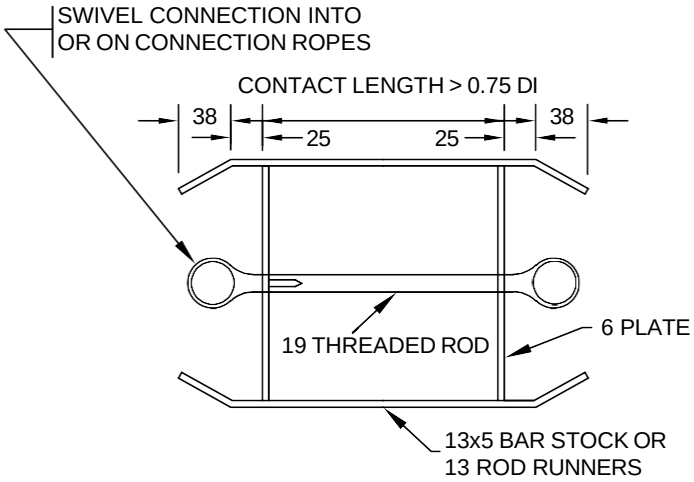
ST. JOHN'S
DEPARTMENT OF ENGINEERING

TRENCH COMPACTION DETAIL

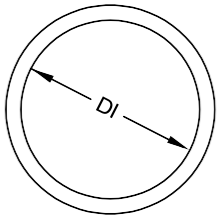
DRAWN BY: R.W.	DATE: FEB. 2025	SCALE: N.T.S.	DRAWING No. 10-211-05



TRANSVERSE SECTION OF MANDREL



LONGITUDINAL SECTION OF MANDREL



END VIEW OF PROVING RING

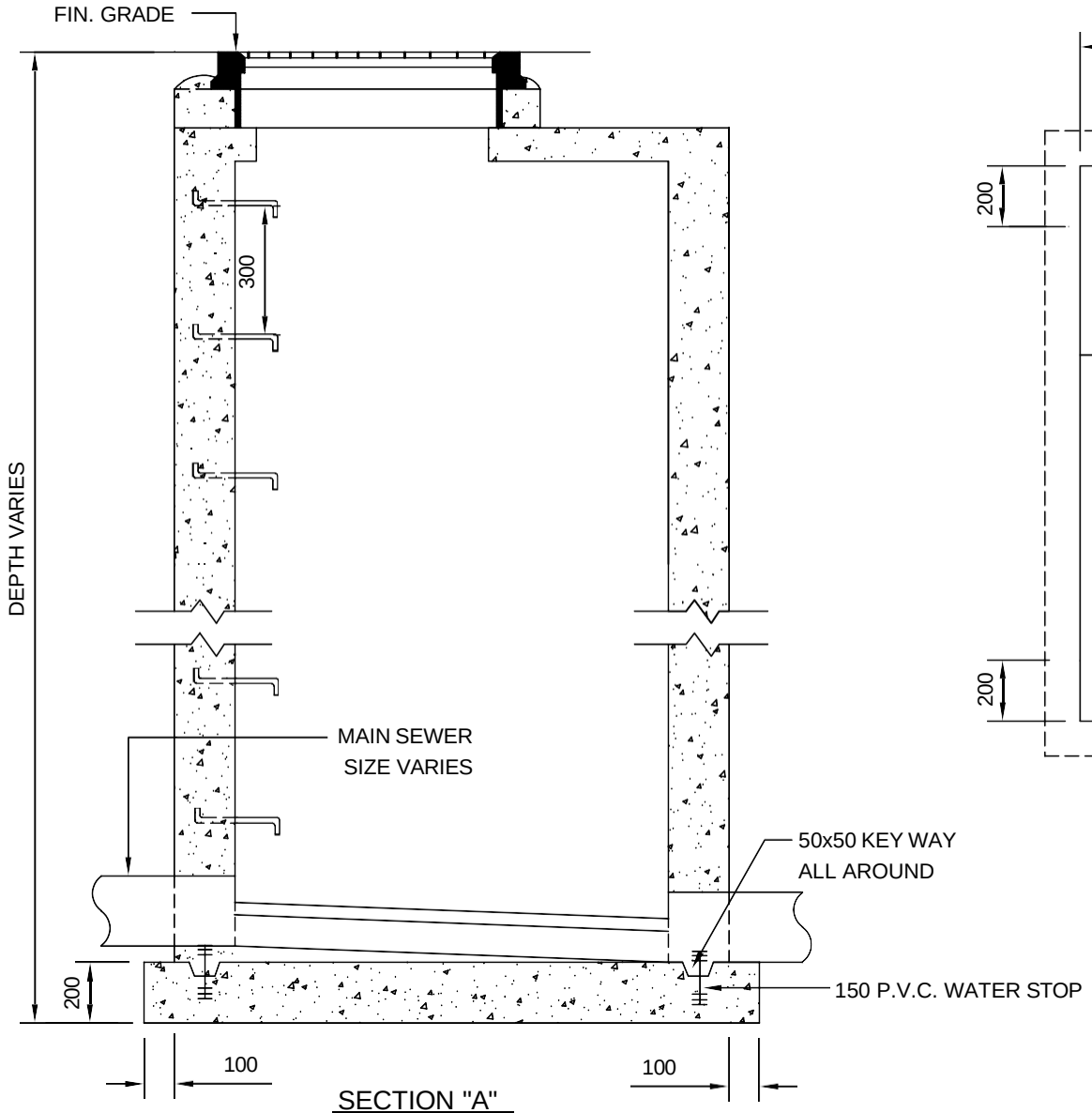
NOTE:

1. MANDRELS LARGER THAN 450mm IN DIAMETER SHALL BE CONSTRUCTED OF SPECIAL BREAKDOWN DEVICES TO FACILITATE ENTRY THROUGH ACCESS MANHOLES.
2. SEE ITEM 221 FOR MANDREL SIZING.

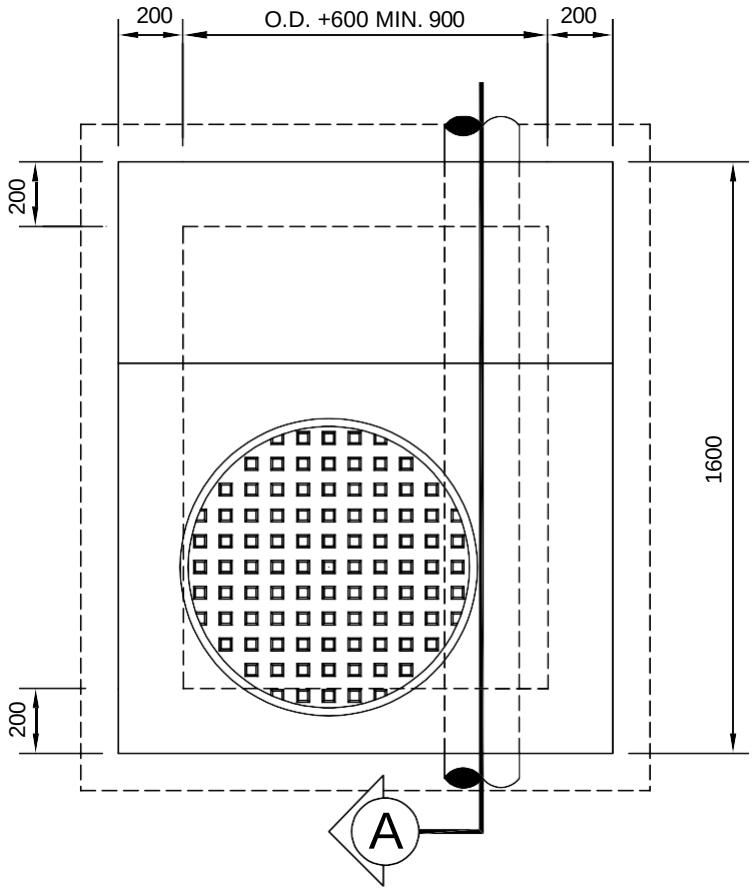
ST. JOHN'S
DEPARTMENT OF ENGINEERING

RIGID "GO-NO-GO" DEVICE

DRAWN BY: R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-221-01



SECTION "A"



PLAN VIEW

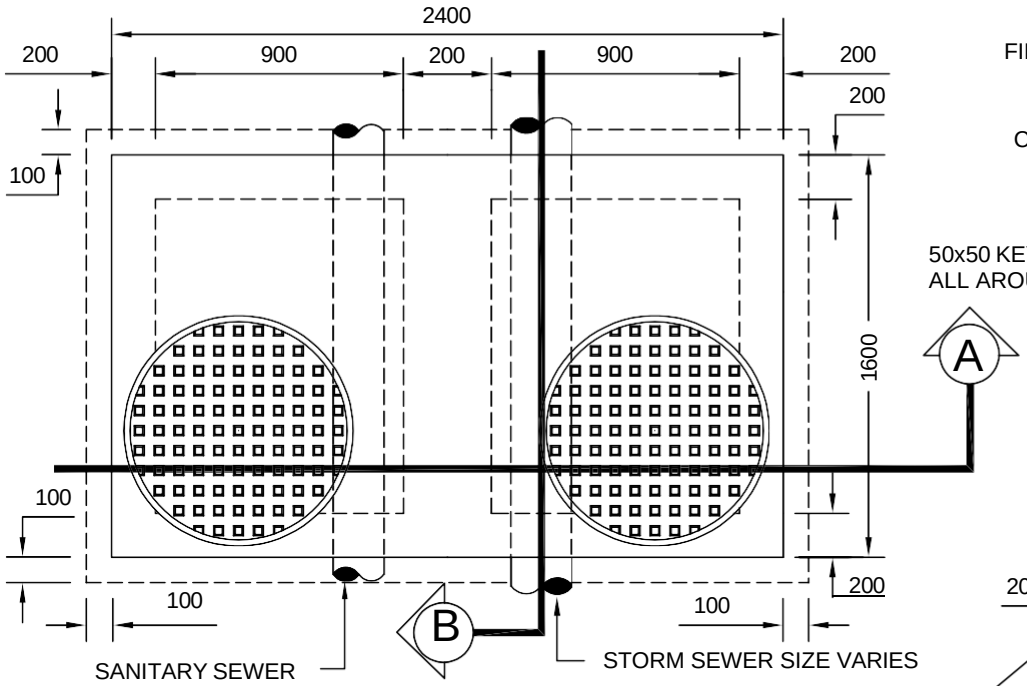
NOTES:

1. CONCRETE TO BE 35 MPa TO MEET CSA A23.1, CLASS C-1 EXPOSURE.
2. MINIMUM DROP OF PIPE THROUGH MANHOLE - 50mm.

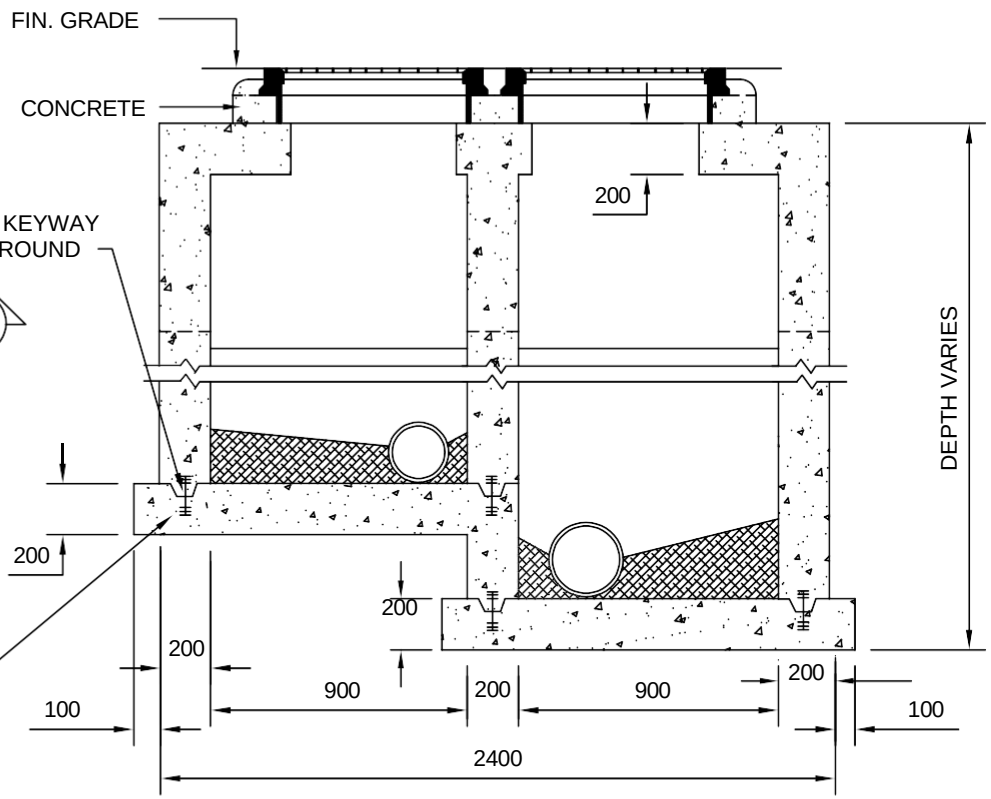
ST. JOHN'S
DEPARTMENT OF ENGINEERING

CAST IN PLACE SINGLE MANHOLE (STRAIGHT RUN)

DRAWN BY:	C. S. \ R.W.	DATE:	JANUARY 2022	SCALE:	N.T.S.	DRAWING No.	10-223-01



PLAN VIEW



SECTION "A"

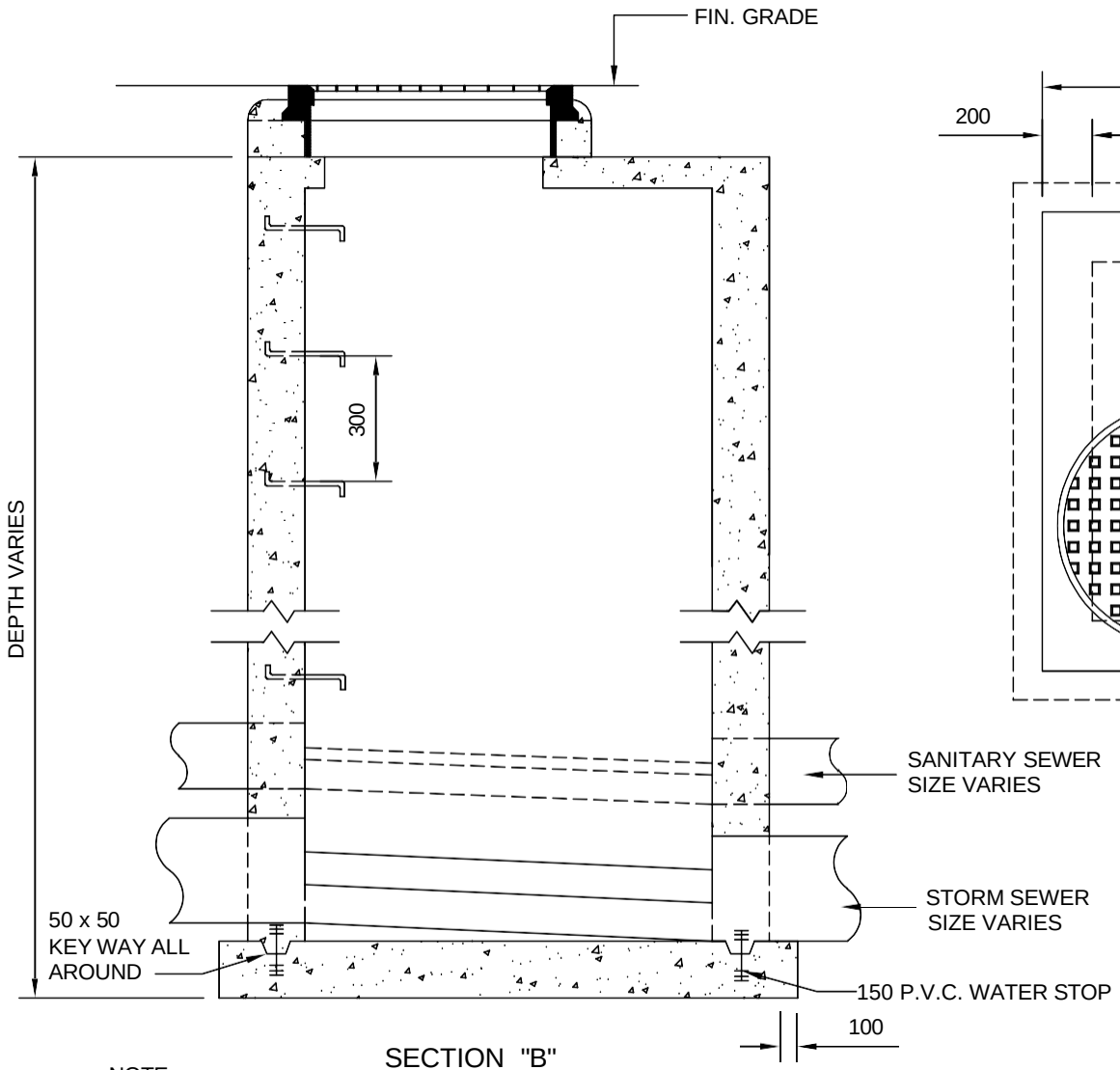
NOTE:

1. CONCRETE TO BE 35 MPa TO MEET CSA A23.1, CLASS C-1 EXPOSURE.
2. MINIMUM DROP OF PIPE ACROSS MANHOLE - 50mm STRAIGHT RUN
   - 150mm TEES AND BENDS

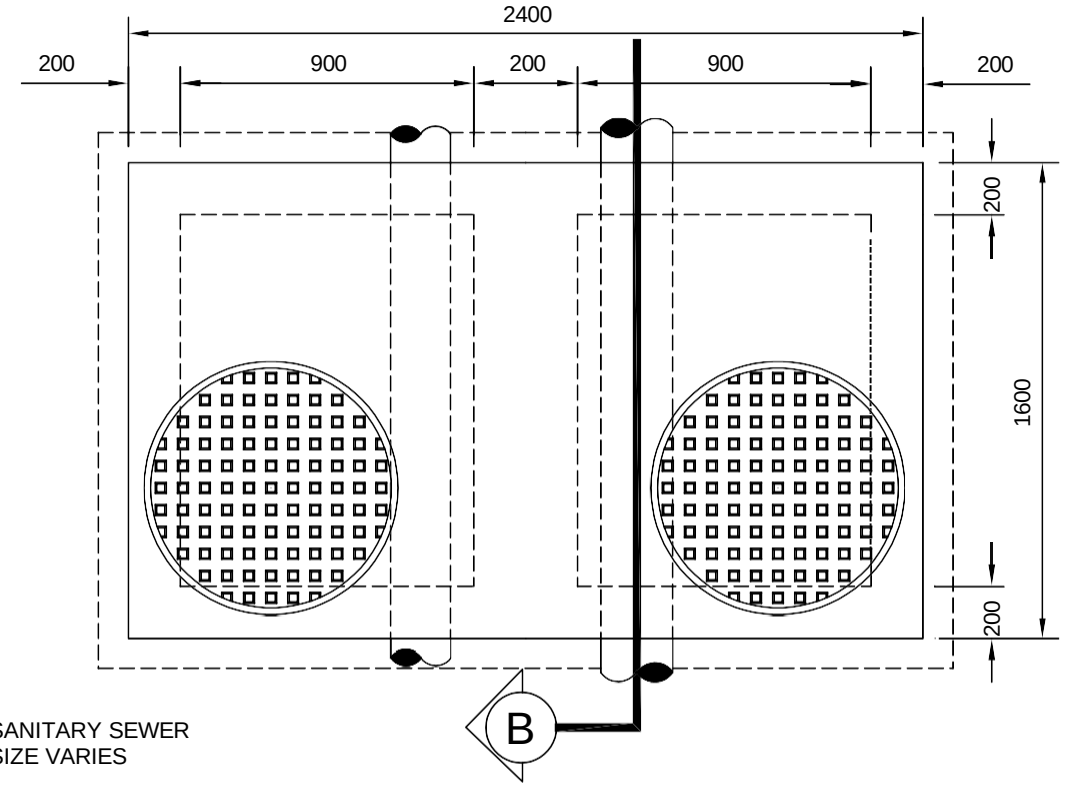
ST. JOHN'S
DEPARTMENT OF ENGINEERING

CAST IN PLACE DOUBLE MANHOLE 1 OF 2

DRAWN BY:	C. S. \ R.W.	DATE:	JANUARY 2022	SCALE:	N.T.S.	DRAWING No.	10-223-02



SECTION "B"



PLAN VIEW

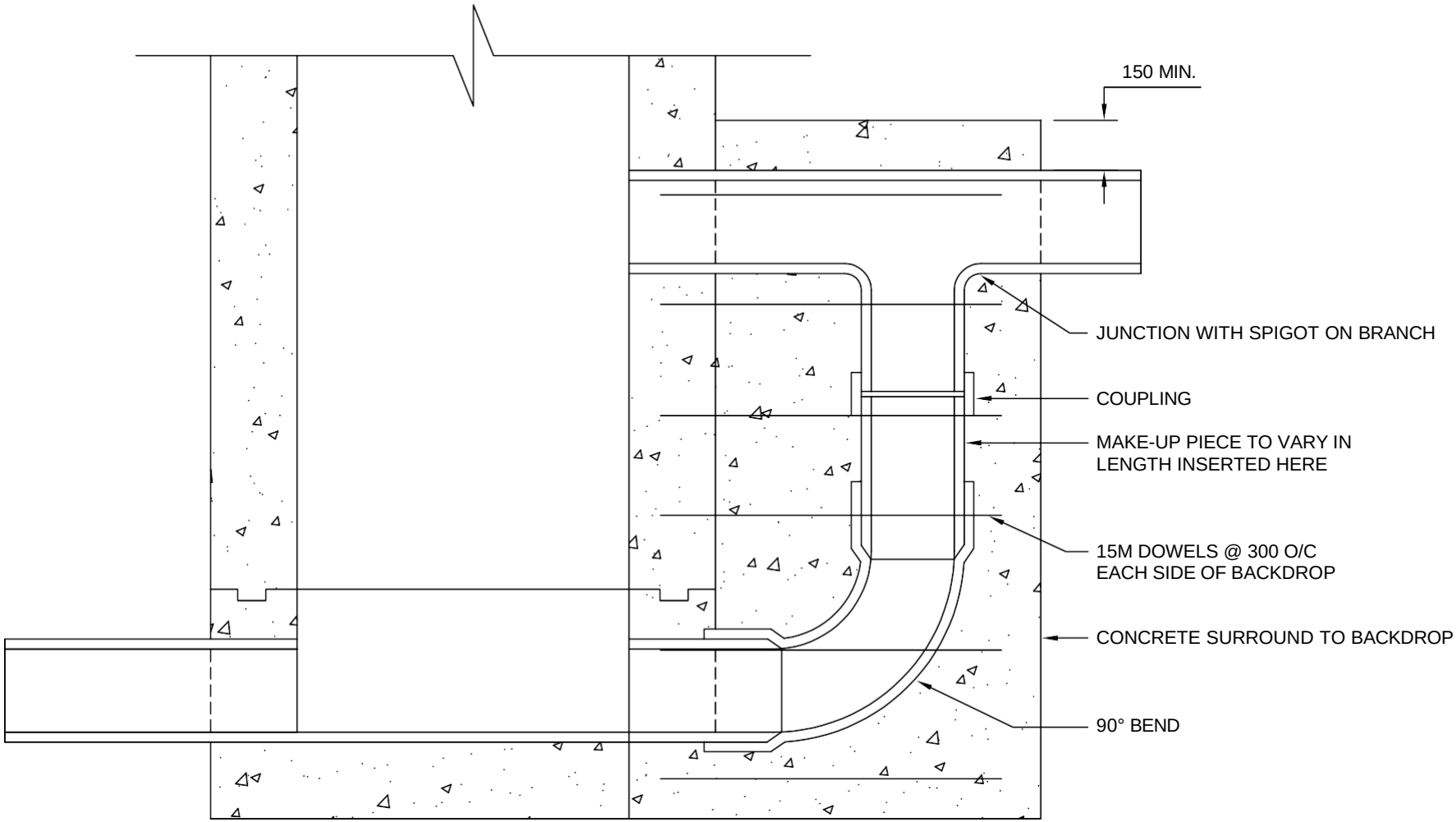
NOTE:

1. CONCRETE TO BE 35 MPa TO MEET CSA A23.1, CLASS C-1 EXPOSURE.
2. MINIMUM DROP OF PIPE ACROSS MANHOLE - 50mm STRAIGHT RUN
   - 150mm TEES AND BENDS

ST. JOHN'S
DEPARTMENT OF ENGINEERING

CAST IN PLACE DOUBLE MANHOLE 2 OF 2

DRAWN BY:	C. S. \ R.W.	DATE:	JANUARY 2022	SCALE:	N.T.S.	DRAWING No.	10-223-03

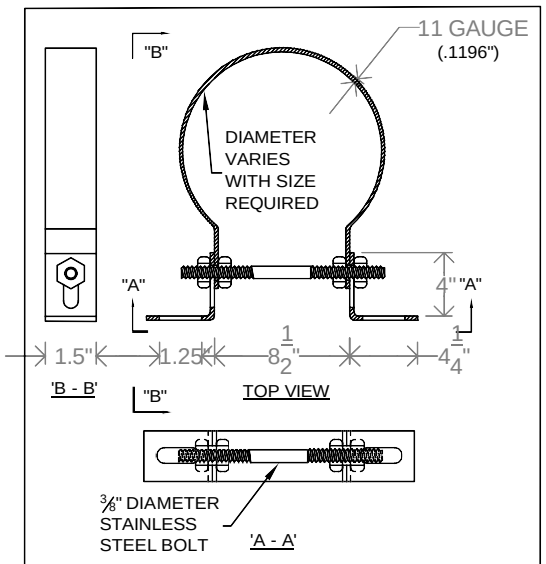


BACKDROP GREATER THAN 1000

ST. JOHN'S
DEPARTMENT OF ENGINEERING

DROP MANHOLE

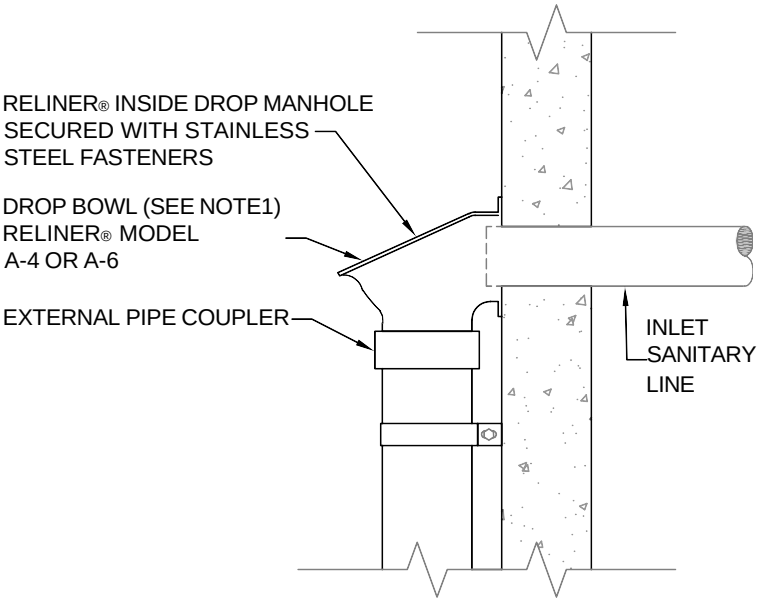
DRAWN BY:	C. S. \ R.W.	DATE:	JANUARY 2022	SCALE:	N.T.S.	DRAWING No.	10-223-04

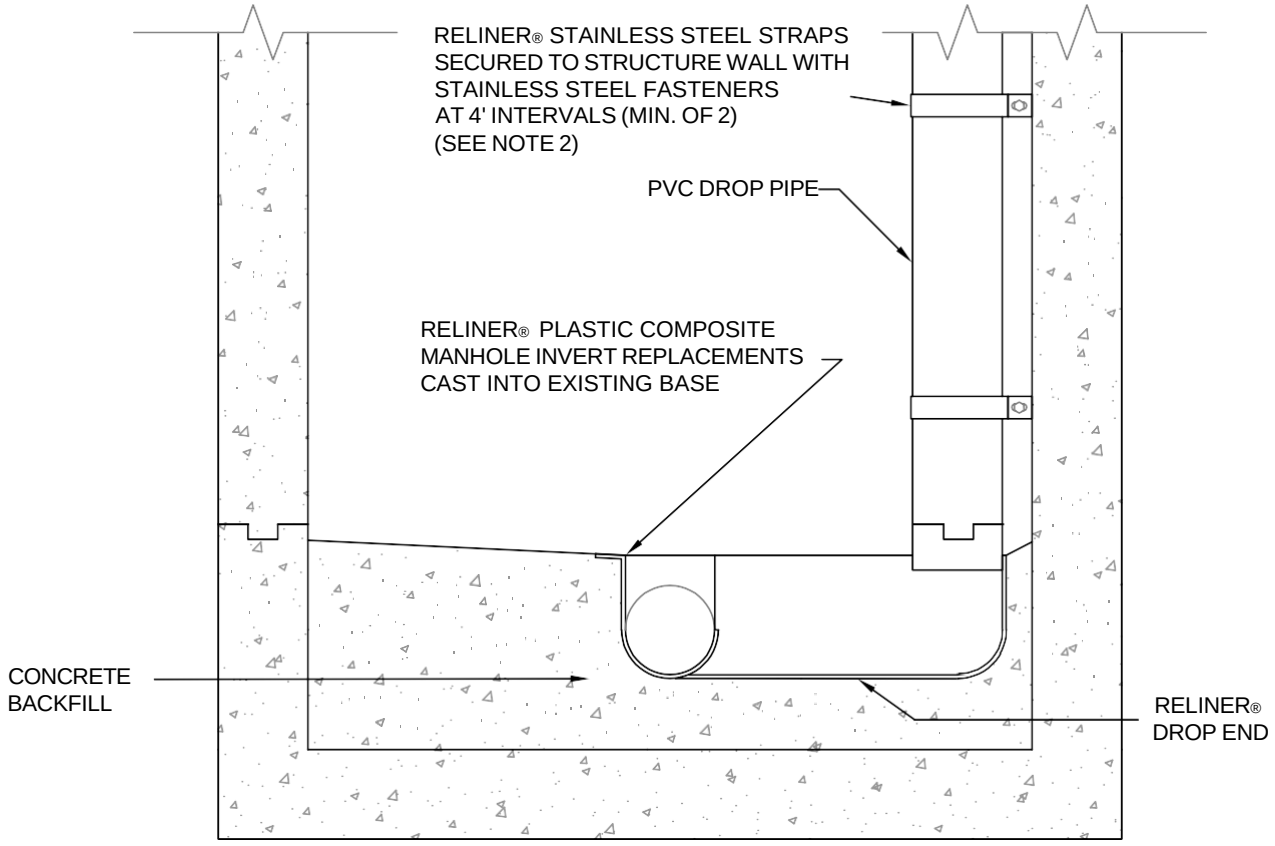


SPECIFICATIONS:

1. CLAMP AND BRACKET IS TYPE 304 STAINLESS STEEL, 11 GAUGE (.1196").
2. 3/8" Ø PINCH BOLT AND NUTS IS TYPE 18-8 STAINLESS STEEL.

CLAMP DETAIL





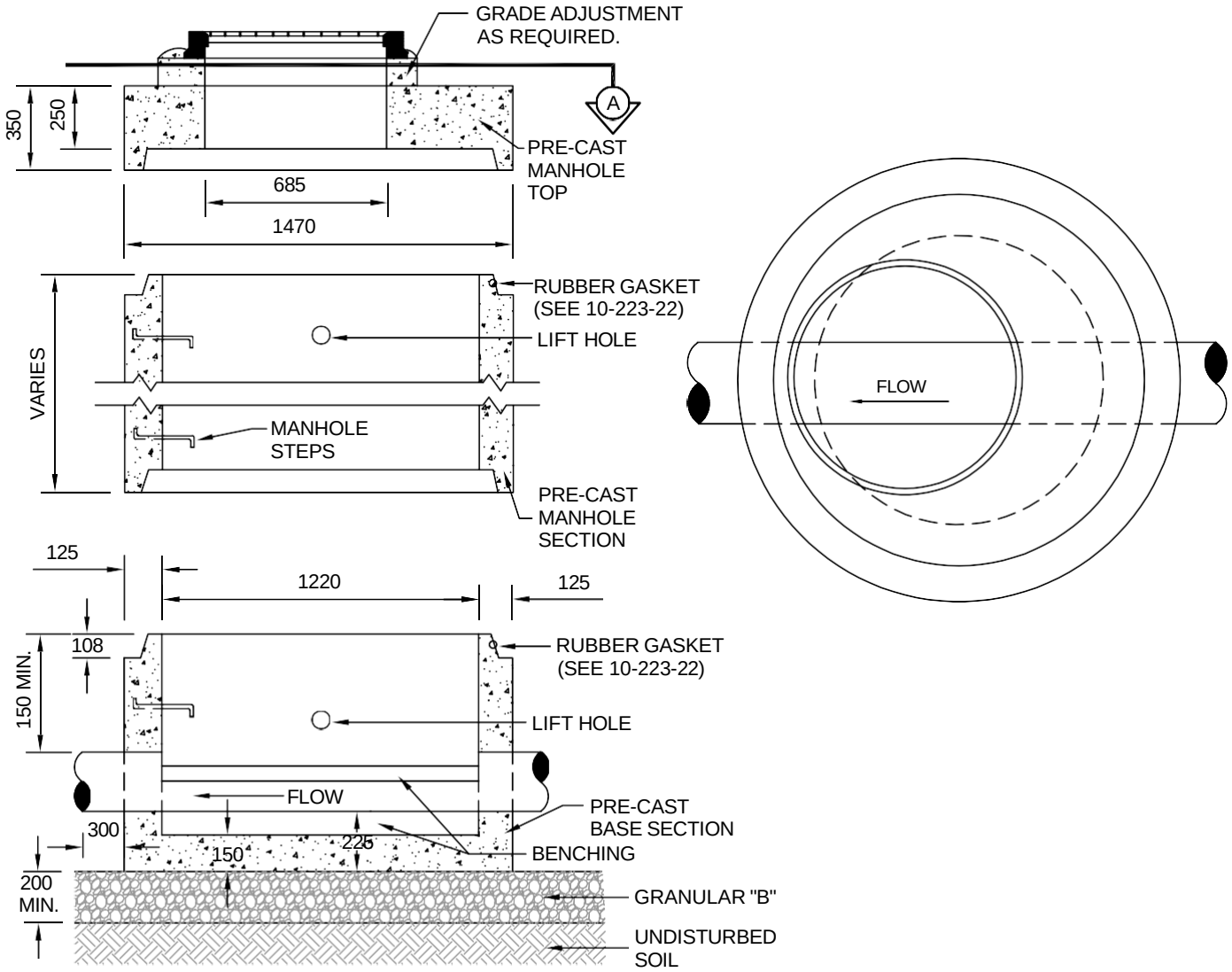
NOTES:

1. THE "A-4" BOWL WILL SERVICE UP THROUGH FULL 6" INLETS. THE "A-6" BOWL WILL SERVICE UP THROUGH FULL 8" INLET, AND CAN BE USED FOR 10" AND 12" INLET MODERATE FLOWS. ALL SIZES ARE FOR RETROFIT OR NEW CONSTRUCTION. FABRICATED IN MARINE GRADE FIBERGLASS AND FINISHED IN BRIGHT WHITE GEL COAT. PROVIDE OPTIONAL FORCE LINE HOOD AT FORCE MAIN INLETS.

ST. JOHN'S
CORPORATE INFORMATION SERVICES

INSIDE DROP MANHOLE DETAIL

DRAWN BY:S.P.\ R.W.	DATE: JANUARY 2022	SCALE: N.T.S	DRAWING No. 10-223-04A



NOTES:

1. ALL CONCRETE TO BE 35 MPa TO MEET CSA A23.1, CLASS C-1 EXPOSURE.
2. WATERTIGHT RUBBER CONNECTORS ARE TO BE USED FOR ALL SANITARY SEWER PIPE ENTRANCES AND PLACED IN BASE SECTION AT FACTORY. WHEN NECESSARY TO CONNECT PIPE TO EXISTING STRUCTURES IN THE FIELD THE REQUIRED HOLE SHALL BE CORE DRILLED USING APPROPRIATE EQUIPMENT AND A RUBBER CONNECTOR INSTALLED WITH THE PIPE. RUBBER CONNECTORS ARE NOT REQUIRED FOR STORM SEWERS.
3. ALL BENCHING TO BE PREFORMED AT FACTORY. BENCHING TO CONFORM TO CAST IN PLACE BENCHING REQUIREMENTS.
4. MSU DAYMOND ALUMINIUM CLIMBING STEP (OR APPROVED EQUAL) TO BE PLACED AT 300mm CENTERS. STEP HOLES ARE TO BE ONLY PARTIALLY THROUGH MANHOLE WALL.
5. LIFT HOLES ARE TO BE ONLY PARTIALLY THROUGH MANHOLE FROM OUTSIDE. HOLES TO BE FILLED WITH GROUT BEFORE BACKFILLING.
6. NO PRE CAST MANHOLE TO BE PLACED IN THE EXCAVATION PRIOR TO INSPECTION BY PROJECT ENGINEER OR SITE REPRESENTATIVE.
7. MINIMUM DROP ACROSS MANHOLE TO BE 50mm FOR STRAIGHT THROUGH TO 45° DEFLECTION.
8. MINIMUM DROP ACROSS MANHOLE TO BE 150mm FOR DEFLECTION GREATER THAN 45° AND UP TO 90°.
9. REINFORCING OMITTED FOR CLARITY, ALL PRE-CAST MANHOLES SHALL BE STRUCTURALLY DESIGNED BY PRE-CASTING SUPPLIER.
10. AFTER INSTALLATION OF THE SANITARY SEWER PIPE AND RUBBER CONNECTOR, THE PIPE SHALL BE GROUTED IN PLACE FROM INSIDE OF THE STRUCTURE. STORM SEWER PIPES SHALL BE GROUTED IN PLACE FROM BOTH INSIDE AND OUTSIDE OF THE STRUCTURE.
11. PRE-CAST SUPPLIER TO DETERMINE IF MANHOLE CAN ACCOMMODATE THE PROPOSED PIPE CONNECTIONS. PROVIDE SHOP DRAWINGS TO THE ENGINEER FOR REVIEW PRIOR TO MANUFACTURE.

ST. JOHN'S
DEPARTMENT OF ENGINEERING

PRE-CAST MANHOLE - TYPE 1200

DRAWN BY: C. S. \ R.W.	DATE: FEB. 2025	SCALE: N.T.S.	DRAWING No. 10-223-05

NOTES:

1. CONCRETE TO BE 35 MPa TO MEET CSA A23.1, CLASS C-1 EXPOSURE.

2. WATERTIGHT RUBBER CONNECTORS ARE TO BE USED FOR ALL SANITARY SEWER PIPE ENTRANCES AND PLACED IN BASE SECTION AT FACTORY. WHEN NECESSARY TO CONNECT PIPE TO EXISTING STRUCTURES IN THE FIELD THE REQUIRED HOLE SHALL BE CORE DRILLED USING APPROPRIATE EQUIPMENT AND A RUBBER CONNECTOR INSTALLED WITH THE PIPE. RUBBER CONNECTORS ARE NOT REQUIRED FOR STORM SEWERS.

3. BENCHING TO BE PREFORMED AT FACTORY OR ON SITE AND TO CONFORM TO CAST IN PLACE BENCHING REQUIREMENTS.

4. MSU DAYMOND ALUMINIUM CLIMBING STEPS (OR APPROVED EQUAL) TO BE PLACED AT 300mm CENTERS. STEP HOLES ARE TO BE ONLY PARTIALLY THROUGH MANHOLE WALL.

5. LIFT HOLES ARE TO BE ONLY PARTIALLY THROUGH MANHOLE FROM OUTSIDE. HOLES TO BE GROUT FILLED BEFORE BACKFILLING.

6. NO PRE-CAST MANHOLE TO BE PLACED IN THE EXCAVATION PRIOR TO INSPECTION BY PROJECT ENGINEER OR SITE REPRESENTATIVE.

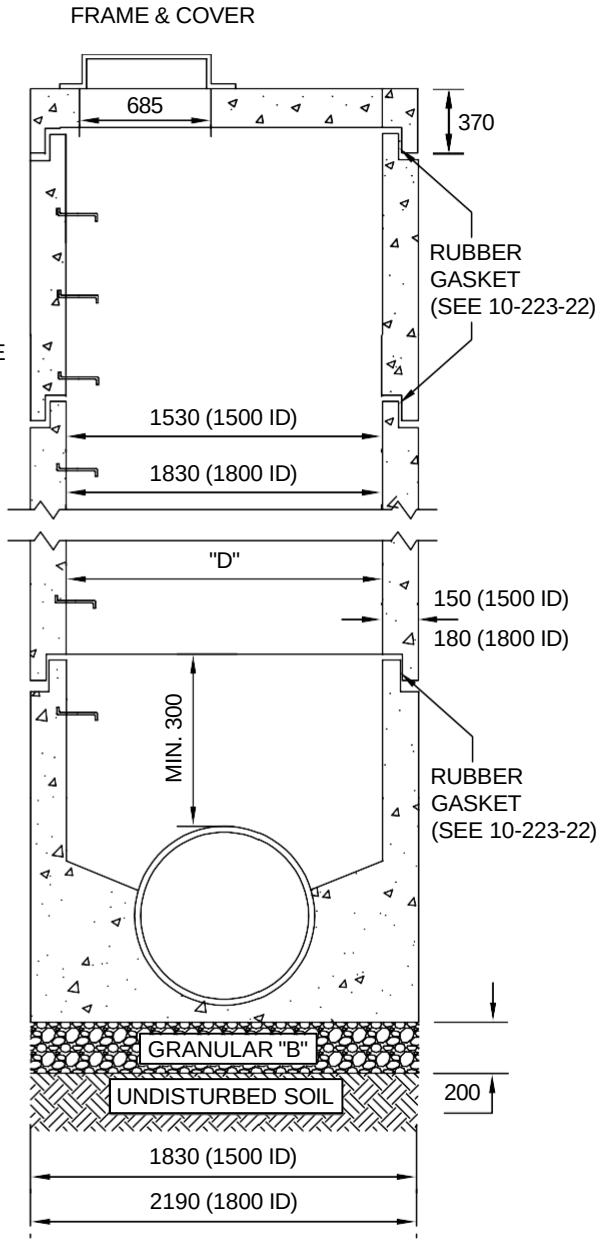
7. MINIMUM DROP ACROSS MANHOLE TO BE 50mm FOR STRAIGHT THROUGH TO 45° DEFLECTION.

8. MINIMUM DROP ACROSS MANHOLE TO BE 150mm FOR DEFLECTION GREATER THAN 45° AND UP TO 90°.

9. REINFORCING OMITTED FOR CLARITY, ALL PRE-CAST MANHOLES SHALL BE STRUCTURALLY DESIGNED BY PRE-CASTING SUPPLIER.

10. AFTER INSTALLATION OF THE SANITARY SEWER PIPE AND RUBBER CONNECTOR, THE PIPE SHALL BE GROUTED IN PLACE FROM INSIDE OF THE STRUCTURE. STORM SEWER PIPES SHALL BE GROUTED IN PLACE FROM BOTH INSIDE AND OUTSIDE OF THE STRUCTURE.

11. PRE-CAST SUPPLIER TO DETERMINE IF MANHOLE CAN ACCOMMODATE THE PROPOSED PIPE CONNECTIONS. PROVIDE SHOP DRAWINGS TO THE ENGINEER FOR REVIEW PRIOR TO MANUFACTURE.

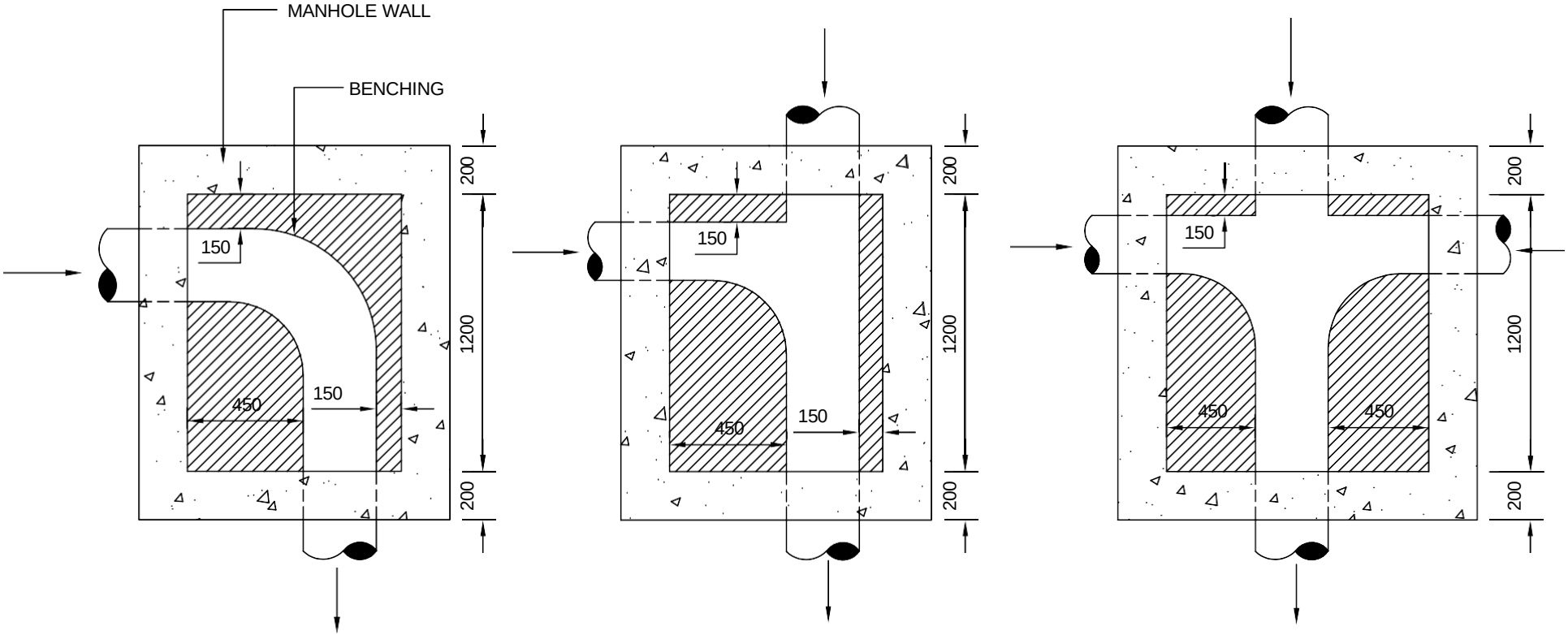


TYPICAL X-SECTION

ST. JOHN'S
DEPARTMENT OF ENGINEERING

PRE-CAST MANHOLE - TYPE 1500, 1800

DRAWN BY: C. S. \ R.W.	DATE: FEB. 2025	SCALE: N.T.S.	DRAWING No. 10-223-06



NOTES:

1. MANHOLE SHALL BE SMOOTHLY BENCHED THROUGHOUT THE CROWN OF ALL PIPES ON A VERTICAL PROJECTION FROM THE SPRING LINE OR AS APPROVED BY THE ENGINEER.

2. ALL PIPES RUNNING STRAIGHT THROUGH A MANHOLE REQUIRE A MINIMUM 50mm DROP ACROSS THE MANHOLE.

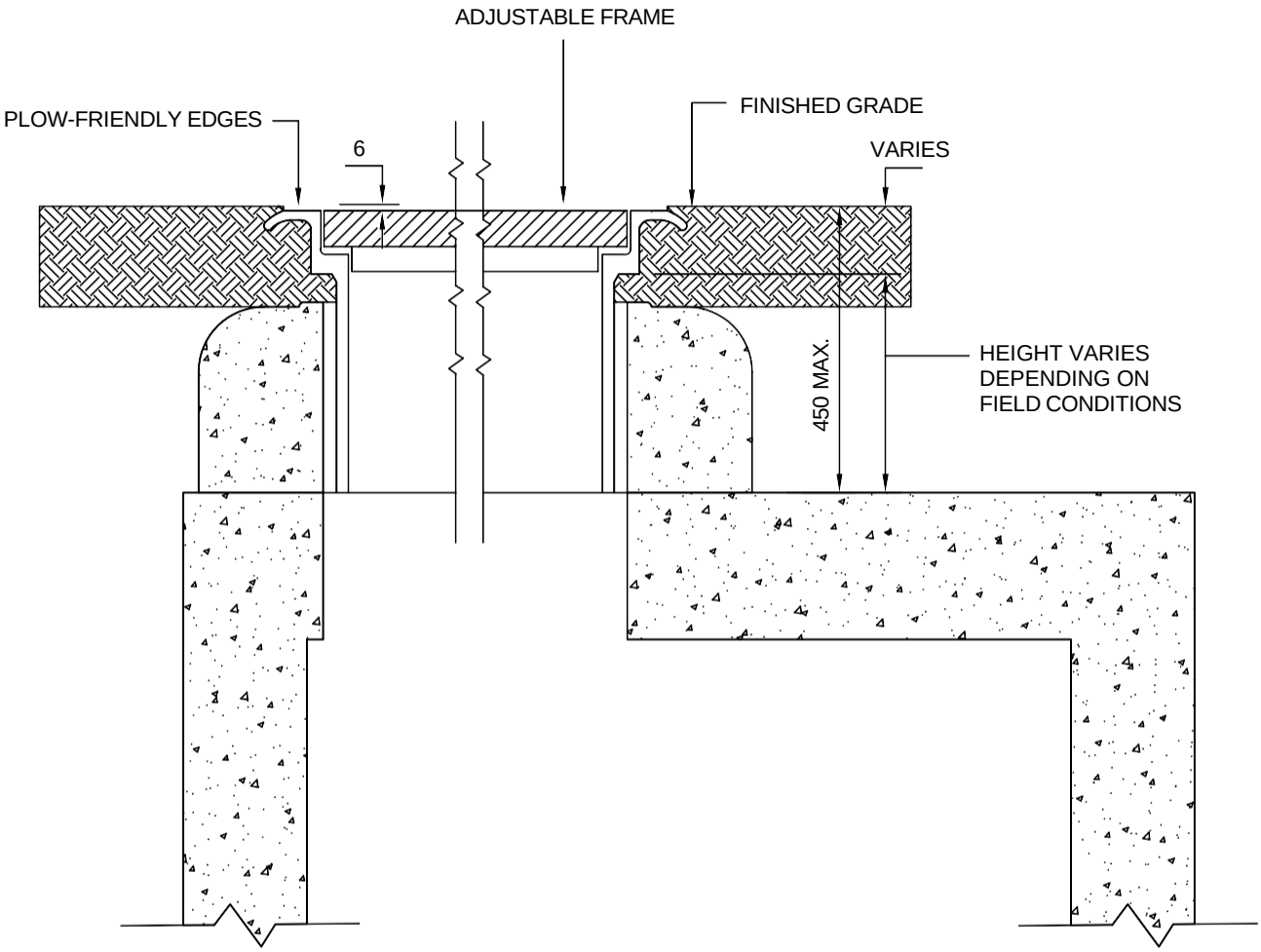
3. ALL PIPES TURNING AT AN ANGLE GREATER THAN 45° IN A MANHOLE REQUIRE A 150mm DROP ACROSS THE MANHOLE.

4. BENCHING SHALL BE GIVEN STEEL TROWEL FINISH

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MANHOLE BASE & BENCHING REQUIREMENTS

DRAWN BY: C. S. \ R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-223-07



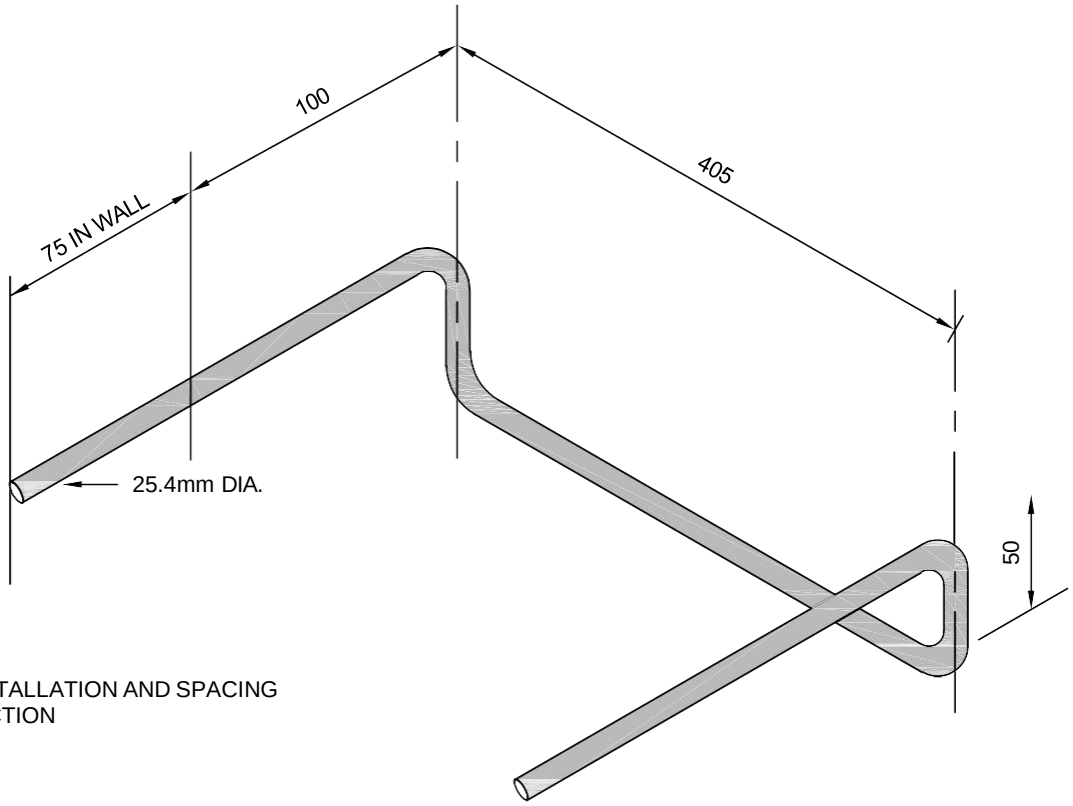
TYPICAL X-SECTION

NOTE:
COVER TO BE DEPRESSED 6mm BELOW FINISHED GRADE.

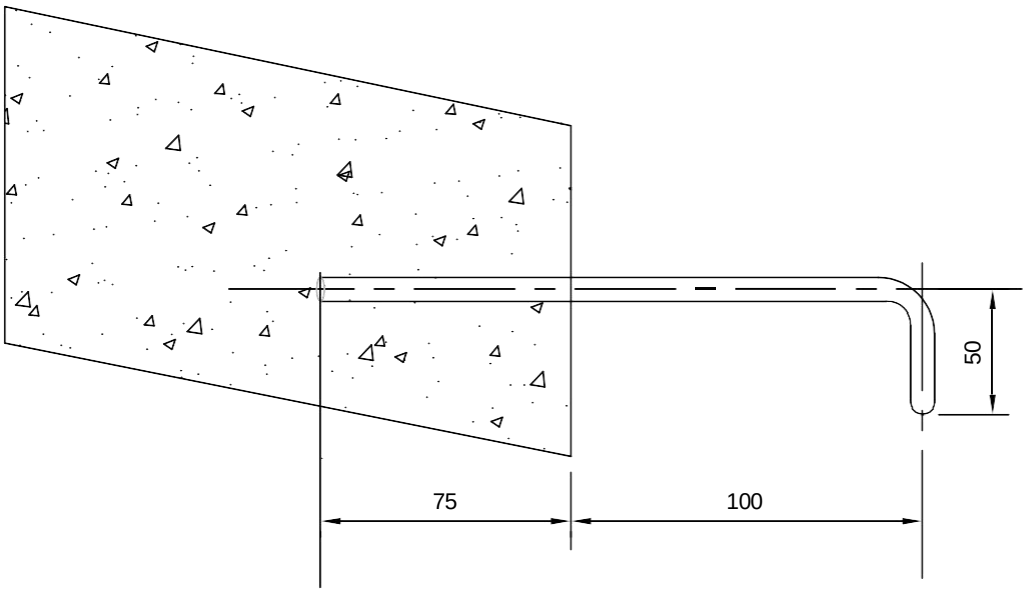
ST. JOHN'S
DEPARTMENT OF ENGINEERING

SELF LEVELING FRAME & COVER BEDDING DETAIL

DRAWN BY: R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-223-08



FOR INSTALLATION AND SPACING
SEE SECTION



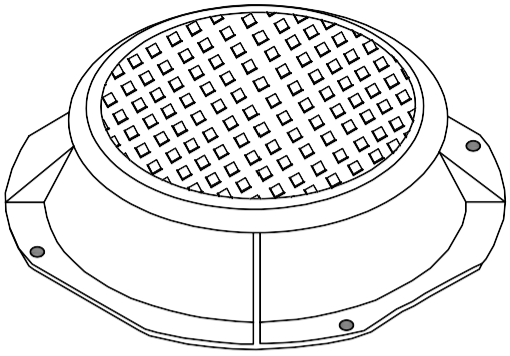
NOTE:
1. MECHANICALLY FASTENED RUNG TO: CAN/CSA 257.4-03

ST. JOHN'S
DEPARTMENT OF ENGINEERING

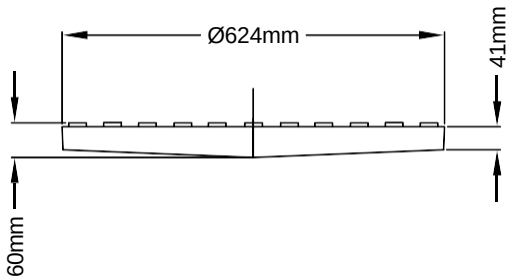
MANHOLE STEP CAST IN PLACE

DRAWN BY: C. S.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-223-09

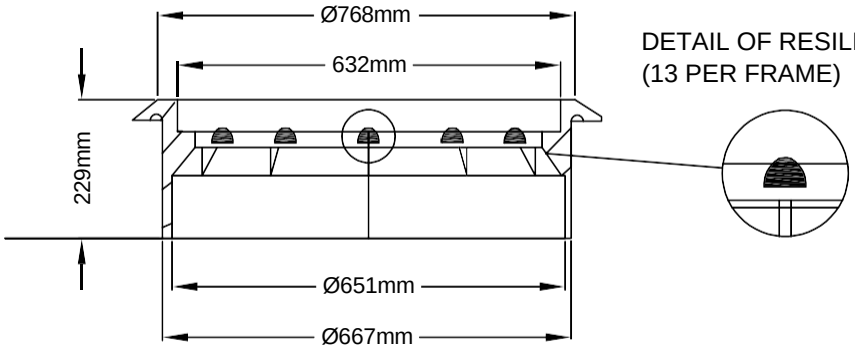
RESILIENT SEATED WITH
CONICAL GUIDE (624mm)



COVER (OPSD 401.010A)
(624mm)
78 kg
DUCTILE OR GRAY IRON
ASTM A536 65-45-12
ASTM A48 CLASS 30

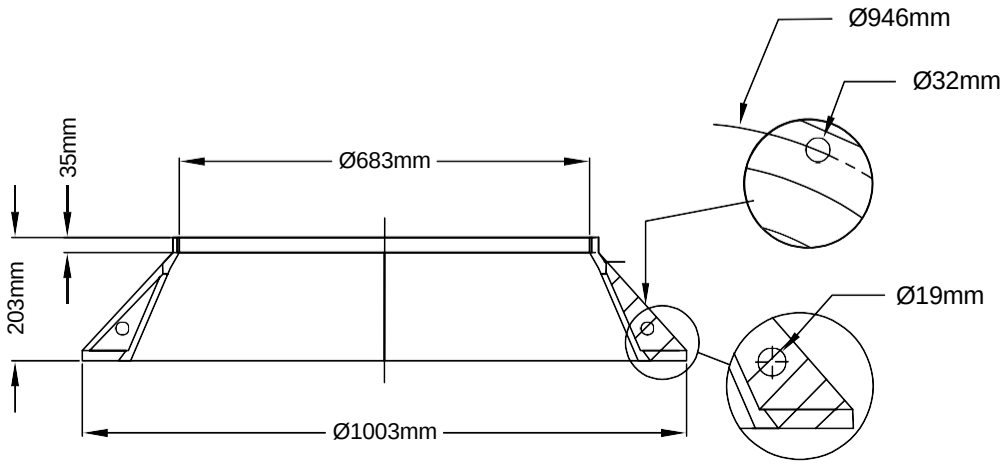


ESR FRAME
(624mm)
76kg
DUCTILE IRON
ASTM A536 65-45-12



DETAIL OF RESILIENT SEAT
(13 PER FRAME)

CONICAL GUIDE
(624mm)
62kg
GRAY IRON
ASTM A48 CLASS30

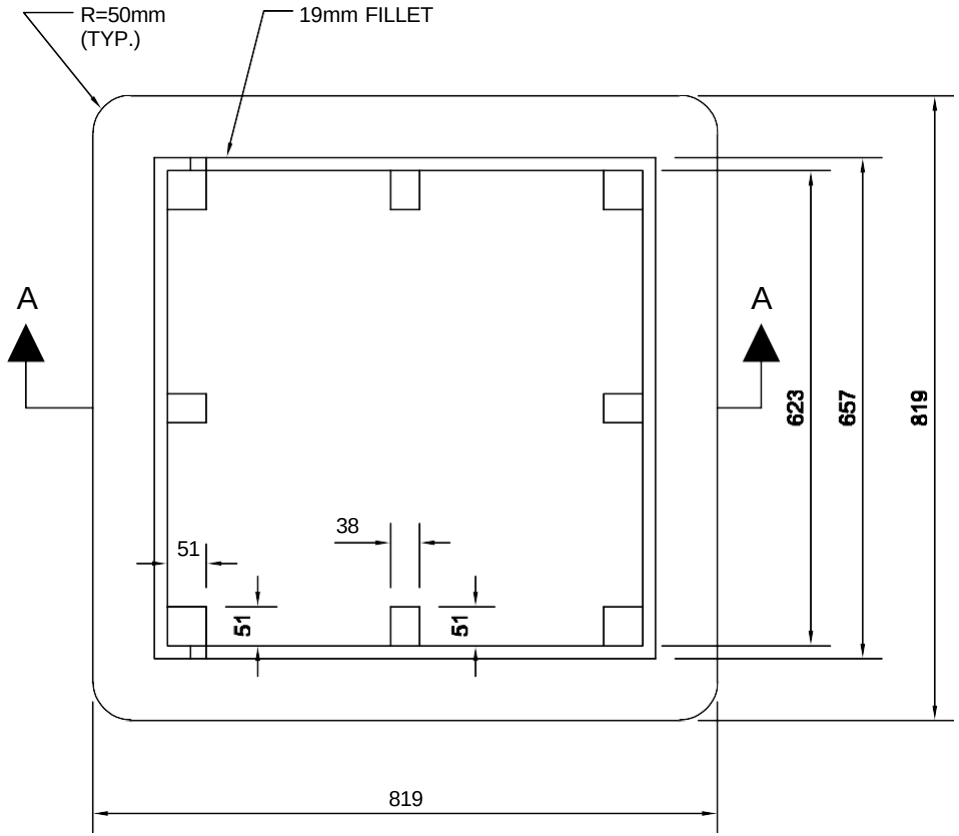


TOTAL WEIGHT 216kg

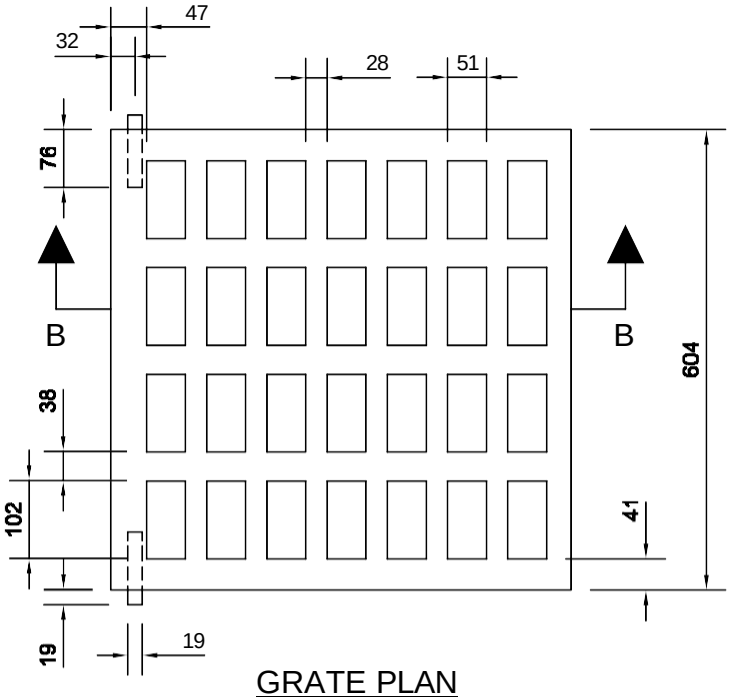
ST. JOHN'S
DEPARTMENT OF ENGINEERING

SELF LEVELING MANHOLE FRAME & COVER DETAIL

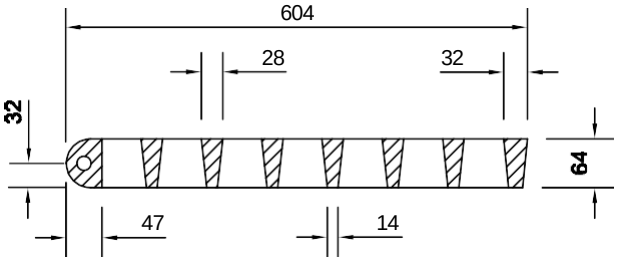
DRAWN BY: R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-223-10



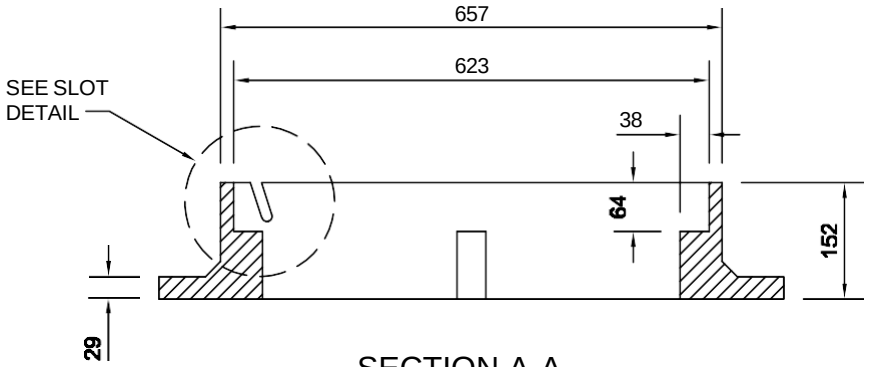
FRAME PLAN



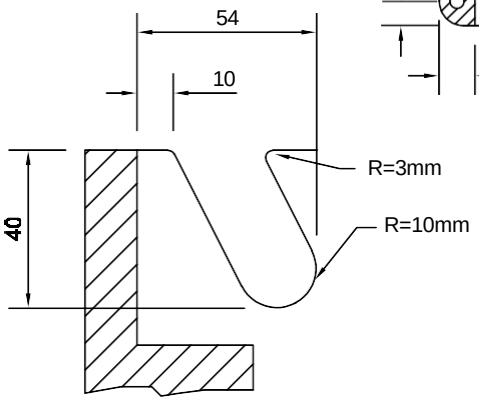
GRATE PLAN



SECTION B-B



SECTION A-A



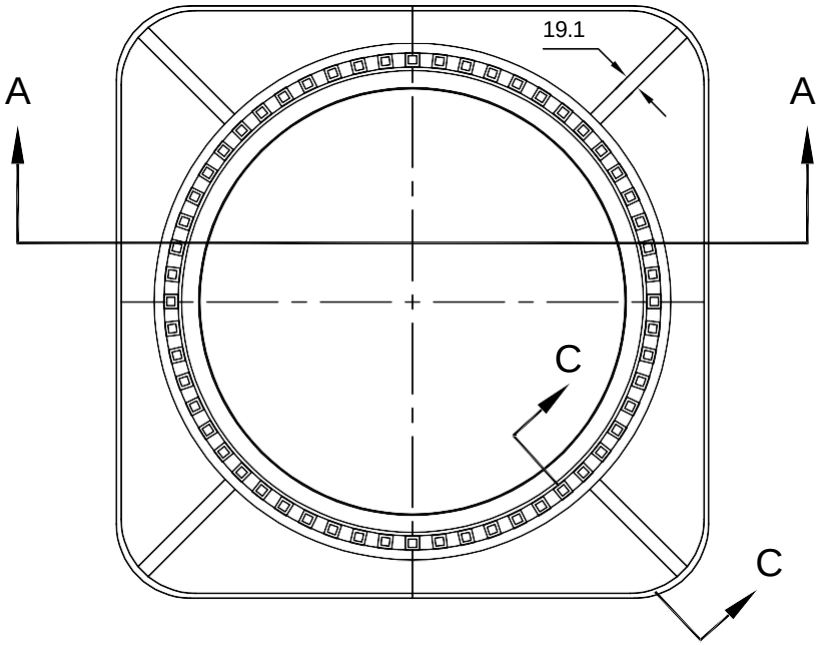
SLOT DETAIL

NOTE:
ALL DIMENSIONS ARE IN MILLIMETRES
UNLESS OTHERWISE SHOWN.

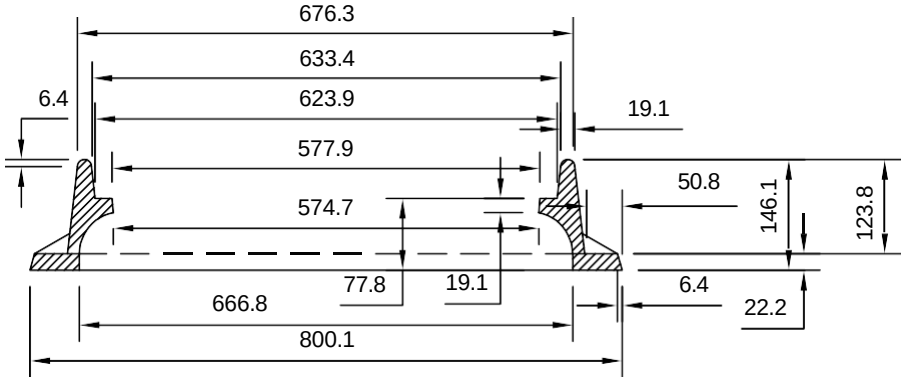
ST. JOHN'S
DEPARTMENT OF ENGINEERING

CATCHBASIN, CAST IRON FRAME & FLAT GRATE (PERFORATED)

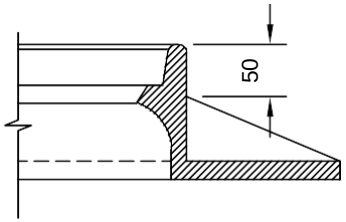
DRAWN BY:	C. S. \ R.W.	DATE:	JANUARY 2022	SCALE:	N.T.S.	DRAWING No.	10-223-11



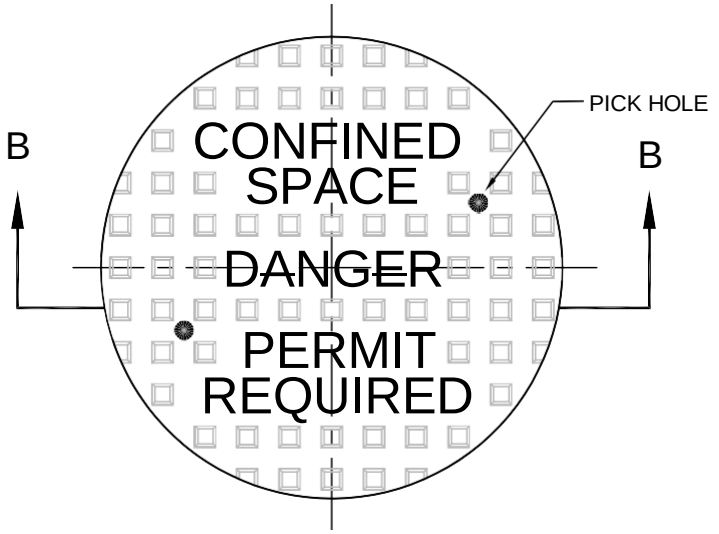
FRAME PLAN



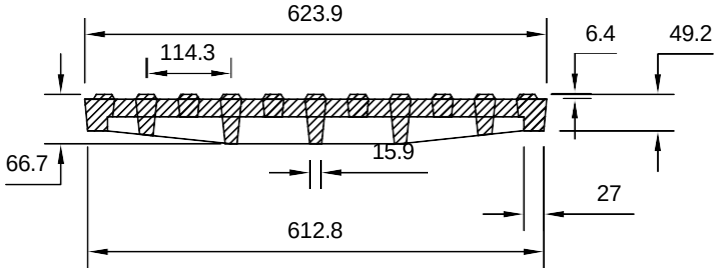
SECTION A - A



SECTION C - C



COVER PLAN



SECTION B - B

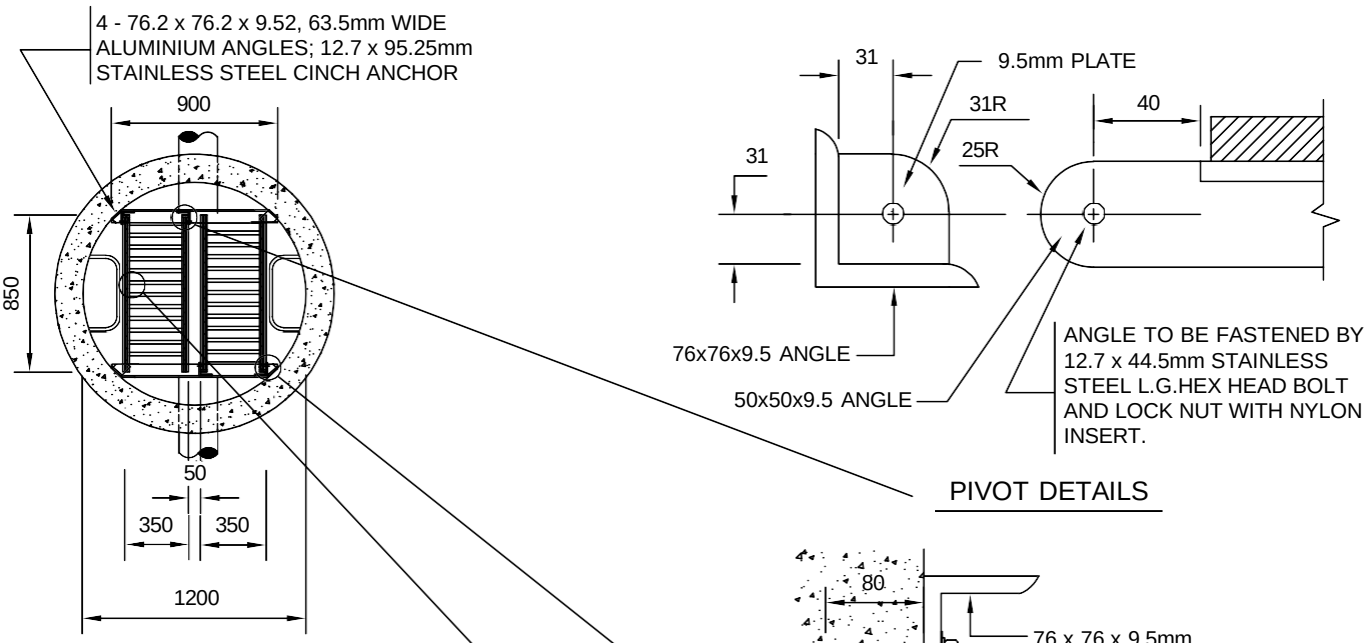
NOTES:

ALLOWABLE TOLERANCES DIMENSIONS 300mm OR LESS 3mm± DIMENSIONS 300mm UP TO AND INCLUDING 900mm 6mm±.
SEAT BETWEEN FRAME & COVER TO BE MACHINE LATHED - BOTH SIDES
IN ASPHALT STREETS, PARKING LOTS, ETC. FRAMES SHALL BE SELF LEVELING AND ADJUSTABLE MANHOLE FRAME AND COVER EJ/BIBBY ST. CROIX OR APPROVED EQUAL.

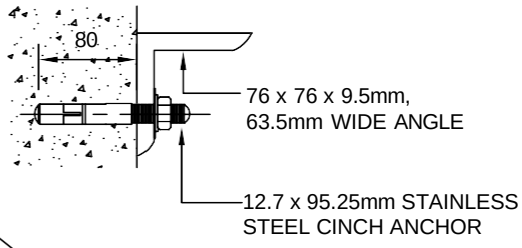
ST. JOHN'S
DEPARTMENT OF ENGINEERING

ROUND MANHOLE FRAME AND COVER

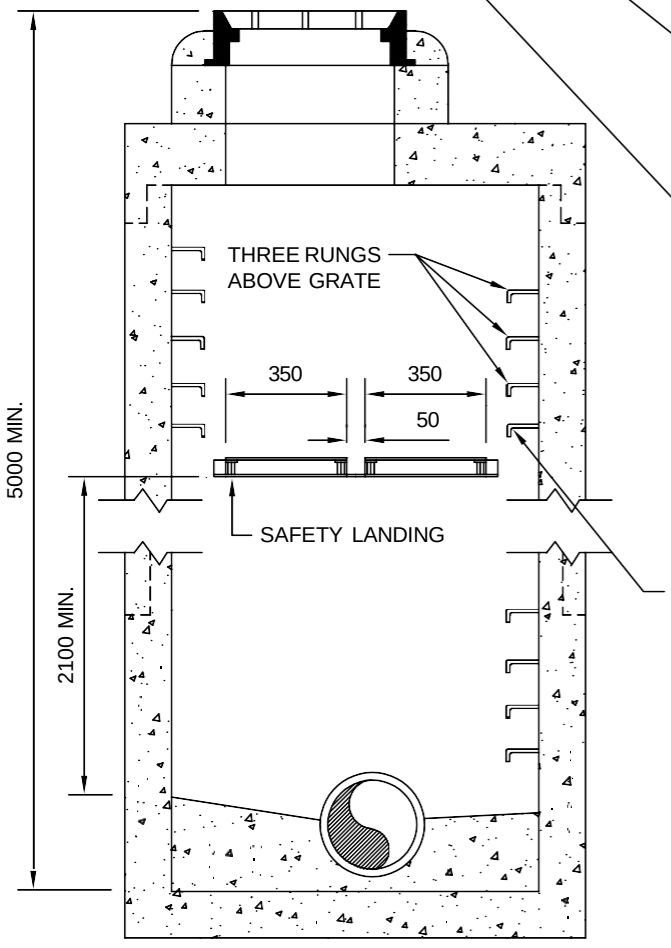
DRAWN BY:	C. S. \ R.W.	DATE:	JANUARY 2022	SCALE:	N.T.S.	DRAWING No.	10-223-12



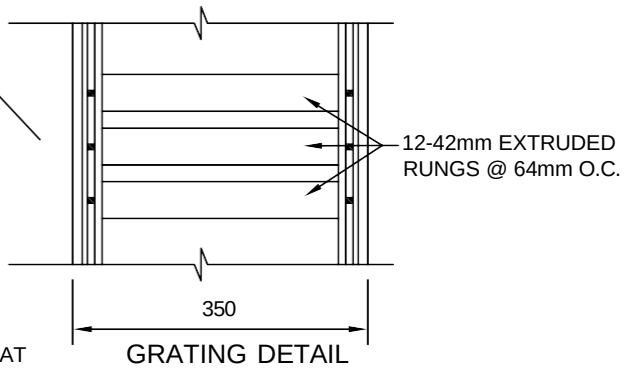
PIVOT DETAILS



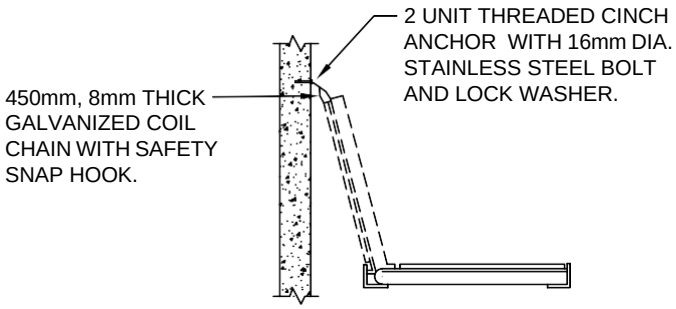
INSTALLATION OF SAFETY GRATE ASSEMBLY



STANDARD MANHOLE



GRATING DETAIL



SIDE VIEW & OPEN POSITION

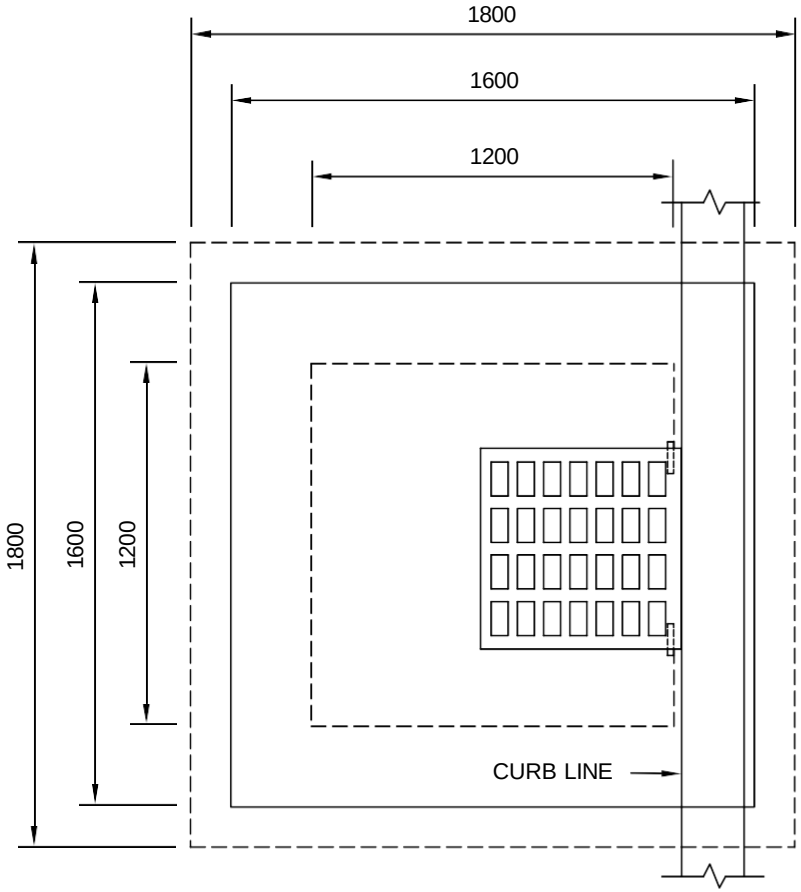
NOTES:

1. SAFETY LANDINGS SHALL BE AS MANUFACTURED BY STEPCON INDUSTRIES OR APPROVED EQUAL AND BE CONSTRUCTED OF ALUMINIUM UNLESS OTHERWISE NOTED.
2. SAFETY LANDINGS TO BE INSTALLED IN ALL MANHOLES OVER 5m DEPTH.
3. FOR MANHOLES BETWEEN 10-15m, 2 SAFETY LANDINGS SHALL BE INSTALLED AT THIRD POINT.
4. FOR SAFETY LANDINGS IN OVERSIZE MANHOLES, SHOP DRAWINGS SHALL BE REQUIRED.

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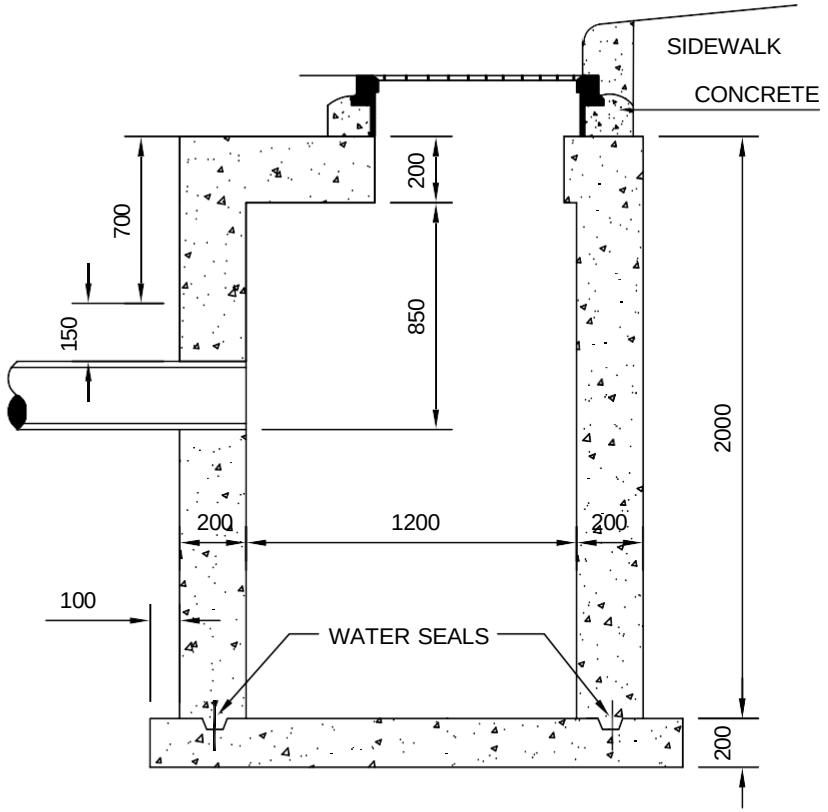
SAFETY LANDING FOR MANHOLE

DRAWN BY: C. S. \ R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-223-13



PLAN VIEW

C.B. LEAD
MIN. = 300Ø
MIN. GRADE 2%



TYPICAL X-SECTION

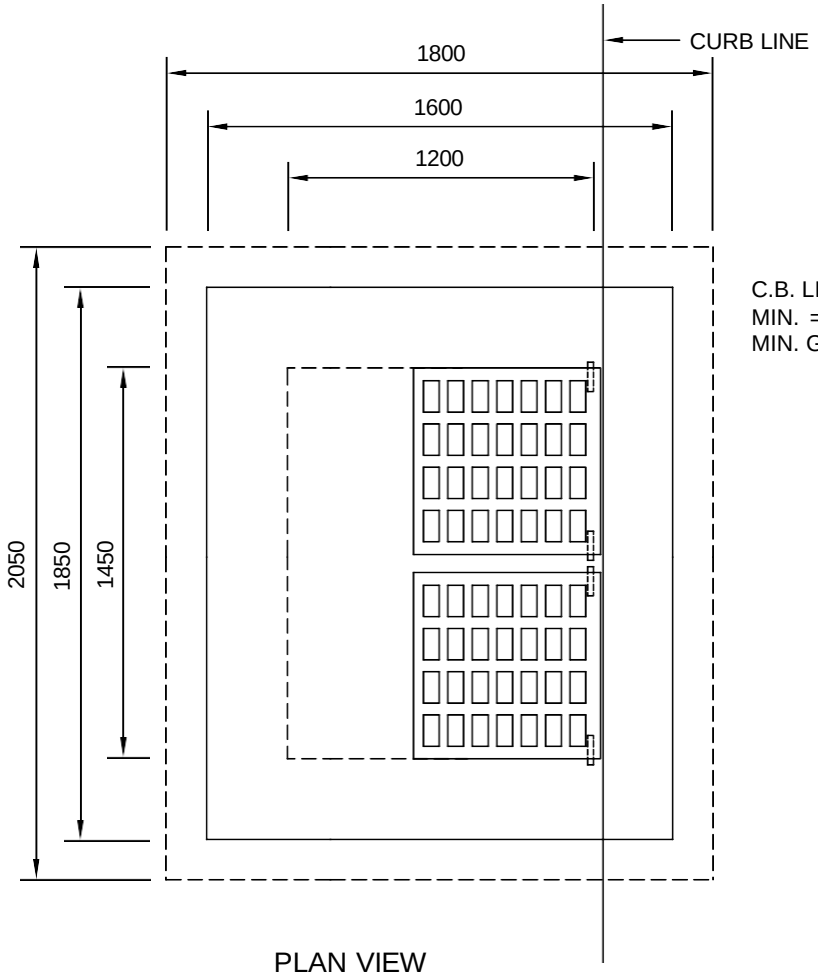
NOTE:

1. CONCRETE TO BE 35 MPa TO MEET CSA A23.1, CLASS C-1 EXPOSURE.
2. CATCH BASIN GRATING SHALL BE DEPRESSED 30mm BELOW GUTTER GRADE.

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DEPARTMENT OF ENGINEERING

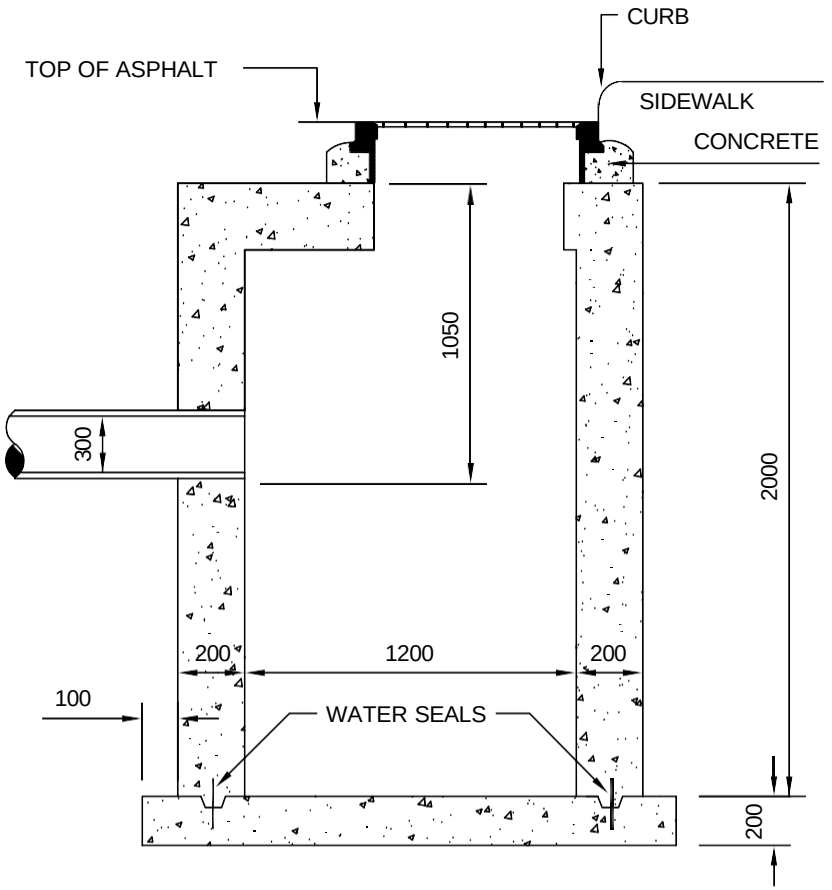
CAST IN PLACE SINGLE CATCH BASIN

DRAWN BY:	C. S. \ R.W.	DATE:	JANUARY 2022	SCALE:	N.T.S.	DRAWING No.	10-223-14



PLAN VIEW

C.B. LEAD
MIN. = 300Ø
MIN. GRADE 2%



TYPICAL X-SECTION

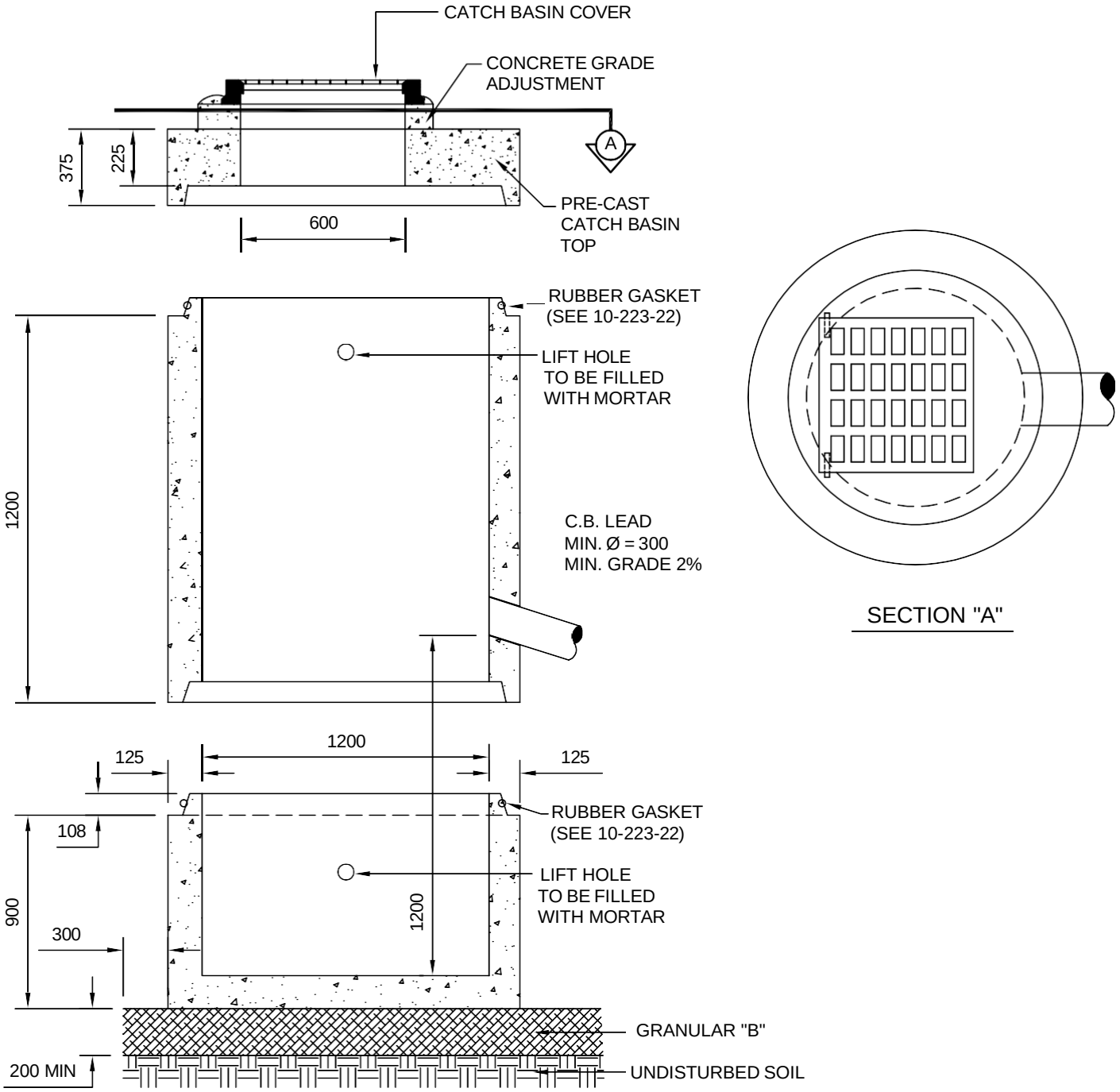
NOTE:

1. CONCRETE TO BE 35 MPa TO MEET CSA A23.1, CLASS C-1 EXPOSURE.
2. CATCH BASIN GRATING SHALL BE DEPRESSED 30mm BELOW GUTTER GRADE.
3. MINIMUM SUMP DEPTH 1200.

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DEPARTMENT OF ENGINEERING

CAST IN PLACE DOUBLE CATCH BASIN

DRAWN BY:	C. S. \ R.W.	DATE:	JANUARY 2022	SCALE:	N.T.S.	DRAWING No.	10-223-15



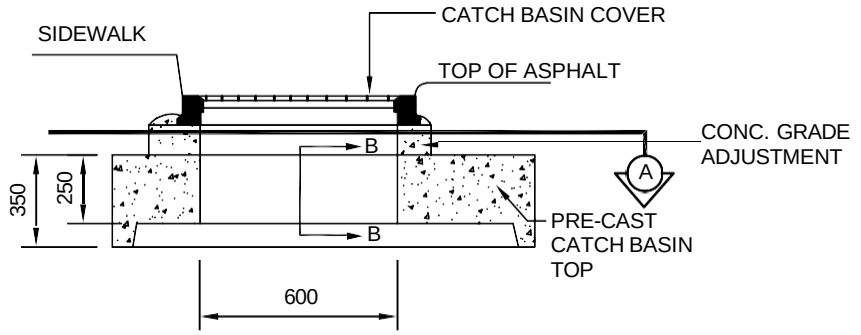
NOTES:

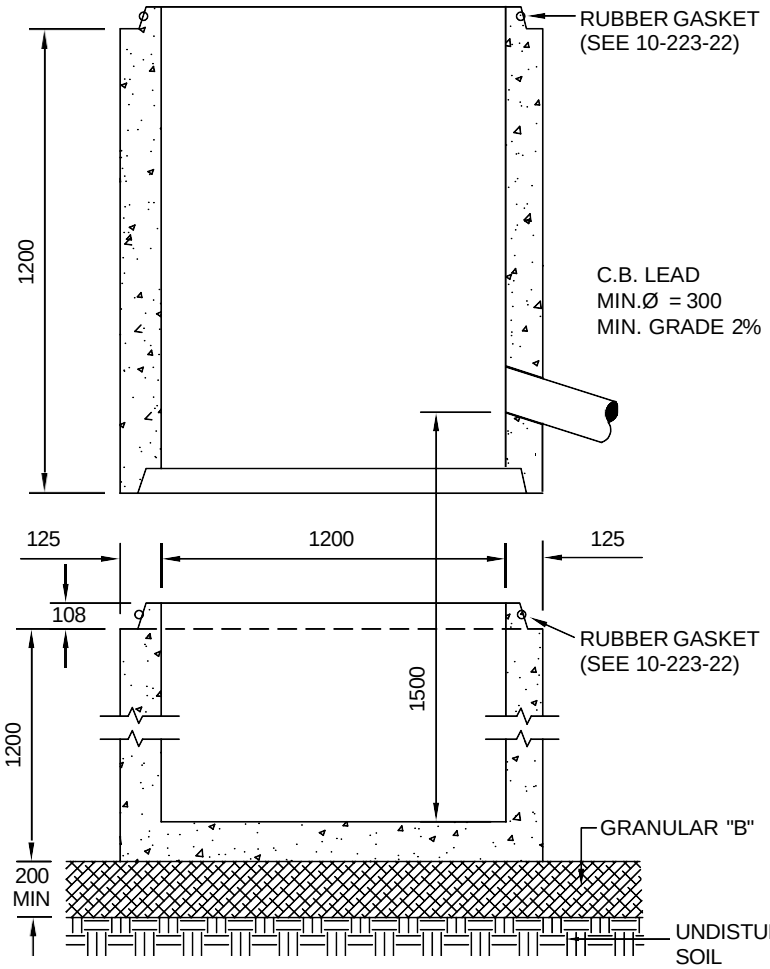
1. CONCRETE TO BE 35MPa TO MEET CSA A23.1, CLASS C-1 EXPOSURE
2. SEE NOTE 2 ON DRAWING 10-223-05
3. SEE NOTE 10 ON DRAWING 10-223-05
4. CATCHBASIN GRATING SHALL BE DEPRESSED 30mm BELOW GUTTER GRADE.
5. LIFT HOLES ARE TO BE PARTIALLY THROUGH MANHOLE FROM OUTSIDE. HOLES TO BE GROUT FILLED BEFORE BACKFILLING.
6. MINIMUM SUMP DEPTH 1200mm.
7. REINFORCING OMITTED FOR CLARITY. PRE-CASTING MANUFACTURER TO PROVIDE STRUCTURAL DESIGN.

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DEPARTMENT OF ENGINEERING

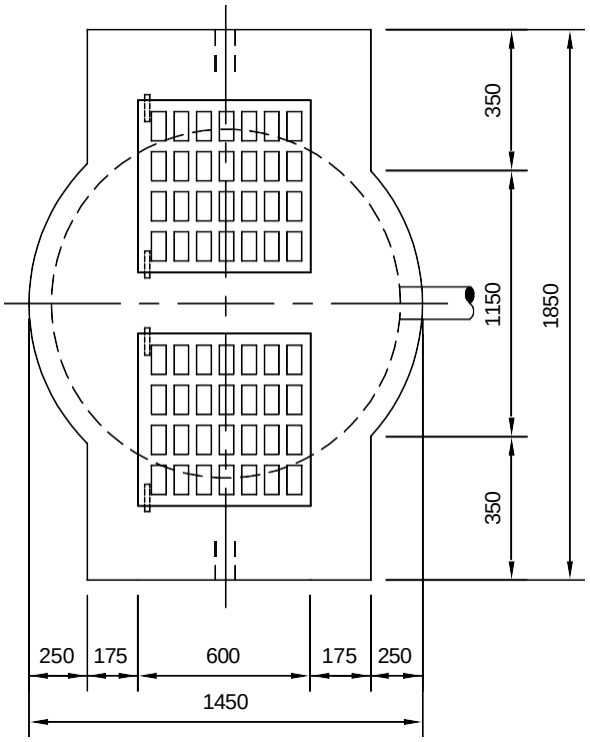
PRE-CAST SINGLE CATCH BASIN

DRAWN BY: C. S. \ R.W.	DATE: FEB. 2025	SCALE: N.T.S.	DRAWING No. 10-223-16

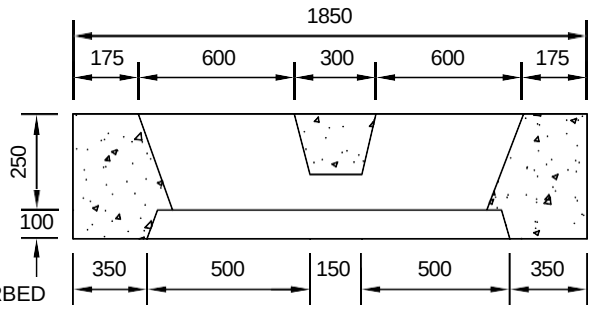




TYPICAL X-SECTION



SECTION A



SECTION B-B

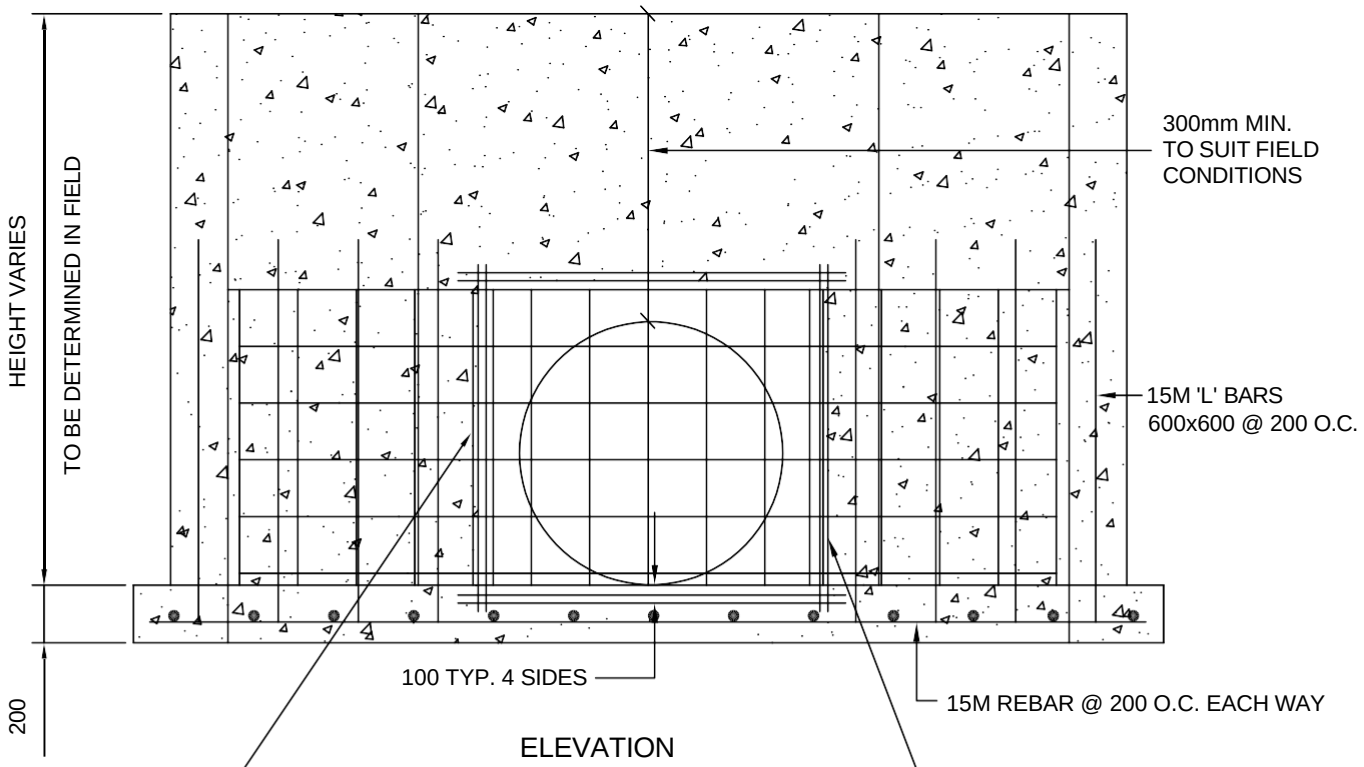
NOTES:

1. CONCRETE TO BE 35MPa TO MEET CSA A23.1, CLASS C-1 EXPOSURE
2. SEE NOTE 2 ON DRAWING 10-223-05
3. SEE NOTE 10 ON DRAWING 10-223-05
4. CATCHBASIN GRATING SHALL BE DEPRESSED 30mm BELOW GUTTER GRADE.
5. LIFT HOLES ARE TO BE PARTIALLY THROUGH MANHOLE FROM OUTSIDE. HOLES TO BE GROUT FILLED BEFORE BACKFILLING.
6. MINIMUM SUMP DEPTH 1500mm.
7. REINFORCING OMITTED FOR CLARITY. PRE-CASTING MANUFACTURER TO PROVIDE STRUCTURAL DESIGN.

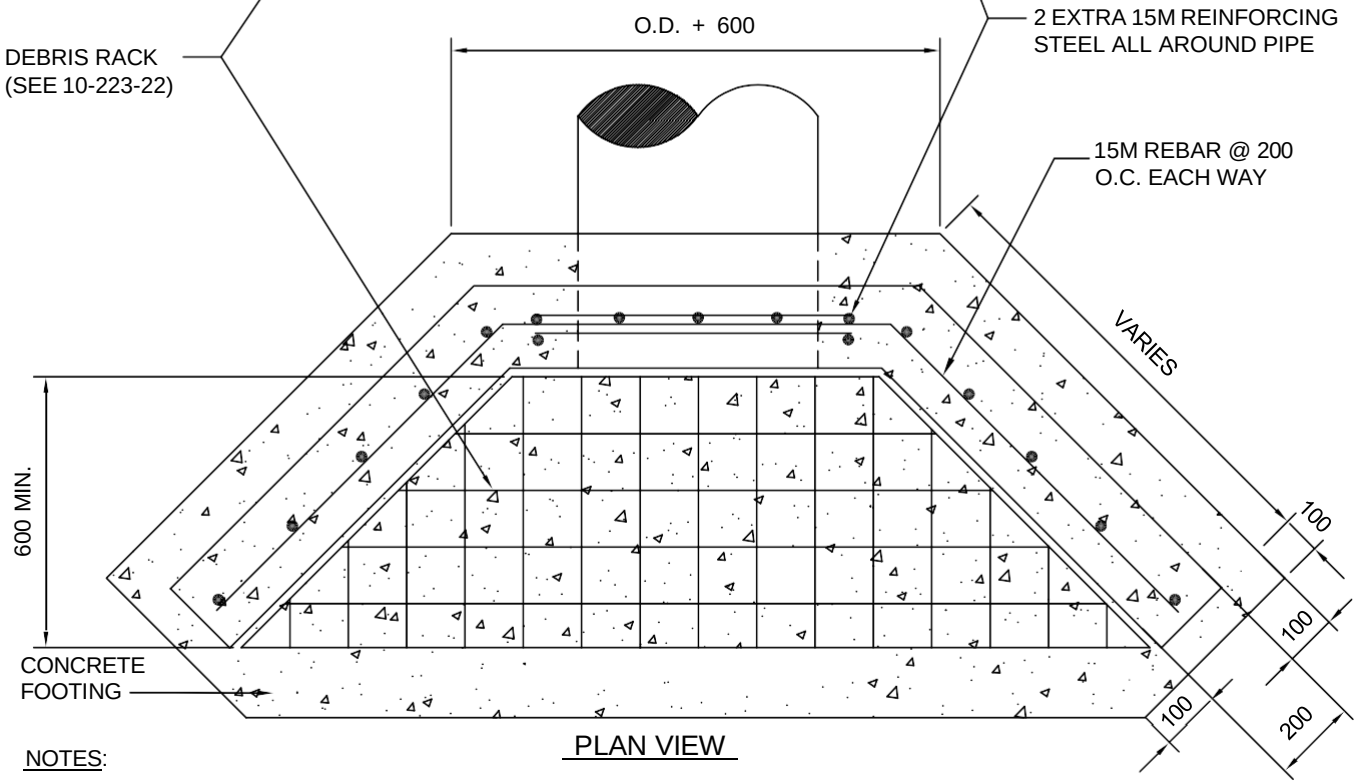
ST. JOHN'S
DEPARTMENT OF ENGINEERING

PRE-CAST DOUBLE CATCH BASIN

DRAWN BY: C. S. \ R.W.	DATE: FEB. 2025	SCALE: N.T.S.	DRAWING No. 10-223-17



ELEVATION



PLAN VIEW

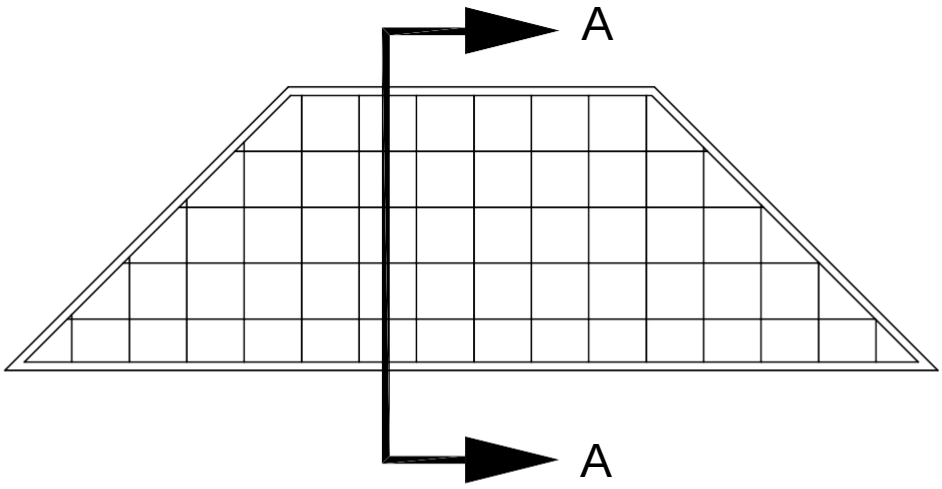
NOTES:

1. CONCRETE TO BE 35MPa TO MEET CSA A23.1, CLASS C-1 EXPOSURE
2. HAND RAIL TO BE PLACED ON WALLS WITH A HEIGHT EQUAL TO OR GREATER THAN 1200mm.
3. EXTRA REINFORCING STEEL SHALL BE INSTALLED AROUND PIPES 500mm O.D. AND GREATER.
4. ALL EXPOSED CORNERS ON CONCRETE WORK SHALL BE CHAMFERED 25mm.
5. FOR PIPES 750mm AND LARGER, A 600mm SQUARE HINGED ACCESS OPENING C/W HASP & CLASP SHALL BE INSTALLED IN THE TOP OF THE DEBRIS RACK.
6. HEADWALL SHALL BE SITED AT A GRADE SUCH THAT THE ULTIMATE OVERFLOW ROUTE IS OVER THE HEADWALL AND NOT THE UPSTREAM BANKS.
7. HEADWALLS WITH PIPES LARGER THAN 1200mm NEED TO BE STRUCTURALLY DESIGNED.

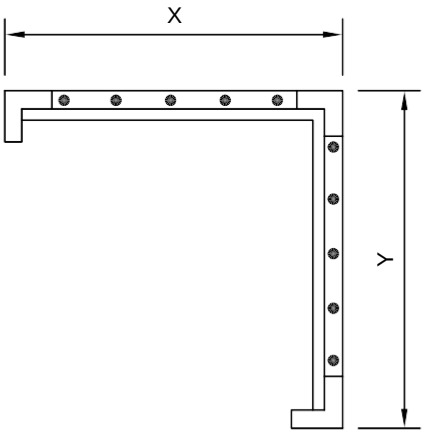
ST. JOHN'S
DEPARTMENT OF ENGINEERING

HEADWALL
(FOR PIPES UP TO 1200mm)

DRAWN BY: C. S. \ R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-223-18



PLAN VIEW



SECTION A

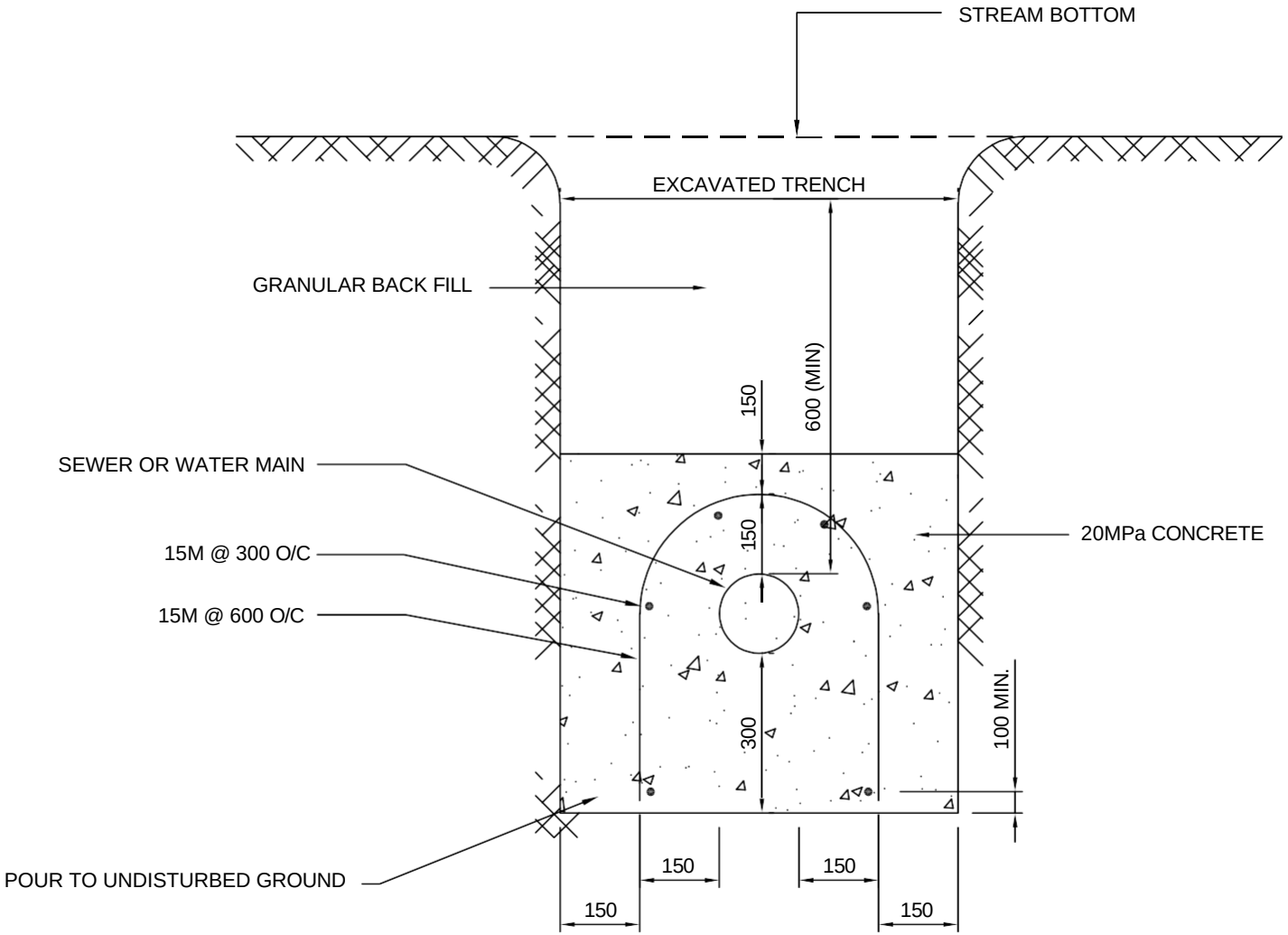
NOTES:

1. ALL JUNCTIONS TO BE SPOT WELDED.
2. FRAMING TO BE 45x45x6 ANGLE EXCEPT WHERE INDICATED.
3. 20M STEEL BARS AT 150mm SPACING.
4. ALL EXPOSED METAL TO BE PAINTED WITH RED OXIDE PRIMER.
5. DIMENSION X TO BE 600mm MINIMUM UNLESS PIPE IS GREATER THAN 750mm, THEN X=750mm.
6. DIMENSION Y TO BE PIPE DIAMETER PLUS 300mm MINIMUM OR TO SUIT FIELD CONDITIONS.
7. RACK TO BE ATTACHED USING 16mm ANCHORS & BOLTS AT 300mm SPACING.

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DEBRIS RACK

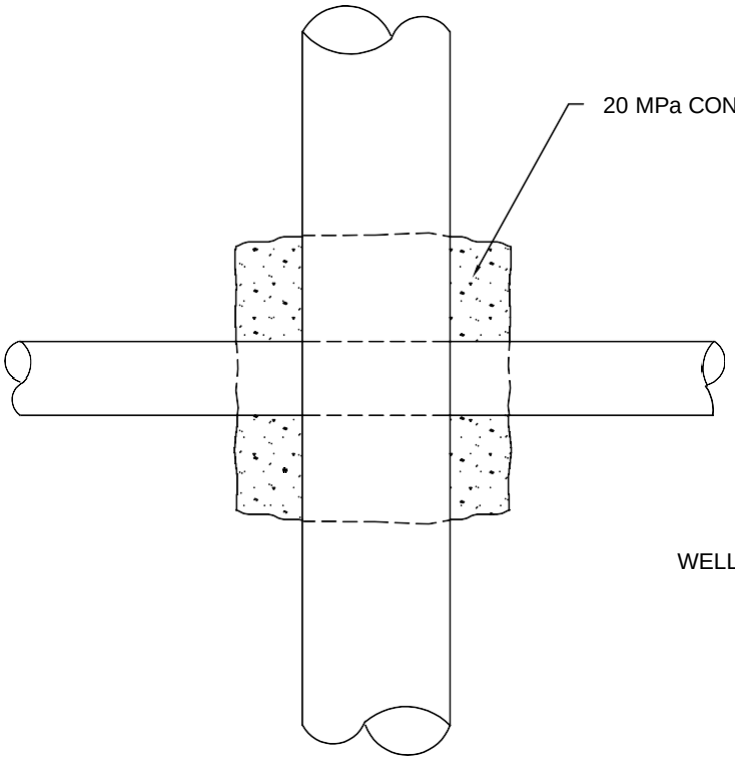
DRAWN BY: C. S. \ R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-223-19



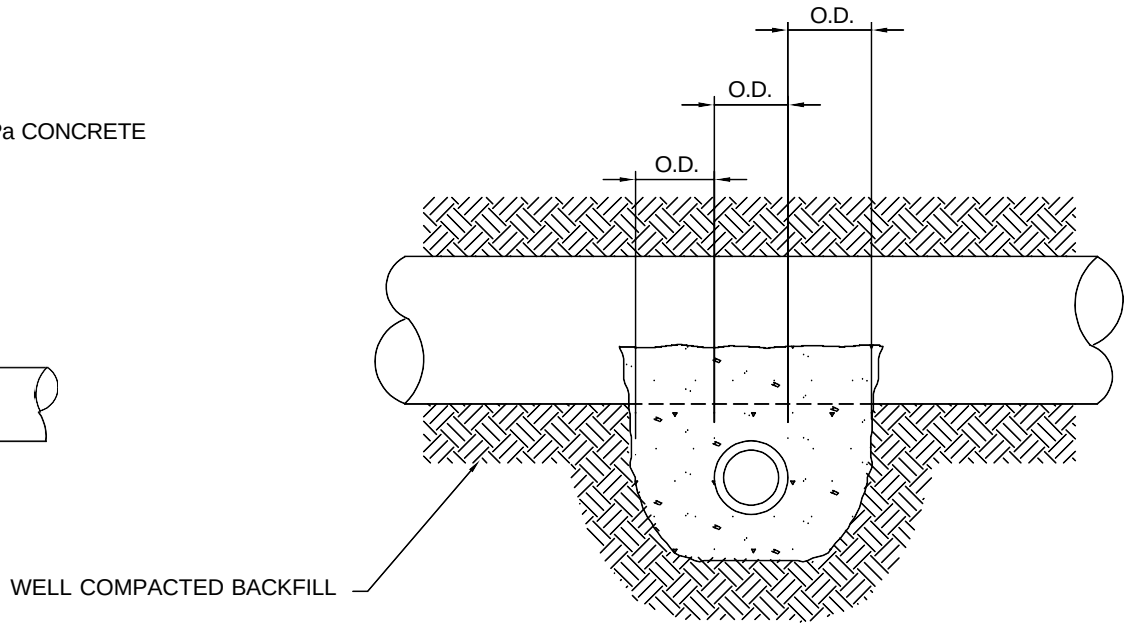
ST. JOHN'S
DEPARTMENT OF ENGINEERING

STREAM CROSSING ENCASEMENT

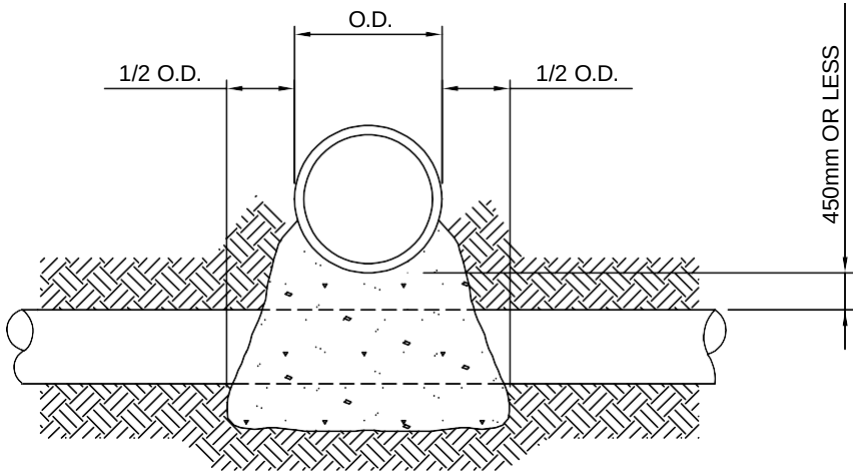
DRAWN BY:	C. S. \ R.W.	DATE:	JANUARY 2022	SCALE:	N.T.S.	DRAWING No.	10-223-20



PLAN



RIGHT SIDE

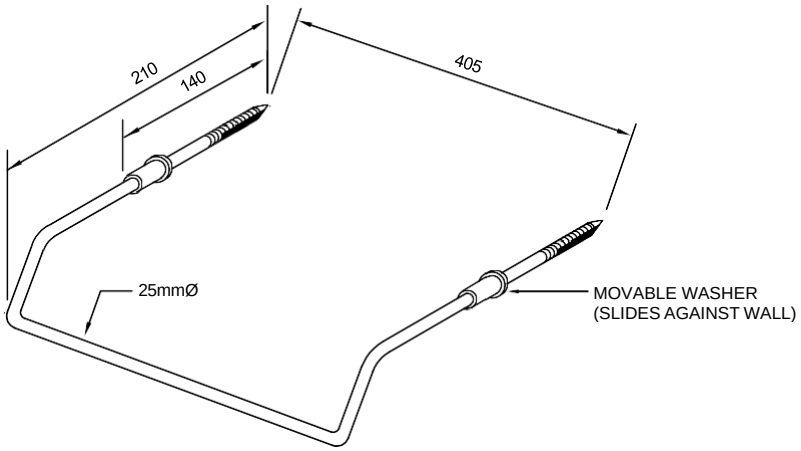


FRONT

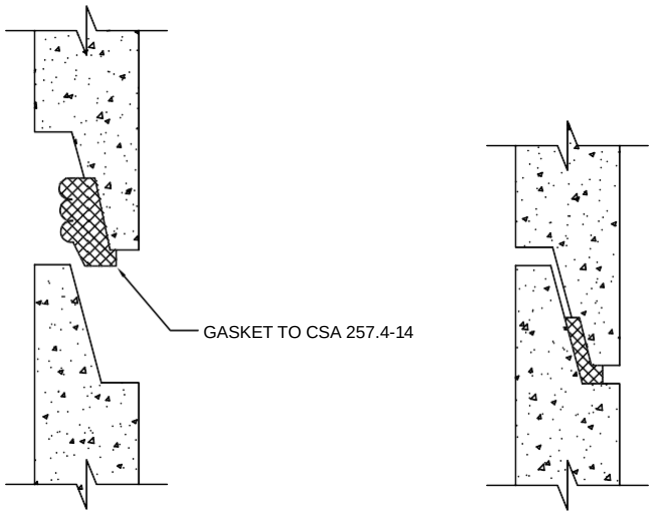
ST. JOHN'S
DEPARTMENT OF ENGINEERING

CONCRETE SUPPORT CRADLE

DRAWN BY: C. S. \ R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-223-21



ALUMINUM MANHOLE STEP
TO CSA 257.4-M92

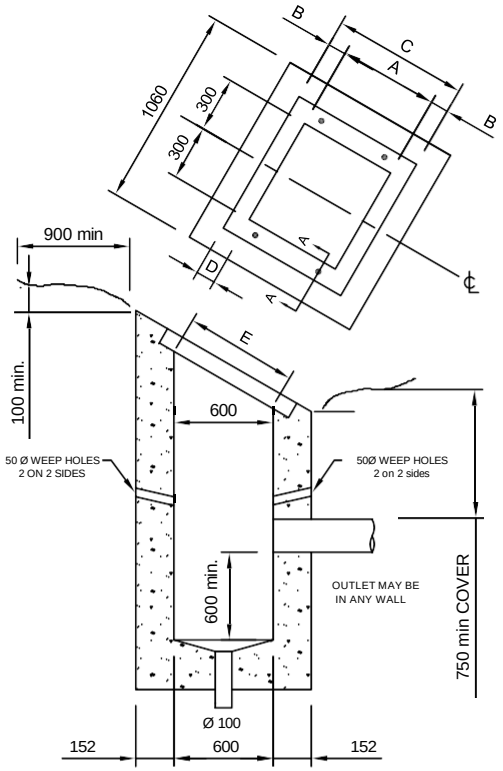


PRE-CAST MANHOLE
JOINT DETAIL

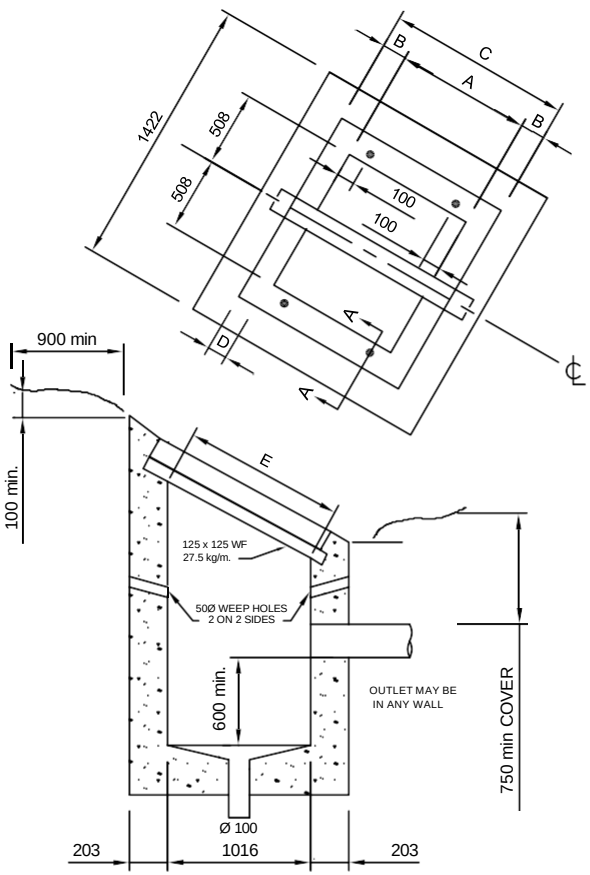
ST. JOHN'S
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MISCELLANEOUS PRE-CAST DETAILS

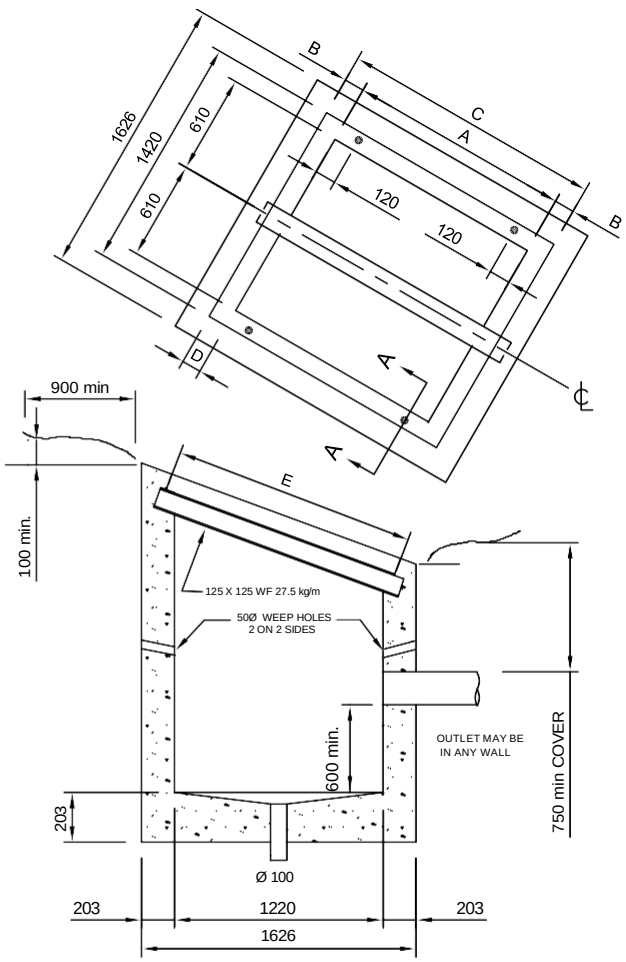
DRAWN BY: C. S. \ R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-223-22



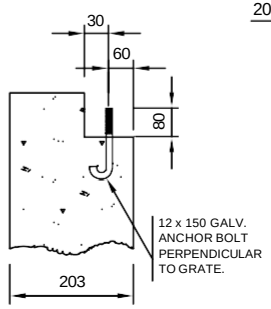
600 x 600 DITCH INLET CATCH BASIN OPENING DIMENSIONS TABLE					
GRATE SLOPE	A	B	C	D	E
2:1	600	95	800	95	610
3:1	600	95	800	60	680
4:1	600	95	800	80	640
6:1	600	95	800	85	630



1000 x 1000 DITCH INLET CATCH BASIN OPENING DIMENSIONS TABLE					
GRATE SLOPE	A	B	C	D	E
2:1	1016	68	1150	68	1015
3:1	1016	68	1150	98	1135
4:1	1016	68	1150	80	1070
6:1	1016	68	1150	93	1045



1200 x 1200 DITCH INLET CATCH BASIN OPENING DIMENSIONS TABLE					
GRATE SLOPE	A	B	C	D	E
2:1	1220	90	1400	90	1220
3:1	1220	90	1400	98	1365
4:1	1220	90	1400	58	1285
6:1	1220	90	1400	71	1258



SECTION A-A

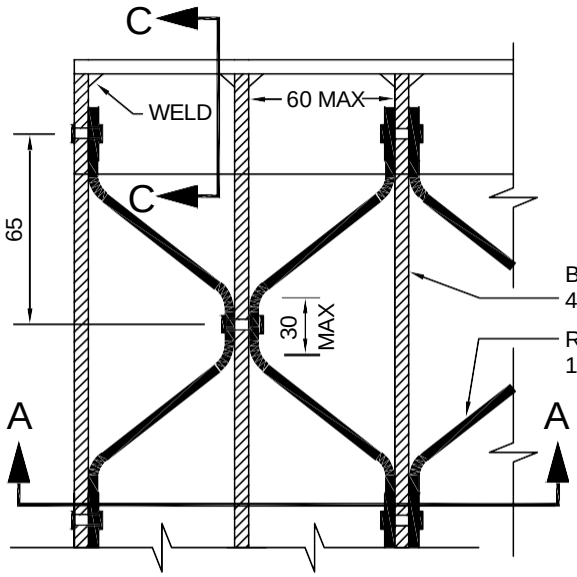
NOTES:

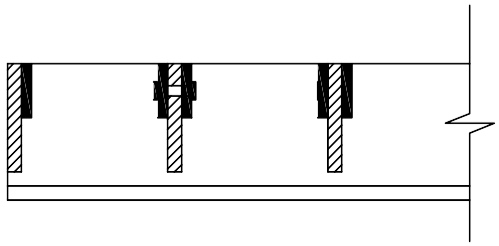
1) POROUS BACK FILL TO BE PLACED TO A MIN. THICKNESS OF 300mm ON ALL SIDES.
2) CONCRETE TO BE 35 MPa TO MEET CSA A23.1, CLASS C-1 EXPOSURE.
3) WEEP HOLES SHALL BE PLACED SO THAT THE TOP OF THE WEEPER ON THE INSIDE AND THE BOTTOM OF THE WEEPER ON THE OUTSIDE ARE LEVEL.
4) WHERE INLET IS PLACED ACROSS DITCH AND IS ACCESSIBLE TO VEHICULAR TRAFFIC GRATING IS TO BE 6 : 1 OR FLATTER.
5) 100 MM DIA. TILE IN POROUS GROUND ONLY, SLOPE BOTTOM AS INDICATED WHEN TILE IS USED.
6) REINFORCING OMITTED FOR CLARITY, ALL PRE-CAST DITCH INLET CATCH BASINS SHALL BE STRUCTURALLY DESIGNED BY PRE-CASTING SUPPLIER.
7) CAST IN PLACE DITCH INLET CATCH BASINS SHALL BE DESIGNED BY PROFESSIONAL ENGINEER.

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DEPARTMENT OF ENGINEERING

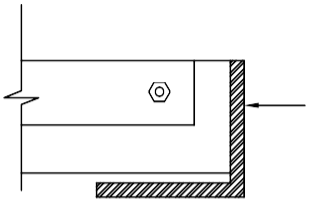
PRE-CAST DITCH INLET CATCH BASINS

DRAWN BY: C. S. \ R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-223-23

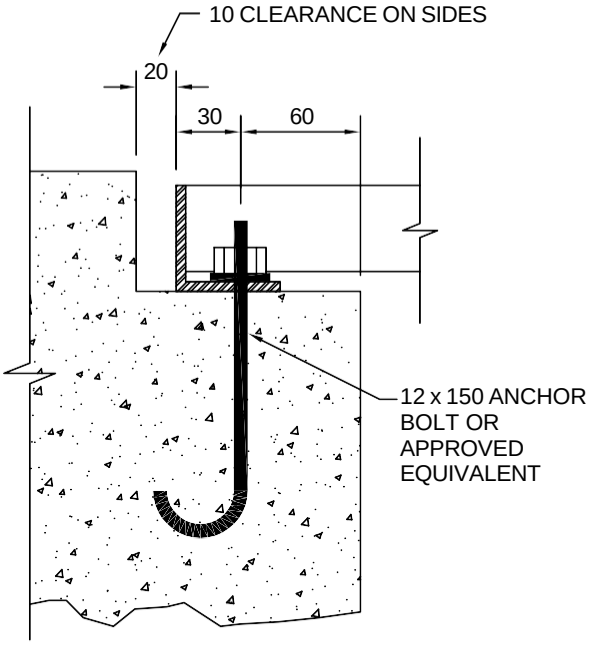




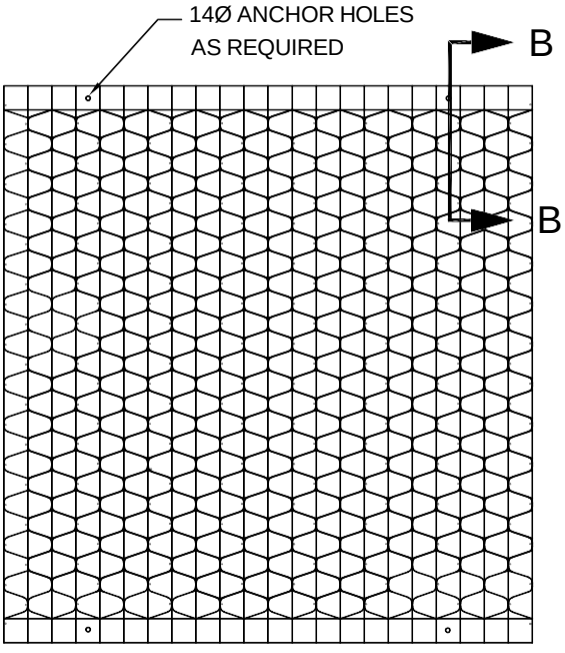
SECTION A-A



SECTION C-C



SECTION B-B



MATERIALS:

BEARING BAR MINIMUM TENSILE STRENGTH SAE-1015
RETICULE BARS MINIMUM TENSILE STRENGTH SAE-1010
RIVETS FLAT HEAD.

FINISH:

ALL SURFACES SHALL BE PAINTED WITH ONE SHOP COAT OF ASPHALT OR TAR BASE BLACK PAINT, HAVING A MINIMUM SOFTENING POINT OF 70°C.

WELDING:

END BEARING BARS TO BE WELDED TO ANGLE BAR ALONG BOTH LEGS WITH A 5mm FILET WELD. STANDARD METAL GRATING INSTITUTE MARKING RF-37-5.
RETICULE BARS MAY BE CRIMPED OR STRAIGHT, MAXIMUM LENGTH OF THE RETICULE BAR PARALLEL TO THE BEARING BAR IS 30 AT EACH RIVET.

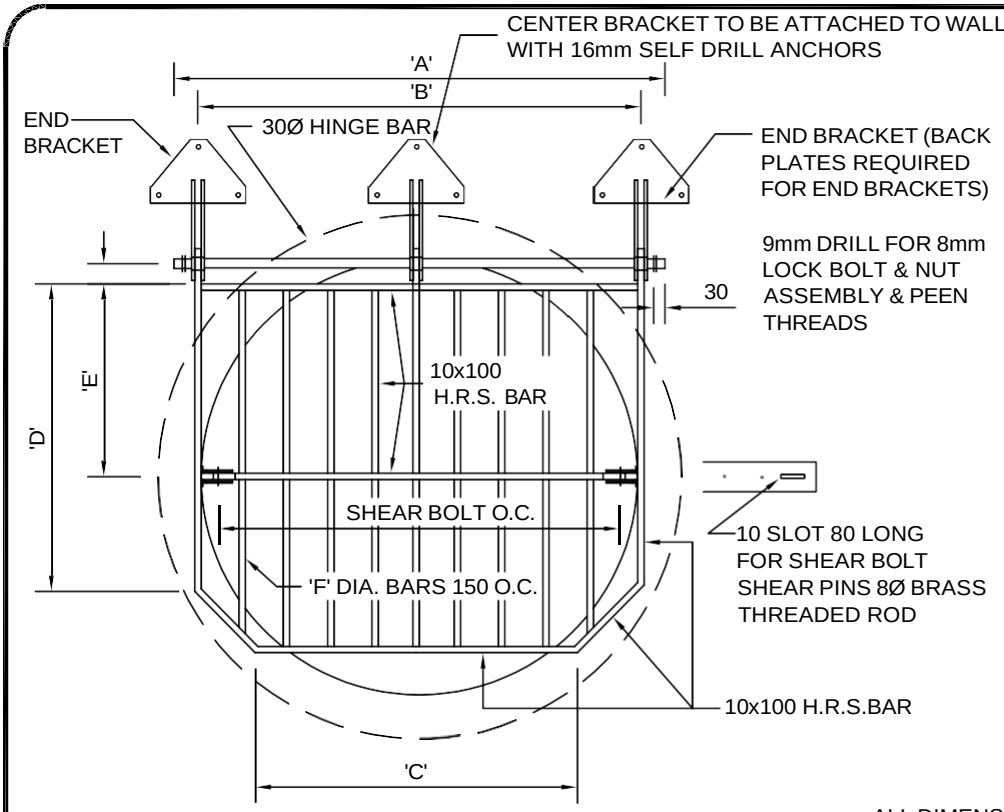
DIMENSIONS:

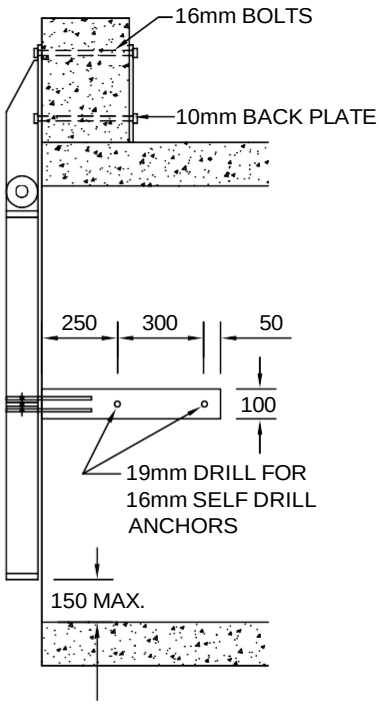
ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED.

ST. JOHN'S
DEPARTMENT OF ENGINEERING

TYPICAL DITCH INLET GRATING DETAIL

DRAWN BY: C. S. \ R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-223-24





ALL DIMENSIONS IN MILLIMETRES

OUTLET SIZE	A	B	C	D	E	F
1350	1500	1350	1150	1025	600	10
1500	1650	1500	1200	1125	675	10
1650	1800	1650	1260	1230	750	10
1800	1950	1800	1320	1335	825	10
2150	2300	2150	1450	1575	1000	20
2450	2600	2450	1550	1775	1150	20
2750	2900	2750	1640	1970	1300	20
3050	3200	3050	1730	2165	1450	30
3350	3500	3350	1820	2410	1600	30
3650	3800	3650	1900	2550	1750	30

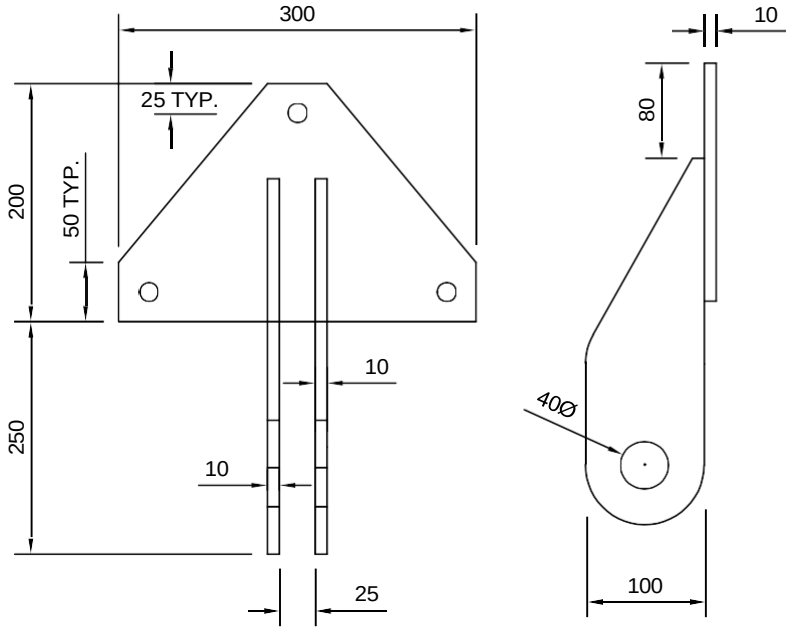
A - HINGE BAR LENGTH
B - GRATE WIDTH
C - BASE WIDTH
D - TOP OF GRATE TO ANGLE
E - TOP OF GRATE TO HORIZONTAL CENTRE
F - DIAMETER OF VERTICAL BARS

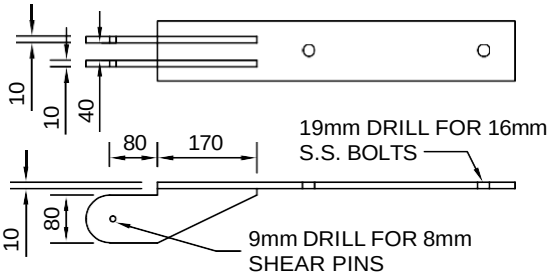
NOTES:
1. ALL STEEL MATERIAL HOT DIP GALVANIZED AFTER FABRICATION.

2. DIMENSIONS FOR 10mm BACK PLATE TO BE THE SAME AS BRACKET.

3. FOR END BRACKET 16mm BOLTS ARE TO BE PLACED THROUGH WALL AND BOLT TO BE A 10mm BACK PLATE.

CENTER BRACKET TO BE USED WHEN OUTLET SIZE IS 1500mm OR GREATER. TO ASSEMBLE CENTER BRACKET TO WALL USE 16mm SELF DRILL ANCHORS THROUGHOUT WITH 16mm STAINLESS STEEL STUDS, NUTS AND WASHERS. TACKWELD HEAD OF NUTS, STUDS AND WASHERS ON COMPLETION TO PREVENT REMOVAL.

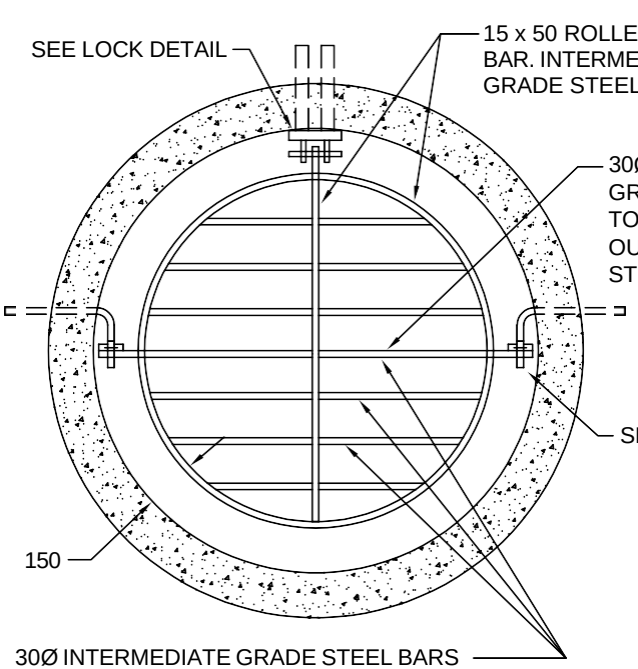


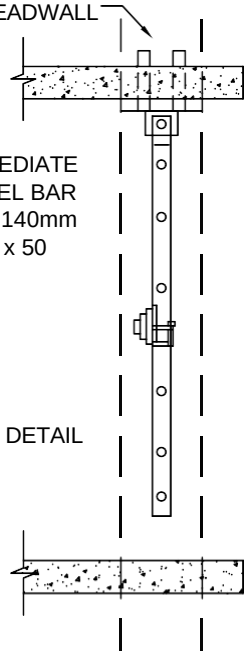


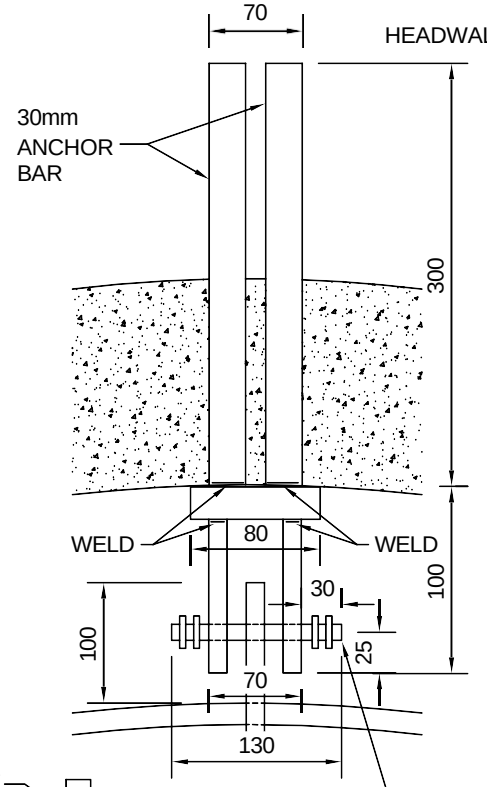
ST. JOHN'S
DEPARTMENT OF ENGINEERING

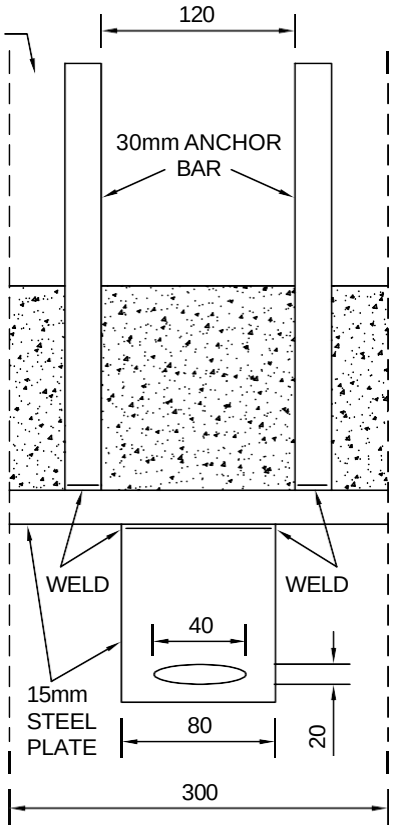
SWING GRATE FOR STORM OUTLETS 1350Ø TO 3650Ø

DRAWN BY: C. S. \ R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-223-25

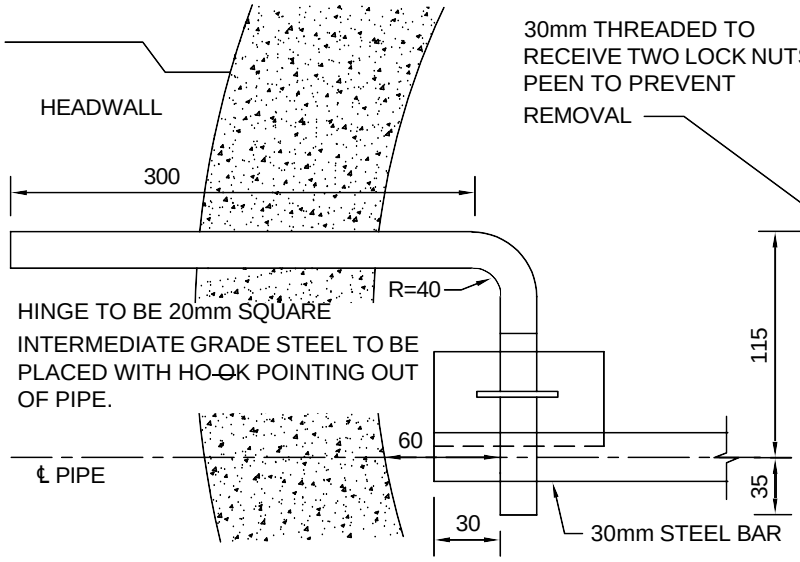


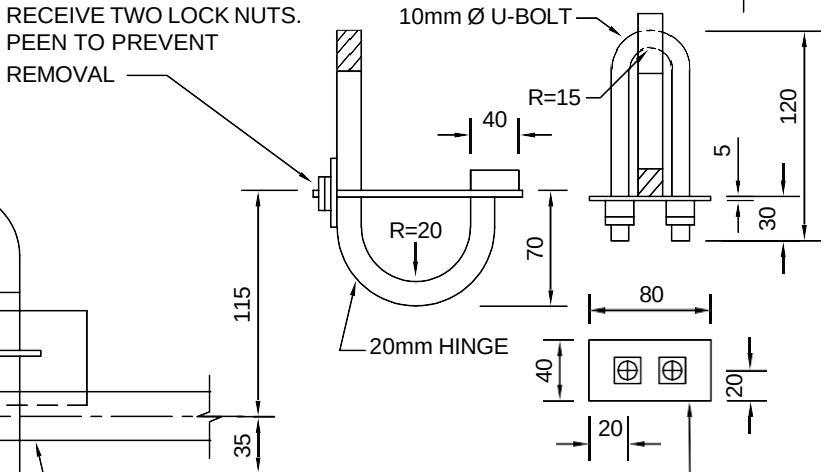






15Ø ROUND BRASS SHEAR PIN THREADED ON EACH END TO RECEIVE TWO NUTS. PEEN ENDS TO PREVENT REMOVAL





HINGE DETAIL

LOCK DETAIL

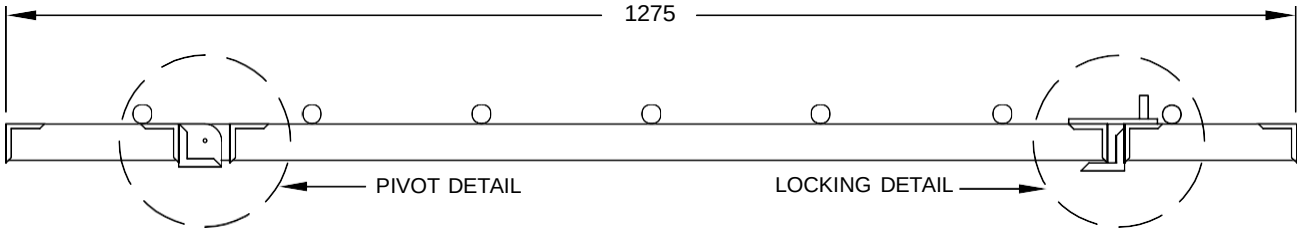
ALL DIMENSIONS IN MILLIMETRES

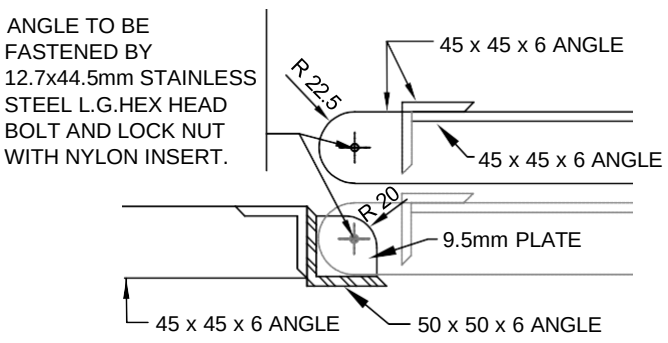
NOTE:
1. GROUT TO BE A FAST DRYING WATERPROOF EPOXY CEMENT.
2. ALL STEEL MATERIAL TO BE HOT DIP GALVANIZED AFTER FABRICATION.

ST. JOHN'S
DEPARTMENT OF ENGINEERING

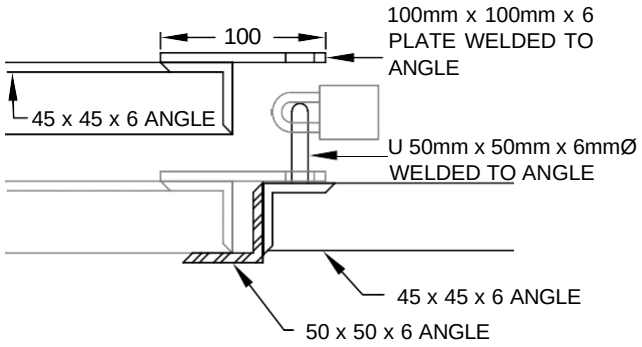
SWING GRATE FOR STORM INLETS
1350Ø TO 3650Ø

DRAWN BY:	C. S. \ R.W.	DATE:	JANUARY 2022	SCALE:	N.T.S.	DRAWING No.	10-223-26

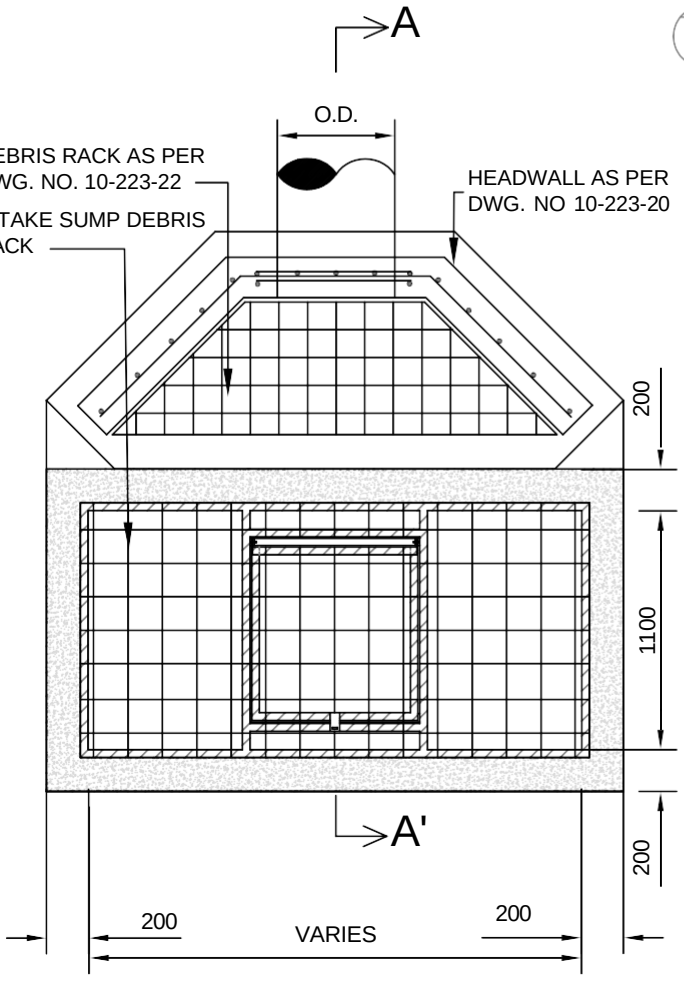




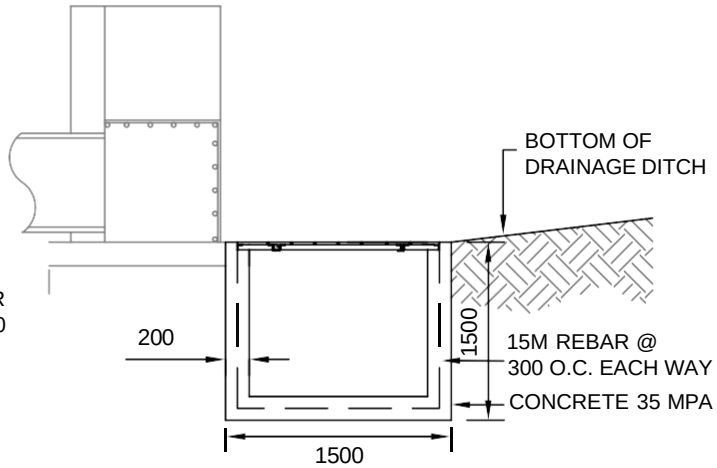
PIVOT DETAILS



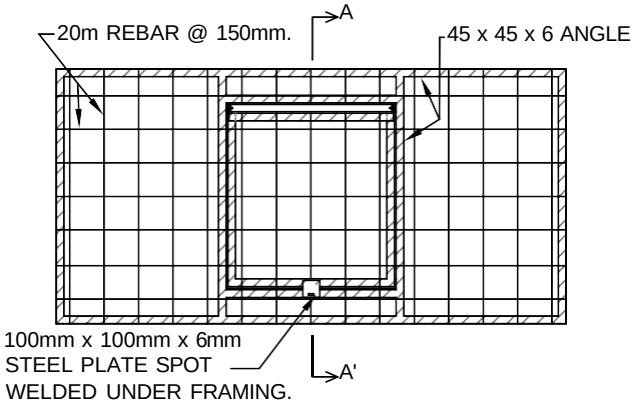
LOCKING DETAILS



PLAN VIEW



SECTION A - A'



NOTES:

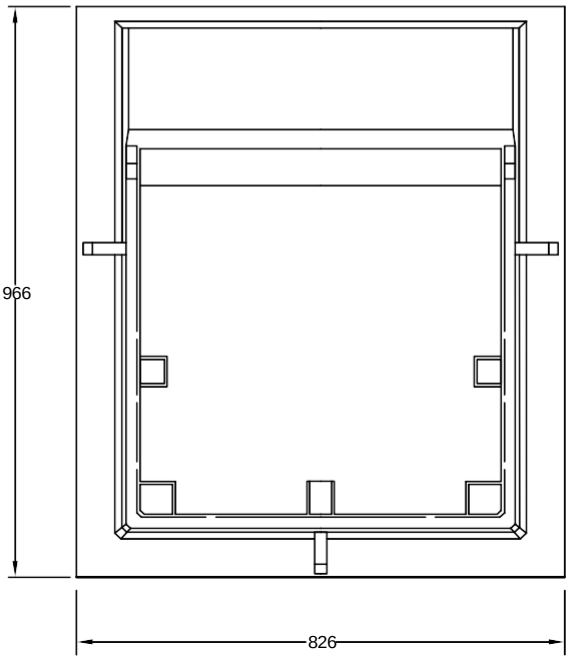
1. ALL JUNCTIONS TO BE SPOT WELDED.
2. USE 100mm x 100mm STEEL HINGES (6mm THICK) SPOT WELDED TO ANGLE.
3. ALL EXPOSED METAL TO BE HOT DIPPED GALVANIZED.
4. RACK TO BE ATTACHED USING 16mm ANCHORS & BOLTS AT 300mm SPACING.

PLAN VIEW

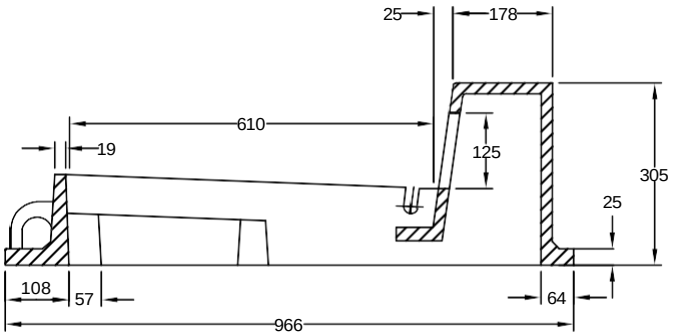
ST. JOHN'S
DEPARTMENT OF ENGINEERING

CUT OFF BERM - INTAKE SUMP DETAILS

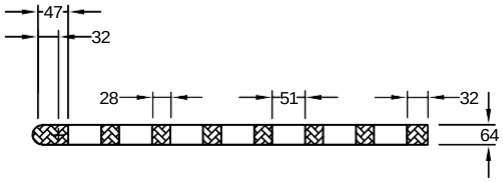
DRAWN BY:	WOK	DATE:	JANUARY 2022	SCALE:	N.T.S.	DRAWING No.	10-223-27

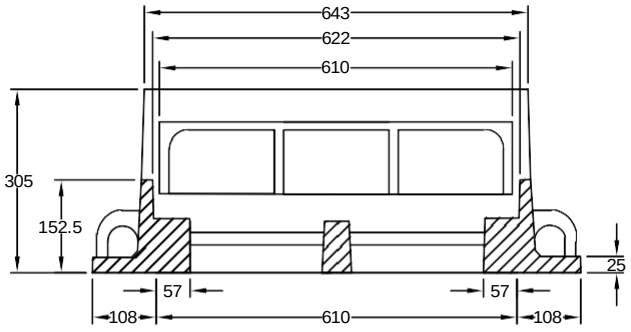


FRAME PLAN

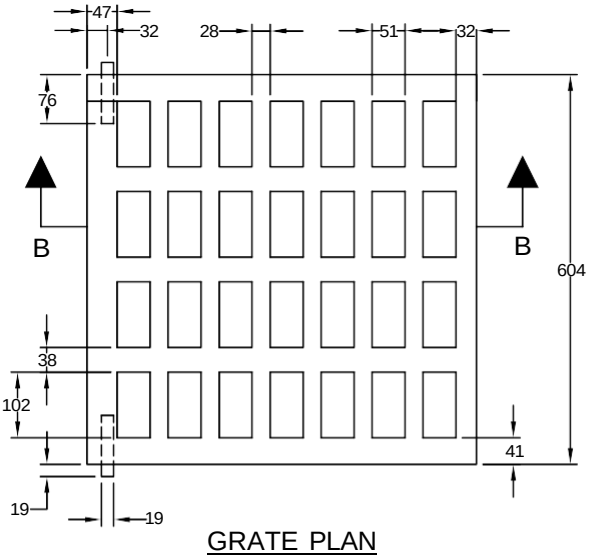


SECTION A-A





SECTION B-B



GRATE PLAN

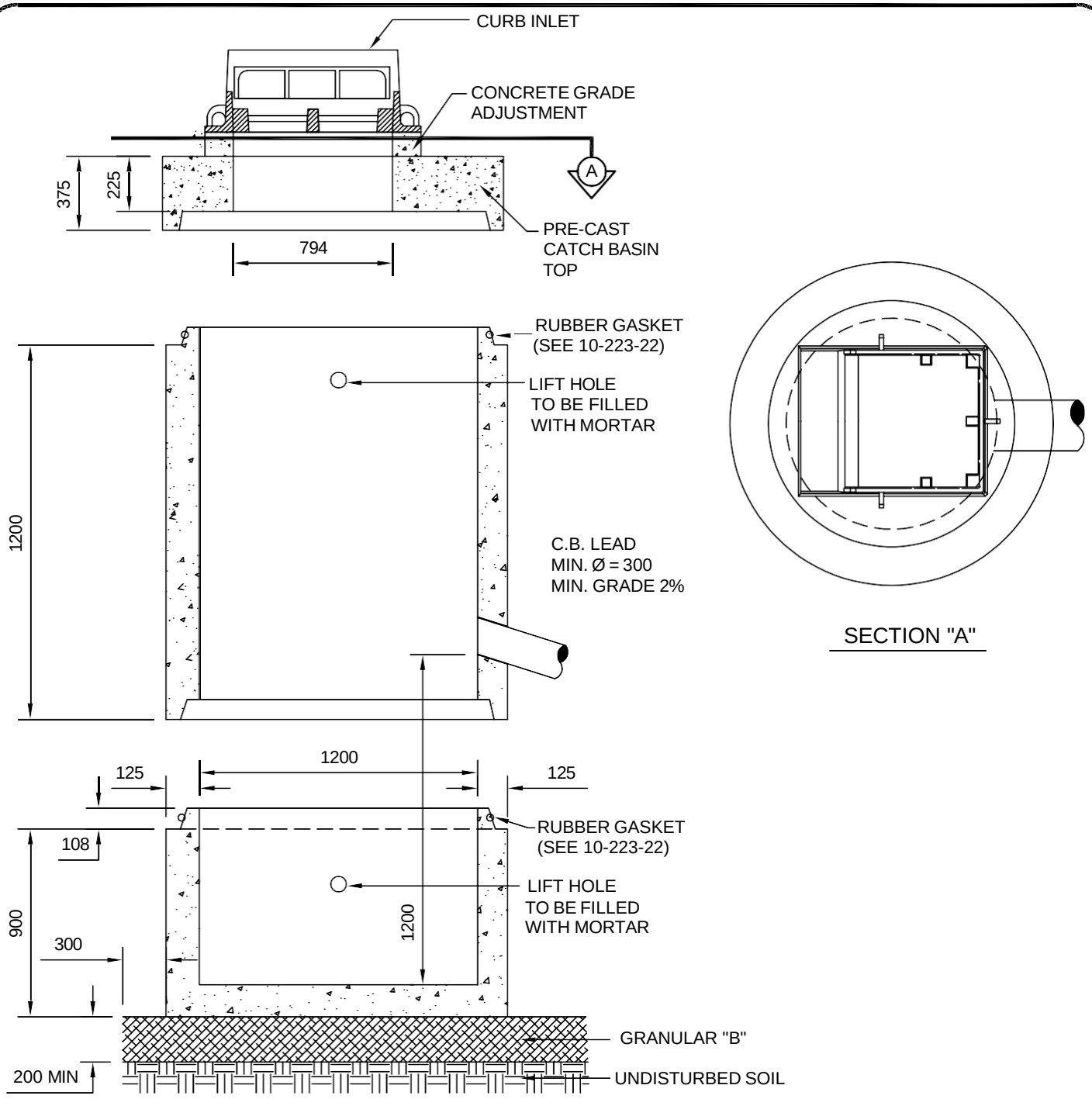
NOTE:
ALL DIMENSIONS ARE IN MILLIMETRES
UNLESS OTHERWISE SHOWN.

LOAD TESTED
ASTM A-48 GREY IRON
CLASS 30

ST. JOHN'S
CORPORATE INFORMATION SERVICES

CATCH BASIN FRAME AND GRATE WITH CURB INLET

DRAWN BY: R.W.	DATE: FEB. 2025	SCALE: N.T.S	DRAWING No. 10-223-28



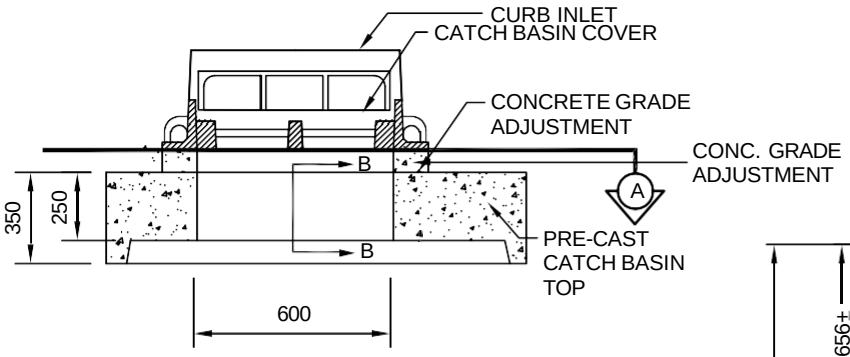
NOTES:

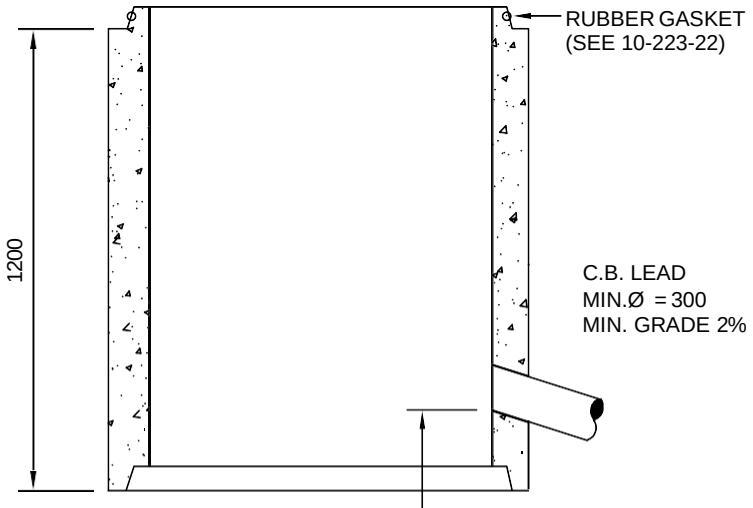
1. CONCRETE TO BE 35MPa TO MEET CSA A23.1, CLASS C-1 EXPOSURE
2. SEE NOTE 2 ON DRAWING 10-223-05
3. SEE NOTE 10 ON DRAWING 10-223-05
4. CATCHBASIN GRATING SHALL BE DEPRESSED 30mm BELOW GUTTER GRADE.
5. LIFT HOLES ARE TO BE PARTIALLY THROUGH MANHOLE FROM OUTSIDE. HOLES TO BE GROUT FILLED BEFORE BACKFILLING.
6. MINIMUM SUMP DEPTH 1200mm.
7. REINFORCING OMITTED FOR CLARITY. PRE-CASTING MANUFACTURER TO PROVIDE STRUCTURAL DESIGN.

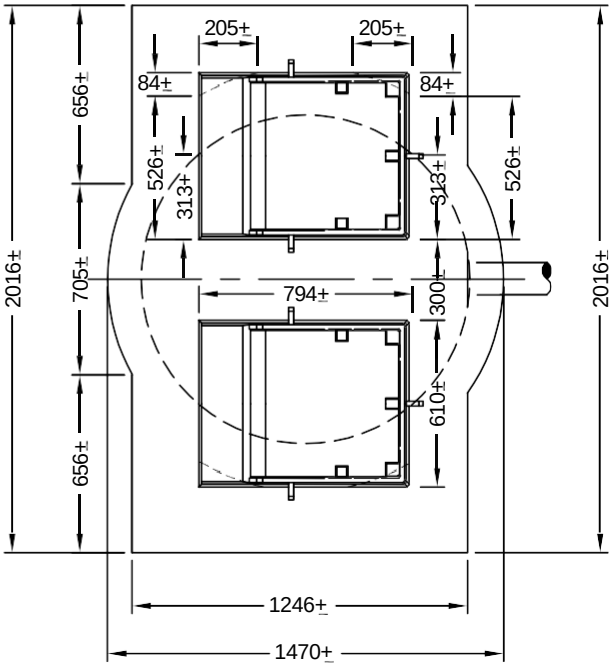
ST. JOHN'S
DEPARTMENT OF ENGINEERING

PRE-CAST SINGLE CURB INLET CATCH BASIN

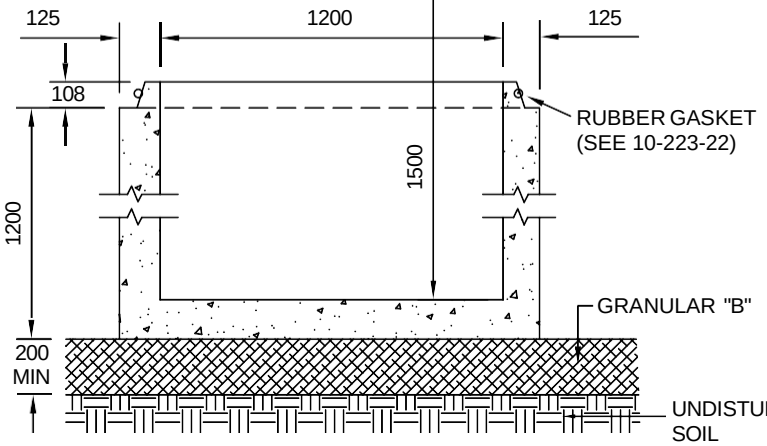
DRAWN BY: C. S. \ R.W.	DATE: FEB. 2025	SCALE: N.T.S.	DRAWING No. 10-223-29



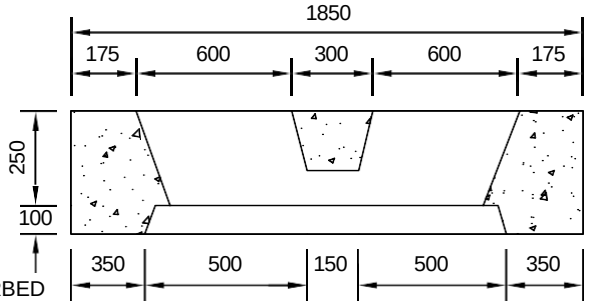




SECTION A



TYPICAL X-SECTION



SECTION B-B

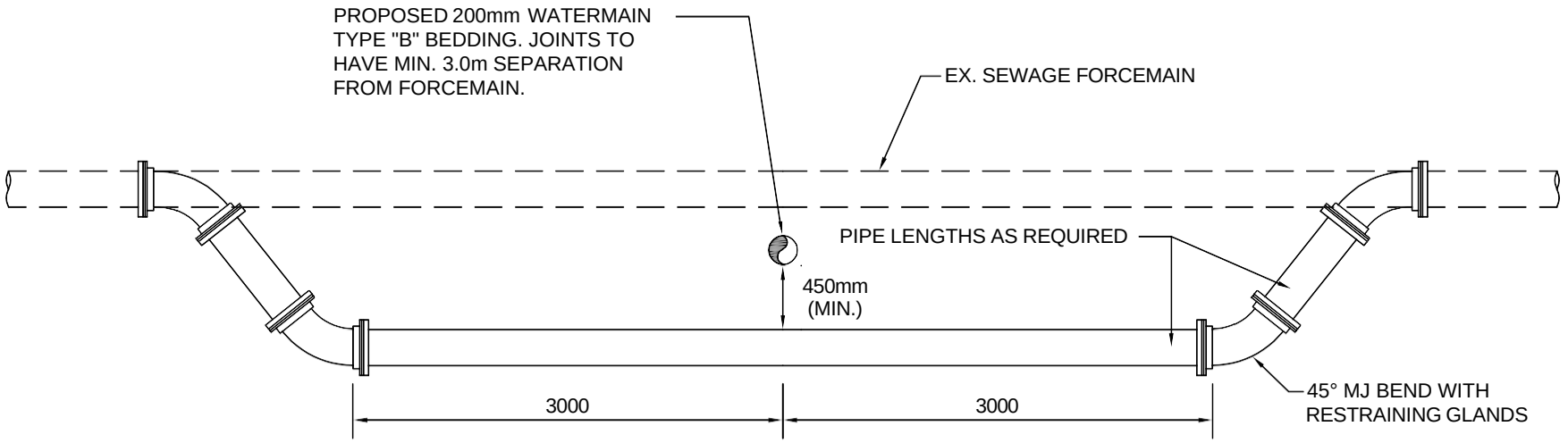
NOTES:

1. CONCRETE TO BE 35MPa TO MEET CSA A23.1, CLASS C-1 EXPOSURE
2. SEE NOTE 2 ON DRAWING 10-223-05
3. SEE NOTE 10 ON DRAWING 10-223-05
4. CATCHBASIN GRATING SHALL BE DEPRESSED 30mm BELOW GUTTER GRADE.
5. LIFT HOLES ARE TO BE PARTIALLY THROUGH MANHOLE FROM OUTSIDE. HOLES TO BE GROUT FILLED BEFORE BACKFILLING.
6. MINIMUM SUMP DEPTH 1500mm.
7. REINFORCING OMITTED FOR CLARITY. PRE-CASTING MANUFACTURER TO PROVIDE STRUCTURAL DESIGN.

ST. JOHN'S
DEPARTMENT OF ENGINEERING

PRE-CAST DOUBLE CURB INLET CATCH BASIN

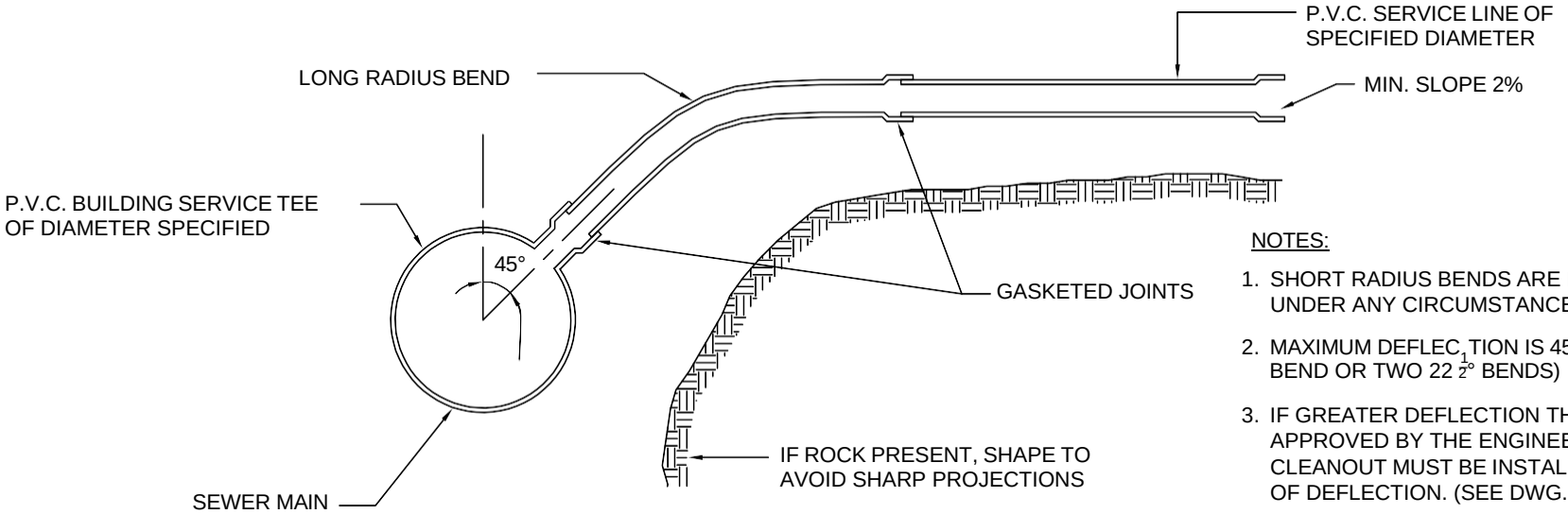
DRAWN BY: C. S. \ R.W.	DATE: FEB. 2025	SCALE: N.T.S.	DRAWING No. 10-223-30



ST. JOHN'S
DEPARTMENT OF ENGINEERING

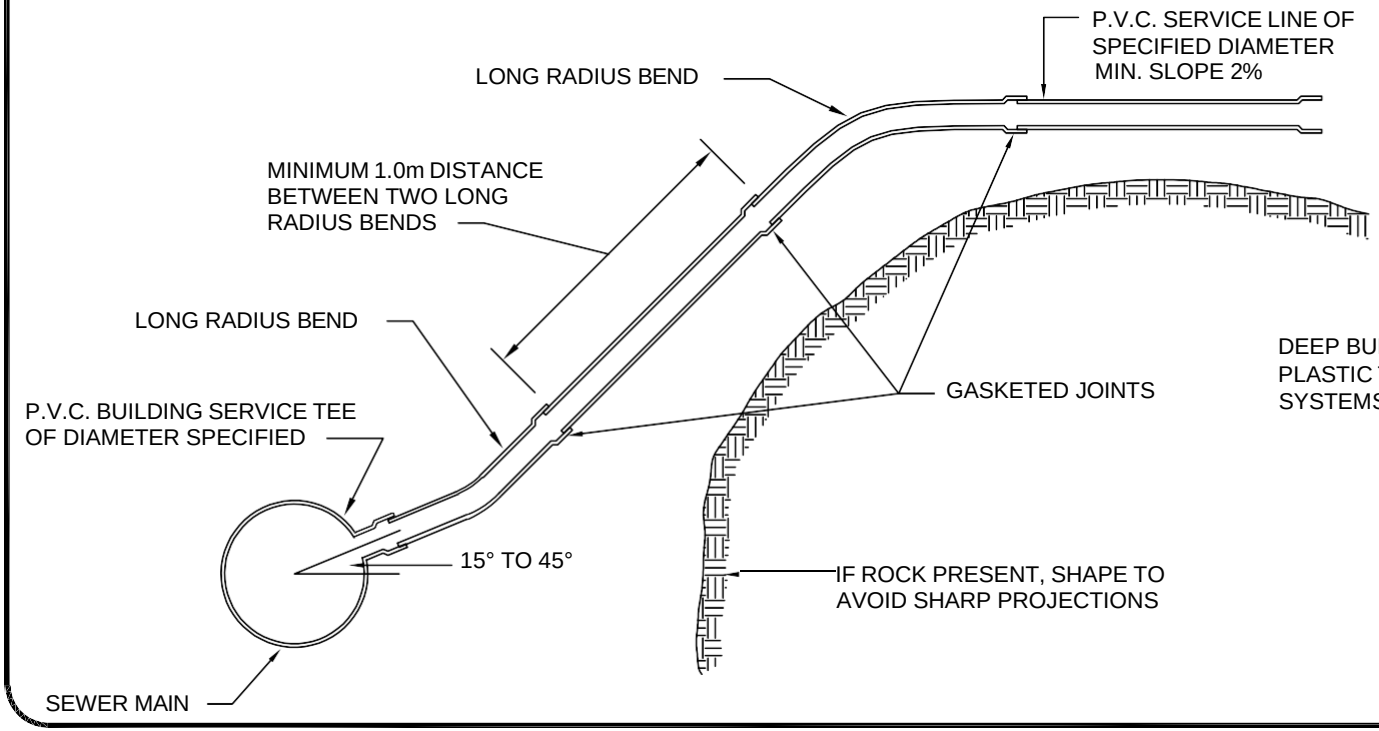
FORCEMAIN CROSSING

DRAWN BY: C. S. \ R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-224-01

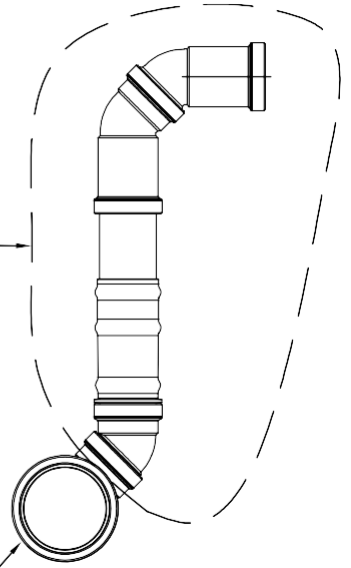


NOTES:

1. SHORT RADIUS BENDS ARE NOT PERMITTED UNDER ANY CIRCUMSTANCES.
2. MAXIMUM DEFLECTION IS 45°. (ONE 45° BEND OR TWO 22 $\frac{1}{2}$° BENDS)
3. IF GREATER DEFLECTION THEN 45° IS APPROVED BY THE ENGINEER THEN A CLEANOUT MUST BE INSTALLED UPSTREAM OF DEFLECTION. (SEE DWG. 10-225-03)
4. THE REQUIREMENTS OF THIS PLAN MUST BE FOLLOWED FOR THE FULL LENGTH OF THE SERVICE LATERAL, FROM THE BUILDING TO THE POINT OF CONNECTION TO THE PUBLIC MAINS.



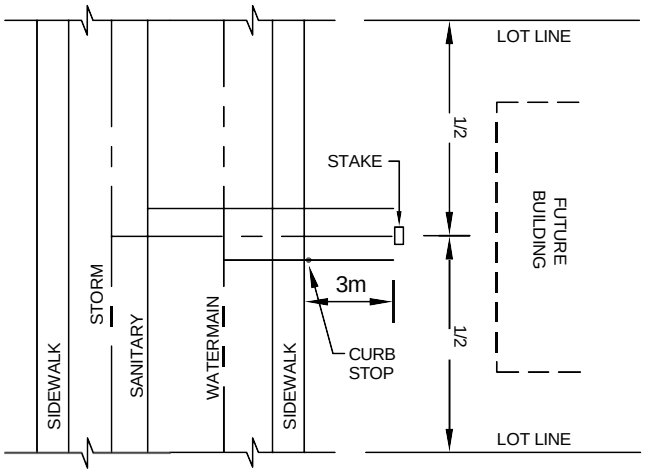
DEEP BURIAL SYSTEM
PLASTIC TRENDS ROYAL PIPE SYSTEMS OR APPROVED EQUAL



ST. JOHN'S
DEPARTMENT OF ENGINEERING

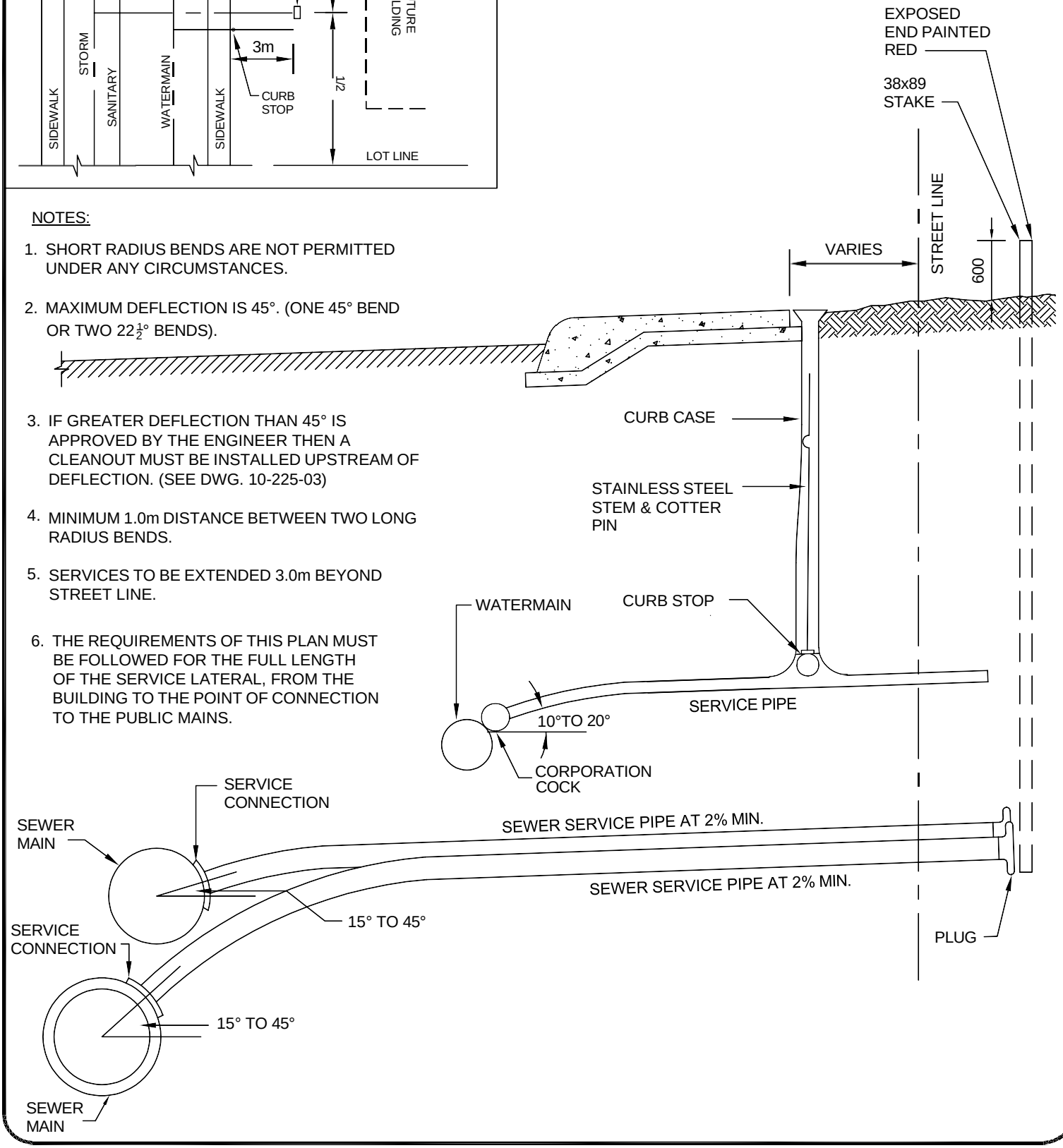
BUILDING SERVICE CONNECTIONS (DEEP SEWER)

DRAWN BY:	C.S. \ R.W.	DATE:	JANUARY 2022	SCALE:	N.T.S.	DRAWING No.	10-225-01



NOTES:

1. SHORT RADIUS BENDS ARE NOT PERMITTED UNDER ANY CIRCUMSTANCES.
2. MAXIMUM DEFLECTION IS 45°. (ONE 45° BEND OR TWO 22½° BENDS).
3. IF GREATER DEFLECTION THAN 45° IS APPROVED BY THE ENGINEER THEN A CLEANOUT MUST BE INSTALLED UPSTREAM OF DEFLECTION. (SEE DWG. 10-225-03)
4. MINIMUM 1.0m DISTANCE BETWEEN TWO LONG RADIUS BENDS.
5. SERVICES TO BE EXTENDED 3.0m BEYOND STREET LINE.
6. THE REQUIREMENTS OF THIS PLAN MUST BE FOLLOWED FOR THE FULL LENGTH OF THE SERVICE LATERAL, FROM THE BUILDING TO THE POINT OF CONNECTION TO THE PUBLIC MAINS.

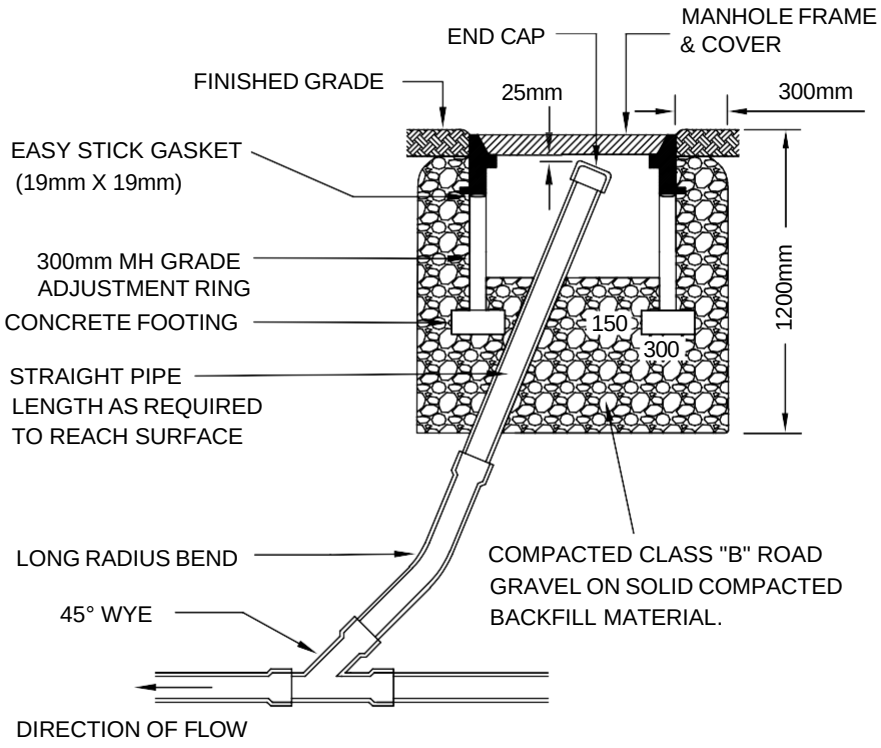


ST. JOHN'S
DEPARTMENT OF ENGINEERING

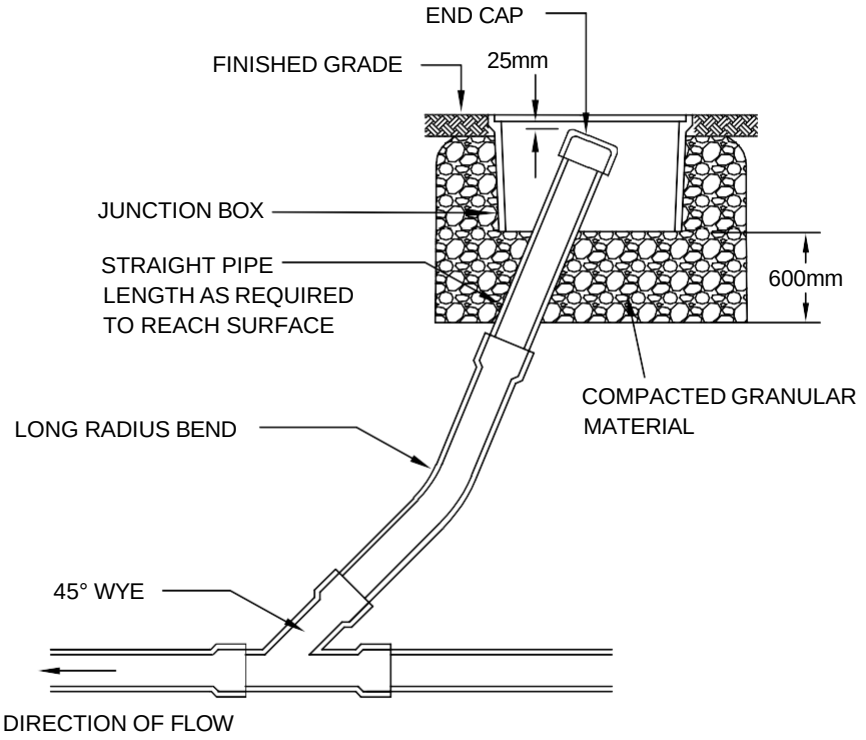
HOUSE SERVICES

DRAWN BY: C. S. \ R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-225-02

CLEAN OUT IN ASPHALT



CLEAN OUT IN SIDEWALK OR GRASS USING A PREFAB JUNCTION BOX (DWG# 10-802-05)



NOTES:

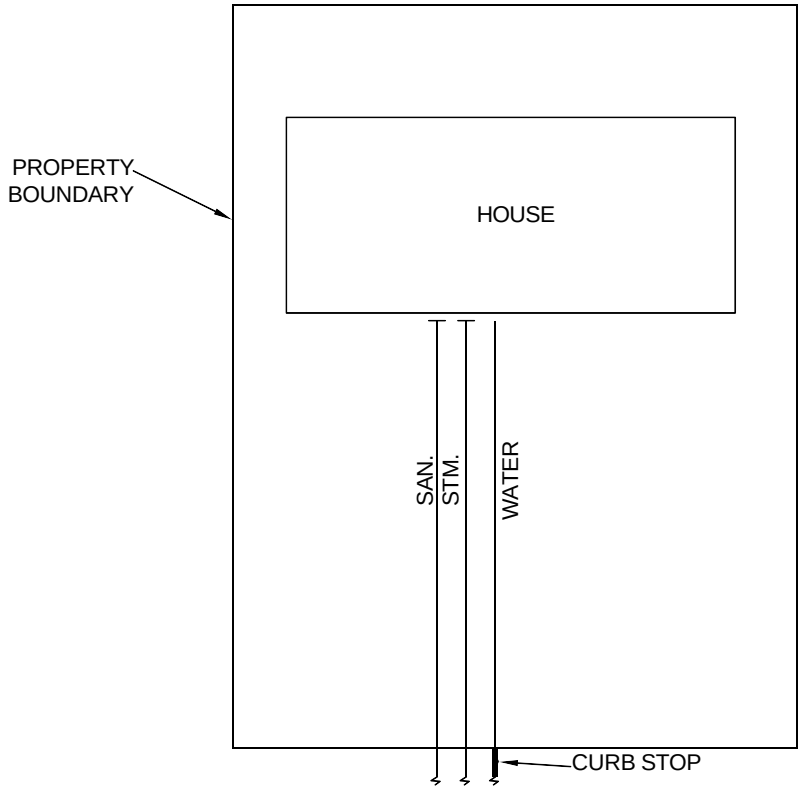
1. TOP OF BOX TO BE PLACED FLUSH WITH TOP OF SIDEWALK OR FINAL GRADE.
2. COVER TO HAVE NO LOGO ON IT (PG1324HA0009).
3. BOX (PG1324BA12) AS MANUFACTURED BY QUAZITE COMPOSITE OR APPROVED EQUAL.

ST. JOHN'S
DEPARTMENT OF ENGINEERING

CLEAN OUT DETAILS

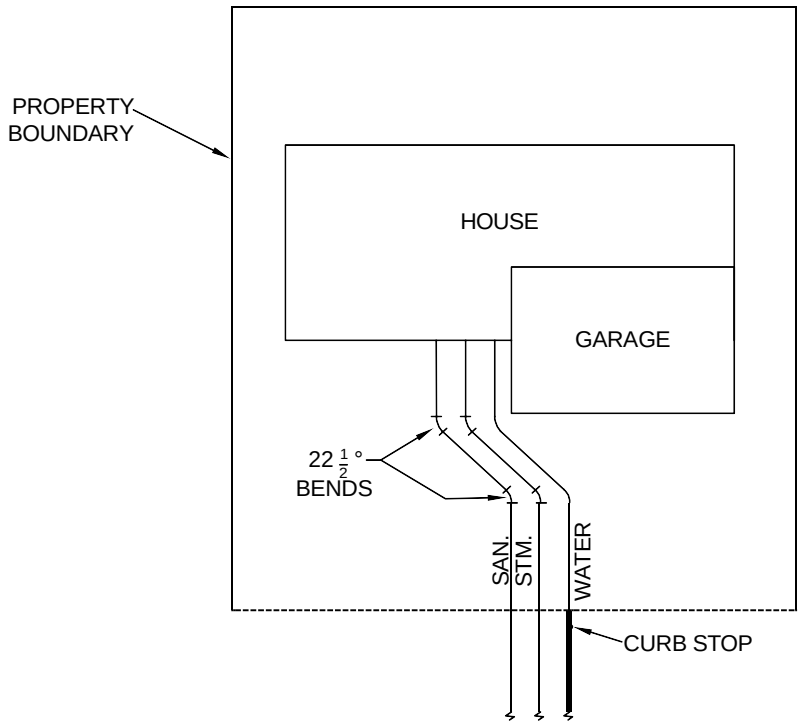
DRAWN BY:	C.S. \ R.W.	DATE:	JANUARY 2022	SCALE:	N.T.S.	DRAWING No.	10-225-03

1



STANDARD CONDITIONS

2



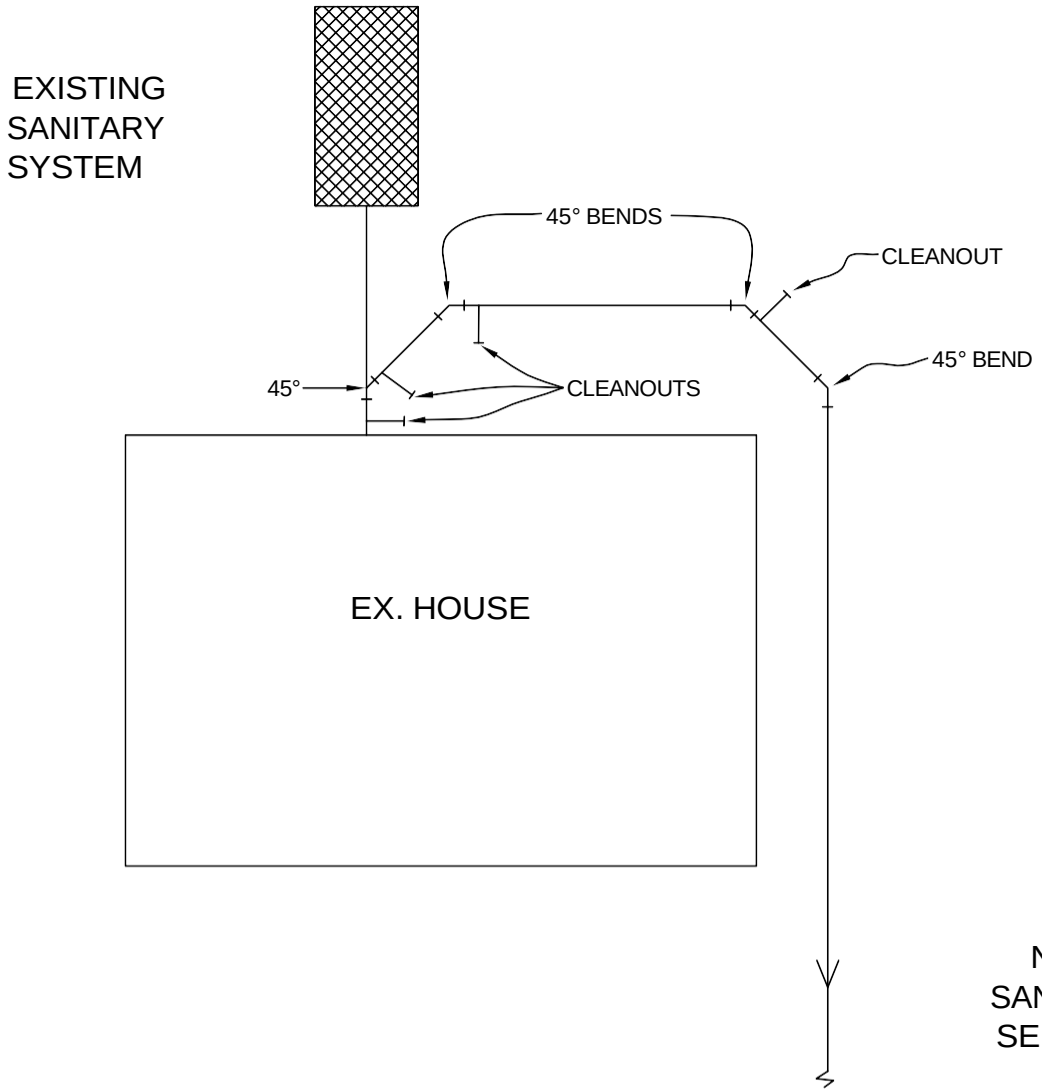
2 - 22 ½ ° LRB ALLOWED WITHOUT A CLEANOUT (PER PIPE)

LESS THAN 45° CHANGE

ST. JOHN'S
DEPARTMENT OF ENGINEERING
SPECIFICATIONS BOOK

HOUSE SERVICES (INSIDE PROPERTY BOUNDARIES)

DRAWN BY: P.H.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-225-04

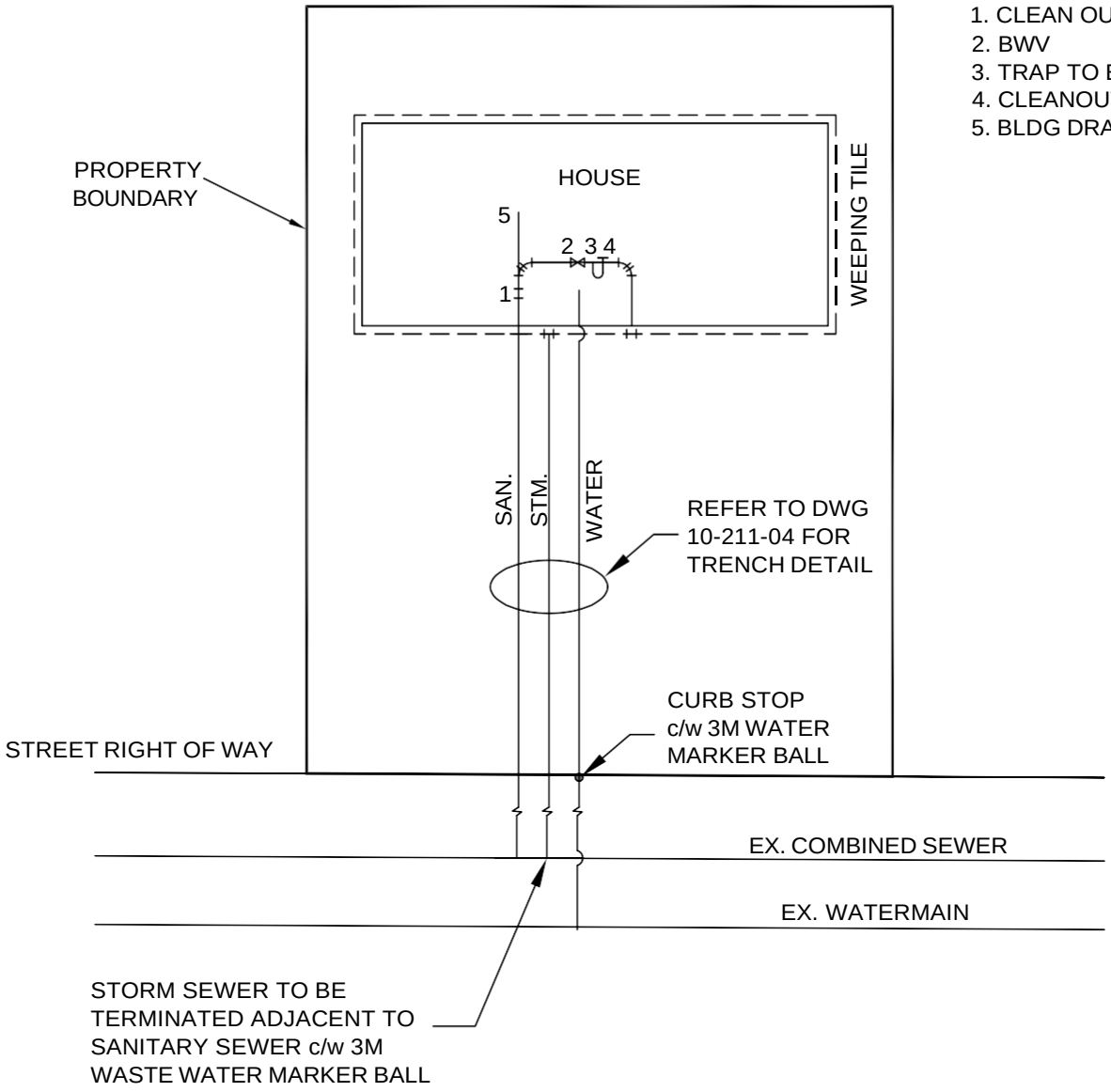


NOTES:

1.) No. 90° BENDS ALLOWED.

2.) INSTALL CLEANOUT AFTER 1 m (MIN.) SECTION OF STRAIGHT PIPE. (WORKING FROM STREET IN) AFTER EVERY 45° BEND. SEE 10-225-03

3.) ALL BENDS TO BE LONG RADIUS.



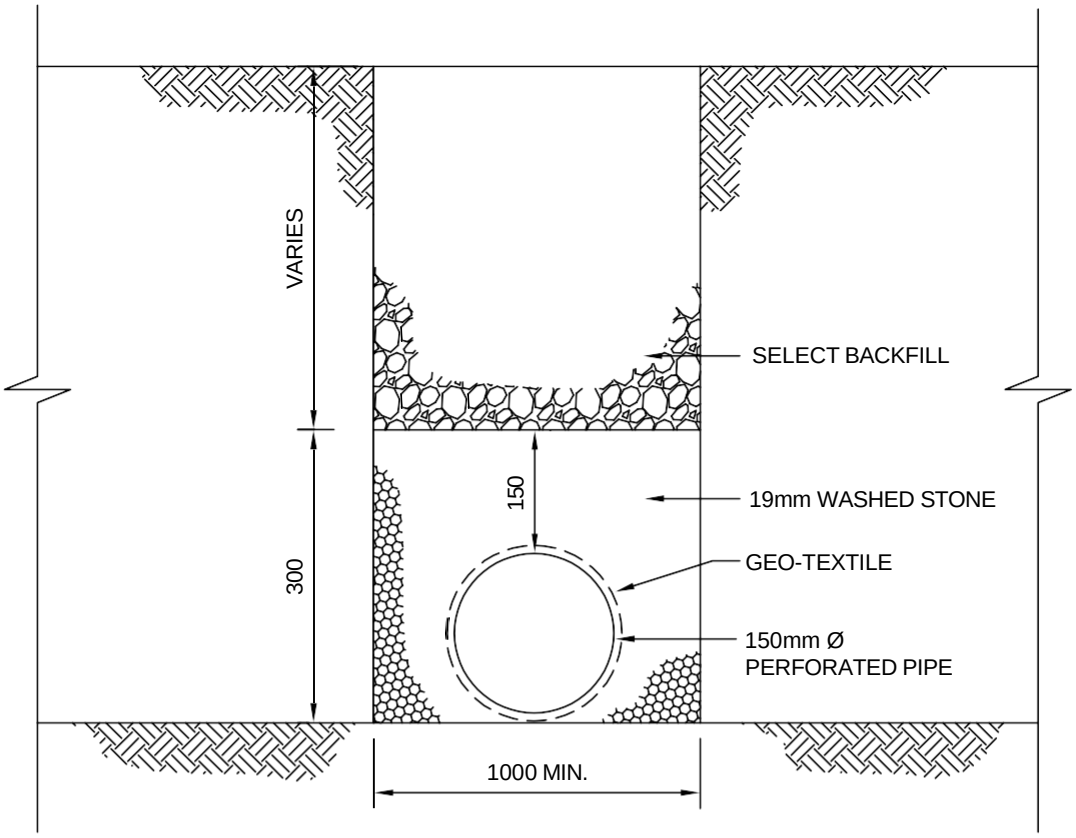
NOTES:

1. PERMIT TO CONNECT FOR THIS METHOD OF STORM SEWER CONNECTION SHALL ONLY BE APPROVED IF THERE IS SUFFICIENT CAPACITY IN THE EXISTING SANITARY SEWER AS DETERMINED BY THE ENGINEERING DEPARTMENT.
2. WEEPING TILE SHALL BE CONNECTED TO THE SANITARY SEWER INSIDE OF THE BUILDING BY MEANS OF A PRIMED TRAP C/W A CLEANOUT, THEN AN APPROVED BACKWATER VALVE SHALL BE INSTALLED.
3. STORM SEWER SERVICE SHALL BE CONNECTED TO THE WEEPING TILE AT THE BUILDING AND LEFT OPEN ADJACENT TO THE EXISTING COMBINED SEWER. THE OPEN END OF THE PIPE SHALL BE PROTECTED BY WRAPPING GEO-TEXTILE AROUND THE END OF THE PIPE AND SECURING USING A SUITABLE METHOD.
4. FULL TIME INSPECTION BY THE CITY OF THE INSTALLATION OF GEO-TEXTILE AND WASHED STONE DETAIL IS REQUIRED. THE CONTRACTOR SHALL CONTACT THE CITY TO ARRANGE THE NECESSARY INSPECTION.
5. THE INTERNAL HOUSE PLUMBING IS SUBJECT TO THE INSPECTION AND APPROVAL OF THE CITY BUILDING DIVISION.
6. MARKER BALLS TO BE PURCHASED BY THE CONTRACTOR, AND PROGRAMMED BY THE CITY OF ST. JOHN'S - ENVIROMENTAL SERVICES DIVISION, BEFORE INSTALLATION

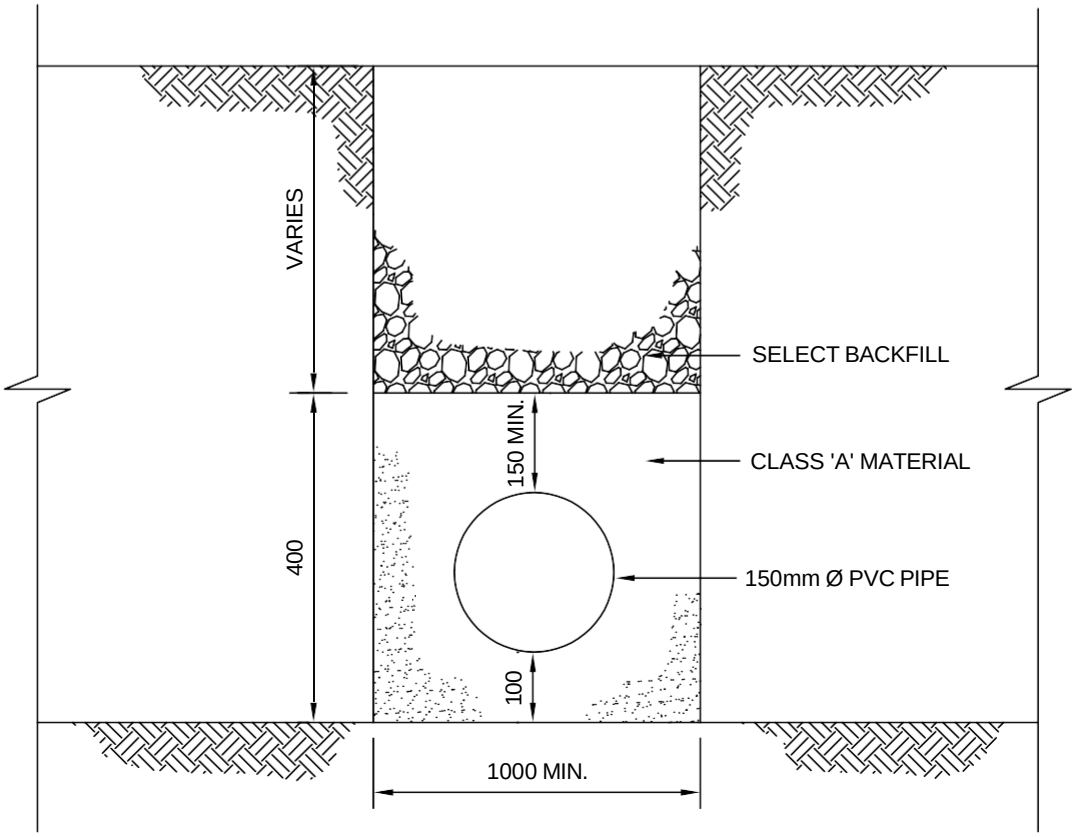
ST. JOHN'S
DEPARTMENT OF ENGINEERING
SPECIFICATIONS BOOK

HOUSE SERVICES (INFILL PROPERTIES ONLY)

DRAWN BY: R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-225-06



WITH GEO-TEXTILE

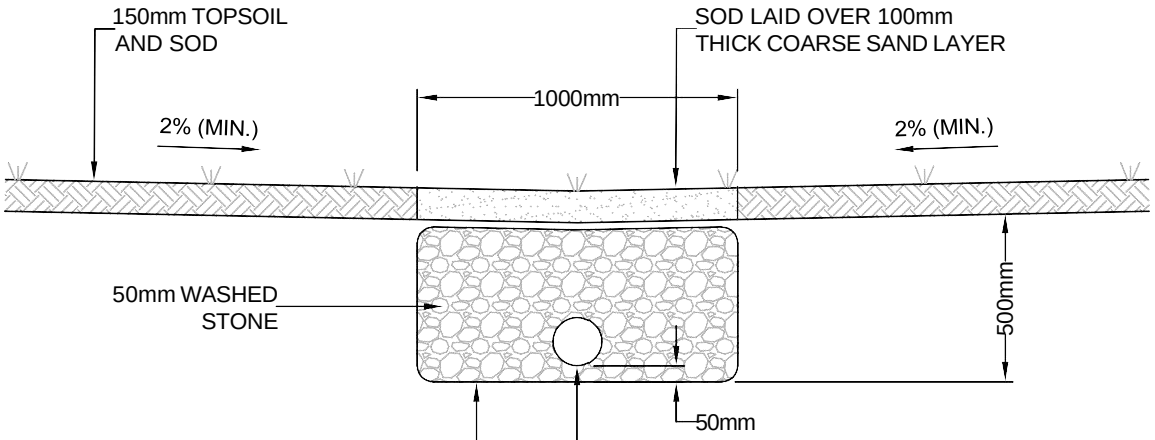


WITHOUT GEO-TEXTILE

ST. JOHN'S
DEPARTMENT OF ENGINEERING

SUB-DRAIN PIPE (WITH & WITHOUT GEO-TEXTILE)

DRAWN BY: C.S. \ R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-226-01



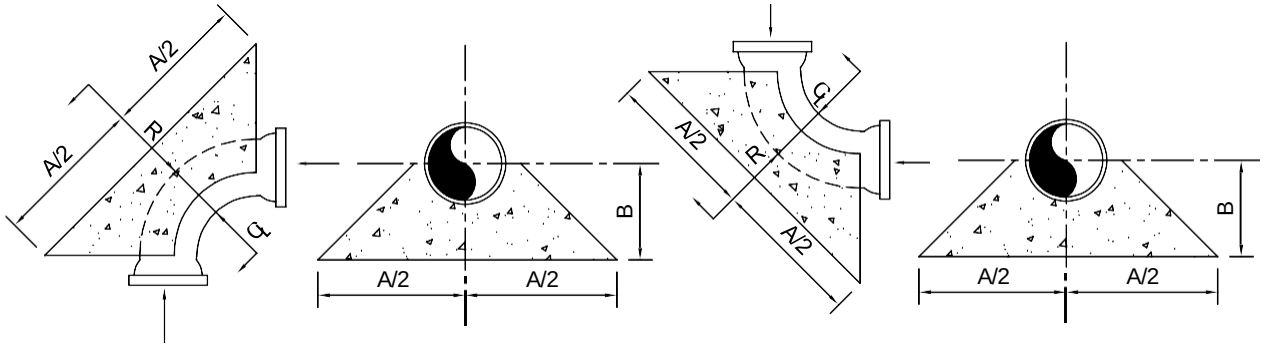
NOTE:
THIS IS THE MINIMUM REQUIREMENT FOR A FRENCH DRAIN.
DEPTHS AND WIDTHS MAY VARY DEPENDING ON THE
APPLICATION AND SITE CONDITIONS.

ST. JOHN'S
CORPORATE INFORMATION SERVICES

FRENCH DRAIN

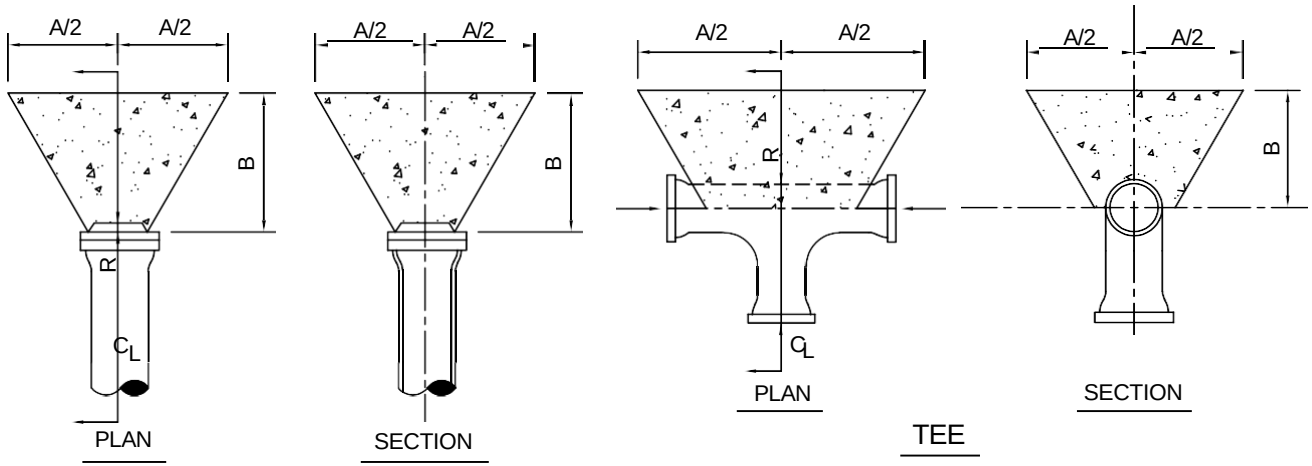
DRAWN BY: S.P.	DATE: JANUARY 2022	SCALE: N.T.S	DRAWING No. 10-226-02

NOMINAL DIA. (mm)	EFFECTIVE AREA (m^2)	BENDS — HORIZONTAL & VERTICAL — UP																				TEE & DEAD END				
		90°					45°					22.5°					11.25°									
		R	b AREA	A	B	CONC	R	b AREA	A	B	CONC	R	b AREA	A	B	CONC	R	b AREA	A	B	CONC	R	b AREA	A	B	CONC
100	.012	1.74	.14	375	300	.04	.94	.08	300	300	.04	.37	.03	300	300	.04	.24	.02	300	300	.04	1.23	.10	375	450	.04
150	.024	3.61	.30	525	300	.04	1.95	.16	450	300	.04	1.00	.08	300	300	.04	.50	.04	300	300	.04	2.55	.21	450	450	.04
200	.042	6.21	.51	750	450	.19	3.36	.27	525	450	.04	1.71	.14	375	450	.04	.86	.07	300	450	.04	4.39	.36	600	450	.08
250	.063	9.21	.75	900	450	.19	5.03	.41	675	450	.08	2.61	.21	450	450	.04	1.29	.11	375	450	.04	6.58	.54	750	450	.19
300	.088	13.24	1.09	1100	450	.38	7.12	.58	750	450	.19	3.65	.30	525	450	.04	1.84	.15	375	450	.04	9.34	.76	900	525	.19



HORIZONTAL BEND

VERTICAL BEND UP



DEAD END

TEE

ABBREVIATIONS

R	- REACTION IN 1000 Kg.
b AREA	- MINIMUM BEARING AREA AT SOIL TO CONCRETE FACE IN m^2.
CONC	- VOLUME OF CONCRETE IN m^3.
A & B	- DIMENSION OF CONCRETE IN mm UNLESS OTHERWISE NOTED.

NOTES:

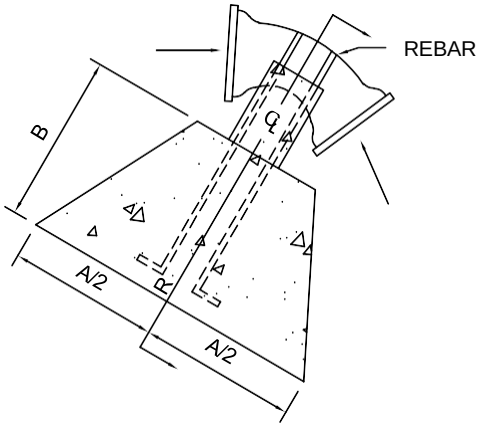
1. CONCRETE - 25 MPa 28 DAY STRENGTH
2. BLOCKS SHALL BE POURED DIRECTLY AGAINST UNDISTURBED SOIL AS INDICATED.
3. DESIGN DATA - STATIC PRESSURE 1000 KPa. MINIMUM BEARING CAPACITY OF SOIL 120 KPa.

ST. JOHN'S
DEPARTMENT OF ENGINEERING

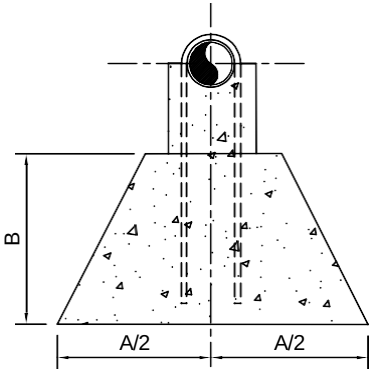
WATER MAIN THRUST BLOCKS "A"

DRAWN BY:	C.S. \ R.W.	DATE:	JANUARY 2022	SCALE:	N.T.S.	DRAWING No.	10-230-01

NOMINAL DIA. (mm)	EFFECTIVE AREA (m^2)	VERTICAL BENDS DOWN																				NOMINAL DIA. (mm)	EFFECTIVE AREA (m^2)	REDUCERS				
		90°					45°					22.5°					11.25°											
		R	RE-BAR	A	B	CONC	R	RE-BAR	A	B	CONC	R	RE-BAR	A	B	CONC	R	RE-BAR	A	B	CONC			R	RE-BAR	A	B	CONC
100	.012	1.74	15M	1150	525	0.75	.94	15M	900	450	0.38	.37	15M	750	450	0.19	.24	15M	750	450	0.19	100x150	.012	1.32	15M	900	450	0.57
150	.024	3.61	20M	1525	750	1.72	1.95	20M	1225	600	0.96	1.00	15M	900	450	0.38	.50	15M	900	450	0.38	150x200	.017	1.84	15M	900	600	0.57
200	.042	6.21	25M	1825	900	2.87	3.36	20M	1450	675	1.53	1.71	15M	1075	525	0.76	.86	15M	900	450	0.38	150x250	.038	4.03	15M	1200	750	1.15
250	.063	9.21	25M	2050	975	4.20	5.03	25M	1675	750	2.29	2.61	20M	1375	675	1.15	1.29	15M	1075	525	0.57	150x300	.047	4.94	15M	1200	750	1.15
300	.088	13.24	25M	2275	1150	5.92	7.12	25M	1900	900	3.25	3.65	20M	1525	750	1.72	1.84	20M	1150	525	0.76	200x300	.064	6.80	20M	1200	900	1.34

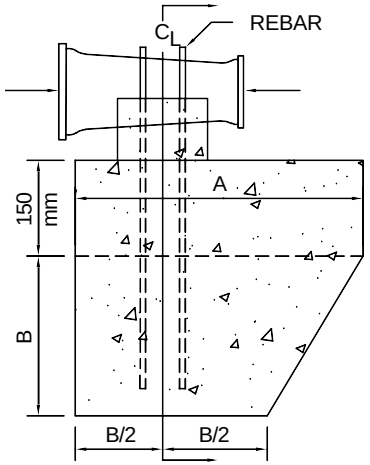


ELEVATION

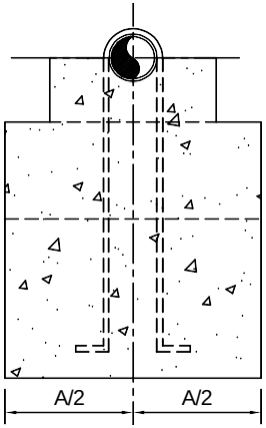


SECTION

VERTICAL BEND DOWN



ELEVATION



SECTION

REDUCER

ABBREVIATIONS

R - REACTION IN 1000 Kg.

CONC - VOLUME OF CONCRETE IN $m.^3$

A & B - DIMENSION OF CONCRETE IN mm UNLESS OTHERWISE NOTED.

NOTES:

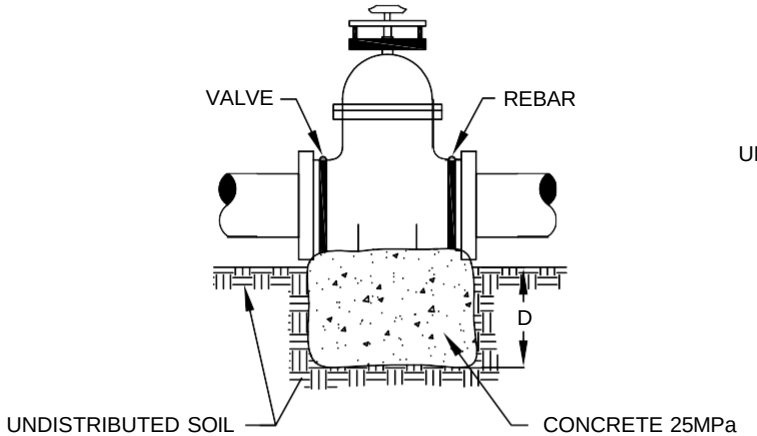
1. CONCRETE - 25 MPa 28 DAY STRENGTH
2. BLOCKS SHALL BE POURED DIRECTLY AGAINST UNDISTURBED SOIL AS INDICATED.
3. DESIGN DATA - STATIC PRESSURE 1000 KPa. MINIMUM BEARING CAPACITY OF SOIL 120 KPa.
4. RE-BARS, REINFORCING STEEL, STRUCTURAL GRADE 125 MPa MINIMUM WORKING STRESS WHEN EXPOSED TO SOIL, BARS SHALL BE COATED WITH CORROSION PREVENTION TAPE. (DENSO OR APPROVED EQUAL).
5. WHERE PVC FITTINGS ARE USED, RE-BAR SHALL BE SUBSTITUTED WITH 50mm FLAT STEEL BAR IN THICKNESS REQUIRED.

RE-BAR	FLAT STELL
15M	50MM X 4MM
20M	50MM X 6MM
25M	50MM X 10MM

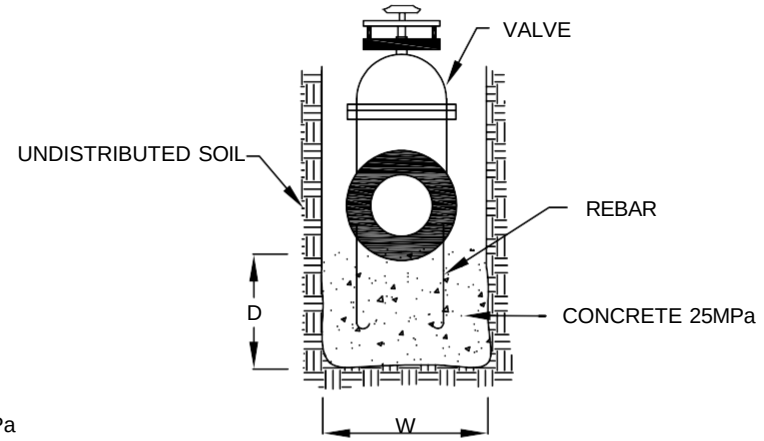
ST. JOHN'S
DEPARTMENT OF ENGINEERING

WATER MAIN THRUST BLOCKS "B"

DRAWN BY:	C.S. \ R.W.	DATE:	JANUARY 2022	SCALE:	N.T.S.	DRAWING No.	10-230-02



ELEVATION



VALVE	BEARING AREA SOIL (m^2)	BEARING AREA ROCK (m^2)	REBAR
400	1.15	0.58	20M
500	1.78	0.89	20M
600	2.54	1.27	20M

NOTES:

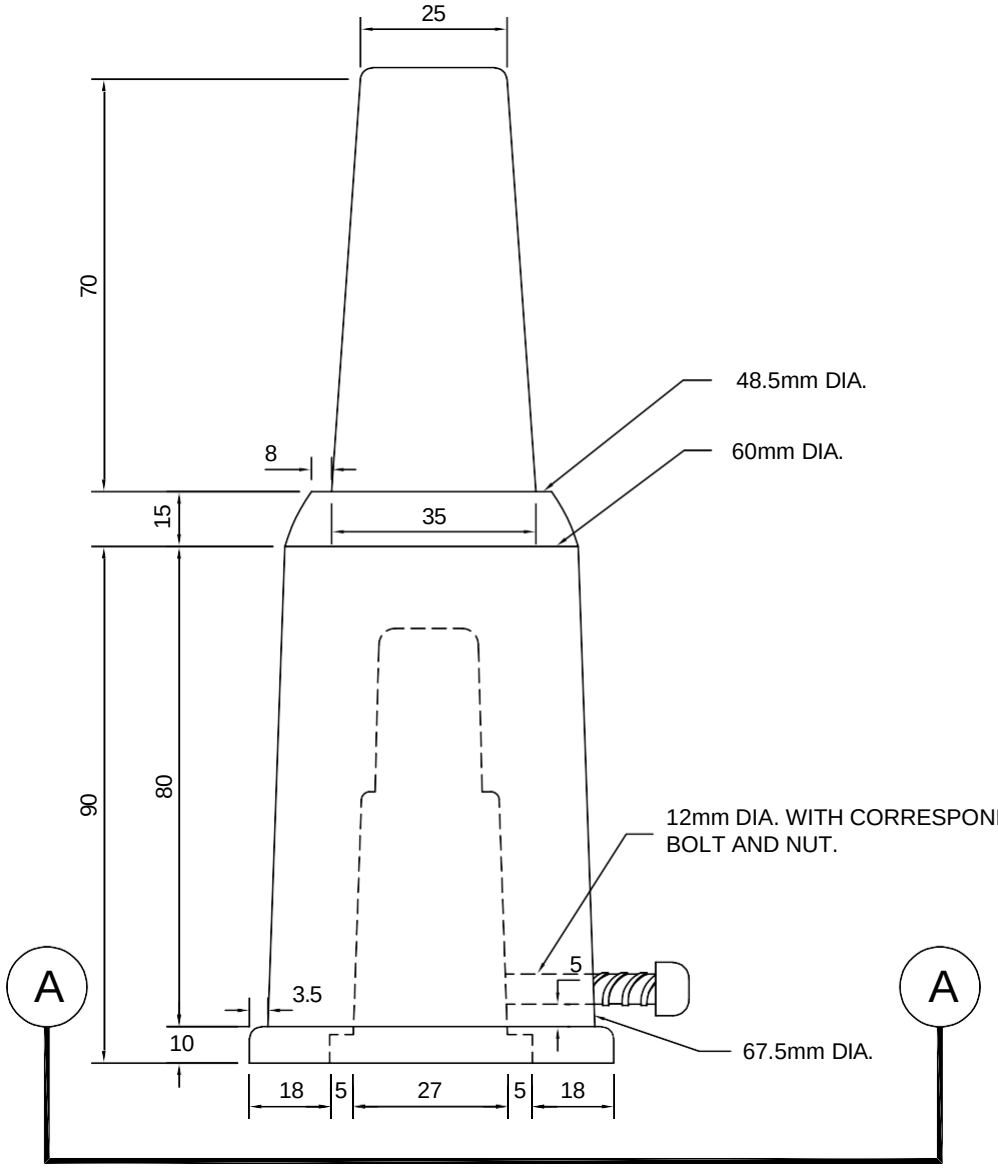
1. BLOCKS SHALL BE POURED DIRECTLY AGAINST UNDISTRIBUTED SOIL
2. BEARING AREA = D X W
3. DESIGN DATA - STATIC PRESSURE 1000 KPa. (145psi)
   - MINIMUM BEARING CAPACITY (SOIL) 200 KPa.
   (ROCK) 400 KPa.
   - SAFETY FACTOR 1.5
4. RE-BARS, REINFORCING STEEL, STRUCTURAL GRADE 125 MPa MINIMUM WORKING STRESS WHEN EXPOSED TO SOIL, BARS SHALL BE COATED WITH CORROSION PREVENTION TAPE. (DENSO OR APPROVED EQUAL)
5. WHERE PVC FITTING ARE USED, RE-BAR SHALL BE SUBSTITUTED WITH 50mm FLAT STEEL BAR IN THICKNESS REQUIRED.

RE-BAR	FLAT STELL
15M	50MM X 4MM
20M	50MM X 6MM
25M	50MM X 10MM

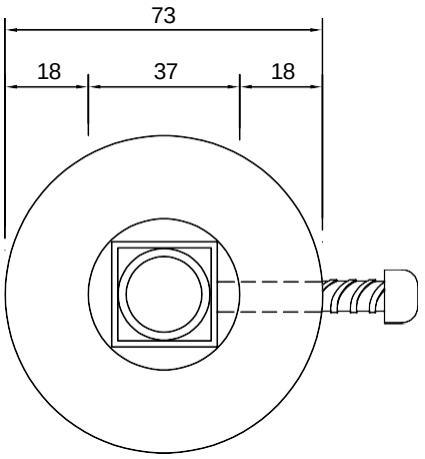
ST. JOHN'S
DEPARTMENT OF ENGINEERING

WATER MAIN VALVE THRUST BLOCKS

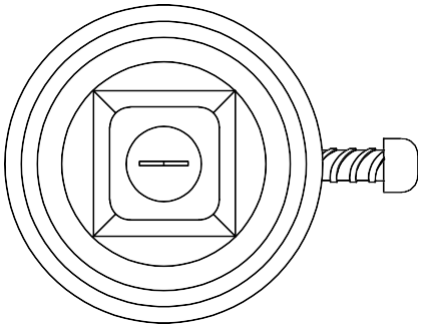
DRAWN BY: R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-230-02A



FRONT VIEW



ELEVATION A-A

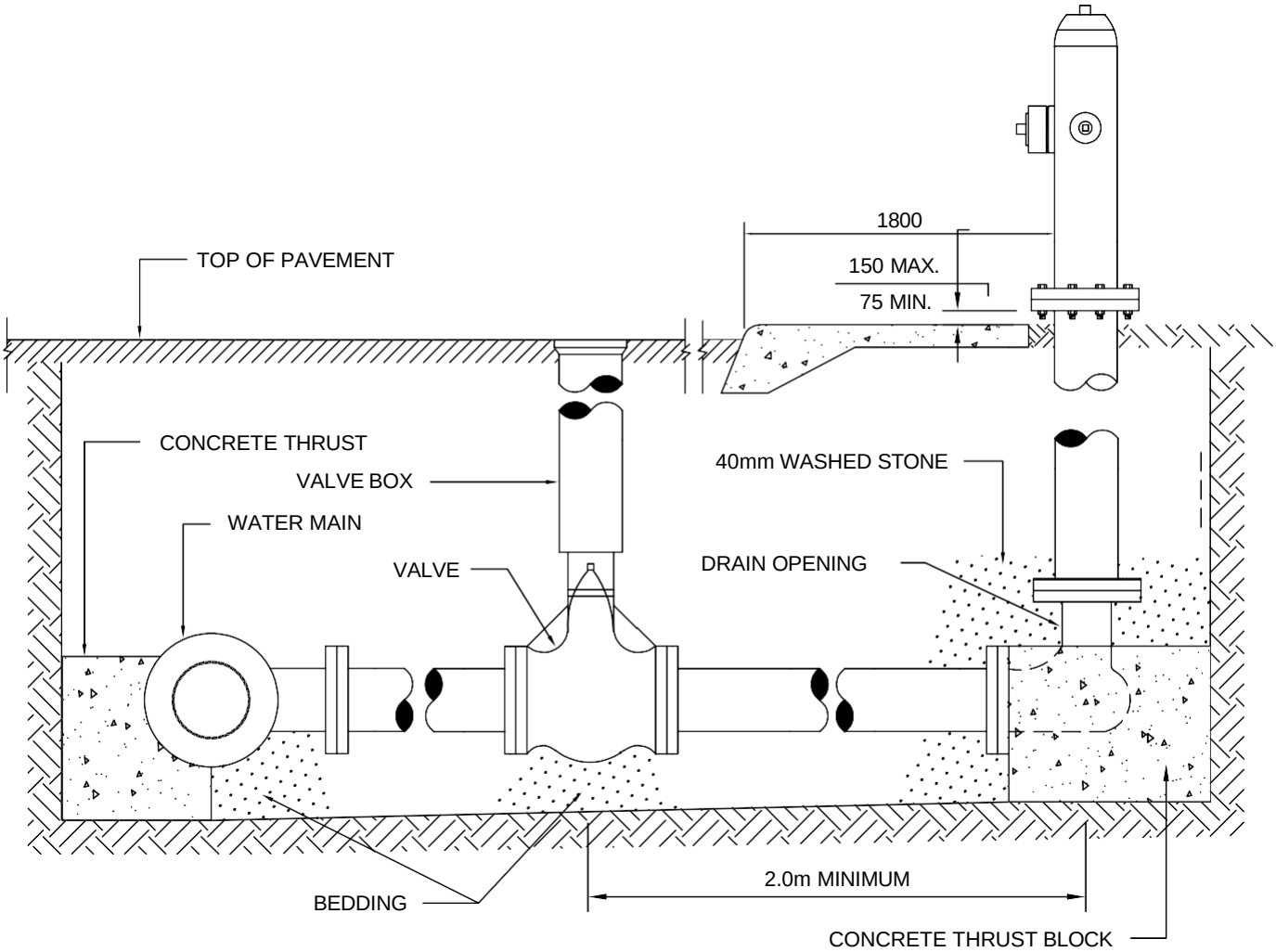


TOP VIEW

ST. JOHN'S
DEPARTMENT OF ENGINEERING

STANDARD VALVE OPERATING NUT

DRAWN BY:	C.S. \ R.W.	DATE:	JANUARY 2022	SCALE:	N.T.S.	DRAWING No.	10-230-03



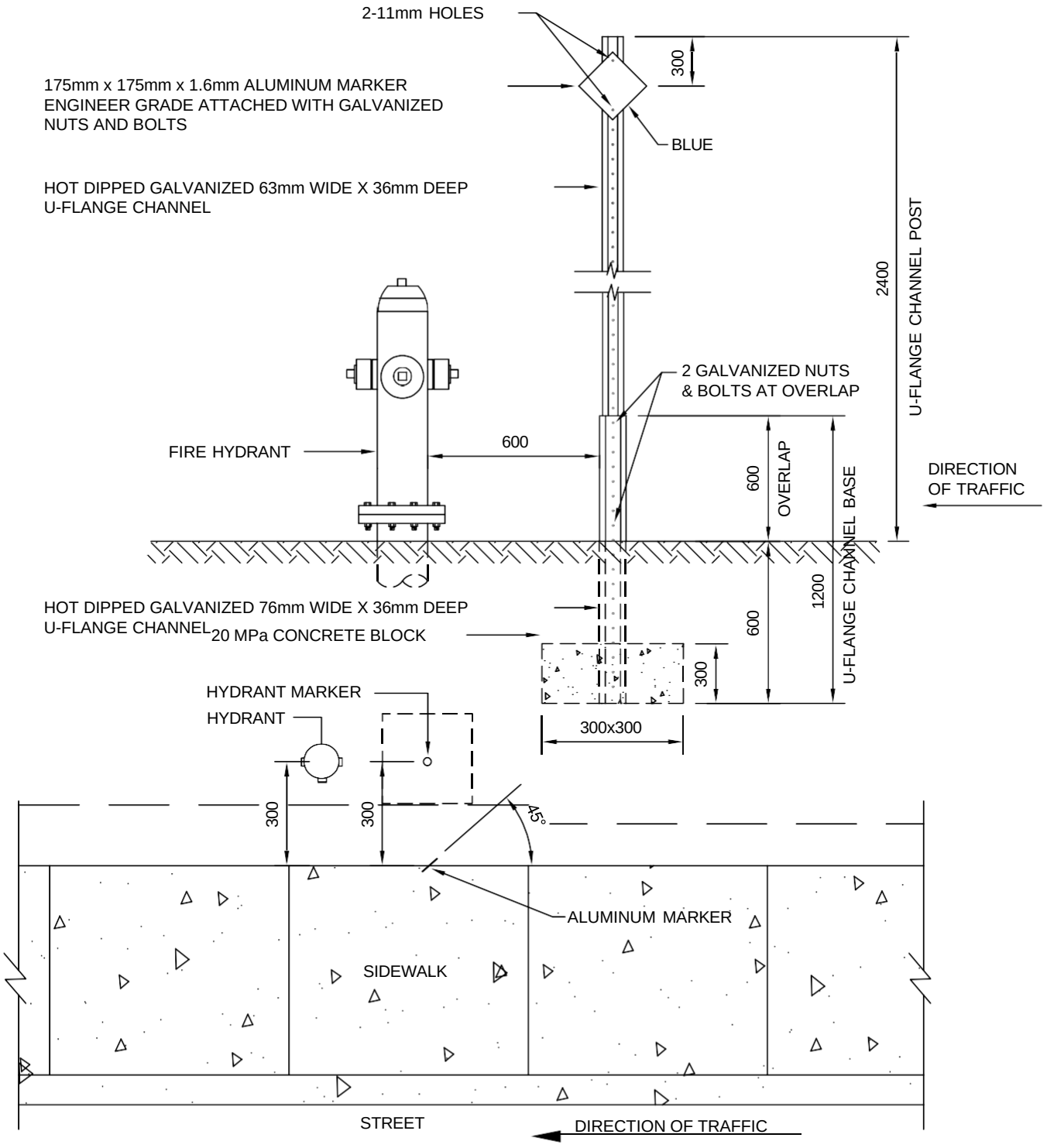
NOTES:

1. HYDRANT LEADS TO BE 150mm DIAMETER PIPE.
2. CONCRETE FOR THRUST BLOCKS TO BE 25 MPa.
3. HYDRANT DRAIN TO BE KEPT CLEAR OF CONCRETE THRUST BLOCK.
4. TEES FOR FIRE HYDRANT LATERALS TO BE 150 OFF ALL DIAMETER LINES. ALL LATERALS TO BE 150 PIPE.
5. HYDRANT VALVES LESS THAN 2.0m FROM THE HYDRANT MUST BE RESTRAINED TO THE MAIN USING APPROVED RESTRAINTS.
6. VALVE BOX COVER TO BE MARKED "HYDRANT".

ST. JOHN'S
DEPARTMENT OF ENGINEERING

HYDRANT CONNECTION

DRAWN BY: C.S. / R.W.	DATE: FEB. 2025	SCALE: N.T.S.	DRAWING No. 10-230-04



NOTES:

1. HYDRANTS THAT ARE TO BE TURNED OVER TO THE CITY FOR MAINTENANCE TO BE PAINTED SAFETY YELLOW (COLOUR YOUR WORLD #8413-METALCLAD SERIES ALKYD GLOSS) OR EQUIVALENT. ALL OTHER HYDRANTS SHOULD BE PAINTED SAFETY RED.

2. U-FLANGE CHANNEL - FINISH TO BE HOT DIPPED GALVANIZED TO CSA-G164 SPECIFICATIONS AND APPLIED AFTER PUNCHING TO PREVENT RUSTING OF THE EXPOSED METAL AROUND THE HOLES.

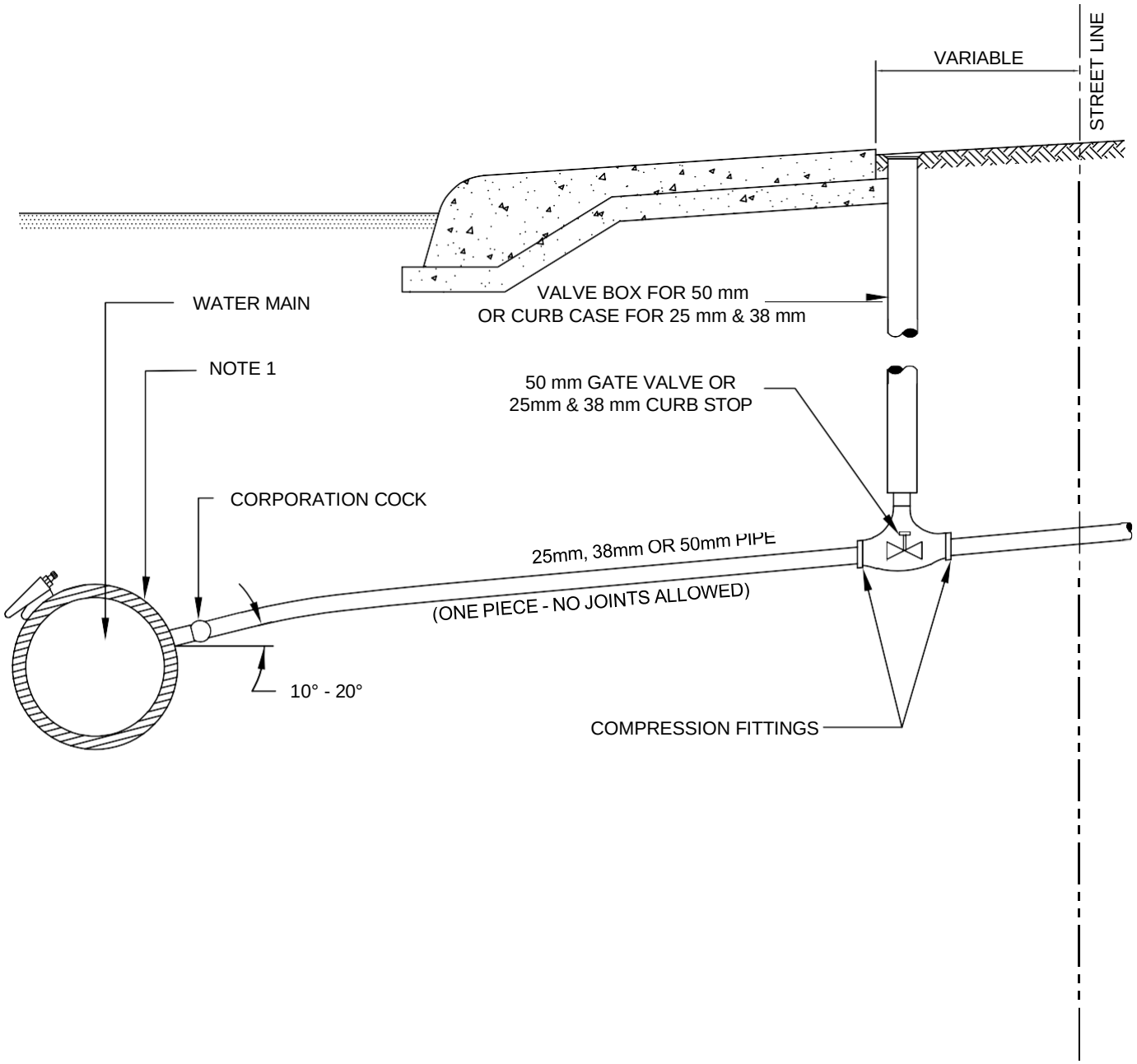
3. POSTS AND BASES TO HAVE 11mm DIAMETER HOLES ON 50mm CENTERS.

4. APPROXIMATE WEIGHT FOR:
   POSTS=3.0kg/m
   BASES=3.7kg/m

ST. JOHN'S
DEPARTMENT OF ENGINEERING

HYDRANT & HYDRANT MARKER

DRAWN BY: C.S. \ R.W.	DATE: FEB. 2025	SCALE: N.T.S.	DRAWING No. 10-230-05



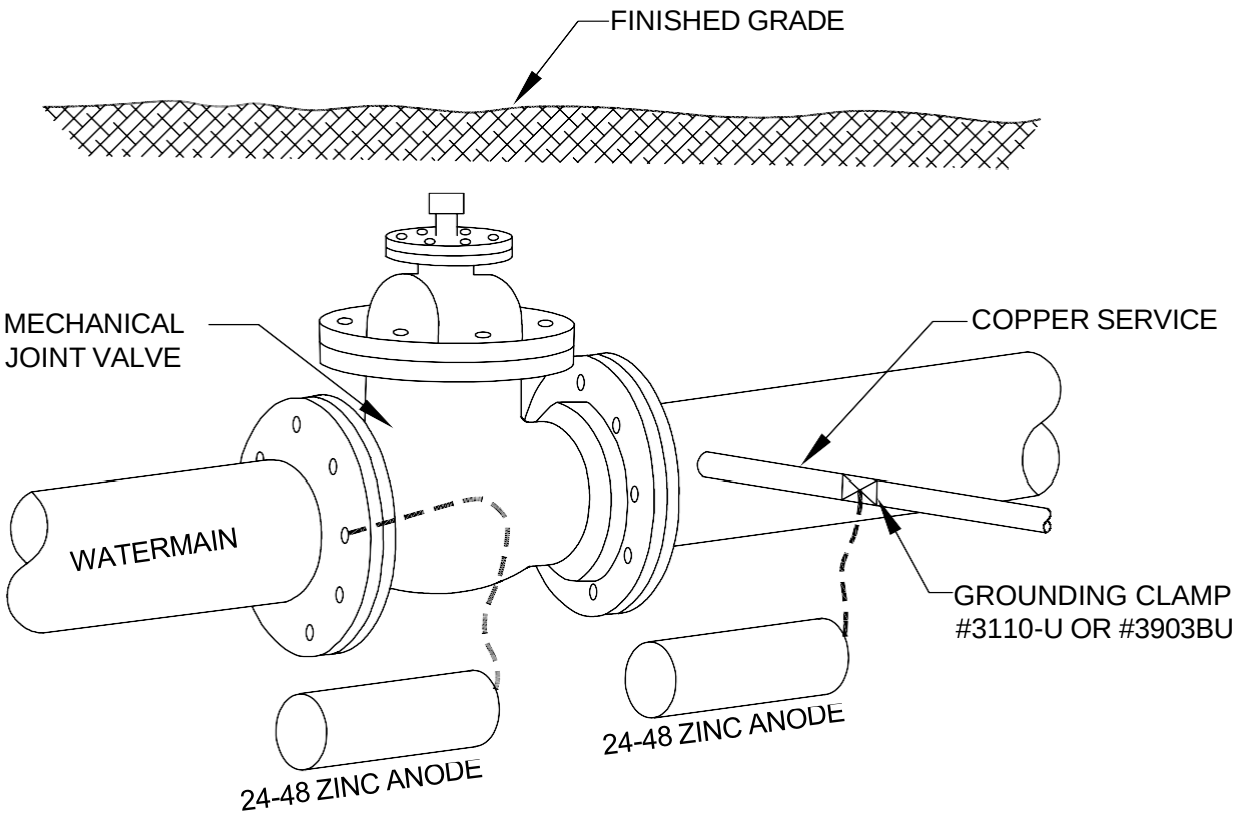
NOTE:

1. WHEN TAPPING INTO AN EXISTING METALLIC IRON PIPE OR EXISTING PVC PIPE, USE A MUELLER BR 2S SERIES SERVICE SADDLE OR EQUAL. WHEN INSTALLING SERVICE IN CONJUNCTION WITH A NEW PVC WATER MAIN 300MM OR SMALLER USE A SERVICE TEE.
2. FOR 25mm DIAMETER SERVICE INTO EXISTING METALLIC PIPE, DIRECT TAP SHALL BE PROVIDED.

ST. JOHN'S
DEPARTMENT OF ENGINEERING
SPECIFICATIONS BOOK

25mm, 38mm & 50mm WATER SERVICES

DRAWN BY: P. H.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-230-06



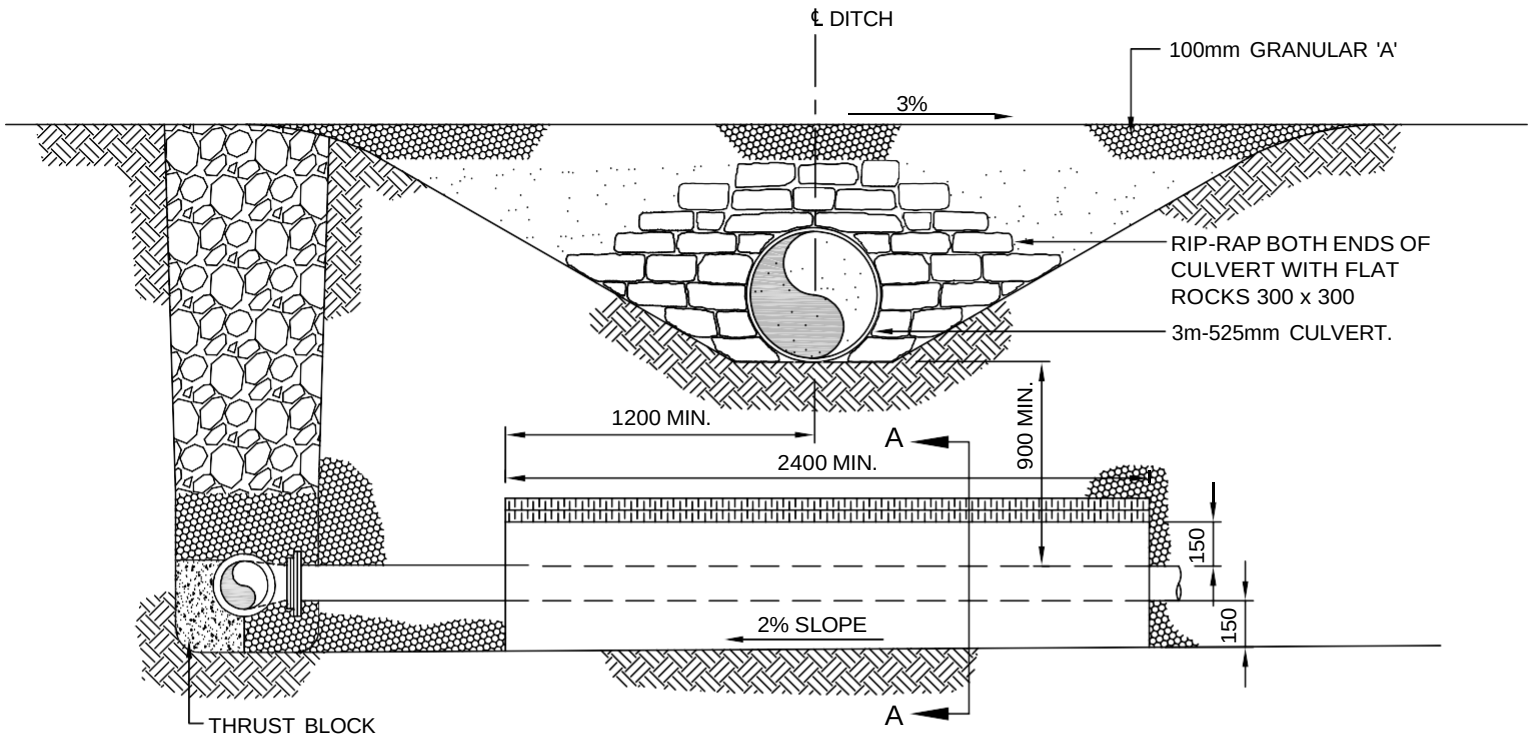
NOTES:

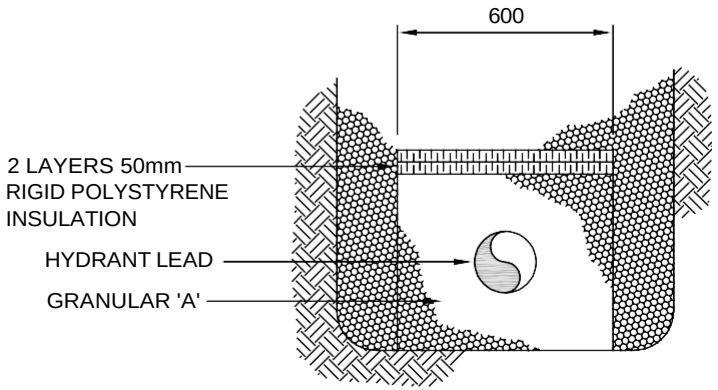
1. SEPARATE ANODE AND VALVE / SERVICE USING 50mm THICK RIGID INSULATION IF ANODE IS INSTALLED WITHIN 500mm OF VALVE / SERVICE.
2. AN ANODE LEAD WIRE SHALL BE WRAPPED AROUND THE PIPE SEVERAL TIMES AND THE LOOSE END OF THE WIRE THERMITE WELDED (CADWELD) TO THE WATERMAIN, METALLIC FITTING, VALVE OR HYDRANT.
3. THE THERMITE WELD SHALL BE INSTALLED ACCORDING TO MANUFACTURER'S SPECIFICATIONS.
4. THE THERMITE WELD AND THE EXPOSED METALLIC SURFACE OF THE PIPE SHALL BE LIBERALLY COATED WITH MASTIC.
5. GROUNDING CLAMP TO BE #3110-U FOR 19mm TO 25mm DIAMETER SERVICES OR #3903BU FOR 32mm TO 50mm DIAMETER SERVICES.

ST. JOHN'S
DEPARTMENT OF ENGINEERING
SPECIFICATIONS BOOK

TYPICAL CATHODIC PROTECTION

P.H.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-230-07



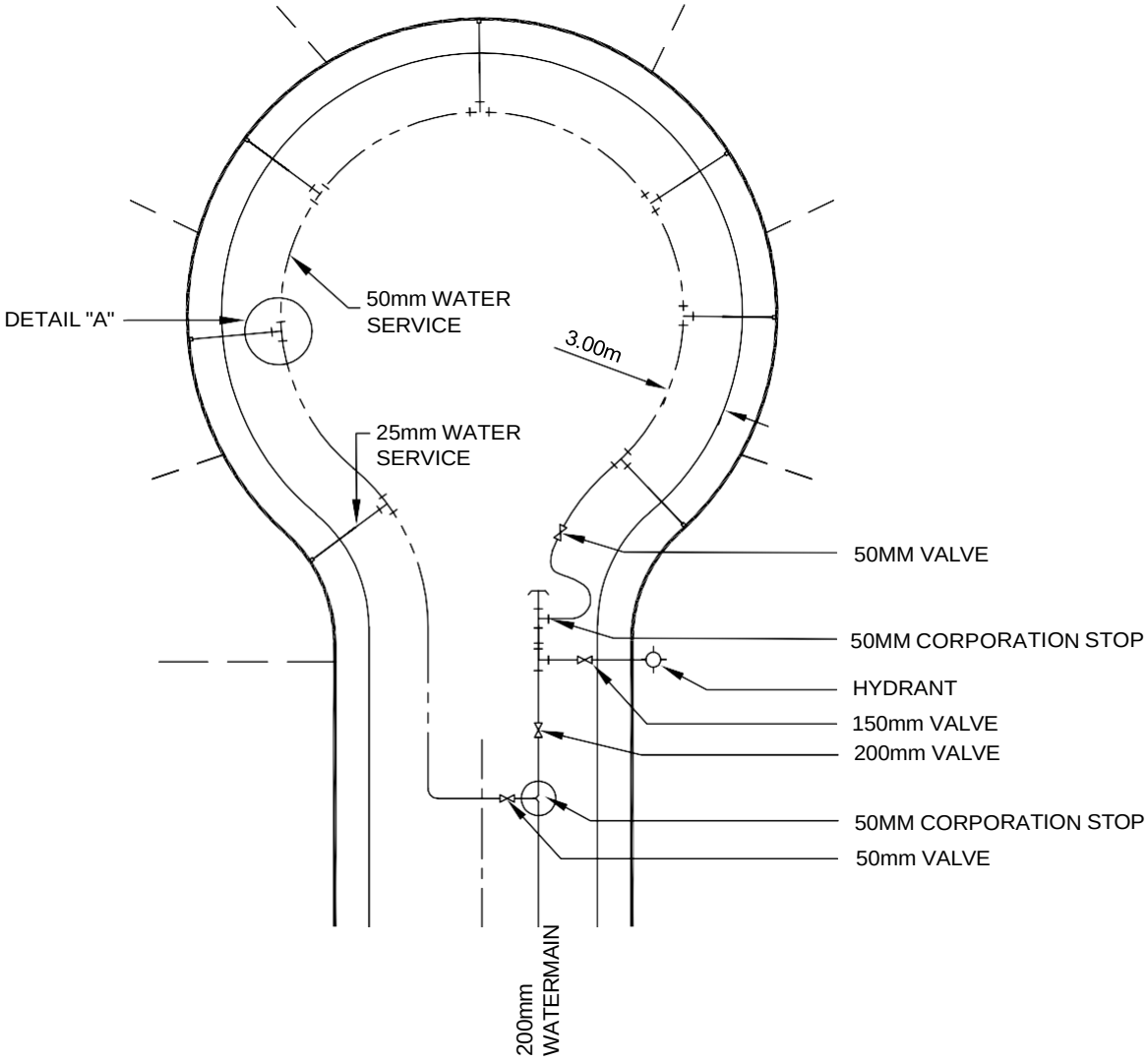


SECTION A-A

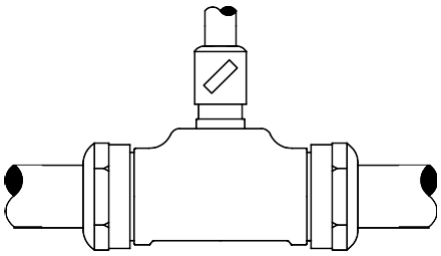
ST. JOHN'S
DEPARTMENT OF ENGINEERING

HYDRANT LEAD UNDER DITCH

DRAWN BY:	C.S. \ R.W.	DATE:	JANUARY 2022	SCALE:	N.T.S.	DRAWING No.	10-230-08



25mm CORP. STOP



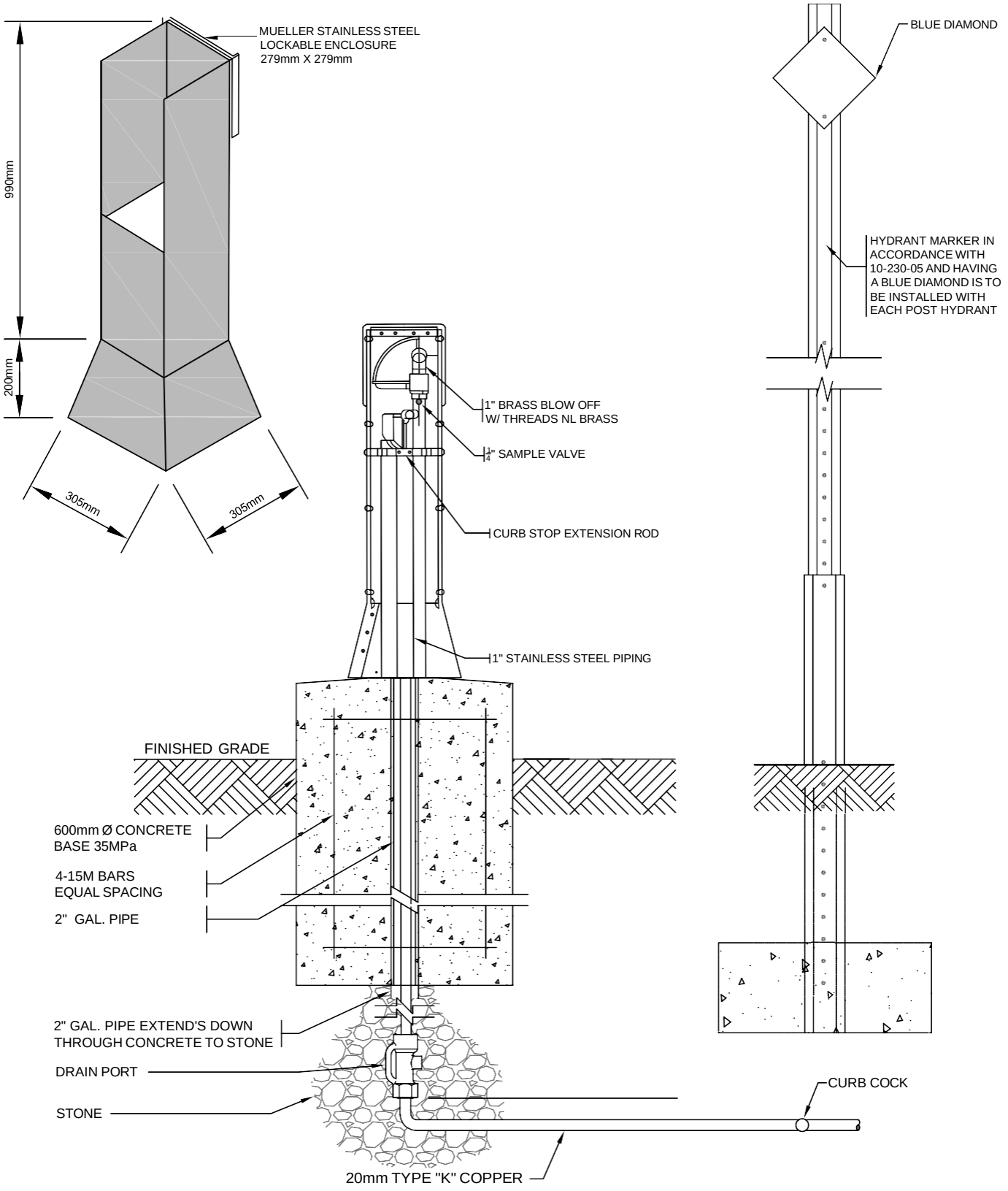
50mm TEE WITH COMPRESSION FITTINGS
AND 25mm AWWA THREADED OUTLET

DETAIL "A"

ST. JOHN'S
DEPARTMENT OF ENGINEERING

50mm WATERMAIN LOOPING IN CUL-DE-SACS

DRAWN BY: R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-230-09



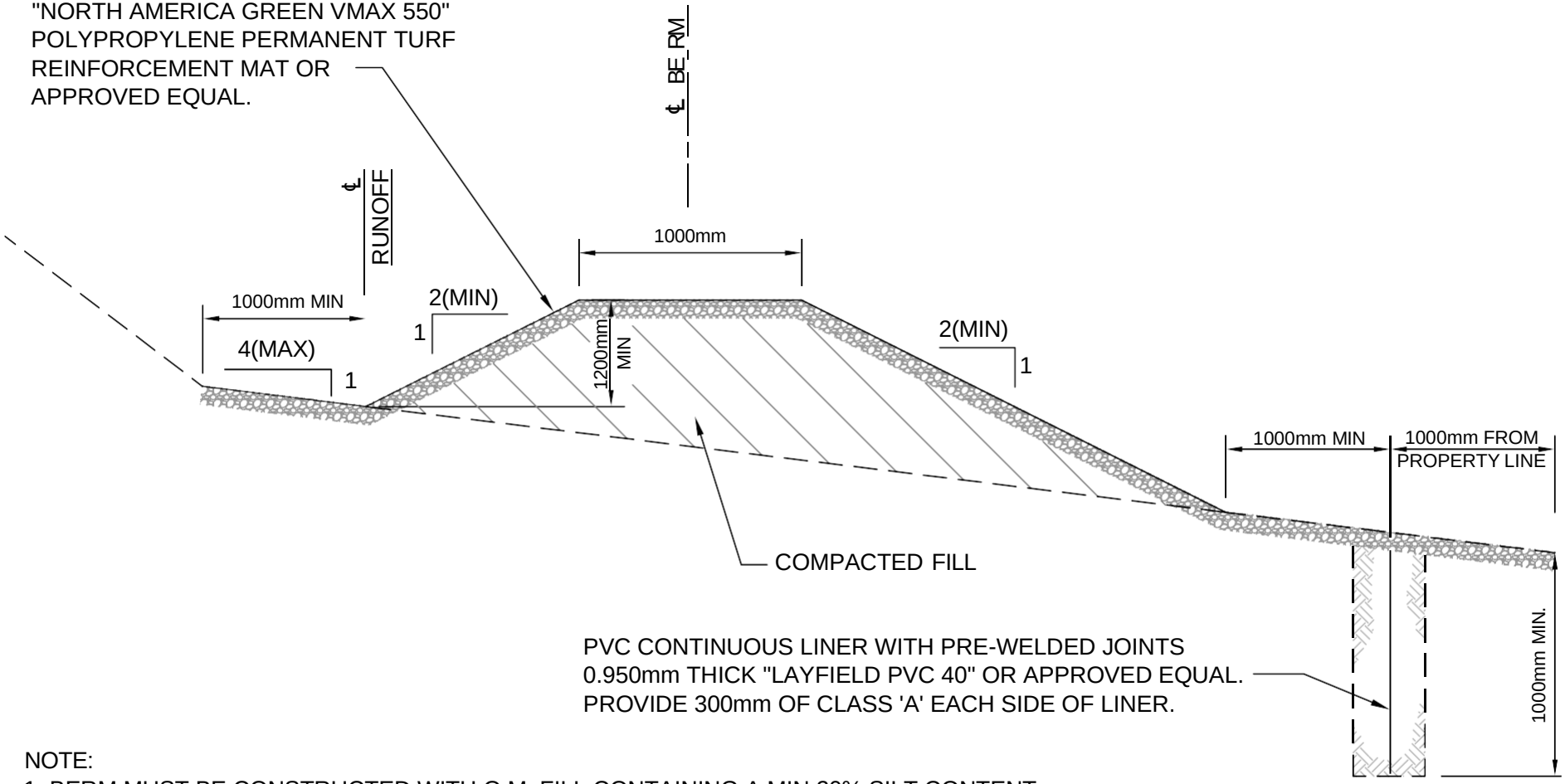
NOTES:

1. MUELLER BSS-01 SAMPLING STATION 1800mm BURY.
2. MUELLER ALUMINUM LOCKABLE ENCLOSURE-BLUE.
3. TAP WATERMAIN WITH 20mm CORPORATION COCK AND PROVIDE 20mm COPPER TYPE "K".
4. PROVIDE A CURB COCK

ST. JOHN'S
DEPARTMENT OF ENGINEERING

POST HYDRANT/ WATER SAMPLING STATION

DRAWN BY: R.W./P.H.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-230-10



NOTE:

1. BERM MUST BE CONSTRUCTED WITH O.M. FILL CONTAINING A MIN 20% SILT CONTENT COMPACTED TO 95% PROCTOR DENSITY IN 200 mm LIFTS.
2. RUNOFF CHANNEL MUST HAVE MINIMUM TRANSVERSE GRADE OF 2%.AND MAX TRANSVERSE GRADE OF 5%
3. EXISTING USM MUST BE REMOVED PRIOR TO CONSTRUCTION OF BERM AND CHANNEL.
4. PVC LINER MUST BE INSTALLED TO A MINIMUM DEPTH OF 1000mm BELOW PROPOSED REAR YARD ELEVATION.

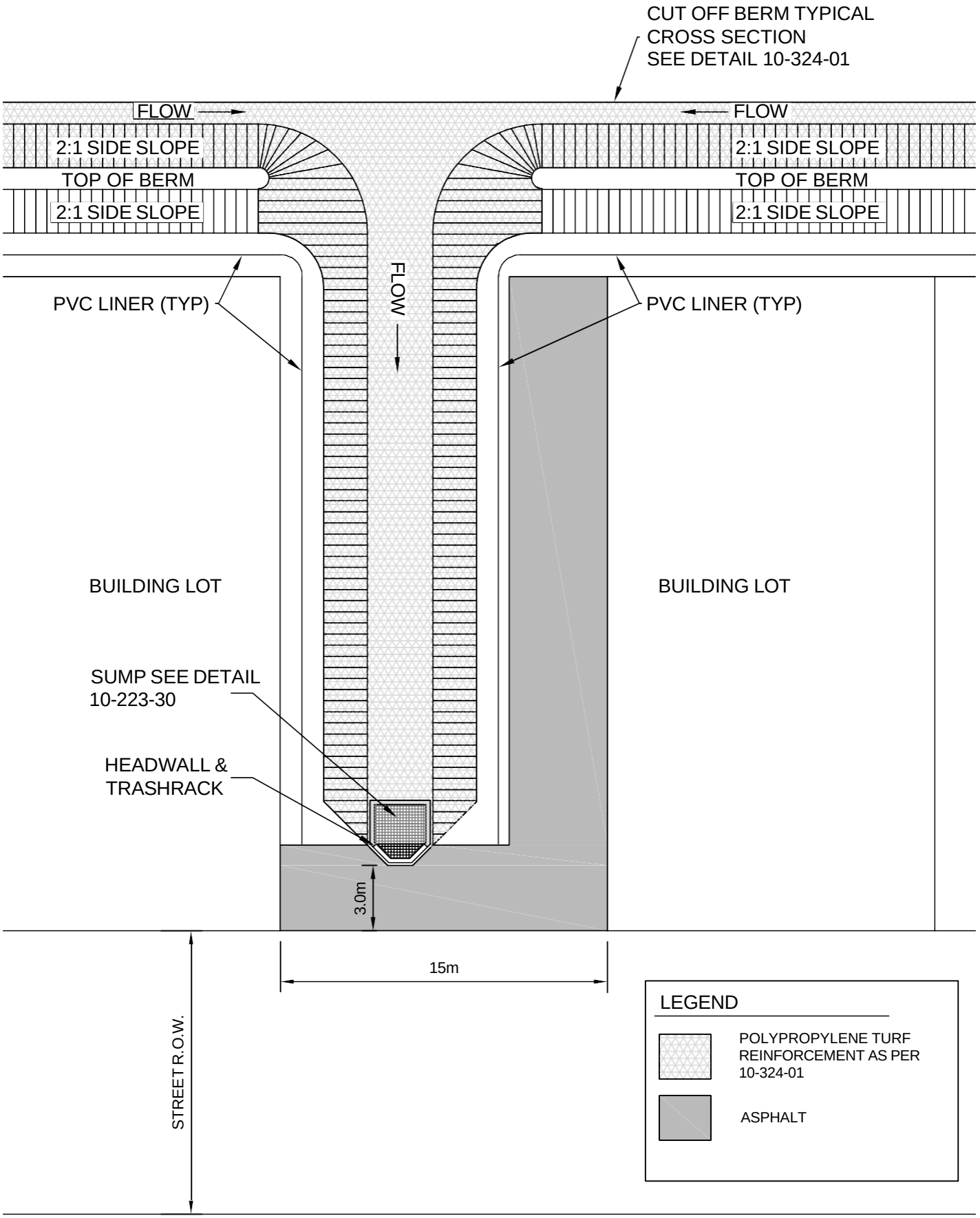
LEGEND

- 150mm TOPSOIL AND HYDROSEED
- CLASS A GRANULAR
- POLYPROPYLENE TURF REINFORCEMENT
- EXISTING GRADE LINE

ST. JOHN'S
DEPARTMENT OF ENGINEERING

CUT OFF BERM - TYPICAL CROSS SECTION

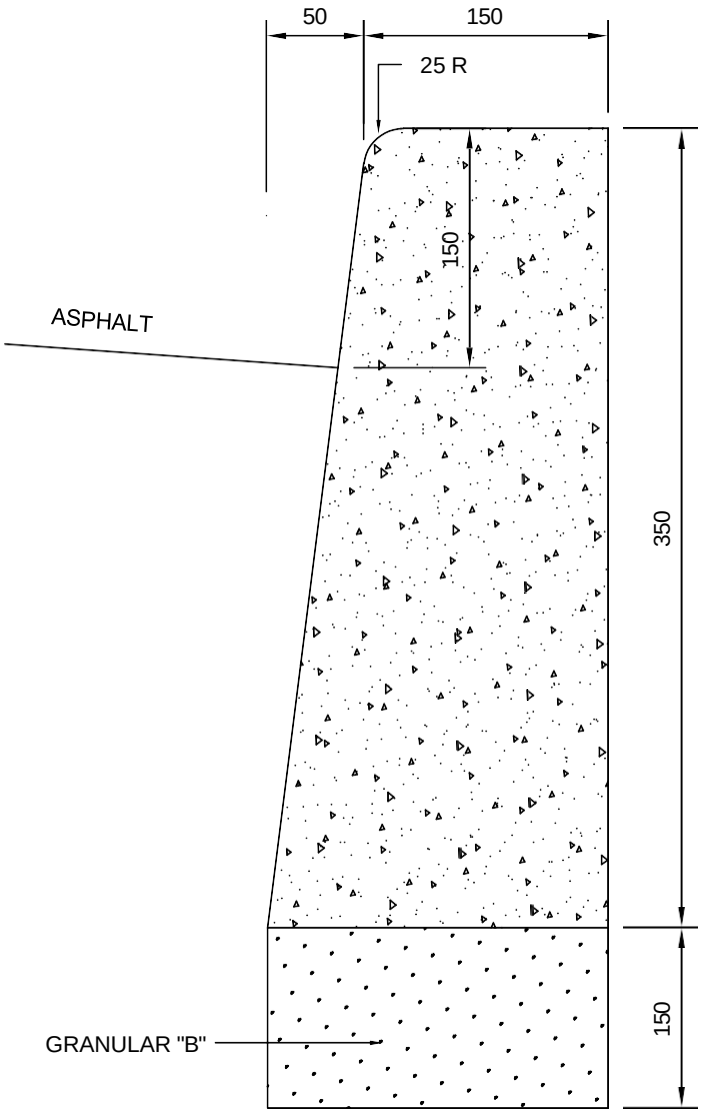
DRAWN BY:	WOK	DATE:	JANUARY 2022	SCALE:	N.T.S.	DRAWING No.	10-324-01



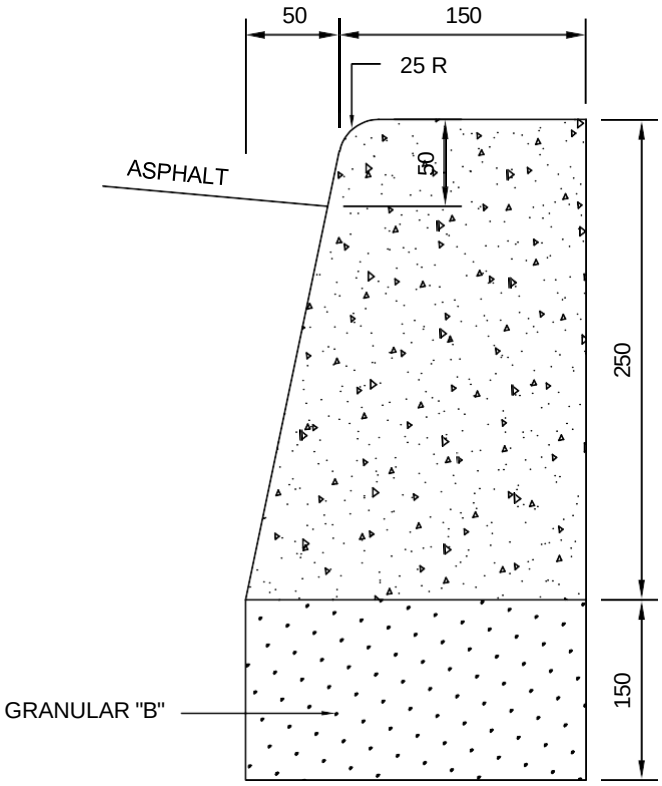
ST. JOHN'S
DEPARTMENT OF ENGINEERING

CUT OFF BERM - INTAKE CHANNEL

DRAWN BY: WOK	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-324-02



HIGH BACK



LOW BACK

TYPICAL X-SECTION

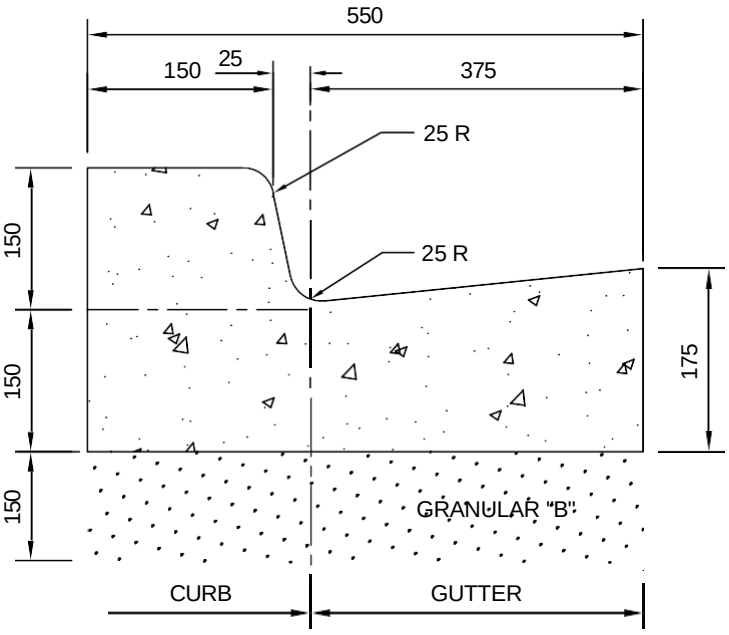
NOTE:

1. CONCRETE TO BE 32 MPa TO MEET CSA A23.1, CLASS C-2 EXPOSURE.

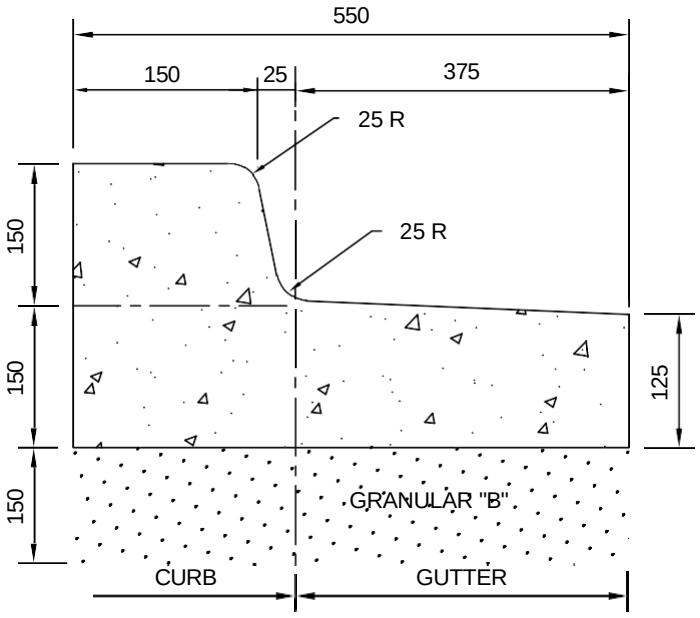
ST. JOHN'S
DEPARTMENT OF ENGINEERING

CURB

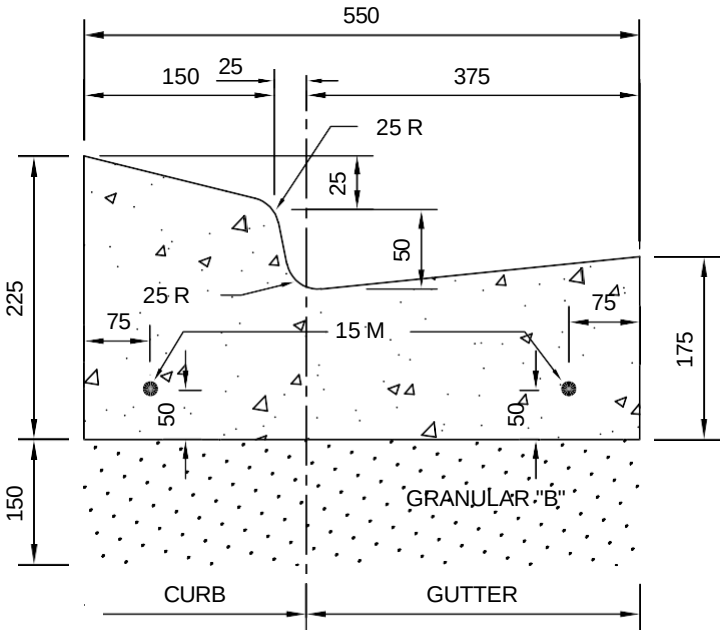
DRAWN BY: C.S. \ R.W.	DATE: MARCH 2021	SCALE: N.T.S.	DRAWING No. 10-330-01



STANDARD
CURB & GUTTER



CURB & GUTTER
FOR SUPER ELEVATION



STANDARD DEPRESSED
CURB & GUTTER

NOTE:

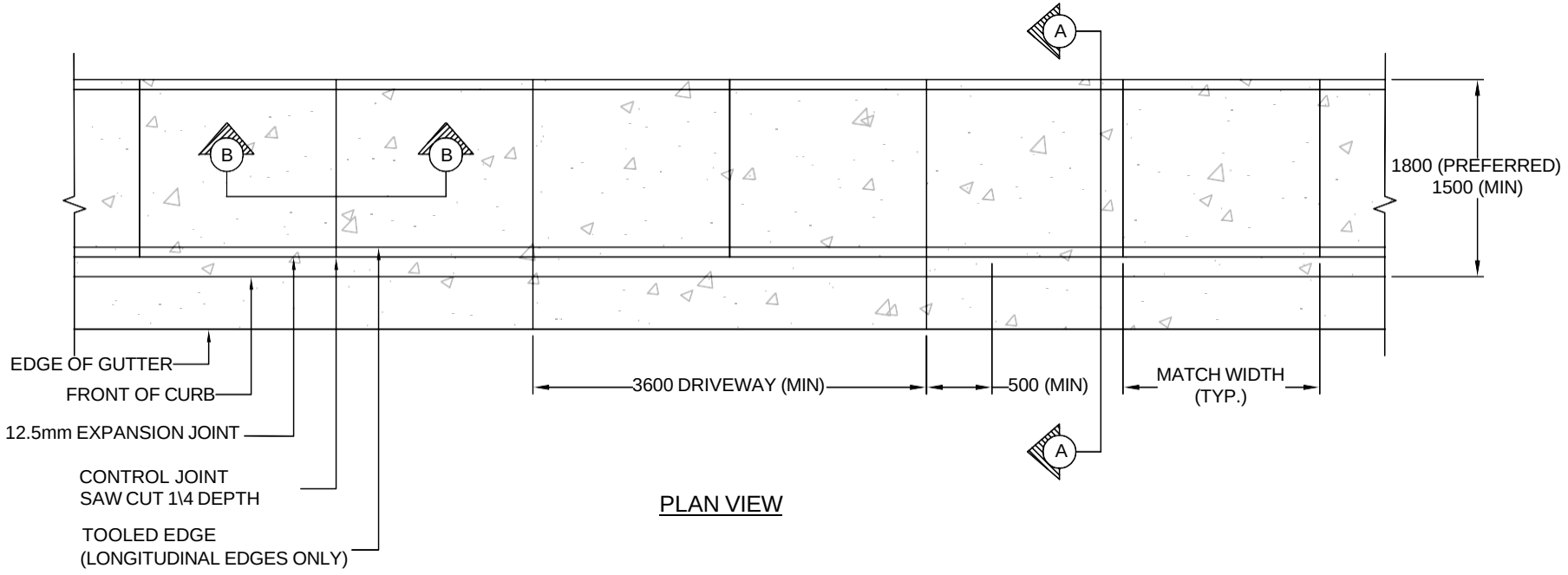
1. CONCRETE TO BE 32 MPa TO MEET CSA A23.1, CLASS C-2 EXPOSURE.

2. 15 M REBARS ARE TO BE USED IN THE STANDARD DEPRESSED CURB & GUTTER ONLY IN COMMERCIAL DRIVEWAY APPLICATIONS.

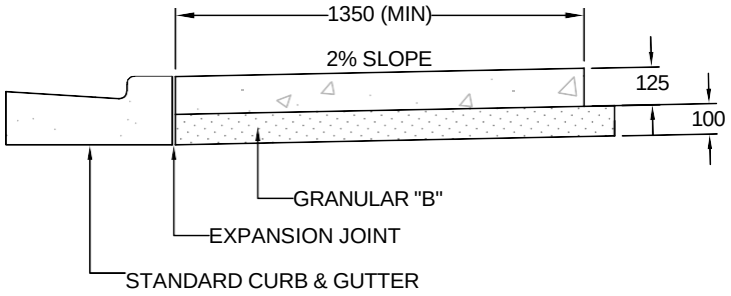
ST. JOHN'S
DEPARTMENT OF ENGINEERING

CURB & GUTTER

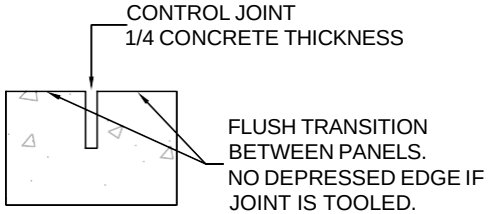
DRAWN BY: C.S. \ R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-330-02



PLAN VIEW



SECTION A-A



SECTION B-B

NOTES:

1. FLARED SIDES SHALL BE 500mm (MIN.) AS ILLUSTRATED. MEASURED AT THE CURB LOCATION, BUT MAY BE BASED MORE ON SITE.

2. . WHERE A COMMERCIAL GRADE SIDEWALK IS SPECIFIED, CONCRETE THICKNESS SHALL BE INCREASED TO:
   - 150mm FOR DRIVEWAYS WITH <=100 VEHICLES PER DAY.
   - 200mm FOR >100 VEHICLES PER DAY.
   - 200mm FOR ANY ACCESS THAT SERVES PRIMARILY COMMERCIAL VEHICLES.
   - PROVIDE WWR IN ALL COMMERCIAL GRADE SIDEWALK (152 x 152 18.7/18.7 WWF).

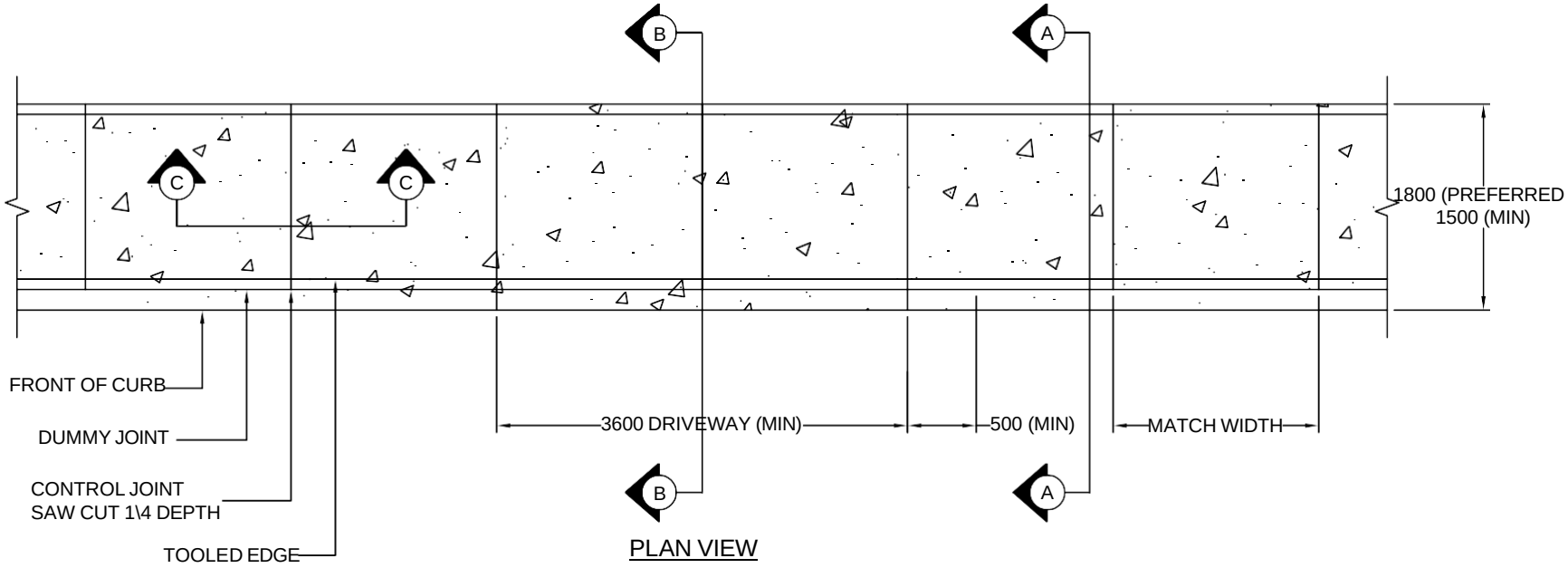
3. REFER TO DETAIL 10-330-21 FOR CURB RAMP TRANSITION SPECS.

4. CONCRETE TO BE 32 MPa TO MEET CSA A23.1, CLASS C-2 EXPOSURE.

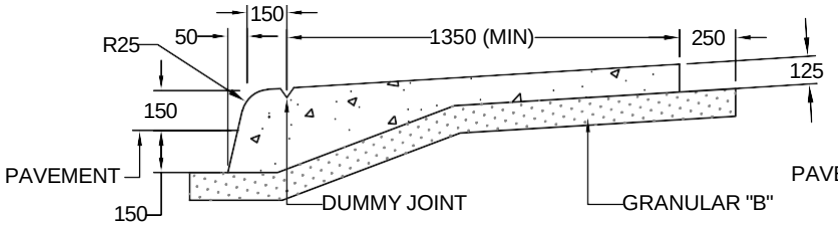
ST. JOHN'S
DEPARTMENT OF PLANNING, ENGINEERING AND REGULATORY SERVICES

CURB, GUTTER & SIDEWALK

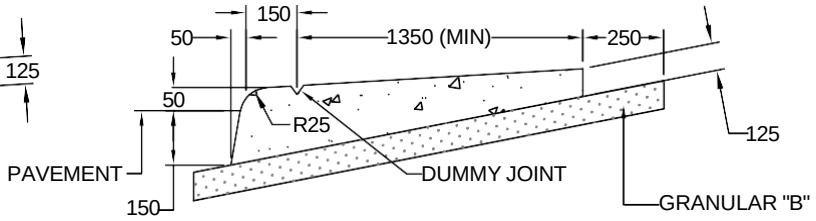
DRAWN BY:	S.P.	DATE:	JANUARY 2022	SCALE:	N.T.S.	DRAWING No.	10-330-03



PLAN VIEW



SECTION A-A



SECTION B-B

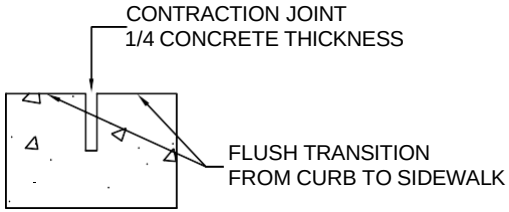
NOTES:

1. FLARED SIDES SHALL BE 500mm (MIN.) AS ILLUSTRATED, MEASURED AT THE CURB LOCATION, BUT MAY BE BASED MORE ON SITE.

2. WHERE A COMMERCIAL GRADE SIDEWALK IS SPECIFIED, CONCRETE THICKNESS SHALL BE INCREASED TO:
   - 150mm FOR DRIVEWAYS WITH <=100 VEHICLES PER DAY.
   - 200mm FOR >100 VEHICLES PER DAY.
   - 200mm FOR ANY ACCESS THAT SERVES PRIMARILY COMMERCIAL VEHICLES.
   - PROVIDE WWR IN ALL COMMERCIAL GRADE SIDEWALK. (152 X 152 18.7/18.7 WWF)

3. REFER TO DETAIL (10-330-21) FOR CURB RAMP TRANSITION SPECS.

4. CONCRETE TO BE 32 MPa TO MEET CSA A23.1, CLASS C-2 EXPOSURE.

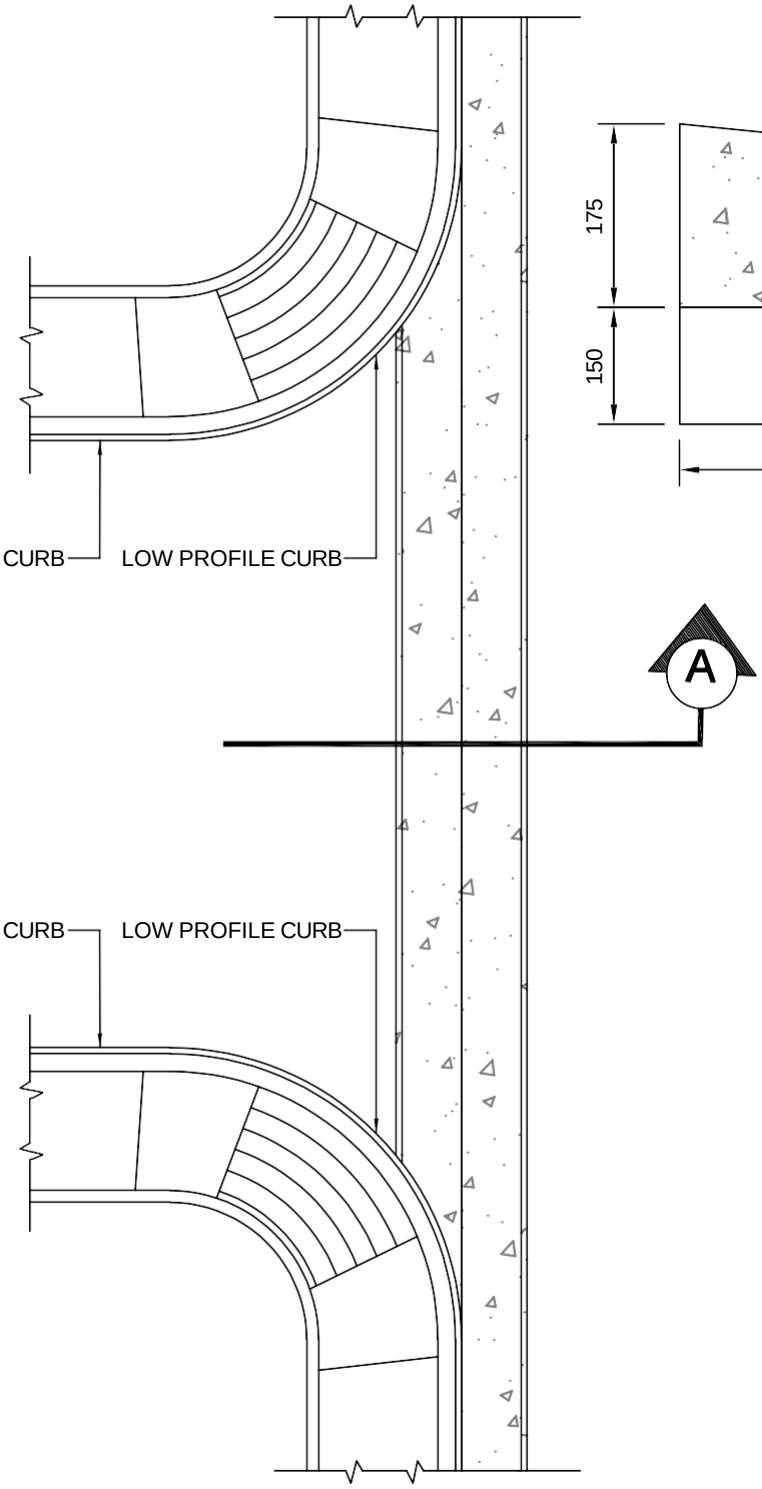


SECTION C-C

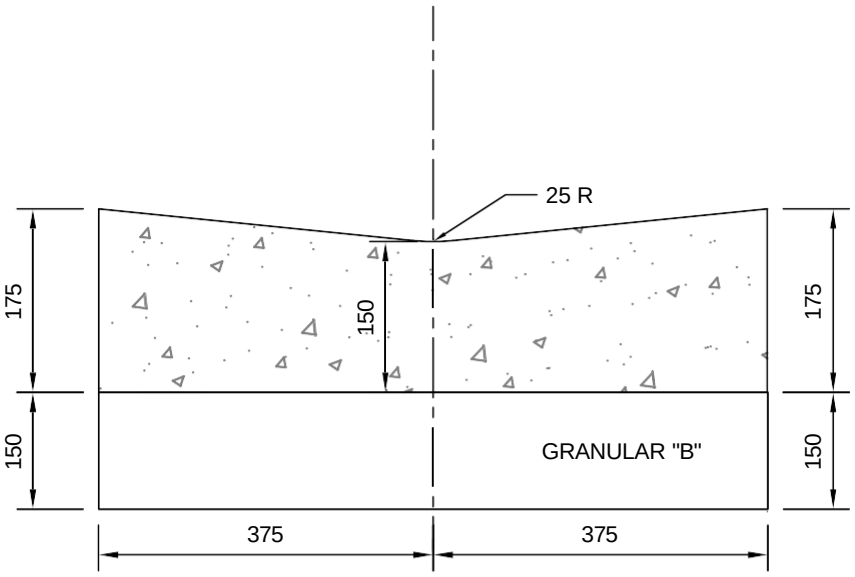
ST. JOHN'S
DEPARTMENT OF PLANNING, ENGINEERING AND REGULATORY SERVICES

COMBINED CURB & SIDEWALK

DRAWN BY:	S.P.	DATE:	JANUARY 2022	SCALE:	N.T.S.	DRAWING No.	10-330-05



PLAN VIEW



STANDARD
DISH GUTTER

SECTION A

NOTE:

1. CONCRETE TO BE 32 MPa TO MEET CSA A23.1, CLASS C-2 EXPOSURE.

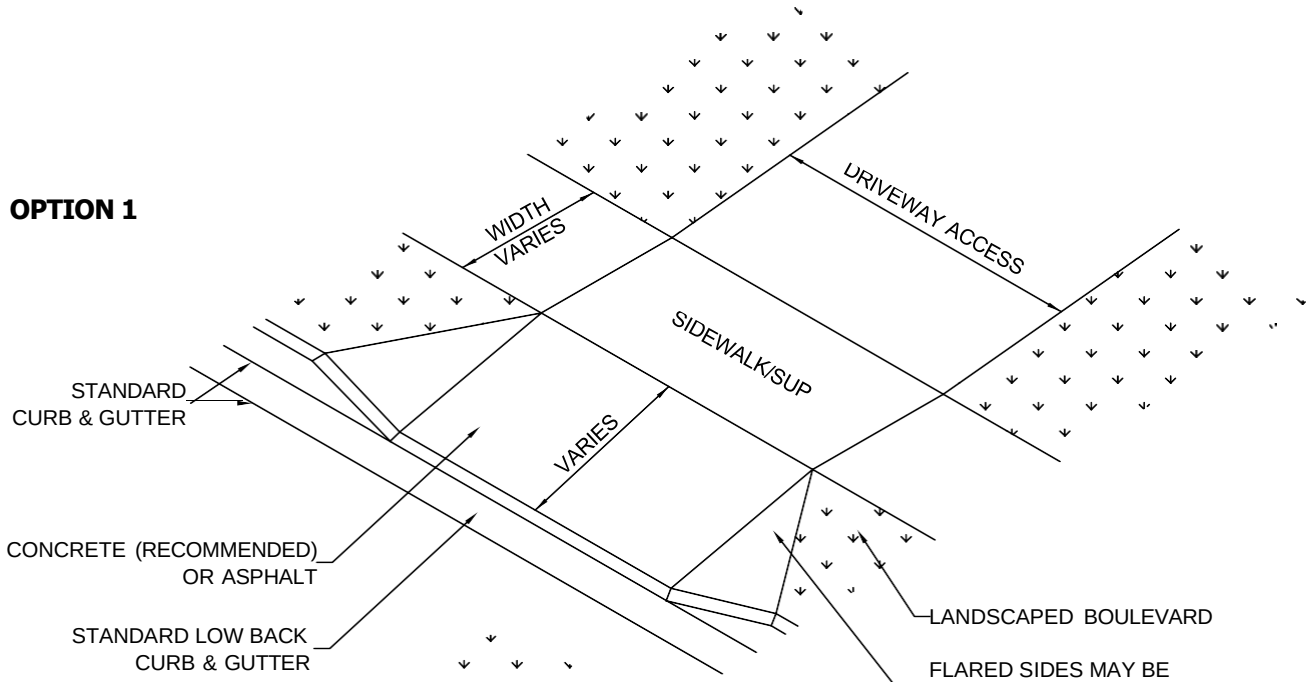
2. 15 M REBARS ARE TO BE USED IN THE STANDARD DEPRESSED GUTTER ONLY IN COMMERCIAL DRIVEWAY APPLICATIONS.

ST. JOHN'S
DEPARTMENT OF PLANNING, ENGINEERING AND REGULATORY SERVICES

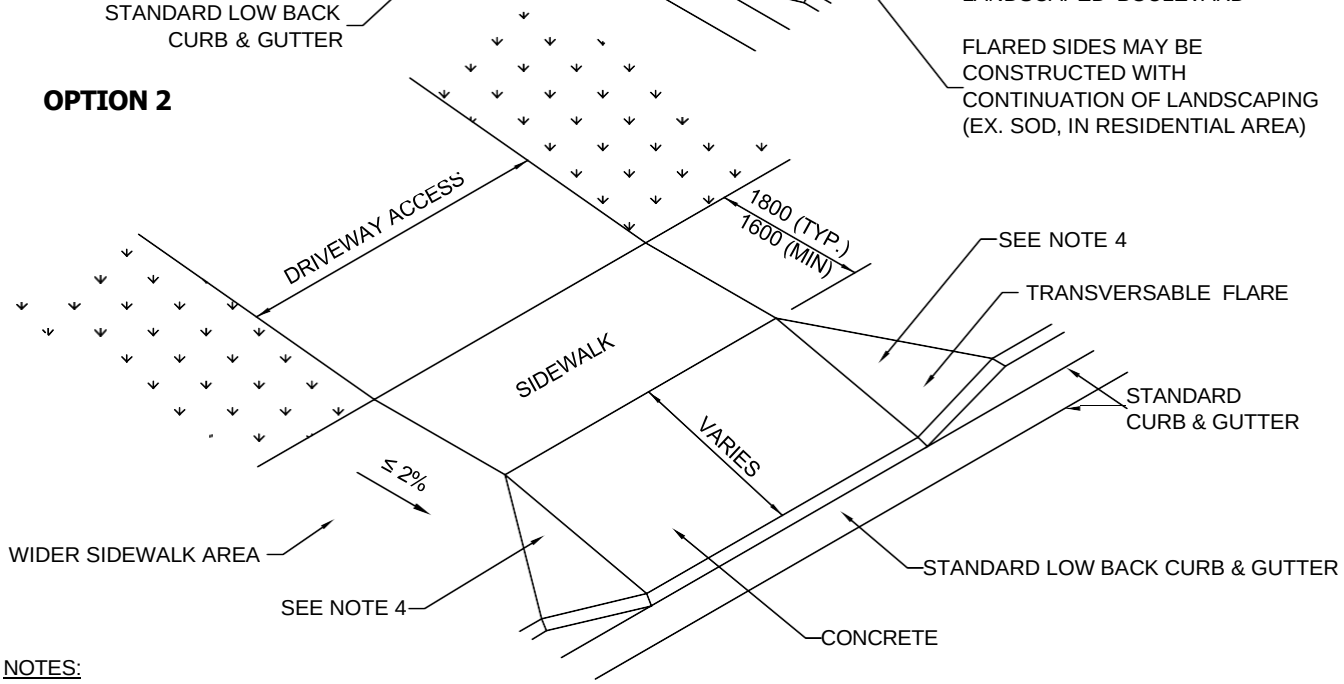
DISH GUTTER

DRAWN BY: R.C. / S.P.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-330-06

OPTION 1



OPTION 2



NOTES:

1. ACCESSIBLE CURB RAMPS SHALL BE PROVIDED AT ALL CROSSWALK LOCATIONS. RUNNING SLOPE TO BE 6.25% (PREFERRED), 10% MAXIMUM. (WITH RESPECT TO LEVEL, NOT STREET RUNNING SLOPE)

2. ACCESSIBLE CURB RAMPS SHALL ALIGN ORTHOGONALLY WITH THE CROSSWALK.

3. THE MINIMUM WIDTH OF CURB RAMPS, EXCLUSIVE OF FLARED SIDES, SHALL BE 1600mm FOR SIDEWALKS. THE MINIMUM WIDTH OF CURB RAMPS, EXCLUSIVE OF FLARED SIDES, SHALL BE 2700mm MIN FOR SHARED USE PATHS. WHERE AT A MARKED CROSSWALK, WIDTH OF CURB RAMP SHALL MATCH THAT OF CROSSWALK.

4. TRANSVERSABLE FLARED SIDES SHALL BE 1500mm (MIN) 2400mm (TYP) OR AS ILLUSTRATED, MEASURED AT THE CURB LOCATION.

5. FLARED SIDES SHALL BE 500mm (MIN.) OR AS ILLUSTRATED, MEASURED AT THE CURB LOCATION, BUT MAY BE BASED MORE ON SITE.

6. WHERE A COMMERCIAL GRADE SIDEWALK IS SPECIFIED, CONCRETE THICKNESS SHALL BE INCREASED TO:
   - 150mm FOR DRIVEWAYS WITH <=100 VEHICLES PER DAY.
   - 200mm FOR >100 VEHICLES PER DAY.
   - 200mm FOR ANY ACCESS THAT SERVES PRIMARILY COMMERCIAL VEHICLES.
   - PROVIDE WWR IN ALL COMMERCIAL GRADE SIDEWALK. (152 X 152 18.7/18.7 WWF)

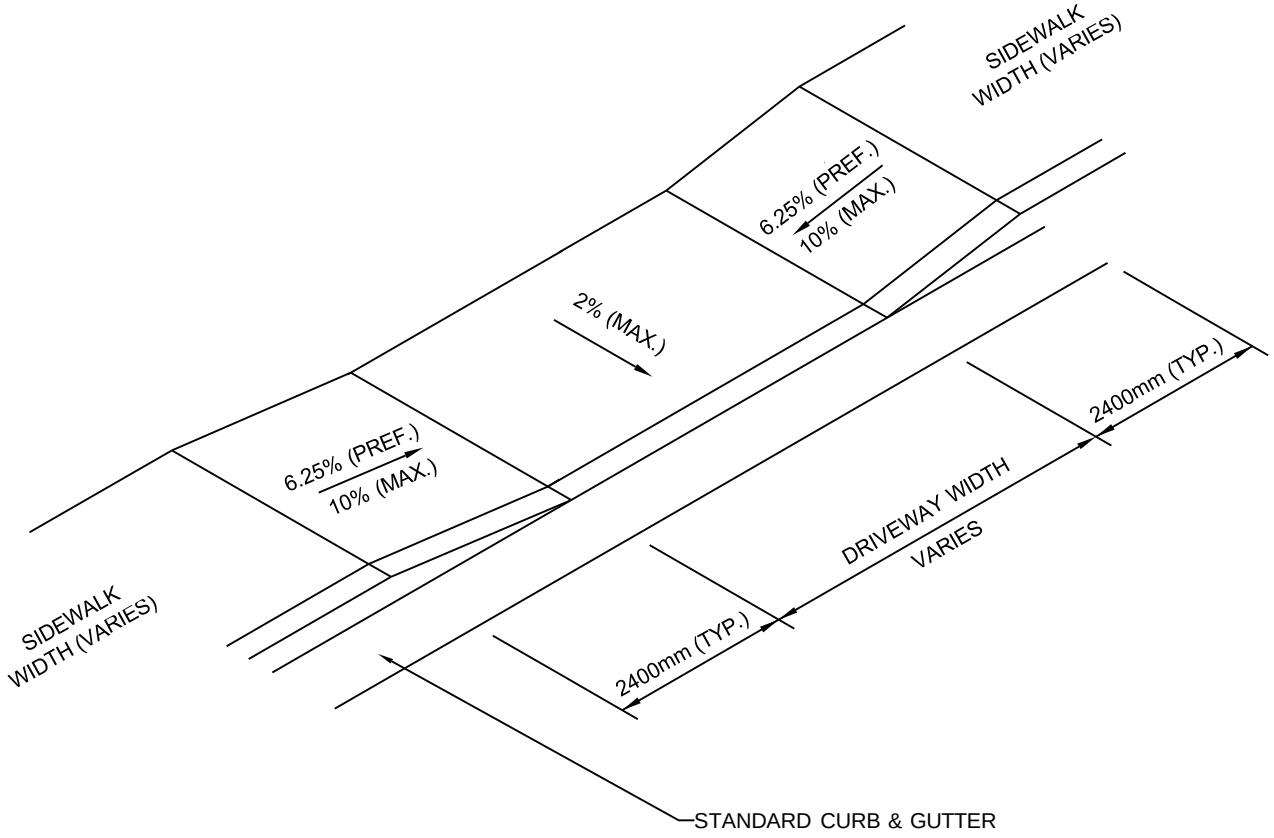
7. ALL LANDING AREAS OF PEDESTRIAN TRAVEL WAY SHALL HAVE ≤ 2% CROSS FALL.

8. REFER TO DETAIL (10-330-19) FOR DETECTABLE WARNING SURFACE PLACEMENT.

ST. JOHN'S
DEPARTMENT OF PLANNING, ENGINEERING AND REGULATORY SERVICES

STANDARD DRIVEWAY RAMP

DRAWN BY: S.P.	DATE: FEB. 2025	SCALE: N.T.S	DRAWING No. 10-330-07



NOTES:

1. ACCESSIBLE CURB RAMPS SHALL BE PROVIDED AT ALL CROSSWALK LOCATIONS. RUNNING SLOPE TO BE 6.25% (PREFERRED), 10% MAXIMUM. (WITH RESPECT TO LEVEL, NOT STREET RUNNING SLOPE)

2. ACCESSIBLE CURB RAMPS SHALL ALIGN ORTHOGONALLY WITH THE CROSSWALK.

3. THE MINIMUM WIDTH OF CURB RAMPS, EXCLUSIVE OF FLARED SIDES, SHALL BE 1600mm FOR SIDEWALKS. THE MINIMUM WIDTH OF CURB RAMPS, EXCLUSIVE OF FLARED SIDES, SHALL BE 2700mm MIN FOR SHARED USE PATHS. WHERE AT A MARKED CROSSWALK, WIDTH OF CURB RAMP SHALL MATCH THAT OF CROSSWALK.

4. FLARED SIDES SHALL BE 500mm (MIN.) OR AS ILLUSTRATED, MEASURED AT THE CURB LOCATION, BUT MAY BE BASED MORE ON SITE.

5. TRANSVERSABLE FLARED SIDES SHALL BE 1500mm (MIN) 2400mm (TYP) OR AS ILLUSTRATED, MEASURED AT THE CURB LOCATION.

6. WHERE A COMMERCIAL GRADE SIDEWALK IS SPECIFIED, CONCRETE THICKNESS SHALL BE INCREASED TO:
   - 150mm FOR DRIVEWAYS WITH <=100 VEHICLES PER DAY.
   - 200mm FOR >100 VEHICLES PER DAY.
   - 200mm FOR ANY ACCESS THAT SERVES PRIMARILY COMMERCIAL VEHICLES.
   - PROVIDE WWR IN ALL COMMERCIAL GRADE SIDEWALK. (152 X 152 18.7/18.7 WWF)

7. ALL LANDING AREAS OF PEDESTRIAN TRAVEL WAY SHALL HAVE $\leq$ 2% CROSS FALL.

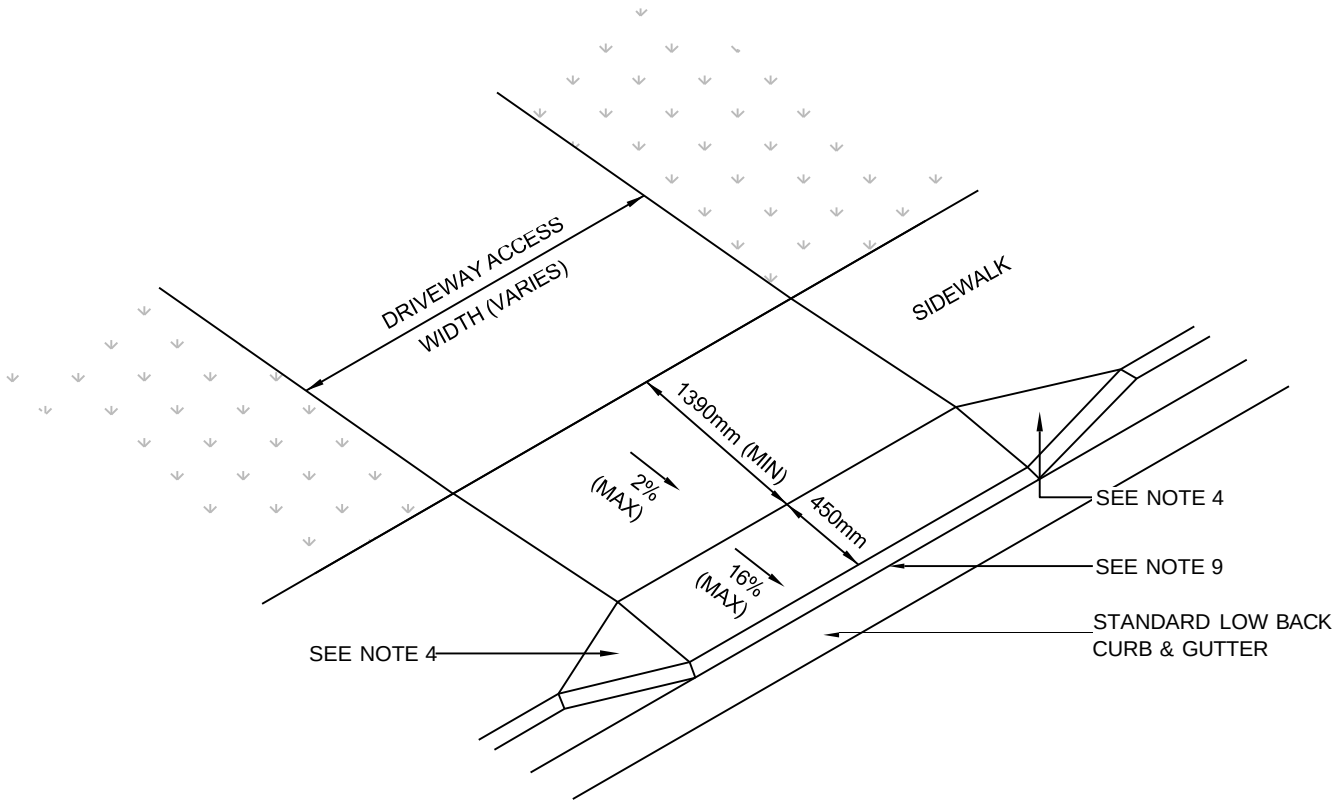
8. REFER TO DETAIL (10-330-19) FOR DETECTABLE WARNING SURFACE PLACEMENT.

9. REFER TO DETAIL (10-330-20) FOR TRUNCATED DOME DETECTABLE WARNING SURFACE PLATE.

ST. JOHN'S
DEPARTMENT OF PLANNING, ENGINEERING AND REGULATORY SERVICES

ALTERNATE DRIVEWAY RAMP

DRAWN BY: S.P.	DATE: FEB. 2025	SCALE: N.T.S	DRAWING No. 10-330-08



NOTES:

1. ACCESSIBLE CURB RAMPS SHALL BE PROVIDED AT ALL CROSSWALK LOCATIONS. RUNNING SLOPE TO BE 6.25% (PREFERRED), 10% MAXIMUM. (WITH RESPECT TO LEVEL, NOT STREET RUNNING SLOPE)

2. ACCESSIBLE CURB RAMPS SHALL ALIGN ORTHOGONALLY WITH THE CROSSWALK.

3. THE MINIMUM WIDTH OF CURB RAMPS, EXCLUSIVE OF FLARED SIDES, SHALL BE 1600mm FOR SIDEWALKS. THE MINIMUM WIDTH OF CURB RAMPS, EXCLUSIVE OF FLARED SIDES, SHALL BE 2700mm MIN FOR SHARED USE PATHS. WHERE AT A MARKED CROSSWALK, WIDTH OF CURB RAMP SHALL MATCH THAT OF CROSSWALK.

4. FLARED SIDES SHALL BE 500mm (MIN.) OR AS ILLUSTRATED, MEASURED AT THE CURB LOCATION, BUT MAY BE BASED MORE ON SITE.

5. TRANSVERSABLE FLARED SIDES SHALL BE 1500mm (MIN) 2400mm (TYP) OR AS ILLUSTRATED, MEASURED AT THE CURB LOCATION.

6. WHERE A COMMERCIAL GRADE SIDEWALK IS SPECIFIED, CONCRETE THICKNESS SHALL BE INCREASED TO:
   - 150mm FOR DRIVEWAYS WITH <=100 VEHICLES PER DAY.
   - 200mm FOR >100 VEHICLES PER DAY.
   - 200mm FOR ANY ACCESS THAT SERVES PRIMARILY COMMERCIAL VEHICLES.
   - PROVIDE WWR IN ALL COMMERCIAL GRADE SIDEWALK. (152 X 152 18.7/18.7 WWF)

7. ALL LANDING AREAS OF PEDESTRIAN TRAVEL WAY SHALL HAVE ≤ 2% CROSS FALL.

8. REFER TO DETAIL (10-330-19) FOR DETECTABLE WARNING SURFACE PLACEMENT.

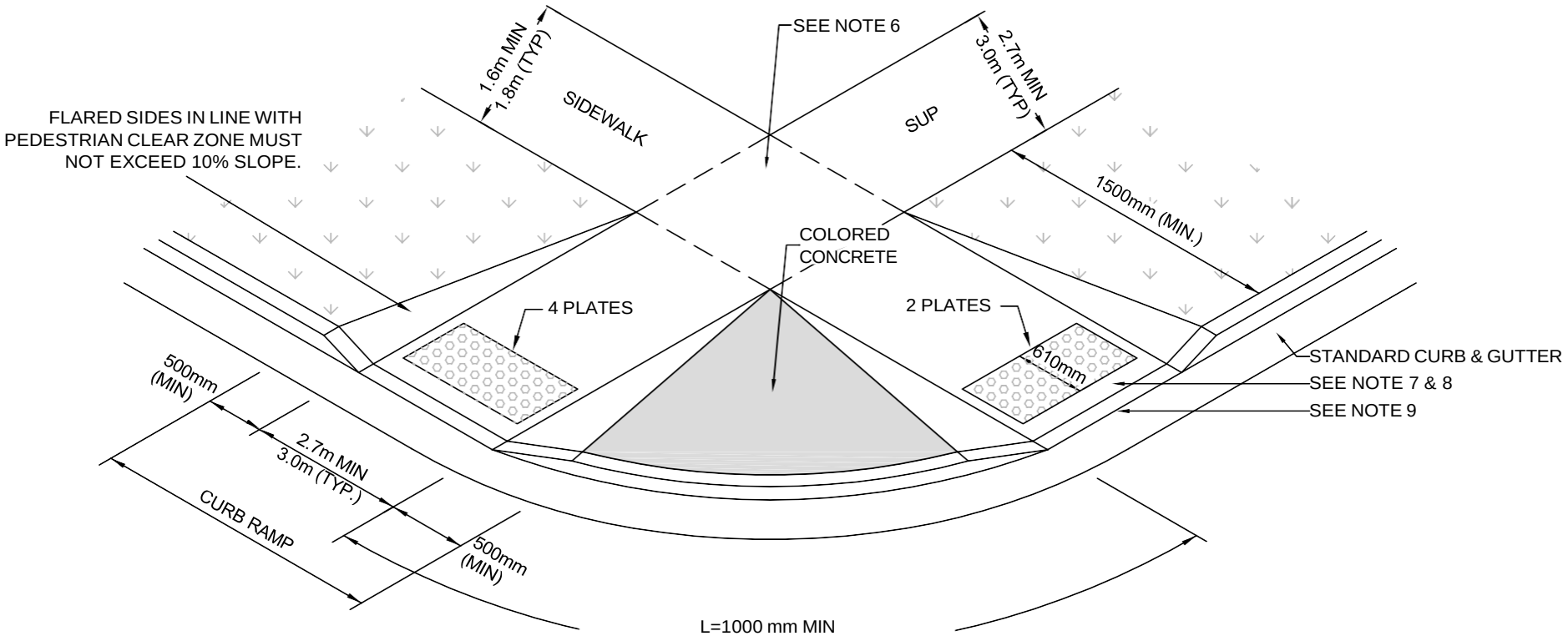
9. REFER TO DETAIL (10-330-20) FOR TRUNCATED DOME DETECTABLE WARNING SURFACE PLATE.

10. REFER TO DETAIL (10-330-21) FOR CURB RAMP TRANSITION SPECS.

ST. JOHN'S
DEPARTMENT OF PLANNING, ENGINEERING AND REGULATORY SERVICES

SHORT DRIVEWAY RAMP

DRAWN BY: S.P.	DATE: FEB. 2025	SCALE: N.T.S	DRAWING No. 10-330-09



NOTES:

1. ACCESSIBLE CURB RAMPS SHALL BE PROVIDED AT ALL CROSSWALK LOCATIONS. RUNNING SLOPE TO BE 6.25% (PREFERRED), 10% MAXIMUM. (WITH RESPECT TO LEVEL, NOT STREET RUNNING SLOPE)

2. ACCESSIBLE CURB RAMPS SHALL ALIGN ORTHOGONALLY WITH THE CROSSWALK.

3. THE MINIMUM WIDTH OF CURB RAMPS, EXCLUSIVE OF FLARED SIDES, SHALL BE 1600mm FOR SIDEWALKS. THE MINIMUM WIDTH OF CURB RAMPS, EXCLUSIVE OF FLARED SIDES, SHALL BE 2700mm MIN FOR SHARED USE PATHS. WHERE AT A MARKED CROSSWALK, WIDTH OF CURB RAMP SHALL MATCH THAT OF CROSSWALK.

4. FLARED SIDES SHALL BE 500mm (MIN.) OR AS ILLUSTRATED, MEASURED AT THE CURB LOCATION, BUT MAY BE BASED MORE ON SITE.

5. TRANSVERSABLE FLARED SIDES SHALL BE 1500mm (MIN) 2400mm (TYP) OR AS ILLUSTRATED, MEASURED AT THE CURB LOCATION.

6. WHERE A COMMERCIAL GRADE SIDEWALK IS SPECIFIED, CONCRETE THICKNESS SHALL BE INCREASED TO:
   - 150mm FOR DRIVEWAYS WITH <=100 VEHICLES PER DAY.
   - 200mm FOR >100 VEHICLES PER DAY.
   - 200mm FOR ANY ACCESS THAT SERVES PRIMARILY COMMERCIAL VEHICLES.
   - PROVIDE WWR IN ALL COMMERCIAL GRADE SIDEWALK. (152 X 152 18.7/18.7 WWF)

7. ALL LANDING AREAS OF PEDESTRIAN TRAVEL WAY SHALL HAVE $\leq$ 2% CROSS FALL.

8. REFER TO DETAIL (10-330-19) FOR DETECTABLE WARNING SURFACE PLACEMENT.

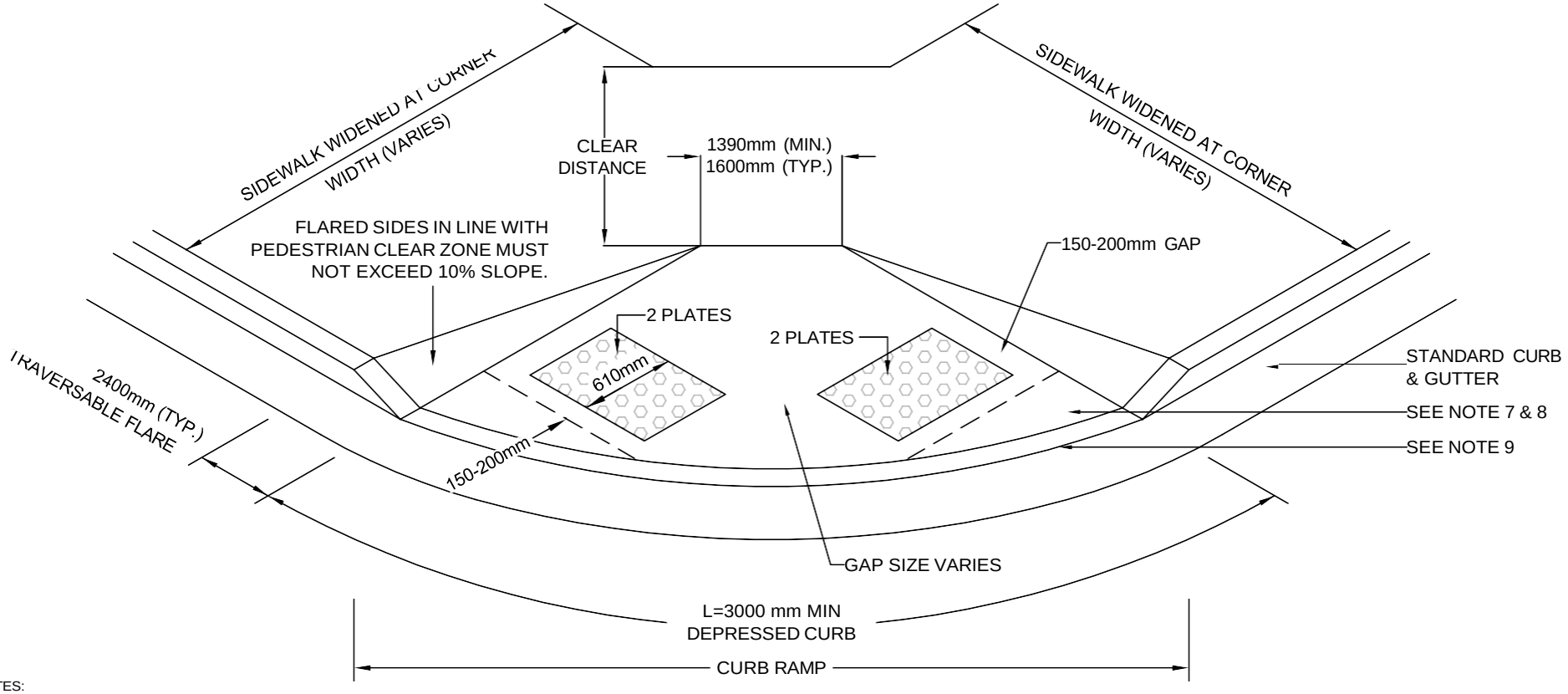
9. REFER TO DETAIL (10-330-20) FOR TRUNCATED DOME DETECTABLE WARNING SURFACE PLATE.

10. REFER TO DETAIL (10-330-21) FOR CURB RAMP TRANSITION SPECS.

ST. JOHN'S
DEPARTMENT OF PLANNING, ENGINEERING AND REGULATORY SERVICES

STANDARD CURB RAMP

DRAWN BY:	S.P.	DATE:	FEB. 2025	SCALE:	N.T.S.	DRAWING No.	10-330-11



NOTES:

1. ACCESSIBLE CURB RAMPS SHALL BE PROVIDED AT ALL CROSSWALK LOCATIONS. RUNNING SLOPE TO BE 6.25% (PREFERRED), 10% MAXIMUM. (WITH RESPECT TO LEVEL, NOT STREET RUNNING SLOPE)

2. ACCESSIBLE CURB RAMPS SHALL ALIGN ORTHOGONALLY WITH THE CROSSWALK.

3. THE MINIMUM WIDTH OF CURB RAMPS, EXCLUSIVE OF FLARED SIDES, SHALL BE 1600mm FOR SIDEWALKS. THE MINIMUM WIDTH OF CURB RAMPS, EXCLUSIVE OF FLARED SIDES, SHALL BE 2700mm MIN FOR SHARED USE PATHS. WHERE AT A MARKED CROSSWALK, WIDTH OF CURB RAMP SHALL MATCH THAT OF CROSSWALK.

4. FLARED SIDES SHALL BE 500mm (MIN.) OR AS ILLUSTRATED, MEASURED AT THE CURB LOCATION, BUT MAY BE BASED MORE ON SITE.

5. TRANSVERSABLE FLARED SIDES SHALL BE 1500mm (MIN) 2400mm (TYP) OR AS ILLUSTRATED, MEASURED AT THE CURB LOCATION.

6. WHERE A COMMERCIAL GRADE SIDEWALK IS SPECIFIED, CONCRETE THICKNESS SHALL BE INCREASED TO:
   - 150mm FOR DRIVEWAYS WITH <=100 VEHICLES PER DAY.
   - 200mm FOR >100 VEHICLES PER DAY.
   - 200mm FOR ANY ACCESS THAT SERVES PRIMARILY COMMERCIAL VEHICLES.
   - PROVIDE WWR IN ALL COMMERCIAL GRADE SIDEWALK. (152 X 152 18.7/18.7 WWF)

7. ALL LANDING AREAS OF PEDESTRIAN TRAVEL WAY SHALL HAVE ≤ 2% CROSS FALL.

8. REFER TO DETAIL (10-330-19) FOR DETECTABLE WARNING SURFACE PLACEMENT.

9. REFER TO DETAIL (10-330-20) FOR TRUNCATED DOME DETECTABLE WARNING SURFACE PLATE.

10. REFER TO DETAIL (10-330-21) FOR CURB RAMP TRANSITION SPECS.

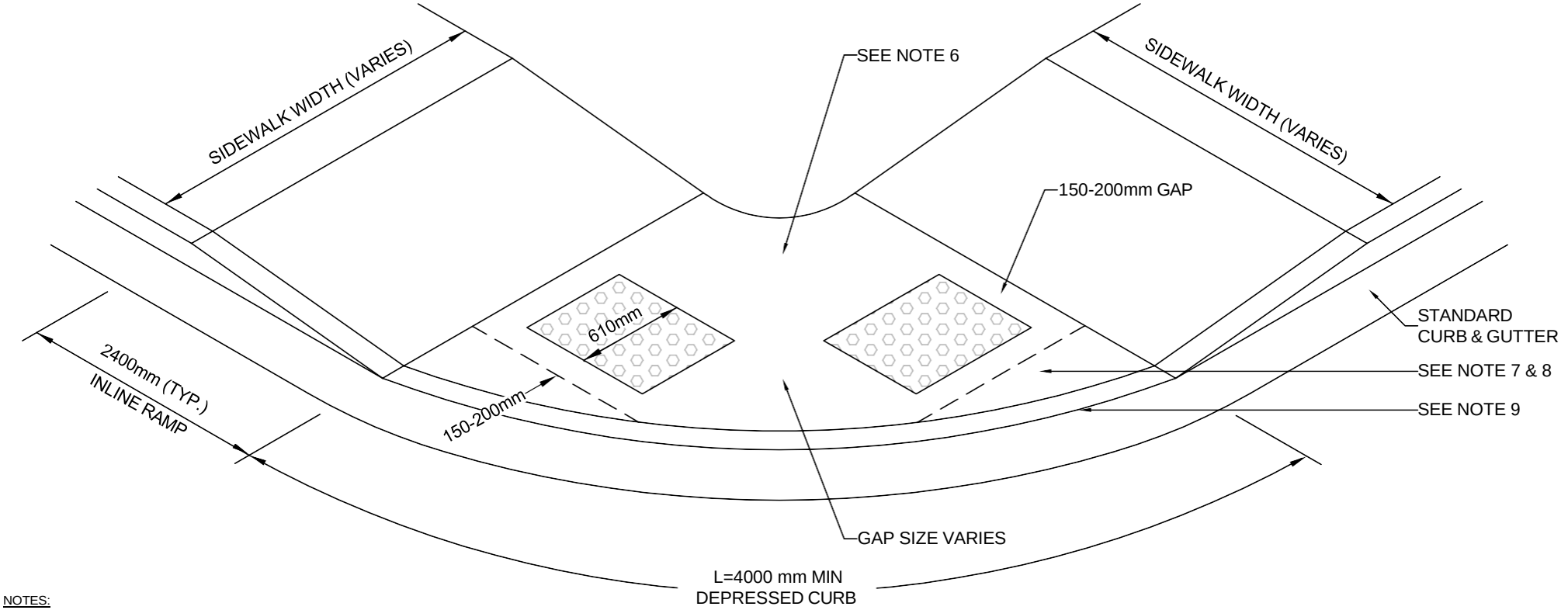
ST. JOHN'S

DEPARTMENT OF PLANNING, ENGINEERING AND REGULATORY SERVICES

ALTERNATE CURB RAMP

(INSUFFICIENT BOULEVARD/ SIDEWALK WIDTH TO ACHIEVE STANDARD)

DRAWN BY: S.P.	DATE: FEB. 2025	SCALE: N.T.S.	DRAWING No. 10-330-12



NOTES:

1. ACCESSIBLE CURB RAMPS SHALL BE PROVIDED AT ALL CROSSWALK LOCATIONS. RUNNING SLOPE TO BE 6.25% (PREFERRED), 10% MAXIMUM. (WITH RESPECT TO LEVEL, NOT STREET RUNNING SLOPE)

2. ACCESSIBLE CURB RAMPS SHALL ALIGN ORTHOGONALLY WITH THE CROSSWALK.

3. THE MINIMUM WIDTH OF CURB RAMPS, EXCLUSIVE OF FLARED SIDES, SHALL BE 1500mm.

4. FLARED SIDES SHALL BE 500mm (MIN.) OR AS ILLUSTRATED, MEASURED AT THE CURB LOCATION, BUT MAY BE BASED MORE ON SITE.

5. WHERE A COMMERCIAL GRADE SIDEWALK IS SPECIFIED, CONCRETE THICKNESS SHALL BE INCREASED TO:
   - 150mm FOR DRIVEWAYS WITH <=100 VEHICLES PER DAY.
   - 200mm FOR >100 VEHICLES PER DAY.
   - 200mm FOR ANY ACCESS THAT SERVES PRIMARILY COMMERCIAL VEHICLES.
   - PROVIDE WWR IN ALL COMMERCIAL GRADE SIDEWALK. (152 X 152 18.7/18.7 WWF)

6. ALL LANDING AREAS OF PEDESTRIAN TRAVEL WAY SHALL HAVE ≤ 2% CROSS FALL.

7. REFER TO DETAIL (10-330-19) FOR DETECTABLE WARNING SURFACE PLACEMENT.

8. REFER TO DETAIL (10-330-20) FOR TRUNCATED DOME DETECTABLE WARNING SURFACE PLATE.

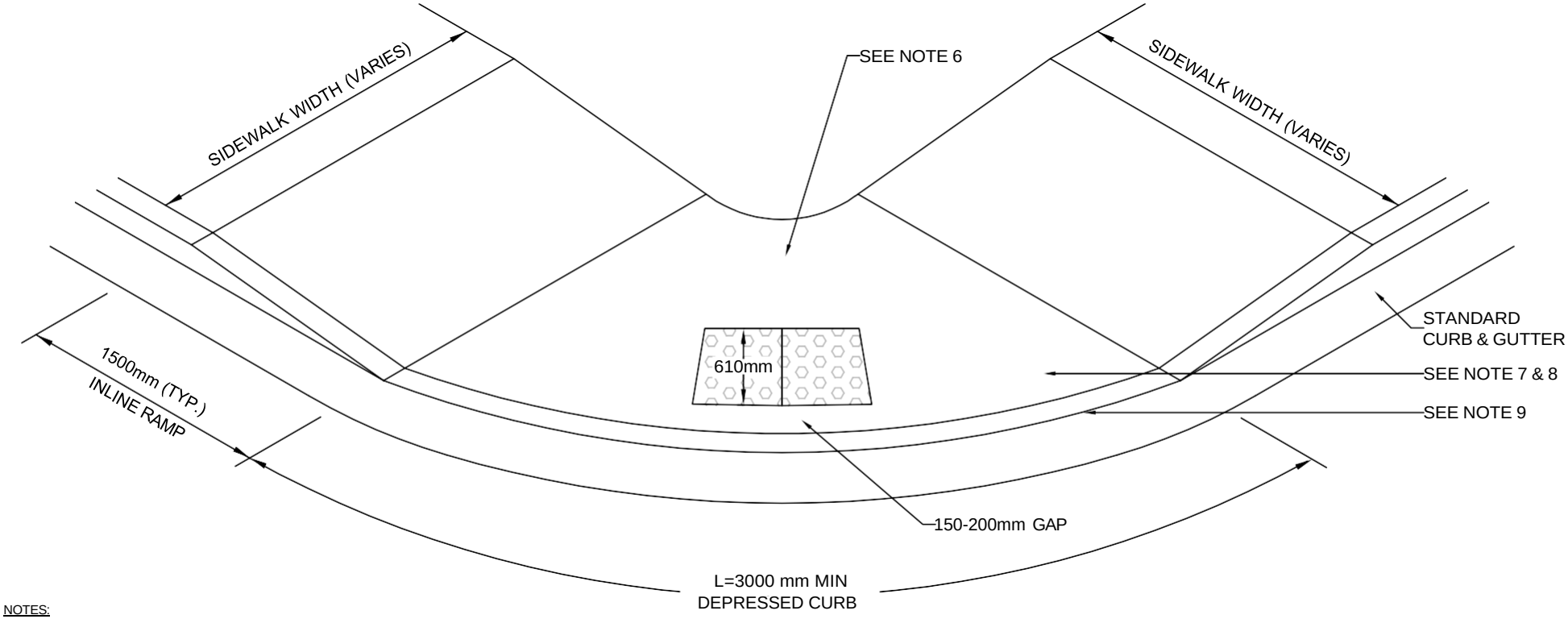
9. REFER TO DETAIL (10-330-21) FOR CURB RAMP TRANSITION SPECS.

ST. JOHN'S
DEPARTMENT OF PLANNING, ENGINEERING AND REGULATORY SERVICES

MINIMUM CURB RAMP-A

(RETROFIT ONLY; NOT POSSIBLE TO PROVIDE STANDARD OR ALTERNATE)

DRAWN BY:	S.P.	DATE:	JANUARY 2022	SCALE:	N.T.S.	DRAWING No.	10-330-13



NOTES:

1. ACCESSIBLE CURB RAMPS SHALL BE PROVIDED AT ALL CROSSWALK LOCATIONS. RUNNING SLOPE TO BE 6.25% (PREFERRED), 10% MAXIMUM. (WITH RESPECT TO LEVEL, NOT STREET RUNNING SLOPE)

2. ACCESSIBLE CURB RAMPS SHALL ALIGN ORTHOGONALLY WITH THE CROSSWALK.

3. THE MINIMUM WIDTH OF CURB RAMPS, EXCLUSIVE OF FLARED SIDES, SHALL BE 1600mm FOR SIDEWALKS. THE MINIMUM WIDTH OF CURB RAMPS, EXCLUSIVE OF FLARED SIDES, SHALL BE 2700mm MIN FOR SHARED USE PATHS. WHERE AT A MARKED CROSSWALK, WIDTH OF CURB RAMP SHALL MATCH THAT OF CROSSWALK.

4. FLARED SIDES SHALL BE 500mm (MIN.) OR AS ILLUSTRATED, MEASURED AT THE CURB LOCATION, BUT MAY BE BASED MORE ON SITE.

5. TRANSVERSABLE FLARED SIDES SHALL BE 1500mm (MIN) 2400mm (TYP) OR AS ILLUSTRATED, MEASURED AT THE CURB LOCATION.

6. WHERE A COMMERCIAL GRADE SIDEWALK IS SPECIFIED, CONCRETE THICKNESS SHALL BE INCREASED TO:
   - 150mm FOR DRIVEWAYS WITH <=100 VEHICLES PER DAY.
   - 200mm FOR >100 VEHICLES PER DAY.
   - 200mm FOR ANY ACCESS THAT SERVES PRIMARILY COMMERCIAL VEHICLES.
   - PROVIDE WWR IN ALL COMMERCIAL GRADE SIDEWALK. (152 X 152 18.7/18.7 WWF)

7. ALL LANDING AREAS OF PEDESTRIAN TRAVEL WAY SHALL HAVE ≤ 2% CROSS FALL.

8. REFER TO DETAIL (10-330-16) FOR DETECTABLE WARNING SURFACE PLACEMENT.

9. REFER TO DETAIL (10-330-17) FOR TRUNCATED DOME DETECTABLE WARNING SURFACE PLATE.

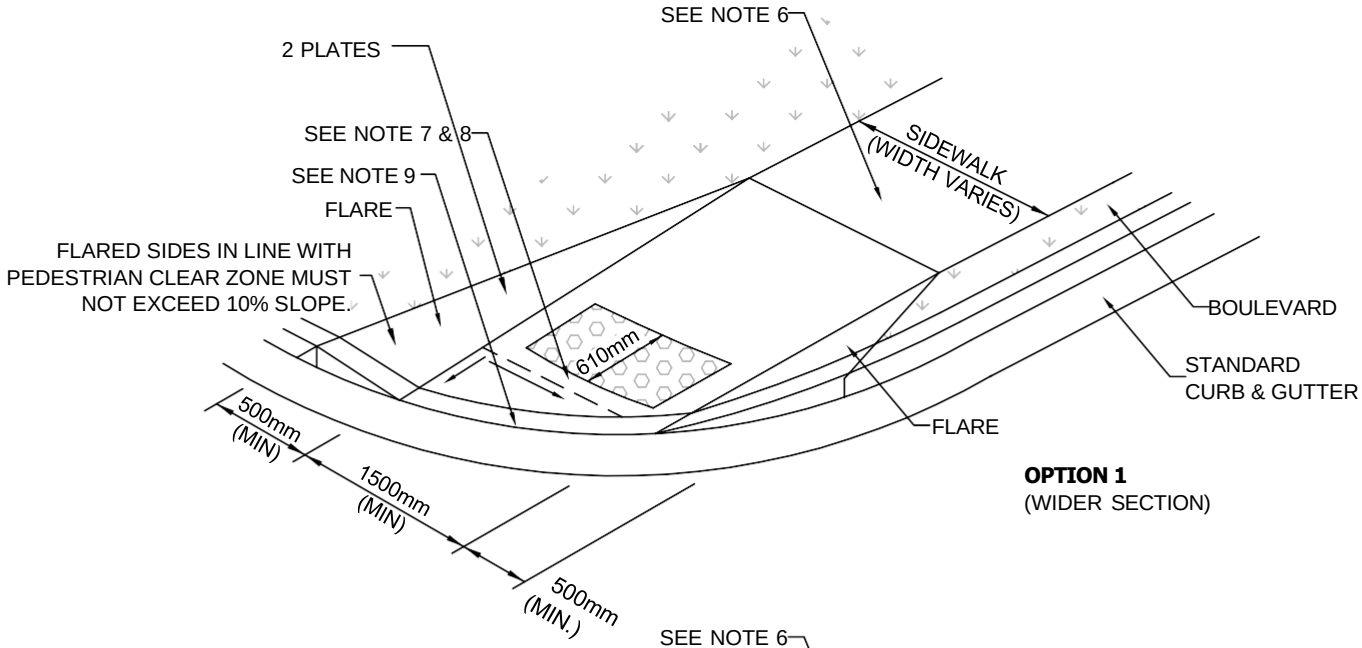
10. REFER TO DETAIL (10-330-18) FOR CURB RAMP TRANSITION SPECS.

ST. JOHN'S
DEPARTMENT OF PLANNING, ENGINEERING AND REGULATORY SERVICES

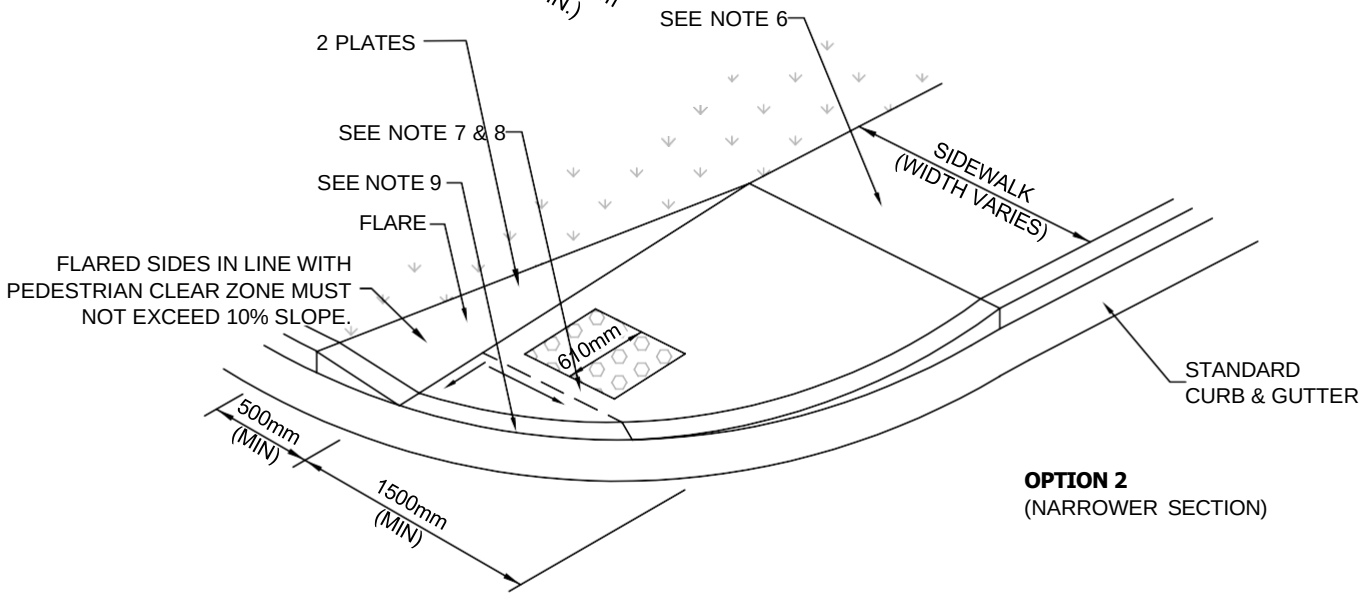
MINIMUM CURB RAMP-B

(RETROFIT ONLY; SMALL RADIUS WITH NO OTHER OPTION)

DRAWN BY:	DATE:	SCALE:	DRAWING No.
S.P.	FEB. 2025	N.T.S.	10-330-14



OPTION 1
(WIDER SECTION)



OPTION 2
(NARROWER SECTION)

NOTES:

1. ACCESSIBLE CURB RAMPS SHALL BE PROVIDED AT ALL CROSSWALK LOCATIONS. RUNNING SLOPE TO BE 6.25% (PREFERRED), 10% MAXIMUM. (WITH RESPECT TO LEVEL, NOT STREET RUNNING SLOPE)

2. ACCESSIBLE CURB RAMPS SHALL ALIGN ORTHOGONALLY WITH THE CROSSWALK.

3. THE MINIMUM WIDTH OF CURB RAMPS, EXCLUSIVE OF FLARED SIDES, SHALL BE 1600mm FOR SIDEWALKS. THE MINIMUM WIDTH OF CURB RAMPS, EXCLUSIVE OF FLARED SIDES, SHALL BE 2700mm MIN FOR SHARED USE PATHS. WHERE AT A MARKED CROSSWALK, WIDTH OF CURB RAMP SHALL MATCH THAT OF CROSSWALK.

4. FLARED SIDES SHALL BE 500mm (MIN.) OR AS ILLUSTRATED, MEASURED AT THE CURB LOCATION, BUT MAY BE BASED MORE ON SITE.

5. TRANSVERSABLE FLARED SIDES SHALL BE 1500mm (MIN) 2400mm (TYP) OR AS ILLUSTRATED, MEASURED AT THE CURB LOCATION.

6. WHERE A COMMERCIAL GRADE SIDEWALK IS SPECIFIED, CONCRETE THICKNESS SHALL BE INCREASED TO:
   - 150mm FOR DRIVEWAYS WITH <=100 VEHICLES PER DAY.
   - 200mm FOR >100 VEHICLES PER DAY.
   - 200mm FOR ANY ACCESS THAT SERVES PRIMARILY COMMERCIAL VEHICLES.
   - PROVIDE WWR IN ALL COMMERCIAL GRADE SIDEWALK. (152 X 152 18.7/18.7 WWF)

7. ALL LANDING AREAS OF PEDESTRIAN TRAVEL WAY SHALL HAVE ≤ 2% CROSS FALL.

8. REFER TO DETAIL (10-330-19) FOR DETECTABLE WARNING SURFACE PLACEMENT.

9. REFER TO DETAIL (10-330-20) FOR TRUNCATED DOME DETECTABLE WARNING SURFACE PLATE.

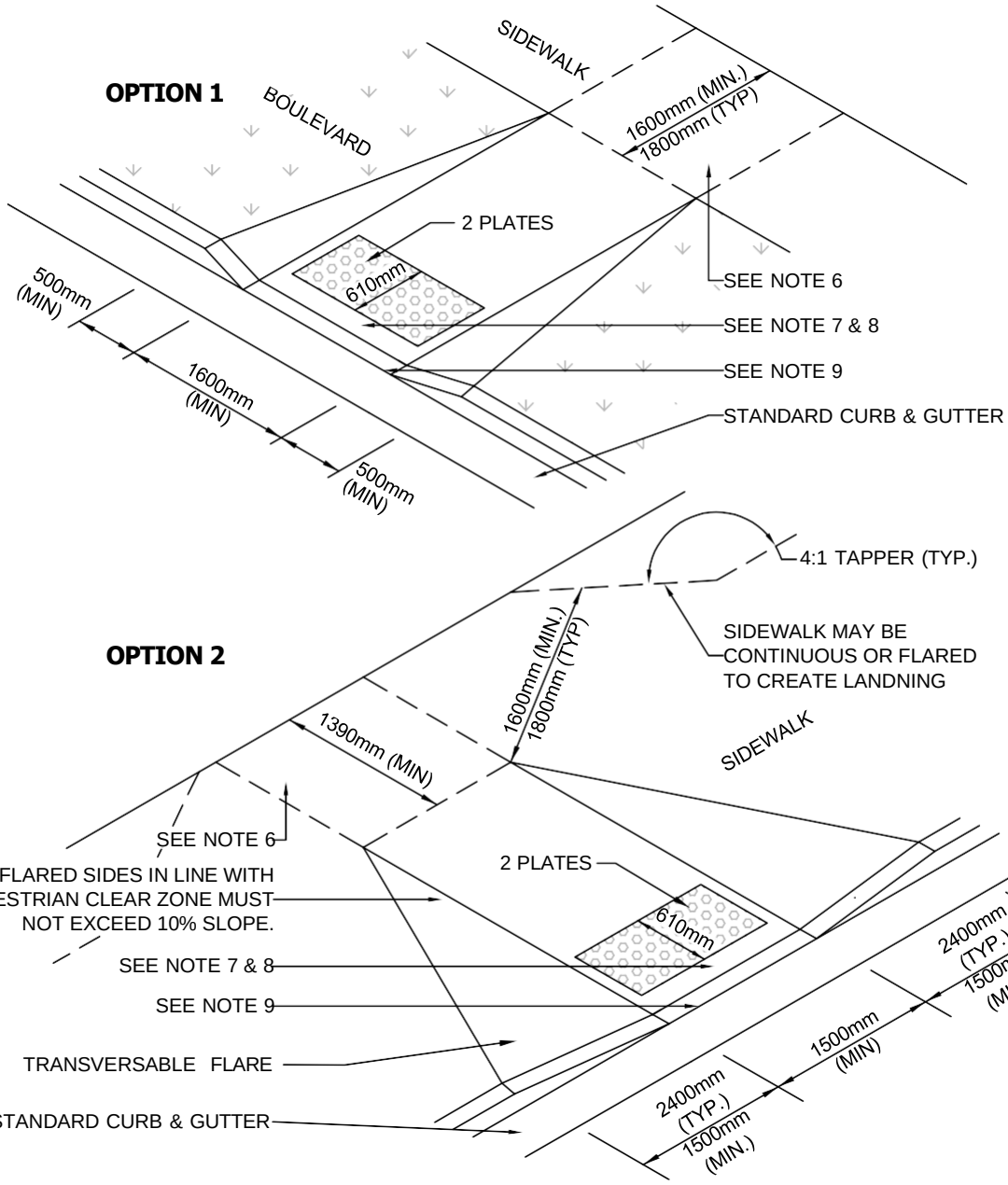
10. REFER TO DETAIL (10-330-21) FOR CURB RAMP TRANSITION SPECS.

ST. JOHN'S
DEPARTMENT OF PLANNING, ENGINEERING AND REGULATORY SERVICES

SINGLE DIRECTION CURB RAMP

(ONLY USED WHEN ORTHOGONAL CROSSING TO BE ACTIVELY DISCOURAGED)

DRAWN BY: S.P.	DATE: FEB. 2025	SCALE: N.T.S	DRAWING No. 10-330-15



NOTES:

1. ACCESSIBLE CURB RAMPS SHALL BE PROVIDED AT ALL CROSSWALK LOCATIONS. RUNNING SLOPE TO BE 6.25% (PREFERRED), 10% MAXIMUM. (WITH RESPECT TO LEVEL, NOT STREET RUNNING SLOPE)

2. ACCESSIBLE CURB RAMPS SHALL ALIGN ORTHOGONALLY WITH THE CROSSWALK.

3. THE MINIMUM WIDTH OF CURB RAMPS, EXCLUSIVE OF FLARED SIDES, SHALL BE 1600mm FOR SIDEWALKS. THE MINIMUM WIDTH OF CURB RAMPS, EXCLUSIVE OF FLARED SIDES, SHALL BE 2700mm MIN FOR SHARED USE PATHS. WHERE AT A MARKED CROSSWALK, WIDTH OF CURB RAMP SHALL MATCH THAT OF CROSSWALK.

4. FLARED SIDES SHALL BE 500mm (MIN.) OR AS ILLUSTRATED, MEASURED AT THE CURB LOCATION, BUT MAY BE BASED MORE ON SITE.

5. TRANSVERSABLE FLARED SIDES SHALL BE 1500mm (MIN) 2400mm (TYP) OR AS ILLUSTRATED, MEASURED AT THE CURB LOCATION.

6. WHERE A COMMERCIAL GRADE SIDEWALK IS SPECIFIED, CONCRETE THICKNESS SHALL BE INCREASED TO:
   - 150mm FOR DRIVEWAYS WITH <=100 VEHICLES PER DAY.
   - 200mm FOR >100 VEHICLES PER DAY.
   - 200mm FOR ANY ACCESS THAT SERVES PRIMARILY COMMERCIAL VEHICLES.
   - PROVIDE WWR IN ALL COMMERCIAL GRADE SIDEWALK. (152 X 152 18.7/18.7 WWF)

7. ALL LANDING AREAS OF PEDESTRIAN TRAVEL WAY SHALL HAVE ≤ 2% CROSS FALL.

8. REFER TO DETAIL (10-330-19) FOR DETECTABLE WARNING SURFACE PLACEMENT.

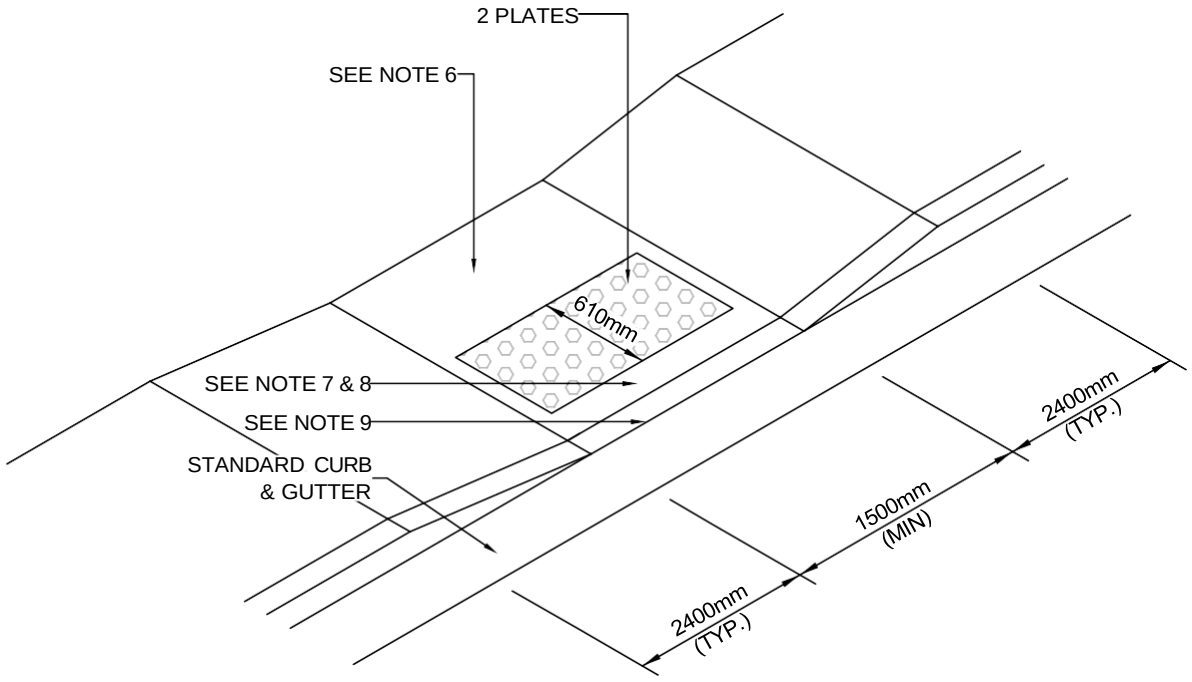
9. REFER TO DETAIL (10-330-20) FOR TRUNCATED DOME DETECTABLE WARNING SURFACE PLATE.

10. REFER TO DETAIL (10-330-21) FOR CURB RAMP TRANSITION SPECS.

ST. JOHN'S
DEPARTMENT OF PLANNING, ENGINEERING AND REGULATORY SERVICES

STANDARD MID-BLOCK CURB RAMP

DRAWN BY: S.P.	DATE: FEB. 2025	SCALE: N.T.S	DRAWING No. 10-330-16



NOTES:

1. ACCESSIBLE CURB RAMPS SHALL BE PROVIDED AT ALL CROSSWALK LOCATIONS. RUNNING SLOPE TO BE 6.25% (PREFERRED), 10% MAXIMUM. (WITH RESPECT TO LEVEL, NOT STREET RUNNING SLOPE)

2. ACCESSIBLE CURB RAMPS SHALL ALIGN ORTHOGONALLY WITH THE CROSSWALK.

3. THE MINIMUM WIDTH OF CURB RAMPS, EXCLUSIVE OF FLARED SIDES, SHALL BE 1600mm FOR SIDEWALKS. THE MINIMUM WIDTH OF CURB RAMPS, EXCLUSIVE OF FLARED SIDES, SHALL BE 2700mm MIN FOR SHARED USE PATHS. WHERE AT A MARKED CROSSWALK, WIDTH OF CURB RAMP SHALL MATCH THAT OF CROSSWALK.

4. FLARED SIDES SHALL BE 500mm (MIN.) OR AS ILLUSTRATED, MEASURED AT THE CURB LOCATION, BUT MAY BE BASED MORE ON SITE.

5. TRANSVERSABLE FLARED SIDES SHALL BE 1500mm (MIN) 2400mm (TYP) OR AS ILLUSTRATED, MEASURED AT THE CURB LOCATION.

6. WHERE A COMMERCIAL GRADE SIDEWALK IS SPECIFIED, CONCRETE THICKNESS SHALL BE INCREASED TO:
   - 150mm FOR DRIVEWAYS WITH <=100 VEHICLES PER DAY.
   - 200mm FOR >100 VEHICLES PER DAY.
   - 200mm FOR ANY ACCESS THAT SERVES PRIMARILY COMMERCIAL VEHICLES.
   - PROVIDE WWR IN ALL COMMERCIAL GRADE SIDEWALK. (152 X 152 18.7/18.7 WWF)

7. ALL LANDING AREAS OF PEDESTRIAN TRAVEL WAY SHALL HAVE ≤ 2% CROSS FALL.

8. REFER TO DETAIL (10-330-19) FOR DETECTABLE WARNING SURFACE PLACEMENT.

9. REFER TO DETAIL (10-330-20) FOR TRUNCATED DOME DETECTABLE WARNING SURFACE PLATE.

10. REFER TO DETAIL (10-330-21) FOR CURB RAMP TRANSITION SPECS.

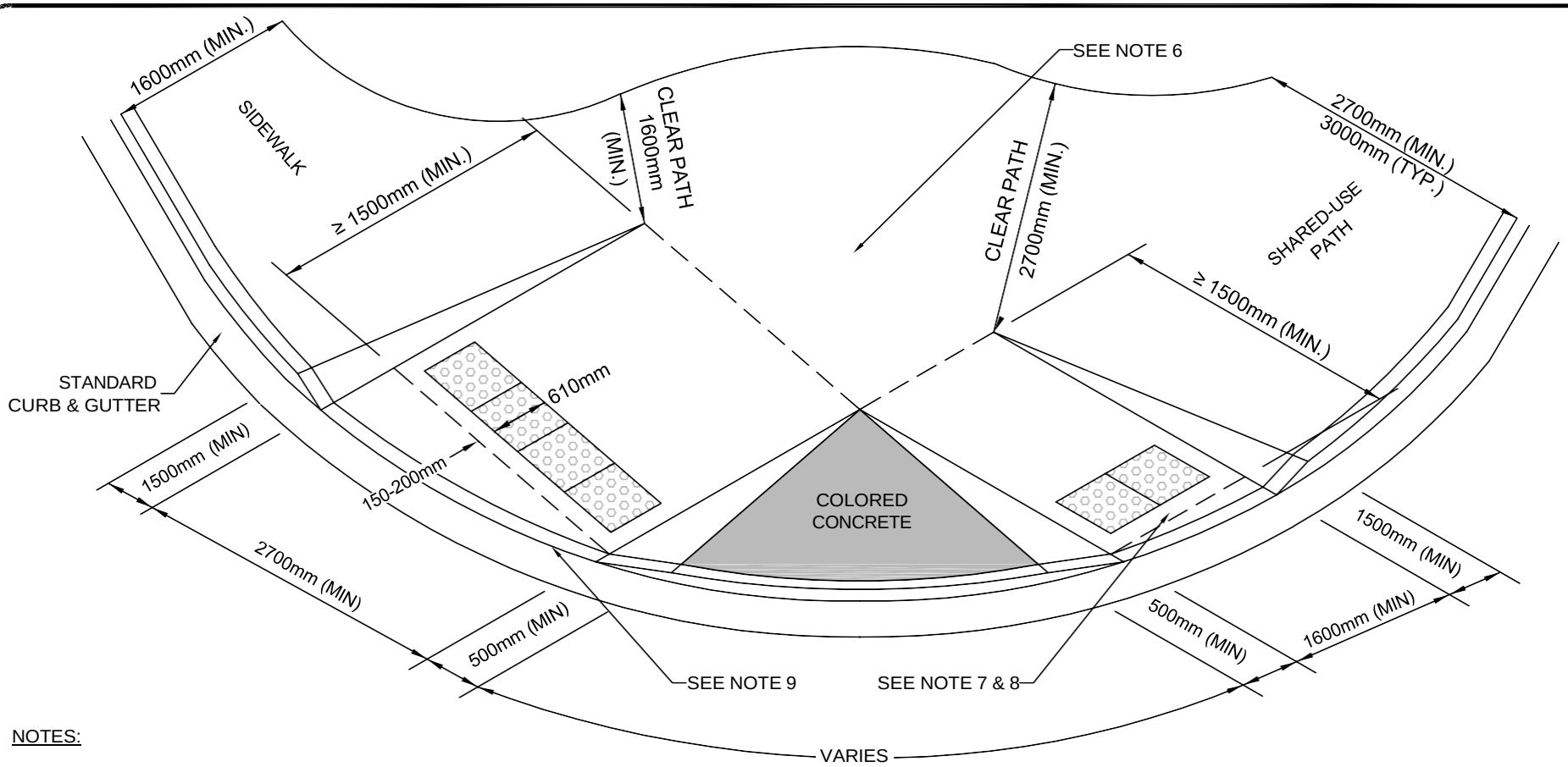
ST. JOHN'S

DEPARTMENT OF PLANNING, ENGINEERING AND REGULATORY SERVICES

ALTERNATE MID-BLOCK CURB RAMP

(INSUFFICIENT SIDEWALK WIDTH TO ACHIEVE STANDARD)

DRAWN BY: S.P.	DATE: FEB. 2025	SCALE: N.T.S	DRAWING No. 10-330-17



NOTES:

1. ACCESSIBLE CURB RAMPS SHALL BE PROVIDED AT ALL CROSSWALK LOCATIONS. RUNNING SLOPE TO BE 6.25% (PREFERRED), 10% MAXIMUM. (WITH RESPECT TO LEVEL, NOT STREET RUNNING SLOPE)

2. ACCESSIBLE CURB RAMPS SHALL ALIGN ORTHOGONALLY WITH THE CROSSWALK.

3. THE MINIMUM WIDTH OF CURB RAMPS, EXCLUSIVE OF FLARED SIDES, SHALL BE 1600mm FOR SIDEWALKS. THE MINIMUM WIDTH OF CURB RAMPS, EXCLUSIVE OF FLARED SIDES, SHALL BE 2700mm MIN FOR SHARED USE PATHS. WHERE AT A MARKED CROSSWALK, WIDTH OF CURB RAMP SHALL MATCH THAT OF CROSSWALK.

4. FLARED SIDES SHALL BE 500mm (MIN.) OR AS ILLUSTRATED, MEASURED AT THE CURB LOCATION, BUT MAY BE BASED MORE ON SITE.

5. TRANSVERSABLE FLARED SIDES SHALL BE 1500mm (MIN) 2400mm (TYP) OR AS ILLUSTRATED, MEASURED AT THE CURB LOCATION.

6. WHERE A COMMERCIAL GRADE SIDEWALK IS SPECIFIED, CONCRETE THICKNESS SHALL BE INCREASED TO:
   - 150mm FOR DRIVEWAYS WITH <=100 VEHICLES PER DAY.
   - 200mm FOR >100 VEHICLES PER DAY.
   - 200mm FOR ANY ACCESS THAT SERVES PRIMARILY COMMERCIAL VEHICLES.
   - PROVIDE WWR IN ALL COMMERCIAL GRADE SIDEWALK. (152 X 152 18.7/18.7 WWF)

7. ALL LANDING AREAS OF PEDESTRIAN TRAVEL WAY SHALL HAVE ≤ 2% CROSS FALL.

8. REFER TO DETAIL (10-330-19) FOR DETECTABLE WARNING SURFACE PLACEMENT.

9. REFER TO DETAIL (10-330-20) FOR TRUNCATED DOME DETECTABLE WARNING SURFACE PLATE.

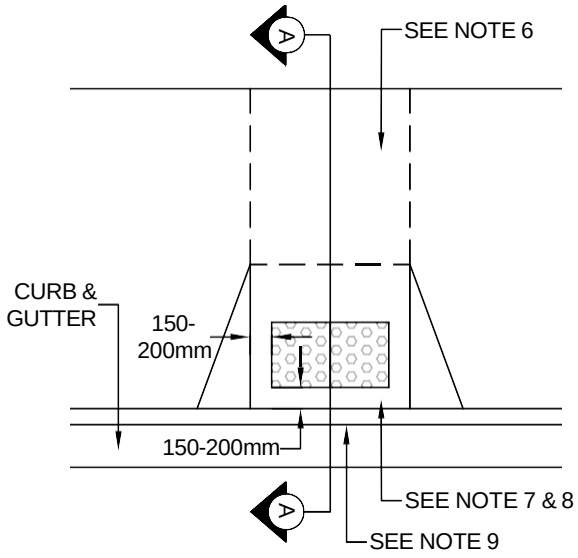
10. REFER TO DETAIL (10-330-21) FOR CURB RAMP TRANSITION SPECS.

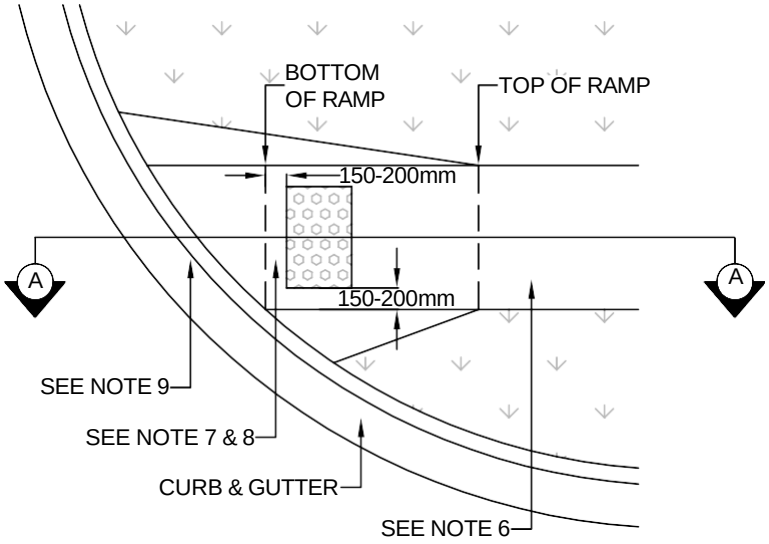
ST. JOHN'S
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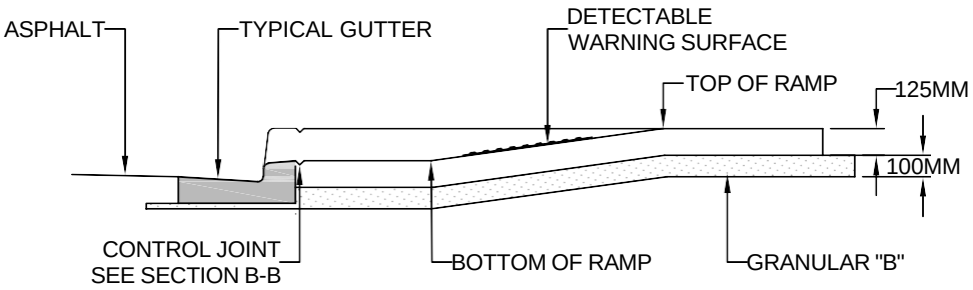
SHARED-USE PATH & SIDEWALK TYPICAL TREATMENT

(EXAMPLE IMPLANTATION)

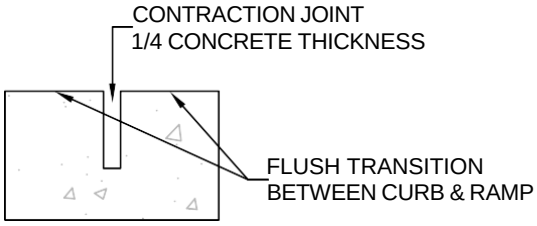
DRAWN BY:	S.P.	DATE:	FEB. 2025	SCALE:	N.T.S.	DRAWING No.	10-330-18







SECTION A-A



SECTION B-B

NOTES:

1. ACCESSIBLE CURB RAMPS SHALL BE PROVIDED AT ALL CROSSWALK LOCATIONS. RUNNING SLOPE TO BE 6.25% (PREFERRED), 10% MAXIMUM. (WITH RESPECT TO LEVEL, NOT STREET RUNNING SLOPE)

2. ACCESSIBLE CURB RAMPS SHALL ALIGN ORTHOGONALLY WITH THE CROSSWALK.

3. THE MINIMUM WIDTH OF CURB RAMPS, EXCLUSIVE OF FLARED SIDES, SHALL BE 1500mm.

4. FLARED SIDES SHALL BE 500mm (MIN.) OR AS ILLUSTRATED, MEASURED AT THE CURB LOCATION, BUT MAY BE BASED MORE ON SITE.

5. WHERE A COMMERCIAL GRADE SIDEWALK IS SPECIFIED, CONCRETE THICKNESS SHALL BE INCREASED TO:
   - 150mm FOR DRIVEWAYS WITH <=100 VEHICLES PER DAY.
   - 200mm FOR >100 VEHICLES PER DAY.
   - 200mm FOR ANY ACCESS THAT SERVES PRIMARILY COMMERCIAL VEHICLES.
   - PROVIDE WWR IN ALL COMMERCIAL GRADE SIDEWALK.

6. ALL LANDING AREAS OF PEDESTRIAN TRAVEL WAY SHALL HAVE ≤ 2% CROSS FALL.

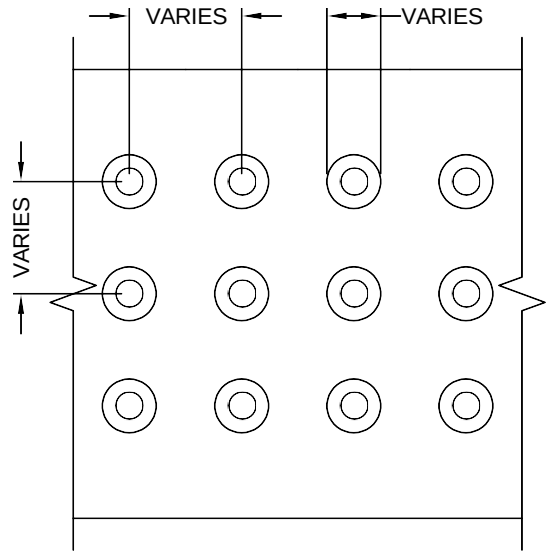
7. REFER TO DETAIL (10-330-20) FOR TRUNCATED DOME DETECTABLE WARNING SURFACE PLATE.

8. REFER TO DETAIL (10-330-21) FOR CURB RAMP TRANSITION SPECS.

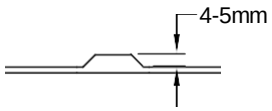
ST. JOHN'S
DEPARTMENT OF PLANNING, ENGINEERING AND REGULATORY SERVICES

DETECTABLE WARNING SURFACE PLACEMENT

DRAWN BY: S.P.	DATE: JANUARY 2022	SCALE: N.T.S	DRAWING No. 10-330-19



PLAN



ELEVATION

NOTES:

1. ALL TEXTURED SURFACES USED AS DETECTABLE WARNING SURFACES SHALL BE CLEARLY DETECTABLE BY WALKING UPON AS BEING DIFFERENT FROM THE SURROUNDING SURFACE. APPLYING PAINT FINISH TO A CONCRETE SURFACE DOES NOT PROVIDE APPROPRIATE DELECTABILITY.

2. DETECTABLE WARNING SURFACES SHALL CONTRAST VISUALLY WITH ADJOINING SURFACES, BEING EITHER LIGHT ON DARK OR DARK ON LIGHT.

3. DETECTABLE WARNING SURFACES SHALL BE SLIP-RESISTANT.

4. DETECTABLE WARNING SURFACES AT CURB RAMPS AND DEPRESSED CURBS SHALL BE COMPOSED OF FLAT-TOPPPED DOMES OR CONES THAT

- ARE 4-5mm HIGH
- HAVE TOP AND BOTTOM DIMENSIONS AS SHOWN IN TABLE 1.1
- ARE ARRANGED IN A REGULAR PATTERN WITH SPACING AS SHOWN IN TABLE 1.1

5. IF A WALKWAY CROSSES OR JOINS A VEHICULAR WAY AND THE WALKING SURFACES ARE NOT SEPARATED BY CURBS, RAILINGS OR OTHER ELEMENTS BETWEEN THE PEDESTRIAN AREAS AND VEHICULAR AREAS, THE BOUNDARY BETWEEN THE AREAS SHALL BE DEFINED BY A CONTINUOUS DETECTABLE WARNING SURFACE, FLAT-TOPPED DOMES OR CONES WHICH IS MINIMUM 920mm WIDE.

6. ALL TRUNCATED DOME DETECTABLE WARNING PLATE DESIGNS ARE TO BE FINALIZED BY THE MANUFACTURE, "BIBBY-STE-CROIX" OR EQUIVALENT. (610mmX610mm SQ.)

7. TRUNCATED DOME PLATES ARE TO BE PLACED 150mm OFFSET FROM BACK OF CURB (200mm MAX.) MINIMUM 150mm CONCRETE REQUIRED FROM OUTER EDGE OF PLATE ASSEMBLY TO EDGE OF SIDEWALK.

8. COLOR OF TRUNCATED DOME PLATES TO BE NATURAL PATINA.

TABLE 1.1

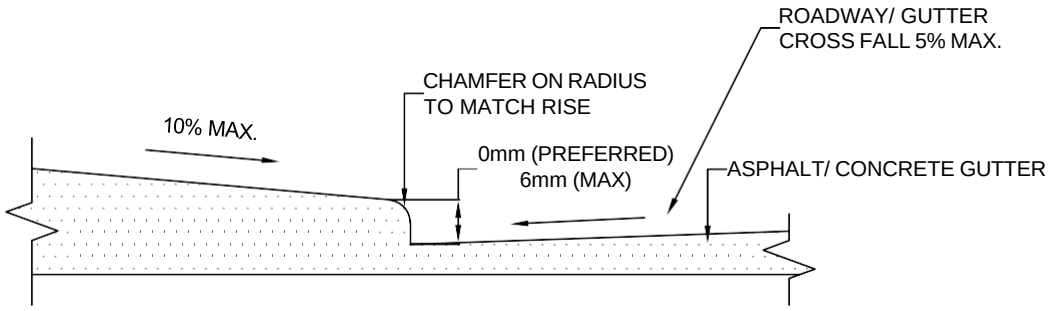
TOP DIAMETER OF FLAT-TOPPPED DOMES OR CONES	SPACING
12mm	42-61mm
15mm	45-63mm
18mm	48-65mm
20mm	50-68mm
25mm	55-70mm
BOTTOM DIAMETER OF FLAT-TOPPED DOMES OR CONES 10 ± 1 GREATER THAN THE TOP DIAMETER	

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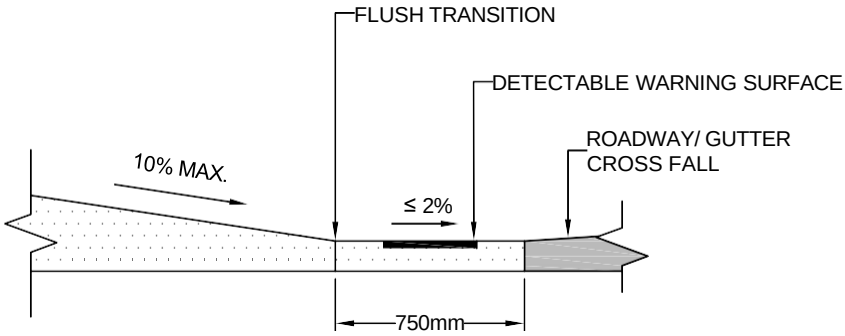
TRUNCATED DOME DETECTABLE WARNING SURFACE PLATE

DRAWN BY: S.P.	DATE: JANUARY 2022	SCALE: N.T.S	DRAWING No. 10-330-20



CURB RAMP TRANSITION AT PAVEMENT/ GUTTER

NOTE: IF TRANSITION HAS ALGEBRAIC GRADE DIFFERENCE OF >13%, THEN ADD TRANSITION STRIP.



NOTES:

1. IF THE FINAL COURSE OF ASPHALT PAVING IS DELAYED, INSTALL A TEMPORARY LIFT OF ASPHALT AT RAMPS OR CURB CUTS TO PROVIDE BARRIER FREE ACCESS.

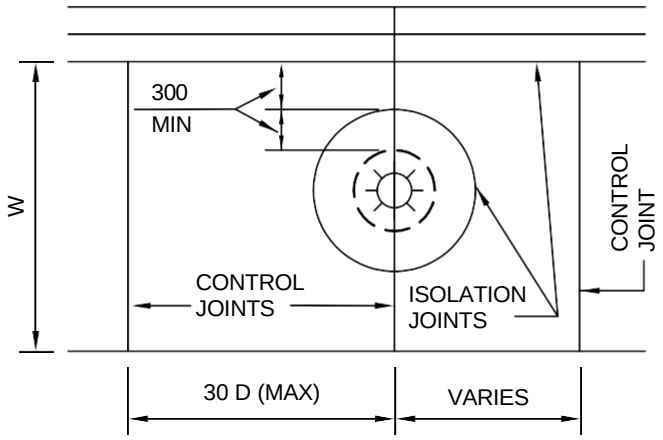
2. CONCRETE TO BE 32 MPa, TO MEET CSA A23.1, CLASS C-2 EXPOSURE.

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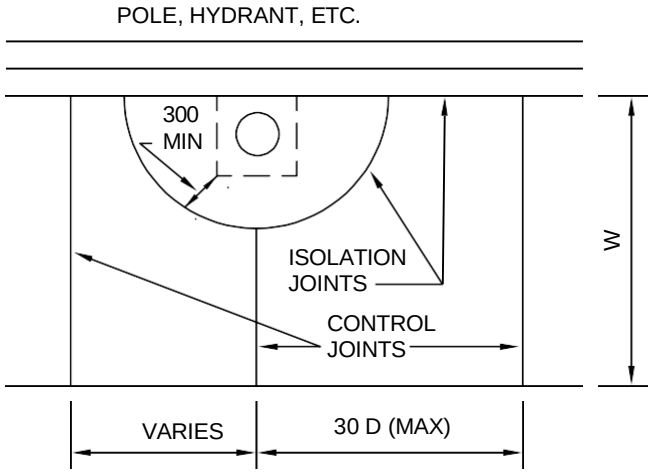
CURB RAMP TRANSITION

DRAWN BY: S.P.	DATE: JANUARY 2022	SCALE: N.T.S	DRAWING No. 10-330-21

D = SIDEWALK DEPTH



DETAIL COVER BOXOUT



DETAIL POLE BOXOUT

NOTES:

1. WHERE CONTROL JOINTS ARE NEEDED, THE METHOD USED MUST GUARANTEE THAT AT LEAST $^{1}/_{4}$ OF THE DEPTH OF CONCRETE IS INDENTED TO CONTROL DRYING SHRINKAGE CRACKING. SUITABLE METHODS ARE THE USE OF PREFORMED JOINT MATERIALS OR SAW CUTTING ONE QUARTER THE SLAB THICKNESS WITHIN 6 TO 18 HOURS AFTER THE CONCRETE HAS HARDENED BEFORE DRYING SHRINKAGE CRACKS APPEAR. FOR SLIPFORM CONSTRUCTION, THE JOINTS MAY BE FORMED USING A GUILLOTINE OR WIRE TO CUT THE PLASTIC CONCRETE, OR BY SAW CUTTING THE HARDENED CONCRETE.

2. CONTROL JOINTS SHALL BE LOCATED AT 24 TO 30 D MAXIMUM. WHERE SIDEWALK WIDTH IS 2.5m OR GREATER, A CONTRACTION JOINT SHOULD ALSO BE FORMED ALONG THE CENTERLINE OF THE WALK. CONTROL JOINT SPACING FOR SIDEWALK SHALL BE APPROXIMATELY THE SAME AS THE WIDTH AND NOT MORE THAN 1.5 TIMES THE WIDTH.

3. CONTROL JOINTS IN CURB AND GUTTER SECTIONS SHOULD EXTEND COMPLETELY THROUGH THE CURB HEIGHT AND D/4 INTO THE GUTTER SECTION. WHEN SIDEWALK IS ADJACENT TO CURB, MAKE JOINTS OF CURB & SIDEWALK ALIGN.

4. IF THE CURB IS INTEGRAL WITH CONCRETE PAVEMENT, CONTROL JOINT SPACING IN THE CURB SHOULD MATCH THAT IN THE PAVEMENT.

5. SPACING OF CONTROL JOINTS SHOULD VARY TO COINCIDE WITH THE CENTER OF MANHOLES OR OTHER BOX-OUTS. (SEE DETAILS).

6. ISOLATION JOINTS SHOULD BE LOCATED ADJACENT TO EXISTING STRUCTURES, (POLES, WALLS, HYDRANTS, BUILDINGS, ETC.). ISOLATION JOINTS SHOULD ALSO BE LOCATED BEFORE AND AFTER CURVE SECTIONS & AT INTERSECTIONS.

7. ISOLATION/EXPANSION JOINT FILLER SHALL BE 12.5mm THICK. ACCEPTABLE PRODUCTS INCLUDE NOMAFLEX, REFLEX OR APPROVED EQUAL. EXPANSION JOINTS SPACED AT 5400mm MAXIMUM.

8. CONSTRUCTION JOINTS SHOULD BE LOCATED WHERE THE PLACING OF CONCRETE MUST BE STOPPED FOR A PERIOD IN EXCESS OF 30 MINUTES.

9. ALL SIDEWALKS SHOULD BE SLOPED AT LEAST 2% TO DRAIN TOWARDS THE STREET.

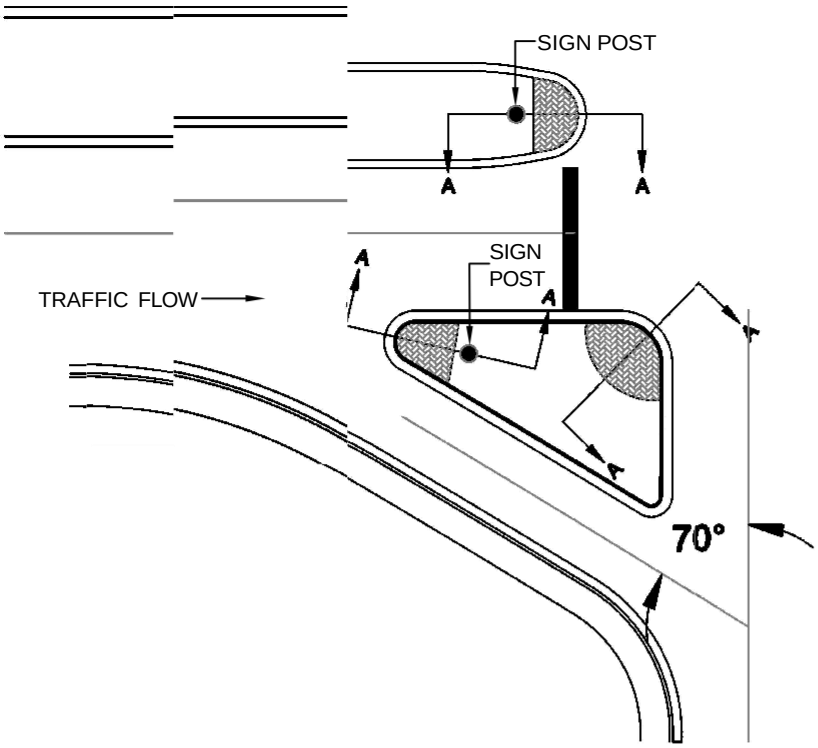
10. TOOLED JOINTS ARE AN ACCEPTABLE ALTERNATE TO SAW CUTTING. HOWEVER THERE SHALL BE NO DEPRESSED EDGES FOR THE TOOLED JOINTS PERPENDICULAR TO THE CURB AND GUTTER

11. SPACING OF EXPANSION JOINTS SHALL BE 5400mm MAX.

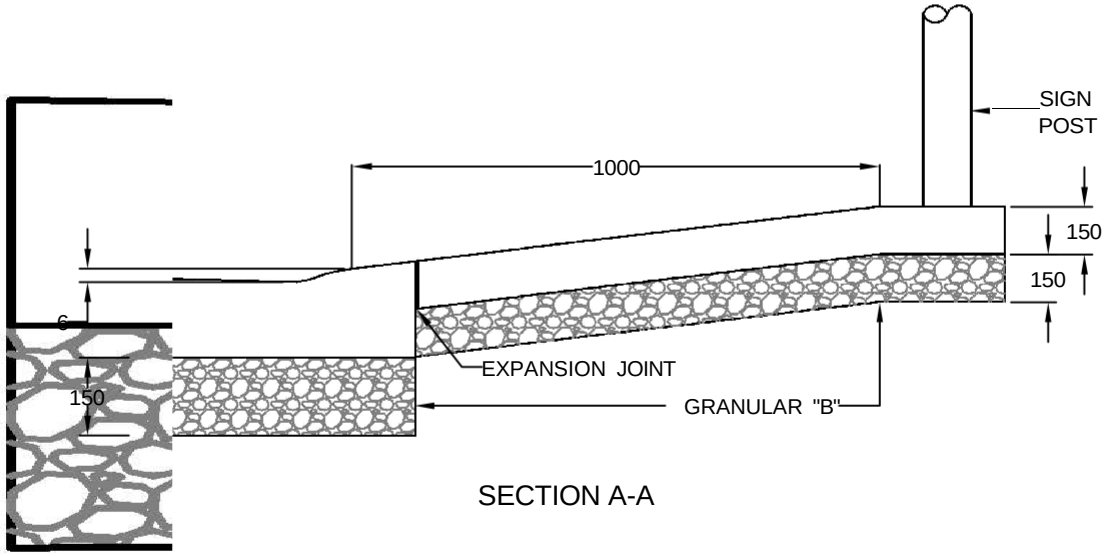
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CONCRETE JOINT NOTES

DRAWN BY: C. S.\ R.W.	DATE: FEB. 2025	SCALE: N.T.S.	DRAWING No. 10-330-22



NOTE: CURB RAMPS AND CROSSWALKS NOT SHOWN FOR SIMPLICITY.



SECTION A-A

NOTES:

1. ACCESSIBLE CURB RAMPS SHALL BE PROVIDED AT ALL CROSSWALK LOCATIONS. RUNNING SLOPE TO BE 6.25% (PREFERRED), 10% MAXIMUM. (WITH RESPECT TO LEVEL, NOT STREET RUNNING SLOPE)

2. ACCESSIBLE CURB RAMPS SHALL ALIGN ORTHOGONALLY WITH THE CROSSWALK.

3. THE MINIMUM WIDTH OF CURB RAMPS, EXCLUSIVE OF FLARED SIDES, SHALL BE 1500mm.

4. FLARED SIDES SHALL BE 500mm (MIN.) OR AS ILLUSTRATED, MEASURED AT THE CURB LOCATION, BUT MAY BE BASED MORE ON SITE.

5. WHERE A COMMERCIAL GRADE SIDEWALK IS SPECIFIED, CONCRETE THICKNESS SHALL BE INCREASED TO:
   - 150mm FOR DRIVEWAYS WITH <=100 VEHICLES PER DAY.
   - 200mm FOR >100 VEHICLES PER DAY.
   - 200mm FOR ANY ACCESS THAT SERVES PRIMARILY COMMERCIAL VEHICLES.
   - PROVIDE WWR IN ALL COMMERCIAL GRADE SIDEWALK.

6. ALL LANDING AREAS OF PEDESTRIAN TRAVEL WAY SHALL HAVE $\leq$ 2% CROSS FALL.

7. REFER TO DETAIL (10-330-19) FOR DETECTABLE WARNING SURFACE PLACEMENT.

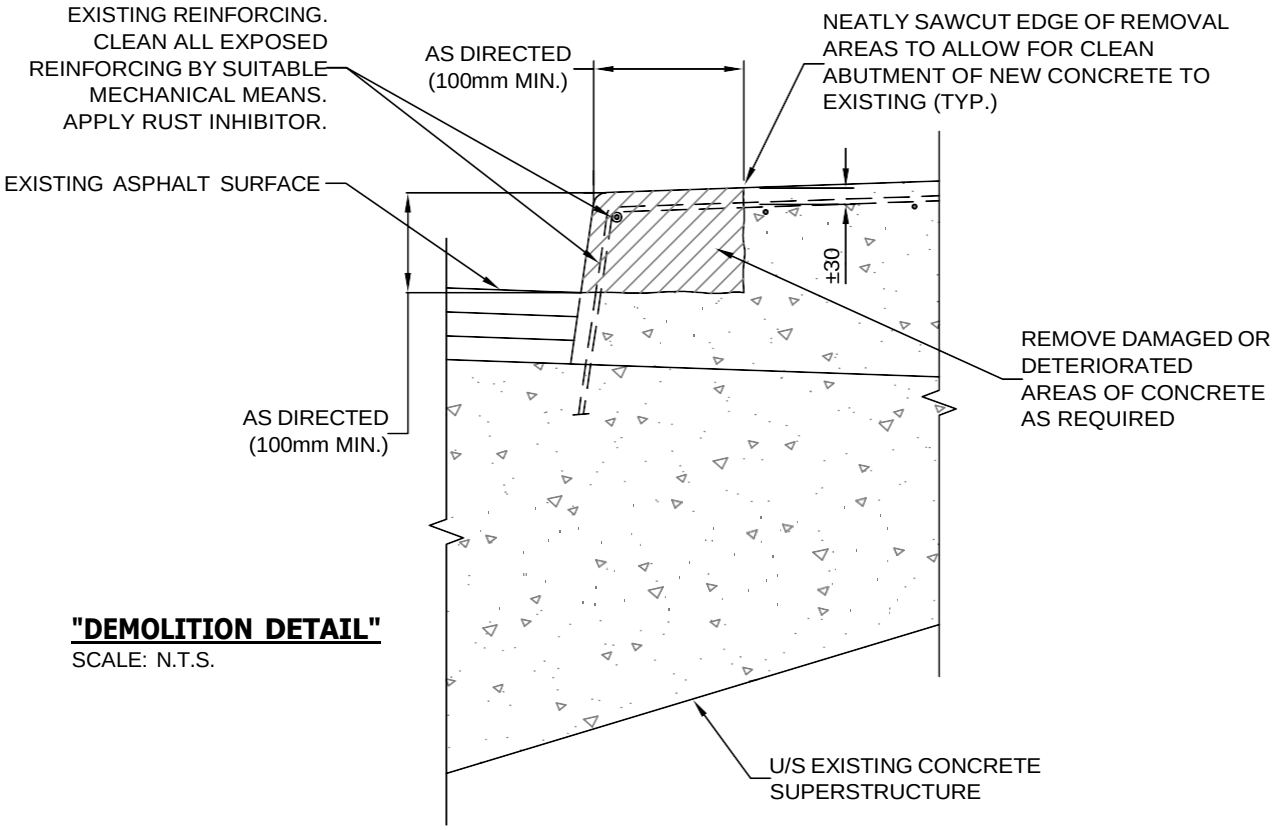
8. REFER TO DETAIL (10-330-20) FOR TRUNCATED DOME DETECTABLE WARNING SURFACE PLATE.

9. REFER TO DETAIL (10-330-21) FOR CURB RAMP TRANSITION SPECS.

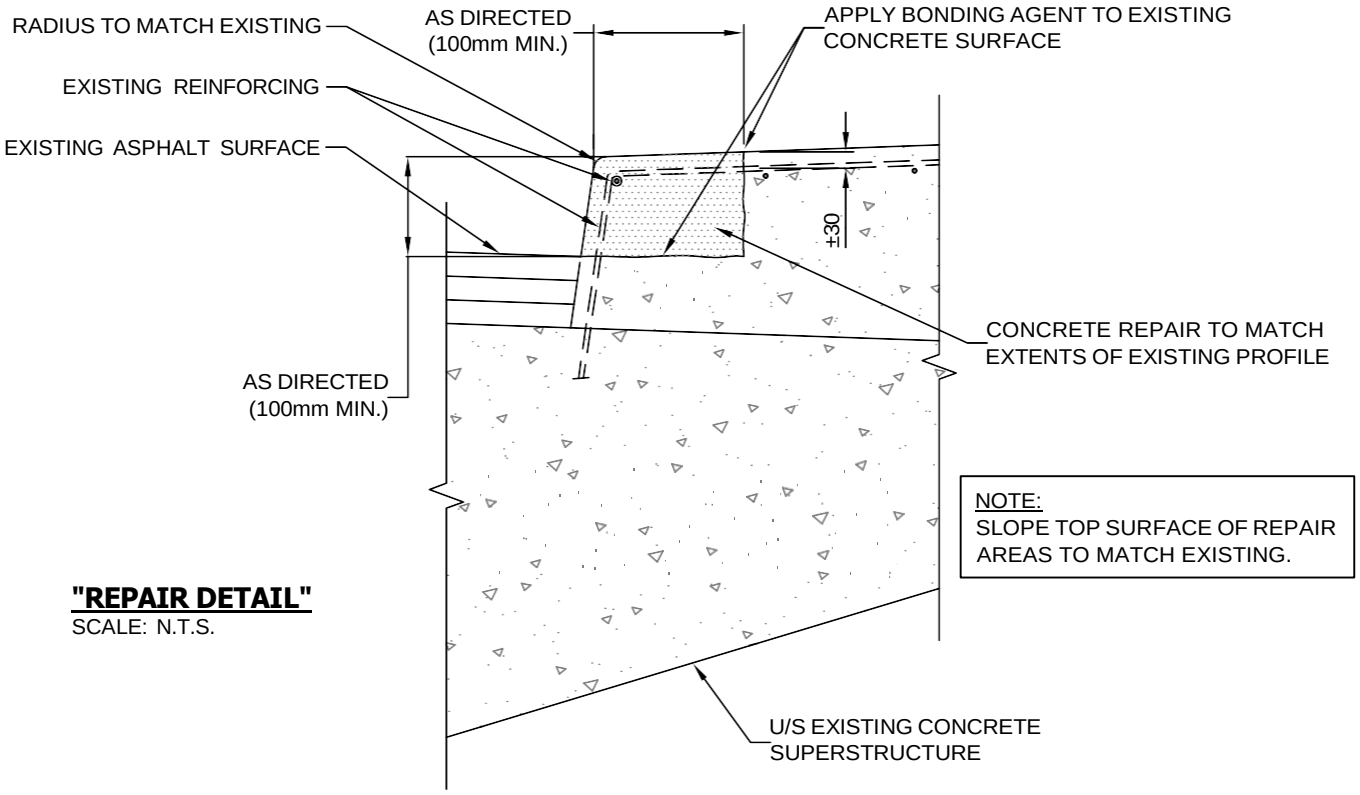
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DEPARTMENT OF PLANNING, ENGINEERING AND REGULATORY SERVICES

70° ENTRY CHANNEL & MEDIAN END TREATMENT

DRAWN BY: S.P.	DATE: JANUARY 2022	SCALE: N.T.S	DRAWING No. 10-330-23



"DEMOLITION DETAIL"
SCALE: N.T.S.

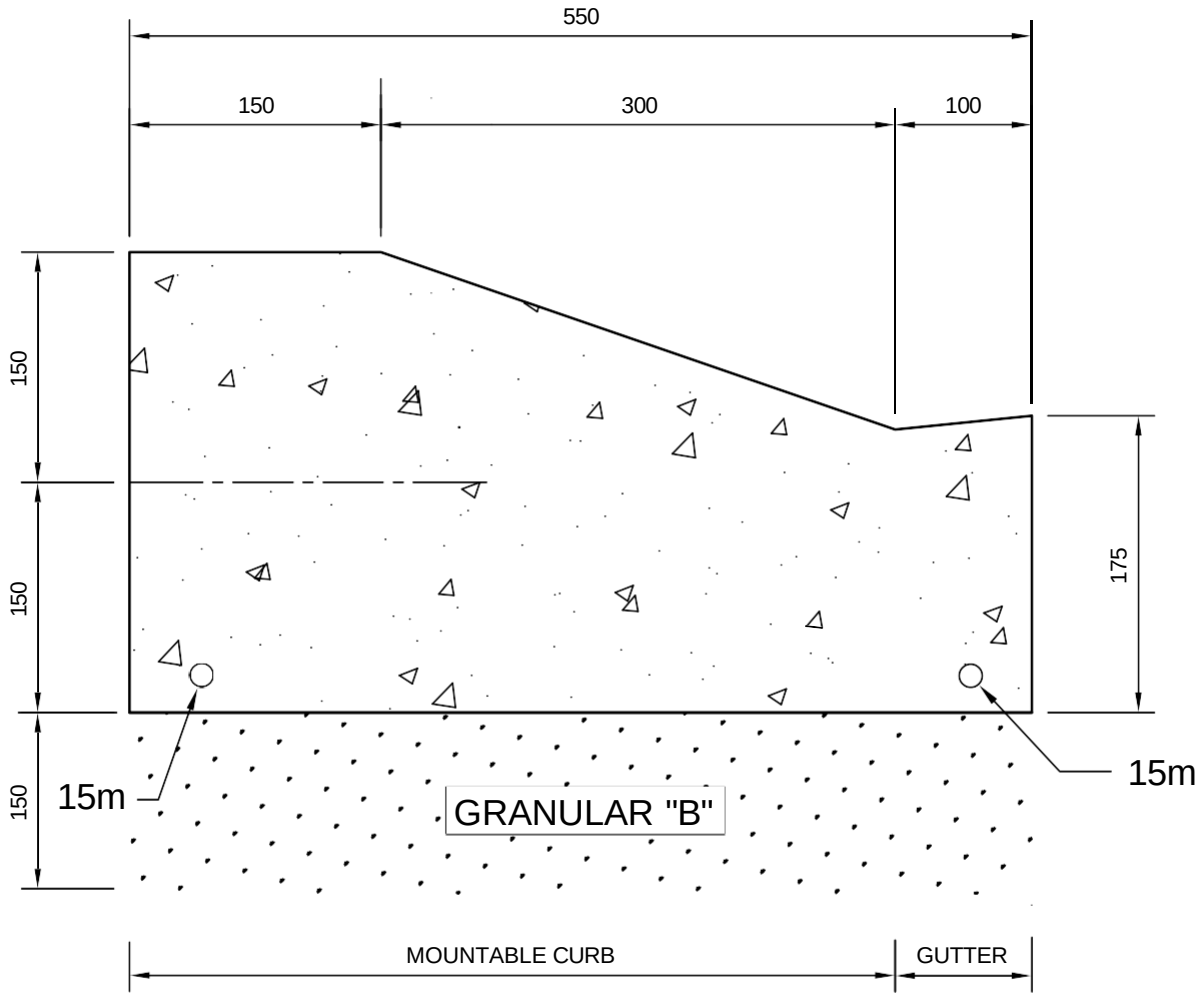


"REPAIR DETAIL"
SCALE: N.T.S.

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STANDARD CURB/SIDEWALK REPAIR-BRIDGE DECK

DRAWN BY: S.P.	DATE: JANUARY 2022	SCALE: N.T.S	DRAWING No. 10-330-24



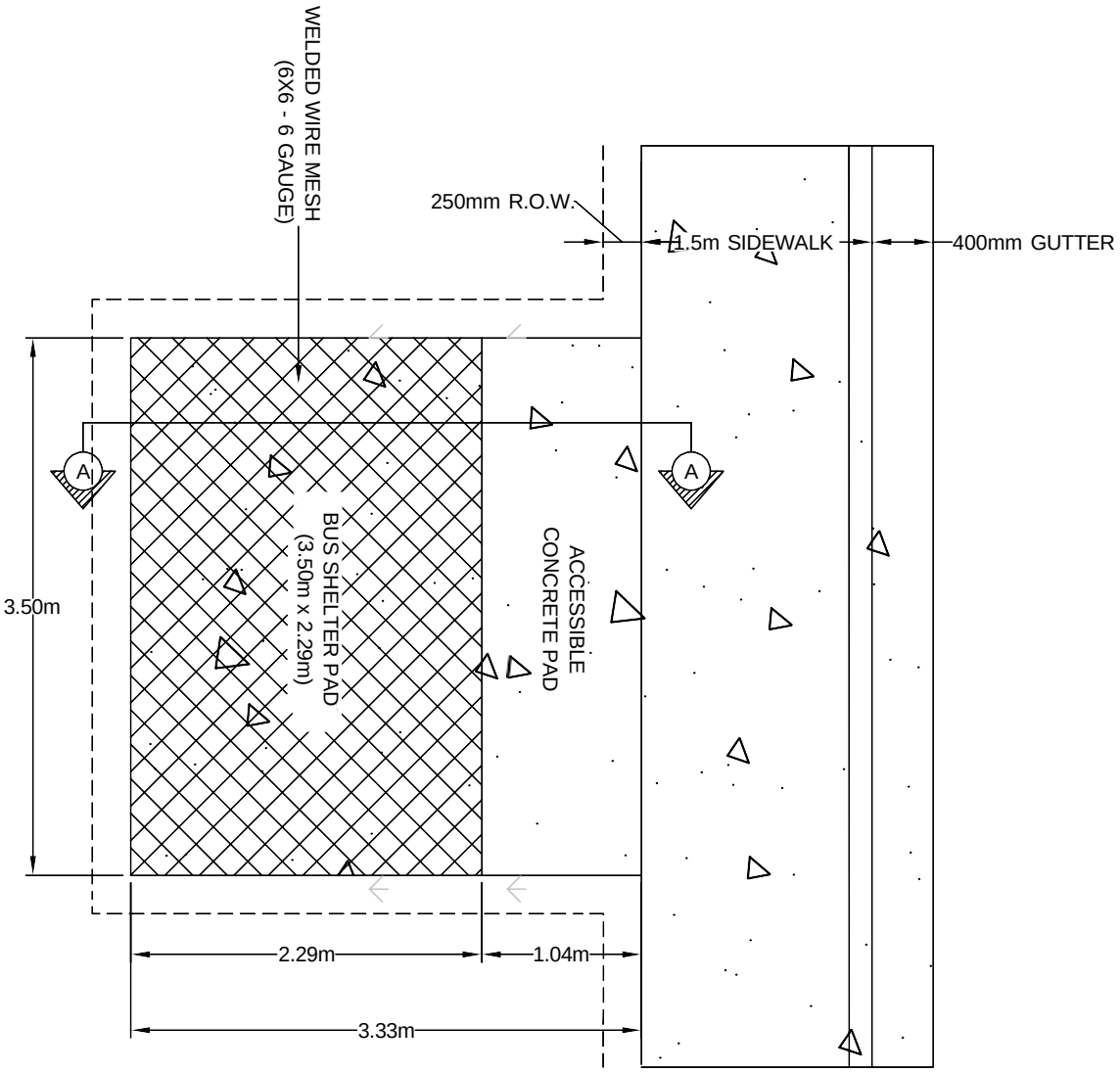
NOTE:

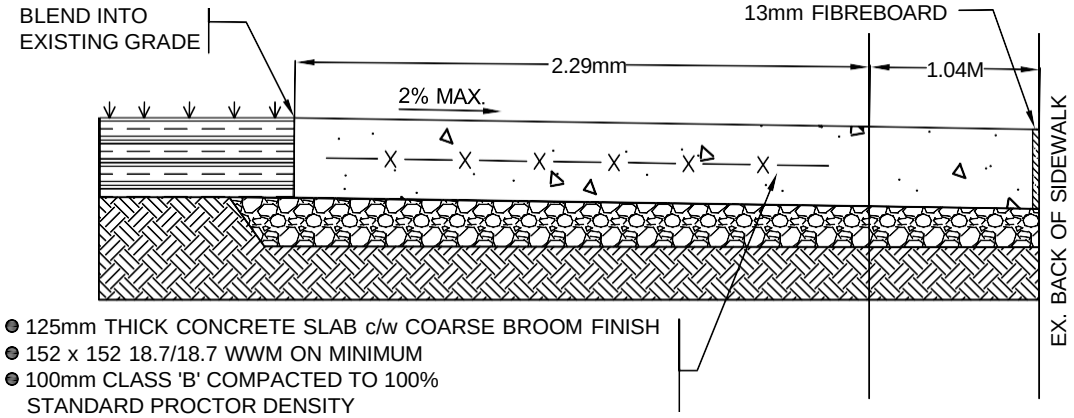
1. CONCRETE TO BE 32 MPA TO MEET CSA A22.1, CLASS C-2 EXPOSURE

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MOUNTABLE TRAFFIC ISLAND CURB & GUTTER

DRAWN BY: R.W.	DATE: FEB. 2025	SCALE: N.T.S.	DRAWING No. 10-330-25





- 125mm THICK CONCRETE SLAB c/w COARSE BROOM FINISH
- 152 x 152 18.7/18.7 WWM ON MINIMUM
- 100mm CLASS 'B' COMPACTED TO 100% STANDARD PROCTOR DENSITY

SECTION A-A

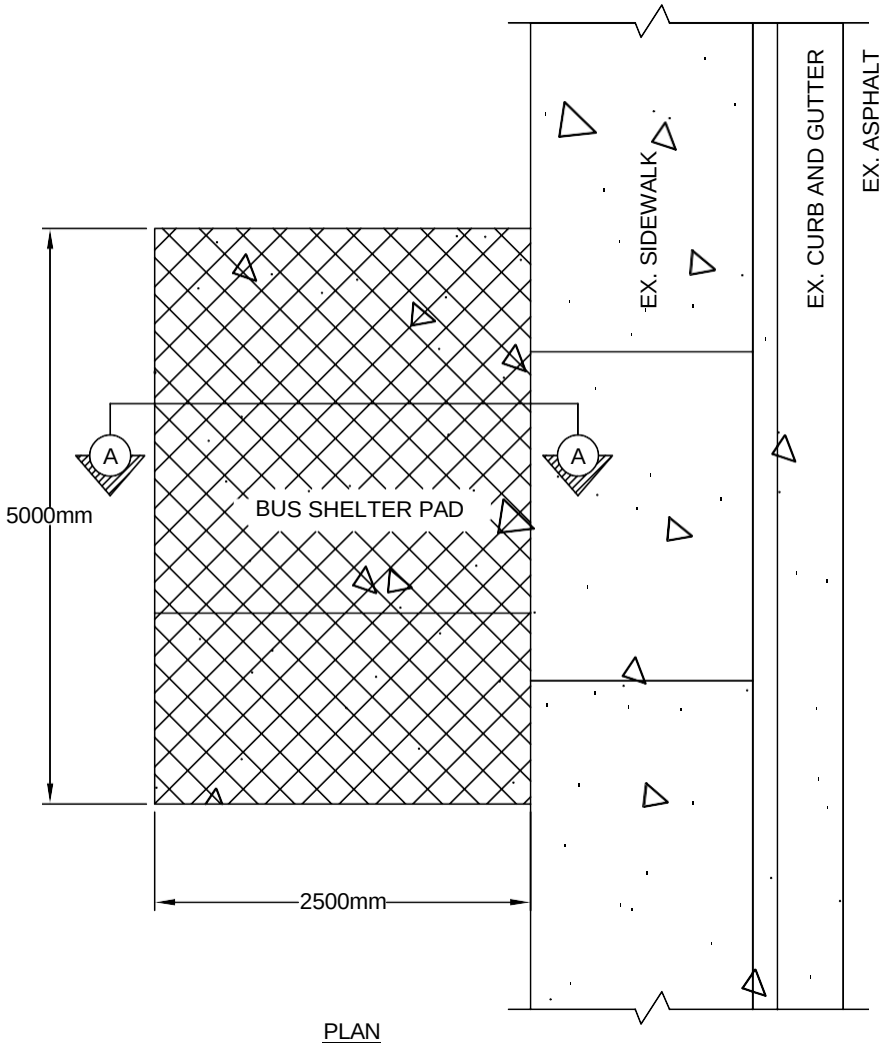
NOTE:

1. CONCRETE TO BE 32 MPA TO MEET CSA A22.1, CLASS C-2 EXPOSURE

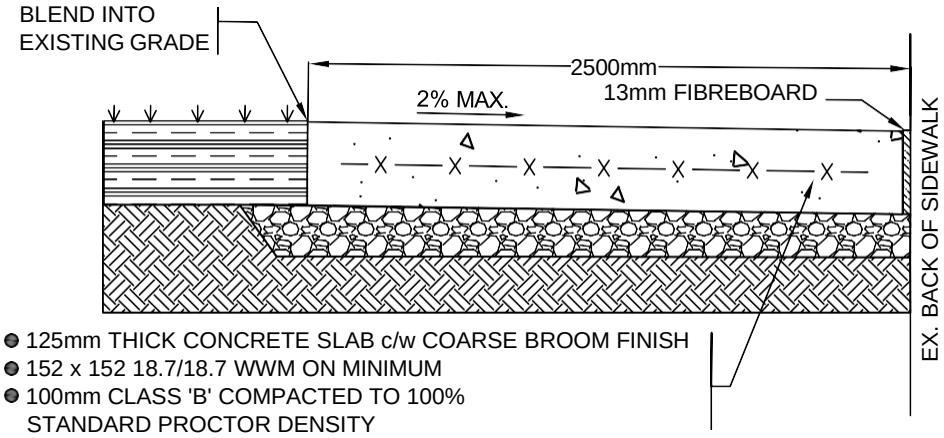
ST. JOHN'S
DEPARTMENT OF PLANNING, ENGINEERING AND REGULATORY SERVICES

BUS SHELTER PAD WITH FRONT ACCESSIBILITY

DRAWN BY:	R.W.	DATE:	FEB. 2025	SCALE:	1:50	DRAWING No.	10-330-34



PLAN



SECTION A-A

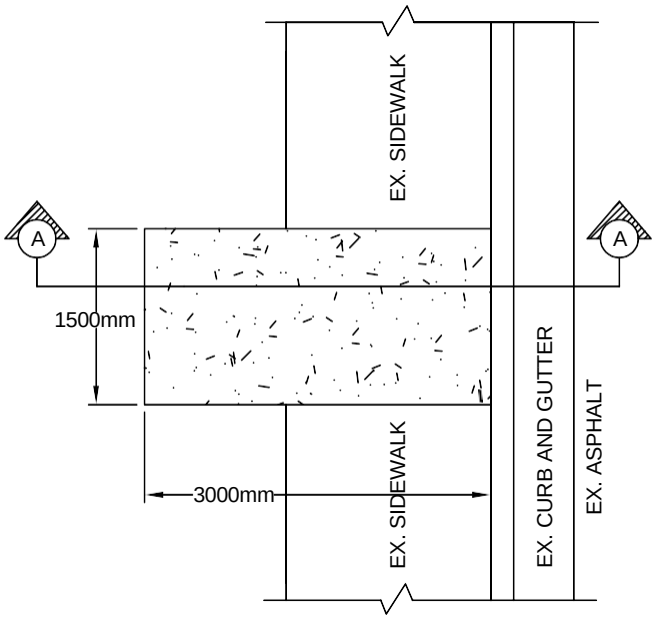
NOTE:

1. CONCRETE TO BE 32 MPA TO MEET CSA A22.1, CLASS C-2 EXPOSURE

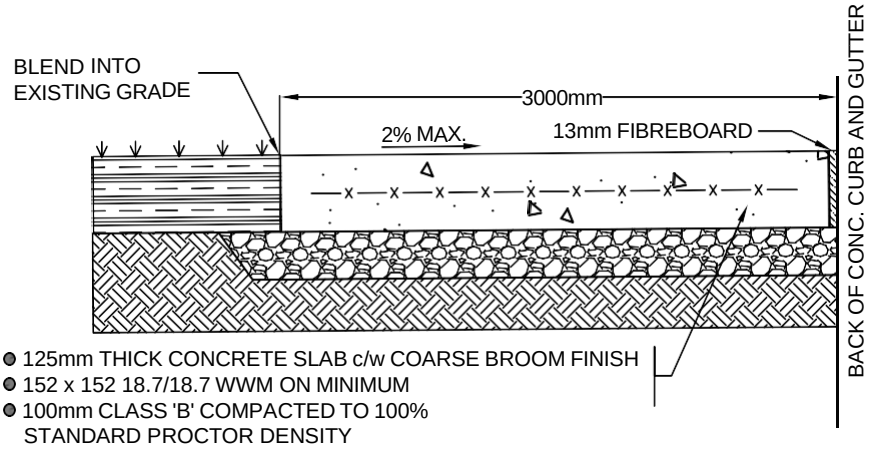
ST. JOHN'S
DEPARTMENT OF PLANNING, ENGINEERING AND REGULATORY SERVICES

BUS SHELTER PAD WITH SIDE ACCESSIBILITY

DRAWN BY: R.W.	DATE: FEB. 2025	SCALE: N.T.S.	DRAWING No. 10-330-35



PLAN



SECTION A-A

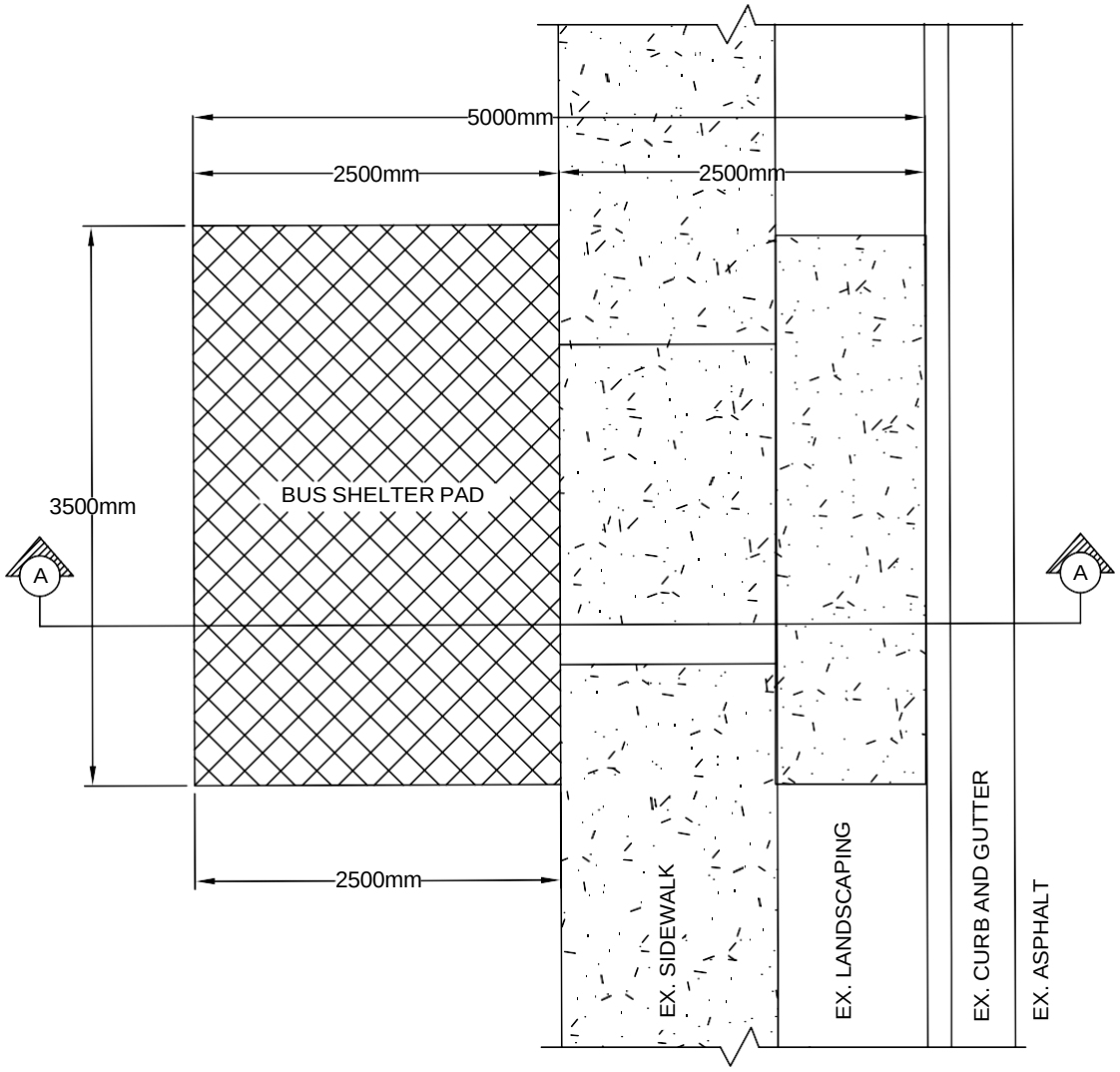
NOTE:

1. CONCRETE TO BE 32 MPA TO MEET CSA A22.1, CLASS C-2 EXPOSURE

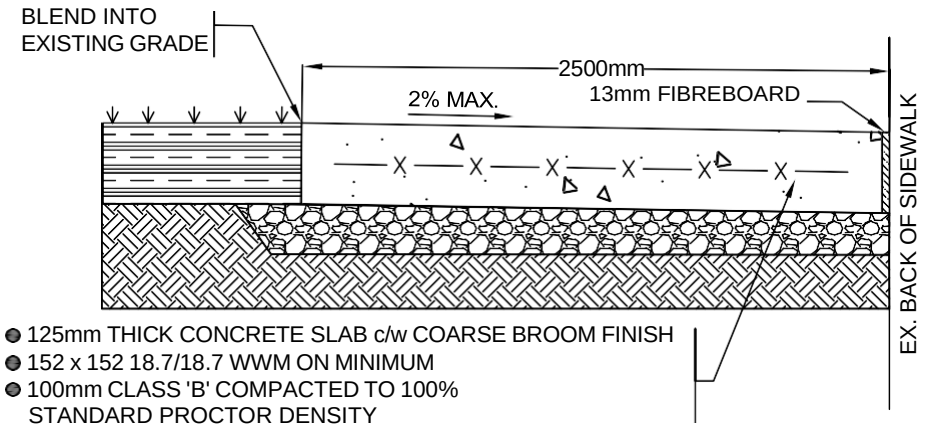
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ACCESSIBLE BUS STOP PAD

DRAWN BY: R.W.	DATE: FEB. 2025	SCALE: N.T.S.	DRAWING No. 10-330-36



PLAN



- 125mm THICK CONCRETE SLAB c/w COARSE BROOM FINISH
- 152 x 152 18.7/18.7 WWM ON MINIMUM
- 100mm CLASS 'B' COMPACTED TO 100% STANDARD PROCTOR DENSITY

SECTION A-A

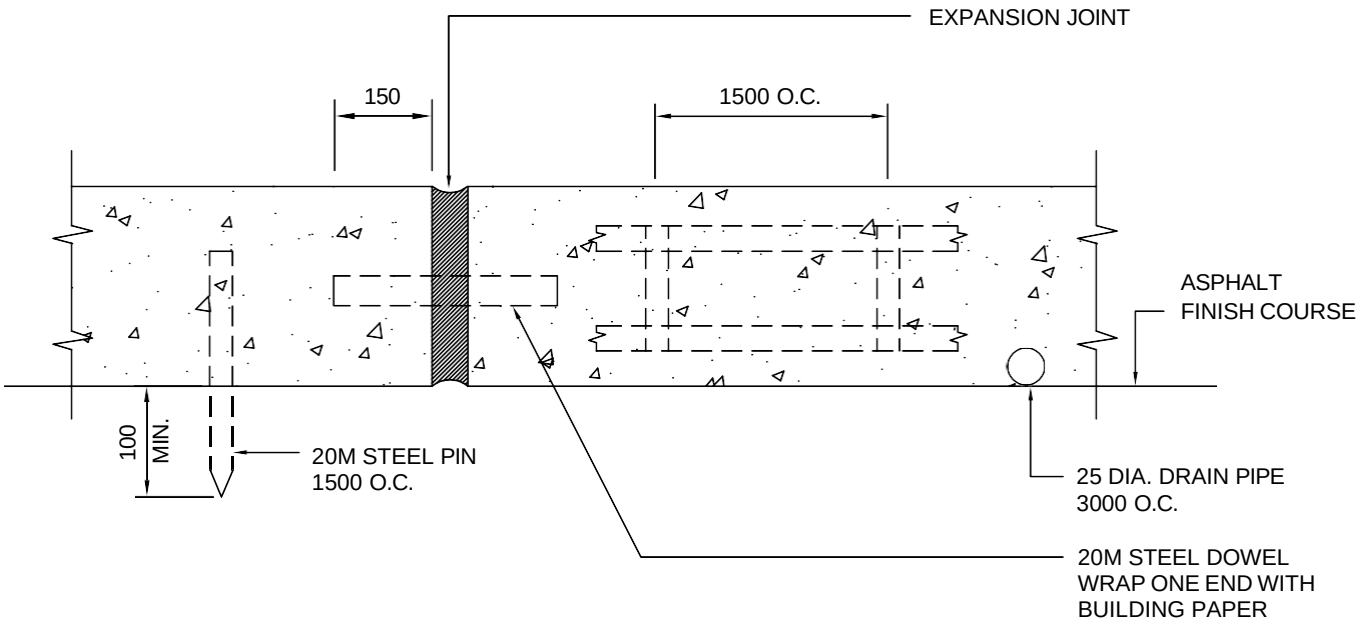
NOTE:

1. CONCRETE TO BE 32 MPA TO MEET CSA A22.1, CLASS C-2 EXPOSURE

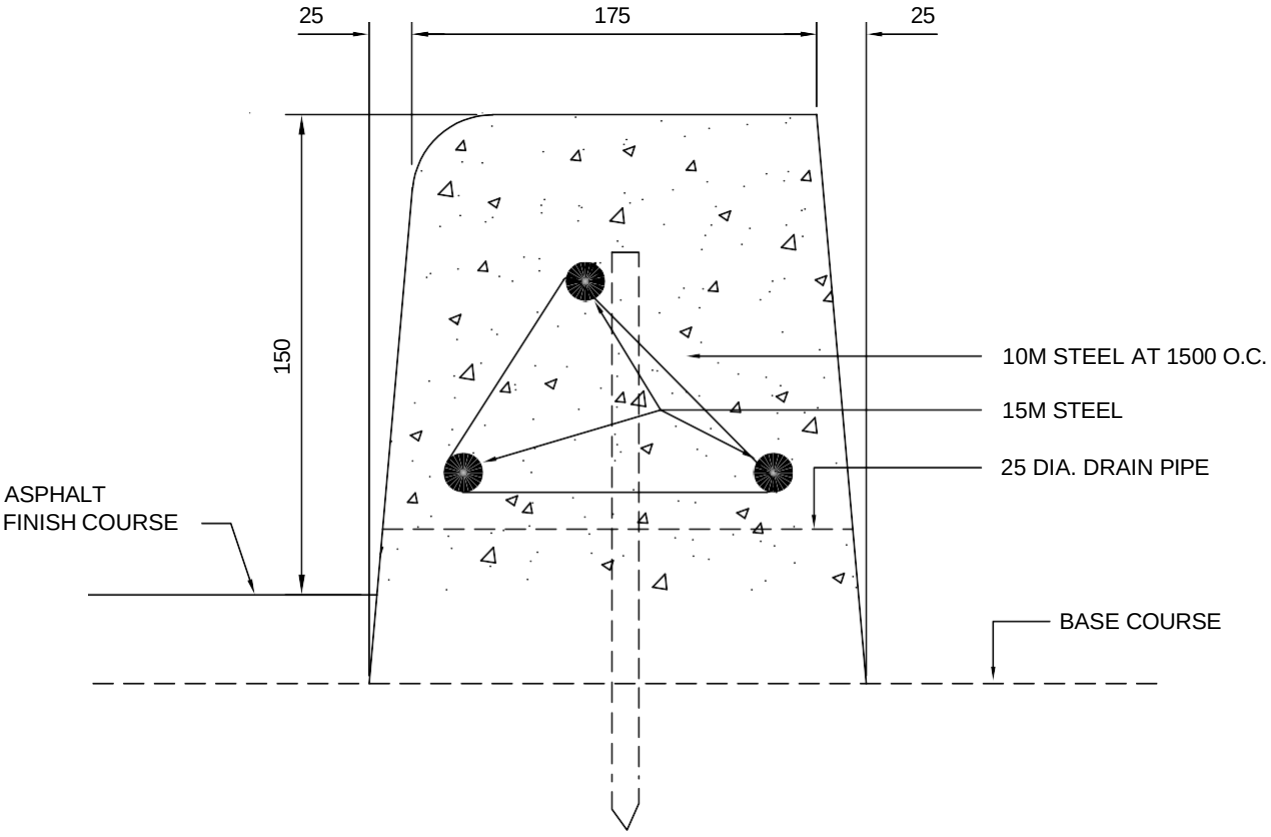
ST. JOHN'S
DEPARTMENT OF PLANNING, ENGINEERING AND REGULATORY SERVICES

BUS SHELTER PAD AT LANDSCAPED BOULEVARDS

DRAWN BY: R.W.	DATE: FEB. 2025	SCALE: 1:50	DRAWING No. 10-330-37



TYPICAL JOINT X-SECTION



TYPICAL X-SECTION

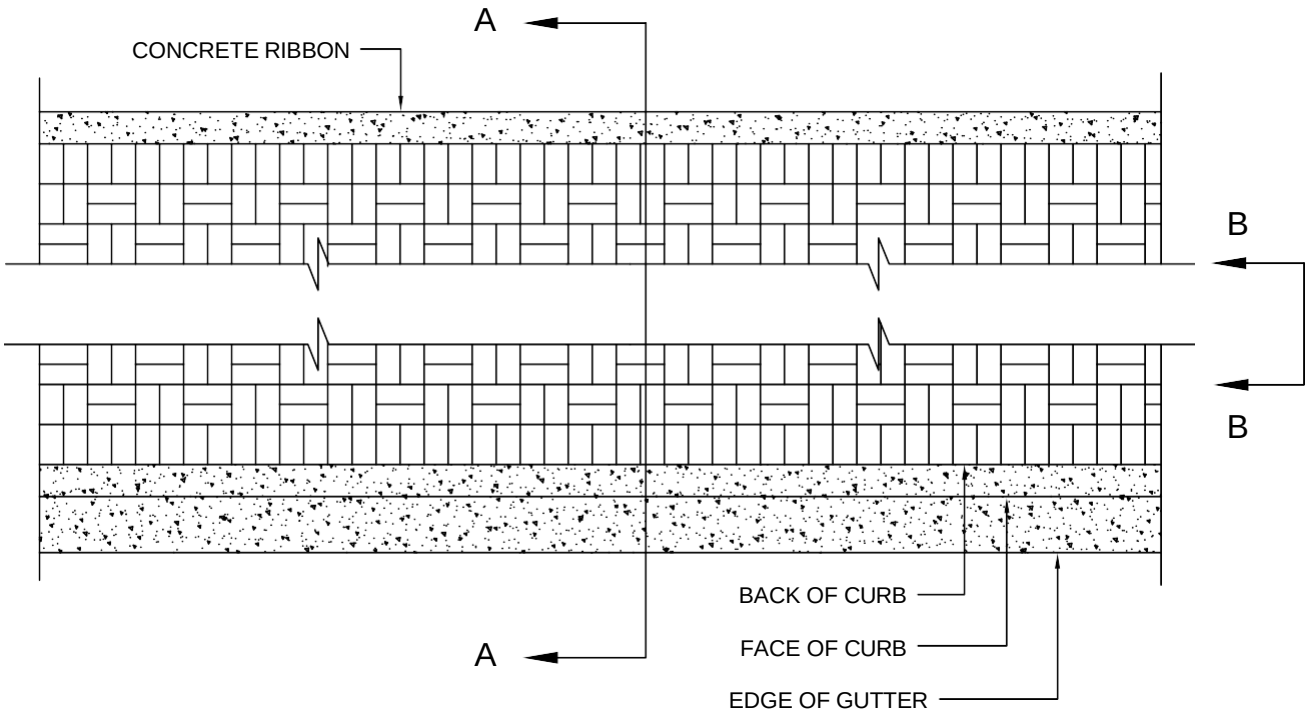
NOTE:

1. CONCRETE TO BE 30 MPa TO MEET CSA A23.1, CLASS C-2 EXPOSURE.
2. JOINTS ARE TO BE SPACED EVERY 3m.

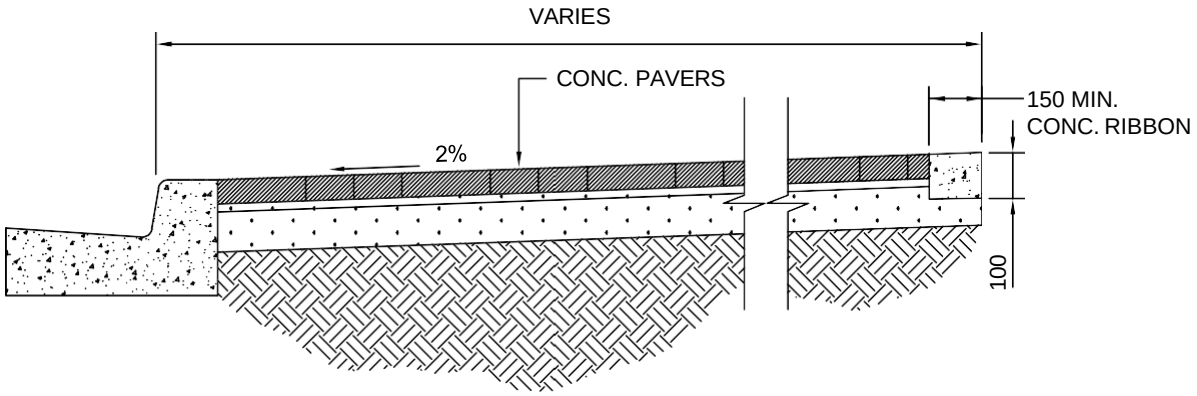
ST. JOHN'S
DEPARTMENT OF ENGINEERING

TRAFFIC ISLAND CURB

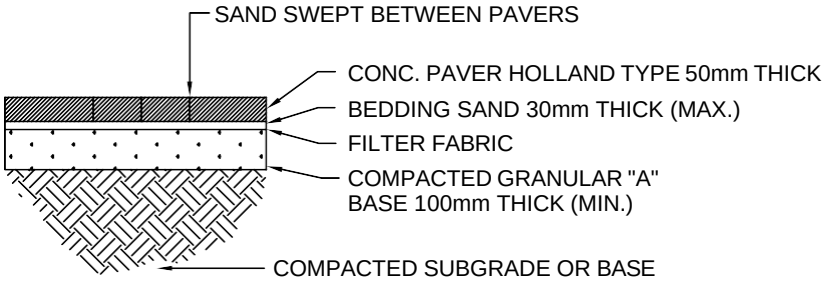
DRAWN BY: C. S.	DATE: FEB. 2025	SCALE: N.T.S.	DRAWING No. 10-330-38



PLAN VIEW



SECTION A-A

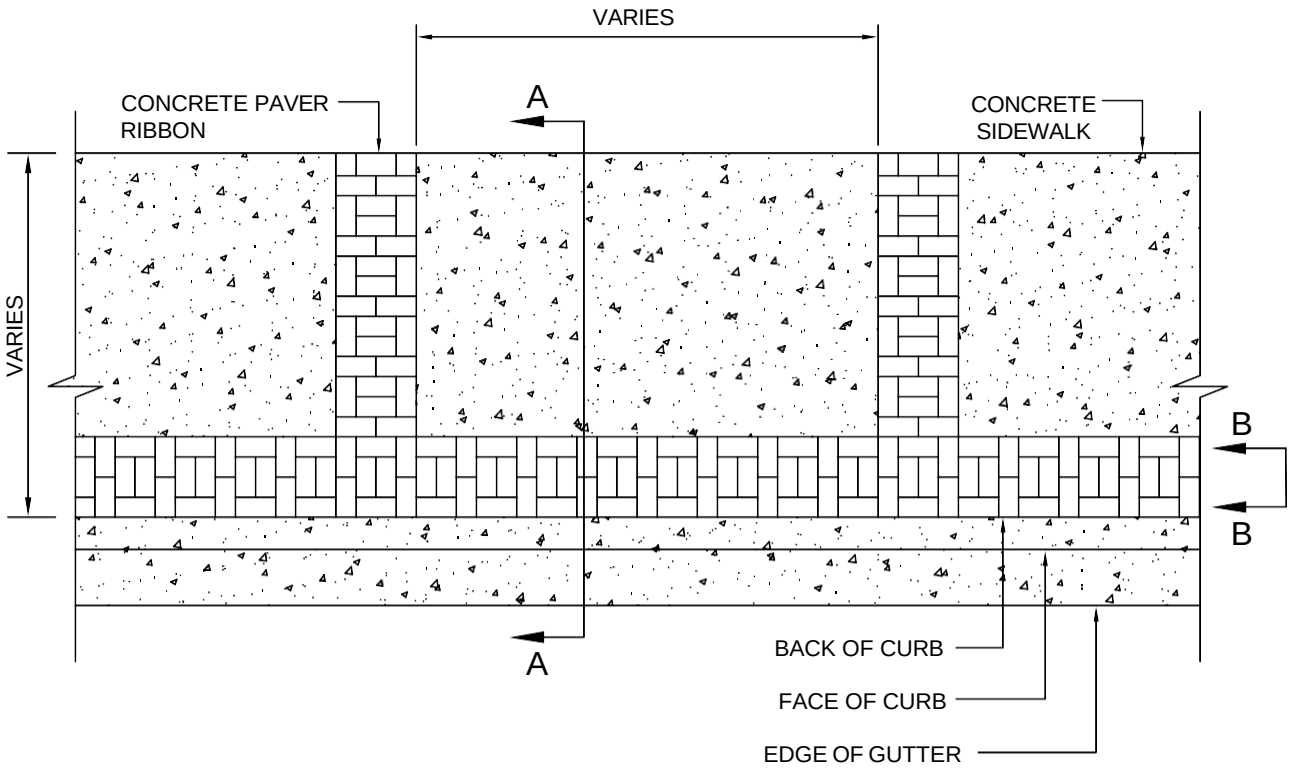


SECTION B-B

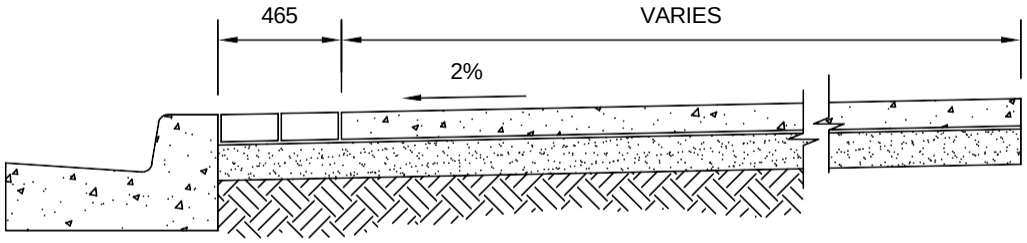
ST. JOHN'S
DEPARTMENT OF ENGINEERING

PRE-CAST CONCRETE PAVER SIDEWALK

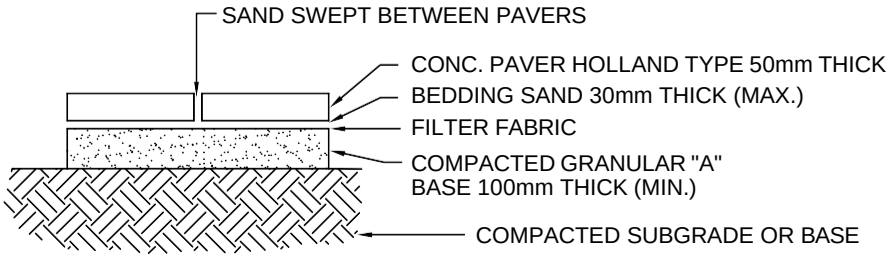
DRAWN BY: C. S.\ R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-331-01



PLAN VIEW



SECTION A-A



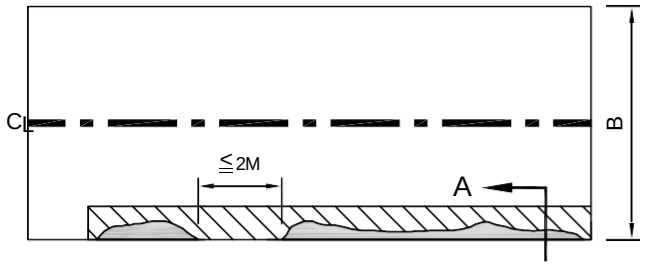
SECTION B-B

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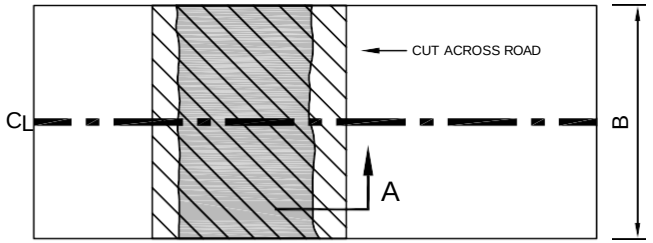
PRE-CAST CONCRETE PAVER RIBBON

DRAWN BY: C. S.\ R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-331-02

EXAMPLE 1(a)



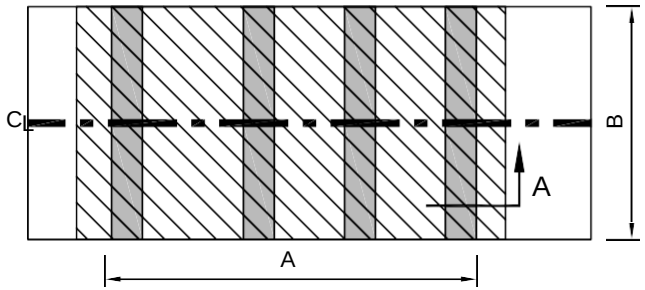
EXAMPLE 1(b)



NOTE: MINOR DESTRUCTION OF ASPHALT SHOULD BE CUT SQUARE AND PROPERLY PATCHED AS PER ▨ AREA.

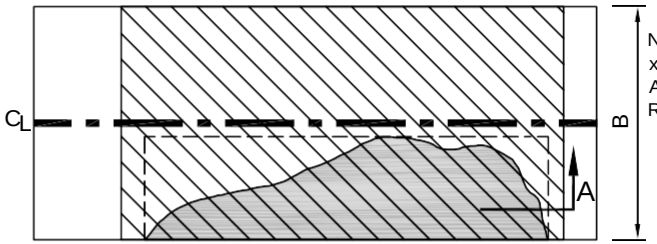
EXAMPLE 2

SHADED AREAS - CUTS ACROSS ROAD



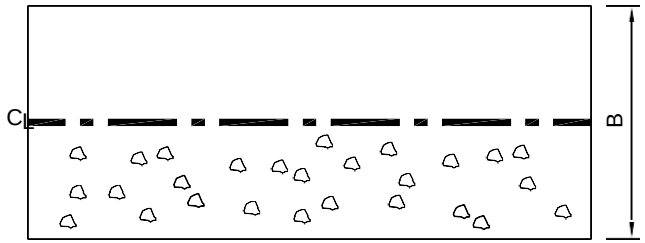
NOTE: IF TOTAL SHADED AREA ≧ 20% OF A x B THEN RESURFACING IS REQUIRED AS PER ▨ AREA.

EXAMPLE 3



NOTE: IF SHADED AREA>=20% A x B THEN AREA MUST BE CUT AND PATCHED TO------LINE THEN RESURFACED TO ▨ AREA.

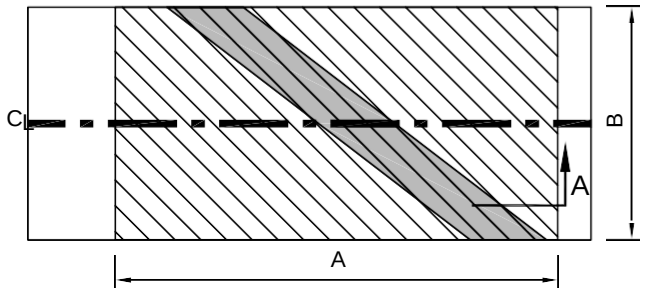
EXAMPLE 4



NOTE: GOUGING OF ASPHALT FROM PILING FILL ON SURFACE WILL CONSTITUTE DAMAGE AND WILL REQUIRE RESURFACING.

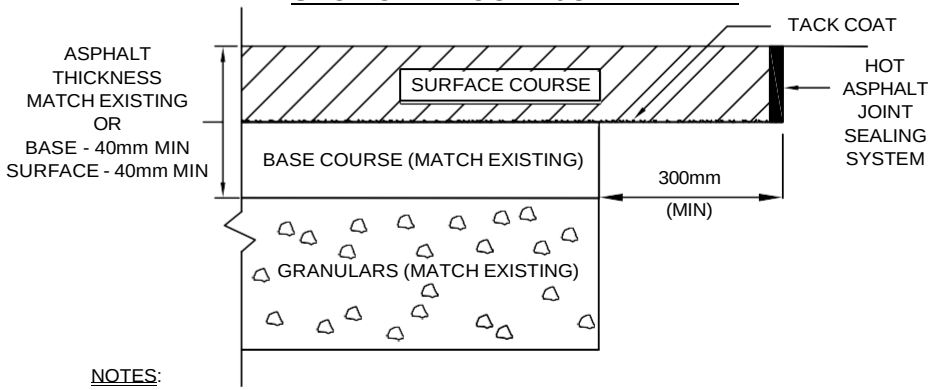
* ALL SURFACES TO RECEIVE APPROVED TACK COAT PRIOR TO RESURFACING.

EXAMPLE 5



NOTE: IF SHADED AREA **>**20% OF A x B THEN ▨ MUST BE RECAPPED AFTER SHADED AREA IS CUT AND PATCHED PROPERLY.

SECTION A - COLD JOINT DETAIL



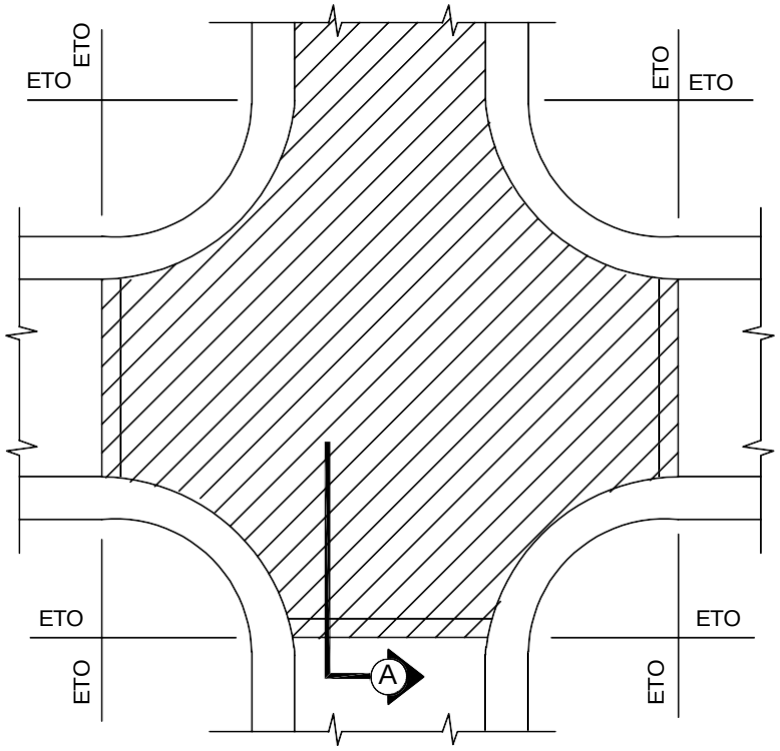
NOTES:

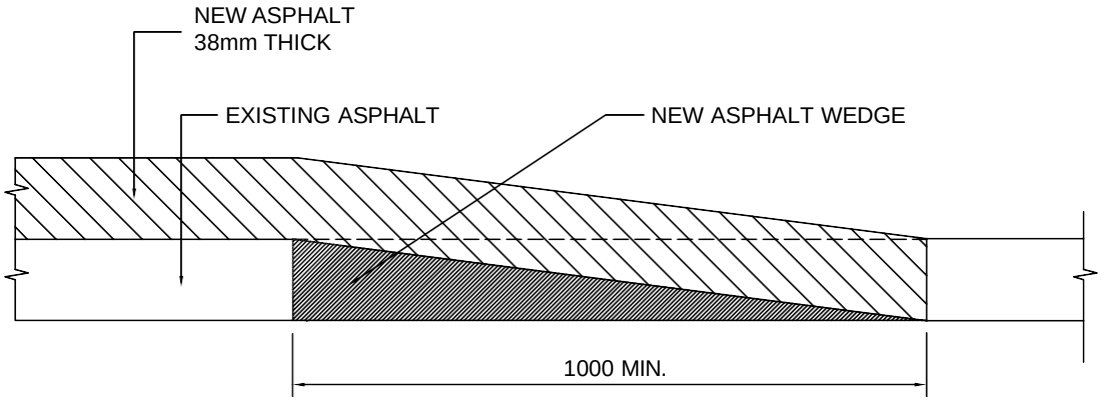
1. COLD JOINTS IN SURFACE COURSE (EXCLUDING GRIND AND PATCH) SHALL UTILIZE HOT ASPHALT JOINT SEALING SYSTEM (DENSO OR APPROVED EQUAL) FOR VERTICAL JOINTS. 2mm THICKNESS FOR RESIDENTIAL STREETS, 8mm THICKNESS FOR COLLECTOR STREETS AND ARTERIALS. FOR BASE COURSE COLD JOINT, APPLY TACK COAT TO VERTICAL AREA.
2. SEE DETAIL 10-211-05 FOR TRENCH COMPACTION. APPLIES TO EXCAVATIONS GREATER THAN 1M DEPTH.
3. SURFACE ASPHALT COLD JOINT IS TO BE MINIMUM 300mm OUTSIDE BASE ASPHALT JOINT. A 300mm SURFACE ASPHALT COLD JOINT MILLING WOULD NOT BE REQUIRED FOR CURB/GUTTER, SIDEWALK AND CATCH BASIN REPAIRS.
4. BASE COURSE AND MILLED ASPHALT AREA SHALL BE TACK COATED PRIOR TO PLACEMENT OF SURFACE COURSE.

ST. JOHN'S
DEPARTMENT OF ENGINEERING

TYPES OF ASPHALT DAMAGE AND EXAMPLES OF REPAIRS REQUIRED

DRAWN BY:	C. S.\ R.W.	DATE:	JANUARY 2022	SCALE:	N.T.S.	DRAWING No.	10-352-01



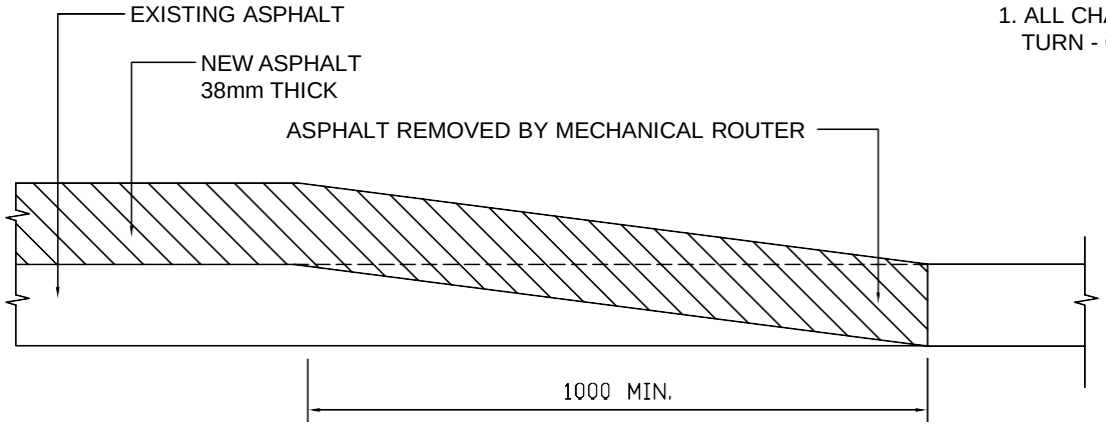


SECTION "A"

CUTTING OUT A 1000 MIN. WIDE STRIP OF EXISTING ASPHALT

NOTE:

1. ALL CHANNEL CUTS TO BE LOCATED AT THE E.T.O. OF ALL TURN - OUTS UNLESS OTHERWISE SPECIFIED BY THE ENGINEER.



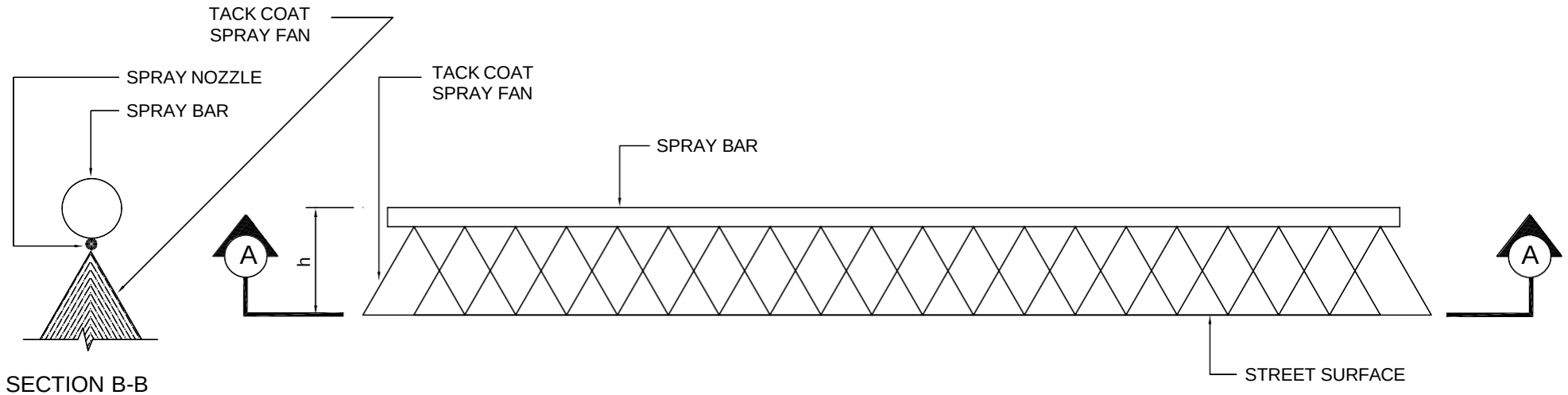
SECTION "A"

USING A MECHANICAL ROUTING MACHINE

ST. JOHN'S
DEPARTMENT OF ENGINEERING

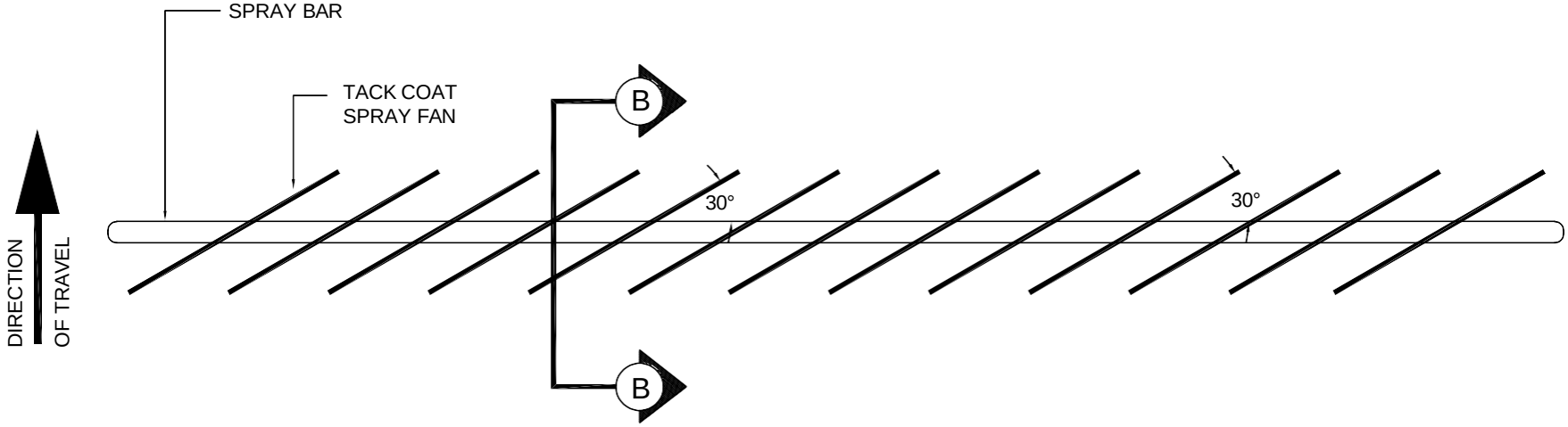
CHANNEL CUT

DRAWN BY: C. S.\ R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-353-01



SECTION B-B

CORRECT SPRAY BAR HEIGHT - DOUBLE COVERAGE



CORRECT ANGLE FOR NOZZLE DISCHARGE

NOTE:
HEIGHT "h" IS THAT REQUIRED TO ENSURE 50% OVERLAP
BETWEEN ADJACENT NOZZLES(IE: DOUBLE COVERAGE)

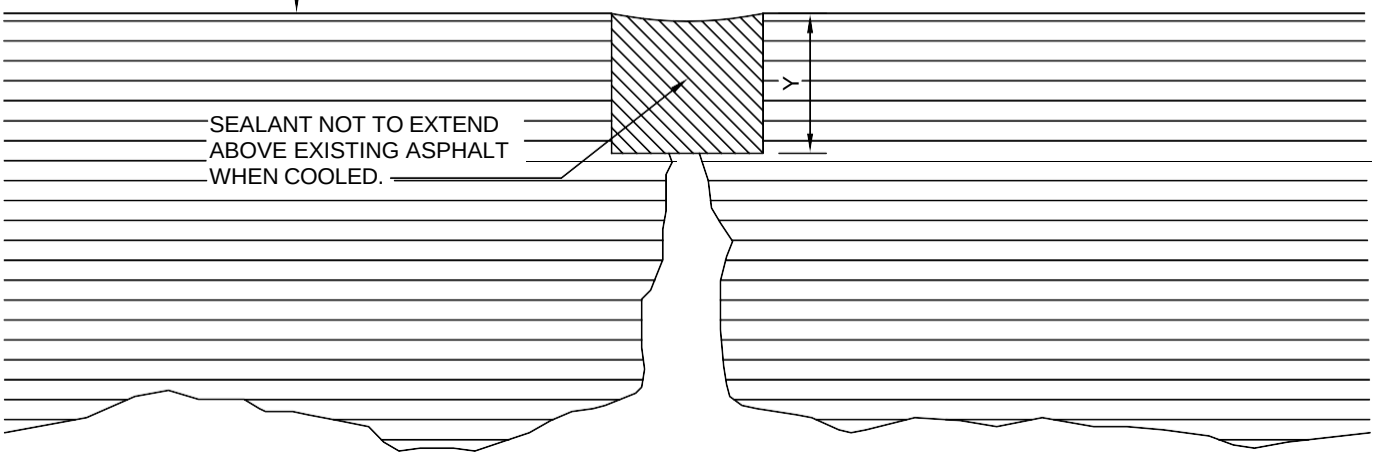
SECTION A-A

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TACK COAT SPRAY BAR

DRAWN BY:	C. S.\ R.W.	DATE:	JANUARY 2022	SCALE:	N.T.S.	DRAWING No.	10-354-01

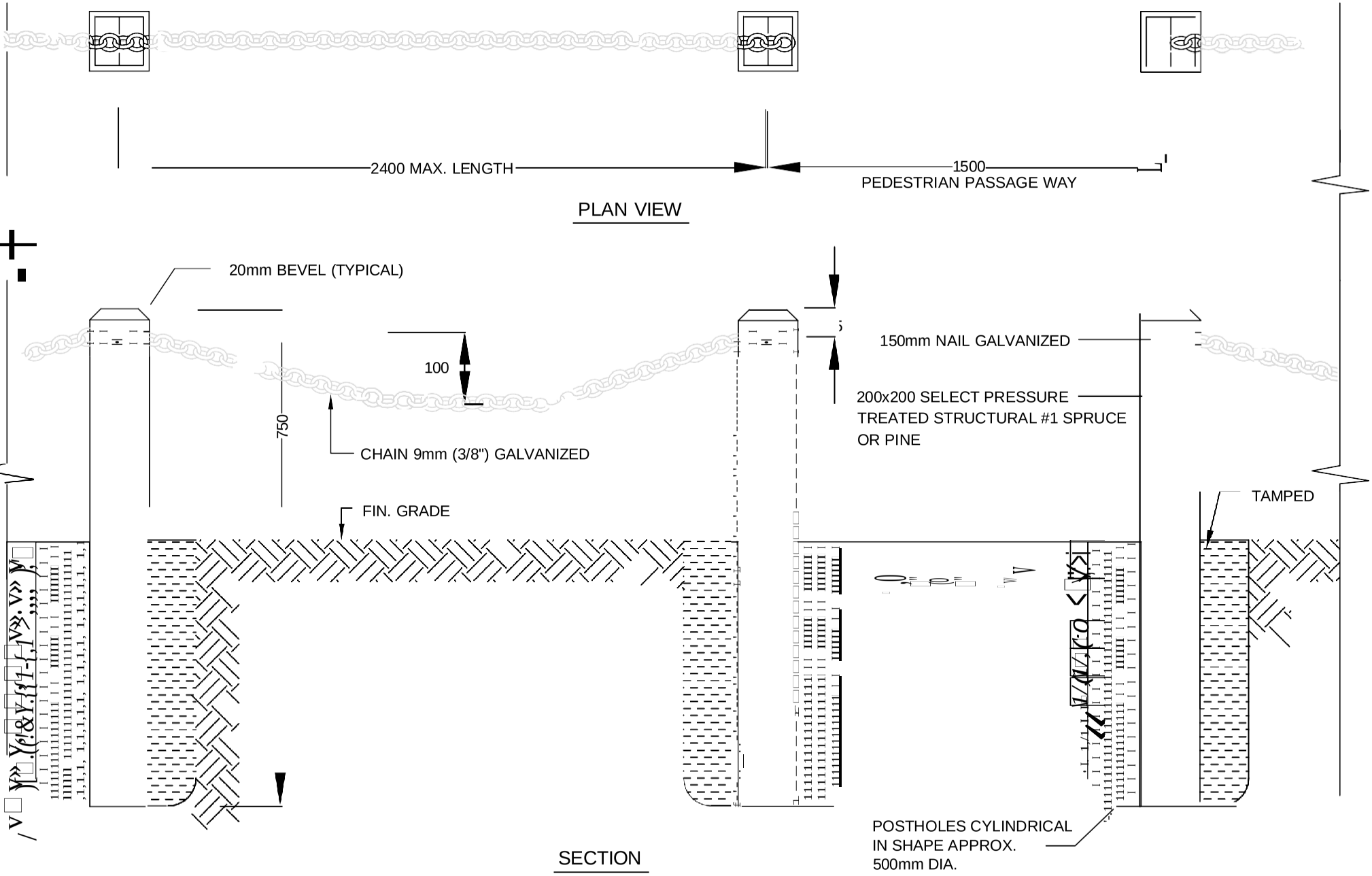
	X	Y
ALTERNATE 1	20	20
ALTERNATE 2	40	10



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ASPHALT CRACK SEALING DETAIL

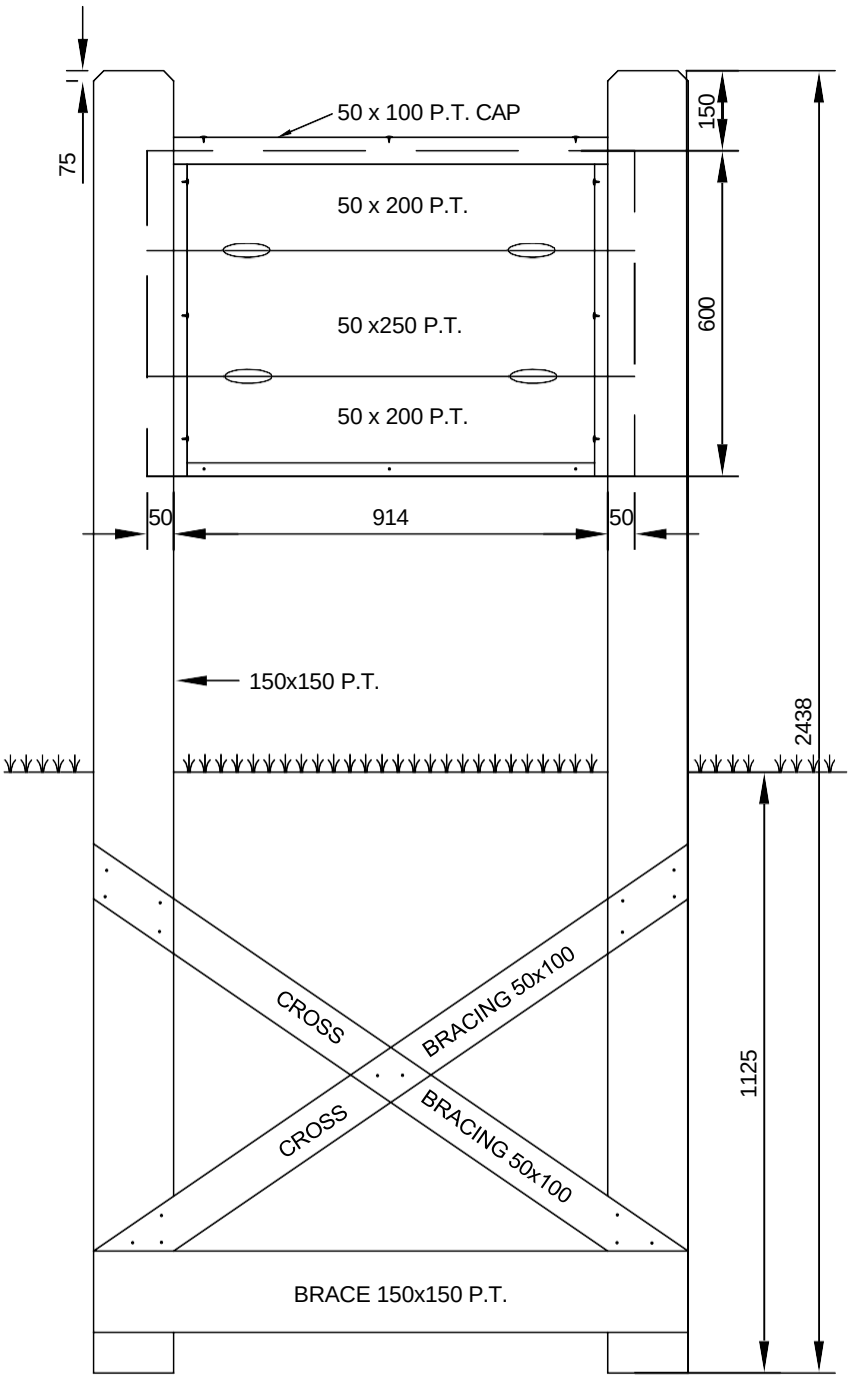
DRAWN BY: C. S.\ R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-357-01



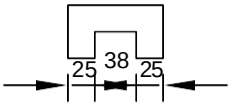
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WOOD POST & CHAIN BARRIER

DRAWN BY:	C. S.\ R.W.	DATE:	JANUARY 2022	SCALE:	N.T.S.	DRAWING No.	10-521-01



CROSS SECTION OF CAP (50x100 P.T.)



SCALE - 2:1

NOTES:

1. BACK FOR SIGN TO BE CONSTRUCTED OF 50 X 100 P.T. BISCUIT JOINED AND GLUED.

2. 75 X 75 P.T. STRIPS DOWN SIDES AND ACROSS BOTTOM OF SIGN.

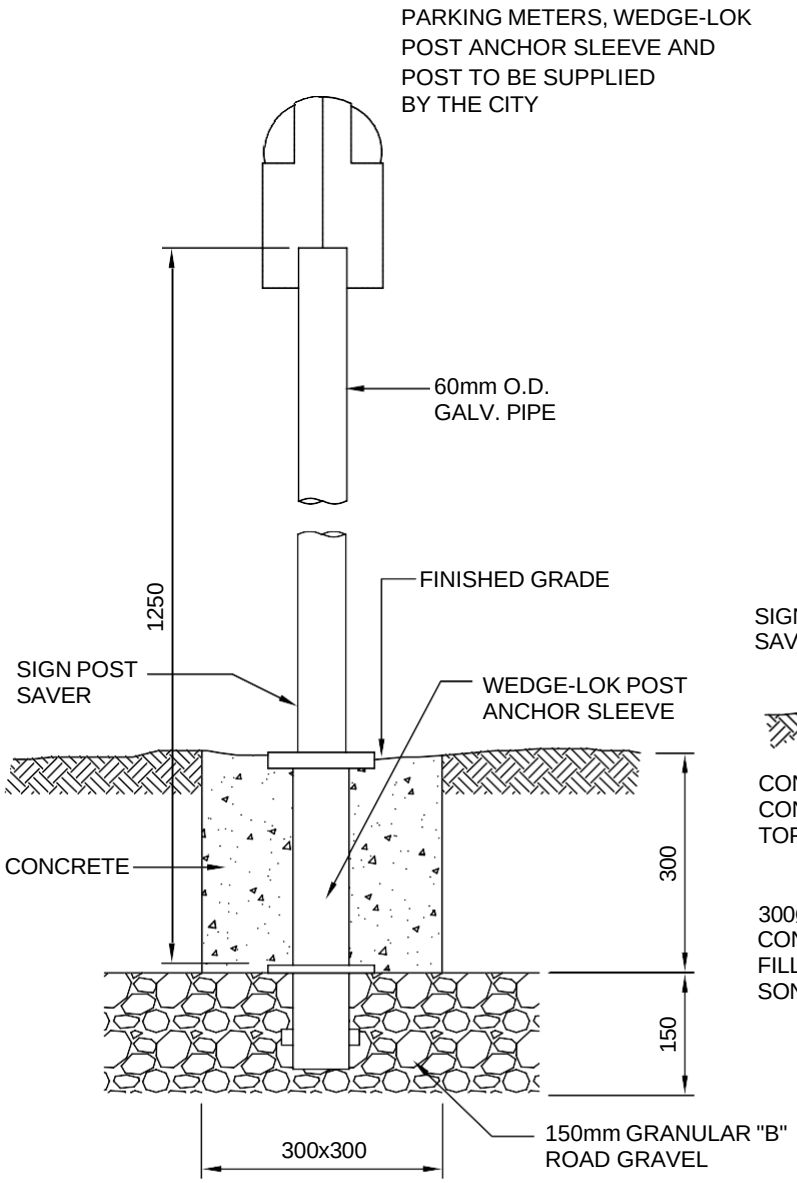
3. BACKING FOR SIGN TO BE SET INTO 150X150 P.T. 50.

4. ALL WOOD TO BE PRESSURE TREATED STRUCTURAL #1 SPRUCE OR PINE.

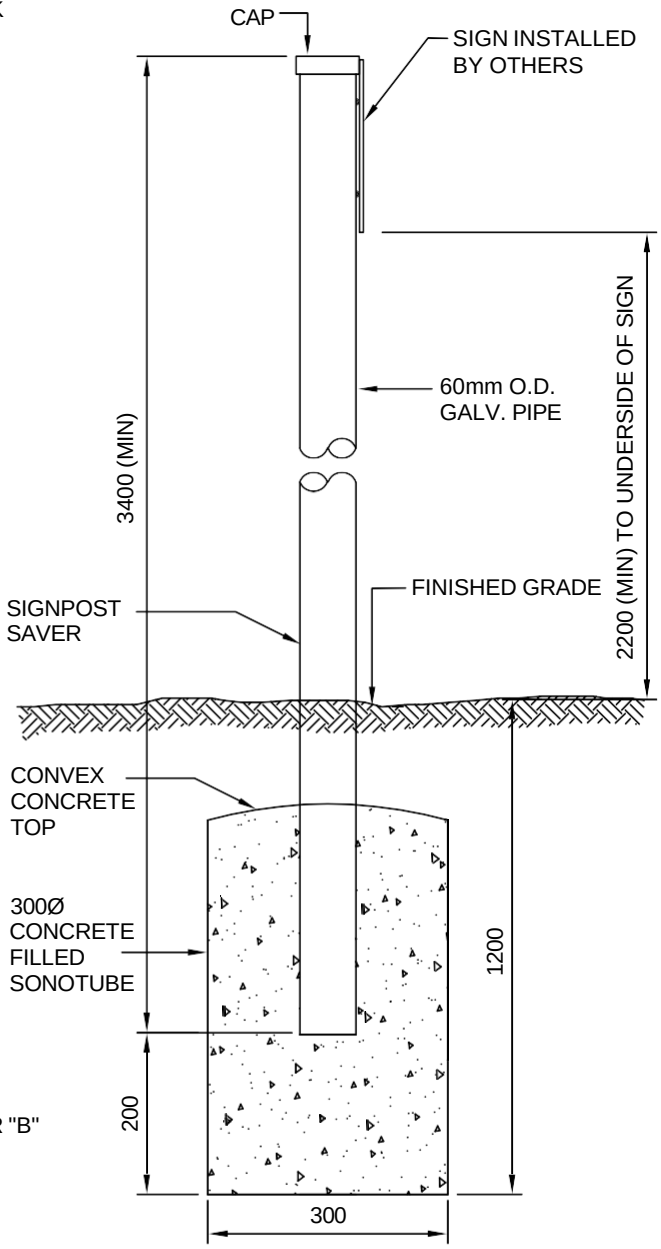
ST. JOHN'S
DEPARTMENT OF ENGINEERING

SIGN DETAIL PARKS

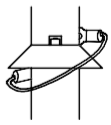
DRAWN BY: P.H.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-521-02



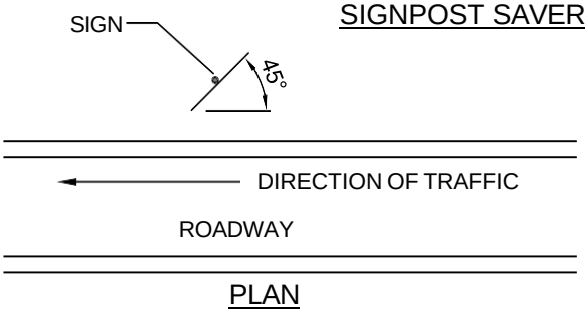
PARKING METER



SIGNPOST



SIGNPOST SAVER



PLAN

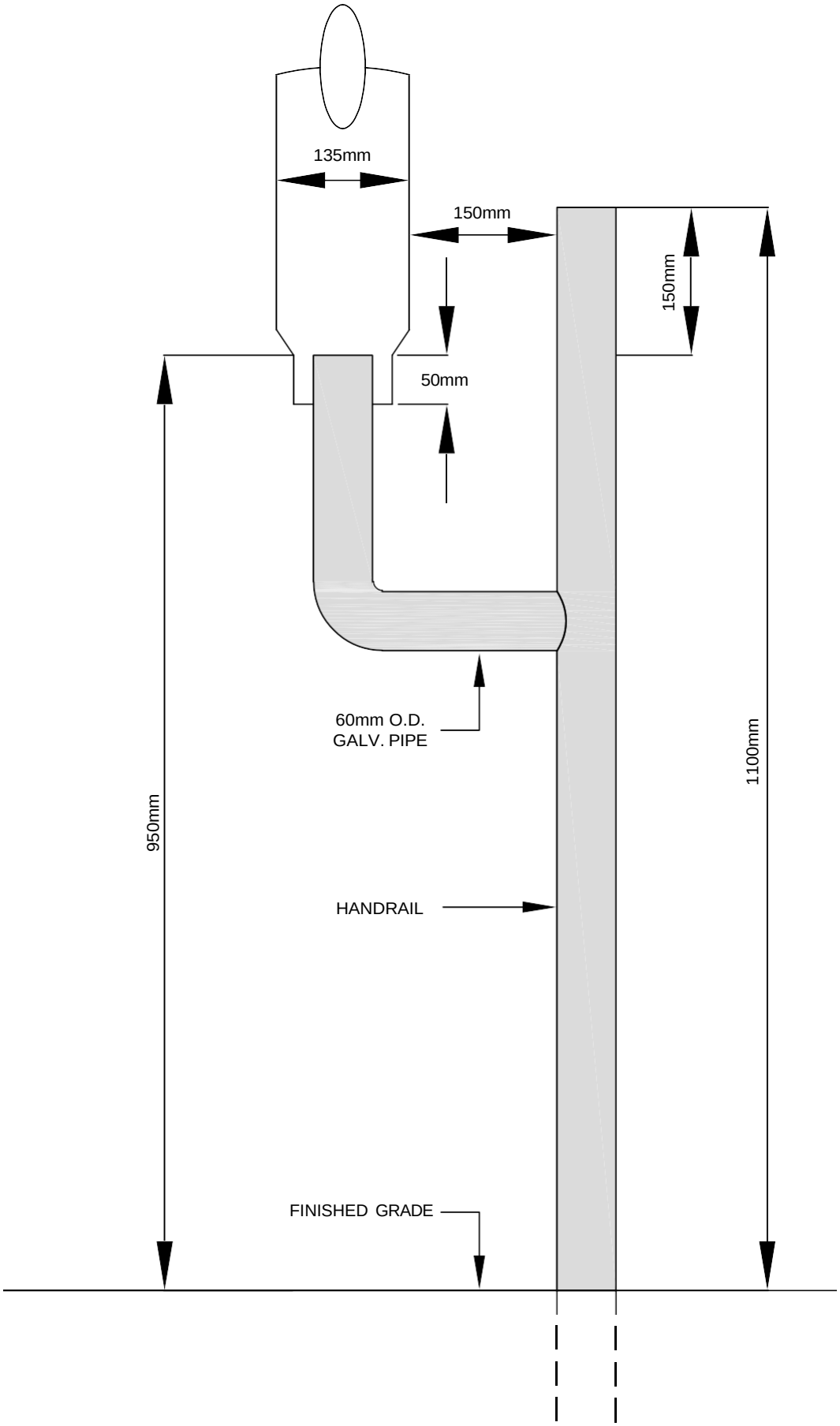
NOTES:

1. PARKING METER POST TO BE GALVANIZED CONTINUOUS WELD SCHEDULE 40 PIPE. (60mm O.D. C/W 3.2mm HOLES DRILLED 300mm FROM EACH END).
2. SIGN POST TO BE GALVANIZED CONTINUOUS WELD SCHEDULE 40 PIPE - O.D. 60mm.
3. CONCRETE IS TO BE 35 MPa TO MEET CSA A23.1, CLASS C-2 EXPOSURE.
4. EXACT LOCATION OF SIGN OR PARKING METER DETERMINED BY THE CITY OF ST. JOHN'S.
5. SURFACE FINISH MAY VARY (ie: CONCRETE, ASPHALT, PAVING STONE, LANDSCAPING).
6. FOR SIGN POST LOCATIONS SUSCEPTIBLE TO FREQUENT DAMAGE (I.E. TRAFFIC ISLANDS AND BUMP OUTS) PROVIDE BREAKAWAY DEVICE (SIGN POST SAVER, OR APPROVED EQUAL)

ST. JOHN'S
DEPARTMENT OF ENGINEERING

PARKING METER POST & SIGNPOST DETAIL

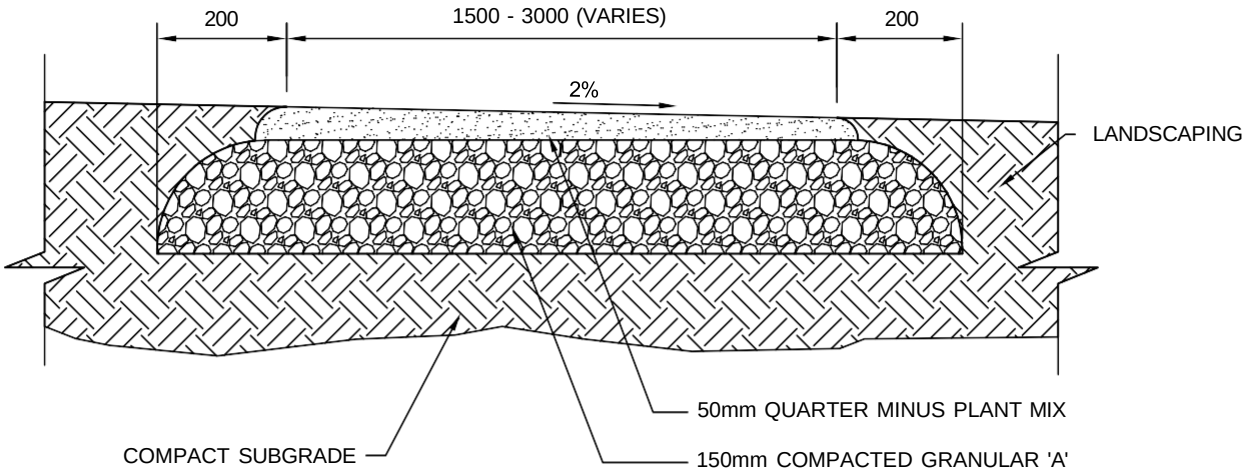
DRAWN BY: C. S. \ R.W.	DATE: FEB. 2025	SCALE: N.T.S.	DRAWING No. 10-530-01

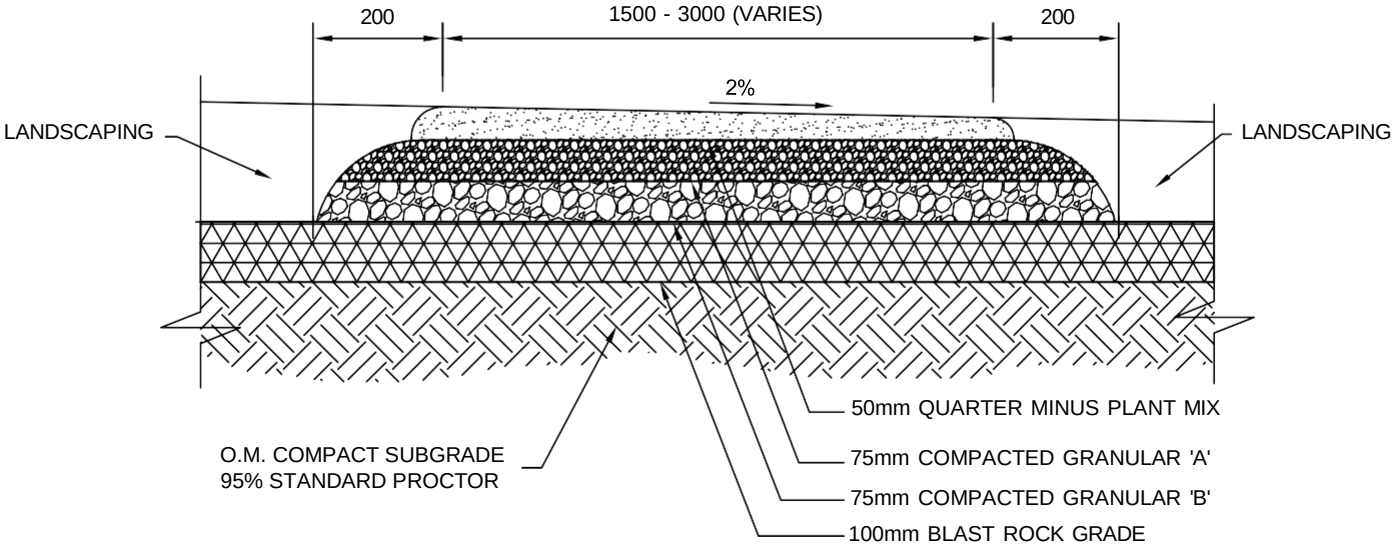


ST. JOHN'S
DEPARTMENT OF ENGINEERING

PARKING METER POST ATTACHED TO HANDRAIL

DRAWN BY: R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-530-02



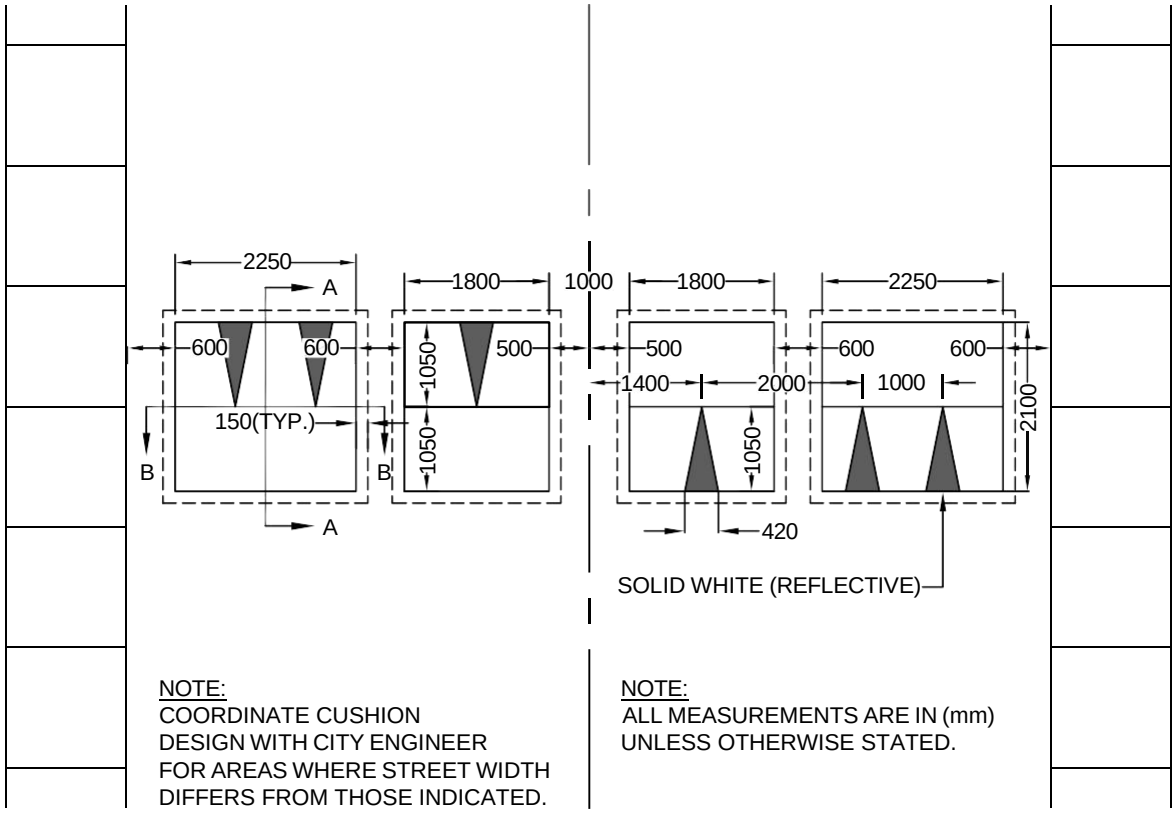


NOTE:
GRUB TO A MINIMUM OF 150mm. WHERE GRUBBING EXCEEDS 150mm, PROVIDE 100mm STONE UNDER THE AREA TO THE REQUIRED DEPTH.

ST. JOHN'S
DEPARTMENT OF ENGINEERING

GRANULAR WALK

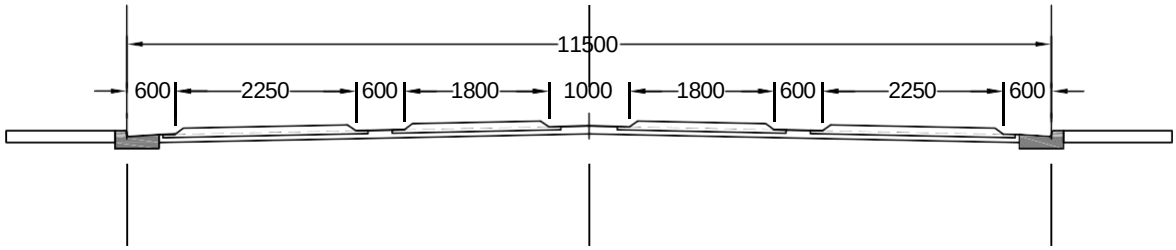
DRAWN BY: C. S. \ R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-530-03



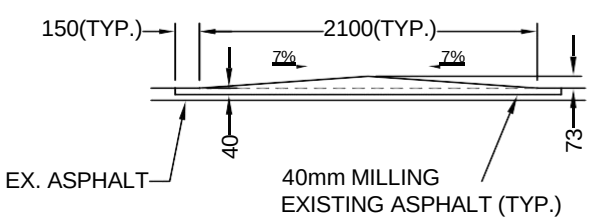
NOTE:
COORDINATE CUSHION DESIGN WITH CITY ENGINEER FOR AREAS WHERE STREET WIDTH DIFFERS FROM THOSE INDICATED.

NOTE:
ALL MEASUREMENTS ARE IN (mm) UNLESS OTHERWISE STATED.

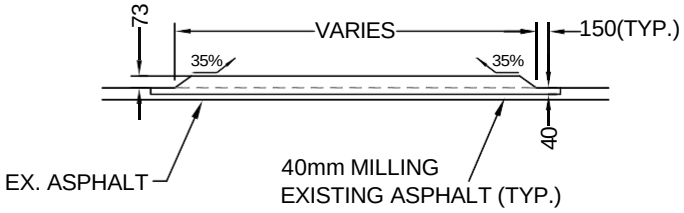
PLAN VIEW



STREET SECTION



SIDE ELEVATION (A-A)

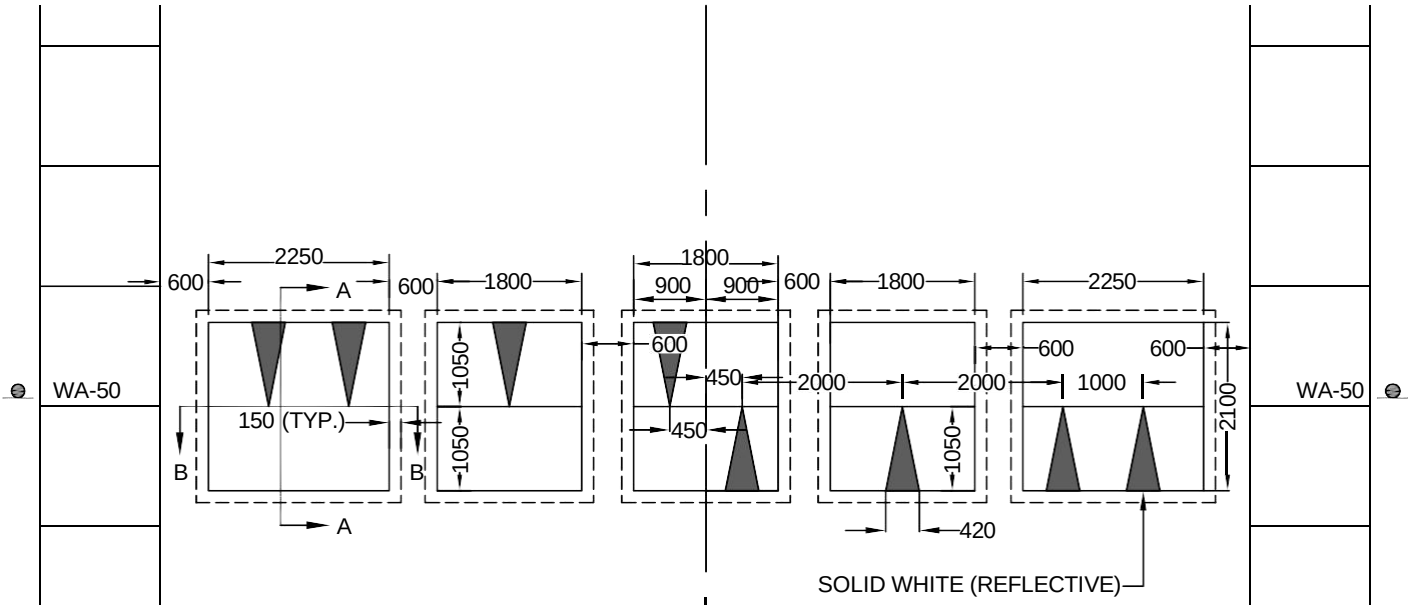


FRONT ELEVATION (B-B)

ST. JOHN'S
CORPORATE INFORMATION SERVICES

STANDARD SPEED CUSHION LOCAL STREET

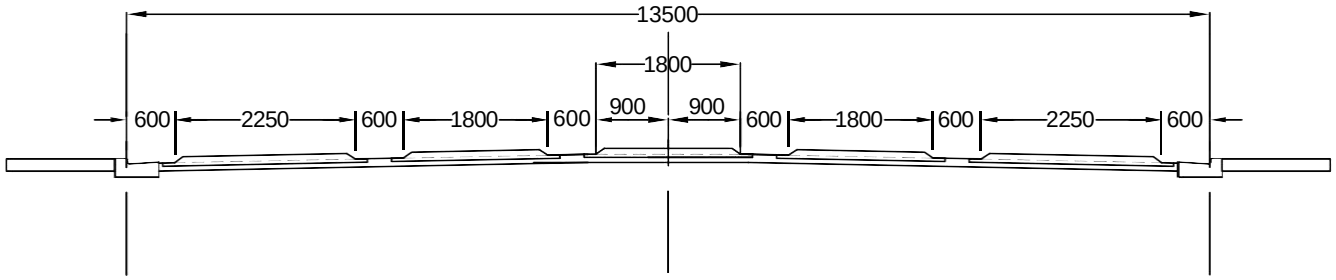
DRAWN BY: SP	DATE: JANUARY 2022	SCALE: N.T.S	DRAWING No. 10-530-05



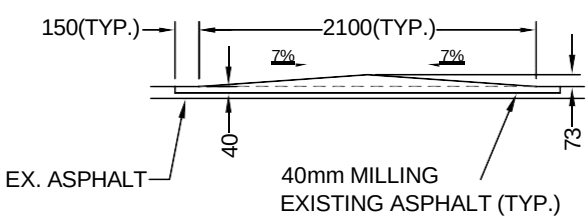
NOTE:
COORDINATE SPEED CUSHION DESIGN WITH CITY ENGINEER FOR AREAS WHERE STREET WIDTH DIFFERS FROM THOSE INDICATED.

NOTE:
ALL MEASUREMENTS ARE IN (mm) UNLESS OTHERWISE STATED.

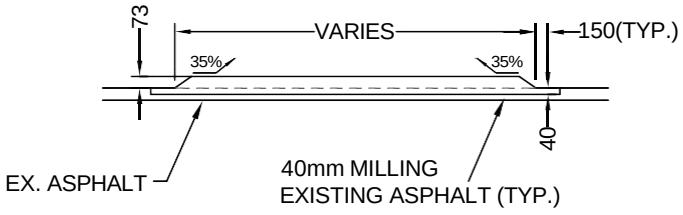
PLAN VIEW



STREET SECTION



SIDE ELEVATION (A-A)

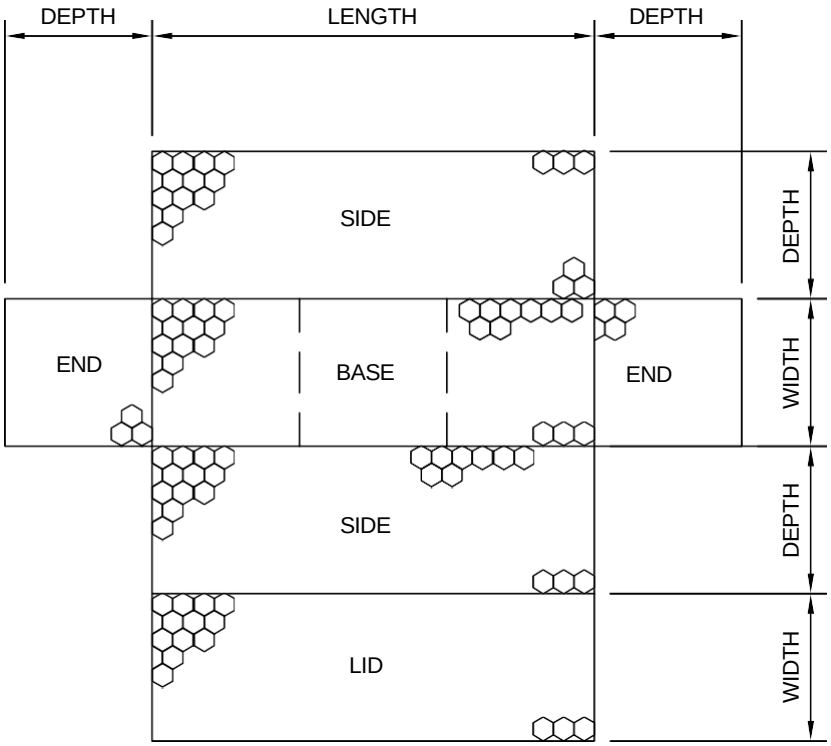


FRONT ELEVATION (B-B)

ST. JOHN'S
CORPORATE INFORMATION SERVICES

STANDARD SPEED CUSHION COLLECTOR STREET

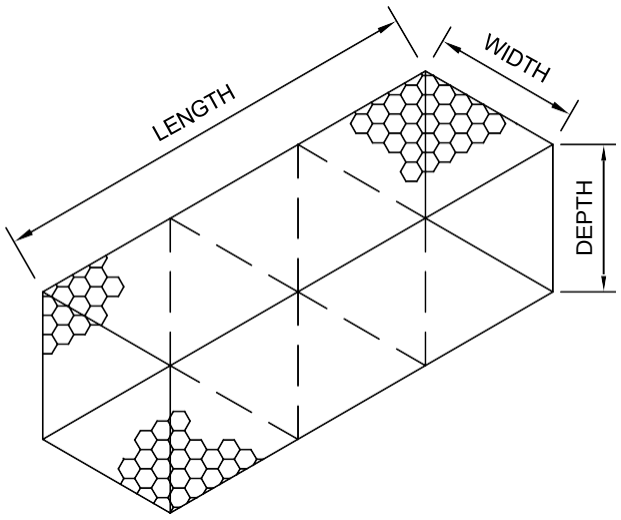
DRAWN BY: SP	DATE: JANUARY 2022	SCALE: N.T.S	DRAWING No. 10-530-06



GABION PLAN

NOTES:

1. GABIONS SHALL BE MADE OF ZINC COATED STEEL WIRE, TRIPLE TWISTED, FORMING A UNIFORM HEXAGONAL MESH PATTERN OF 80x100 OPENING.
2. GALVANIZED WIRE SHALL BE 2.9Ø FOR GALVANIZED GABIONS AND 2.7Ø FOR PVC COATED GABIONS.
3. GABIONS SHALL BE SUPPLIED FOLDED FLAT TO FACILITATE HANDLING & TRANSPORTATION. THEY SHALL FORM RECTANGULAR BASKETS OF SPECIFIED SIZE WHEN CONSTRUCTED.
4. GABIONS SHALL BE SUPPLIED WITH SECURELY TIED DIAPHRAGMS CONNECTED TO THE BASE WITH MATERIAL OF THE SAME COMPOSTION AS THE GABION, TO FORM INDIVIDUAL CELLS OF 1.0m IN WIDTH.
5. THE EDGES OF THE GABION WITH THE SECURELY TIED DIAPHRAGM WILL BE MANUFACTURED INTO SECURELY CONNECTED SELVAGES TO PREVENT RAVELING.
6. THE SELVAGE OR PERIMETER WIRE SHALL BE MADE OF 3.8Ø GALVANIZED WIRE FOR GALVANIZED GABIONS & 3.4Ø PVC COATED FOR PVC COATED GABIONS.
7. PVC COATED & GALVANIZED TYING AND CONNECTING WIRE SHALL BE SUPPLIED IN THE AMOUNT OF 2.2Ø WIRE OF NOT LESS THAN 8% OF THE WEIGHT OF THE BASKET.
8. ZINC COATING 0.26 kg/m².
9. PVC COATING FOR PVC COATED GABIONS SHALL BE 0.4 THICK.



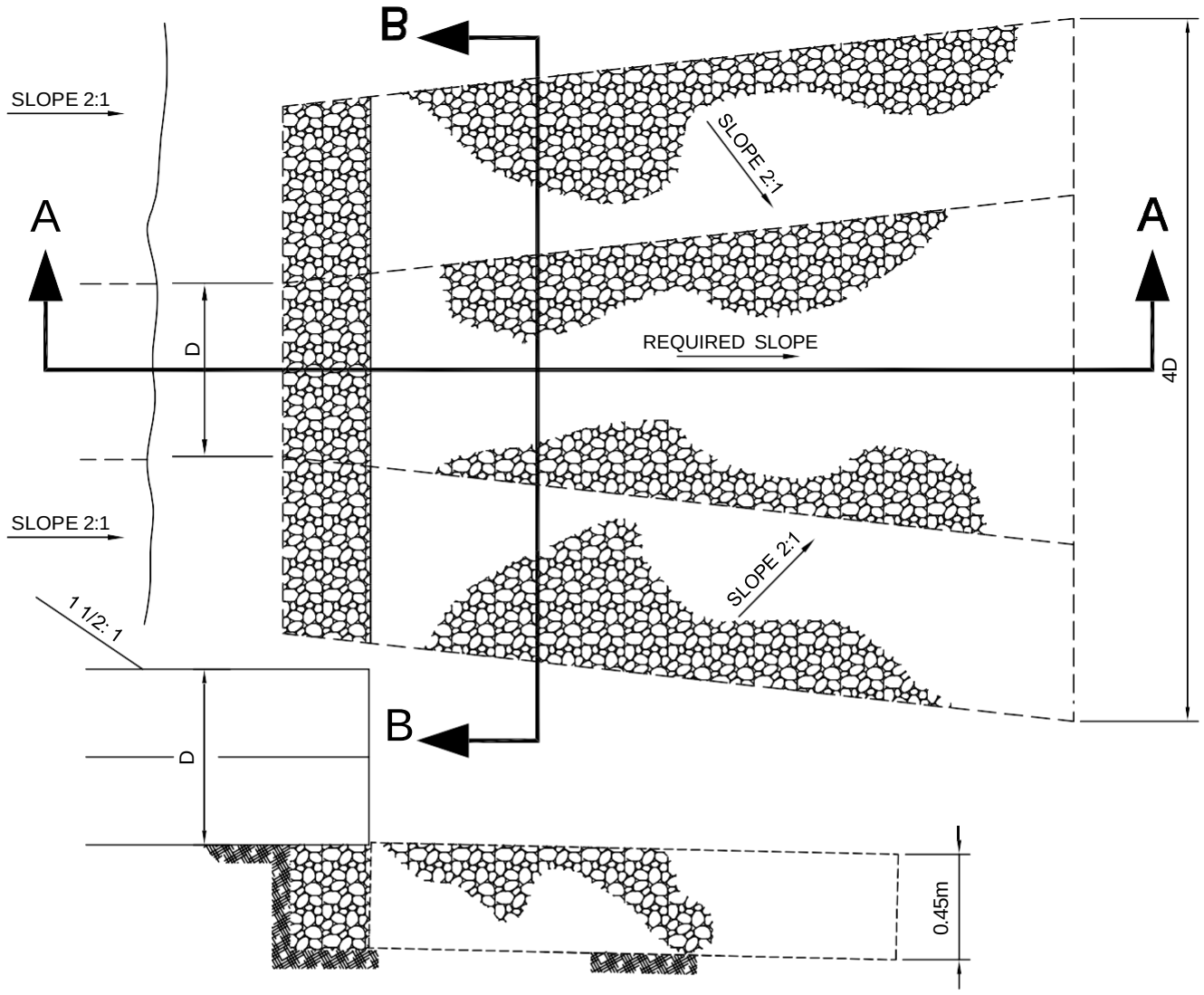
ISOMETRIC

GABION TYPE	LENGTH m	WIDTH m	DEPTH m	No. OF DIAPHS.	CAPACITY m^3
A	2	1	1	1	2
B	3	1	1	2	3
C	4	1	1	3	4
D	2	1	0.5	1	1
E	3	1	0.5	2	1.5
F	4	1	0.5	3	2
G	2	1	0.3	1	0.6
H	3	1	0.3	2	0.9
I	4	1	0.3	3	1.2

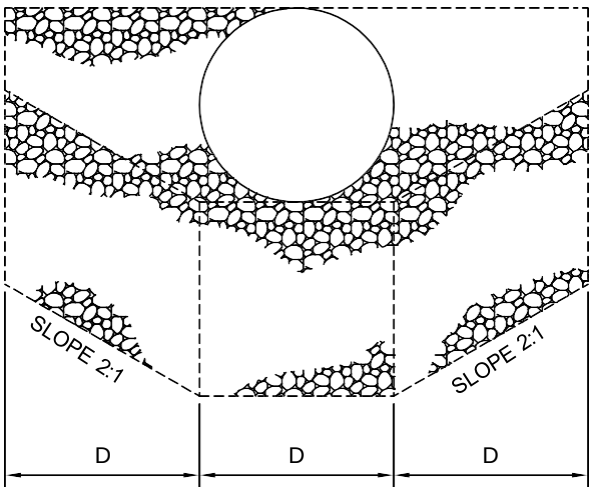
ST. JOHN'S
DEPARTMENT OF ENGINEERING

GABIONS

DRAWN BY: C. S. \ R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-542-01



SECTION A - A

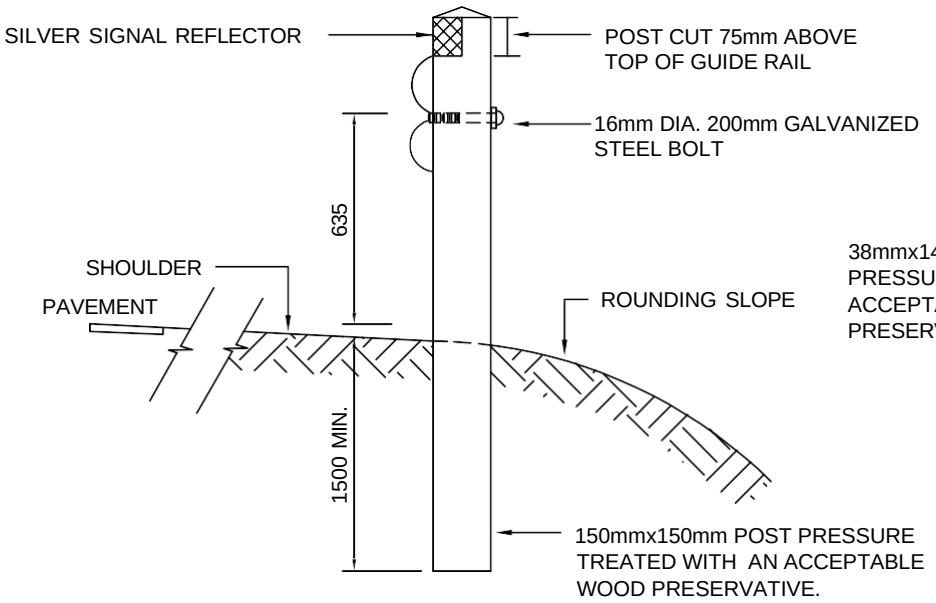


SECTION B - B

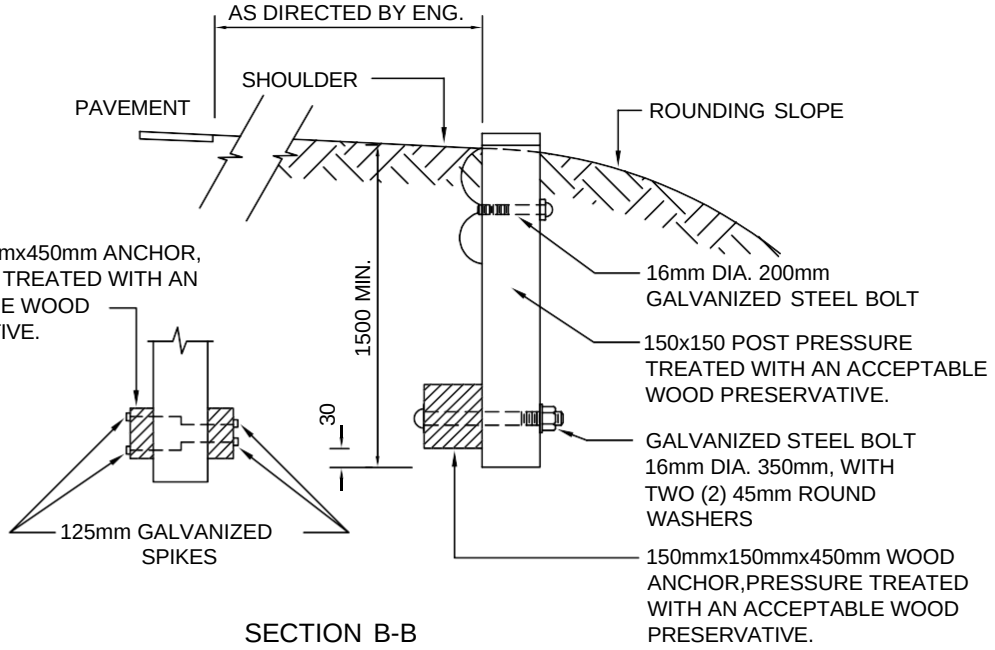
ST. JOHN'S
DEPARTMENT OF ENGINEERING

RIP RAP TREATMENT - STORM SEWER OUTLET

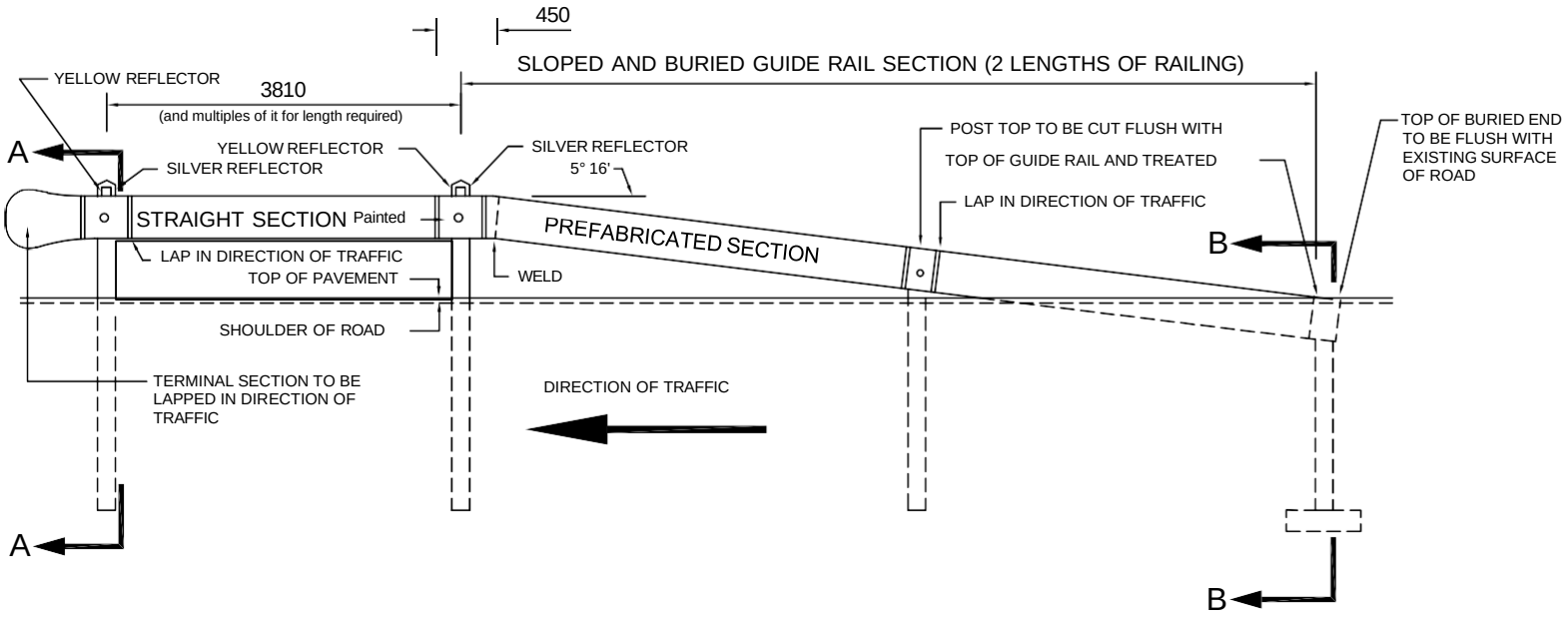
DRAWN BY: C. S. \ R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-542-02



SECTION A-A



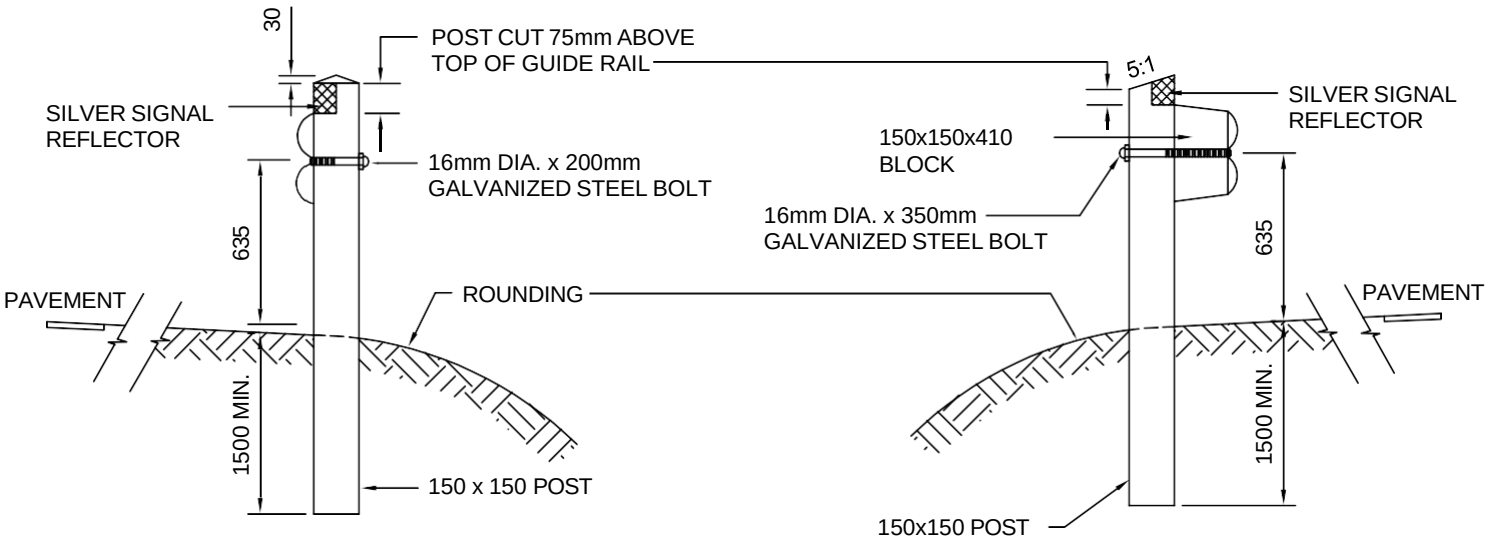
SECTION B-B



ST. JOHN'S
DEPARTMENT OF ENGINEERING

GUIDE RAIL STANDARD INSTALLATION

DRAWN BY:	C. S. \ R.W.	DATE:	JANUARY 2022	SCALE:	N.T.S.	DRAWING No.	10-602-01



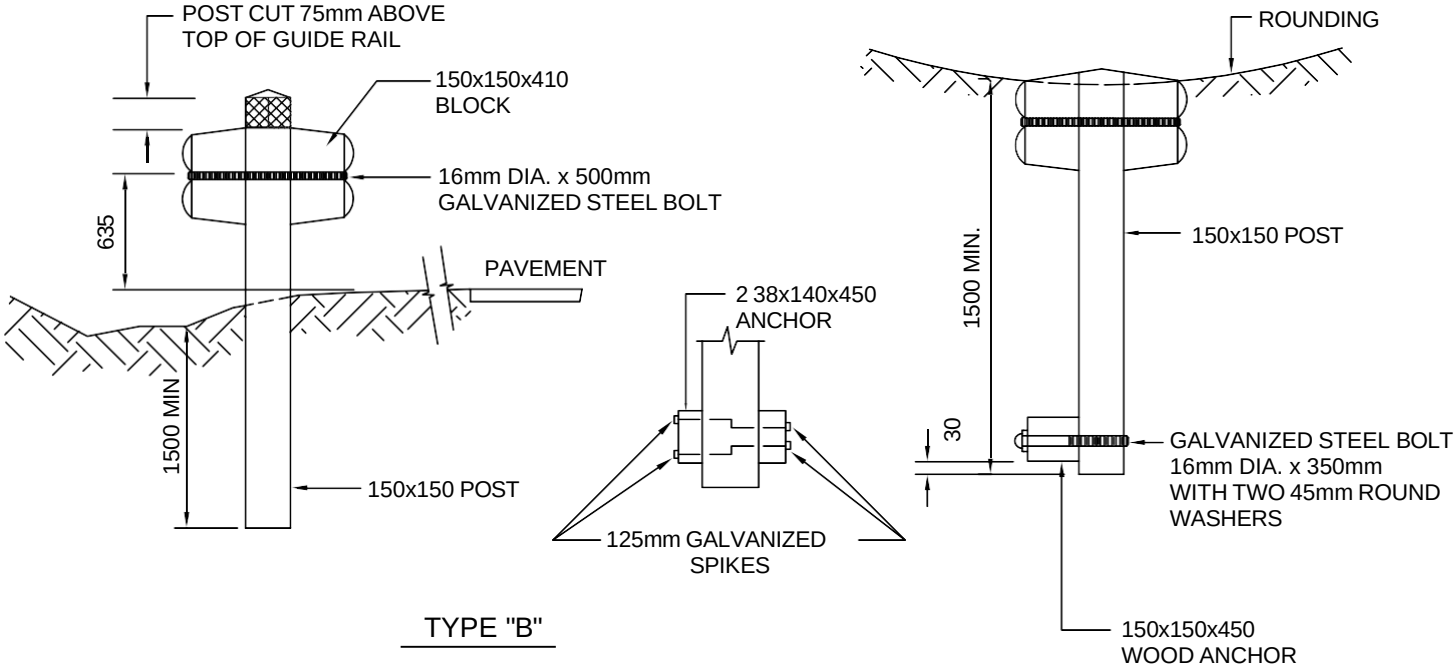
STANDARD TYPE

TYPE "A"

NOTE:

1. SLOPED AND BURIED GUIDE RAIL SECTION (2 LENGTHS OF RAILING) TYPICAL STANDARD GUIDE RAIL INSTALLATION.

2. ALL WOOD TO BE PRESSURE TREATED WITH AN ACCEPTABLE WOOD PRESERVATIVE.



TYPE "B"

NOTE:

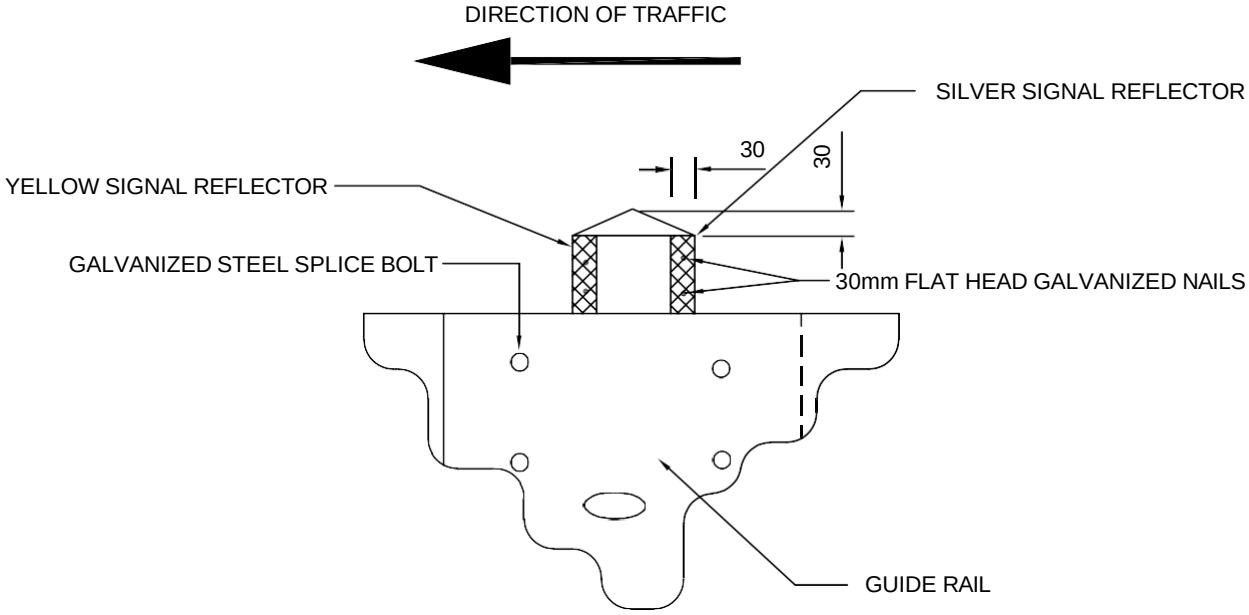
1. ALL ANGLED SECTIONS TYPICAL OF STANDARD TYPE GUIDE RAIL.

2. ALL RAIL TERMINAL SECTIONS TYPICAL OF STANDARD GUIDE RAIL INSTALLATION.

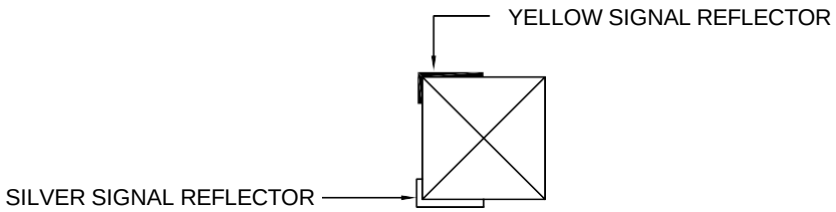
ST. JOHN'S
DEPARTMENT OF ENGINEERING

TYPICAL GUIDE RAIL INSTALLATION TYPES

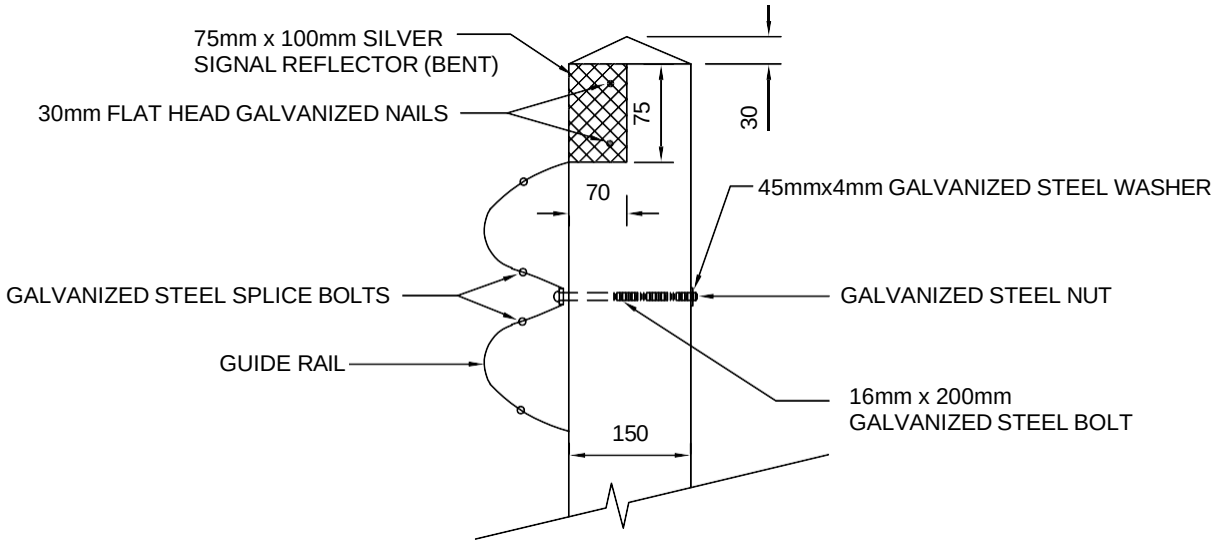
DRAWN BY: C. S. \ R.W	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-602-02



FRONT VIEW



TOP VIEW



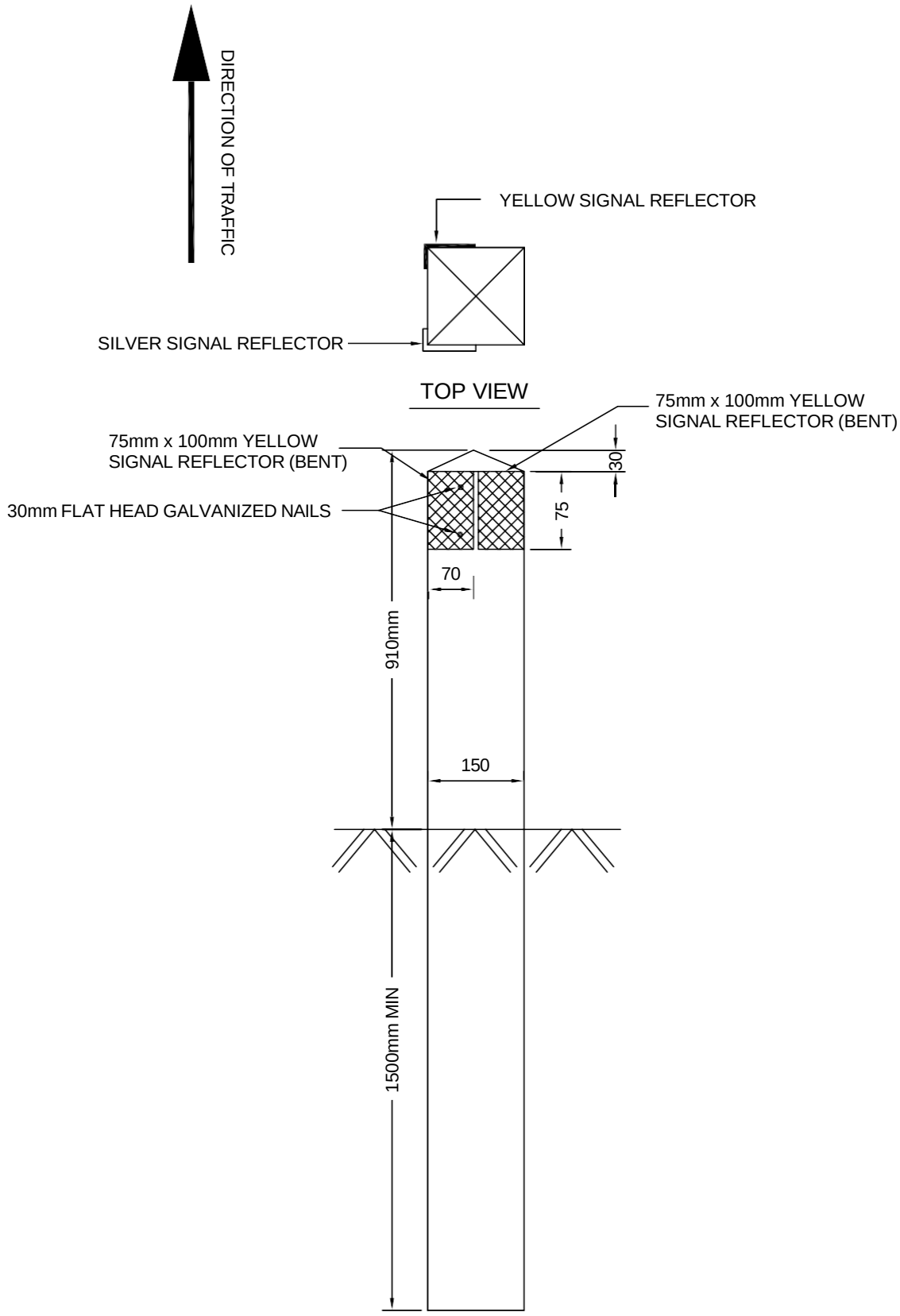
RIGHT SIDE VIEW

NOTE:
1. YELLOW SIGNAL REFLECTORS ARE OMITTED ON DIVIDED HIGHWAY.

ST. JOHN'S
DEPARTMENT OF ENGINEERING

SIGNAL REFLECTORS ON GUIDE RAIL POSTS

DRAWN BY: C. S.\ R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-602-03

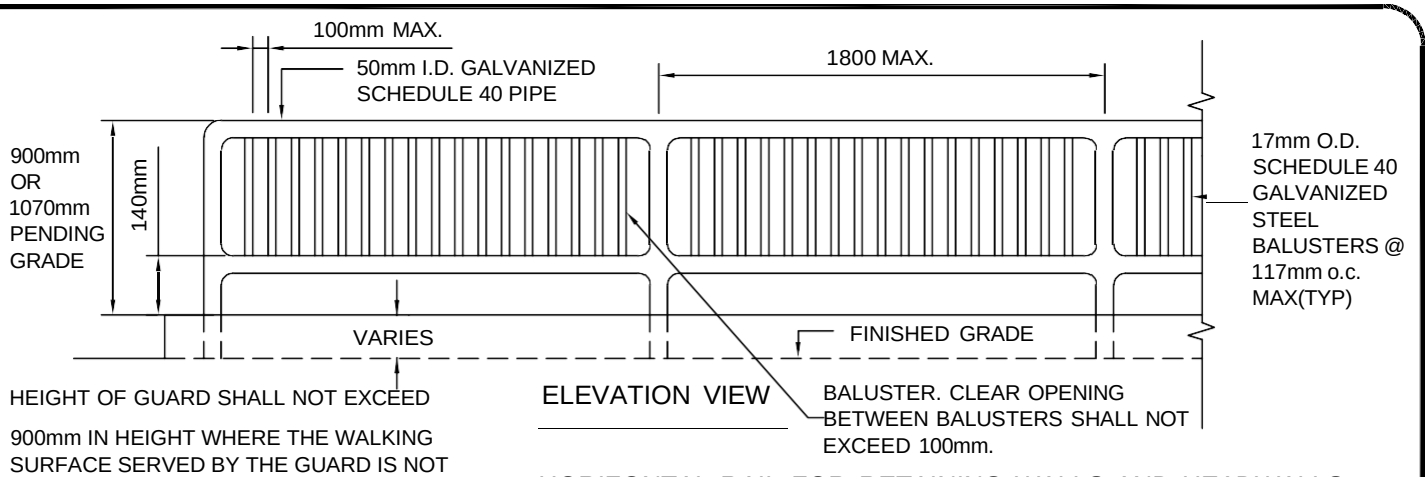


NOTE:
1. YELLOW SIGNAL REFLECTORS ARE OMITTED ON DIVIDED HIGHWAY.

ST. JOHN'S
DEPARTMENT OF ENGINEERING

GUIDE POST

DRAWN BY: C. S.\ R.W.	DATE: FEB. 2025	SCALE: N.T.S.	DRAWING No. 10-602-04

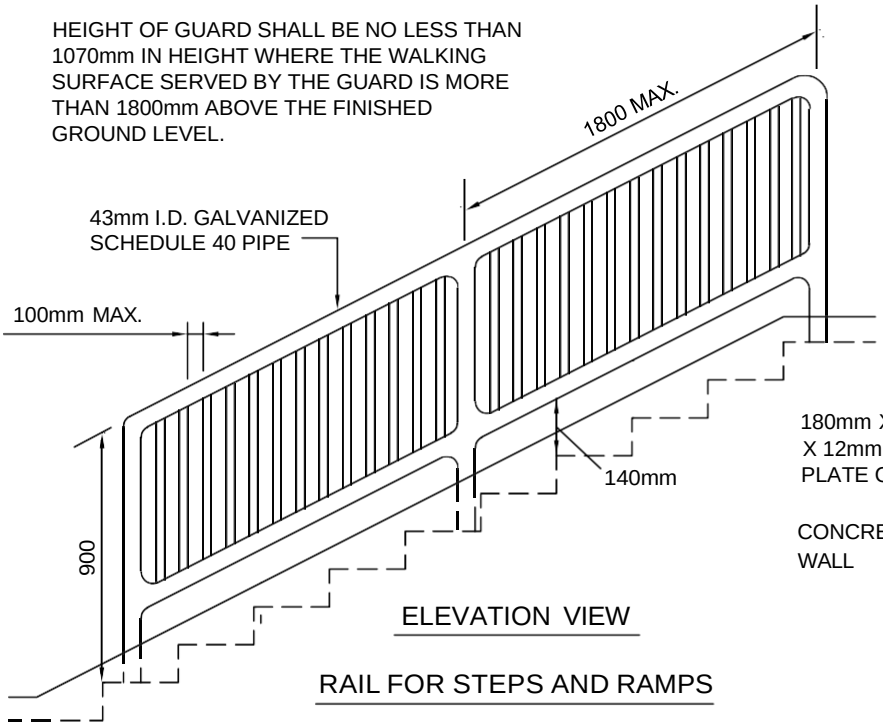


ELEVATION VIEW

HEIGHT OF GUARD SHALL NOT EXCEED 900mm IN HEIGHT WHERE THE WALKING SURFACE SERVED BY THE GUARD IS NOT MORE THAN 1800mm ABOVE THE FINISHED GROUND LEVEL.

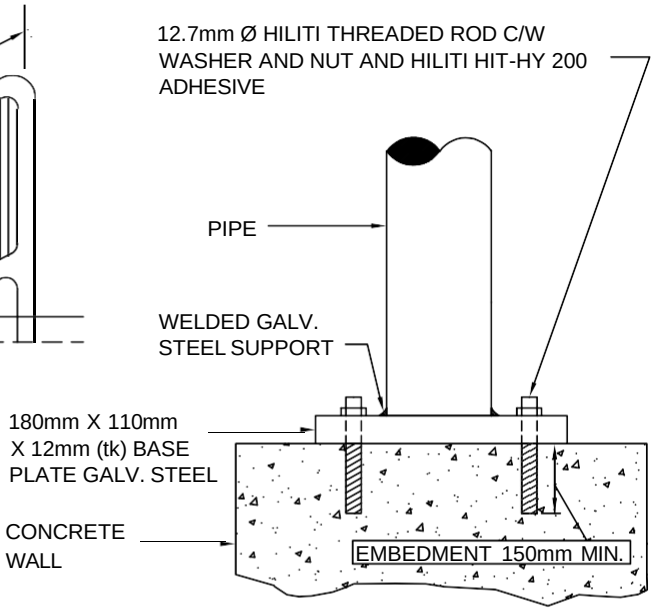
HORIZONTAL RAIL FOR RETAINING WALLS AND HEADWALLS.

HEIGHT OF GUARD SHALL BE NO LESS THAN 1070mm IN HEIGHT WHERE THE WALKING SURFACE SERVED BY THE GUARD IS MORE THAN 1800mm ABOVE THE FINISHED GROUND LEVEL.

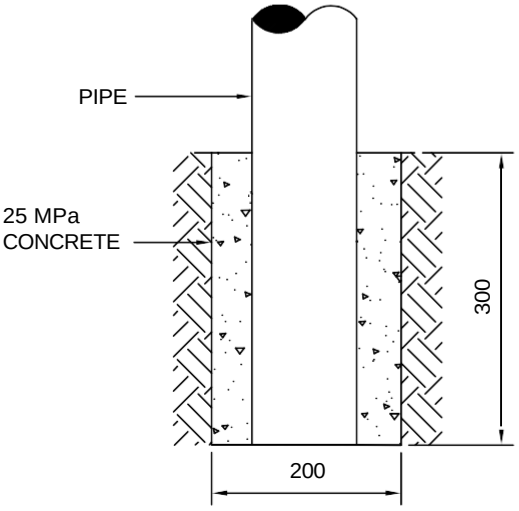


ELEVATION VIEW

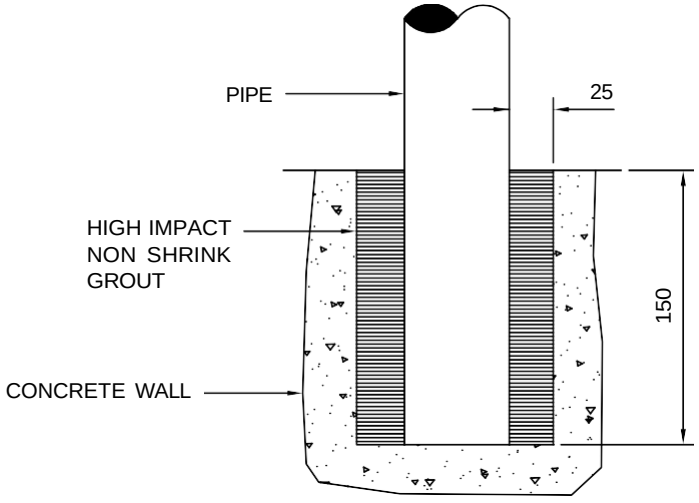
RAIL FOR STEPS AND RAMPS



CONNECTIONS DETAIL FOR WALL CONDITIONS - BASE PLATE OPTION



FOOTING DETAIL FOR O.M. CONDITIONS



CONNECTIONS DETAIL FOR WALL CONDITIONS - CORE & GROUT OPTION

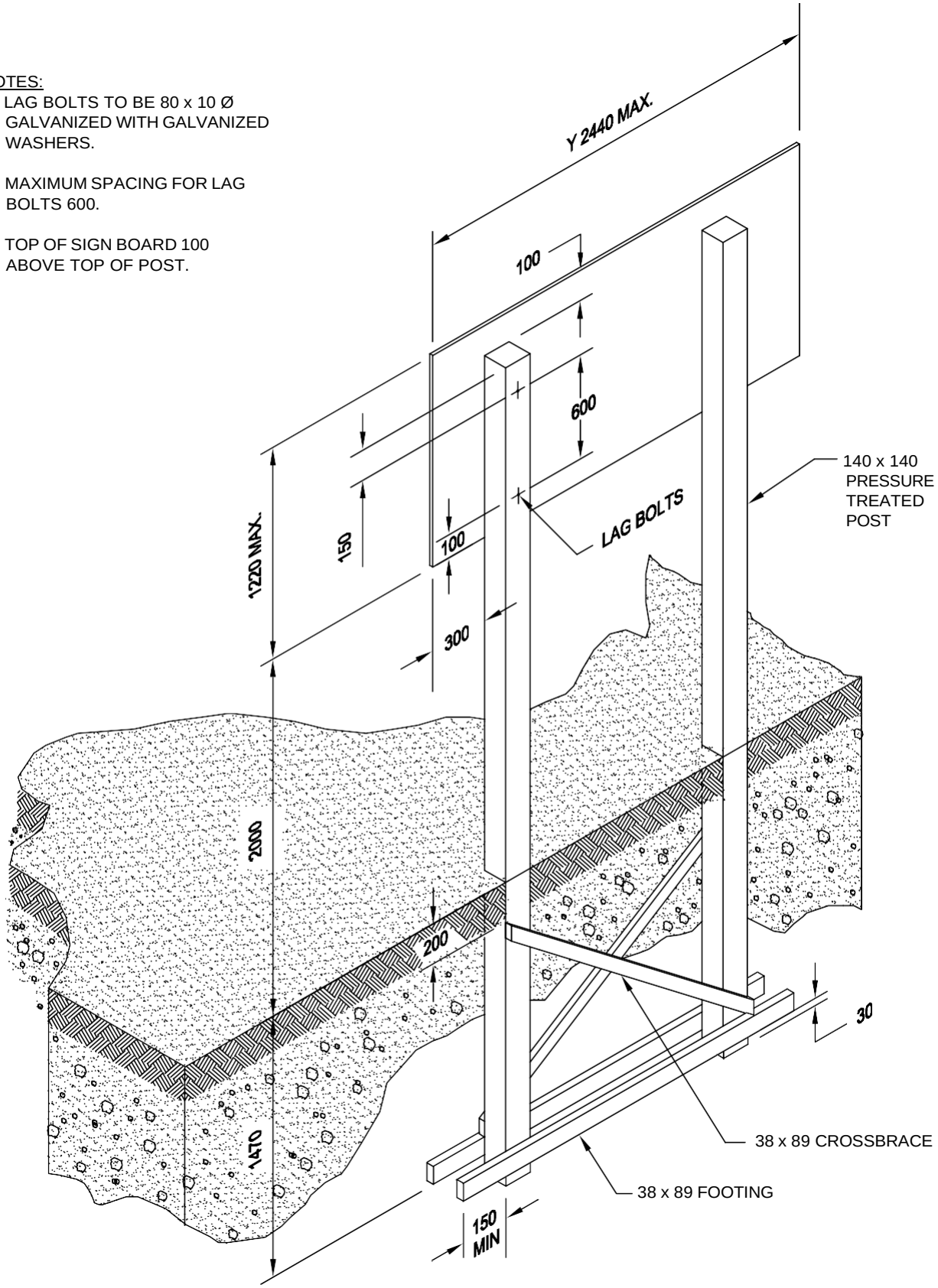
ST. JOHN'S
DEPARTMENT OF ENGINEERING

HANDRAIL

DRAWN BY: C. S. \ R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-603-01

NOTES:

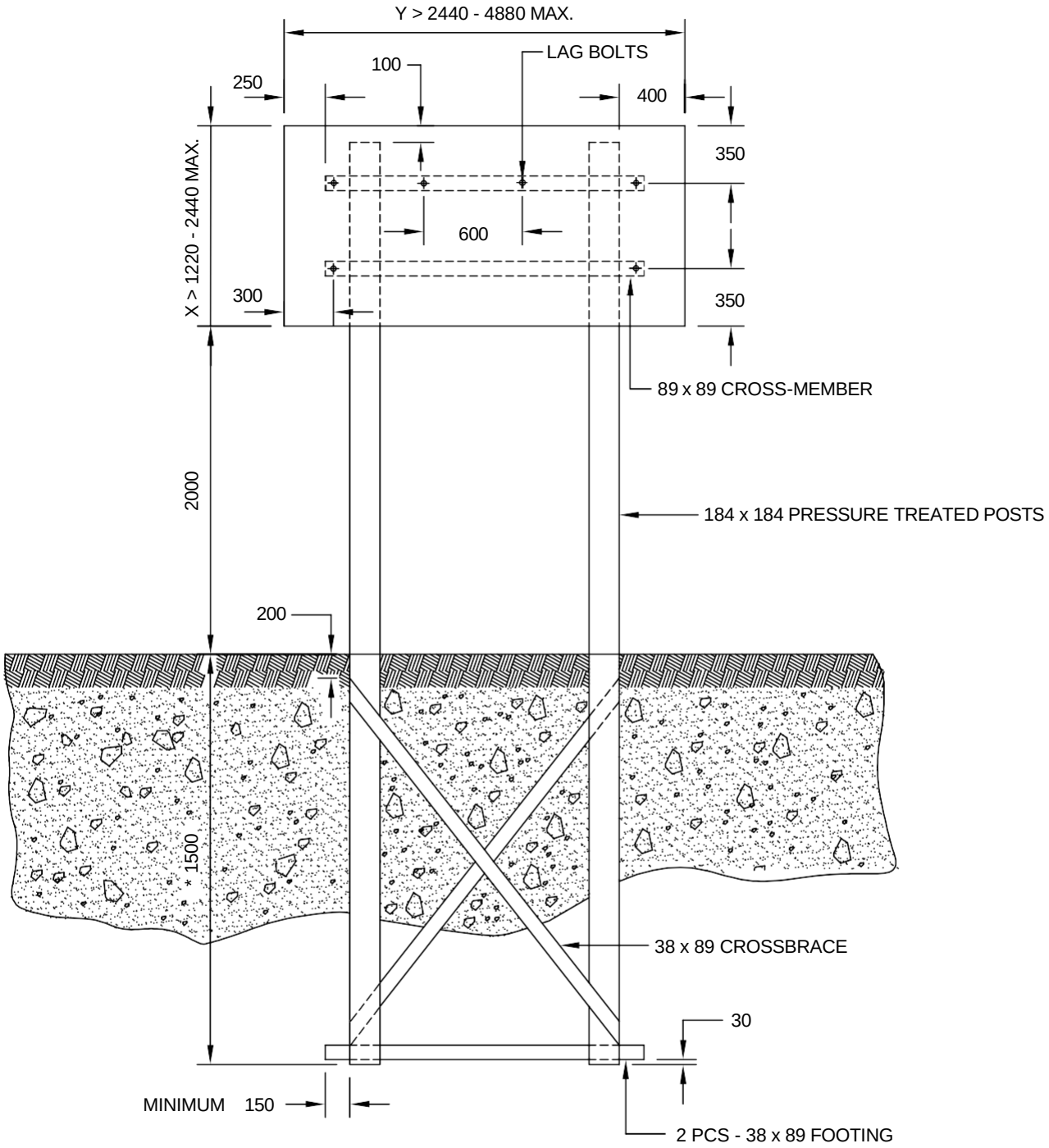
1. LAG BOLTS TO BE 80 x 10 Ø GALVANIZED WITH GALVANIZED WASHERS.
2. MAXIMUM SPACING FOR LAG BOLTS 600.
3. TOP OF SIGN BOARD 100 ABOVE TOP OF POST.



ST. JOHN'S
DEPARTMENT OF ENGINEERING

SIGNPOST INSTALLATION TYPE "C"

DRAWN BY: C. S. \ R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-610-01



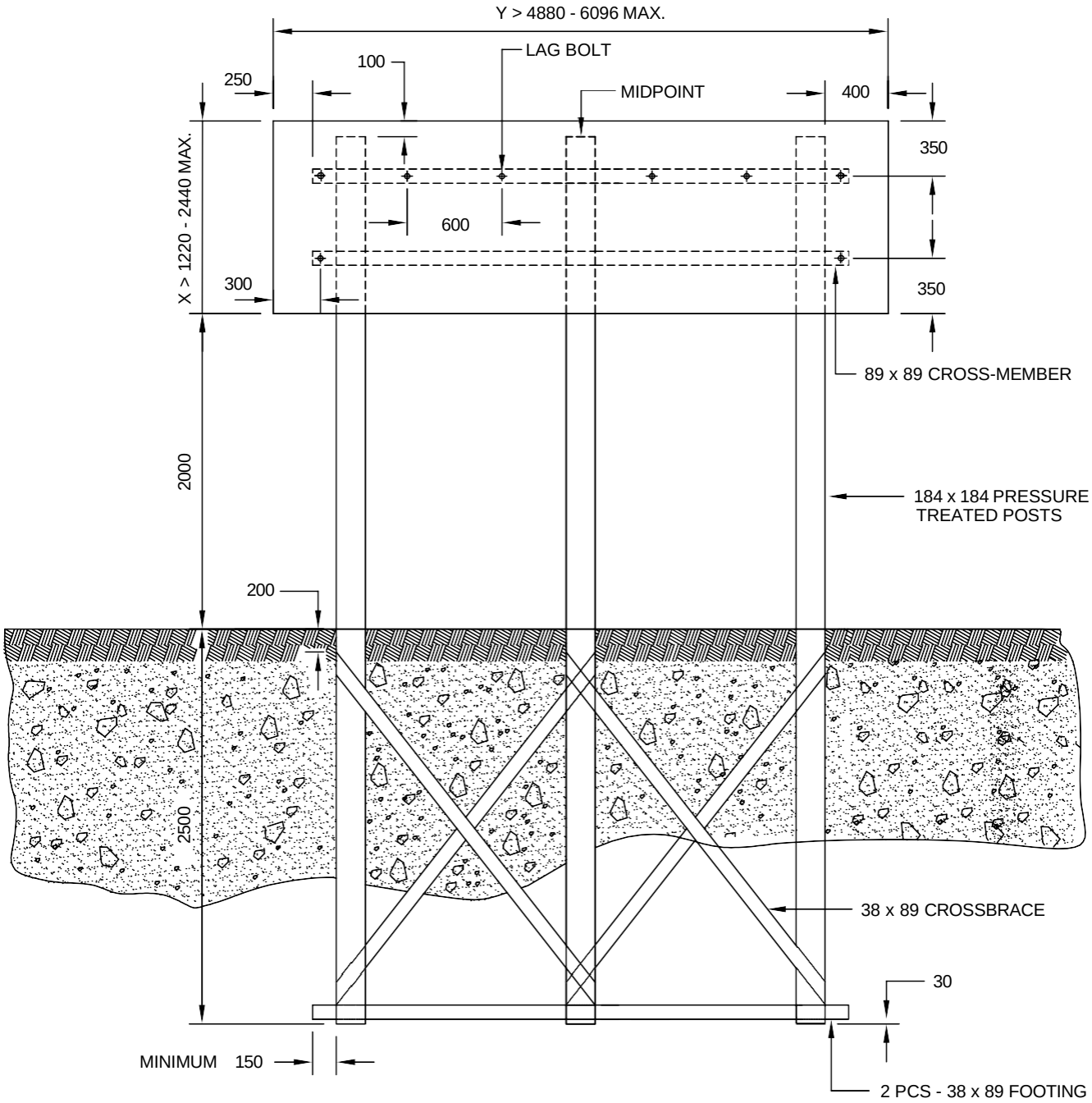
NOTES:

1. TOP OF SIGN BOARD 100 ABOVE TOP OF POST.
2. LAG BOLTS TO BE 80 x 10Ø GALVANIZED WITH GALVANIZED WASHERS.
3. MAXIMUM SPACING FOR LAG BOLTS IS 600.
4. CROSS MEMBERS TO BE ATTACHED TO POSTS USING 300 x 20 GALVANIZED NUTS AND WASHERS.
5. ALL LUMBER TO BE PRESSURE TREATED.

ST. JOHN'S
DEPARTMENT OF ENGINEERING

SIGNPOST INSTALLATION TYPE "D"

DRAWN BY: C. S. \ R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-610-02



NOTES:

1. TOP OF SIGN BOARD 100 ABOVE TOP OF POST.
2. LAG BOLTS TO BE 80 x 10Ø GALVANIZED WITH GALVANIZED WASHERS.
3. MAXIMUM SPACING FOR LAG BOLTS IS 600.
4. CROSS MEMBERS TO BE ATTACHED TO POSTS USING 300 x 20Ø GALVANIZED BOLTS, WITH NUTS AND WASHERS.
5. ALL LUMBER TO BE PRESSURE TREATED.

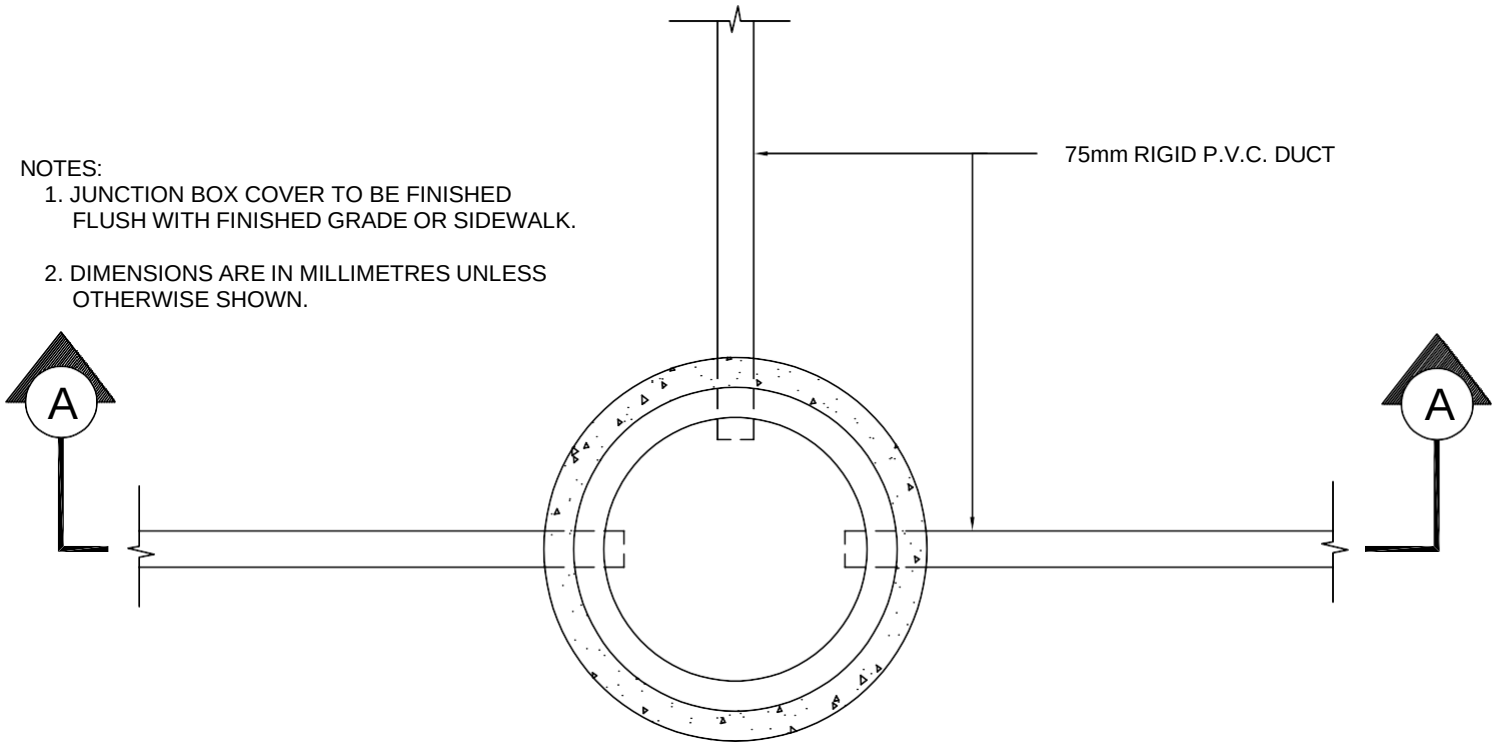
ST. JOHN'S
DEPARTMENT OF ENGINEERING

SIGNPOST INSTALLATION DETALS TYPE "E"

DRAWN BY: P.H.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-610-03

NOTES:

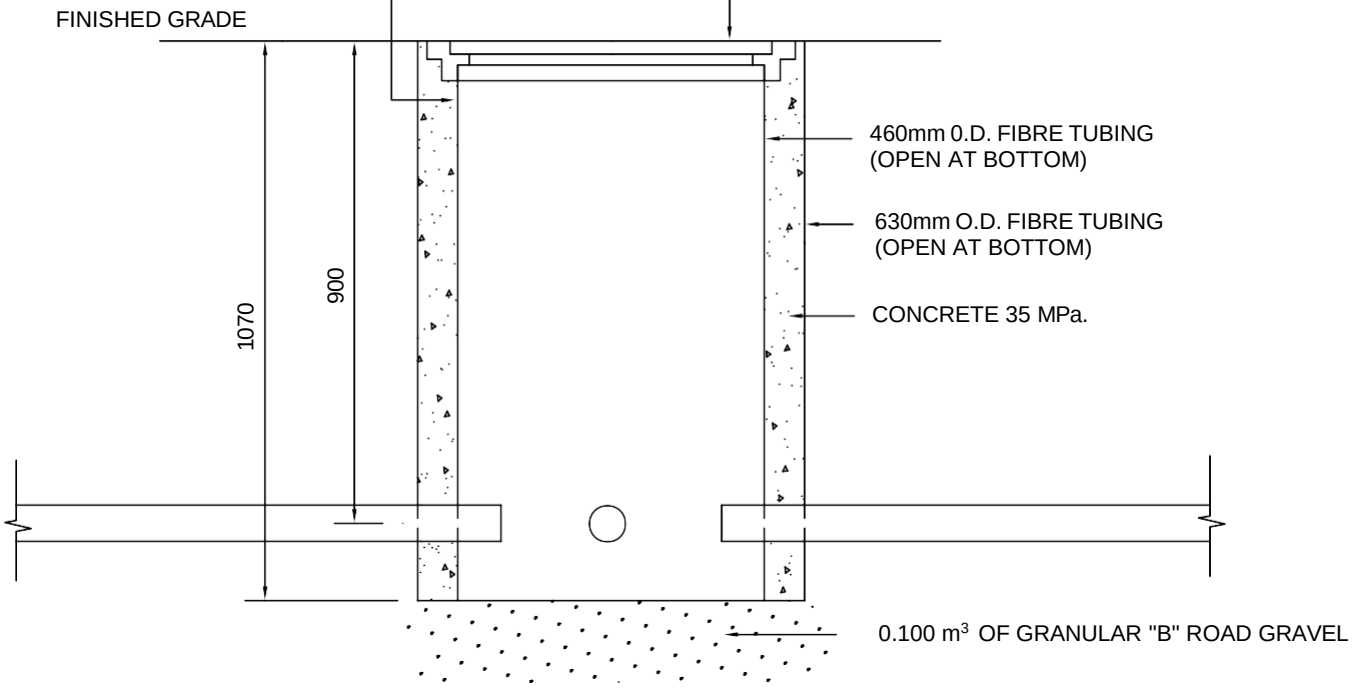
1. JUNCTION BOX COVER TO BE FINISHED FLUSH WITH FINISHED GRADE OR SIDEWALK.
2. DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN.



PLAN

CUT 3-11mm x 38mm SLOTS IN FIBRE TUBE AT EACH LOCATION OR VERTICAL FRAME ADJUSTMENT. ANCHOR FRAME IN CONCRETE WITH 3-10mmØ x 38mmØ LONG GALVANIZED MACHINE BOLTS.

460mm CAST IRON FRAME AND COVER ALMAT METAL LTD. CAT. No. DD.-1428 OR EQUAL (NO LETTERING ON COVER) COVER TO BE RETAINED BY A 13mmØ STAINLESS STEEL CAP SCREW. SEE NOTE 1.

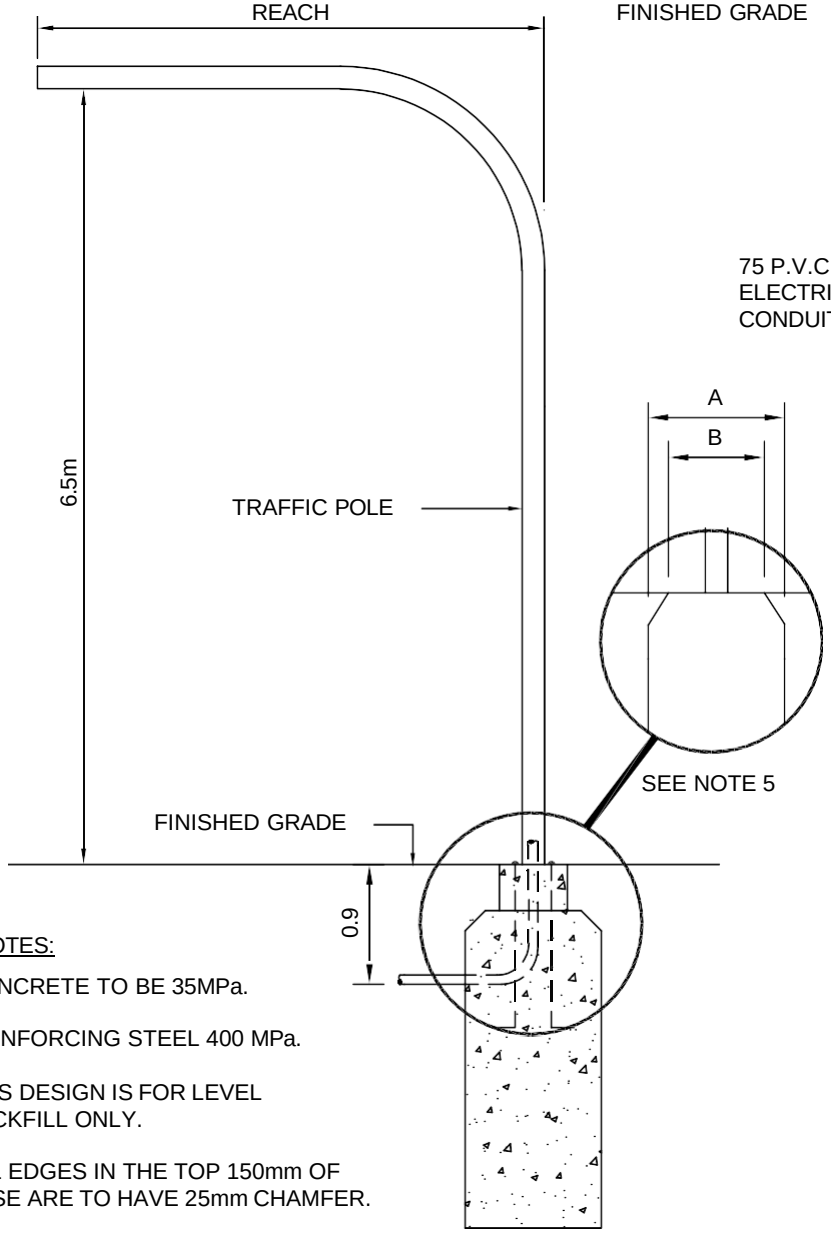


SECTION A-A

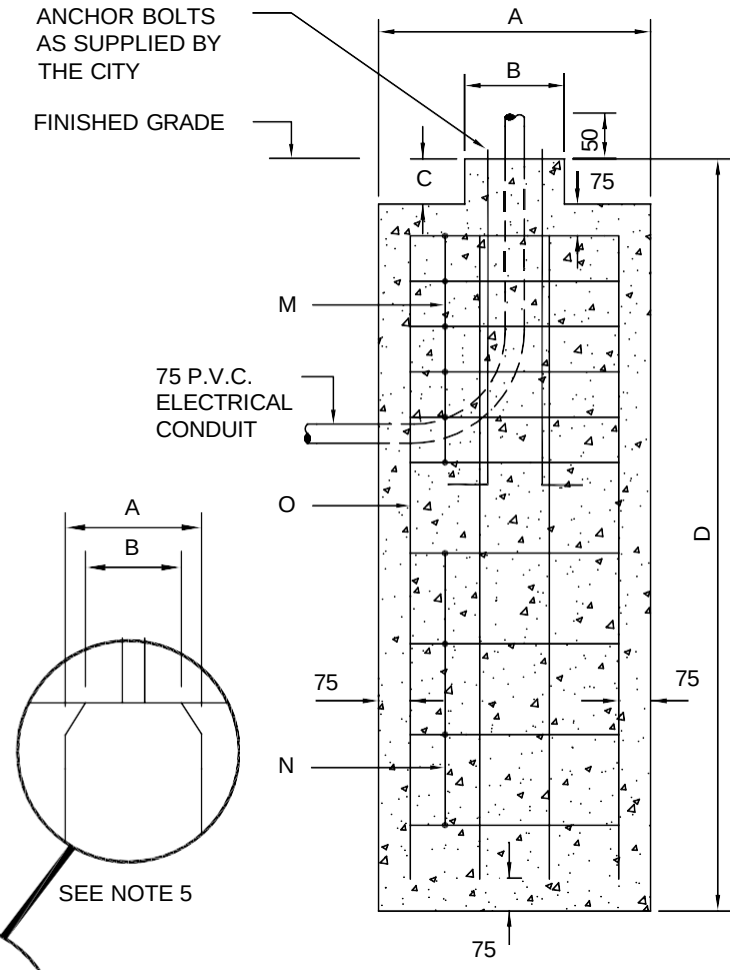
ST. JOHN'S
DEPARTMENT OF ENGINEERING

ELECTRICAL JUNCTION BOX

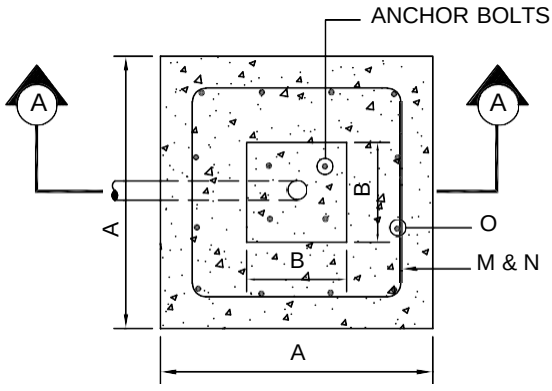
DRAWN BY: C. S. \ R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-802-01



SIDE VIEW



SECTION A-A



PLAN

NOTES:

1. CONCRETE TO BE 35MPa.
2. REINFORCING STEEL 400 MPa.
3. THIS DESIGN IS FOR LEVEL BACKFILL ONLY.
4. ALL EDGES IN THE TOP 150mm OF BASE ARE TO HAVE 25mm CHAMFER.
5. TAPER TO BE USED IN CERTAIN SITUATIONS AT DISCRETION OF THE ENGINEER.

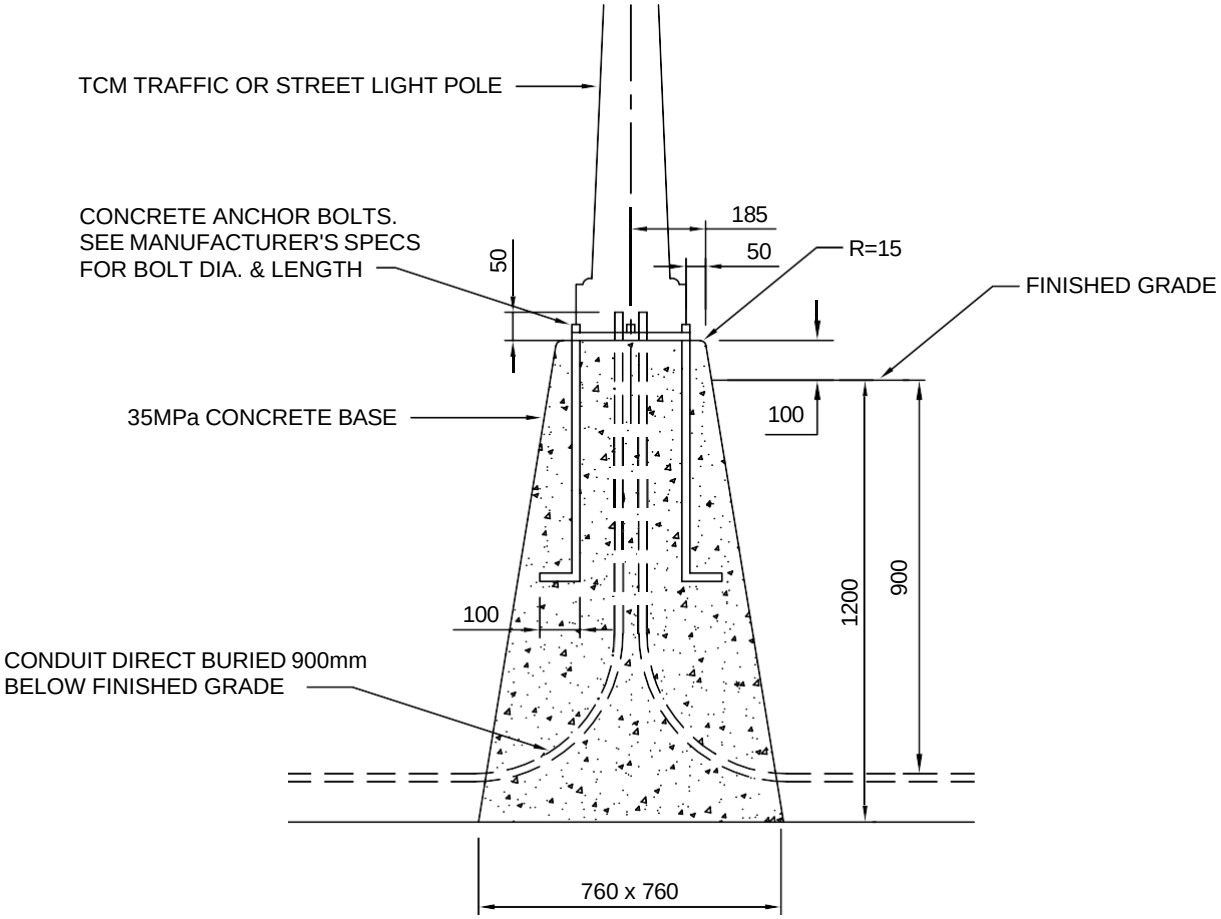
	A	B	C	D	"O" BARS			"M" BARS		"N" BARS	
REACH	mm	mm	mm	mm	No.	SIZE	LENGTH mm	No.	SIZE & SPACING	No.	SIZE & SPACING
9m/LESS	750	600	150	1800	12	25m	1500	4	10m AT 150	3	10m AT 300
11m	900	600	150	2400	12	30m	2100	6	10m AT 150	4	10m AT 300

6. THESE POLE BASES ARE DESIGNED FOR STANDARD CITY OF ST. JOHN'S TRAFFIC POLES AND EQUIPMENT LOADING IN ST. JOHN'S WEATHER CONDITIONS. DETAILED INFORMATION IS AVAILABLE FROM THE TRAFFIC DIVISION.
7. IF THESE BASES ARE PRE-FABRICATED OFF SITE, AND NOT AT A CSA CERTIFIED PRE-CAST PLANT, THIRD PARTY. CERTIFICATION WILL BE REQUIRED.

ST. JOHN'S
DEPARTMENT OF ENGINEERING

DAVIT TRAFFIC POLE BASES

DRAWN BY: C. S. \ R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-802-02



NOTES:

1. THESE POLE BASES ARE DESIGNED FOR STANDARD CITY OF ST. JOHN'S TRAFFIC POLES AND EQUIPMENT LOADING IN ST. JOHN'S WEATHER CONDITIONS. DETAILED INFORMATION IS AVAILABLE FROM THE TRAFFIC DIVISION.

2. IF THESE BASES ARE PRE-FABRICATED OFF SITE, AND NOT AT A CSA CERTIFIED PRE-CAST PLANT, THIRD PARTY. CERTIFICATION WILL BE REQUIRED.

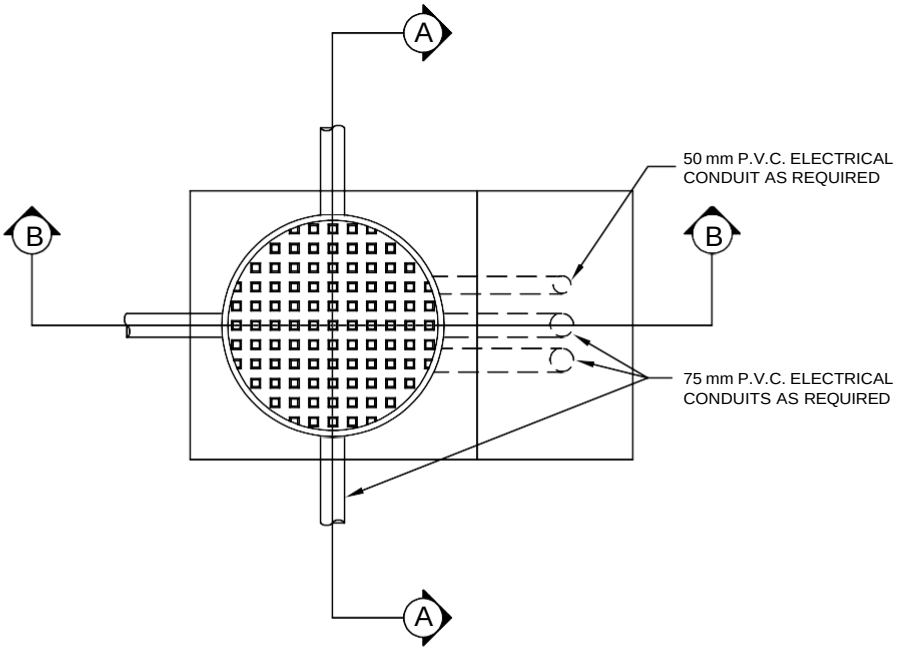
3. SIZE AND QUANTITY OF CONDUITS AS REQUIRED.

4. CONCRETE TO BE 35MPa. TO MEET CSA A23.1, CLASS C-2 EXPOSURE.

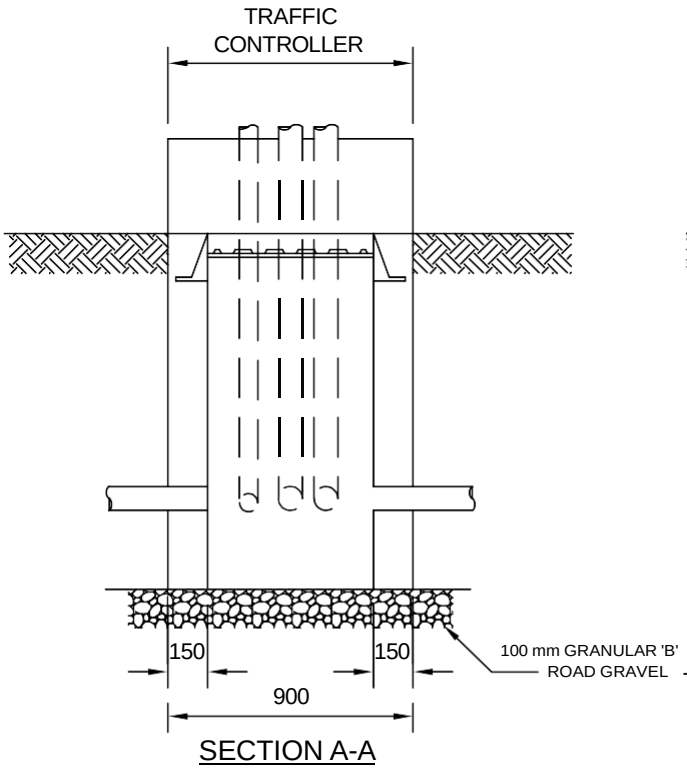
ST. JOHN'S
DEPARTMENT OF ENGINEERING

LAMP POST & TCM TRAFFIC POLE BASE

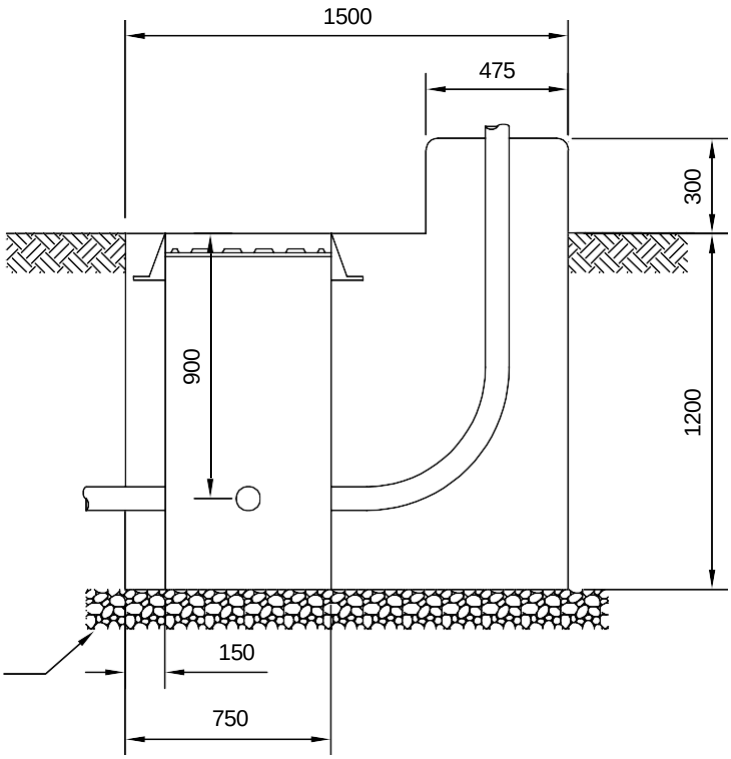
DRAWN BY: C. S. \ R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-802-03



PLAN VIEW



SECTION A-A



SECTION B-B

NOTES:

1. CONCRETE 35 MPa TO MEET CSA A23.1, CLASS C-2 EXPOSURE.
2. ALL EXPOSED EDGES TO BE CHAMFERED 25 mm.
3. ANCHOR BOLTS TO BE INSTALLED LATER AS REQUIRED.

ST. JOHN'S
DEPARTMENT OF ENGINEERING

TRAFFIC CONTROLLER BASE

DRAWN BY: C. S. \ R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-802-04

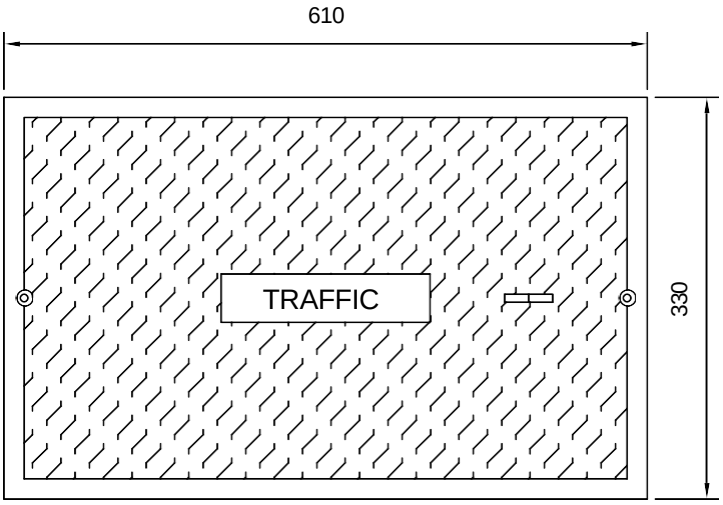
NOTES:

1. TOP OF BOX TO BE PLACED FLUSH WITH TOP OF SIDEWALK OR FINAL GRADE.

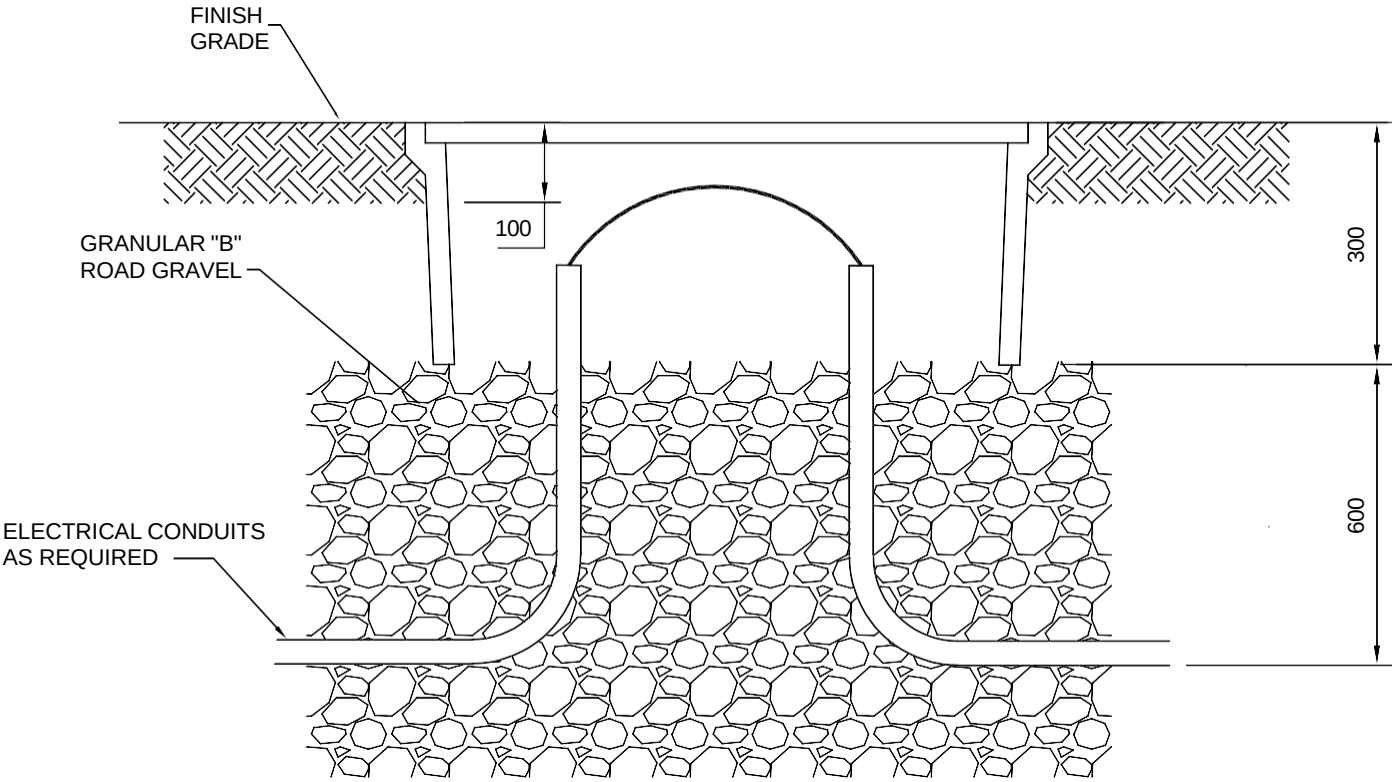
2. COVER TO HAVE TRAFFIC LOGO IMPRINTED ON TOP.

3. APPROVED MANUFACTURER
   QUAZITE COMPOSOLITE
   3621 INDUSTRIAL PARK DR.
   LENOIR CITY, TENNESSEE
   37771
   TEL. : 800/346-3062 OR APPROVED EQUAL

   COVER: PG1324HA44
   BOX: PG1324BA12



TOP VIEW

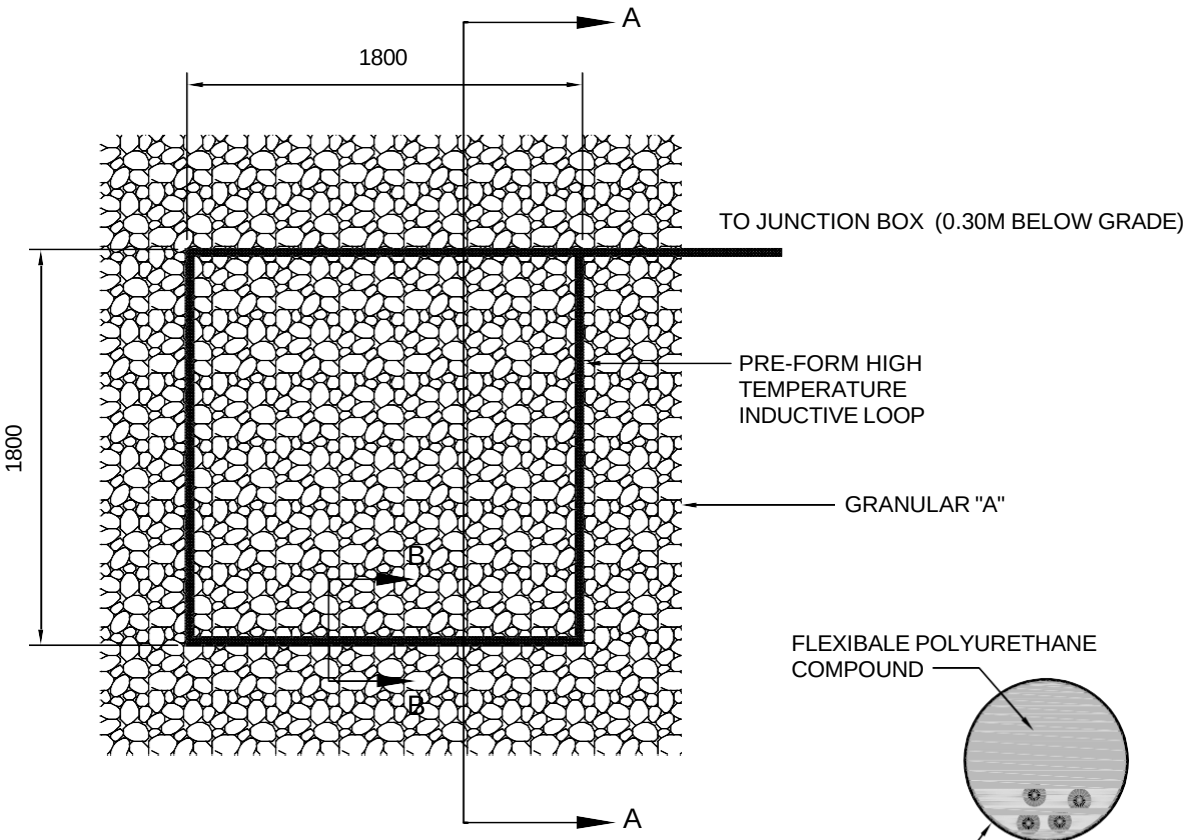


ELEVATION

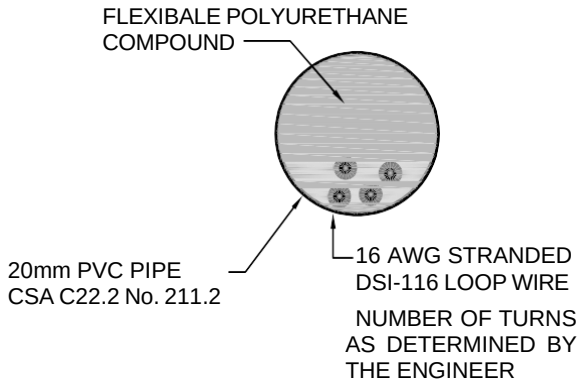
ST. JOHN'S
DEPARTMENT OF ENGINEERING
SPECIFICATIONS BOOK

TRAFFIC CONTROL PREFAB JUNCTION BOX-QUAZITE COMPOSOLITE

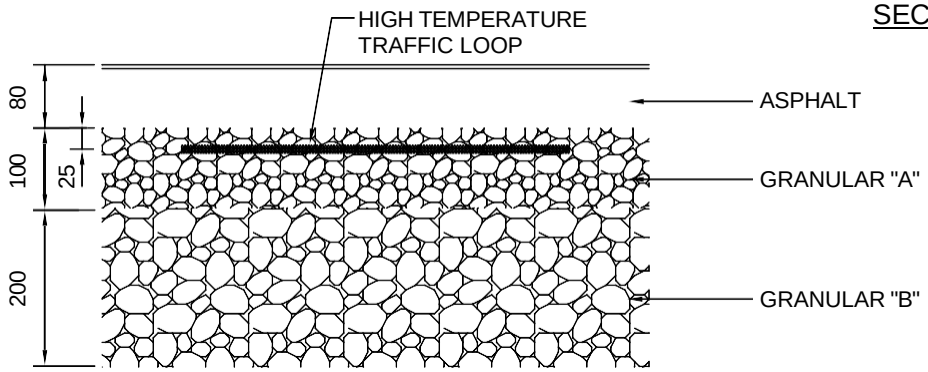
DRAWN BY: C. S.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-802-05



PLAN



SECTION B-B



SECTION A-A

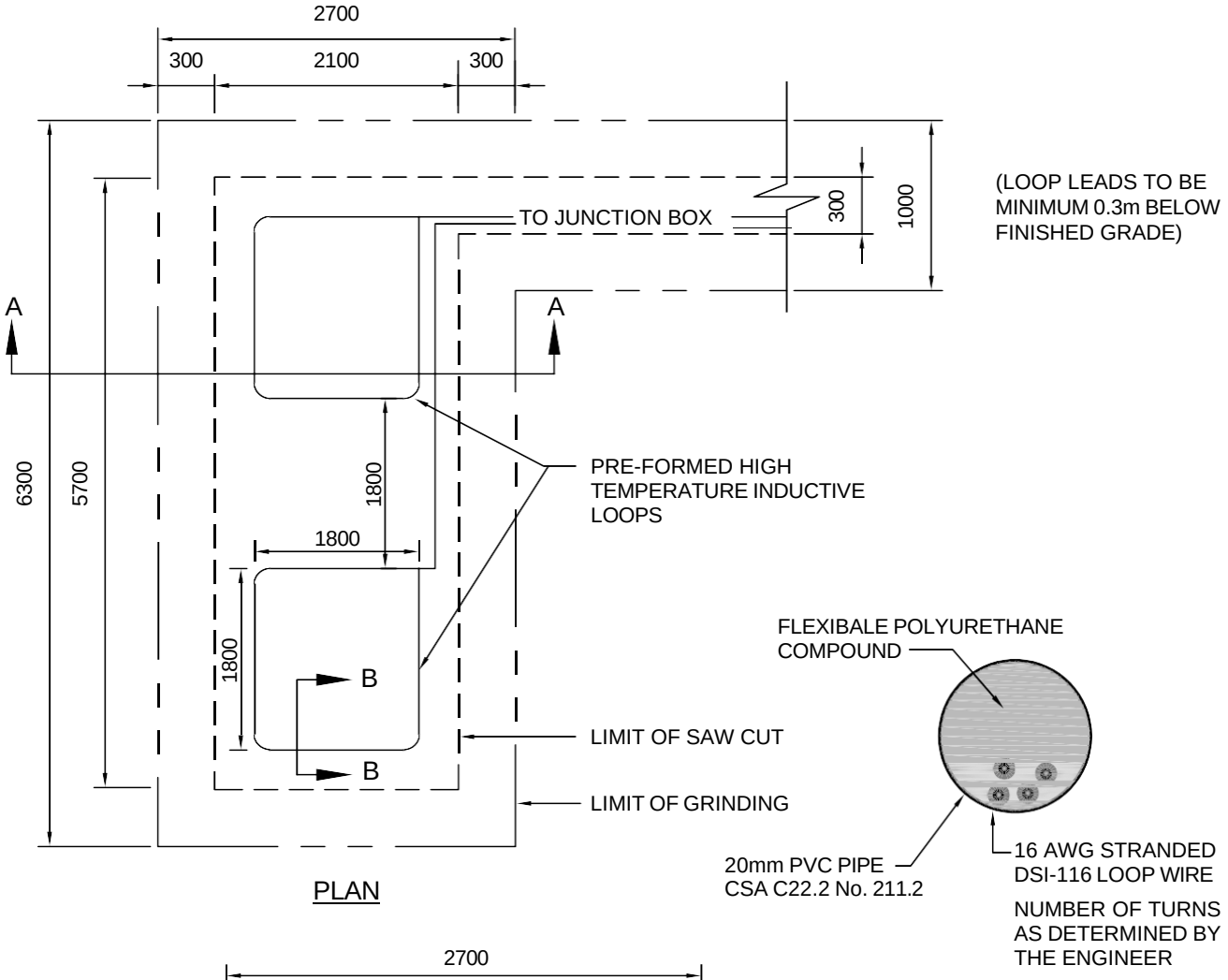
NOTE:

1. WIRE PAIR FROM JUNCTION BOX TO LOOP TO BE TWISTED 17 TURNS/m.

ST. JOHN'S
DEPARTMENT OF ENGINEERING

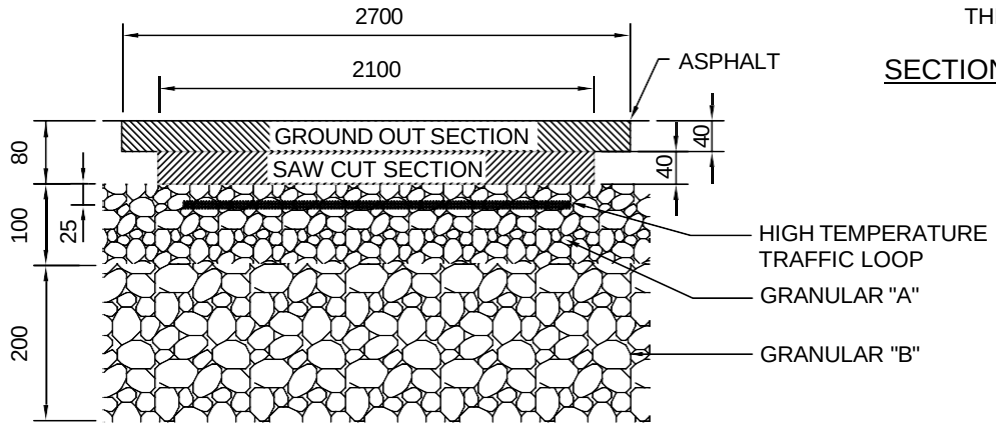
TYPE 1 INSTALLATION OF PRE-FORMED INDUCTIVE LOOP PLACEMENT IN NEW ROAD

DRAWN BY: C. S. \ R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-815-01



PLAN

SECTION B-B



SECTION A-A

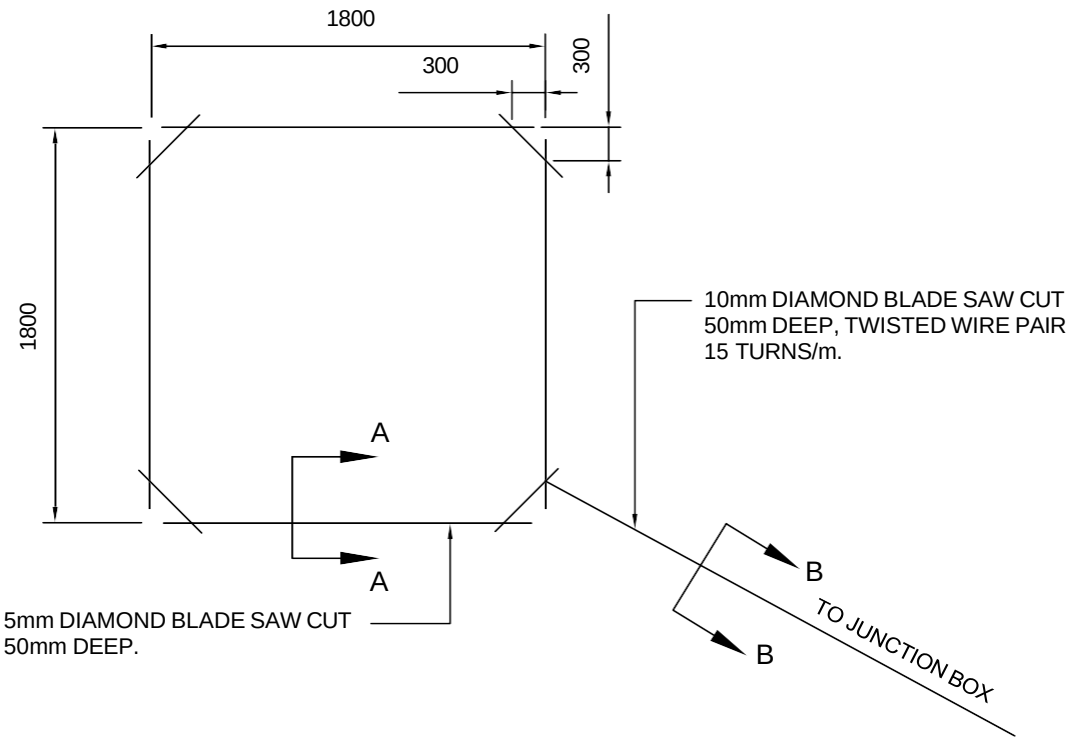
NOTE:

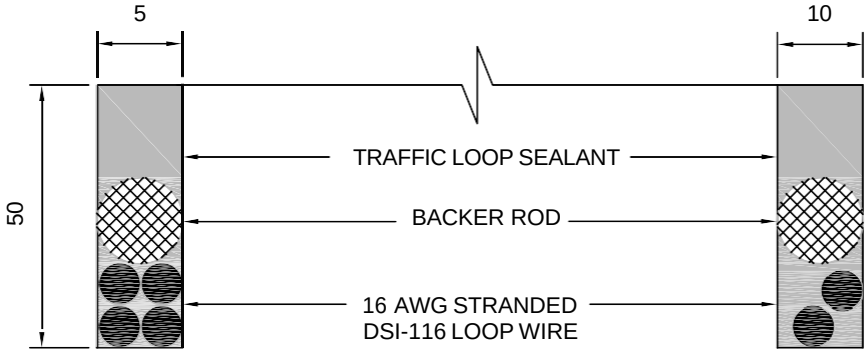
1. WIRE PAIR FROM JUNCTION BOX TO LOOP TO BE TWISTED 17 TURNS/m.
2. TOP 40mm OF ASPHALT TO BE GROUND OUT AT A WIDTH OF 2700mm.
3. REMAINING 40mm OF ASPHALT TO BE SAW CUT OUT AT A WIDTH OF 2100mm.
3. ASPHALT SHALL BE REINSTATED AS PER DIVISION 3-ITEM 352 AND ITEM 358.

ST. JOHN'S
DEPARTMENT OF ENGINEERING

TYPE 2 INSTALLATION OF PRE-FORMED INDUCTIVE LOOP PLACEMENT IN EXISTING ROAD

DRAWN BY: C. S. \ R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-815-02





SECTION A-A

SECTION B-B

NOTE:

1. SEALANT TO SET AROUND & OVER ENTIRE WIRE AND BACKER ROD.

2. PLACE 100mm PIECES OF BACKER ROD INTERMITTENTLY TO KEEP WIRE IN PLACE WHILE POURING TRAFFIC LOOP SEALENT.

ST. JOHN'S
DEPARTMENT OF ENGINEERING

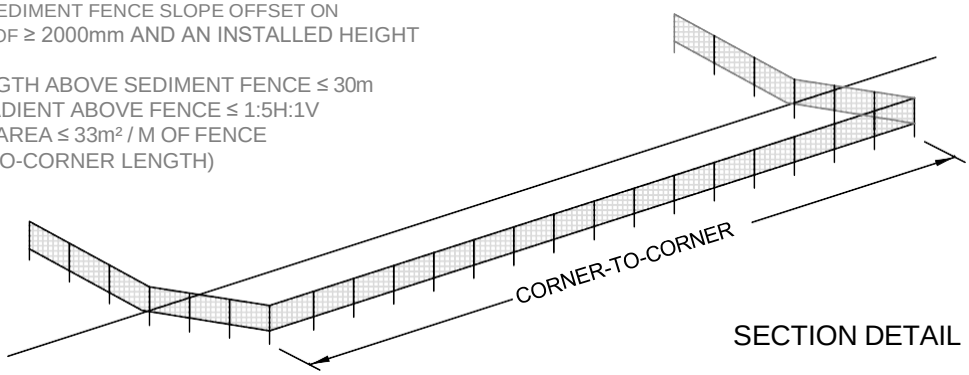
ASPHALT CUT INDUCTIVE LOOP

DRAWN BY: C. S. \ R.W.	DATE: JANUARY 2022	SCALE: N.T.S.	DRAWING No. 10-815-03

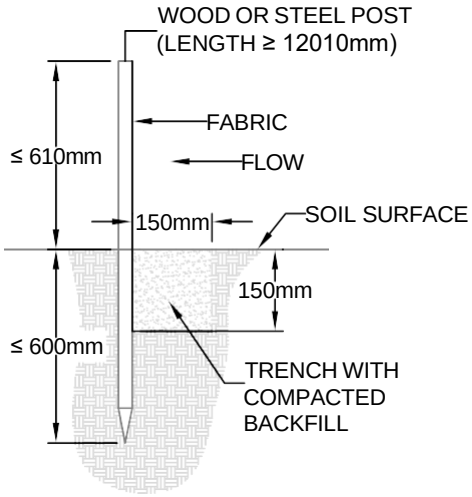
ISOMETRIC VIEW

ASSUMING A SEDIMENT FENCE SLOPE OFFSET ON FLAT GROUND OF ≥ 2000mm AND AN INSTALLED HEIGHT OF 610mm:

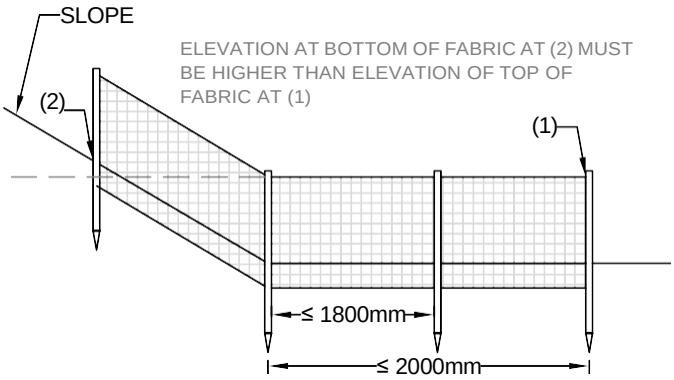
1. SLOPE LENGTH ABOVE SEDIMENT FENCE ≤ 30m
2. SLOPE GRADIENT ABOVE FENCE ≤ 1:5H:1V
3. DRAINAGE AREA ≤ 33m² / M OF FENCE (CORNER-TO-CORNER LENGTH)



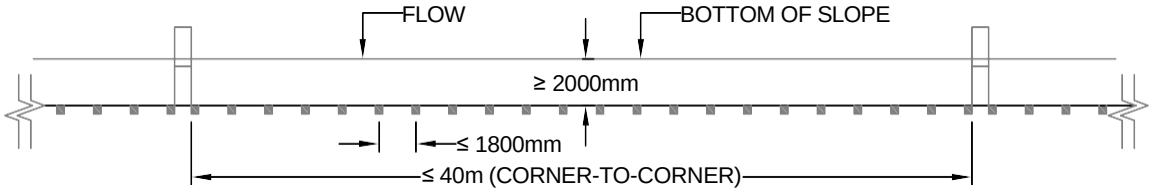
SECTION DETAIL



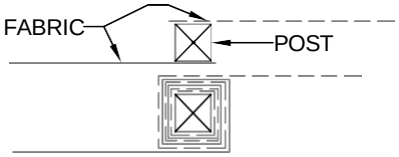
SIDE VIEW



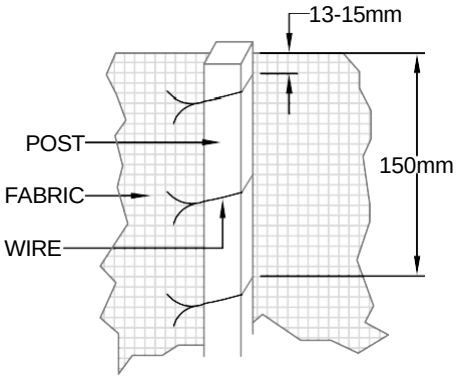
PLAN VIEW



SEDIMENT JOINT FENCE DETAIL



FABRIC FASTENER DETAIL



NOTES:

1. SEDIMENT FENCE MUST BE CORRECTLY CONFIGURED, INSTALLED AND MAINTAINED FOR EFFECTIVE SEDIMENT CONTROL FUNCTION.
2. SEDIMENT FENCE FUNCTIONS BY POOLING RUNOFF TO PROMOTE SEDIMENTATION.
3. RUNOFF THROUGH, UNDER OR AROUND FENCE IS NOT DESIRABLE.
4. DO NOT INSTALL ACROSS WATERCOURSE OR DRAINAGE WAYS.
5. ENHANCE INTEGRITY OF SEDIMENT FENCE BY INSTALLING ADDITIONAL POSTS.
6. SEDIMENT FENCING, IF INSTALLED CORRECTLY, DOES NOT REQUIRE WIRE BACKING.
7. FUNCTIONAL LIFE OF SEDIMENT FENCE IS 1 YEAR.
8. FIGURE IS PROVIDED FOR REFERENCE ONLY. CONSULT QUALIFIED PROFESSIONAL FOR SITE-SPECIFIC DESIGN.
9. PROVIDE DETAILS OF SITE SPECIFIC EROSION AND SEDIMENTATION CONTROL PLAN.

ST. JOHN'S
CORPORATE INFORMATION SERVICES

SEDIMENT FENCE

DRAWN BY: S.P.	DATE: JANUARY 2022	SCALE: N.T.S	DRAWING No. 10-945-01