



SANITARY SEWERS



Design and Construction Manual Linear Municipal Infrastructure Standards



REVISION TRACKING

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2024 Revisions

| Section | Modification & Commentary |
|---|---|
| 2.0 Other Reference Documents (Pg 2) | Municipal Consolidated Linear Infrastructure Environmental Compliance Approval (CLI ECA) |
| 2.0 Other Reference Documents (Pg 2) | Accordance to manufacturer's specifications |
| 5.0 General (Pg 5) | This section outlines the minimum requirements to aid the Consulting Engineer in the design of sanitary sewers and forcemains in the City. Exceptions may be made based on MECP allowances. Direction to proceed regarding any exceptions will be initiated by the City on a case-by-case basis. |
| 6.2 Population Equivalents Based on Land Use (Pg 6) – Table 3 | Removed 'Hospital' Section |
| 9.3 Minimum Pipe Cover (Pg 8) | Additional depth may be required in areas where there is potential for conflict with other underground infrastructure. Refer to OPSS or manufacturer specification for requirements for maximum pipe cover. |
| 9.5 Pipe Material (Pg 8) | PVC (SDR 35) is the preferred pipe material. |
| 11.1 General Requirements (Forcemain Requirements) (Pg 10) | Forcemains shall be designed to avoid fouling and plugging and to minimize the generation of hydrogen sulphide. Swab launching ports and/or flushing ports shall be provided as per MECP criteria. |
| 11.4 Pipe Material (Pg 11) | Forcemain pipe and thrust blocks shall be selected to meet maximum operating conditions and transients. |

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| <p>11.7 Siphons (Pg 12)</p> | <p>Unlike sanitary sewers, siphons operate under pressure. Siphons shall be installed with at least two pipes.</p> <p>A multiple barrel system better achieves self-cleansing velocities (minimum 0.9 m/s), which manages the potential for gas generation and allows for flexibility in maintenance and operational activities.</p> <p>Inlet and outlet structures and adequate pipe sizing are required to allow for cleaning, inspection, flushing activities, flow control and odour control.</p> |
| <p>11.11 Valve Chamber Requirements (Pg 13)</p> | <p>Wrap tracer wire to top step and/or secure to wall for easier maintenance access.</p> |
| <p>11.12 Joints, Fittings, Couplings and Restraint Devices for Force mains (Pg 13)</p> | <p>Thrust blocks shall be designed in accordance with OPSD. Thrust blocks shall be selected to meet maximum operating conditions and transients.</p> |
| <p>13.10 Access Requirements (Pg 15)</p> | <p>— Steps — Design of steps shall be in accordance with OPSD.</p> <p>— Safety Landings — Safety landings shall be in accordance with OPSD.</p> |
| <p>15.0 Siphons</p> | <p>Siphons shall be designed in accordance with the MECF criteria. Siphons shall be installed with at least two pipes.</p> |
| <p>16.0 – 31.7</p> | <p>Sections after 15.0 renumbered to accommodate new Siphon section</p> |

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| <p>16.3 Execution - Cleaning, Testing and Video Inspection - (Pg 19)</p> | <p>A deflection test shall be completed for all new flexible Sanitary Sewers at least 30 calendar days after backfilling but prior to paving. Deflection testing shall be conducted as per OPSS standards.</p> <p>Leakage test shall be completed for all new sanitary sewers in accordance with MECP design criteria.</p> |
| <p>16.3 Execution – Bedding, Embedment and Cover- (Pg 18)</p> | <p>Where specified, concrete encased pipe crossings shall be completed with unshrinkable backfill. Unshrinkable backfill shall have a compressive strength of 0.4 MPa at 28 days. Width of unshrinkable fill shall cover the full width of the trench; the length shall extend 0.5m beyond the O.D. of the crossing pipe, and extend from 0.3m below the bottom of the lower pipe, to the bottom of the upper pipe. Bond breaker shall be supplied between all pipe materials and unshrinkable fill.</p> |
| <p>16.3 Execution – Dewatering of Excavations – (Pg 19)</p> | <p>The Contractor must ensure compliance with the City of Brantford, Chapter 281, Sewer System – Regulation – Use (Sewer Use By-law) including permitting requirements.</p> |
| <p>25.0 Cleaning, Inspection and Testing (Pg 25)</p> | <p>New section title</p> |
| <p>25.3 Execution –Inspection- (Pg 25)</p> | <p>Where CCTV is not feasible, alternative methods prescribed in MECP criteria shall be considered on a case-by-case basis by the City.</p> |

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| 25.3 Execution –Testing- (Pg 28) | <p>All new and replaced Sanitary Sewers, forcemains, maintenance holes, connections and chambers shall be tested to ensure integrity of the installed material for water tightness prior to placing into service. Inspection and testing plans including; procedure, equipment, schedule, safety requirements, and emergency response plan shall be submitted to the City at least two (2) weeks prior to the inspection or testing. Plans must be accepted by the City prior to proceeding with the inspection or testing. Testing shall be conducted in accordance with the MECP Design Criteria for Sanitary Sewers, Storm Sewers, and Forcemains for Alterations Authorized under an Environmental Compliance Approval. Contractor must submit approved Inspection & testing plan on the City's template. This is available upon request. All tests shall be carried out in the presence of and accepted by the Municipality</p> |
| 28.4 Design Parameters (Pg 32) | <p>Design parameters as outlined in Table 11.</p> <p>Table 11. Cured In-Place Sewer Lining Design Parameters</p> <p>Removed Table</p> |
| Standard Drawings and Details (Pg 56) | <p>New Drawing A-103 – Single Forcemain Outlet Chamber</p> |
| Forcemain Commissioning Plan (Pg 63) | <p>Added new Forcemain Commissioning Plan</p> |

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INTRODUCTION

INTRODUCTION

1.0 GENERAL REQUIREMENTS

This manual has been prepared to provide the City, consulting engineers, contractors, developers and the general public with a common reference to ensure the consistent application of sanitary sewer design and construction practices in the City.

The information provided is not intended to hinder innovation and is rooted on meeting performance requirements over the lifecycle of the infrastructure. This manual is intended to be updated as needed on a regular basis, however proponents may submit any suggested changes via the Design Standard Change Form (**Appendix G-1 in the General Preface**) for review and approval by the City.

The key guiding principles underlying this manual are to:

- Prioritize the health and safety of the public and minimize damage to property.
- Undertake sustainable planning of the Sanitary Sewer System.
- Protect the natural waterbodies in the City, including the Grand River and other minor creeks.
- Meet regulatory and legislative municipal requirements.
- Consider impacts due to climate change.
- Promote and implement shared responsibility between the City and stakeholder.

2.0 OTHER REFERENCE DOCUMENTS

All sanitary sewers and appurtenances shall be designed and constructed in accordance with the latest versions of this manual as well as other industry standards and best practices, including but not limited to:

- [Ontario Provincial Standard Specifications \(OPSS\) and Ontario Provincial Standard Drawings \(OPSD\)](#)
- [Ministry of Environmental, Conservation and Parks \(MECP\) Design Guidelines for Sewage Works](#)
- [Ministry of Environmental, Conservation and Parks \(MECP\) Design Criteria for Sanitary Sewers, Storm Sewers and Forcemains for alterations authorized under Environmental Compliance Approval](#)
- [Municipal Consolidated Linear Infrastructure Environmental Compliance Approval \(CLI ECA\)](#)
- Accordance to manufacturer's specifications

3.0 INDUSTRY STANDARDS AND SPECIFICATIONS

All sanitary sewer and appurtenances materials and components shall comply with the latest versions of all applicable industry standards and specifications for quality management and quality control, including but not limited to:

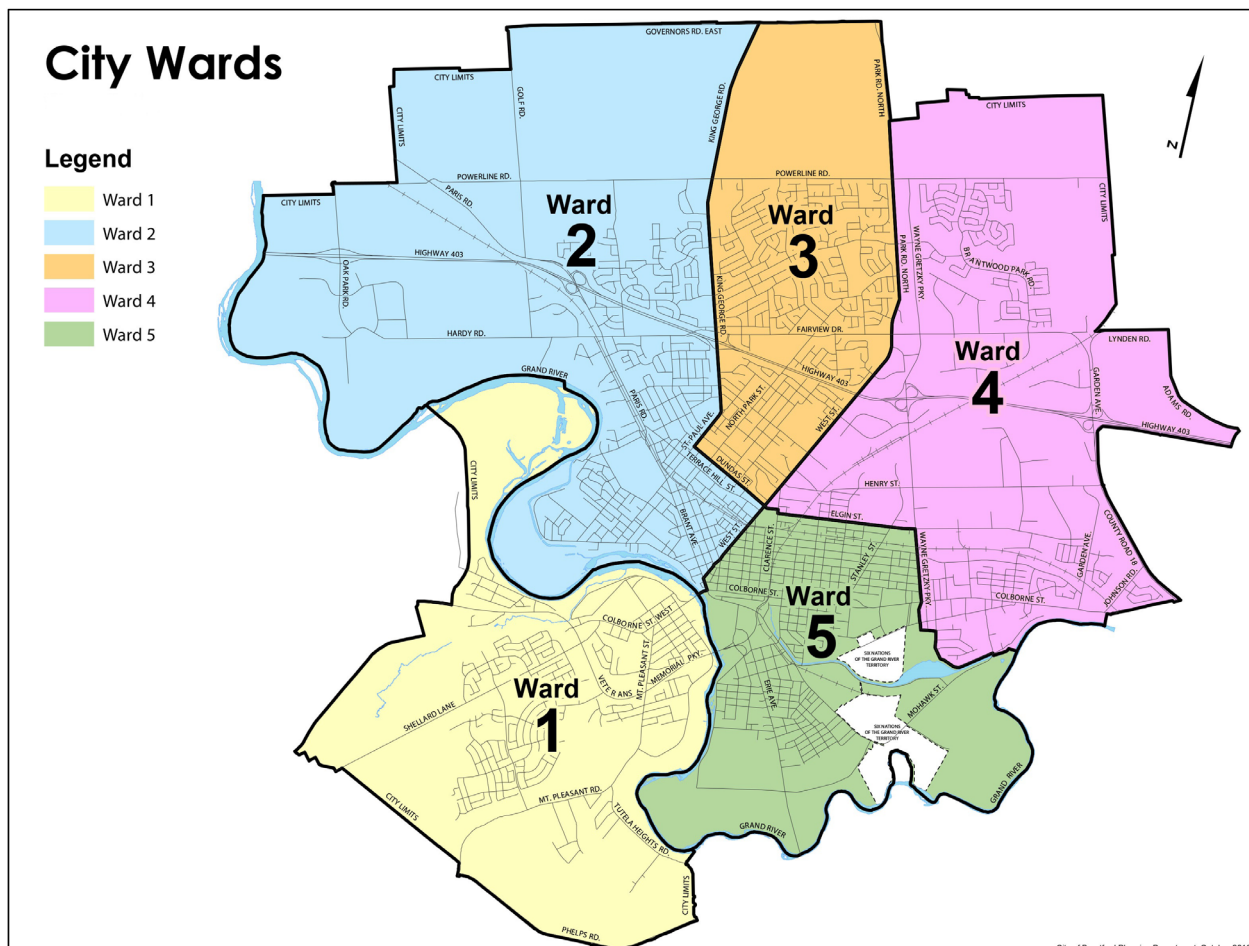
- The Canadian Standards Association (CSA)
- The American Standard and Testing Materials (ASTM)
- City of Brantford Sewer Use Bylaw

4.0 OTHER APPLICABLE ACTS AND LEGISLATIONS

This manual does not supersede, nor replace any legislation governing the design and construction of linear sanitary systems.

The Proponent shall be fully familiar with the latest versions of these legislative requirements when carrying out design and construction of City linear projects such as:

- [Municipal Act](#)
- [Ontario Water Resources Act](#)
- [Environmental Assessment Act](#)
- [Environmental Protection Act](#)
- [Accessibility for Ontarians with Disabilities Act \(AODA\)](#)



DESIGN

DESIGN

5.0 GENERAL

This section outlines the minimum requirements to aid the Consulting Engineer in the design of sanitary sewers and forcemains in the City. Exceptions may be made based on MECP allowances. Direction to proceed regarding any exceptions will be **initiated by the City** on a case-by-case basis.

6.0 DESIGN CRITERIA

6.1 Design Flow

Sanitary sewers shall be sized to convey peak dry weather flow using design criteria outlined in **Table 1**.

Table 1. Sanitary Design Criteria

| Type of Development | Average Per Capita DWF (L/cap/d) | Peaking Factor | Extraneous Flow (L/s/ha) |
|---------------------|----------------------------------|---------------------------|--------------------------------|
| Residential | 245 | Harmon (min 2.0, max 4.0) | 0.30 (inflow and infiltration) |
| Employment | 270 | Harmon (min 2.0, max 4.0) | 0.30 (inflow and infiltration) |

Note: Employment includes industrial, commercial and institutional land uses

Dry Weather Flow (Q_{DWF}) will be calculated as the sum of the residential and estimated non-residential flows estimated using **Table 1**.

This design flow shall be calculated as follows:

$$Q_{DESIGN} = \frac{(Q_{DWF} \times P)}{86.4} \times M + (I \times A)$$

- where,
- Q_{DESIGN} = Peak Design Flow (L/s)
 - Q_{DWF} = Per Capital Average Dry Weather (DWF) (L/cap/d)
 - M = Harmon Peaking Factor
 - P = Population in thousands
 - I = Extraneous flow allowance (L/ha/s)
 - A = Gross drainage area (ha)

Harmon Peaking Factor (residential):

$$M = 1.0 + \frac{14}{4 + \sqrt{P}}$$

where, P = Population in thousands

Harmon Peaking Factor (Employment):

$$M_e = (1.0 + \frac{14}{4 + \sqrt{P_e}}) \times 0.8$$

where,

- M_e = Ratio of peak flow to average flow
- P_e = Equivalent tributary population in thousands

Harmon Peaking Factor (combined land uses):

$$M_{av} = K_{av} \times (1 + \frac{14}{4 + \sqrt{(P+P_e)}})$$

where,

$$K_{av} = \frac{A_R + 0.80 A_e}{(A_R + A_e)}$$

and,

- A_R = Residential area
- A_e = Employment area (ICI)
- P = Population in thousands
- P_e = Equivalent tributary population in thousands

Design flows for sanitary sewer networks shall be calculated and submitted to the City using the Sanitary Sewer Design Sheet provided in this manual.

An electronic copy of the spreadsheet in Excel format can be obtained and shall be completed as per design requirements.

Sanitary sewers are not permitted to accept any storm drainage including foundation, roof drainage and weeping tile connections.

6.2 Population Equivalents Based on Land Use

The approved population densities based on type of development shall be obtained from **Table 2** and **Table 3**, respectively.

Table 2. Residential Population Densities

| Residential Housing Type | Population Per Unit (ppu) |
|---|---------------------------|
| Low Density (e.g. single and semi-detached units) | 3.05 |
| Medium Density (e.g. townhomes, row houses) | 2.47 |
| High Density (e.g. apartments) | 1.60 |
| City of Brantford, 2014 Development Charges Background Study, Hemson Consulting, March 2014 | |

The Consulting Engineer shall confirm population densities, based on existing and future land use, with the City prior to commencing design.

Table 3. Employment Equivalent Population Densities

| Land Use Type | Equivalent Population Density (ppha) |
|---|--------------------------------------|
| Commercial (e.g. business parks, shopping malls) | 90 |
| Institutional (e.g. schools, homes for the aged) | 40 |
| Industrial (e.g. warehouses, autobody repair) | 125 |
| Note: ppha = Persons Per Hectare | |

7.0 HYDRAULIC LEVEL OF SERVICE

7.1 Velocity

The flow velocity shall be determined using the following formula:

$$v = \frac{Q}{A}$$

where, v = Velocity (m/s)
 Q = Flow (m³/s)
 A = Cross Sectional Area of Flow (m²)

Flow velocities for sanitary sewers shall meet the following requirements, in accordance with MECP Guidelines:

- Minimum flow velocity (calculated based on pipe flowing full) = 0.6 m/s (transport solids and void deposition).
- The sewer shall be considered "flowing full" on the basis of the pipe flow depth being at 0.8 the pipe diameter. The capacity of the sewer shall be determined on the basis of the pipe at or below 80% full flow.
- Where, under peak flow conditions (See formula for QDESIGN in Section 6.1), the flow depth in the pipe will not be $\geq 30\%$ of the pipe diameter, the flow velocity at peak flow conditions (Q-DESIGN) should be calculated, and the design revised to ensure this velocity meets the 0.6 m/s minimum.
- Maximum full flow velocity = 3.0 m/s

To determine velocities based on actual flow, the Consulting Engineer shall complete the City's Sanitary Sewer Design Computation Sheet that includes the roughness coefficient required for Manning's Equation calculations.

$$Q = \frac{1}{n} \times A \times R^{2/3} \times S^{1/2}$$

Q = Design Flow (m³/s)

n = Manning's roughness coefficient

A = Cross Sectional Area of Flow (m²)

R = Hydraulic Radius
(area of flow / wetted perimeter)

S = Slope of the Hydraulic Grade Line (m/m)

7.2 Manning's Roughness Coefficient

A Manning's Roughness Coefficient, n , of 0.013 shall be typically used.

7.3 Pipe Classification

The classification of sanitary sewers will be based on the size of the network, the service population and the tributary drainage area.

In the City, sanitary sewers are classified as follows:

— Trunk Sanitary Sewer —

A major conveyance sewer is dedicated to the conveyance of flow from local sewers to the sanitary pumping or treatment facilities.

— Local Sanitary Sewer —

A local sewer is used primarily to collect sanitary flow within a local drainage area.

7.4 Pipe Grade

All sanitary sewers shall be designed with minimum and maximum grade as outlined in MECP. The minimum pipe grade for the first run of sanitary sewers shall be 1% from manhole to manhole.

The remaining system shall be sloped as required to achieve the minimum velocity as outlined in Section 7.1.

8.0 SYSTEM LAYOUT

8.1 General Requirements

No changes in flow direction shall be permitted without the use of a maintenance hole. All benching and pipe opening alternatives shall be designed in accordance with OPSD. Pipes between inlet and outlet are not to be installed at angles $<90^\circ$. Pipes 1050 mm and larger shall not exceed a maximum change in direction of 45° .

Easements shall be avoided where feasible. All sewer easements must be a minimum of 5.0m wide for one service, depending on the depth of the sanitary sewer. Any exceptions shall be approved by the City. Actual width will vary based on size and depth of pipe.

Common trenches will be considered when supported by the recommendations of a soils report prepared by a qualified Geotechnical Engineer.

8.2 New Construction

Sanitary sewers shall be in accordance with the City's Standard Drawings and Detailed Cross-sections shown in the Roads & Transportation section of this manual.

Sanitary sewers shall be terminated with a maintenance hole, at the subdivision limits when the external drainage areas are considered in the design. The design of the upstream terminal maintenance holes shall allow for the future extension of the sanitary sewer.

8.3 Existing Infrastructure

Location of replacement sanitary sewers shall be determined specifically based on the location of existing utilities and other site conditions.

All efforts shall be made to design in accordance with the City's Standard Drawings and Detailed Cross-sections in this manual.

8.4 Horizontal and Vertical Separation

Clearances between watermains, sanitary and storm sewers shall be based on the MECP Procedure F-6-1: Procedures to Govern the Separation of Sewers and Watermains.

9.0 PIPE REQUIREMENTS

9.1 General Requirements

The pipe and appurtenances identified in this manual refer to conventional open cut installation methods.

Where special methods for installation are proposed to be used, (e.g., tunneling, micro-tunneling, jack and bore) drawings and specifications for the installation methods and support for the pipe must be submitted with the overall design. Alternative infrastructure installation methods will be submitted to the City for review prior to design completion.

9.2 Pipe Size

Pipe size shall be determined using Manning's Formula. The minimum pipe size shall be 250 mm diameter, regardless of the type of land use. A size of 200 mm may be acceptable, if required to achieve minimum (self-cleansing) velocity. A decrease in pipe size from upstream to downstream shall be avoided.

9.3 Minimum Pipe Cover

The preferred minimum depth of cover shall be 2.5 m from the finished grade to the top of the pipe.

Additional depth may be required in areas where there is potential for conflict with other underground infrastructure. Refer to OPSS or manufacturer specification for requirements for maximum pipe cover.

9.4 Insulation of Sanitary Sewer and Services

Unless otherwise specified, sewer pipe and services with less than 1.5m depth of cover or horizontal separation from ventilated underground structures at any location along the length shall be insulated.

The width and thickness of insulation used shall

be as specified in Standard Detail Drawings **W-312, W-312A & W-312B**.

Supporting calculations shall be provided to demonstrate pipe deflection will not exceed specified limits due to live loading at shallow burial. Pre-insulated pipe will be considered by the City on a case-by-case basis.

9.5 Pipe Material

All pipe material and fittings shall be in accordance with CSA and ASTM. Both rigid and flexible pipe are permitted in the construction of sanitary sewer systems.

In determining the suitable pipe class to be used, live load, dead load, soil type and trench conditions in accordance with OPSS shall be considered in the calculation.

The pipe manufacturer's recommendations shall be incorporated into the design.

PVC (SDR 35) is the preferred pipe material. Evaluation of other pipe materials must be submitted to the City for review and approval prior to selection of pipe materials. Pipe materials selection shall be supported by site conditions including the geotechnical, hydrogeological and hydraulic investigations.

These materials shall meet the requirements outlined in **Table 4**.

9.6 Pipe Deflection

The deformation gauge, also known as the Mandrel test for flexible pipes, shall be successfully completed prior to the City's acceptance of the sanitary sewer. The Mandrel test shall be conducted according to OPSS.

Maximum pipe deflection from combined live and dead loading shall not exceed the more stringent of OPSS and the pipe manufacturer's recommendations.

Table 4. Approved Sanitary Sewer Pipe Materials

| Main Size (mm) | Joint Type | Specification | General Comments |
|---|--------------------------|--------------------------------|--|
| Polyvinyl Chloride (PVC) | | | |
| ≤ 600 mm | Gasketed Bell and Spigot | CSA B 182.2 & OPSS 1841 | PVC pipe shall have a maximum SDR of 35 and a minimum stiffness of 320 kPa. Smooth-walled pipe only. Only manufactured tees shall be used. |
| Concrete (Reinforced) | | | |
| ≥ 450 mm | Gasketed Bell and Spigot | CSA A257.2, A257.2 & OPSS 1820 | N/A |
| AWWA C301 pipe and joints may be considered for concrete pipe deep installations. In areas of high water table, joints shall be diaphraged and grouted. | | | |

9.7 Radius Pipe

The use of radius pipe will be permitted to achieve changes in horizontal alignment for sewer sizes 1050 mm diameter and larger. The minimum radius allowed for various pipe diameters shall be as detailed in the manufacturer specifications. Smaller diameter radius pipe shall be considered on a case by case basis provided that a manhole is located at the beginning or at the end of the radial section of pipe.



10.0 SERVICE LATERALS

10.1 Connection Types

Connections to sanitary sewers shall be made using pre-manufactured tee fittings or strap-on-saddles in accordance with OPSS. Wye fittings shall be considered on a case-by-case basis where tee fittings cannot be achieved.

Cross-connections and sump pump connections to the sanitary sewer shall not be permitted. Direct connections between sanitary sewer laterals and maintenance holes shall be approved on a case-by-case basis. Service tees shall not be within 1.0 m of maintenance hole structure. 12 O'clock connections are not permitted.

10.2 Service Size

Single family, semi-detached dwellings and rowed townhouse dwellings in residential areas shall have a minimum 100 mm diameter lateral from the mainline to property line. Commercial, industrial and institutional laterals shall be a minimum of 150 mm diameter.

10.3 Service Location

The City's preferred location of the sanitary lateral is shown in the Typical Residential Lot Plan in **Appendix G-2 in the General Preface**.

New sanitary service laterals to single family, semi-detached and rowed townhouse dwellings shall be individual service laterals. Shared service laterals shall not be permitted.

Wherever possible, private service connections shall not be connected to trunk sanitary sewers.

10.4 Minimum Service Cover

The preferred cover at property lines for all service connections shall be 2.15 m.

10.5 Service Material

PVC pipe shall be used for residential lateral connections. The pipe shall be green in colour and DR 28 shall be used. Laterals larger than 150 mm shall be PVC DR 35.

10.6 Service Grade

The grade of the sanitary sewer lateral shall range between a minimum and maximum of 2% and 8%, respectively. Connections to mainline sewers consisting of rigid or flexible pipe shall be made at 10 and 2 o'clock (along the top of the pipe) using long sweep elbows.

10.7 Cleanout Requirements

Sanitary cleanouts shall be deemed necessary at the discretion of the City and shall be located 0.15 m within right-of-way from property line.

Double cleanout to be installed as per standard drawing **A-102** if required.

10.8 Inspection Maintenance Hole

For institutional, commercial, industrial and multi-residential properties an inspection maintenance hole shall be located on the private side of the property line for access to the service lateral. A corresponding maintenance hole shall not be required along the mainline sanitary sewer at each property, unless it is required to meet OPSD.

10.9 Marking and Plugging Requirements

Plugged or capped service connections shall be marked by a green painted 2x4 stake at the end cap with adhesive tape labeled "CAUTION SANITARY SEWER".

The service lateral shall be capped 0.3 m inside of property line.

11.0 FORCEMAIN REQUIREMENTS

11.1 General Requirements

A forcemain is a pressurized pipeline conveying wastewater from a pumping station to a maintenance hole or facility.

Forcemains shall be designed to avoid fouling and plugging and to minimize the generation of hydrogen sulphide. Swab launching ports and/or flushing ports shall be provided as per MECF criteria.

Forcemains shall be designed to withstand all surge and transient pressures and full vacuum. Transient analyses shall be part of the engineering scope for all forcemains, taking into account the number and timing of the pump cycles to which they will be subjected.

Ideally, local high points or low points shall be avoided.

11.2 Pipe Size

Flow velocities in sanitary forcemains shall be determined using the Hazen-William's formula:

$$Q = 0.275 CD^{2.63} S^{0.54}$$

where,

- Q = Design Flow (m³/s)
- C = Hazen Williams Friction Coefficient
- D = Diameter (m)
- S = Slope of the Energy Grade Line (m/m)

Forcemain sizes shall be based on maintaining adequate flow velocities within the following limits:

- Minimum acceptable velocity = 1.0 m/s
- Maximum acceptable velocity = 2.5 m/s

Forcemain sizes greater than 200mm diameter may include 45° bends. Forcemain sizes less than and equal to 200mm diameter must include sweeps as opposed to 45° bends.

11.3 Minimum Forcemain Cover

The preferred minimum depth of cover shall be 1.85 m from the finished grade to the top of the pipe. Additional depth may be required in areas where there is potential for conflict with other underground infrastructure.

Where the preferred minimum specified cover of 1.85 m over the forcemain cannot be achieved, sufficient insulation to prevent freezing. Supporting calculations shall be provided to demonstrate pipe deflection will not exceed specified limits due to live loading.

11.4 Pipe Material

Forcemain pipe shall be selected to meet maximum operating conditions and transients. Approved forcemain pipe material is outlined in **Table 5**. Under no circumstances shall the material be coloured blue.

11.5 Pipe Deflection

Maximum pipe deflection from combined live and dead loading shall not exceed the more stringent of OPSS and the pipe manufacturer's recommendations. Restrained or mechanical joint bends are preferred.

11.6 Forcemain Outlets

The Consulting Engineer shall make provisions for a smooth transition from forcemain pressure flow to gravity sanitary sewer flow.

Forcemains shall discharge to maintenance holes at an invert elevation no greater than 0.6 m above the obvert of the outlet sanitary sewer.

Forcemains shall not be designed to discharge into other forcemains.

Table 5. Approved Forcemain Pipe Material

| Main Size (mm) | Joint Type | Specification | General Comments |
|----------------------------------|------------------------------|---|---|
| Polyvinyl Chloride (PVC) | | | |
| ≤ 400 mm | Gasketed Bell and Spigot | Pipe: AWWA M23, AWWA C900, AWWA C905 & CSA 137.3 Fittings: (100 to 300mm) AWWA C907 & CSA B137.2 (250 to 300mm) AWWA C900 & CSA B137.3 | Consulting Engineer shall determine pressure class and rating based on project requirements. |
| High Density Polyethylene (HDPE) | | | |
| ≤ 400 mm | Butt Fusion | AWWA C906 | Project Specific basis as determined by design review process. For use on siphons. |
| Ductile Iron, Hyprotec Coated | | | |
| ≤ 400 mm | Mechanical, Flanged or Tyton | AWWA C104, C105, C110, C111, C115, C150, C151, C153 | Project specific basis as determined by design review process. Cathodic protection is required. |

11.7 Corrosion Protection

Corrosion protection for forcemains shall be in accordance with OPSS and shall be a complete petrolatum coating system or cathodic protection in the form of zinc anodes as follows:

Table 6. Corrosion Protection

| Component | Petrolatum System | Cathodic Protection |
|--|-------------------|---------------------|
| Buried Metallic Fittings – on flanged surfaces, nuts, bolts, tie rods, clamps, valves, sleeves and couplings | Required | Required |
| Mechanical Restraints | Required | Not Required |
| Valve Chambers – surface of pipes, valves and appurtenances | Required | Not Required |
| Metallic Forcemain – at each metallic component | Not Required | Required |
| PVC Watermain – 1.0 m horizontally from each metallic component | Not Required | Required |

11.8 Tracer Wire

Tracer wire shall be installed on all forcemains.

The wire shall be installed in such a manner as to be able to properly trace the forcemain without loss or deterioration of signal or without the transmitted signal migrating off the tracer wire. Test Boxes and tracer wires shall be clearly marked. The maximum distance between test boxes shall be 300 m. Preferred locations for forcemain test boxes are within the vicinity of municipal fire hydrants.

Tracer wire shall be specifically manufactured for direct bury applications.

11.9 Valves and Valve Chambers

Valve chambers are required for combination air release / vacuum valves and drain valves on forcemains.

11.10 Valve Size and Type

Combination air release and vacuum valves suitable for sanitary sewer applications shall be located in chambers with vent lines that include a double check valve assembly for flood protection.

All combination air release and vacuum valves shall be provided with isolation valves and drains.

Drain pipe and check valves shall be located in chambers.

11.11 Valve Chamber Requirements

In order to facilitate operation and maintenance activities, valve chambers shall provide the following:

- Minimum headroom of 2.1 m
- Minimum of 0.5 m and maximum of 0.8 m clearance between the invert of the sanitary sewer and the chamber floor and,
- Minimum of 0.3 m cover above the chamber top slab.
- Minimum of 0.6 m of horizontal clearance on valves and 0.3 m below valves to allow sufficient space for servicing and / or removal when required.
- Valve chamber and lid size shall be selected to adequately accommodate all valves and other ancillary equipment.
- All concrete valve chambers shall be provided with adequate thrust restraint, approved waterproofing, sealed joints and insulated below the frost depth.
- PVC is not permitted through a valve chamber. Piping at valve chambers shall transition from PVC to ductile iron using couplings located 500 mm from chamber walls.
- Valve chambers located in gravel shoulders shall be provided with a paved area sufficient for parking one vehicle. See detail **A-101** in the standard drawings section of this manual.
- Wrap tracer wire to top step and/or secure to wall for easier maintenance access.

11.12 Joints, Fittings, Couplings and Restraint Devices for Force mains

All joints, fittings, couplings and restraint devices for force mains shall be in accordance with OPSS and OPSD and shall be compatible with the pipe material and class with which they will be used.

Approved fittings and joints shall be as shown in **Table 5**.

Joints restraints shall be designed to withstand testing pressure. All joints shall be mechanically restrained as required and thrust blocks shall be used at all tees, bends and valve caps.

Thrust blocks shall be used at all tees and bends deflecting 11.25 degrees or more.

Required restraint distances shall be determined by the size of pipe, manufacturer and soil conditions and shall be approved by the City.

All restraints shall be designed to a 1.5 Safety Factor and consider worst case scenario soil conditions.

Thrust blocks shall be designed in accordance with OPSD. Thrustblocks shall be selected to meet maximum operating conditions and transients.

12.0 BEDDING, COVER AND BACKFILL REQUIREMENTS

12.1 Bedding, Embedment and Cover

Bedding and cover material shall consist of ONLY Granular A.

Bedding, cover and embedment materials shall meet OPSS and be placed and compacted in accordance with the standard and associated drawings. Bedding, embedment and cover materials shall be placed for the full width of the trench and mechanically compacted to 98% Standard Proctor Maximum Dry Density (SPMDD) as determined by ASTM.

12.2 Backfill

Backfill shall be considered as starting at 300 mm above the sanitary sewer. All materials below this point shall be considered as bedding.

13.0 MAINTENANCE HOLES

13.1 General Requirements

Maintenance holes shall be in accordance with OPSS and OPSD. Maintenance holes shall be pre-benched, located at changes in alignment, grade, pipe size and material, at pipe junctions.

There is a maximum permitted spacing of maintenance holes for sanitary sewers based on the diameter of pipe (refer to **Table 7**).

Wherever possible, maintenance holes placed in the travel portion of roadways shall not be placed in vehicle wheel paths.

13.2 Type and Size

Maintenance holes shall be precast concrete structures. Under special circumstances, designs using cast-in-place concrete will be considered. Maintenance holes shall be provided with monolithic bases and watertight joints. Grade adjustment units shall be provided where grade adjustments are necessary and shall be in accordance with OPSS.

Where structures are located >0.6m below the High Ground Water Level, waterproof membrane shall be provided as per the MECP Design Criteria. Structures >0.6m below the High Ground Water Level shall be designed for flotation.

13.3 Spacing

The maximum spacing distance between each sanitary maintenance hole shall be as outlined in **Table 7**.

Table 7. Maximum Spacing for Sanitary Maintenance Hole

| Pipe Size (mm) | Maximum Spacing (m) |
|----------------|-------------------------|
| 200 to 975 | 100 |
| 975 to 1350 | 130 |
| > 1350 | As approved by the City |

13.4 Frame and Cover Requirements

Frames and covers shall be in accordance with OPSD and OPSS. Maintenance hole covers shall be Type 'A' closed.

Maintenance hole lids shall be watertight if they are to be located within floodplains or stormwater storage areas (i.e., parking lots). The practice of bolting covers will be considered as required.

13.5 Connections to Maintenance Holes

Flexible sanitary sewers shall be connected to maintenance holes using approved adaptors. Connections for rigid pipe shall be grouted in place.

13.6 Maintenance Hole Adjustments

Frames and covers should be adjusted to final grades with cast-in-place concrete. For maintenance holes situated in roadways, the frame and covers shall be adjusted using the coring method after pavement of surface asphalt. Concrete collars are to be used on collector and arterials roads.

13.7 Benching Requirements

Maintenance holes shall be pre-benched. Pipe opening alternatives shall be designed in accordance with OPSD.

13.8 Drop Across Maintenance Holes

The minimum drop across a maintenance hole shall be based on the change in direction between the inlet and outlet pipes, as outlined in **Table 8**.

Table 8. Minimum Drop Across Maintenance Hole

| Change in Direction | Minimum Drop Across Maintenance Hole (mm) |
|---------------------|---|
| 0° | 25 |
| 1° to 45° | 50 |
| 46° to 90° | 80 |

13.9 Drop Structures

Drop structures shall be provided in maintenance holes when the difference in elevation between the invert of the inlet and the bottom of the maintenance hole is greater than 0.6 m. Drop structures shall be designed in accordance with OPSD.

External drop structures are preferred. Internal drop structures will be considered on a case-by-case basis and shall be designed to accommodate person access. Where possible, a deeper sanitary sewer shall be considered prior to designing excessive invert drops, drop maintenance holes, or excessively steep benching.

14.0 JOINTS, FITTINGS, COUPLINGS AND RESTRAINT DEVICES

All joints, fittings, couplings and restraint devices for sanitary sewer systems shall be in accordance with OPSS and OPSD and shall be compatible with the pipe material and class with which they will be used.

15.0 SIPHONS

Siphons shall be designed in accordance with the MECP criteria. Siphons shall be installed with at least two pipes.

CONSTRUCTION

CONSTRUCTION SPECIAL PROVISIONS — CONTRACT

16.0 PIPE REQUIREMENTS

16.1 General

This section is in accordance with the provisions of OPSS. The pipe size, type and class shall be as specified. Fittings shall be suitable for and compatible with the pipe material and class with which they are used.

16.2 Materials Requirements

All pipe material and fittings shall be in accordance with CSA and OPSS. Both rigid and flexible pipe are permitted in the construction of sanitary sewer systems.

In determining the suitable pipe class to be used, live load, dead load, soil type and trench conditions shall be in accordance with OPSD.

The pipe manufacturer's recommendations shall be incorporated.

These materials shall meet the requirements outlined in **Table 4** and **Table 5**.

16.3 Execution

— Excavations —

All excavations shall be done in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects, Revised Statutes of Ontario, 1990 Chapter 1 as amended, most recent Ontario Regulation.

— Minimum Pipe Cover —

The minimum depth of cover for a sanitary sewer shall be 2.5 m and for a forcemain shall be 1.85 m from the finished grade to the top of the pipe. Additional depth may be required in areas where there is potential for conflict with other underground infrastructure.

Where the minimum specified cover cannot be achieved, sufficient insulation to prevent freezing of sections of sanitary sewer shall be provided as specified in the Sanitary Design section and in the Contract Drawings and Standard Details.

The Contractor shall confirm the location and depth, at the property limit, of all existing storm laterals prior to placing the pre-manufactured tee on the proposed sanitary sewer.

— Maximum Lengths of Open Trench —

The maximum length of open trench when laying storm sewer shall be 90m or the distance necessary to accommodate the amount of pipe installed in a single day, whichever is smaller, or as specified by a Geotechnical Engineer.

The distance is the collective length at any location including open excavation, pipe length and appurtenant construction and backfill, which has not been completed.

The City's standard practice is for trenches to be backfilled at the end of each working day. In the event the City approves a trench to remain open overnight, at a minimum the trench must be completely enclosed with snow fencing and the pipe capped with a watertight seal cap, regardless of location, appropriate signage and notification.

— Pipe Laying and Jointing —

Pipe laying and jointing shall be completed in accordance with OPSS.

Proper equipment implements, tools and facilities shall be provided and used. All materials shall be lowered into the trench in accordance with manufacturer's specification.

Maximum pipe deflection from combined live and dead loading shall not exceed the more stringent of OPSS and the pipe manufacturer's recommendations. For forcemains, restrained or mechanical joint bends are preferred.

— Cutting of Pipe —

The pipe shall be cut in conformance with pipe manufacturer's recommendations. Cutting of Abestos Cement pipe shall be in accordance with the OHSA.

16.3 Execution (cont'd)

— Bedding, Embedment and Cover —

Bedding and cover material shall consist of ONLY Granular A.

Bedding, cover and embedment materials shall meet OPSS and be placed and compacted in accordance with the standard and associated drawings.

Bedding, embedment and cover materials shall be placed for the full width of the trench and mechanically compacted to 98% SPMDD, as determined by ASTM.

Where specified, concrete encased pipe crossings shall be completed with unshrinkable backfill. Unshrinkable backfill shall have a compressive strength of 0.4 MPa at 28 days. Width of unshrinkable fill shall cover the full width of the trench; the length shall extend 0.5m beyond the O.D. of the crossing pipe, and extend from 0.3m below the bottom of the lower pipe, to the bottom of the upper pipe. Bond breaker shall be supplied between all pipe materials and unshrinkable fill.

— Backfill —

Backfill shall be considered as starting at 300 mm above the sanitary sewer. All materials below this point shall be considered as bedding.

Backfill for structures such as maintenance holes and valve chambers shall start at the sub-grade for the structure and will be brought up simultaneously and equally on all sides of the structure, as specified in OPSS.

All backfill material shall be placed and compacted according to OPSS. All backfill materials shall be compacted to 98% SPMDD, in accordance with ASTM.

Care shall be exercised during backfill operations so that the pipe is not damaged or displaced.

Trenches may be backfilled with select, approved native excavated earth materials, or approved granular material meeting OPSS.



— Horizontal and Vertical Separation —

Clearances between watermains, sanitary and storm sewers shall be in accordance with the Contract Drawings and MECP Procedure F-6-1: Procedures to Govern the Separation of Sewers and Watermains.

— Support of Sanitary Sewer or Sanitary Sewer Lateral —

At any point where a sanitary sewer or sanitary sewer lateral crosses below any existing watermain, sanitary or storm sewer or utility, the Contractor may be required to install temporary shoring. Any shoring shall be designed and sealed by a Professional Engineer.

— Maintaining Sewer Flows —

The Contractor shall ensure that all sanitary sewer flows are maintained throughout the construction activity. At the end of each working day or as required, the new installations shall be reconnected to the existing sanitary sewers.

The Contractor shall take all reasonable precautions to eliminate discharge to the natural environment.

— Bulkheads —

The sanitary sewers under construction shall be bulkheaded, as required, in such a manner as to prevent infiltration and flushing water from entering the sanitary sewer system. Installation of required bulkheads and their subsequent removal upon completion of work shall be at the Contractor's expense.

16.3 Execution (cont'd)

— Dewatering of Excavations —

Dewatering for excavations for construction shall be in accordance with Ontario Water Resources Act – Ontario Regulation 387/04

- More than 50,000 L/day requires registrations
- More than 400,000 L/day requires a Permit to Take Water

Any water encountered within the trench must be pumped to an approved location. This water must be metered, by a Contractor supplied meter, which has been approved for use by the City.

The Contractor must ensure compliance with the City of Brantford, Chapter 281, Sewer System – Regulation – Use (Sewer Use By-law) including permitting requirements.

— Special Pipe and Material Installation Methods —

Where special methods for installation are proposed to be used, (e.g. tunneling, microtunneling, jack and bore) drawings and specifications must be submitted with the overall design.

— Cleaning, Testing and Video Inspection —

The sanitary sewers shall be cleaned, tested and video inspected in accordance with City standards.

A deflection test shall be completed for all new flexible Sanitary Sewers at least 30 calendar days after backfilling but prior to paving. Deflection testing shall be conducted as per OPSS standards.

Leakage test shall be completed for all new sanitary sewers in accordance with MECP design criteria.

16.4 Measurement for Payment

Measurement for sanitary sewer installation shall be by length of pipe in linear metres by installation method and size. The payment

includes all labour, equipment and material for excavation, sewer installation, bedding, pipe cover and backfill. Price shall include removal of any existing pipes and sewers (during same trench replacement) and disposal offsite including any applicable disposal fee.

Price shall also include groundwater dewatering and trench pumping equal to or less than 50,000 L/day, and maintain existing flow in the sanitary system using pumping and pipe insulation.

17.0 SERVICE LATERALS

17.1 General

This section is in accordance with the provisions of OPSS. The service lateral size, type and class shall be as specified.

Fittings shall be suitable for and compatible with the pipe material and class with which they are used. Single family, semi-detached and rowed townhouse dwellings in residential areas shall have a preferred minimum size of 100 mm in diameter.

Direct connections between sanitary sewer laterals and maintenance holes shall be approved on a case-by-case basis. Service tees shall not be within 1.0 m of maintenance hole structure.

Commercial, industrial and institutional laterals shall have a preferred minimum size of 150 mm in diameter.

The Consulting Engineer shall confirm the location and depth, at the property limit, of all existing sanitary laterals prior to placing the pre-manufactured tee on the proposed sanitary sewer.

17.2 Materials Requirements

PVC pipe is preferred for residential lateral connections. Service connections to the main line sanitary sewer shall be at a maximum of 45° from the horizontal. The pipe shall be green in colour and DR 28 shall be used. Laterals larger than 150 mm shall be PVC DR 35.

17.3 Execution

New sanitary service laterals to single family, semi-detached and rowed townhouse dwellings shall be individual service laterals.

Shared service laterals shall not be permitted. Wherever possible, private service connections shall not be connected to trunk sanitary sewers.

The preferred cover at property lines for all service connections shall be 2.15 m.

The grade of the sanitary lateral shall range between a minimum and maximum of 2% and 8%, respectively. Connections to sanitary sewers shall be made using pre-manufactured tee fittings or strap-on-saddles in accordance with OPSS. Wye fittings shall be considered on a case-by-case basis where tee fittings cannot be achieved.

Cross-connections and sump pump connections to the sanitary sewer shall not be permitted.

Direct connections between sanitary sewer laterals and maintenance holes shall be permitted on a case-by-case basis. Service tees shall not be within 1.0 m of maintenance hole structure.

Connections to mainline sanitary sewers consisting of rigid or flexible pipe shall be made at 10 and 2 o'clock (along the top of the pipe) using long sweep elbows.

17.4 Measurement for Payment

Measurement for payment shall be by length of service pipe in linear metres.

18.0 CLEANOUTS

18.1 General Requirements

Sanitary cleanouts shall be determined necessary at the discretion of the City and located 0.15 m within ROW from property line.

Double cleanout to be installed as per standard drawing **A-102** if required.

18.2 Materials Requirements

Cleanout units shall consist of PVC class SDR 28.

18.3 Execution

Cleanout units shall be delivered complete of all components such as cap, stem, tee, reducers and couplings.

Cleanouts installed within paved areas shall have caps consisting of flat metal plates with no protruding bolts or nuts and shall be installed flush with the surrounding asphalt or concrete surface. In all other areas caps shall be placed approximately 50 mm below the ground surface.



18.4 Measurement for Payment

Measurement for payment shall be for each cleanout.

19.0 RECONNECT EXISTING SEWER LATERALS

19.1 General Requirements

This section is in accordance with the provisions of OPSS.

19.2 Materials Requirements

N/A

19.3 Execution

To connect new laterals to the existing system, jointing procedures shall be in accordance with OPSS. A watertight connection to the existing lateral is to be made with an approved adapter.

19.4 Measurement for Payment

Measurement for payment under this item shall be for each lateral reconnected.

20.0 PRE-CAST CONCRETE MAINTENANCE HOLES

20.1 General Requirements

This section is in accordance with the provisions of OPSS.

20.2 Materials Requirements

Precast maintenance hole materials shall be in accordance with OPSS.

20.3 Execution

Installation of the precast maintenance hole shall be in accordance with OPSS. A minimum clearance of 500 mm shall be provided between the concrete structure and the trench wall to facilitate proper manual compaction of the Granular A.

Upon completion of construction, the interior of the sanitary sewers, maintenance holes and other access points shall be cleaned thoroughly to remove all debris. Debris and other material removed shall be prevented from passing downstream to receiving sewers or watercourses.

Maintenance holes shall be maintained in a clean and serviceable condition until assumption by the City.

20.4 Measurement for Payment

Measurement for this unit price bid shall be per maintenance hole installed based on size and depth.



21.0 FORCEMAIN VALVES AND VALVE CHAMBERS

21.1 General Requirements

This section is in accordance with the provisions of OPSS. Only licensed City operators can operate valves. All valves must open in a clockwise direction.

They shall provide a minimum two (2) working days' notice to coordinate any required shut down and mobilize to site.

21.2 Materials Requirements

All valves and valve chamber materials shall be in accordance with OPSS and OPSD.

21.3 Execution

Valve chambers located in gravel shoulders shall be provided with a paved area sufficient for parking one vehicle. See detail **A-101** in the standard drawings section of this manual.

21.4 Measurement for Payment

Measurement for this unit price bid shall be per chamber installed based on size and depth.

22.0 JOINTS, FITTINGS AND RESTRAINT DEVICES FOR FORCEMAINS

22.1 General Requirements

This section is in accordance with the provisions of OPSS. All connections, caps and bends shall be restrained by concrete blocking or restrained joints.

Concrete for thrust blocks shall be placed against undisturbed ground. Joints and couplings shall remain free from concrete. Joints and fittings shall be in accordance with OPSS.

22.2 Materials Requirements

Fittings shall be suitable for and compatible with the pipe material and class with which they will be used and as outlined in **Table 5**. All concrete pressure pipe will be diapiered using Type 50 Cement.

22.3 Execution

Adequate restraints for forcemains shall be provided to withstand the testing pressure. All restraints shall be designed to a 1.5 Safety Factor and consider worst case scenario soil conditions. Refer to Forcemain Design section for acceptable restraint distance requirements. Thrust blocks shall be designed in accordance with OPSD.

22.4 Measurement for Payment

Payment for Joints, Fittings and Restraint Devices shall be included in the per linear metre payment for all permanent forcemain installations.

23.0 CORROSION PROTECTION

23.1 General Requirements

This section shall be in accordance with the provisions of OPSS.

23.2 Materials Requirements

— Complete Petrolatum Coating System —

All material for complete petrolatum coating systems shall be in accordance with OPSS and AWWA.

— Cathodic Protection —

Zinc anodes shall be 11 kg Packaged Zinc Anode. This anode shall be manufactured using a High Purity Zinc 99.99% pure in accordance with ASTM.

The anode must have a metallic core, or fusion bonded sleeve and have a depolarizing gypsum base material surrounding the anode.

An insulated copper (AWG 10-14) wire 3.0 metres in length shall be brazed to the end of the core wire.

The following are specified anode sizing:

- Valves and Fittings — 11 kg

23.3 Execution

| Component | Petrolatum System | Cathodic Protection |
|--|-------------------|---------------------|
| Buried Metallic Fittings – on flanged surfaces, nuts, bolts, tie rods, clamps, valves, sleeves and couplings | Required | Required |
| Mechanical Restraints | Required | Not Required |
| Valve Chambers – surface of pipes, valves and appurtenances | Required | Not Required |
| Metallic Forcemain – at each metallic component | Not Required | Required |
| PVC Watermain – 1.0 m horizontally from each metallic component | Not Required | Required |

23.4 Measurement for Payment

Payment for Corrosion Protection shall be included in the per linear metre payment for all permanent forcemain installations.

24.0 TRACER WIRE

24.1 General

The provisions of the latest revisions of OPSS. Tracer wire shall be installed on forcemains.

The wire shall be installed to properly trace the forcemain without loss or deterioration of signal or without the transmitted signal migrating off the tracer wire.

24.2 Materials Requirements

Tracer wire shall be TWU, number eight (8) gauge, stranded, insulated copper wire with 60 mil of white, cross-linked polyethylene (PEX) insulation specifically manufactured for direct burial applications.

All tracer wire welds onto pipe shall be completely sealed. In all cases, the pipe is to be properly cleaned and material applications shall be according to the manufacturer's instructions.

All spliced or repaired wire connections in the tracer wire system shall be made using a Dryconn Waterproof Connector or a Model Number 454, Catalogue Number 30-454, Wing Nut Wire Connector (for two to four #8 wires), or approved equivalent and made waterproof using an approved buried service wire closure.

The buried service wire closure shall be either a Klik-It II Number C8816 Buried Service Wire Closure or a Raychem GHFC-2-90 H-Frame Gel Closure or approved equivalent.

Test boxes, as part of the tracer wire system, shall be installed within the boulevard and close to an identified appurtenance or location specified on the Contract Drawings.

24.3 Execution

Tracer wire shall be laid flat and securely affixed to the pipe at 3.0 metre intervals. The wire shall be protected from damage during the execution of the works.

No breaks or cuts in the tracer wire or tracer wire insulation shall be permitted. Except for approved spliced in connections, tracer wire shall be continuous and without splices from test box to test box.

For directional drilling, augering or boring installations, four #8 tracer wires shall be installed with the pipe and connected to the tracer wire at both ends, or cadwelded to the existing iron pipe at both ends.

24.4 Measurement for Payment

Payment for Tracer Wire shall be included in the per linear metre payment for all non-conductive permanent sanitary sewer installations and non-conductive sanitary service installations. A lump sum payment shall be provided for conducting the tracer wire continuity test, and submission and approval of the Tracer Wire Report.

25.0 CLEANING, INSPECTION AND TESTING

25.1 General Requirements

During construction the Contractor will be responsible for the flushing and cleaning of all new and existing sewers. The Contractor is required to provide sanitary sewer videos for all new and existing downstream sewers after construction is completed within one leg downstream of the construction limits.

Flushing and cleaning of sewers must be performed by a Qualified Contractor. Any debris in the sewers must be trapped and removed at downstream maintenance holes.

25.1 General Requirements (cont'd)

The videos shall be scheduled to be completed immediately following the base asphalt paving. Work must be performed by a Qualified Contractor. The purpose for a sanitary sewer video inspection is to show that the new, existing and downstream sewers are clean, undamaged from the construction and are operating properly.

25.2 Materials Requirements

N/A

25.3 Execution

— Cleaning —

Flushing and cleaning of sewers must be performed by a Qualified Contractor.

— Inspection —

All work shall be in accordance with the below provisions and PACP® / CSA PLUS 4012 Pipeline Assessment and Certification Program (PACP®) Canadian Edition. CSA Standards, working with NASSCO, Inc. (National Association of Sewer Service Companies), have created the Canadian Edition of the Pipeline Assessment and Certification Program (PACP®), available through certified trainers across Canada. The Canadian Edition includes the NASSCO PACP® manual and CSA's plus 4012 Visual Sewer Pipe Inspection Technical Guide.

These resources provide industries with the ability to accurately model infrastructure assets using standard tools and methodology common across Canada and the United States.

The CSA plus 4012 Visual Sewer Inspection Technical Guide introduces the concept of distress and defect "severity" and "extent". This provides a framework to organize distress and defect codes into "primary failure modes" and maps the PACP® codes into the framework – a significant addition to accepted practice in Canada.

All inspectors shall have successfully completed the PACP® / CSA PLUS 4012 Pipeline assessment and Certification Program (PACP®) Canadian

Edition.

The Contractor will be required to inspect and record the sanitary sewer pipe and assess the condition of the pipe according to coding standards specified in the NASSCO PACP® manual and CSA's plus 4012 Visual Sewer Pipe Inspection Technical Guide including but not limited to:

- Structural condition of pipe walls. Length, size, material type and depth of each pipe (all depths) shall be referenced from the top of the maintenance hole frame to the invert of the pipe being inspected.
- Any blockage or obstruction located within the pipe.
- Condition of pipe joints and lateral connections.
- Any change in pipe diameter or pipe materials encountered in any section between two maintenance holes.
- Report on grade of pipe as to whether it is uniform or whether there appears to be sectional settlement or grade changes.
- Infiltration.
- Explanation for water level fluctuations.
- Location and condition of connection of sanitary sewer laterals, including pan and tilt of all junctions / connections unless otherwise specified by the City.
- Still capture pictures shall be taken of all significant structural and/or operational deficiencies.

Where CCTV is not feasible, alternative methods prescribed in MECP criteria shall be considered on a case-by-case basis by the City.

25.3 Execution (cont'd)

— Equipment —

CCTV equipment shall include video cameras, a video monitor cable, power sources and all equipment necessary to perform a CCTV inspection.

The cameras shall have Pan-and-Tilt capabilities, a minimum of 360 x 270 degree rotation and provide a minimum of 460 lines of resolution. The focal distance shall be adjustable through a range from 25 mm (1 inch) to infinity.

During CCTV inspection, lighting intensity shall be adjusted to minimize glare. Lighting and picture quality shall be adjusted to provide a clear, in-focus picture of the entire periphery of the pipeline for all conditions encountered.

All camera systems shall be able to navigate around minor objects, roots and debris. The system used to move the camera through the pipe shall not obstruct the camera's view or interfere with proper documentation of the sanitary sewer conditions.

The camera cable shall be retracted to remove slack and to ensure an accurate distance reading. The distance shall be measured between the exit of the start maintenance hole and the entrance of the finish maintenance hole for a true measurement of the length of the pipe segment, as required by PACP. It shall be recorded in standard units and the video display readout shall display units to one-tenth of a metre.

The cable footage-counter shall be accurate to plus or minus 2 metres per 1,000 metres. Video inspection and reporting shall be submitted in a NASSCO-compatible format. The camera lens shall be kept clear of condensation and debris during the CCTV inspection.

— Video —

The Contractor shall make a continuous colour digital recording in MPEG 4 format for each pipe segment inspected. Video files shall have a minimum resolution of 352 x 240 pixels and an interlaced frame rate at a minimum of 24 frames per second. Audio reporting will be avoided to prevent inconsistent operator subjectivity. Video inspection will not exceed a traverse rate of 30 feet per minute.

The Contractor shall pause the digital recording at any time there is a delay in the inspection and restart the digital video recording in the same digital file. The pause shall in no way affect, freeze, or interrupt the replay of the video and shall not close the video file during the inspection.

Each pipe segment (maintenance hole to maintenance hole) shall be identified with an initial text screen and completed in accordance with PACP's CCTV inspection form header Instructions and shall be in accordance with **Table 9**.

Table 9. CCTV Inspection Form Header Requirement

| Line Number | Description |
|-------------|----------------------------------|
| 1 | Surveyed By |
| 2 | City |
| 3 | Street |
| 4 | Weather |
| 5 | Direction of Survey |
| 6 | Use of Sewer (Sanitary or Storm) |
| 7 | Pipe Material |
| 8 | Pipe Diameter |
| 9 | Pipe Length (on plan) |
| 10 | Start Maintenance Hole Number |
| 11 | End Maintenance Hole Number |
| 12 | Pipe ID |
| 13 | Inspection Date/Time |

25.3 Execution (cont'd)

This data must completely match the data entered in the database header information. The initial text screen shall appear no more than 15 seconds at the beginning of the video footage and shall appear before the 360 degree pan of the starting maintenance hole.

During the CCTV inspection, the video shall show the text in **Table 10** at all times.

Table 10. Sewer Video Text

| Line Number | Description |
|-------------|--------------------------------------|
| 1 | City |
| 2 | Street |
| 3 | Inspection Date, Time, Running total |
| 4 | Pipe ID |
| 5 | Start/End Maintenance Hole Number |

During the CCTV inspection, the camera shall stop at all defects and significant observations to ensure a clear and focused view of the pipe condition and shall rotate the camera head at the defect to allow for adequate evaluation at a later time.

All defects and significant observations shall include a text overlay of the recorded observation. The video recording shall include on-screen observation text for every observation recorded in the database.

The naming of the video file shall be as per GIS ID numbers as supplied by the City.

— Photographs —

Digital photographs in JPEG format shall be made of all recorded defect observations. These photographs will be computer generated with the use of the inspection reporting system software. JPEG images shall be captured at a minimum resolution of 640 x 480 pixels. At a minimum, all photographs shall be named consisting of the following descriptions:

“FROM MAINTENANCE HOLE NUMBER”, “TO MAINTENANCE HOLE NUMBER”, eight digit inspection date and the defect location (measurement) along the pipe.

It is the Contractor's discretion as to additional data information that may be needed in the naming of the files to make each file unique within the file naming constraints of their inspection software.

A minimum of two (2) photographs of each defect shall be taken, one with a perspective view and one with a close-up view.

— Additional Inspection Procedures —

A full 360 degree pan of all maintenance holes is required. This video footage shall occur at the beginning of each pipe segment survey inspection from the bottom of the maintenance hole panning up the maintenance hole shaft.

The Contractor shall cover the maintenance hole opening to prevent too much light from entering the structure and to ensure a clear and focused view of the maintenance hole interior. In instances when the maintenance hole is the terminating maintenance hole, then the pan shall occur at the end of the pipe segment survey inspection.

Video footage shall be taken centered on the pipe with the water level running horizontally.

25.3 Execution (cont'd)

— Additional Inspection Procedures (cont'd) —

The camera shall run along the invert of the pipe and not at its side, unless it is passing a point obstacle. If extended driving on the side of the pipe is required, then either the pipe needs a more thorough cleaning or an observation should be noted from the PACP codes describing the nature of the obstacle.

Obstructions may be encountered during the course of the CCTV inspection that prevents the travel of the camera. In instances when obstructions are not passable, the Contractor shall withdraw the equipment and begin a CCTV inspection from the opposite end of the sanitary sewer reach.

— Inspection Record Submission —

Contractor shall include all versions of the inspections in the database. The Contractor shall submit the following deliverables once all video inspections are complete:

- One (1) copy of the sewer video must be submitted electronically in MPEG Format.
- Each section videoed shall have a separate video report. Video report shall be in PDF format on the USB flash drive.
- The Contractor shall also submit one (1) hard copy report and a map illustrating the sewer routing.
- Video inspection data including PACP defect coding data recorded during inspection.

- Inspection data to be provided in .mdb format to enable direct upload of the defect coding data into NASSCO's Access Database format (PACP coding and scoring).
- Still capture pictures of all defects as outlined in Section 1.4.

— Testing—

All new and replaced Sanitary Sewers, forcemains, maintenance holes, connections and chambers shall be tested to ensure integrity of the installed material for water tightness prior to placing into service.

Inspection and testing plans including; procedure, equipment, schedule, safety requirements, and emergency response plan shall be submitted to the City at least two (2) weeks prior to the inspection or testing. Plans must be accepted by the City prior to proceeding with the inspection or testing.

Testing shall be conducted in accordance with the MECP Design Criteria for Sanitary Sewers, Storm Sewers, and Forcemains for Alterations Authorized under an Environmental Compliance Approval.

Contractor must submit approved Inspection & testing plan on the City's template. This is available upon request.

All tests shall be carried out in the presence of and accepted by the Municipality

25.4 Measurement for Payment

Measurement for payment shall be per metre of pipe for cleaning and inspection, including the deliverables.

TRENCHLESS REHABILITATION

TRENCHLESS REHABILITATION

26.0 SEWER PREPARATION AND FLOW CONTROL

26.1 General

This Section outlines the preparation and flow control required in order to properly rehabilitate sewers using cured-in-place Pipe lining methods.

26.2 Execution

The sewer section shall be reamed to remove deposits and protrusions using an approved reaming method. Deposits and protrusions may include (but are not limited to), calcite build up and roots. An acceptable TV camera must monitor reaming operations. Reaming shall include reaming, cutting or grinding as required.

— Protruding Service Connections —

Service Connections that protrude into the sewer section must be cut or ground back prior to reaming of the sewer. If the service connection is damaged or broken by the Contractor, then the Contractor shall repair the damage (by using excavation if necessary) at no additional cost to the City.

The Contractor shall submit for approval of the proposed method of repair and reinstatement for damaged service connections.

— Precaution to Prevent Damage to Sewer Section —

The Contractor shall plan and execute the reaming operation to prevent damage to the sewer section and any service connections.

Proper precautions shall be taken by the Contractor to ensure that the reaming operation does not cut into the sewer itself, to ensure that the reaming tools do not become jammed in the sewer and that any areas of the sewer that are structurally unsound are not further damaged.

If it is necessary to excavate for any reason, such as retrieval of lodged equipment, repair of defective liner, reinstatement of service connections and by-pass of flow, the Contractor shall undertake such excavation, repair, backfill and restoration at their own expense unless other arrangements are agreed with the City in advance.

— Reaming Tolerances —

Reaming tolerances should be developed and confirmed during design.

— Sewer Cleaning —

Refer to **Section 25.0** for details on cleaning of sewers.

— Flow Control —

The Contractor must maintain on site both a by-pass pump and pump power supply of adequate size and capacity to handle the flow, or an approved equivalent method of controlling sewer flow. Sufficient power supply and hoses must be on site in order to allow the pump to discharge into the next downstream sewer section.

All by-pass pumping capacities, configurations and flow diversion plans must be reviewed by the City prior to the work date.

27.0 VIDEO INSPECTION OF SEWERS

27.1 General

For each sewer section, the Contractor shall submit the following video inspection records of the work for the review and approval by the City:

- V1: Preliminary Video Inspection
- V2: Post Preparation Video Inspection
- V3: Completed Rehabilitation Video Inspection

— V1: Preliminary Video Inspection —

The Preliminary Inspection shall be completed prior to undertaking any work for the purpose of assessing the existing condition of the sewer and connections.

The preliminary video must include any required cleaning and flushing necessary to advance the camera and to assess the condition of the sewer and connections.

— V2: Post Preparation Video Inspection —

After completion of the pipe preparation of the sewer section, a video inspection of the full length of the sewer section shall be made.

A final count of the service connections must be made during V2. The V2 video must be submitted to the City for approval at least two (2) business days prior to lining or within a timeframe that is otherwise approved by the City.

— V3: Completed Rehabilitation Video Inspection —

After completion of all work including reinstatement of service connections and any required remedial work: a video inspection of the full length of the sewer section shall be made.

The Final Video (V3) shall be submitted to the City no more than three (3) business days after the lining installation in each section.

27.2 Deliverables

The contractor shall submit the following deliverables:

- One (1) copy of the sewer video must be submitted electronically in MPEG format.
- Each section videos shall have a separate video report. Video report shall be in PDF format on the USB flash drive.
- The Contractor shall also submit three (3) hard copy reports and maps illustrating the sewer routing. The hard copy reports must be submitted to the City no later than ten (10) business days after the section of rehabilitation is complete. The report must include each of the V1, V2, and V3 videos.
- Each section videos shall have a separate video report. Video report shall be in PDF format on the USB flash drive.
- Video inspection data including PACP defect coding data recorded during inspection.
- Inspection data to be provided in .mdb format to enable direct upload of the defect coding data into NASSCO's Access Database format (PACP coding and scoring).
- Still capture pictures of all defects as outlined in the City's CCTV Inspection Standard.

Each sewer inspection report must also contain still photographs of each sewer lateral connection.

28.0 CURED-IN-PLACE SEWER LINING: DESIGN

28.1 General

The intent of this Section is to outline the requirements for the design of Cured in Place Pipe Liner that is to be used for the rehabilitation of sewers and service laterals.

28.2 Type of Lining

The lining shall be cured-in-place in accordance with ASTM. The inner layer of the finished liner shall have an impermeable plastic coating which is required for enhancement of corrosion, flow and abrasion properties.

28.3 Styrene Restriction

Only liners with styrene free resin or UVCGR will be accepted for CIPP rehabilitation of storm sewers.

28.4 Design Parameters

The lining shall be designed, including the lining wall thickness, for the fully deteriorated pipe condition as defined in ASTM.

28.5 Liner Sizing

The Contractor shall measure the internal diameters and lengths of each sewer section to be lined before any liner installation may occur. The measurements taken must be suitable for proper sizing of the liners to be installed.

The Contractor shall not rely on sewer dimensions provided by the City. A record of the internal diameter measurements shall be available to the City for review.

28.6 Payment

All CIPP design shall be included under the supply and install CIPP items in the Form of Tender.

29.0 CURED-IN-PLACE SEWER LINING: FIT AND FINISH

29.1 General

The intent of this section is to outline the fit and Finish requirements for the cured-in-place liner.

29.2 Liner Fit to the Existing Sewer

The outside surface of the finished liner shall be in contact with the inside surface of the existing sewer subject to the contact tolerance.

The inside surface of the existing sewer is the surface after the sewer has been prepared for lining in accordance with the preparation requirements.

The contact tolerance is 1.0 mm. Where any space or gap between the outside surface of the liner and the inside surface of the existing sewer exceeds 1.0 mm, the liner fit will be deficient, subject to exceptions noted below.

29.3 Exception to Liner Fit

An exception to the liner fit may occur at existing sewer irregularities, such as: off-set joints, protrusions, bumps, or other similar situations in the existing sewer that remain after the sewer has been prepared in accordance with the preparation requirements.

Neither ovalisation of the existing sewer, nor curves made by joint deflection are irregularities in this context.

Where an irregularity exists, exception to the liner contact tolerance requirements will be allowed in the irregularity zone. The irregularity zone is defined as a zone extending a distance of up to one eighth (1/8) of the liner inside diameter in any direction from the irregularity.

A liner fit exception at an existing sewer irregularity shall not present an obstruction to sewage flow whether or not it complies with the allowed exceptions.

29.4 Liner Shape

In general, the liner shape shall conform to the shape of the existing sewer inside surface after its preparation in accordance with the preparation requirements. However, where the existing sewer shape is deformed (missing pieces of sewer) the liner may either bridge the missing wall section or indent into the missing wall section.

Where the liner bridges, the shape of the liner shall match the shape of the adjacent sewer; and the inside diameter of the liner shall be as required for Contact Tolerance for the adjacent sewer. Where the liner indents, the depth of the indent shall not reduce the liner wall thickness below the Wall Thickness Tolerance.

29.5 Liner Wall Thickness Tolerance

The liner's finished average wall thickness shall be as specified in the engineered design with the following tolerances:

- Average Plus Tolerance: 25%
- Average Minus Tolerance: 0%

29.6 Liner Installation

Prior to the lining of each sewer section the Contractor shall submit to the City a standard certificate of analysis, identifying the batch No. and product name, confirming that the liner design complies with the product specification. The Contractor shall also provide the City with copies of the wet out information sheet itemizing the dimensions of the liner and the quantity of each material used in the lining of the sewer section.

Any proposed deviation from the submitted procedure shall be submitted, with explanation, to the City for approval and the submission shall include the approval of the lining manufacturer or senior licenser.

The finished liner shall be free of any interior bulges, ribs, ripples, folds, voids, cavities, bubbles, or other irregularities except where these irregularities comply with the Liner Wall Thickness Tolerance, fit and shape given above.

Following installation of the liner the Contractor shall provide the City with copies of any documentation of the liner curing process as specified in ASTM. Documentation should be recorded such that the City can perform a direct comparison with the process curing cycle.

Any water used in the process of liner curing must be cooled before released into the City's sewers. Water must be cooled to 40°C in the storm sewer and 60°C in the sanitary sewer.

29.7 Liner Termination at and Through Maintenance Holes

At maintenance hole entrances and exits, the interface between the exterior surface of the liner and the maintenance hole shall be watertight to the requirements for external hydrostatic pressure. The finished ends of the liner shall be neat and smoothly cut.

Where a watertight seal is not obtained, a seal shall be applied that is compatible with the liner pipe. The benching in the maintenance holes shall be modified where required to conform to liner dimensions and the requirements for benching.

In the case where the liner is installed through an existing maintenance hole, the liner shall be trimmed neatly and parged at the spring line of the liner and at the interface between the liner and any other existing sewers or service connections entering into the maintenance hole.

29.8 Odour Control

A ventilation fan shall be used to exhaust air from the manhole for the purposes of odour control.

29.9 Clean-Up and Restoration

All disturbed areas shall be restored to their original condition or better. All debris and excess materials shall be removed and disposed of off-site by the Contractor immediately after the lining process.

Sod, driveway and other used surfaces shall be restored as per the City's standards and OPSS.

29.10 Field Samples and Testing

— Finished Liner Sample —

One (1) sample will be required for each diameter of liner used as part of this contract. For each required sample, the Contractor shall furnish to the City a cylindrical sample of the lining at least 100 mm - 200 mm in length and produce a 200 mm - 300 mm sample that will be used for the testing process.

The samples shall be taken from lining that extends into any maintenance hole on the section and shall be an extension of the lining installed for that section.

A suitable form shall be used to create the samples so that the conditions of making the samples are as close as possible to the installation and curing conditions for the corresponding section of lining.

— Finished Liner Sample: Testing —

The testing of the above noted sample is to be completed by an accredited third party laboratory knowledgeable in the testing of CIPP and approved by the City. All testing of samples will be in accordance with ASTM.

The Contractor will supply the lab with the sample and the sample will be tested for the following properties:

- Flexural Modulus
- Flexural Strength
- Wall Thickness

29.10 Field Samples and Testing (cont'd)

— Finished Liner Sample: Testing (cont'd) —

The test results shall meet or exceed the values used in the Contractor's designs that have been approved by the City.

Where the results do not meet these criteria, the liner shall be deemed deficient.

A deficient liner may be reconciled by repeating the design for the liner using the test results for flexural modulus and flexural strength, while keeping all other design parameters the same.

Where the repeating of the design shows that the combination of test results provides a liner that meets the design requirements, the liner shall not be deemed deficient.

Design reconciliation shall not be permitted when test results do not meet the minimum requirements for flexural modulus and flexural strength as outlined in ASTM.

— Deficiencies —

Where deficiencies have been identified, either by the City or the Contractor, the Contractor shall resolve, correct, or rectify the deficiencies. Where there is no repair or correction, an appropriate addition or deduction in the original tendered price will occur.

Where deficiencies seriously impact sewer or service connection flow capacity and are considered likely to cause sewer back-ups onto properties or other overflows, the Contractor shall take immediate action to prevent problems.

Final resolution of any deficiency, if required, shall be with a method acceptable to the City.

Should the Contractor fail to commence repairs as noted, the City will arrange for this work to be done at the Contractor's expense and no additional payment will be made due to this requirement.

The cost of any remedial work to rectify a deficiency is the responsibility of the Contractor.

29.11 Measurement for Payment

Measurement shall be per linear metre for all CIPP work.

30.0 LATERAL CONNECTION REINSTATEMENT AND REHABILITATION

30.1 General

The intent of this Section is to outline the requirements for the reinstatement and rehabilitation procedure of the sewer lateral connections.

30.2 Lateral Reinstatement

All live service connections, including but not limited to any openings to drop structures, tees, private services shall be reopened to their full diameter; and the interface between the liner and existing pipe shall be made leak tight by remote means.

All connections that are identified as abandoned or plugged services must also be reinstated to the same extent as live service connections.

Service connections must be reinstated to the entire opening of the service connection or service connection pipe, whichever is the greater.

No sleeve or liner protrusions, sealer, grout, or other foreign material is permitted into such area. All cuts shall be smooth and without residual material left around the opening.

The Contractor may be required to provide a clean, properly functioning, portable chemical toilet for the entire time that a service connection is blocked at the sewer.

Such toilets shall be delivered prior to any service connections being blocked in the sewer and shall be promptly retrieved by the Contractor upon service connection reinstatement.

30.3 Preliminary Lateral Sewer Inspection

The Contractor will complete a CCTV inspection of each sewer lateral located within the mainline sewer rehabilitation sections (including connections to manholes) to obtain the following information.

- The condition of the public portion of the lateral. Does the lateral require rehabilitation?
- Potential liner impediments (i.e. excessive elbows, wye connections) or conditions that cannot be rectified by lining such as excessive settlements or misalignments.
- Can the lateral rehabilitation be accomplished by lining from the mainline?
- Any other pre-design information required for lining such as diameter, material and location of clean outs.

The Contractor will complete an inspection report for each lateral and indicate if the lateral is suitable for lining from the mainline.

If it is determined that the lateral is not suitable, the Contractor will provide reasons and recommendations for rehabilitation.

30.4 Lateral Rehabilitation

Service and lateral rehabilitation will be paid under the appropriate item.

The installation of the lateral liner shall be from the main sewer only and there will be no access allowed on the property, including the installation of clean outs.

30.4 Lateral Rehabilitation (cont'd)

The rehabilitation must be completed in accordance with contract's specifications for preparation, fit & finish and design. An outline of the procedure and materials to be used must be provided to the City and approved. The one piece lateral lining systems shall be in accordance with ASTM.

All lateral rehabilitation will be completed from the sewer mainline and extending 0.3 m past the residential property line, using an entirely trenchless method.

30.5 Customer Notification

At all times when live service connections are to be covered, the Contractor must provide a Service Disruption Notice to all affected parties.

Such notice must be typed on the Contractor's letterhead and clearly indicate both daytime and after hours local contact telephone numbers. The Contractor must schedule the liner installation accordingly.

No service disruption will be allowed without such notification. The Contractor will provide a sample letter to the City for review and acceptance prior to distribution.

In the event that the Contractor is unable to install the liner on the date stated in the Service Disruption Notice, the Contractor must immediately provide written notification to the Customer and City, of the change of date including the new date for the liner installation.

After the service connection has been reinstated the Contractor must provide written notification to all affected parties that their service connection is again in service. The Contractor shall maintain a detailed record of the time at which the reinstatement of each service connection is completed.

30.6 Measurement for Payment

Measurement shall be per each service connections reinstated and rehabilitated.

31.0 SEWER PIPE JOINT SEALING AND MAIN SEWERS

31.1 General

It is the intent of this section to seal sewer pipe joints which have visible leaks or potential leaks using the internal joint sealing method. It is realized that this method may only be used on sewer pipe sections in sound physical condition. Longitudinally cracked or broken pipe will not be sealed.

31.2 Equipment

The basic equipment shall consist of equipment including, but not limited to, a pan / tilt closed-circuit television system, necessary chemical sealant container, pumps, regulators, valves, hoses and joint sealing packers for the various sizes of sewer pipes.

31.3 Joint Sealing Procedure

Joints showing visible leakage shall be sealed as specified. Joint sealing shall be accomplished by forcing chemical sealing materials into or through faulty joints by a system of pumps, hoses and sealing packers.

Jetting or driving pipes from the surface that could damage or cause undermining of the pipelines shall not be allowed.

The packer shall be positioned over the faulty joint by means of a measuring device and the closed-circuit television camera in the line.

It is important that the procedure used by the Contractor for positioning the packer be accurate to avoid over-pulling the packer and not effectively sealing the intended joint. The packer ends including end element and sleeves shall be expanded using controlled pressure.

The expanded ends shall seal against the inside periphery of the pipe to form a void area at the faulty joint, now completely isolated from the remainder of the pipeline. Into this isolated area, sealant materials shall be pumped through the hose system at controlled pressures, which are in excess of groundwater pressures to the point of refusal.

Refusal shall be defined as the point of blow-by on the packer bladders at any point after a minimum of 0.95 litres of sealant per 25 mm diameter has been pumped into the defective joint.

The pumping unit, metering equipment and the packer device shall be designed so that proportions and quantities of materials can be regulated in accordance with the type and size of the leak being sealed.

31.4 Joint Sealing Verification

Upon achieving refusal at each joint, the packer shall be deflated, moved away from the joint to break away the doughnut of gel formed by the packer void.

The injection port on the packer shall be cleared with a quick burst of pressure test fluid such that the void pressure meter reads zero pressure. The packer should then be repositioned on the joint, re-inflated and the joint retested as specified.

Should the void pressure meter not read zero, the Contractor shall clean his equipment of residual grout material or make the necessary equipment repairs / adjustments to produce accurate void pressure readings.

Joints that fail to meet the specified test criteria shall be resealed and retested until the test criteria can be met.

31.5 Residual Sealing Material

Residual sealing materials that extend into the pipe, reduce the pipe diameter, or restrict the flow shall be removed from the joint. The sealed joints shall be left reasonably flush with the existing pipe surface.

If excessive residual sealing materials accumulate in the line, the section shall be cleaned.

31.6 Chemical Sealing (Grouting Material)

— General —

The intent of this section is to define the properties that a sealing material must have to perform effectively in the intended application and under expected field conditions.

All chemical sealing materials used in the performance of the work specified must have the following characteristics:

- The chemical sealant must be able to react in the presence of groundwater.
- The cured material must withstand submergence in water without degradation.
- The resultant sealant (grout) formation must prevent infiltration through the sewer pipe joint.
- The sealant material after curing must be flexible.
- In place, the sealant formation should be able to withstand freeze, thaw, wet dry cycles without adversely affecting the seal.
- The sealant formation must not be biodegradable.
- The cured sealant should be chemically stable and resistant to the mild concentrations of acids, alkalis and organics found in normal sewage.
- Packaging of component materials must be compatible with field storage and handling requirements. Packaging must provide for worker safety and minimize spillage during handling.
- Residual sealing materials must be easily removable from the sewer line to prevent reduction of blockage of the sewer flow.

31.7 Measurement for Payment

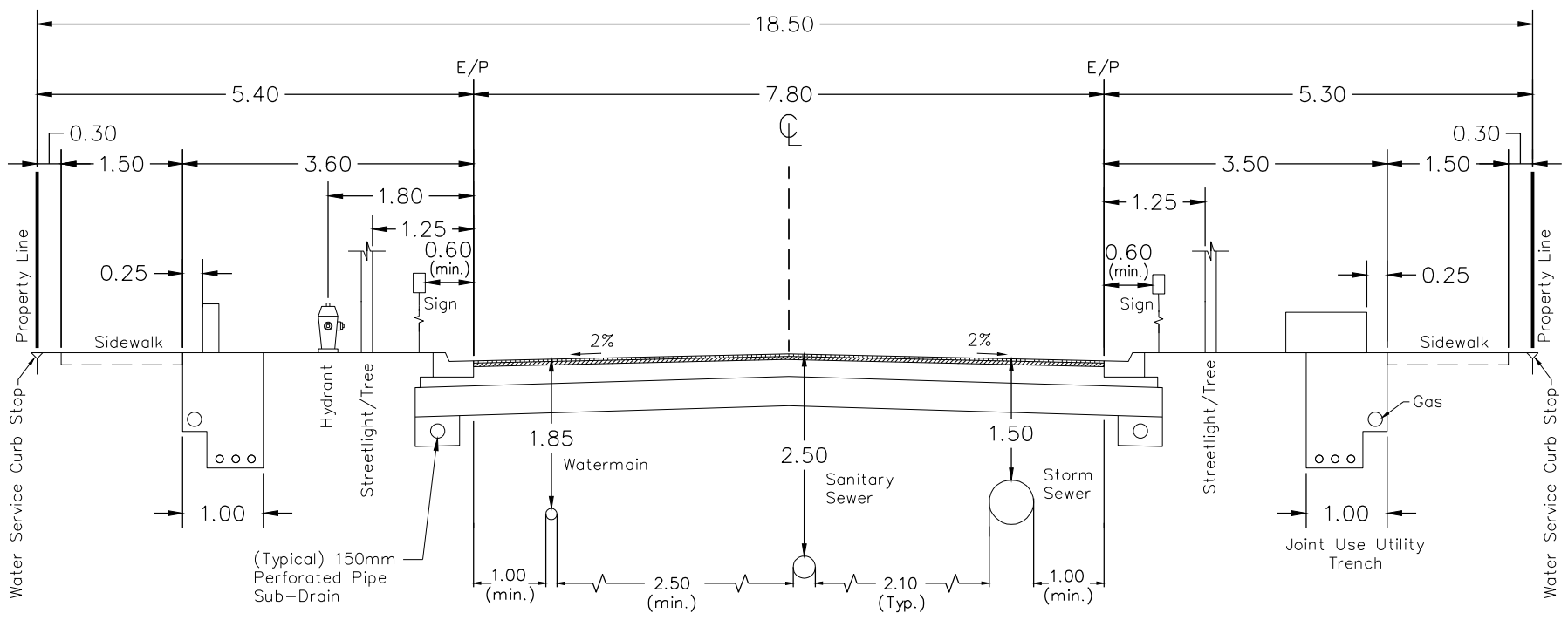
Measurement shall be per each by each joint actually sealed and tested.

DESIGN SHEET

DETAILED ENGINEERED CROSS-SECTIONS

DETAILED ENGINEERED CROSS-SECTIONS

| Drawing No. | Title |
|-------------|--|
| H-101 | Local Road, 18.5 m ROW Width, 7.8 m Road Width |
| H-102 | Local Road, 18.5 m ROW Width, 10.2 m Road Width |
| H-102B | Local Road, 20.0 m ROW Width, 10.2 m Road Width |
| H-103 | Minor Collector Road, 24.5 m ROW Width, 12.6 m Road Width |
| H-104 | Minor Collector Road, 24.5 m ROW Width, 15.0 m Road Width |
| H-105 | Major Collector Road, 27.5 m ROW Width, 18.2 m Road Width |
| H-105B | Major Collector Road, 27.5 m ROW Width, 14.7 m Road Width |
| H-106 | Major Collector Road, 30.5 m ROW Width, 17.4 m Road Width |
| H-107 | Arterial Road, 40.0 m ROW Width, 20.8 m Road Width |
| H-108 | Arterial Road, 40.0 m ROW Width, 22.1 m Road Width |
| H-109 | Industrial Minor Collector Road, 27.5 m ROW Width, 10.0 m Road Width |

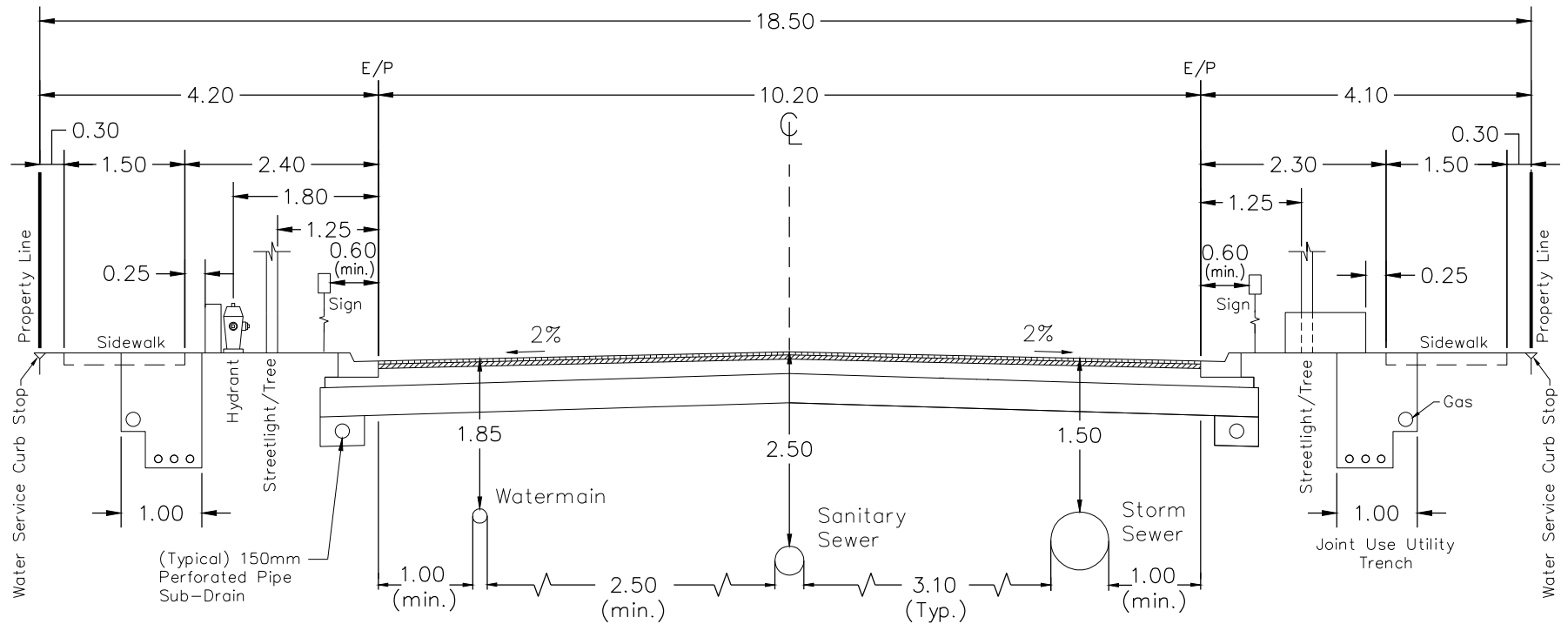


DETAILED SECTION – LOCAL STREET

N.T.S.

- NOTE: 1) All dimensions are in metres unless otherwise shown.
 2) Curb and gutter to meet O.P.S.D. or City of Brantford detail drawing RD-104 for two-stage curb construction in accordance with project drawings
 3) Road grade and crossfall shall be in accordance with the Design and Construction Manual.
 4) Sidewalk Grade: minimum of 0.5% and maximum of 5%; Sidewalk Crossfall: minimum of 2% and maximum of 4%.
 5) Water service curb stops shall be on the property line. Installation on hard surfaced area, such as driveways and walkways shall be avoided.
 6) Refer to Standard Detail Drawing UT-105 for Joint Use Utility Trench.
 7) A minimum clearance of 0.3 m must be maintained between the gas line and the property line.
 8) If utilities cannot be installed according to this standard, they are to be installed as close as possible to the prescribed location subject to the approval of the City.
 9) Spacing between streetlights and trees should be sufficient to ensure no interference between tree canopy and lighting fixture.

| | |
|---|-------|
| CITY OF BRANTFORD | |
| DETAILED SECTION LOCAL STREET (18.5m ROW 7.8m ROAD WIDTH) | |
| DATE: FEB. 2020 REV: JAN. 2022 DRAWN BY: E.K. | H-101 |

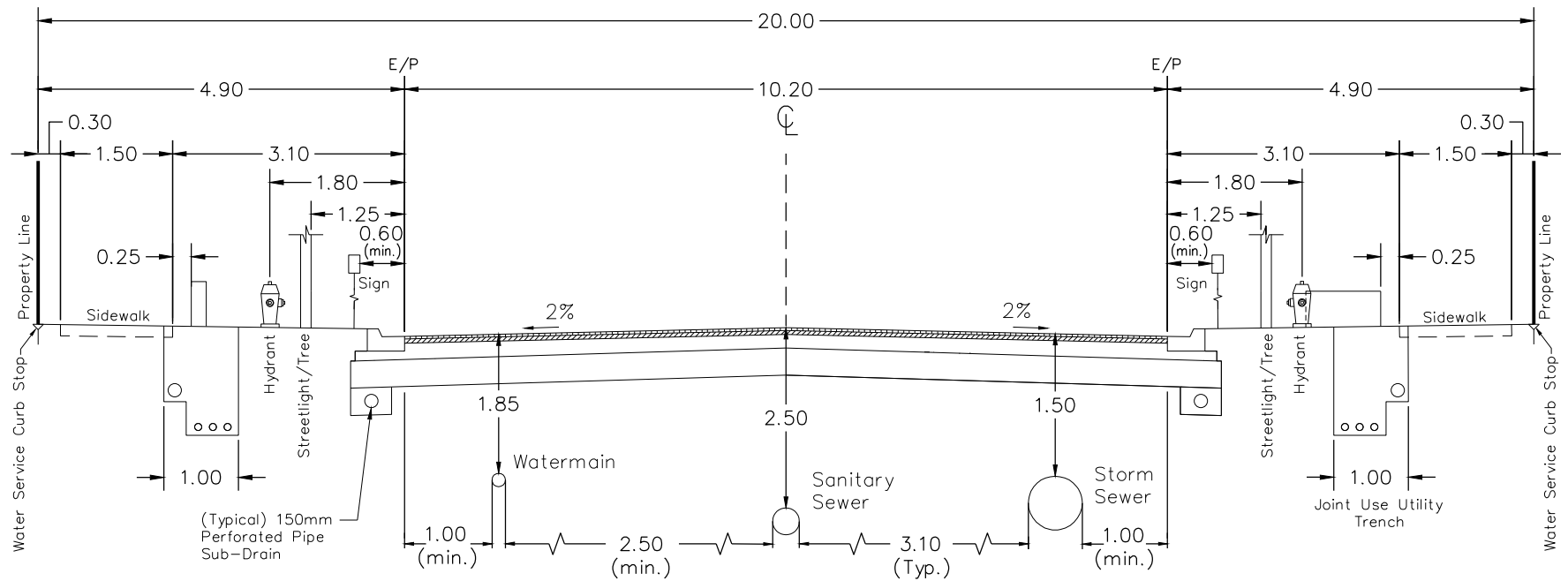


DETAILED SECTION – LOCAL STREET

N.T.S.

- NOTE: 1) All dimensions are in metres unless otherwise shown.
 2) Curb and gutter to meet O.P.S.D. or City of Brantford detail drawing RD-104 for two-stage curb construction in accordance with project drawings
 3) Road grade and crossfall shall be in accordance with the Design and Construction Manual.
 4) Sidewalk Grade: minimum of 0.5% and maximum of 5%; Sidewalk Crossfall: minimum of 2% and maximum of 4%.
 5) Water service curb stops shall be on the property line. Installation on hard surfaced area, such as driveways and walkways shall be avoided.
 6) Refer to Standard Detail Drawing UT-105 for Joint Use Utility Trench.
 7) A minimum clearance of 0.3 m must be maintained between the gas line and the property line.
 8) If utilities cannot be installed according to this standard, they are to be installed as close as possible to the prescribed location subject to the approval of the City.
 9) Spacing between streetlights and trees should be sufficient to ensure no interference between tree canopy and lighting fixture.

| | |
|---|--------------|
| CITY OF BRANTFORD | |
| DETAILED SECTION LOCAL STREET (18.5m ROW 10.2m ROAD WIDTH) | |
| DATE: FEB. 2020 REV: JAN. 2022 DRAWN BY: E.K. | H-102 |



DETAILED SECTION – LOCAL STREET

N.T.S.

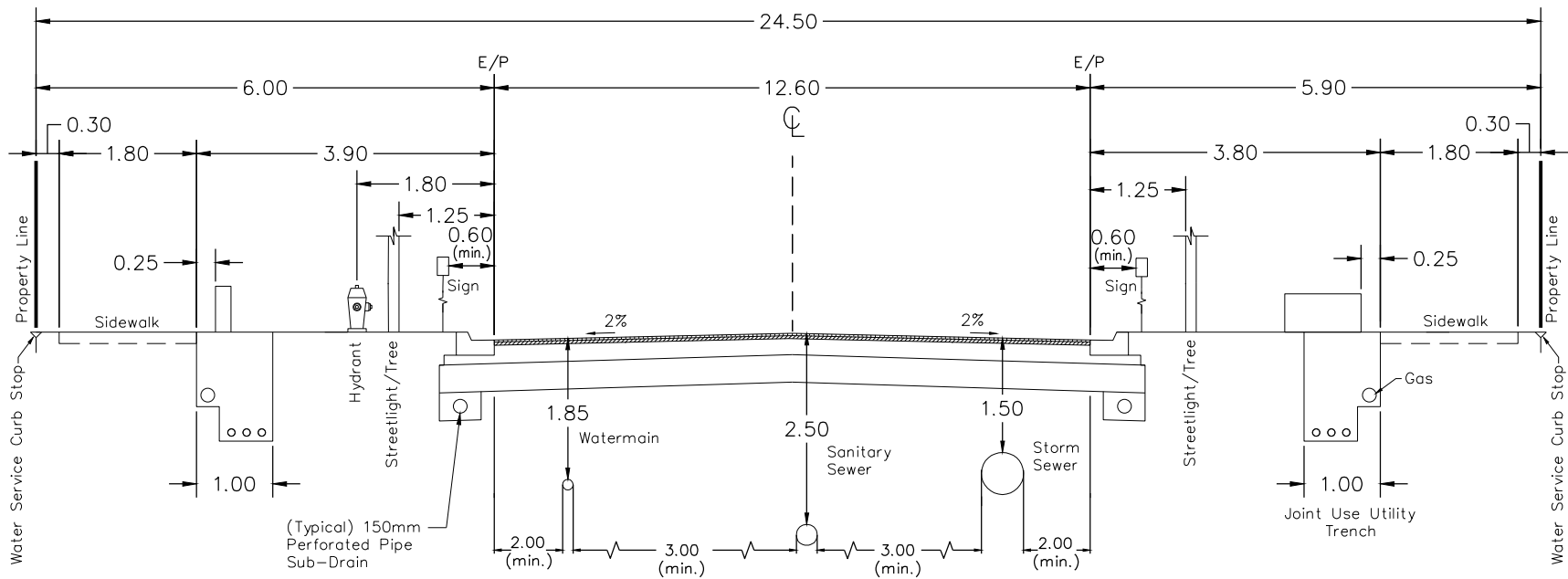
- NOTE: 1) All dimensions are in metres unless otherwise shown.
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 9) Spacing between streetlights and trees should be sufficient to ensure no interference between tree canopy and lighting fixture.

CITY OF BRANTFORD

DETAILED SECTION
 LOCAL STREET
 (20.0m ROW 10.2m ROAD WIDTH)

DATE: FEB. 2020
 REV: JAN. 2022
 DRAWN BY: E.K.

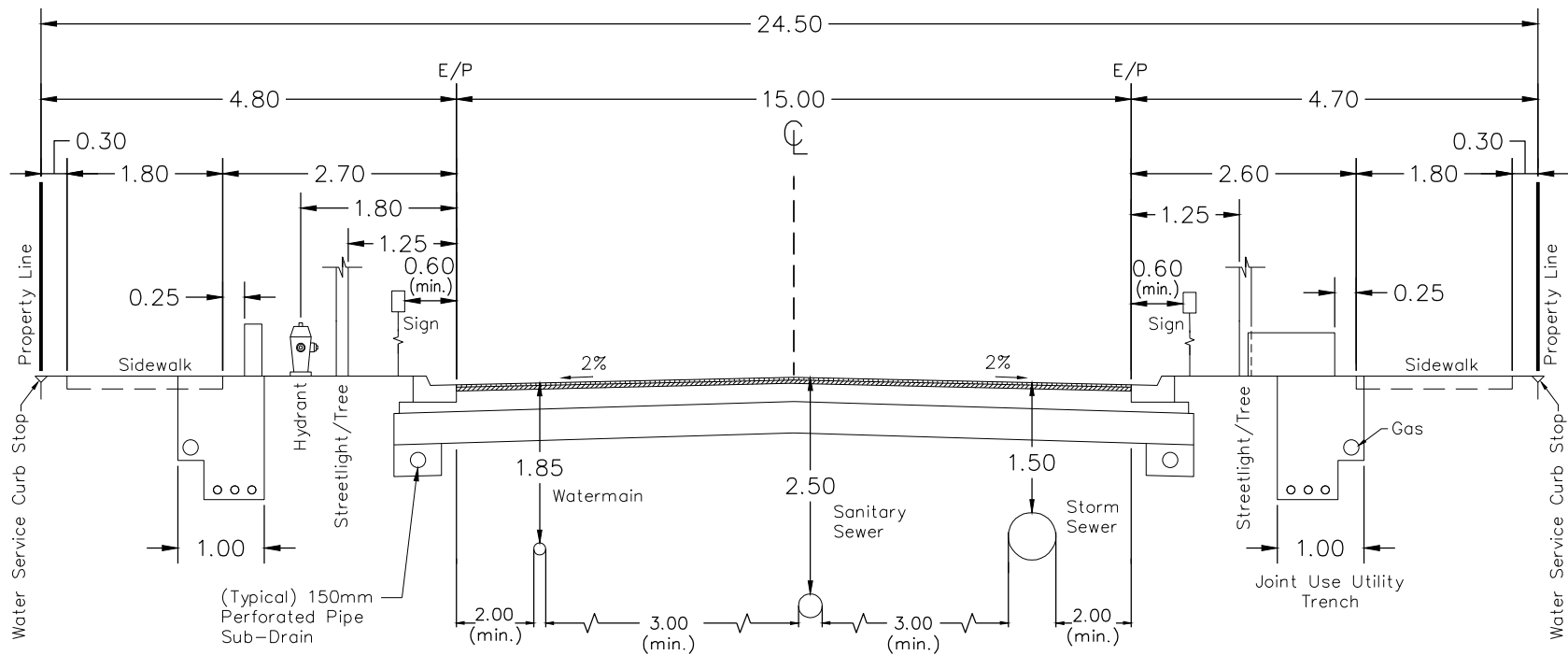
H-102B



DETAILED SECTION – MINOR COLLECTOR
N.T.S.

- NOTE: 1) All dimensions are in metres unless otherwise shown.
 2) Curb and gutter to meet O.P.S.D. or City of Brantford detail drawing RD-104 for two-stage curb construction in accordance with project drawings
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| | |
|---|-------|
| CITY OF BRANTFORD | |
| DETAILED SECTION MINOR COLLECTOR (24.5m ROW 12.6m ROAD WIDTH) | |
| DATE: FEB. 2020 | H-103 |
| REV: JAN. 2022 | |
| DRAWN BY: E.K. | |



DETAILED SECTION – MINOR COLLECTOR

N.T.S.

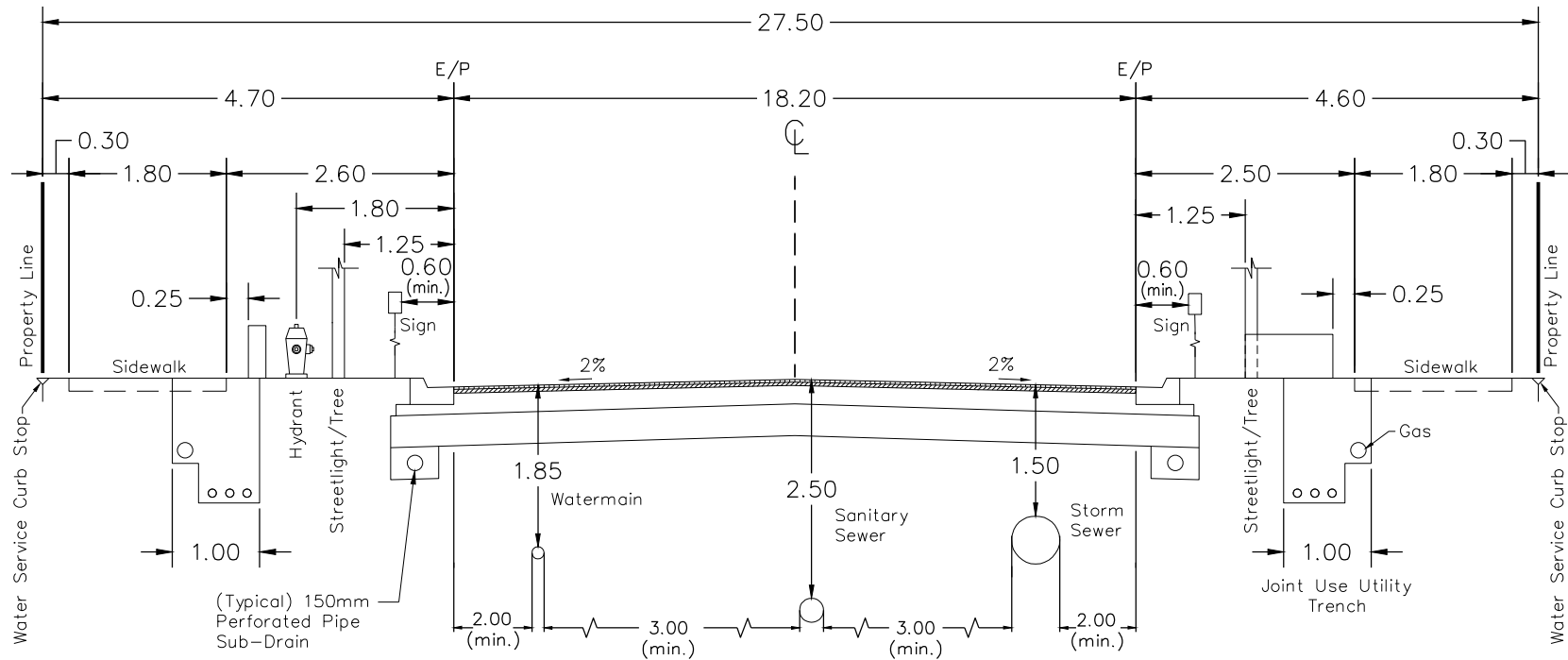
- NOTE: 1) All dimensions are in metres unless otherwise shown.
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 8) If utilities cannot be installed according to this standard, they are to be installed as close as possible to the prescribed location subject to the approval of the City.
 9) Spacing between streetlights and trees should be sufficient to ensure no interference between tree canopy and lighting fixture.

CITY OF BRANTFORD

DETAILED SECTION
 MINOR COLLECTOR
 (24.5m ROW 15.0m ROAD WIDTH)

DATE: FEB. 2020
 REV: JAN. 2022
 DRAWN BY: E.K.

H-104



DETAILED SECTION – MAJOR COLLECTOR
N.T.S.

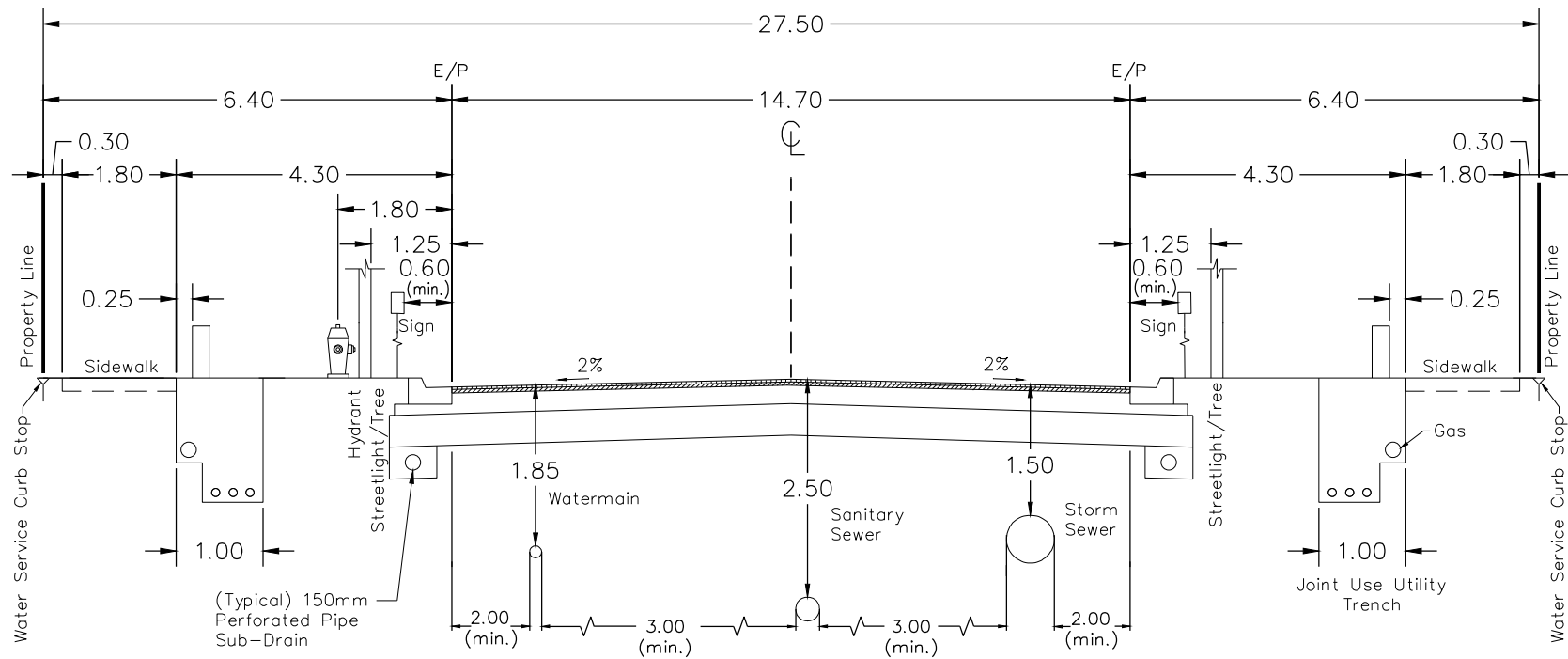
- NOTE: 1) All dimensions are in metres unless otherwise shown.
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CITY OF BRANTFORD

DETAILED SECTION
 MAJOR COLLECTOR
 (27.5m ROW 18.2m ROAD WIDTH)

DATE: FEB. 2020
 REV: JAN. 2022
 DRAWN BY: E.K.

H-105



DETAILED SECTION – MAJOR COLLECTOR
N.T.S.

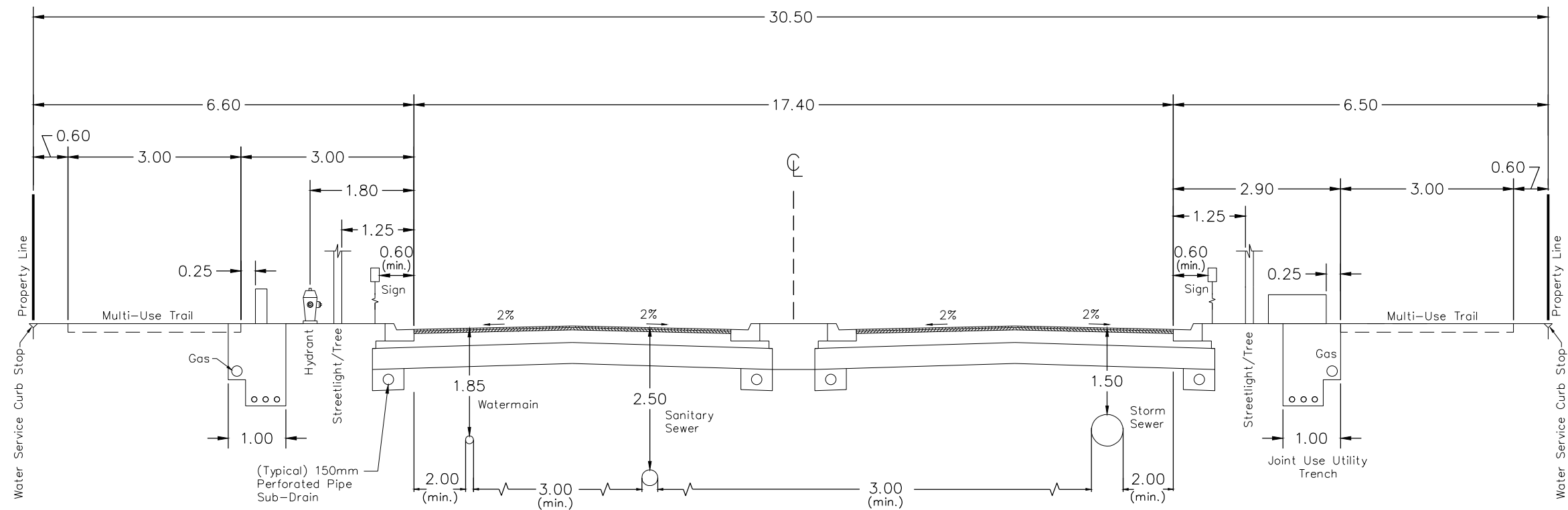
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CITY OF BRANTFORD

DETAILED SECTION
 MAJOR COLLECTOR
 (27.5m ROW 14.7m ROAD WIDTH)

DATE: FEB. 2023
 REV:
 DRAWN BY: E.K.

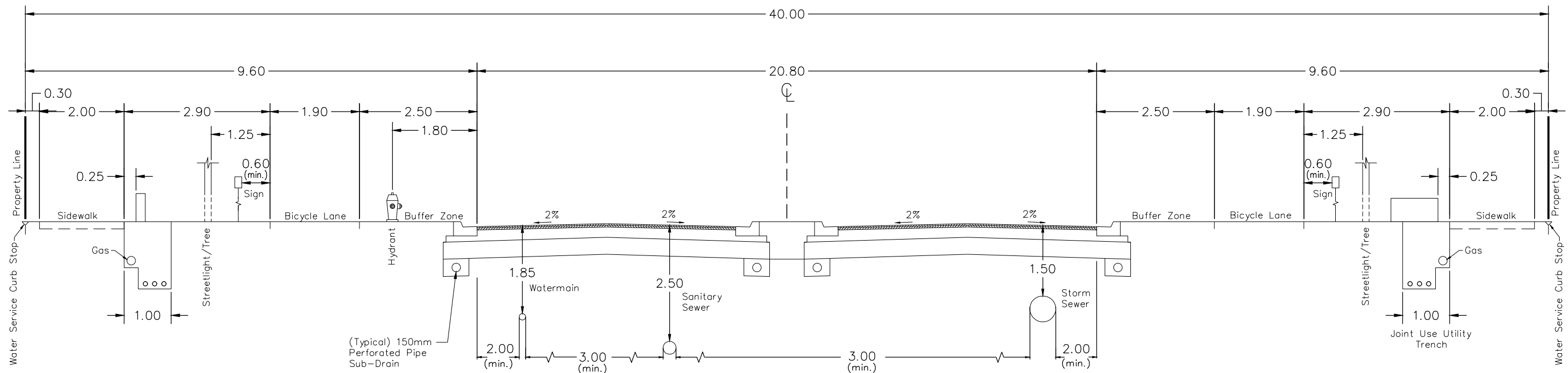
H-105B



DETAILED SECTION – MAJOR COLLECTOR
N.T.S.

- NOTE: 1) All dimensions are in metres unless otherwise shown.
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| | |
|---|-------|
| CITY OF BRANTFORD | |
| DETAILED SECTION MAJOR COLLECTOR (30.5m ROW 17.4m ROAD WIDTH) | |
| DATE: FEB. 2020 REV: JAN. 2022 DRAWN BY: E.K. | H-106 |

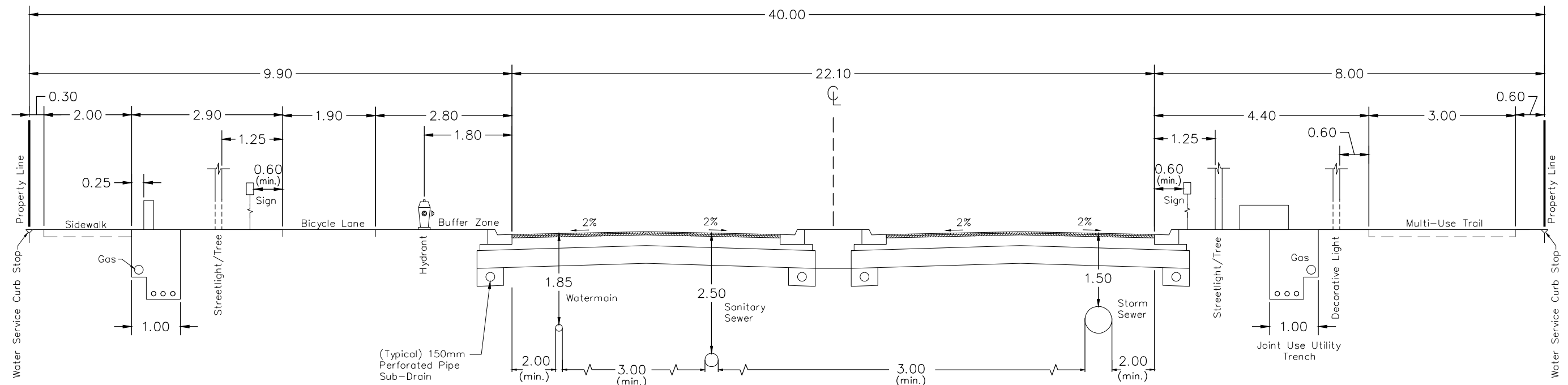


DETAILED SECTION – ARTERIAL

N.T.S.

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 8) If utilities cannot be installed according to this standard, they are to be installed as close as possible to the prescribed location subject to the approval of the City.
 9) Spacing between streetlights and trees should be sufficient to ensure no interference between tree canopy and lighting fixture.
 10) Preferred sidewalk width = 2.0 m, minimum width = 1.8 m for arterial road.

| | |
|--|-------|
| CITY OF BRANTFORD | |
| DETAILED SECTION ARTERIAL (40.0m ROW 20.8m ROAD WIDTH) | |
| DATE: FEB. 2020 REV: FEB. 2023 DRAWN BY: E.K. | H-107 |



DETAILED SECTION – ARTERIAL

N.T.S.

- NOTE: 1) All dimensions are in metres unless otherwise shown.
 2) Curb and gutter to meet O.P.S.D. or City of Brantford detail drawing RD-104 for two-stage curb construction in accordance with project drawings
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 10) Preferred sidewalk width = 2.0 m, minimum width = 1.8 m for arterial road.

CITY OF BRANTFORD

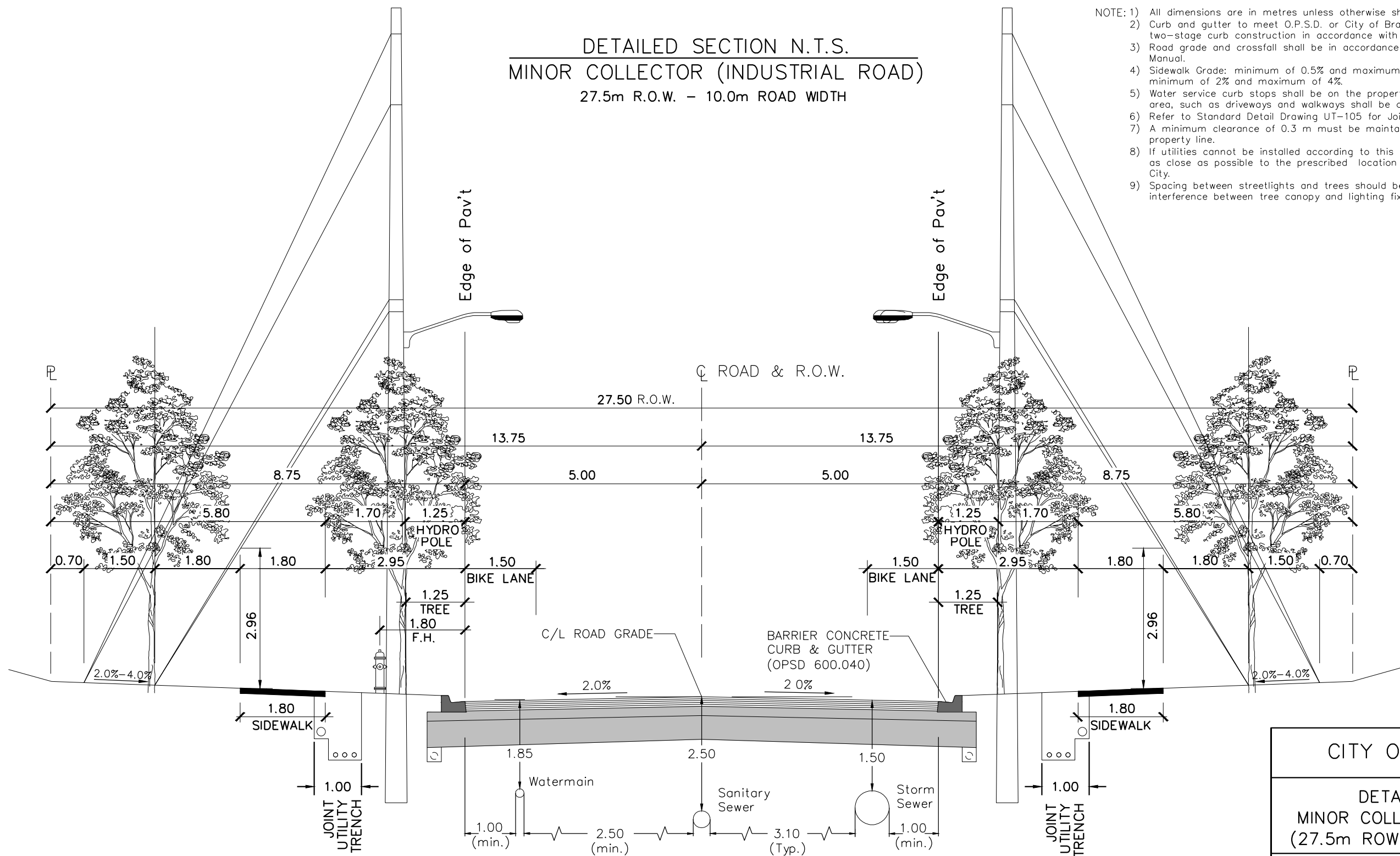
DETAILED SECTION
 ARTERIAL
 (40.0m ROW 22.1m ROAD WIDTH)

DATE: FEB. 2020
 REV: FEB. 2023
 DRAWN BY: E.K.

H-108

DETAILED SECTION N.T.S.
MINOR COLLECTOR (INDUSTRIAL ROAD)
 27.5m R.O.W. - 10.0m ROAD WIDTH

- NOTE: 1) All dimensions are in metres unless otherwise shown.
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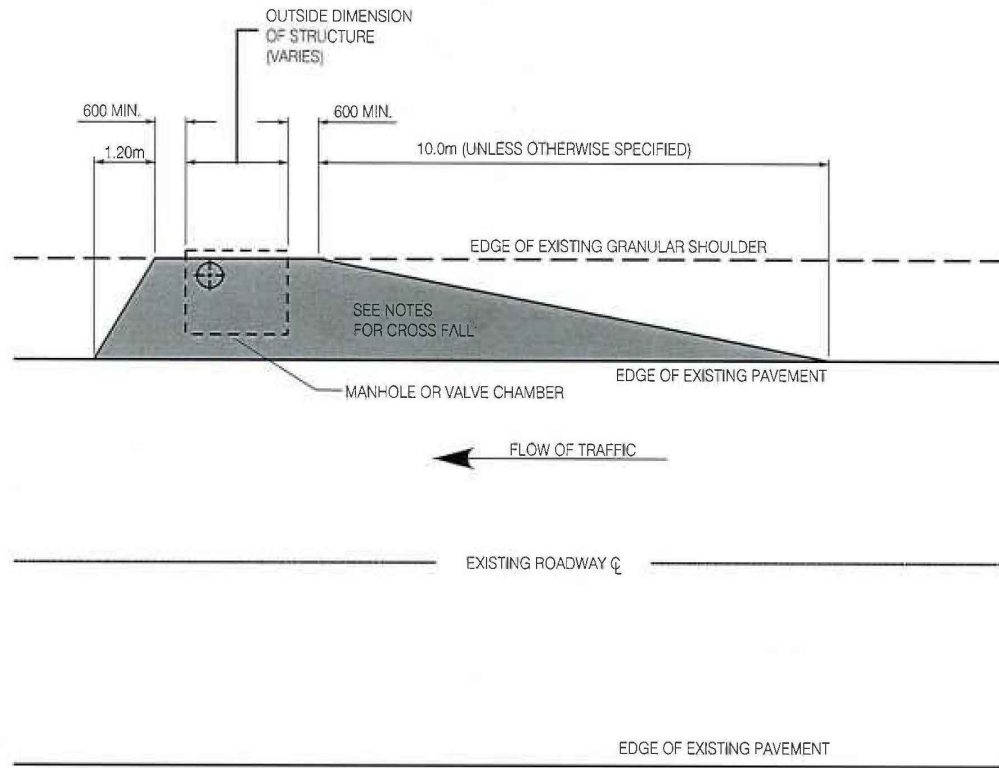


| | |
|---|-------|
| CITY OF BRANTFORD | |
| DETAILED SECTION MINOR COLLECTOR (INDUSTRIAL) (27.5m ROW 10.0m ROAD WIDTH) | |
| DATE: JAN. 2021 | H-109 |
| REV: | |

STANDARD DRAWINGS AND DETAILS

STANDARD DRAWINGS AND DETAILS

| Drawing No. | Title |
|-------------|--|
| A-101 | Shoulder Paving |
| A-102 | Sanitary Service Double Clean Out |
| A-103 | Single Forcemain Outlet Chamber |
| W-312 | Insulation of Sewers and Watermains in Shallow Trenches "Frost Barrier" |
| W-312A | Insulation of Sewers and Watermains in Shallow Trenches "Frost Box" |
| W-312B | Insulation of Sewers, Watermains and Service Connections Adjacent to Ventilated Structures |



NOTES:

1. CROSSFALL OF PROPOSED SHOULDER PAVING TO SUIT EXISTING CONDITIONS
2. CHAMBER COVERS TO BE SET TO MATCH SHOULDER PAVING CROSSFALL
3. AREA TO BE PAVED MINIMUM 75mm SURFACE ASPHALT

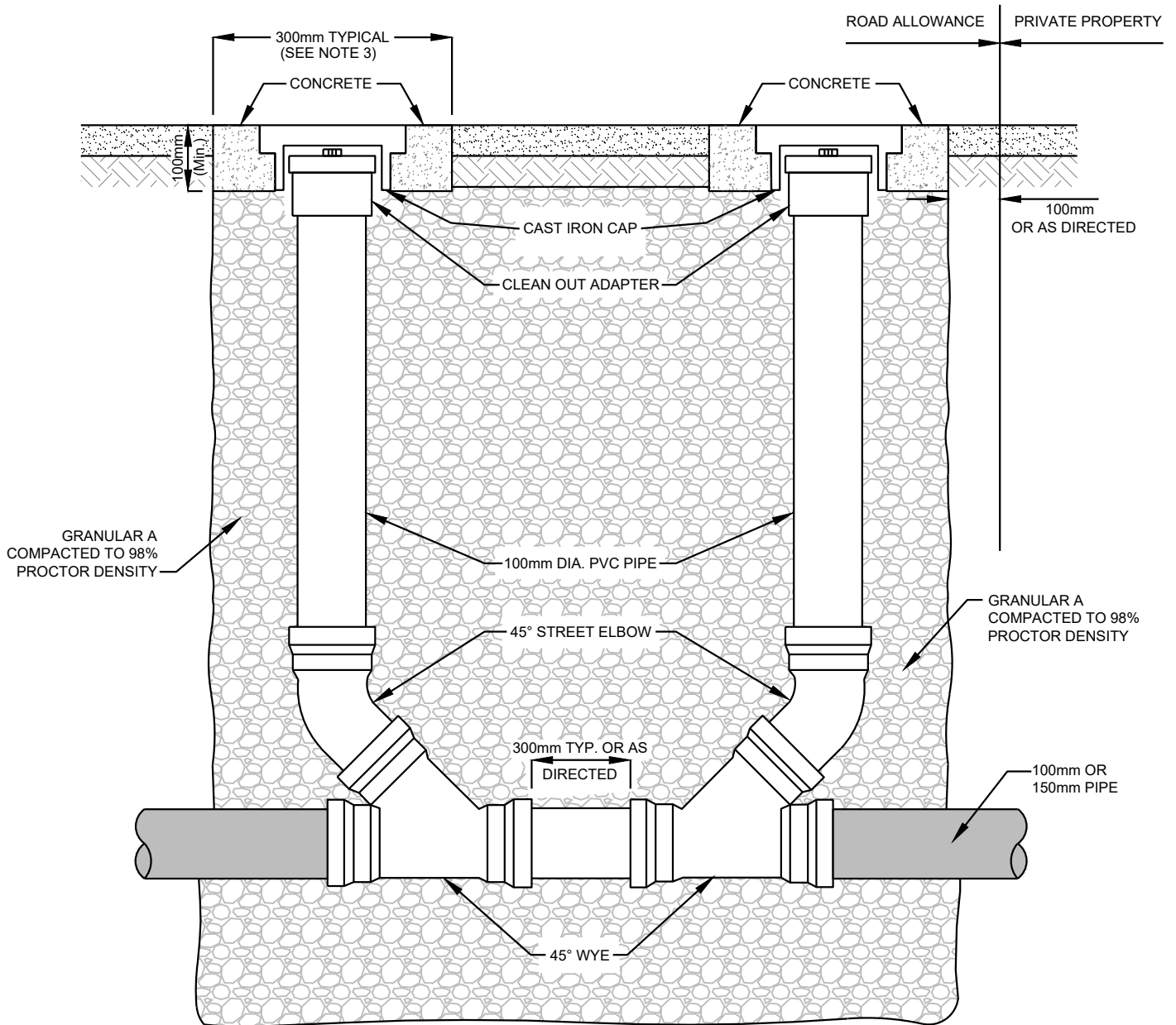


Shoulder Paving for Manholes and Chambers in Shoulder of Road A-101

ENGINEERING SERVICES
DEPARTMENT

January 2019

N.T.S.



NOTES:

1. INSTALL CAST IRON CAP FLUSH WITH GRADE IN HARD SURFACE OR 150mm BELOW GRADE IN LANDSCAPED AREAS.
2. FORM CONCRETE USING 300mm SONOTUBE WHEN INSTALLING IN ASPHALT SURFACE.



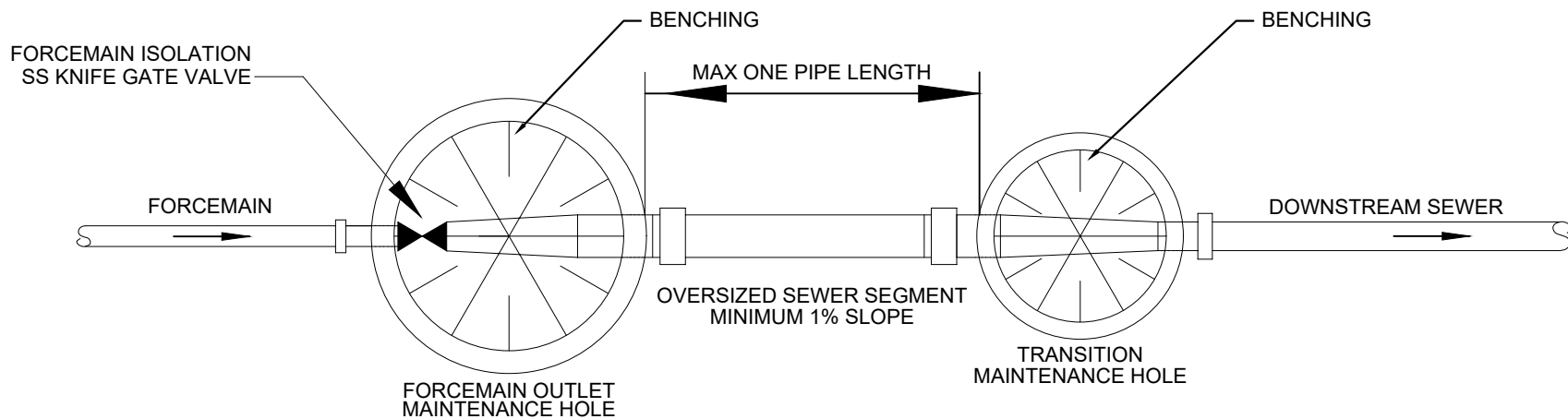
**SANITARY SEWER SERVICE
DOUBLE CLEAN OUT DETAIL
A-102**

ENGINEERING SERVICES
DEPARTMENT

MARCH 2015

N.T.S.

DETAIL No. 2-11-M



- NOTES:**
- 1) OVERSIZED SEWER SEGMENT TO BE DESIGNED TO ACCOMODATE THE HYDRAULIC TRANSITION FROM PRESSURE TO GRAVITY FLOW.
 - 2) APPLY CORROSION PROTECTIVE COATING TO ALL CONCRETE SURFACES IN FORCEMAIN OUTLET MAINTENANCE HOLE.
 - 3) DESIGN FORCEMAIN OUTLET PROFILE SUCH THAT NO MORE THAN ONE PIPE LENGTH DRAINS WHEN PUMPS ARE OFF.



SINGLE FORCEMAIN OUTLET CHAMBER

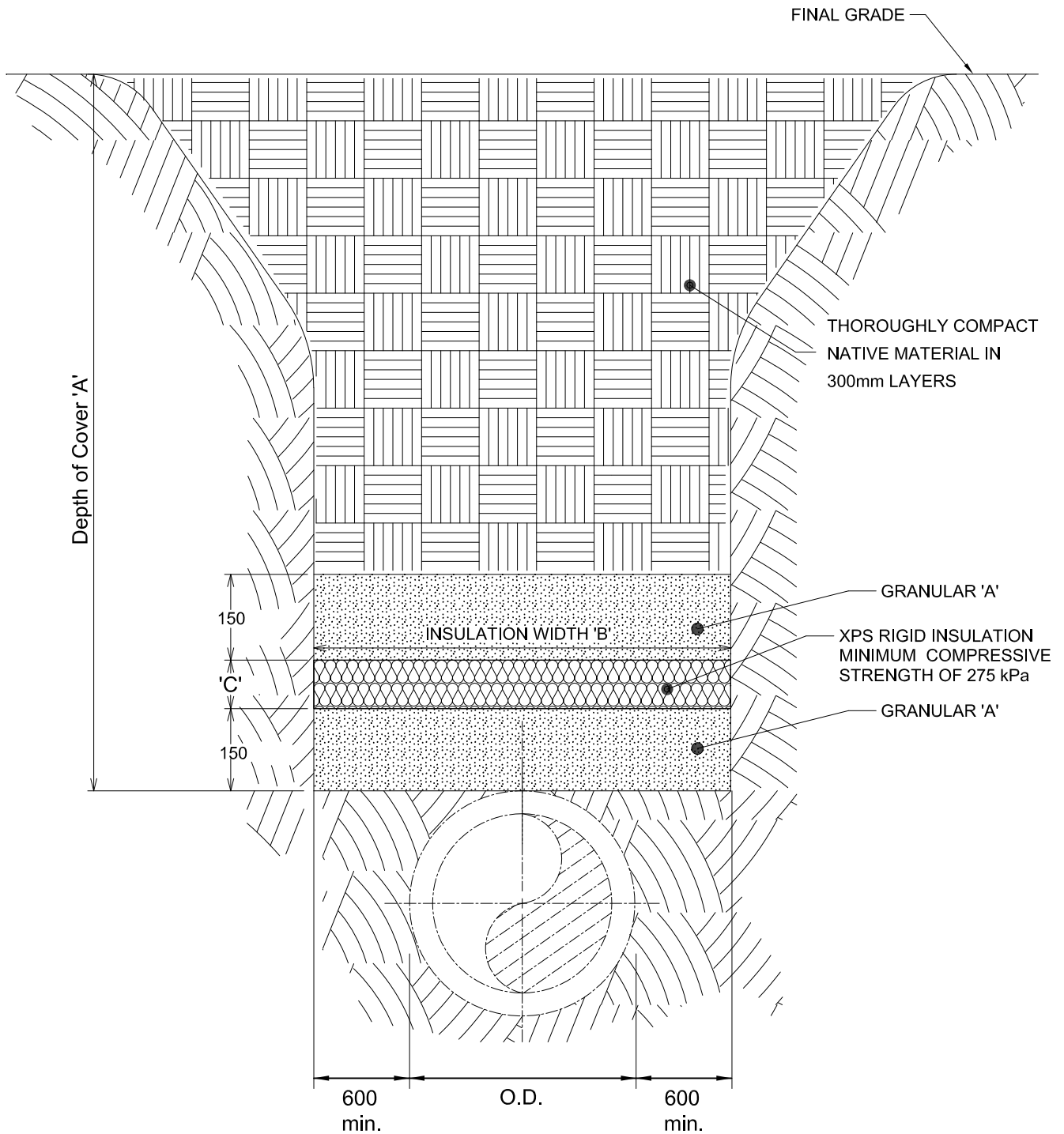
N.T.S.
ENGINEERING SERVICES
DEPARTMENT

DATE: JAN. 2024

REV:

A-103

DRAWN BY:
N. MANCINI



NOTE:

- 1) SELECTED NATIVE MATERIAL FOR BACKFILL OVER 150mm (6") GRANULAR 'A' LAYER.
- 2) ALL JOINTS TO BE STAGGERED FOR MULTIPLE INSULATION SHEETS.
- 3) ALL JOINTS TO BE TAPED.
- 4) ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED.

| DEPTH OF COVER (m) 'A' | WIDTH OF INSULATION (m) 'B' | THICKNESS OF INSULATION (mm) 'C' |
|---------------------------|--------------------------------|-------------------------------------|
| <1.50 | 1.20 + O.D. | 50 |
| <1.20 | 1.20 + O.D. | 50 |
| <1.05 | 1.20 + O.D. | 100 |
| <0.90 | 1.50 OR 1.20 + O.D.* | 100 |

* Use greater value



INSULATION OF SEWERS AND WATERMANS IN SHALLOW TRENCHES "FROST BARRIER"

ENGINEERING SERVICES DEPARTMENT

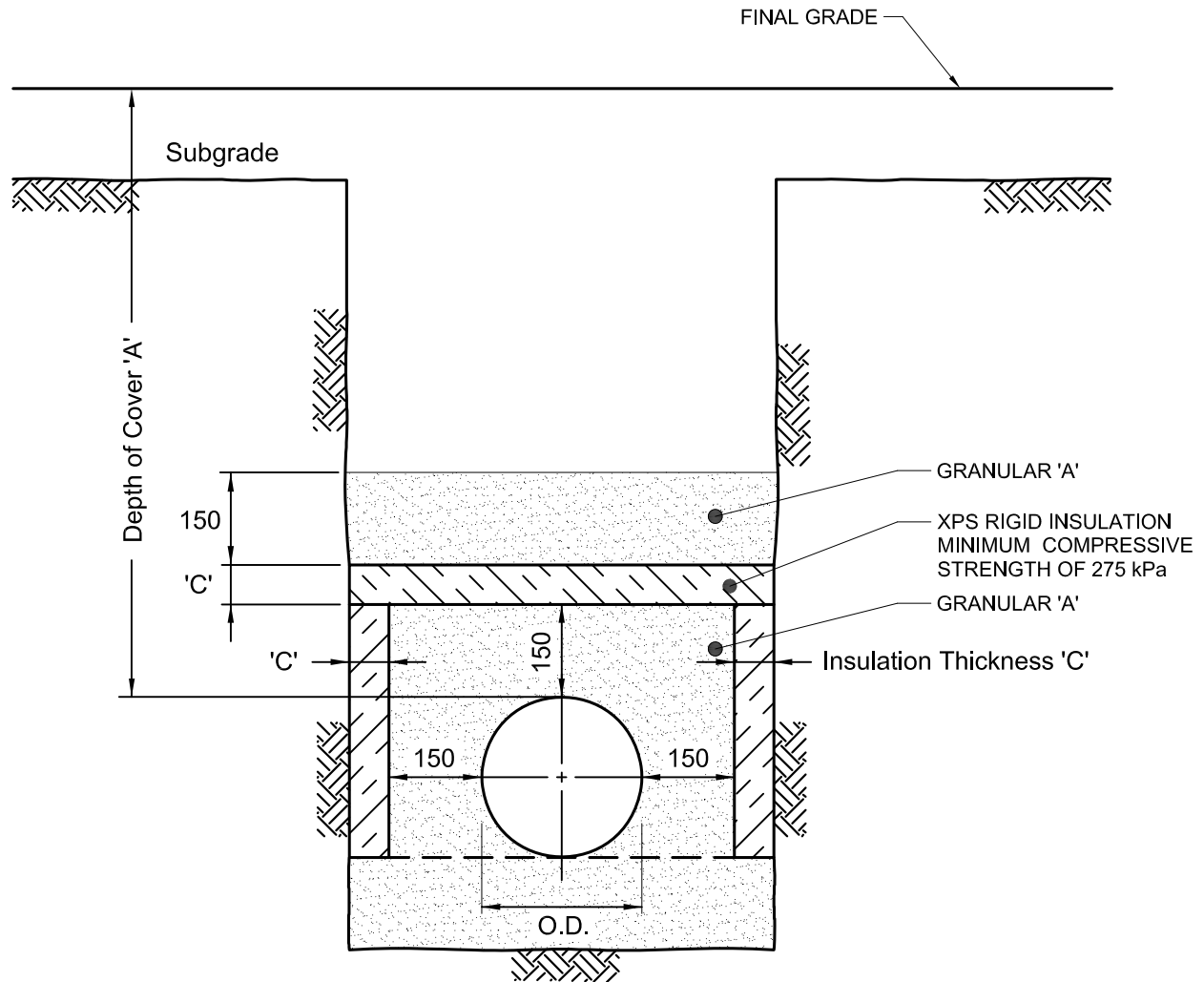
DATE: JAN. 1989

REV: JAN. 2023

N.T.S.

W-312

DRAWN BY:
A. SCHOEN



NOTE:

- 1) SELECTED NATIVE MATERIAL FOR BACKFILL OVER 150mm (6") GRANULAR 'A' LAYER.
- 2) ALL JOINTS TO BE STAGGERED FOR MULTIPLE INSULATION SHEETS.
- 3) ALL JOINTS TO BE TAPED.
- 4) ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED.

| DEPTH OF COVER (m) 'A' | THICKNESS OF INSULATION (mm) 'C' |
|---------------------------|-------------------------------------|
| <1.50 | 50 |
| <1.20 | 50 |
| <1.05 | 100 |
| <0.90 | 100 |



INSULATION OF SEWERS AND WATERMAINS IN SHALLOW TRENCHES "FROST BOX"

ENGINEERING SERVICES
DEPARTMENT

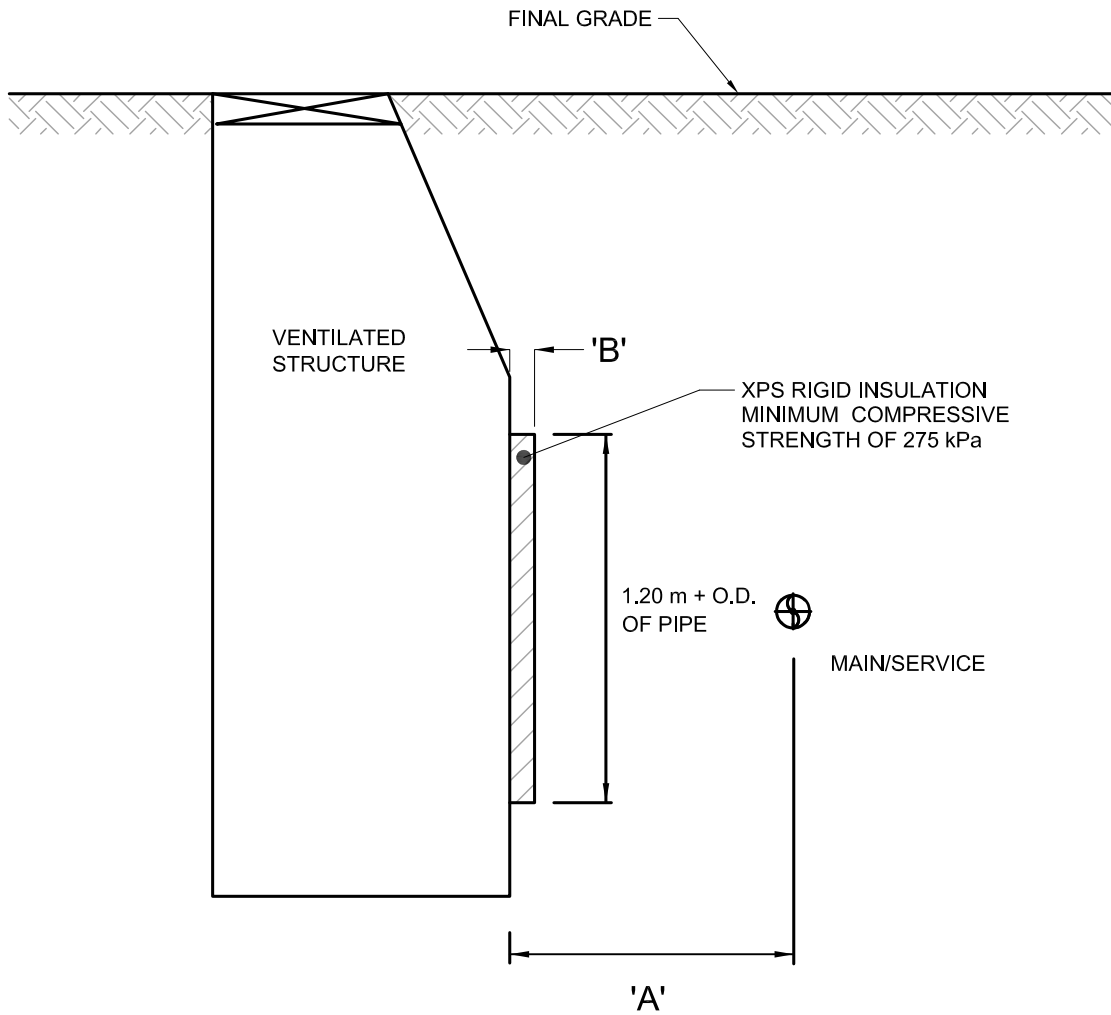
DATE: DEC. 2021

REV: JAN. 2023

W-312A

N.T.S.

DRAWN BY:
E. KERR



NOTE:

- 1) ALL JOINTS TO BE STAGGERED FOR MULTIPLE INSULATION SHEETS.
- 2) ALL JOINTS TO BE TAPED.
- 3) ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED.

| HORIZONTAL DISTANCE (m) 'A' | THICKNESS OF INSULATION (mm) 'B' |
|--------------------------------|-------------------------------------|
| <1.50 | 50 |
| <1.20 | 50 |
| <1.05 | 100 |
| <0.90 | 100 |



**INSULATION OF SEWERS,
WATERMAINS AND SERVICE
CONNECTIONS ADJACENT TO
VENTILATED STRUCTURES**

ENGINEERING SERVICES
DEPARTMENT

DATE: DEC. 2021

REV: JAN. 2023

W-312B

N.T.S.

DRAWN BY:
E. KERR

**FORCEMAIN
COMMISSIONING PLAN**



FORCEMAIN COMMISSIONING PLAN

| | |
|--------------------------------|--|
| PROJECT NAME: | |
| FROM - TO / DESCRIPTION | |
| CONTRACTOR NAME | |
| DATE SUBMITTED | |

GENERAL NOTES:

The Forcemain Commissioning Plan (FCP);

- Must be submitted and approved by the City,
- In accordance with the latest version of the Design and Construction Manual for Linear Municipal Infrastructure, City of Brantford

Please note;

- City of Brantford DOES NOT provide meters for pressure tests.



1. STAGING

The forcemain shall be pressure and leakage tested in Stage(s) _____ comprised of the following areas:

| STAGE | STREET | FROM | TO | CITY COMMENTS | INITIAL |
|--------------------|--------|------|----|---------------|---------|
| | | | | | |
| DESCRIPTION | | | | | |
| | | | | | |
| DESCRIPTION | | | | | |



2. WATER SOURCE

The forcemain under test may be connected to the City's watermain distribution system for source water. A tested and certified RPZ backflow preventer shall be installed at every connection to the City's watermain distribution system.

| TEMPORARY CONNECTION TO CITY WATERMAIN | | CITY COMMENTS | INITIAL |
|--|--|---------------|---------|
| Street (Name) | | | |
| Location (Station/Intersection) | | | |
| Source Watermain diameter (mm) | | | |
| Source Watermain Material | | | |
| OTHER SOURCE | | CITY COMMENTS | INITIAL |
| Source Type | | | |
| Source Information (Company Info) | | | |

3. CLEANING AND FLUSHING

All forcemains shall be cleaned and flushed prior to Hydrostatic Testing.



4. HYDROSTATIC TESTING

Hydrostatic testing shall be performed in accordance with OPSS.MUNI 412 at a minimum pressure of 1.5 times the maximum operating pressure. The test pressure must be documented on the Layout Plan. Water used in the hydrostatic testing shall be disposed to Sanitary Sewers. The maximum pressure shall be measured and recorded at the lowest point along the length of the pipe subject to testing.

| PRESSURE TEST | | | | | CITY COMMENTS | INITIAL |
|---------------------------------|--------|--------------------|------------------|-------------------|---------------|---------|
| TEST POINT | STREET | STATION (x+xxx) | ELEVATION (m) | PRESSURE (kPa) | | |
| Test Pressure Application Point | | | | | | |
| High Point | | | | | | |
| Low Point | | | | | | |
| Test Pressure Application Point | | | | | | |
| High Point | | | | | | |
| Low Point | | | | | | |



5. LEAKAGE TEST

| LEAKAGE TEST | | CITY COMMENTS | INITIAL |
|--|--|---------------|---------|
| Length of test section | | | |
| Diameter of test section | | | |
| Allowable leakage volume for Stage 1 for a 2 hour period | | | |
| Length of test section | | | |
| Diameter of test section | | | |
| Allowable leakage volume for Stage 2 for a 2 hour period | | | |

LEAKAGE TEST will be completed in accordance with OPSS.MUNI 412:

1. Allowable Leakage Rate: 0.082 Litres per millimeter of pipe diameter per kilometer of pipe for the 2 hour test period.
2. Calculate amount of water prior to start of leakage test
3. Watermain pressurized to required test pressure
4. Every 15 minutes, repressurize the watermain to required test pressure
5. At the end of 2 hours, calculate amount of water used



6. LAYOUT SKETCH/DRAWING

Attach a drawing(s) or sketch(s) showing the entire forcemain, testing sections (if more than 1 stage), test pressure and differential pressures (as applicable due to elevation change, etc.).

Commissioning Plan Review

Review of this plan does not relieve the proponent of its responsibility for compliance with the requirements of the Design and Construction Manual for Linear Municipal Infrastructure and all other applicable regulations and guidelines.

- Reviewed Submission No.

- Reviewed as Noted Reviewed By:

- Revise and Re-submit Date:

