STORM SEWERS

Design and Construction Manual Linear Municipal Infrastructure Standards

THE CORPORATION OF THE CITY OF BRANTFORD

V9- Feb 2025

REVISION TRACKING

Existing Version	Versions Number
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2025 Revisions

Section	Modification & Commentary
2.0 Other Reference Documents (Pg 3)	CVC Low Impact Development Stormwater Management Planning and Design Guide (2010)
7.5 Runoff Coefficients (Pg 8)	Antecedent Precipitation Factor (Ca) should be used and Rational Formula to be modified accordingly to **(Table 3)**, however, the product of the Antecedent Precipitation Factor (Ca) and Runoff Coefficient (C) shall not exceed 1.0.
10.5 Pipe Material (Pg 11)	All pipe material and fittings shall be in accordance with CSA, ~~and~~ OPSS, and the CLI ECA.
12.1 Stormwater Management (Pg 13)	Current stormwater management practice ~~advocates~~ requires the consideration of Stormwater Management Practices (SWMP's) on a hierarchical basis, whereby more pro-active techniques are considered first.
12.1 Stormwater Management (Pg 14)	As per the City's Stormwater Management CLI-ECA, stormwater volumes generated from the geographically specific 90th percentile rainfall event on an annual average basis from all surfaces on the entire site are targeted for control. Control is in the following hierarchical order, with each step exhausted before proceeding to the next: 1) retention (infiltration, reuse, or evapotranspiration), 2) LID filtration, and 3) conventional Stormwater management. Further details regarding the application of this criteria can be found in the MECP Draft LID Guidance Document, a copy can be provided at request.
12.4 ~~Oil and Grit Seperators (OGS)~~ Manufactured Treatment Device (Pg 15)	Changed Heading All Oil and Grit Separators (OGS) within municipal right-of-ways shall be ~~verified by the Canadian Environmental Technology Verification (ETV) program~~ designed in accordance with the CLI ECA. (This is the preferred method for pre-treatment in a treatment train approach.) All OGS on private site shall be verified by the Canadian Environmental Technology Verification (ETV) program.
12.6 The Low Impact Development Practice (LID) (Pg 16)	The City ~~encourages and supports~~ requires the consideration of and a report verifying the feasibility of the use of these creative solutions for stormwater management and the development of innovative designs and technologies where feasible.

12.6 The Low Impact Development Practice (LID) (Pg 16)	These solutions should be developed based on the best practices of the available design guiding documents in Ontario ~~and~~, MECP Stormwater Management Planning and Design Manuals, MECP LID Guidance Document and CVC LID Guidance Document. Designs must incorporate the principles from the CVC Low Impact Development Stormwater Management Planning and Design Guide (2010) when implementing LID practices / features. Hyperlink: https://wiki.sustainabletechnologies.ca/wiki/Main_Page
12.10 Downspout Discharge (Pg 16)	Commercial, industrial and high-density residential building sites may not have the ability to discharge to landscaped areas, therefore, the storm water roof drainage may be discharged directly to grade. When discharging into a storm sewer system ~~given that~~ flow control shall be applied where deemed necessary.
12.13 Inlets, Outfalls and Special Structures -Outlets- (Pg 18)	All outlets shall blend in the direction of flow of the watercourse with the directional change being taken up in the sewer rather than the channel. Any outlets established or altered shall conform to the CLI ECA.
14.7 Maintenance Hole Adjustments (Pg 20)	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~~ in accordance to the Linear Design and Construction Roads and Transportation Manual.
16.0 Siphons (Pg 21)	Siphons shall be installed with at least two pipes, and each pipe shall be designed to convey the full flow.
17.3 Execution -Horizontal and Vertical Separation- (Pg 24)	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~~ Watermain Design Criteria for Future Alterations Authorized Under a Drinking Water Works Permit (MECP). Where adequate separation cannot be achieved, mitigating measures shall be applied as per the **Watermain Design Criteria for Future Alterations Authorized Under a Drinking Water Works Permit (MECP).**

17.3 Execution **-Cleaning, Testing and Video Inspection – (Pg 25)**	The deformation gauge, also known as the Mandrel test for flexible pipes, shall be successfully completed at least 30 calendar days after backfilling but prior to paving. The Mandrel test shall be conducted according to OPSS.

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INTRODUCTION

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1.0 GENERAL REQUIREMENTS

This manual has been prepared to provide City staff, consultants, contractors, developers, and the general public with a common reference to ensure the consistent application of storm sewer and drainage design and construction practices in the City of Brantford.

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 Storm Sewer System.
- Preserve and / or establish a more natural hydrologic cycle.
- Reduce impacts to the natural environment and protect against erosion.
- Improve runoff water quality to protect surface and groundwater supply.
- Promote and implement shared responsibility between the City and stakeholder.

2.0 OTHER REFERENCE DOCUMENTS

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

- Ontario Provincial Standard Specifications (OPSS) and Ontario Provincial Standard Drawings (OPSD)
- Ministry of Environment, Conservation and Parks (MECP) Design Guidelines for Sewage Works
- Ministry of Environment, Conservation and Parks (MECP) Stormwater Management Planning and Design Manual
- Ministry of Environmental, Conservation and Parks (MECP) Design Criteria for Sanitary Sewers, Storm Sewers and Forcemains for alterations authorized under Envionmental Compliance Approval
- Grand River Conservation Authority (GRCA) Stormwater Management Guidelines
- MTO Highway Drainage Design Standards
- Low Impact Development Stormwater Management Planning and Design Guide
- Official Plan of the City Of Brantford
- Municipal Consolidated Linear Infastrucutre Environmental Compliance Approval (CLI ECA)
- CVC Low Imact Development Stormwater Management Planning and Design Guide (2010)
- Accordance to manufacturer's specifications

3.0 INDUSTRY STANDARDS AND SPECIFICATIONS

All storm sewer and appurtenances materials and components shall comply with the latest

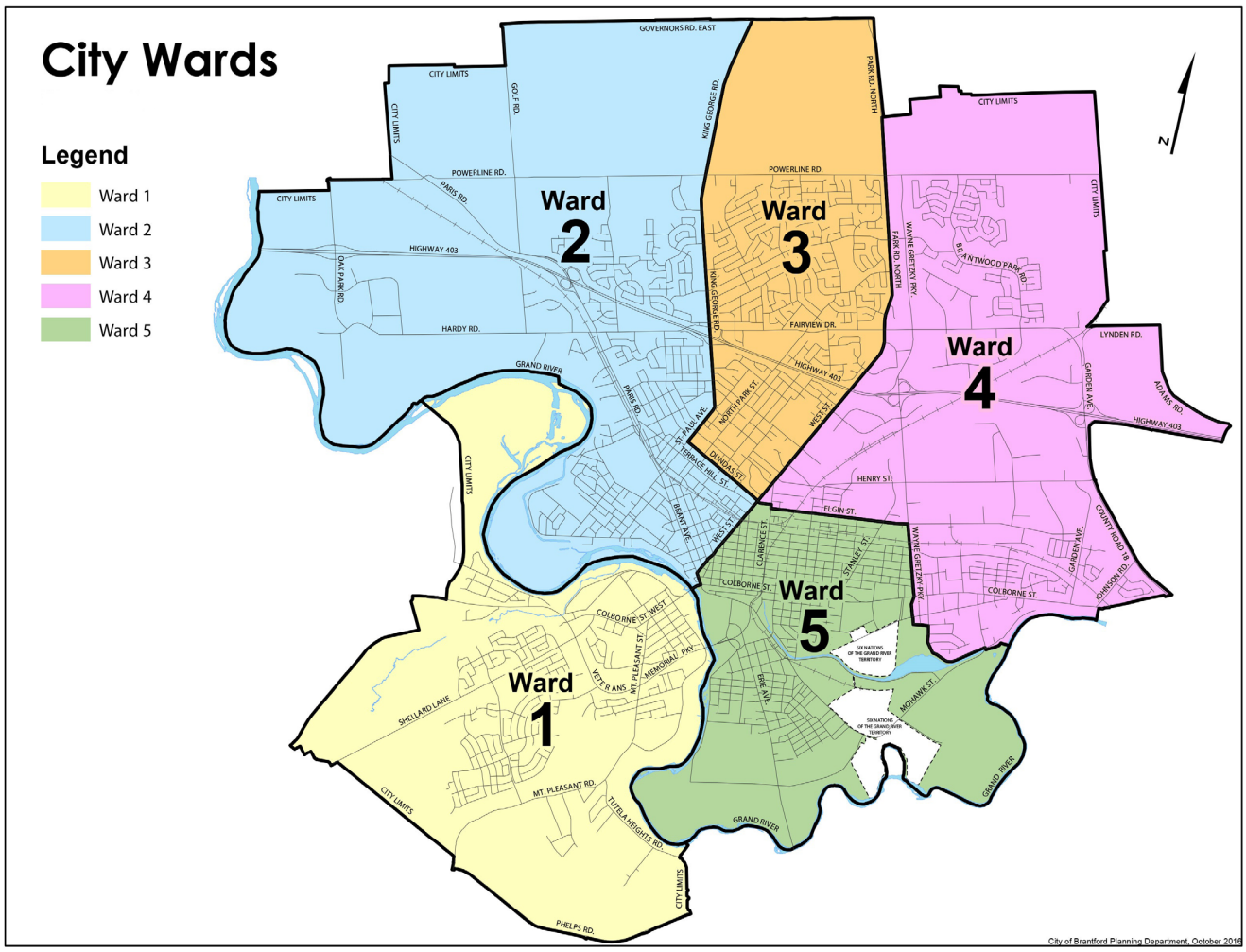
version of all applicable industry standards and specifications for quality management and quality control, including but not limited to:

- 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

The Proponents shall be fully familiar with the latest version 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
- Ontario Drainage Act
- Ontario Envrionmental Bill of Rights
- 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 minor and major storm systems in the City.

Further to the design requirements contained herein, the City's current Master Servicing Plan shall be referenced for Sub-Watershed specific design requirements. Special design considerations may apply based on specific site conditions, such as locations within the Grand River Northwest Sub-Watershed. Furthermore, permeability will be established on a site by site basis, based on pre-consultation with the City.

6.0 DRAINAGE SYSTEM CLASSIFICATION

The urban drainage system consists of the minor system and the major system, as outlined in **Table 1**.

Table 1. Minor and Major System Design Components

Minor System	Major System
Objective: To prevent nuisance flooding.	Objective: To reduce risk to life and property damage.
Elements: • Roadside Ditches • Roof Gutters • Downspouts • Foundation Drains • Small Channels and Swales • Street Gutters and Drains • Catchbasins and Maintenance Holes • Storm Sewers • Service Connections	Elements: • Overland Flow Routes • Natural Streams • Valleys • Roads • Channels • Stormwater Management Ponds
Design Storm Frequency: 1 in 5 years (Frequent)*	Design Storm Frequency: 1 in 100 years (Infrequent)

* A 1 in 2 year design storm frequency may be used upon **direction by the City.**

The minor / major systems are comprised of distinct yet closely inter-related features with regard to the design, control and management of stormwater. Under special circumstances, a higher design storm frequency (e.g. 1 in 10 year) may be required.

7.0 DESIGN CRITERIA

7.1 Design Flow

Storm sewers shall be designed to collect stormwater runoff from pervious and impervious surfaces both on private and public lands via catchbasins and storm drain connections.

Foundation drains connected to private drain connections via sump pump with gooseneck are required in new construction.

Storm sewers shall be designed to accommodate a 5-year design flow, unless **directed** otherwise by the City, and shall operate without surcharge. 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. Storm sewers and other open channels shall be sized based on design flows as determined using the Rational Formula as follows:

$$Q = \frac{CIA}{360}$$

where,

- 360 is a constant
- Q = Peak Flow (m^3/s)
- C = Runoff Coefficient (dimensionless)
- I = Average Rainfall Intensity (mm/hr)
- A = Contributing Drainage Area (ha)

The Rational Method calculations must be checked using approved hydrologic and hydraulic modelling software where the drainage area is greater than 5 hectares. The larger of the flows is to be used in the design of the sewer system.

7.1 Design Flow (cont'd)

Design flows for storm sewer networks shall be calculated using the Rational Method for each maintenance hole reach, and shall be submitted to the City using the Storm Sewer Design Sheet provided in this manual.

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

7.2 Rainfall Intensity

The Rainfall Intensity ("i") shall be based on the 5-year Intensity-Duration-Frequency (IDF) curve. This manual utilizes the County of Brant IDF curve as this is the most current, local information that the City has available.

It should be noted that IDF curves are subject to review and may be altered from time to time to more accurately represent local trends in rainfall patterns, including impacts due to climate change.

For normal residential and industrial developments, the rainfall intensity shall be determined using the following formula:

$$i = \frac{A}{(t_C + B)^c}$$

where, A, B, C = IDF Parameters
i = rainfall intensity (mm/hr)
t_C = time of concentration (minutes)

7.3 Time of Concentration

The time of concentration (tc) at the upstream end of a system shall be a minimum of 10 minutes. For pre-development, the Consulting Engineer shall calculate the initial time of concentration for upstream, undeveloped lands.

7.4 Contributing Drainage Area

The Drainage Area ("A") shall be determined using available contour mapping. The drainage and sub-drainage area limits for which storm sewers are to be designed shall follow lot and block lines to the maintenance holes within the right of way.

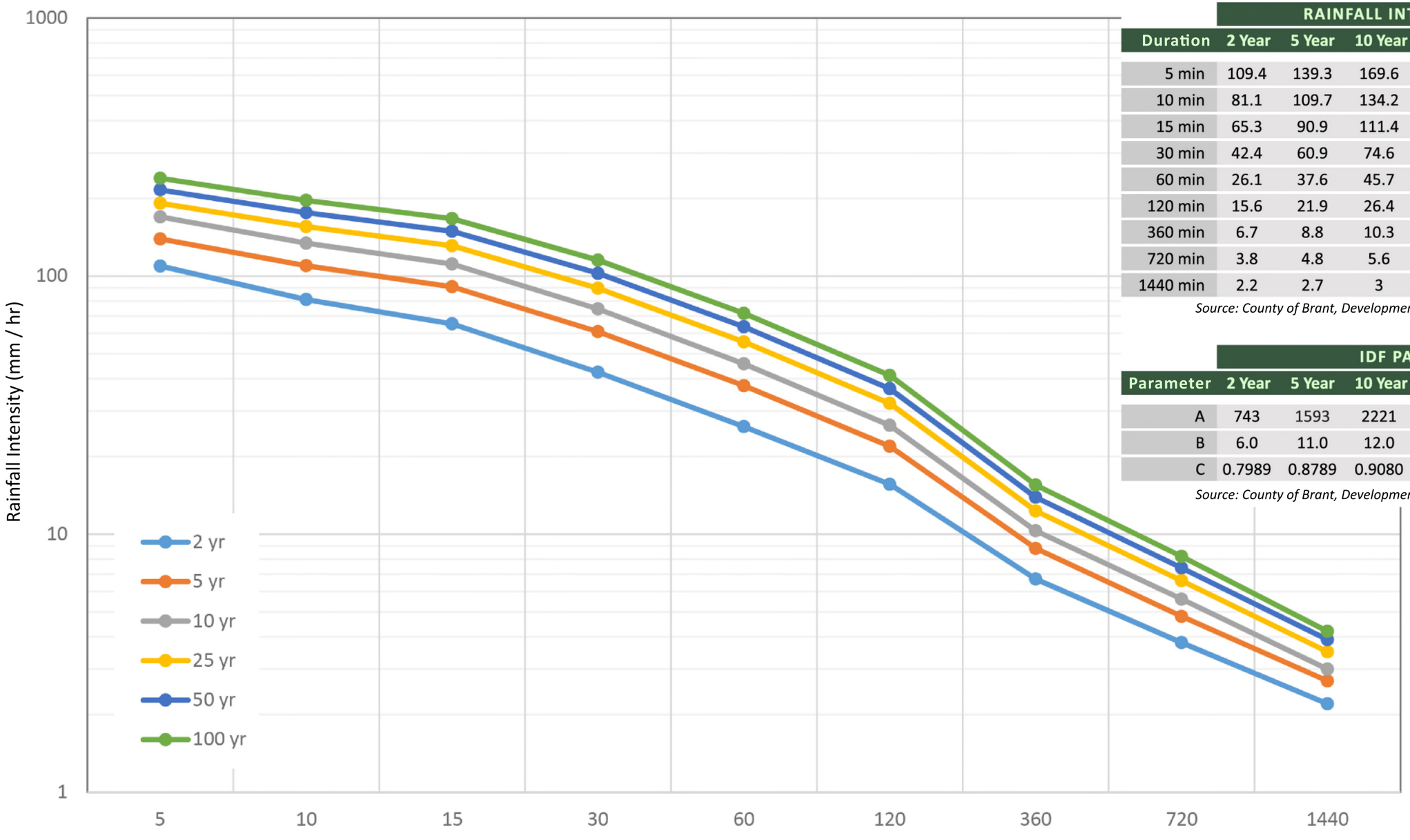
All areas and coefficients are to be shown for each drainage and sub-drainage area. Drainage area plans shall be completed as per design requirements.

When the design abuts undeveloped areas, the Consulting Engineer shall review and confirm the external watershed limits as provided by Grand River Conversation Authority (GRCA).

Any deviations to the existing mapped areas shall be reviewed and approved by the City and GRCA. Areas, coefficients and times of concentration shall be shown for all drainage areas within external watershed limits.

In lieu of exact data on development on the whole or any piece of a watershed area, the most recent zoning by-law and official plan issued by the Planning Department will be utilized for all external areas in the design and to determine the particular zone to which these values apply.

In large areas under single ownership of blocks requiring future site plan agreements, the design shall be prepared on the basis of the whole area being contributory to one manhole in the abutting storm sewer except if more than one private storm connection is necessary to serve the property in which case the approriate area tributary to each connection shall be clearly shown and taken into account in the storm sewer design.



RAINFALL INTENSITY (MM/HR)						
Duration	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
5 min	109.4	139.3	169.6	191.6	215.8	239.4
10 min	81.1	109.7	134.2	155.5	176.2	196.5
15 min	65.3	90.9	111.4	131.1	149.1	166.9
30 min	42.4	60.9	74.6	89.7	102.5	115.3
60 min	26.1	37.6	45.7	55.6	63.6	71.7
120 min	15.6	21.9	26.4	32.1	36.6	41.2
360 min	6.7	8.8	10.3	12.3	13.9	15.5
720 min	3.8	4.8	5.6	6.6	7.4	8.2
1440 min	2.2	2.7	3	3.5	3.9	4.2

Source: County of Brant, Development and Engineering Standards, May 2014

IDF PARAMETERS						
Parameter	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
A	743	1593	2221	3158	3886	4688
B	6.0	11.0	12.0	15.0	16.0	17.0
C	0.7989	0.8789	0.9080	0.9355	0.9495	0.9624

Source: County of Brant, Development and Engineering Standards, May 2014

Rainfall Intensity Duration Frequency Values

(Source: County of Brant)

7.5 Runoff Coefficients

The runoff coefficient ("C") is based on the relative perviousness of the drainage area and vary based on the type of land use. Minimum runoff coefficients to be used in storm sewer design shall be as follows in Table 2.

Mixed land uses and reconstructions will require a composite (blended) runoff coefficient based on an area-weighted average of coefficients to represent specific land uses.

Runoff coefficients shall be reviewed and approved by the City on a case-by-case basis and checked against MECP.

Table 2. Runoff Coefficients for Urban Areas

Area Description	Runoff Coefficient (C)
Parks > 4 Hectares	0.20
Parks ≤ 4 Hectares	0.25
Single Family Residential	0.45
Single Family Residential (Frontage <12.2m)	0.60
Semi-detached Residential	0.60
Townhouses, Maisonette, Row Houses, etc.	0.75
Apartments	0.75
Schools And Churches	0.75
Industrial	0.80
Commercial	0.90
Heavily Developed Areas	0.90

The runoff coefficients (c) listed in Table 2 are applicable for storm 2, 5 and 10-year frequencies. For less frequent storms Antecedent Precipitation Factor (Ca) should be used and Rational Formula to be modified accordingly to **(Table 3)**, however, the product of the Antecedent Precipitation Factor (Ca) and Runoff Coefficient (C) shall not exceed 1.0.

$$Q = Ca \times \frac{CIA}{360}$$

'*Ca*' Values are listed below

Table 3. Antecedent Precipitation Factor (Ca)

Storm	Ca
2 to 10 year	1.00
25 year	1.10
50 year	1.20
100 year	1.25

8.0 HYDRAULIC LEVEL OF SERVICE

8.1 Velocity

The flow velocity shall be determined using the following formula:

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

where,
- v = Velocity (m/s)
- Q = Flow (m^3/s)
- A = Cross Sectional Area of Flow (m^2)

Flow velocities for storm 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). Where the minimum velocity is required to be < 0.75 m/s due to site constraints, the Consulting Engineer shall provide recommendations for maintenance that the system will require for review and approval by the City.
- Minimum flow velocity (calculated based on pipe flowing full) for pipes ≥ 1200 mm diameter = 0.9 m/s.
- Where, under peak flow conditions (See formula for QDESIGN in Section 7.1), the flow depth in the pipe will not be ≥ 0.3 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 0.75 m/s minimum.
- Maximum velocity = 4.5 m/s. Where the maximum velocity is required to be > 4.5 m/s, the Consulting Engineer shall provide design considerations for scouring and displacement for review and approval by the City.

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

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

where,
- Q = Design Flow (m^3/s)
- n = Manning's roughness coefficient
- A = Cross Sectional Area of Flow (m^2)
- R = Hydraulic Radius (area of flow / wetted perimeter)
- S = Slope of Pipe (m/m)

8.2 Manning's Roughness Coefficient

The Manning Roughness Coeffiecent (n) shall be as specified in **Table 4.**

Table 4. Mannings Roughness Coefficient (n)

Pipe Material	Mannings (n)
Concrete Pipe	0.013
PVC	0.013
HDPE	0.013
Corrugated Metal - 12mm corrugations	0.024
Corrugated Metal - 50mm corrugations	0.035

8.3 Pipe Grade

The minimum pipe grade shall be 1% on the first leg of the sewer. The remaining system shall be sloped as required to achieve the minimum velocity as stated above. The minimum grades for storm sewers, flowing fully, based on (n) = 0.013 are specified in **Table 5**.

Table 5. Minimum Pipe Grades

Size of Pipe	Minimum Slope
250 mm	0.38%
300 mm	0.30%
375 mm	0.23%
450 mm	0.18%
525 mm	0.15%
600 mm	0.12%
675 mm	0.102%
750 mm	0.089%
825 mm	0.078%
900 mm	0.070%
975 mm	0.063%
1050 mm	0.057%
100 mm or 150 mm	Connections 2.0%

9.0 SYSTEM LAYOUT

9.1 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°. 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 storm sewer. Any exceptions shall be approved by the City. Actual width will vary based on size and depth of pipe.

Common trench with sanitary sewers will be considered when supported by the recommendations of a soils report prepared by a qualified Geotechnical Engineer.

9.2 New Construction

Storm sewers shall be in accordance with the City's Standard Drawings and Detailed Cross-Sections in this manual.

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

9.3 Existing Infrastructure

Location of replacement storm 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.

9.4 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.

10.0 PIPE REQUIREMENTS

10.1 General Requirements

Alternative infrastructure installation methods will be submitted to the City for review prior to design completion.

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

10.2 Pipe Size

Pipe size shall be determined using Manning's Formula. The capacity of the storm sewer shall be determined on the basis of the pipe at or below 80% full flow.

The preferred minimum size for a mainline storm sewer shall be 300 mm, regardless of the type of land use.

No decrease of pipe size from a larger upstream to a smaller size downstream will be allowed regardless of the increase in grade (capacity).

10.3 Minimum Pipe Cover

The preferred minimum depth of cover shall be 1.5 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.

10.4 Insulation of Storm 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.

10.5 Pipe Material

All pipe material and fittings shall be in accordance with CSA, OPSS and the CLI ECA.

Both rigid and flexible pipe are permitted in the construction of storm sewer systems.

In determining the suitable pipe class to be used, live load, dead load, soil type and trench conditions in accordance with OPSD shall be considered in the calculation. The pipe manufacturer's recommendations shall be incorporated into the design. See **Table 6**.

10.6 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 storm 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 or the pipe manufacturer's recommendations.

Table 6. Approved Storm Sewer Pipe Material

Main Size (mm)	Joint Type	Specification	General Comments
Polyvinyl Chloride Pipe (PVC)			
≤ 600 mm	Gasketed Bell and Spigot	Pipe: CSA B 182.2 & OPSS 1841 Fittings: Injection moulded gasketed PVC fittings to CSA B182.2	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			
>300 mm	Gasketed Bell and Spigot	Pipe: CSA A257.2, A257.2 & OPSS 1820 Fittings:Reinforced concrete gasketed fittings to CSA A 257.2	N/A

10.7 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.

11.0 SERVICE LATERALS

11.1 Connection Types

Connections to storm 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.

Storm sewer lateral connections to maintenance holes are permitted.

Connections shall be made using long sweep elbows and tees or wyes (if approved). Connections shall not be made by breaking through the pipe wall on site.

11.2 Minimum Pipe Size

Storm service laterals shall have a preferred minimum pipe size of 150 mm. One storm sewer lateral is permitted per lot.

11.3 Service Location

The City's preferred location of the storm lateral is shown in the Standard Drawings in **Appendix G-2 in the General Preface**. Storm laterals shall never be connected to any sanitary mainline.

Under no circumstances, will flow from the PDC enter the main against the flow in the main.

11.4 Minimum Service Cover

Storm sewer laterals shall have a minimum cover of 1.2 m at the property line from finished grade to the top of the pipe.

11.5 Service Material

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

11.6 Service Grade

The grade of the storm sewer lateral shall range between a minimum and maximum of 2% and 8%, respectively. Connections to mainline storm 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.

11.7 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 storm sewer at each property, unless it is required to meet OPSD.

An oil grit separator is not permitted as an inspection manhole.

11.8 Marking and Plugging Requirements

Plugged or capped service laterals shall be marked by a white painted 2x4 Stake at the end cap with adhesive tape labelled "CAUTION STORM SEWER".

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

12.0 STORMWATER MANAGEMENT, LOW IMPACT DEVELOPMENT (LID) AND INNOVATIVE APPROACH

12.1 Stormwater Management

Stormwater management is required to mitigate the effects of urbanization on the hydrological cycle including increased runoff and decreased infiltration of rain and snowmelt. Without proper stormwater management, reduced base flow, degradation of water quality and increased flooding and erosion can lead to reduced diversity of aquatic life, fewer opportunities for human uses of water resources and loss of property and human life (Stormwater Management Planning and Design Manual, 2003).

The minor system conveys the frequent runoff events up to the design frequency of the system (typically 1 in 5 – year design storm) while the major system conveys the runoff from infrequent storm events (typically >5 to 100 – year design storm) that exceeds the minor system capacity.

The minor system includes the lot drainage components i.e. lot grades, ditches, swales, street gutters, catchbasins and the storm sewer system. The major system may include overland flow routes, roadways, artificial channels, streams and valleys.

The major and minor systems are to be designed to safely convey stormwater flows to a sufficient outlet, without negative impacts on adjacent properties.

The storm sewers should include an integrated approach of the major and minor systems to meet the design criteria for Site Grading, Erosion Control, Servicing and Stormwater Management targets.

The hydraulic capacity of the receiving minor and major storm system is to be determined to verify that drainage can be safely conveyed as proposed.

Stormwater management in general needs to be designed to mitigate urbanization impacts related to flooding, erosion, water quality and water balance.

The maximum depth of ponding for major flow routes shall be 300mm deep. Ponding shall not occur in the roadway for minor storm events.

The major storm drainage system shall permit continous overland flow along roads and easements without flooding onto lots during a 100 year storm. The route of major overland flow resulting from this storm through to a receiving watercourse shall be shown on a plan and any potential area of flooding shall be identified.

Current stormwater management practice requires the consideration of Stormwater Management Practices (SWMP's) on a hierarchical basis, whereby more pro-active techniques are considered first.

The SWMP's are grouped under the following headings in order of preferred application:

- Lot Level and Source Control Techniques.
- Conveyance Controls.
- End-of-Pipe Controls.

The City supports the progressive implementation of a wide range of appropriate and innovative stormwater management techniques. This range is expected to increase and change over time, as long-term monitoring results indicating the level of success of various techniques, become available.

A 3 hour Chicago Distribution should be applied for hydrological /hydraulic modelling in the City of Brantford. SCS storm distributions may also be applicable in larger subwatershed study areas, and consulting engineers should confirm with the City when use of these other storm distributions are acceptable or applicable. 1

12.1 Stormwater Management (Cont'd)

The design of source, conveyance and end-of-pipe controls shall be in accordance with guidance from the latest version of the MECP Stormwater Management Planning and Design Manual, the Toronto Region Conservation Authority, Low Impact Development Stormwater Management Planning and Design Guide (LID Manual) in addition to relevant City policies.

As per the City's Stormwater Management CLI-ECA, stormwater volumes generated from the geographically specific 90th percentile rainfall event on an annual average basis from all surfaces on the entire site are targeted for control. Control is in the following hierarchical order, with each step exhausted before proceeding to the next: 1) retention (infiltration, reuse, or evapotranspiration), 2) LID filtration, and 3) conventional Stormwater management. Further details regarding the application of this criteria can be found in the MECP Draft LID Guidance Document, a copy can be provided at request.

12.2 Stormwater Quantity Control

Typically, the increase in direct runoff as a result of uncontrolled development (i.e. increased impervious areas) combined with rapid storm conveyance systems, results in increased peak flows.

The potential impacts of increased peak flows include flooding and increased risks to life and property. In order to minimize these risks, the stormwater Quantity Control requirements for development should ensure that the post-development peak flow rates are not to exceed the corresponding pre-development peak flow rates for the 1 in 2 year, 1 in 5 year, 1 in 10 year, 1 in 25 year, 1 in 50 year and the 1 in 100 year design storm events (unless otherwise specified).

12.3 Stormwater Quality Control

Contaminants, such as oil, grease, metals, pesticides, fertilizers, winter salt and sediment tend to build up on surfaces in urbanized areas. These pollutants come from sources such as pavement deterioration, tire and brake pad wear, vehicle emissions, spills, construction and road maintenance. In order to protect water quality, water quality treatment performance shall conform to Provincial requirements, (Stormwater Management Planning and Design Manual, 2003; and Water Management Policies, Guidelines, Provincial Water Quality Objectives, MOEE, 1994) and the requirements of the City and the Grand River Conservation Authority).

Specific guidelines for SWMP application have been developed by the Province based on the type of fisheries habitat downstream of the proposed development. All development must provide water quality control measures designed according to (Stormwater Management Planning and Design Manual, 2003).

Water quality treatment will be required for all new development within the City. Water quality treatment shall conform to MECP requirements and shall use the treatment train approach to stormwater management with source, conveyance and end-of-pipe measures.

All stormwater management (SWM) measures shall provide as a minimum an "Enhanced" level of protection (i.e. 80% TSS Removal). Quality measures shall be reviewed with the City at project commencement.

As a general consideration, maintenance of the natural water balance is encouraged where soil conditions permit. Reducing the volume of runoff has inherent water quality benefits as reducing the volume of runoff from a site will also reduce the loading of pollutants to watercourses. Therefore, the use of SWM facilities which reduce runoff volumes should be considered for each development.

It is required to provide calculations for Stormwater quality control facilities and plans of the quality management measure(s) with cross sections of the facilities, details of inlets, outlets, maintenance access, berm construction and landscaping.

12.4 Manufactured Treatment Device

All Oil and Grit Separators (OGS) within municipal right-of-ways shall be designed in accordance with the CLI ECA. (This is the preferred method for pre-treatment in a treatment train approach.)

All OGS on private site shall be verified by the Canadian Environmental Technology Verification (ETV) program.

12.5 Erosion and Sediment Control

Urban developments can accelerate natural sediment loading rates to the surrounding water bodies, particularly during construction, when the ground cover has been removed. In order to control the impacts of sediment loading from development (i.e. poor water quality and aesthetics, restricted channel conveyance), it is required that erosion and sediment control measures be instituted.

It is required to provide adequate erosion protection in accordance with Provincial Guidelines, unless it can be demonstrated through appropriate modelling and / or analysis that stream stability will not be adversely affected by the proposed development.

Where watercourse alterations are proposed as part of a development, the design of such alterations shall incorporate and consider the Natural Channel Design. The Natural Channel Design is required to incorporate hydrology, stream hydraulics, fluvial morphology and fisheries habitat assessment. Each discipline has to determine design parameters which will be beneficial in the integrated design approach.

For all development, the minimum erosion control requirement is extended detention of the 4 hour, 25 mm Chicago Distribution rainfall event or as directed by the City.

12.6 The Low Impact Development Practice (LID)

Low impact development (LID) practice is a stormwater management strategy that seeks to mitigate the impacts of increased runoff and stormwater quality managing runoff as close to its source as possible.

LID comprises a set of site design strategies that minimize runoff and that mimic natural or pre-development hydrology through the processes of infiltration, evapotranspiration, harvesting, filtration and detention of stormwater.

These practices can effectively reduce the volume and intensity of stormwater flows and they can remove nutrients, pathogens and metals from runoff.

These practices focus on a number of lot level and conveyance stormwater management practices that have been used extensively at a number of demonstration sites in Ontario as part of the treatment train approach for stormwater management.

These practices include, but are not limited to, the following:

- Bioretention
- Perforated Pipe Systems
- Permeable Pavements
- Soakaways
- Green Roofs
- Enhanced Grass Swales
- Dry Swales
- Rainwater Harvesting

12.6 The Low Impact Development Practice (LID) (Cont'd)

The City requires the consideration of and a report verifying the feasibility of the use of these creative solutions for stormwater management and the development of innovative designs and technologies where feasible.

These solutions should be developed based on the best practices of the available design guiding documents in Ontario, MECP Stormwater Management Planning and Design Manuals, MECP LID Guidance Document and CVC LID Guidance Document.

Designs must incorporate the principles from the CVC Low Impact Development Stormwater Management Planning and Design Guide (2010) when implementing LID practices/features.

12.7 Low Impact Development Measures

The use of Low Impact Development (LID) measures in Stormwater Management Design are encouraged in the City. The use of LIDs to control quantity and quality shall be based on best management practices and will be subjected to review and approval.

The selection of appropriate LID measures shall be site-specific and will depend on the type of urban or rural application.

The City will discuss proposals for implementation of LIDs when a development application is submitted or prior to submission.

In particular, a LID proposal could consider the following technologies, where applicable:

- Downspouts shall not be connected directly to a storm sewer lateral.
- Soak away trenches / pits.
- Infiltration galleries
- Permeable pavement, perforated pipes and / or storage chambers.

In addition to the requirements outlined herein, a separate stormwater management report may be required as part of the development application, to identify appropriate stormwater management techniques required to support the application based on a pre-consultation meeting with the City.

All LID facilities shall have a design capacity that exceeds the existing conditions recharge volume by 15 percent as a factor of safety to account for aging, compaction and potential clogging.

During construction all LID measures shall be bypassed to prevent accelerated clogging.

12.8 Culverts and Outfalls

Culverts shall be in accordance with MTO's Highway Drainage Design Standards, OPSS and OPSD.

12.9 Foundation Drain Connections

The City requires that all single family development applications include a foundation drain (weeping tile) connection to the local storm sewer lateral via a sump pump with a gooseneck.

If no local storm sewer lateral is available, then the sump pump shall discharge via a concrete splash pad to a grassed area away from the house avoiding driveways, walkways and adjacent properties.

12.10 Downspout Discharge

Downspouts shall discharge into side yard swales via concrete splash pads. Downspouts shall not discharge onto driveways or walkways, as they pose a safety (slipping) hazard in the winter.

Houses located on corner lots have roof leader(s) at the corners of the house, closest to the street lines.

Commercial, industrial and high-density residential building sites may not have the ability to discharge to landscaped areas, therefore, the storm water roof drainage may be discharged directly to grade. When discharging into a storm sewer system flow control shall be applied where deemed necessary.

12.11 Swales

Rear yards which drain through abutting lower back-to-front type lots are permitted where:

- A maximum of five rear yards or 0.1 ha may drain to a single swale;
- Sufficient fall shall be available between the adjacent streets to achieve desired grades for swales and yards;
- Cut-off swales along the rear lot lines shall direct runoff from the upper lots into the lower lot side yard swales.

Driveways are not permitted as outlets for drainage swales.

Swale depths should be a minimum of 150 mm. The actual swale depth depends on location and safety consideration, but should not exceed 1 m.

— Swale Grades —

Minor swales (providing drainage for up to 5 lots) should have a minimum grade of 2%.

Major swales (providing drainage for more than 5 lots) should have a minimum grade of 2% for the first 5 lots (from the high end of the swale furthest from the catch basin) and 1% thereafter.

— Flow —

- The maximum allowable flow in a side yard swale should be that from three back yards.
- The maximum flow in rear yard swales should be that from 10 to 20 backyards, depending on lot size and grade. The maximum length of a rear yard swale without outlet should be 150 m. The maximum area contributing to the rear yard swale should be 1 hectare. The maximum flow in rear yard swales (that discharge to the road allowance) is that from three back yards.
- The maximum depth of ponding at a catchbasin until it overflows to another outlet is 0.3 m.
- No front yard catchbasins to be used.

— Side Slope —

The maximum side slope on swales should be 3 horizontal to 1 vertical (3H:1V). The maximum slope of embankments between properties should also be 3H:1V. Failing this, a retaining wall should be designed.

12.12 Infiltration Gallery Design Critieria

Infiltration gallery design shall be in accordance with guidance from the Low Impact Development Stormwater Management Planning and Design Guide (LID Manual).

12.13 Inlets, Outfalls and Special Structures

— General —

Inlet and outlet structures shall be fully designed on the engineering drawings. The details provided shall include the existing topography, proposed grading and the work necessary to protect against erosion.

— Inlets —

For other than minor swales, where catchbasins with bird cage (OPSD 400.12) are used, inlet structures shall be fully designed. Ditch inlet grates shall generally consist of Honey Comb Grating(OPSD 403.010) or Raised Bar Grating (OPSD 403.011) based on location of ditch inlet and Susceptibility of clogging. Gabions or rip-rap shall be provided at all inlets to protect against erosion and to channel the flow to the inlet structure.

—Outlets —

The OPSD Standard Headwall shall be used for all storm sewers up to 1800mm. For sewers over 1800mm in diameter, the headwalls shall be individually designed. All headwalls shall be equipped with a horizontal grating over the outlet end of the pipe and a railing across the top of the headwall for the protection of the public. Alternate outlet designs will be considered on a specific basis. All outlets shall blend in the direction of flow of the watercourse with the directional change being taken up in the sewer rather than the channel. Any outlets established or altered shall conform to the CLI ECA.

Gabions, rip-rap or other erosion protection shall be provided at all outlets to prevent erosion of the watercourse and to the area adjacent to the outlet. The composition and extent of the erosion protection shall be indicated on the engineering drawings and shall be dependent upon the velocity of the flow in the storm sewer outlet, the soil conditions, the flow in the existing watercourse, site conditions and the requirements of the appropriate Conservation Authority, if applicable.

—Open Channels —

The proposed criteria for an open channel design shall be submitted to the City for acceptance, by the Developer's Engineer, prior to the actual design being undertaken. The Developer's Engineer shall also be responsible for obtaining the approval of the design from the Ministry of Natural Resources, the Department of Fisheries and Oceans and the local Conservation Authority. Generally, the stream alignment, and erosion control features, should follow a natural path.

13.0 BEDDING, COVER AND BACKFILL REQUIREMENTS

13.1 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 standard and associated drawings.

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

13.2 Backfill

Backfill shall be considered as starting at 300 mm above the storm sewer.

14.0 MAINTENANCE HOLES AND CATCHBASINS

14.1 General Requirements

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

Wherever possible, maintenance holes placed in the travel portion of roadways shall not be placed in vehicle wheel paths. Catchbasins shall be in accordance with OPSS and OPSD. Catchbasins shall generally be located upstream of all pedestrian crossings and upstream of intersections where the road grade falls towards the intersection.

Catchbasins shall not be located on walkways or driveway entrances / aprons.

Double catchbasins are required at low points where drainage is received from more than one direction. The design of the catchbasin location and type shall take into consideration the lot areas, the lot grades, pavement widths, road grades and intersection locations. The maximum area to be served by any catchbasin shall be 2000m² of paved area or 4000 m² of sodded area.

14.2 Type and Size

Maintenance holes and catchbasins shall be precast concrete structures. Under special circumstances, designs using cast-in-place concrete will be considered.

Maintenance holes and catchbasins shall be provided with monolithic bases and watertight joints. Adjustment units shall be provided where grade adjustments are necessary and shall be in accordance with OPSS.

Side inlet catchbasins will be considered on a case-by-case basis. Rear yard catchbasins shall not contain sumps. Setback catchbasins (as per detail drawings **RD110 & RD111**) are the preferred option in Local and Collector roadways.

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.

14.3 Spacing

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

Table 7. Maximum Spacing for Storm Maintenance Hole

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

14.3 Spacing (cont'd)

The preferred maximum spacing distance between each catchbasin shall be 50 m unless supporting calculations are completed in which case the maximum spacing shall be in accordance with MECP design criteria. The location and layout of storm maintenance holes and catchbasins shall be reviewed and approved by the City.

14.4 Catchbasin Leads

The minimum size and slope of catchbasin leads for single, double and rear lot catchbasins shall be as outlined in **Table 8**.

Catchbasins shall not be connected to other catchbasins.

Table 8. Catchbasin Leads

Catchbasin Type	Minimum Connection Size (mm)	Minimum Grade
Single and Rear Lot Catchbasin	250	1.0 %
Double Catchbasin	300	1.0 %

14.5 Frame, Cover and Grate Requirements

Frames, covers and grates shall be in accordance with OPSD and OPSS and with the Accessibility for Ontarian's with Disability Act (AODA). Maintenance hole covers shall be Type 'A' closed. Catchbasin grates in the roadway shall be herring bone.

14.6 Connections to Maintenance Holes

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

14.7 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 in accordance to the Linear Design and Construction Roads and Transportation Manual.

Catchbasins shall be designed to include precast adjustment units and shall be in accordance with OPSD.

14.8 Benching and Pipe Opening Requirements

Maintenance hole benching and pipe opening alternatives shall be designed in accordance with OPSD.

14.9 Drops Across Maintenance Hole

The minimum drop across a maintenance hole shall be based on the change in direction of the inlet and outlet pipes, and is as outlined in **Table 9**.

Table 9. Minimum Drop Across Maintenance Hole

Change in Direction	Minimum Drop Across Maintenance Hole (mm)
0°	25
1° to 45°	50
46° to 90°	80
Note: Changes in direction through a maintenance hole greater than 90° will not be permitted.	

14.10 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 storm sewer shall be considered prior to designing excessive invert drops, drop maintenance holes, or excessively steep benching.

14.11 Access Requirements

All incoming pipes are to be below safety gratings, where possible.

15.0 JOINTS AND FITTINGS

All joints, fittings, couplings and restraint devices for storm sewers 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 6**.

16.0 SIPHONS

Siphons shall be designed in accordance with the MECP criteria. Siphons shall be installed with at least two pipes, and each pipe shall be designed to convey the full flow.

CONSTRUCTION

CONSTRUCTION SPECIAL PROVISIONS — CONTRACT

17.0 PIPE REQUIREMENTS

17.1 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.

17.2 Materials Requirements

All pipe material and fittings shall be in accordance with the CSA and OPSS. Both rigid and flexible pipe are permitted in the construction of storm 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 8** in the Storm Sewer Design Section in this manual.

17.3 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 shall be 1.5 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.

Where the minimum specified cover cannot be achieved, sufficient insulation to prevent freezing of sections of storm sewer shall be provided as specified in the Storm 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 storm 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 OPSS and manufacturer's specification.

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

— Cutting of Pipe —

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

17.3 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 storm sewer. All materials below this point shall be considered as bedding.

Backfill for structures such as maintenance holes and catchbasins 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 exacavated earth materials from trenches, or approved granular material meeting OPSS.

— Horizontal and Vertical Separation —

Clearances between watermains, sanitary and storm sewers shall be based on the Watermain Design Criteria for Future Alterations Authorized Under a Drinking Water Works Permit (MECP). Where adequate separation cannot be achieved, mitigating measures shall be applied as per the **Watermain Design Criteria for Future Alterations Authorized Under a Drinking Water Works Permit (MECP).**

— Support of Storm Sewer or Storm Service Lateral —

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

— Bulkheads —

The storm sewers under construction shall be bulkheaded to prevent infiltration and flushing water from entering the storm sewer system. Installation of required bulkheads and their subsequent removal upon completion of work shall be at the Contractor’s expense.

— Dewatering of Excavations —

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

- more than 50,000 L/day requires registrations and
- 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, 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 storm sewers shall be cleaned, tested and video inspected in accordance with City standards.

A deflection test shall be completed for all new flexible Storm 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 Storm sewers in accordance with MECP design criteria.

The deformation gauge, also known as the Mandrel test for flexible pipes, shall be successfully completed at least 30 calendar days after backfilling but prior to paving. The Mandrel test shall be conducted according to OPSS.

17.4 Measurement for Payment

Measurement for storm 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 storm system using pumping and pipe insulation.

18.0 SERVICE LATERALS

18.1 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. Storm service laterals shall have a minimum pipe size of 150 mm.

18.2 Materials Requirements

PVC pipe shall be used for residential lateral connections. The pipe shall be white in colour and DR 28 shall be used. Laterals larger than 150mm shall be PVC, DR35.

18.3 Execution

Connections to storm 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.

Connections shall not be made by breaking through the pipe wall on site. Storm sewer laterals shall have a minimum cover of 1.2 m at the property line from finished grade to the top of the pipe. The grade of the storm sewer lateral shall range between a minimum and maximum of 2% and 8%, respectively.

Storm sewer lateral connections to maintenance holes are permitted.

Connections to mainline storm 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. The City requires that all single family homes include a foundation drain (weeping tile) connection to the local storm sewer lateral via a sump pump with a gooseneck. If no local storm sewer lateral is available, then the sump pump shall discharge via a concrete splash pad to a grassed area away from the house avoiding driveways, walkways and adjacent properties with the approval of the City.

Downspouts shall discharge into side yard swales via concrete splash pads. Downspouts shall not discharge onto driveways or walkways, as they pose a safety (slipping) hazard in the winter. Houses located on corner lots have roof leader(s) at the corners of the house, closest to the street lines.

Commercial, industrial and high-density residential building sites may not have the ability to discharge to landscaped areas, therefore, the storm water roof drainage may be discharged

directly into a storm sewer system given that flow control shall be applied where deemed necessary. Cross-connections and sump pump connections to the sanitary sewer shall not be permitted.

18.4 Measurement for Payment

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

19.0 PRE-CAST CONCRETE MAINTENANCE HOLES AND CATCHBASINS

19.1 General

This section is in accordance with the provisions of OPSS.

19.2 Materials Requirements

Precast maintenance hole materials shall be in accordance with OPSS.

19.3 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.

Upon completion of construction, the interior of the storm sewers, maintenance holes, catchbasins 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 storm sewers or watercourses.

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

19.4 Measurement for Payment

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

20.0 INSTALLATION OF NEW PIPE CULVERT

20.1 General

The provisions of OPSS apply.

20.2 Material Requirements

Culvert materials shall be as specified in the City's Approved Products List and shall be in accordance with OPSS. Bedding and cover shall be in accordance with OPSD for flexible pipe and rigid pipe.

20.3 Execution

Culvert construction shall be in accordance with OPSS. Bedding and cover shall be in accordance with OPSD for flexible and rigid pipe.

Pipe culvert frost treatment in accordance with OPSD.

20.4 Measurement for Payment

Measurement for payment shall be per the horizontal length of the pipe in metres.

21.0 CLEANING, INSPECTIONS AND TESTING

Refer to the Sanitary Sewers section of this manual for requirements of cleaning, inspection and testing of storm sewers. Testing may be required based on City and/or MECP design criteria or direction.

22.0 TRENCHLESS REHABILITATION

Refer to the Sanitary Sewers section of this manual for requirements of trenchless rehabilitation of storm sewers.

DESIGN SHEET

The City of Brantford - Project Name
Storm Sewer Design Computations

Calculated By:
Approved By:
Date:

Design Flow:
Q (d) = 2.78*C*i*A
Q (d) = Design Flow (L/s)
C = Runoff Coefficienct
i = Rainfall Intensity (mm/hr)
A = Drainage Area (ha.)

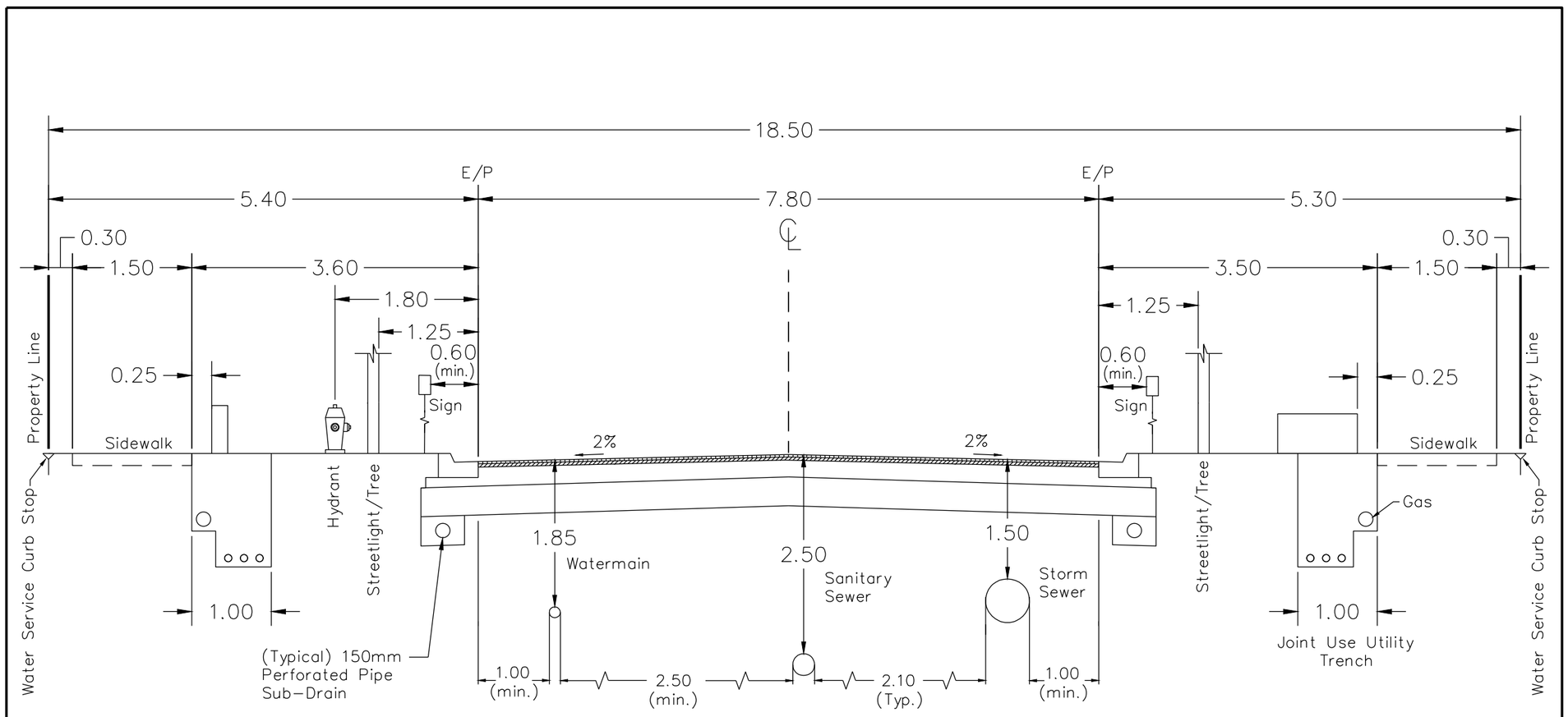
Rainfall Intensity:
i = A / (tc + B) ^C
Design Storm = ________
IDF Parameter A = ________
IDF Parameter B = ________
IDF Parameter C = ________

Location			Design Flow							Proposed Sewer									
Street	From M.H.	To M.H.	Runoff Coefficient (C)	Drainage Area (A)	Individual 2.78*C*A	Cumulative 2.78*C*A	Time of Conc. (tc)	Rainfall Intensity (i)	Design Flow Q (d)	Length	Pipe Size (D)	Material	Manning's Roughness	Grade	Capacity Q (full)	Full flow velocity	Q (d) / Q (full) Ratio	H/D	Actual vel. at Q (d)
				hectares			*miutes*	*mm/hour*	*L/s*	*m*	*mm*		*n*	*%*	*L/s*	*m/s*	*-*	*%*	*m/s*

DETAILED ENGINEERED CROSS-SECTIONS

DETAILED ENGINEERED CROSS-SECTIONS

Drawing No.	Title
H-101	Local Road, 18.5 m ROW Width, 7.5 m Road Width
H-102	Local Road, 18.5 m ROW Width, 10.2m 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, 12.3 m Road Width
H-104	Minor Collector Road, 24.5 m ROW Width, 14.4 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.

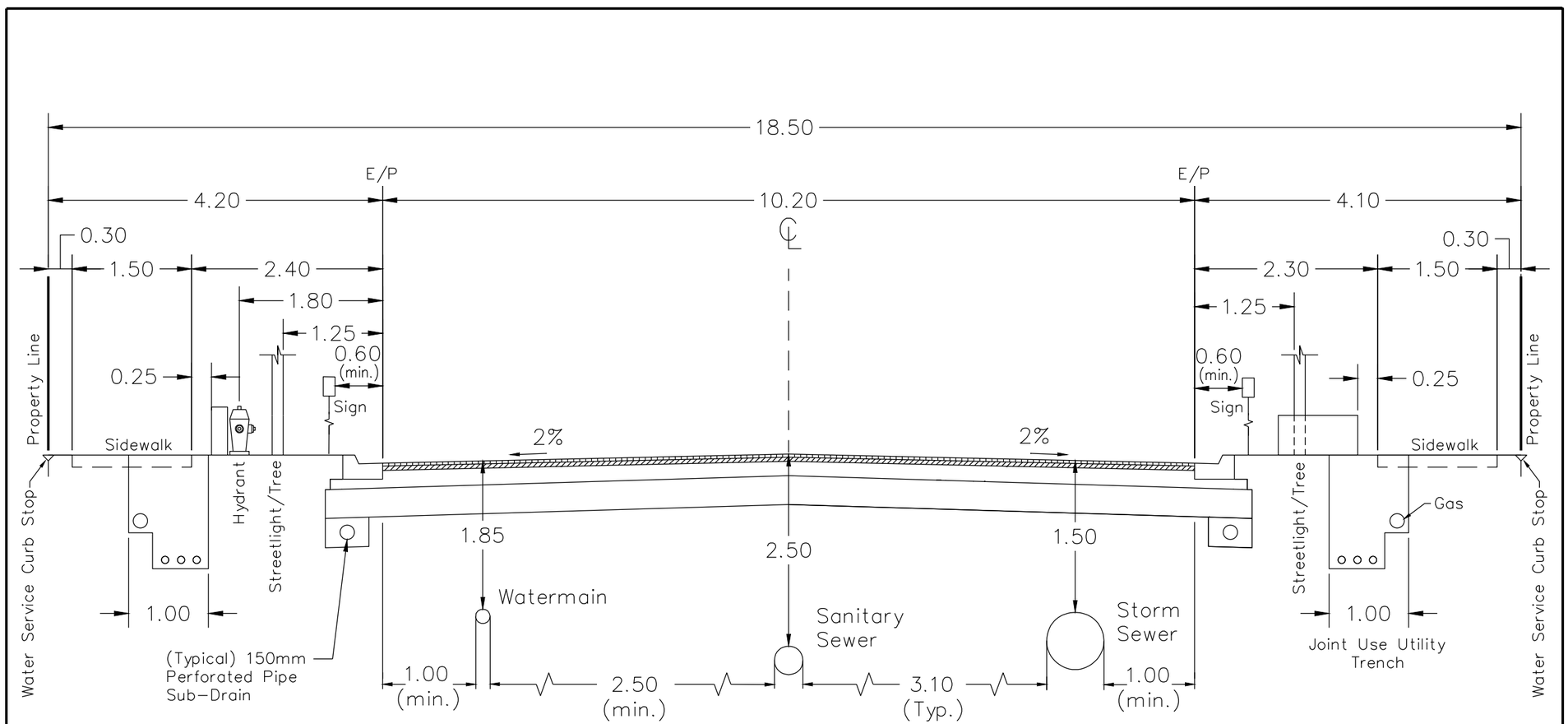
NOTE:
1) All dimensions are in metres unless otherwise shown.
2) Curb and gutter to meet O.P.S.D. or City of Brantford detail drawing RD–104 for two–stage curb construction in accordance with project drawings
3) Road grade and crossfall shall be in accordance with the Design and Construction Manual.
4) Pavement design details not shown. See Roads manual for pavement design standards.
5) Sidewalk Grade: minimum of 0.5% and maximum of 5%; Sidewalk Crossfall: minimum of 2% and maximum of 4%.
6) Water service curb stops shall be on the property line. Installation on hard surfaced area, such as driveways and walkways shall be avoided.
7) Refer to Standard Detail Drawing UT–105 for Joint Use Utility Trench.
8) A minimum clearance of 0.3 m must be maintained between the gas line and the property line.
9) 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.
10) 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: FEB. 2025
DRAWN BY: E.K.

H–101



DETAILED SECTION – LOCAL STREET

N.T.S.

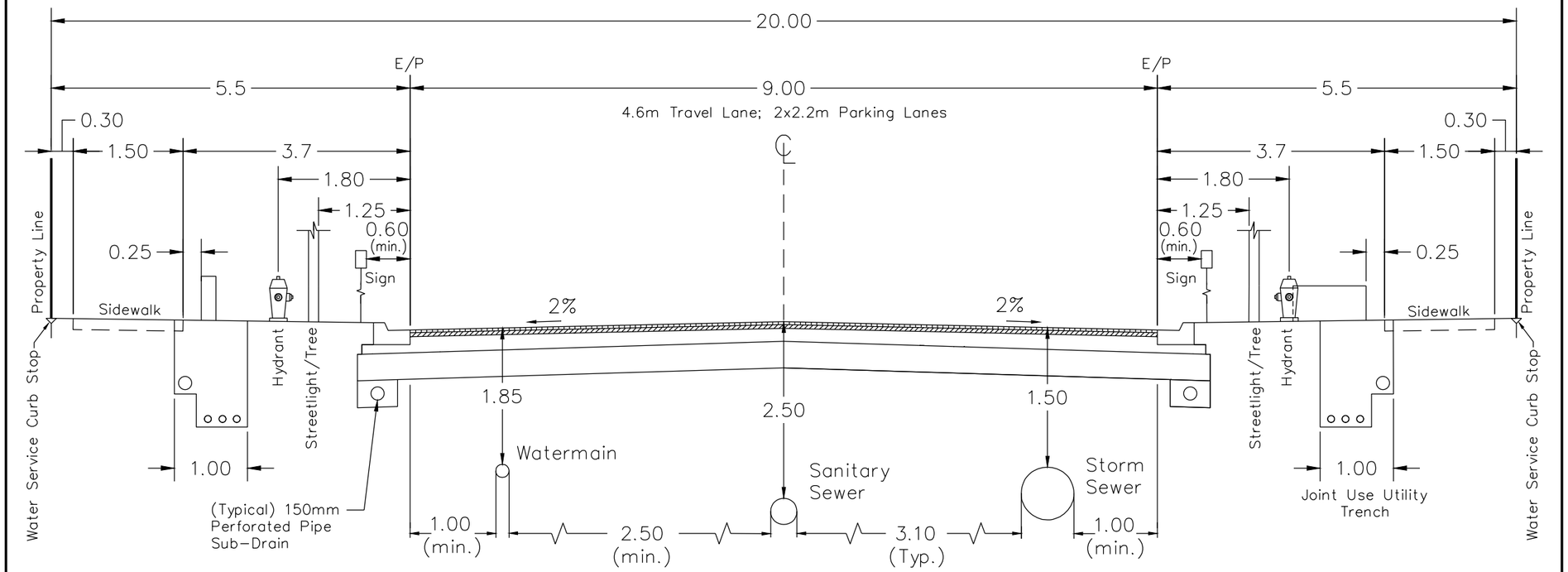
NOTE:
1) All dimensions are in metres unless otherwise shown.
2) Curb and gutter to meet O.P.S.D. or City of Brantford detail drawing RD–104 for two–stage curb construction in accordance with project drawings
3) Road grade and crossfall shall be in accordance with the Design and Construction Manual.
4) Pavement design details not shown. See Roads manual for pavement design standards.
5) Sidewalk Grade: minimum of 0.5% and maximum of 5%; Sidewalk Crossfall: minimum of 2% and maximum of 4%.
6) Water service curb stops shall be on the property line. Installation on hard surfaced area, such as driveways and walkways shall be avoided.
7) Refer to Standard Detail Drawing UT–105 for Joint Use Utility Trench.
8) A minimum clearance of 0.3 m must be maintained between the gas line and the property line.
9) 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.
10) 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: FEB. 2025
DRAWN BY: E.K.

H–102



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) Pavement design details not shown. See Roads manual for pavement design standards.
5) Sidewalk Grade: minimum of 0.5% and maximum of 5%; Sidewalk Crossfall: minimum of 2% and maximum of 4%.
6) Water service curb stops shall be on the property line. Installation on hard surfaced area, such as driveways and walkways shall be avoided.
7) Refer to Standard Detail Drawing UT-105 for Joint Use Utility Trench.
8) A minimum clearance of 0.3 m must be maintained between the gas line and the property line.
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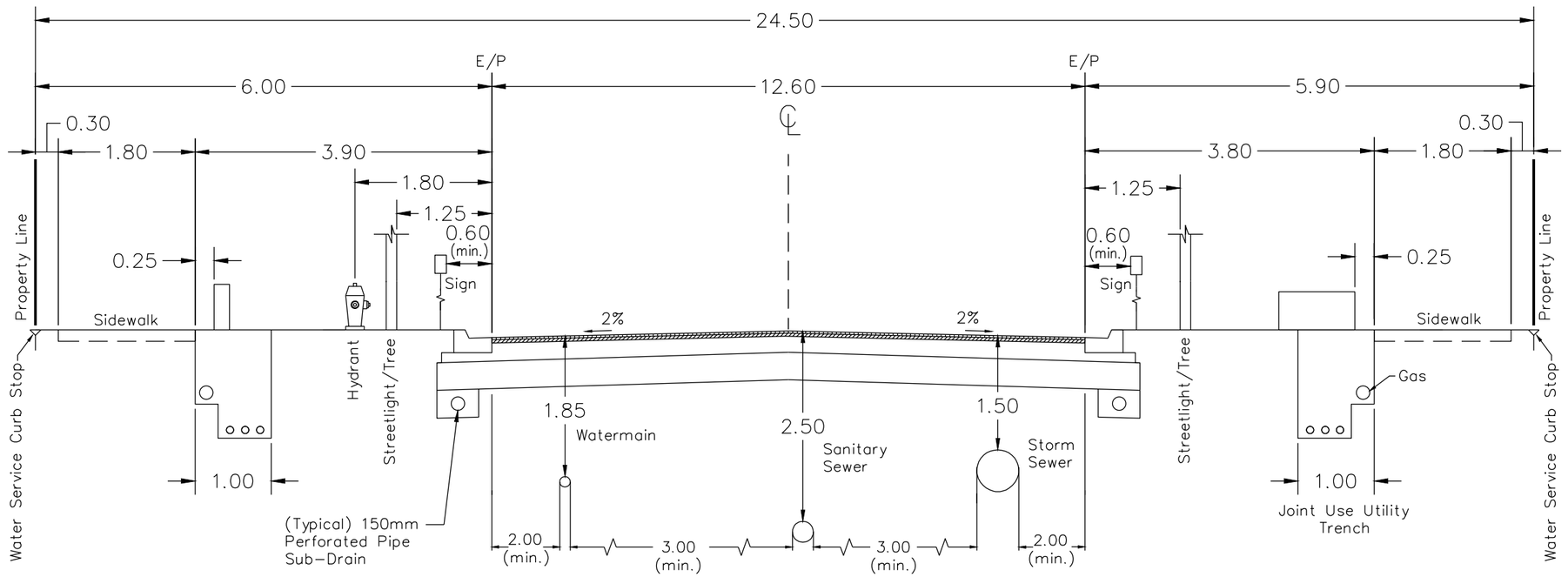
CITY OF BRANTFORD

DETAILED SECTION
LOCAL STREET
(20.0m ROW 9.0m ROAD WIDTH)

DATE: FEB. 2020
REV: FEB. 2025
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
3) Road grade and crossfall shall be in accordance with the Design and Construction Manual.
4) Pavement design details not shown. See Roads manual for pavement design standards.
5) Sidewalk Grade: minimum of 0.5% and maximum of 5%; Sidewalk Crossfall: minimum of 2% and maximum of 4%.
6) Water service curb stops shall be on the property line. Installation on hard surfaced area, such as driveways and walkways shall be avoided.
7) Refer to Standard Detail Drawing UT–105 for Joint Use Utility Trench.
8) A minimum clearance of 0.3 m must be maintained between the gas line and the property line.
9) 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.
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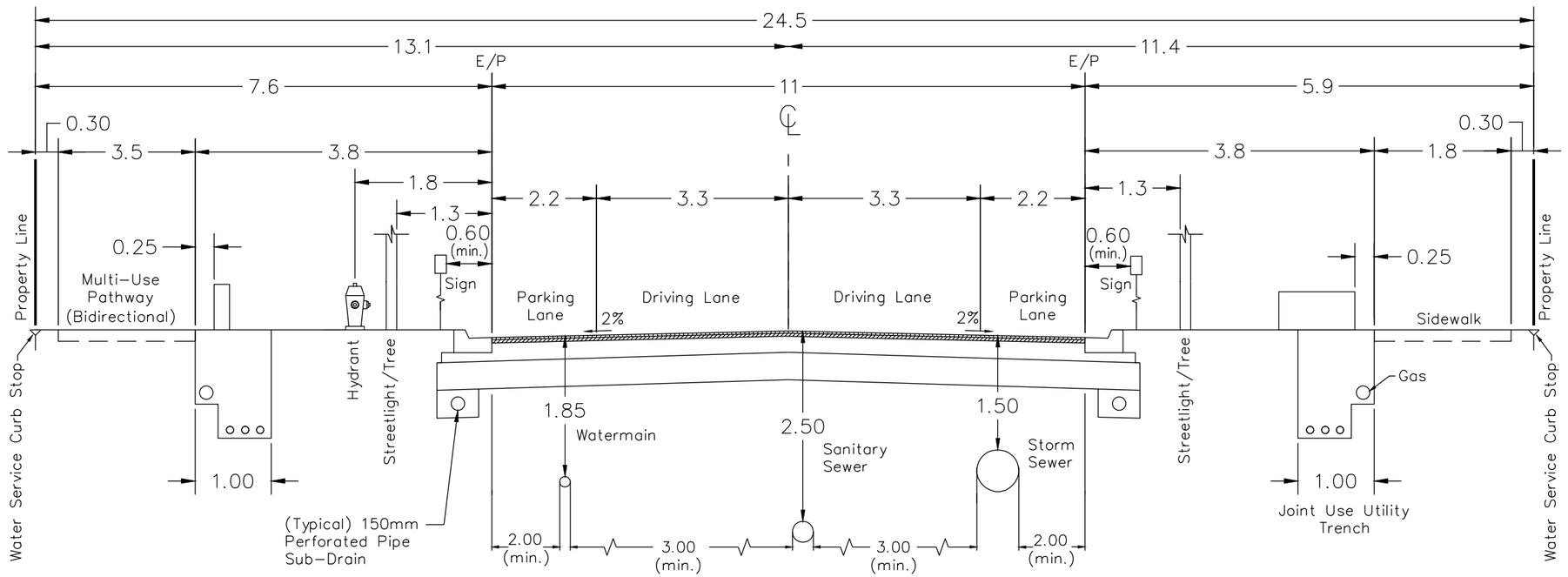
CITY OF BRANTFORD

DETAILED SECTION
MINOR COLLECTOR
(24.5m ROW 12.6m ROAD WIDTH)

DATE: FEB. 2020
REV: FEB. 2025
DRAWN BY: E.K.

H–103



DETAILED SECTION – MINOR COLLECTOR

N.T.S.

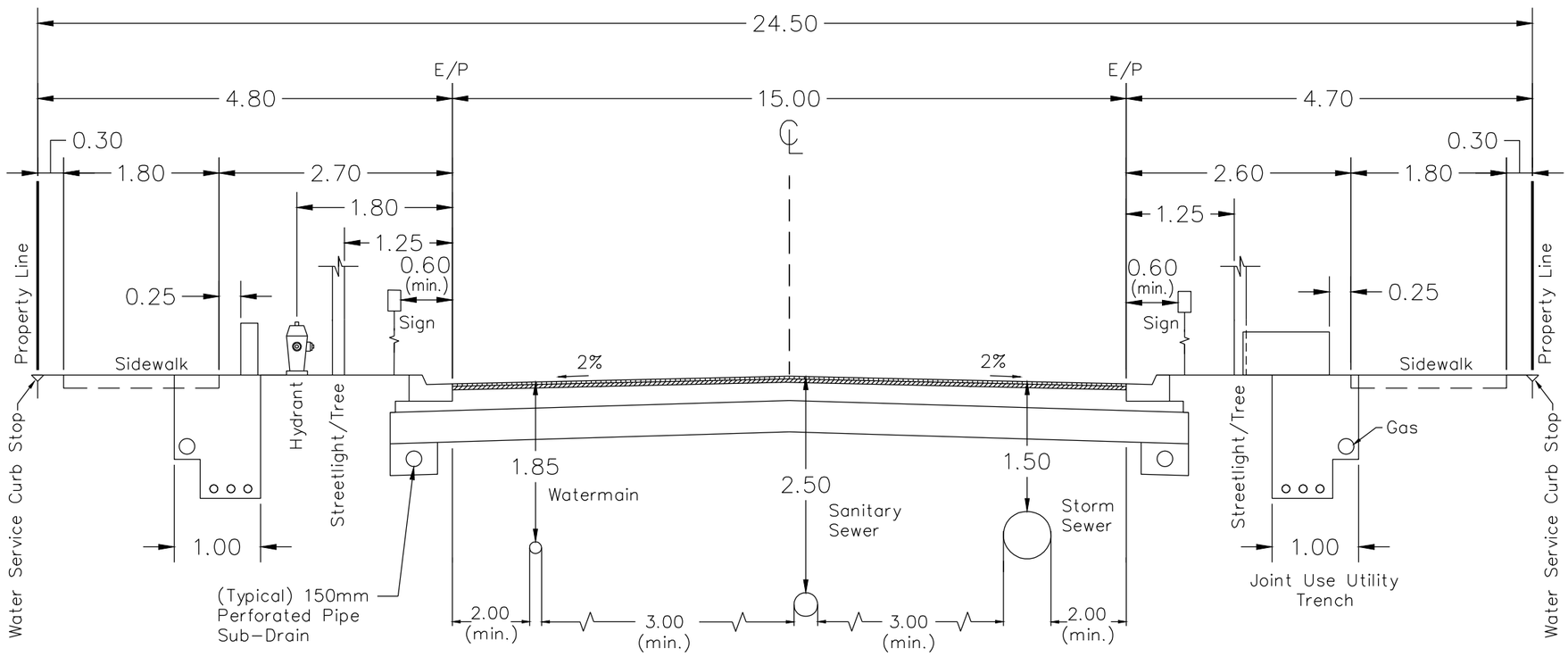
NOTE:
1) All dimensions are in metres unless otherwise shown.
2) Curb and gutter to meet O.P.S.D. or City of Brantford detail drawing RD-104 for two-stage curb construction in accordance with project drawings
3) Road grade and crossfall shall be in accordance with the Design and Construction Manual.
4) Pavement design details not shown. See Roads manual for pavement design standards.
5) Sidewalk Grade: minimum of 0.5% and maximum of 5%; Sidewalk Crossfall: minimum of 2% and maximum of 4%.
6) Water service curb stops shall be on the property line. Installation on hard surfaced area, such as driveways and walkways shall be avoided.
7) Refer to Standard Detail Drawing UT-105 for Joint Use Utility Trench.
8) A minimum clearance of 0.3 m must be maintained between the gas line and the property line.
9) 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.
10) 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 11.0m ROAD WIDTH)

DATE: JAN. 2025
REV: JAN. 2025
DRAWN BY: N.M.

H-103B



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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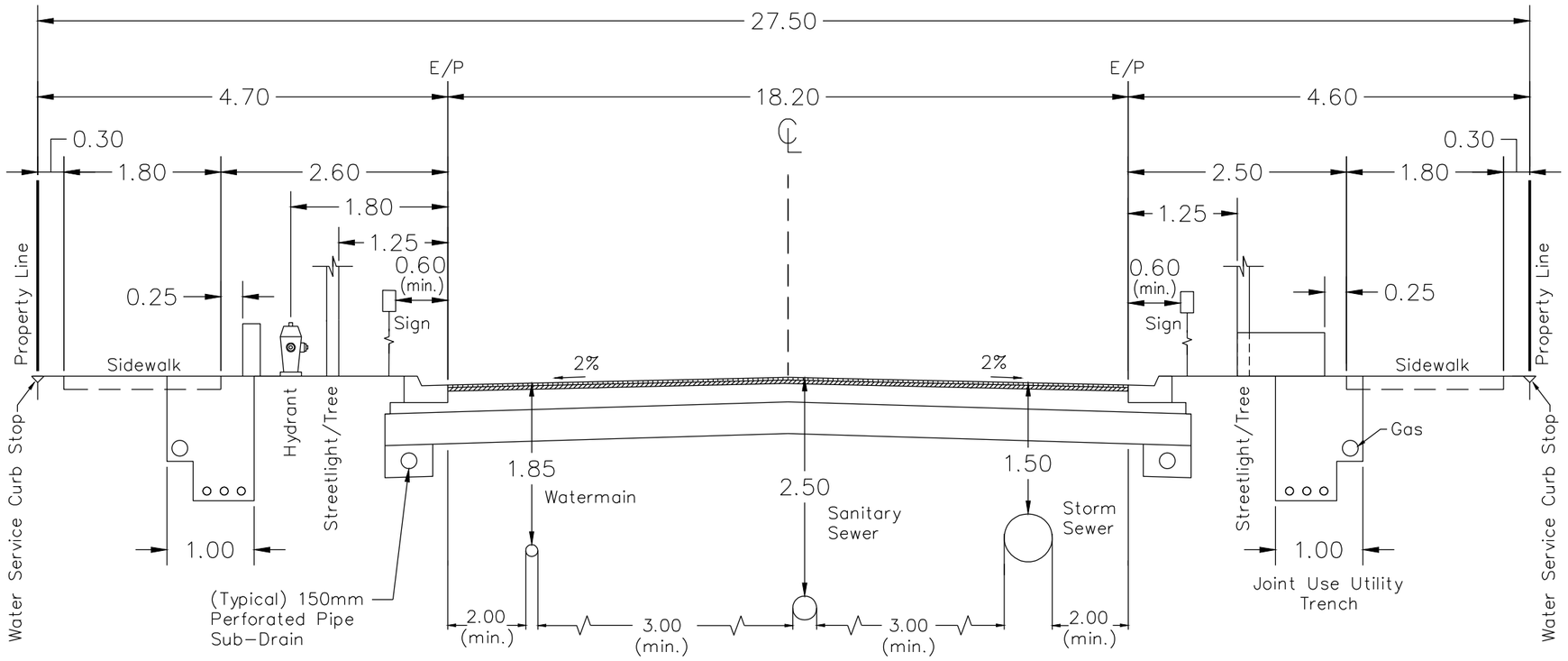
8) A minimum clearance of 0.3 m must be maintained between the gas line and the property line.
9) If utilities cannot be installed according to this standard, they are to be installed as close as possible to the prescribed location subject to the approval of the City.
10) Spacing between streetlights 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: FEB. 2025
DRAWN BY: E.K.

H–104



DETAILED SECTION – MAJOR 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
3) Road grade and crossfall shall be in accordance with the Design and Construction Manual.
4) Pavement design details not shown. See Roads manual for pavement design standards.
5) Sidewalk Grade: minimum of 0.5% and maximum of 5%; Sidewalk Crossfall: minimum of 2% and maximum of 4%.
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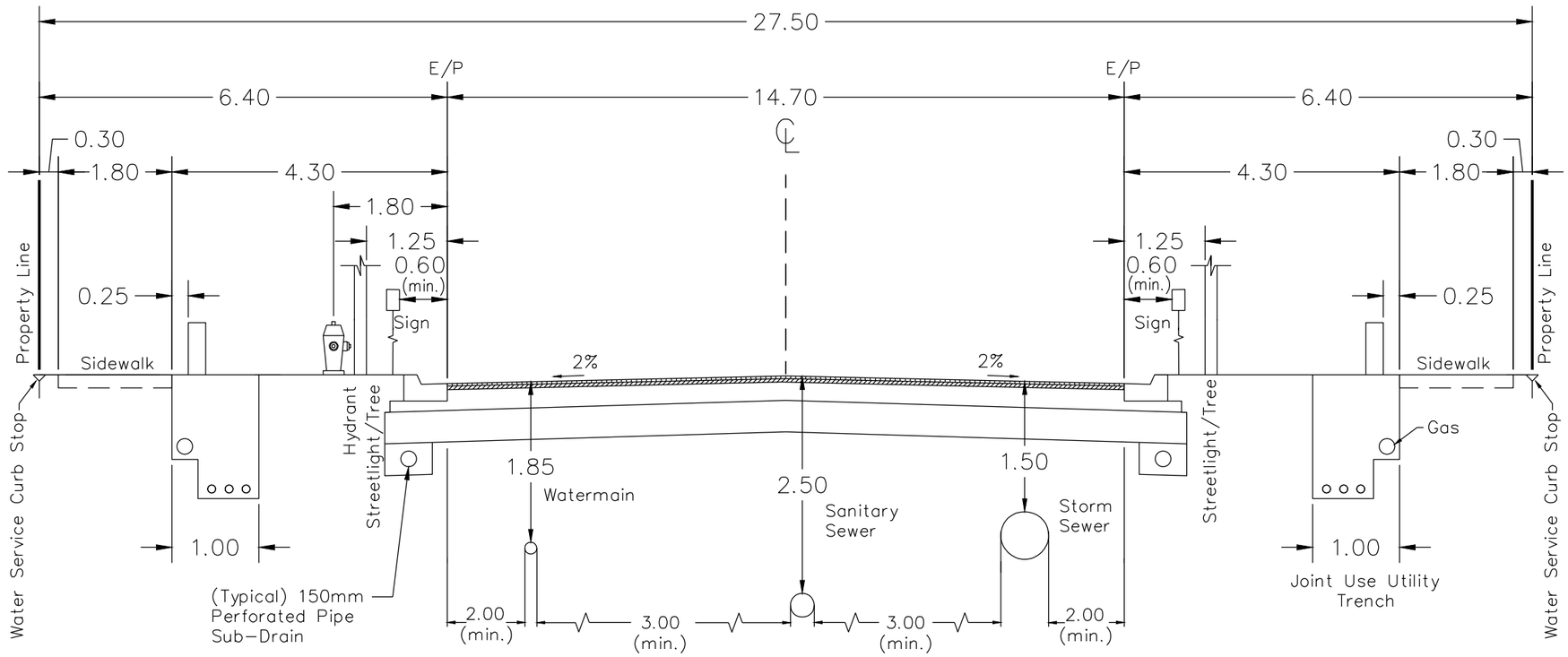
10) Spacing between streetlights and trees should be sufficient to ensure no interference between tree canopy and lighting fixture.

CITY OF BRANTFORD

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

DATE: FEB. 2020
REV: FEB. 2025
DRAWN BY: E.K.

H–105



DETAILED SECTION – MAJOR 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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9) 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.
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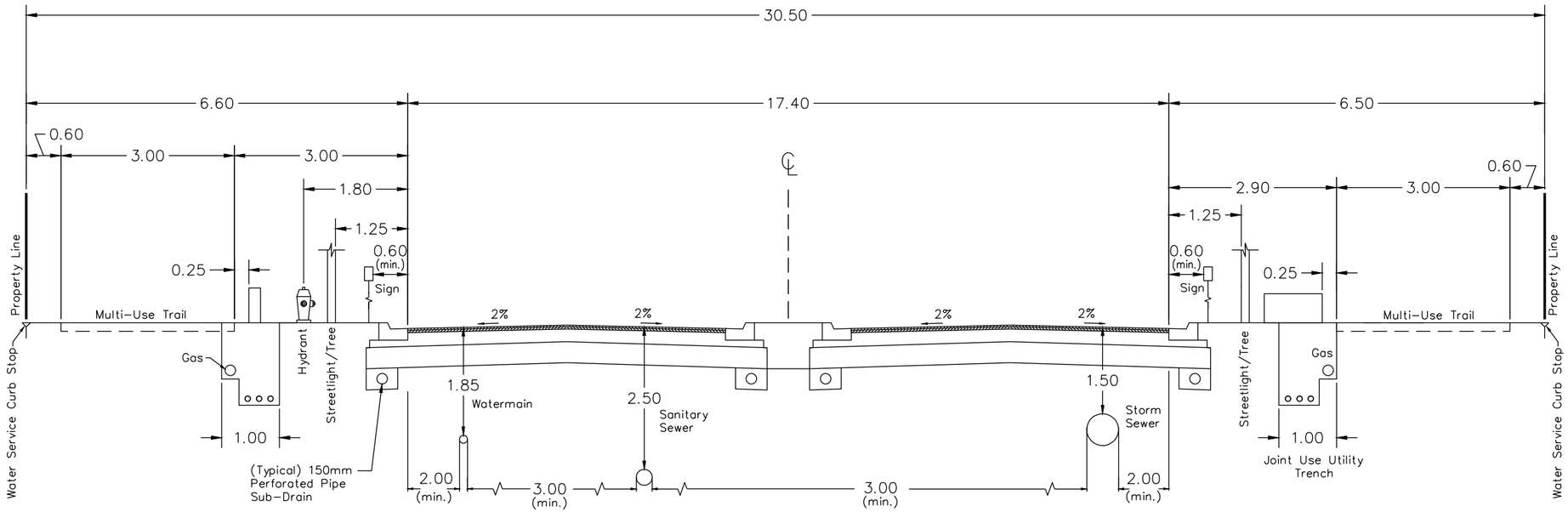
CITY OF BRANTFORD

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

DATE: FEB. 2023
REV: FEB. 2025
DRAWN BY: E.K.

H-105B



DETAILED SECTION – MAJOR COLLECTOR

N.T.S.

NOTE:
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4) Pavement design details not shown. See Roads manual for pavement design standards.
5) Sidewalk Grade: minimum of 0.5% and maximum of 5%; Sidewalk Crossfall: minimum of 2% and maximum of 4%.
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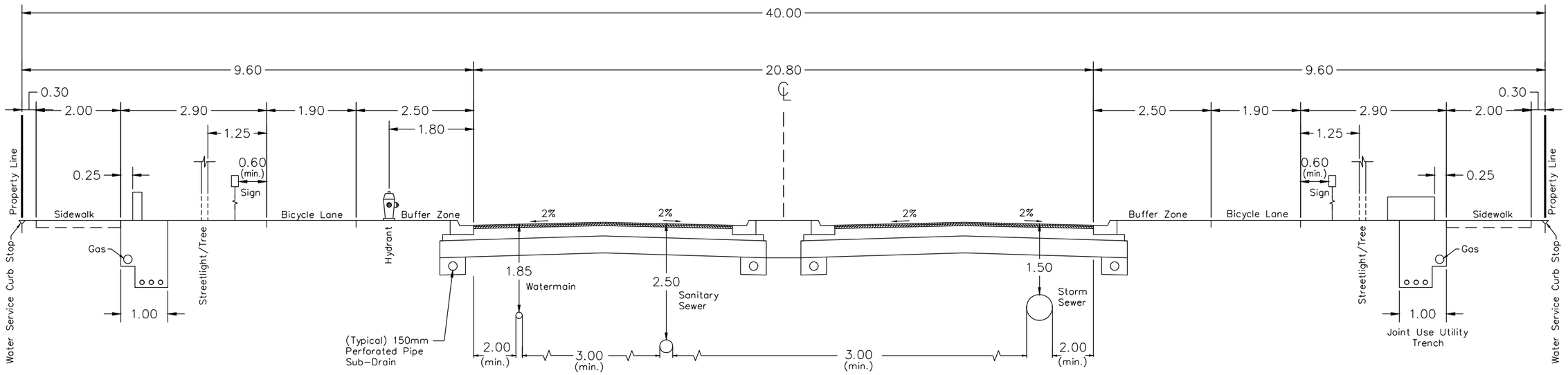
CITY OF BRANTFORD

DETAILED SECTION
MAJOR COLLECTOR
(30.5m ROW 17.4m ROAD WIDTH)

DATE: FEB. 2020
REV: FEB. 2025
DRAWN BY: E.K.

H–106



DETAILED SECTION – ARTERIAL

N.T.S.

NOTE:
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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) Pavement design details not shown. See Roads manual for pavement design standards.
5) Sidewalk Grade: minimum of 0.5% and maximum of 5%; Sidewalk Crossfall: minimum of 2% and maximum of 4%.
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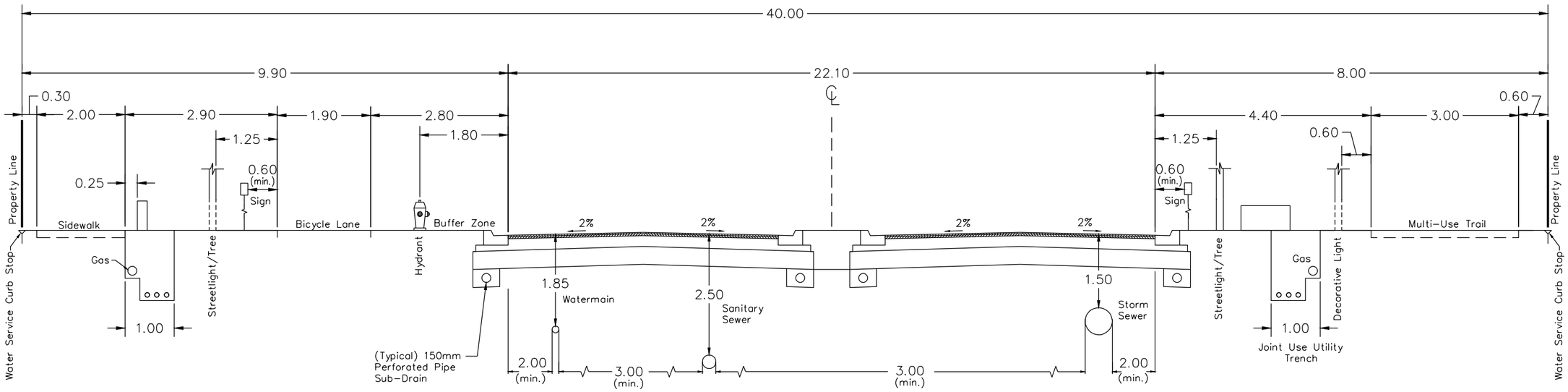
10) Spacing between streetlights and trees should be sufficient to ensure no interference between tree canopy and lighting fixture.

CITY OF BRANTFORD

DETAILED SECTION
ARTERIAL
(40.0m ROW 20.8m ROAD WIDTH)

DATE: FEB. 2020
REV: FEB. 2025
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
3) Road grade and crossfall shall be in accordance with the Design and Construction Manual.
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8) A minimum clearance of 0.3 m must be maintained between the gas line and the property line.
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10) Spacing between streetlights and trees should be sufficient to ensure no interference between tree canopy and lighting fixture.

CITY OF BRANTFORD

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

DATE: FEB. 2020
REV: FEB. 2025
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.
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) Pavement design details not shown. See Roads manual for pavement design standards.
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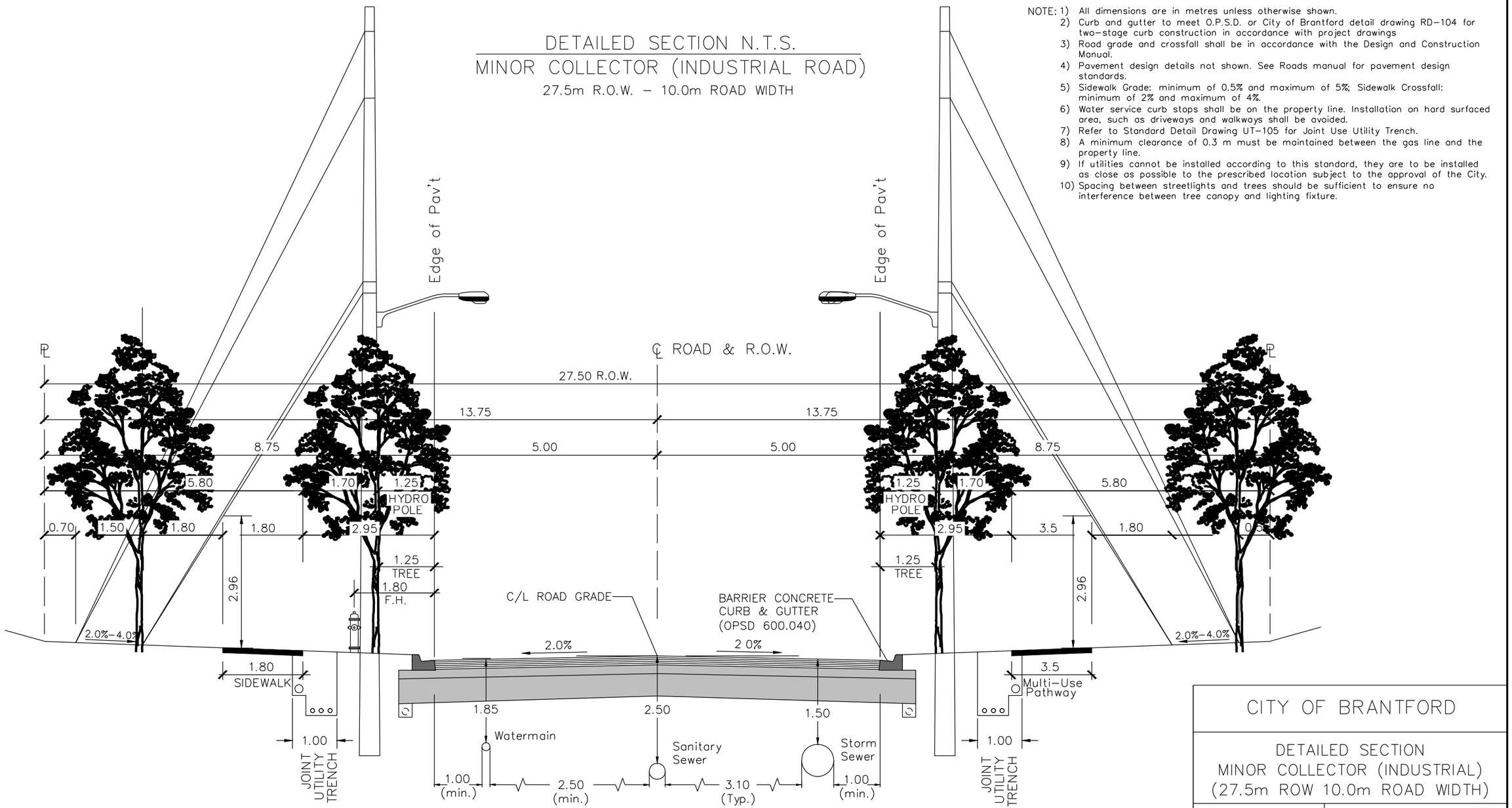
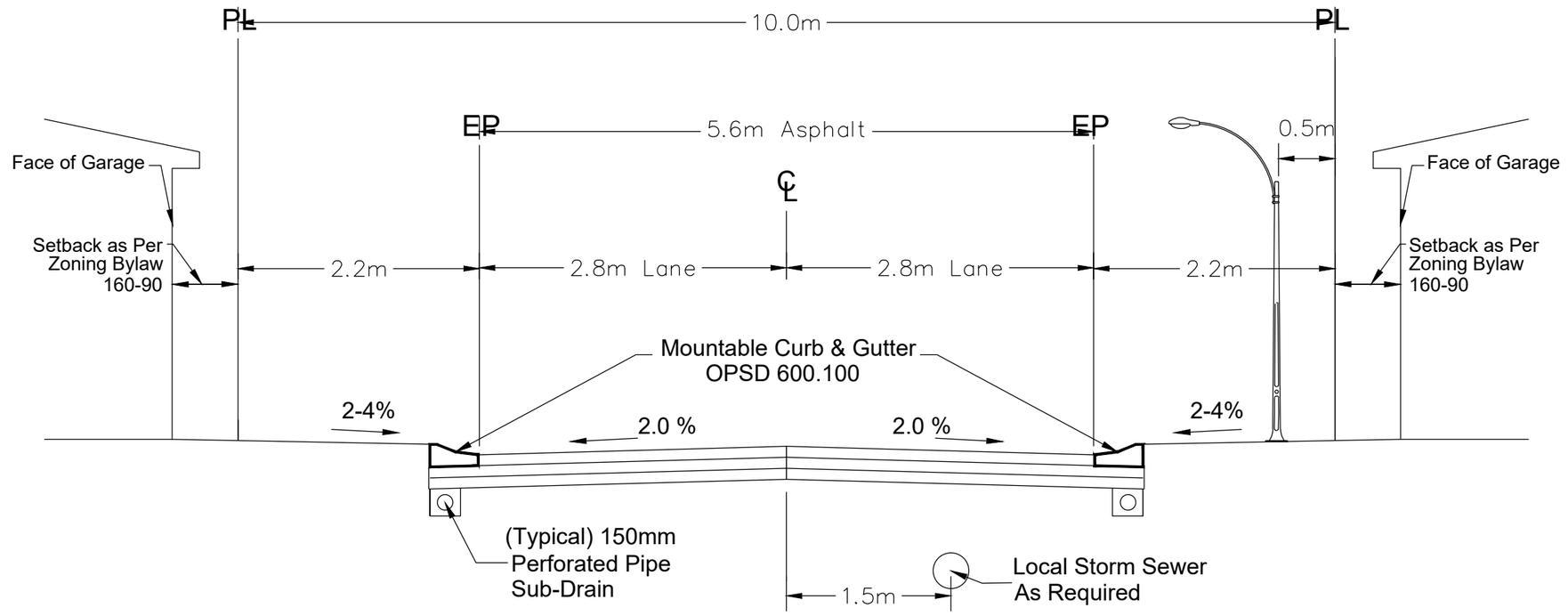


CITY OF BRANTFORD

DETAILED SECTION
MINOR COLLECTOR (INDUSTRIAL)
(27.5m ROW 10.0m ROAD WIDTH)

DATE: JAN. 2021
REV: MAR. 2025

H–109



DETAILED SECTION – REAR LANEWAY

N.T.S.

NOTE: 1) No above-ground utility poles shall be located within the laneway corridor

CITY OF BRANTFORD

DETAILED SECTION
REAR LANEWAY
(10.0m ROW 5.6m ROAD WIDTH)

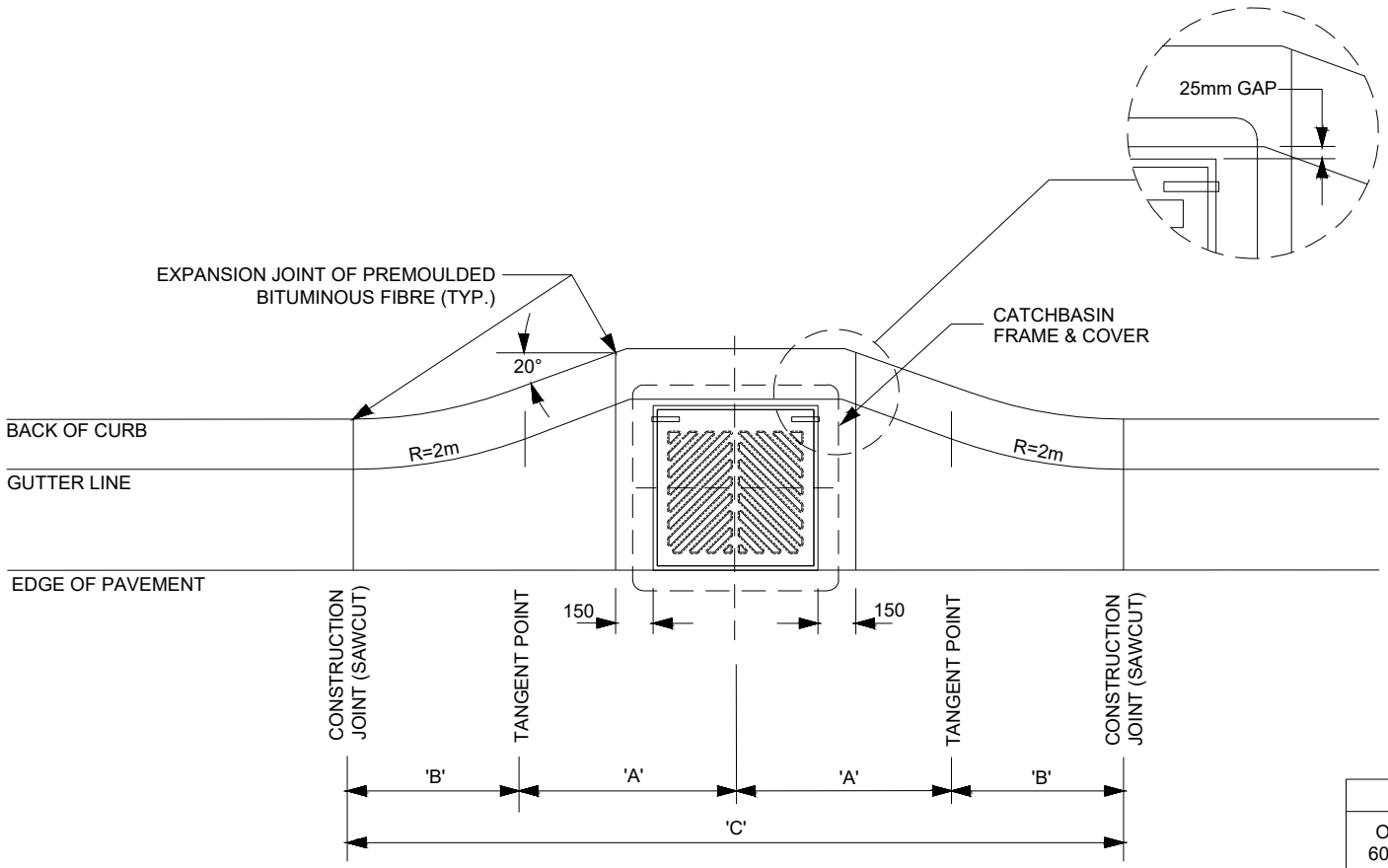
DATE: FEB. 2025
REV:
DRAWN BY: N.M.

H-110

STANDARD DRAWINGS AND DETAILS

STANDARD DRAWINGS AND DETAILS

Drawing No.	Title
RD-110	Offset Curb and Gutter Detail at Single Catchbasin
RD-111	Offset Curb and Gutter Detail at Double Catchbasin
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



		CURB TYPE		
		OPSD 600.010	OPSD 600.040	OPSD 600.080
DIMENSON (mm)	A	850	1100	1825
	B	700	700	700
	C	3100	3600	5050

NOTES

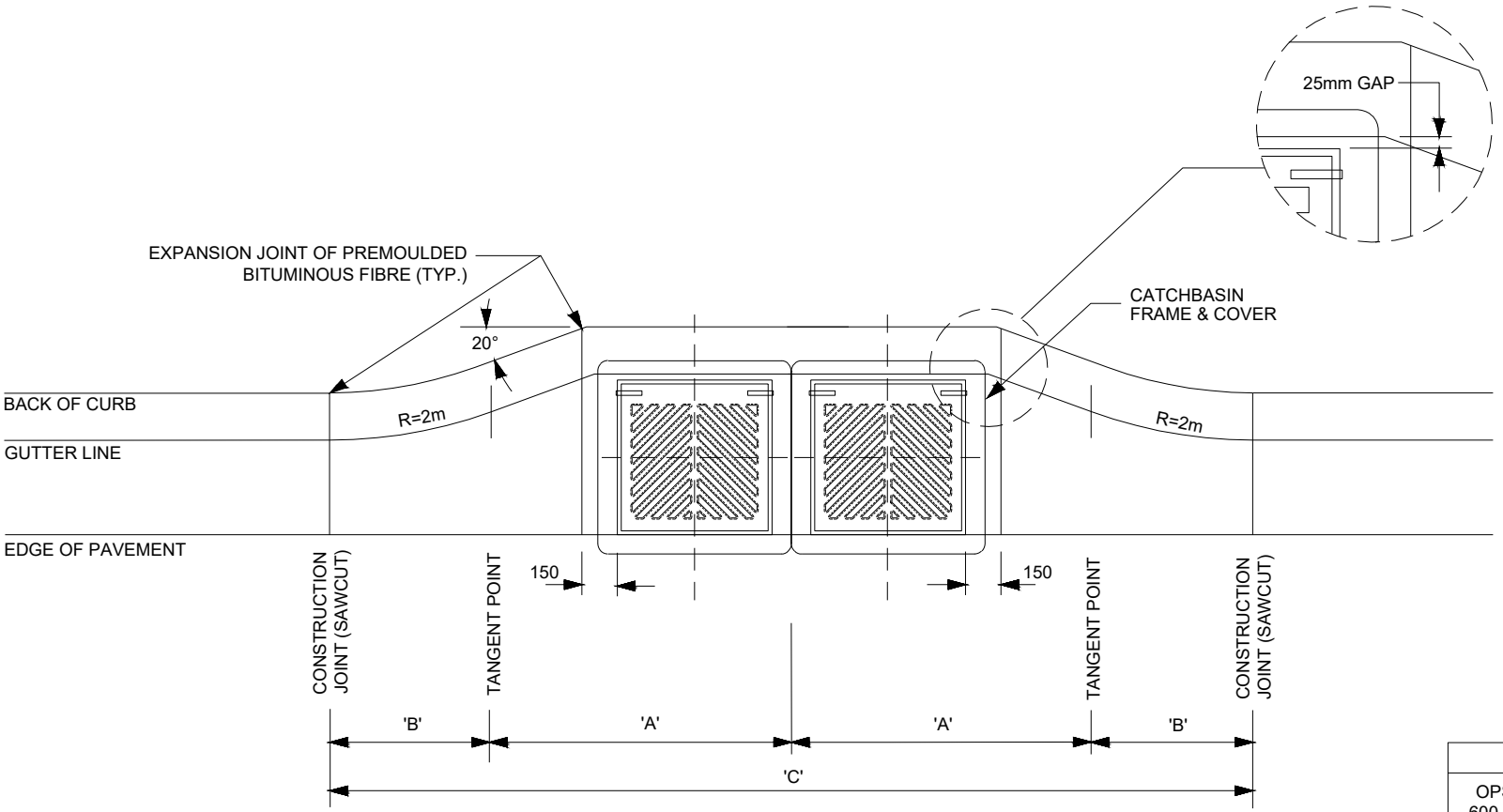
1) APPROVED CATCHBASIN FRAME AND GRATE OPSD 400.010 & 400.020

THE CORPORATION OF THE CITY OF BRANTFORD

CITY OF BRANTFORD
ENGINEERING SERVICES DEPARTMENT

OFFSET CURB & GUTTER DETAIL AT SINGLE CATCH BASIN

DIMENSIONS SHOWN ARE IN MILLIMETRES UNLESS OTHERWISE NOTED	DRAWN BY:	DATE:	REV:	DWG NO:
	E.K.	FEB. 2020	JAN. 2022	RD-110



		CURB TYPE		
		OPSD 600.010	OPSD 600.040	OPSD 600.080
DIMENSON (mm)	A	1300	1550	2250
	B	700	700	700
	C	4000	4500	5900

NOTES

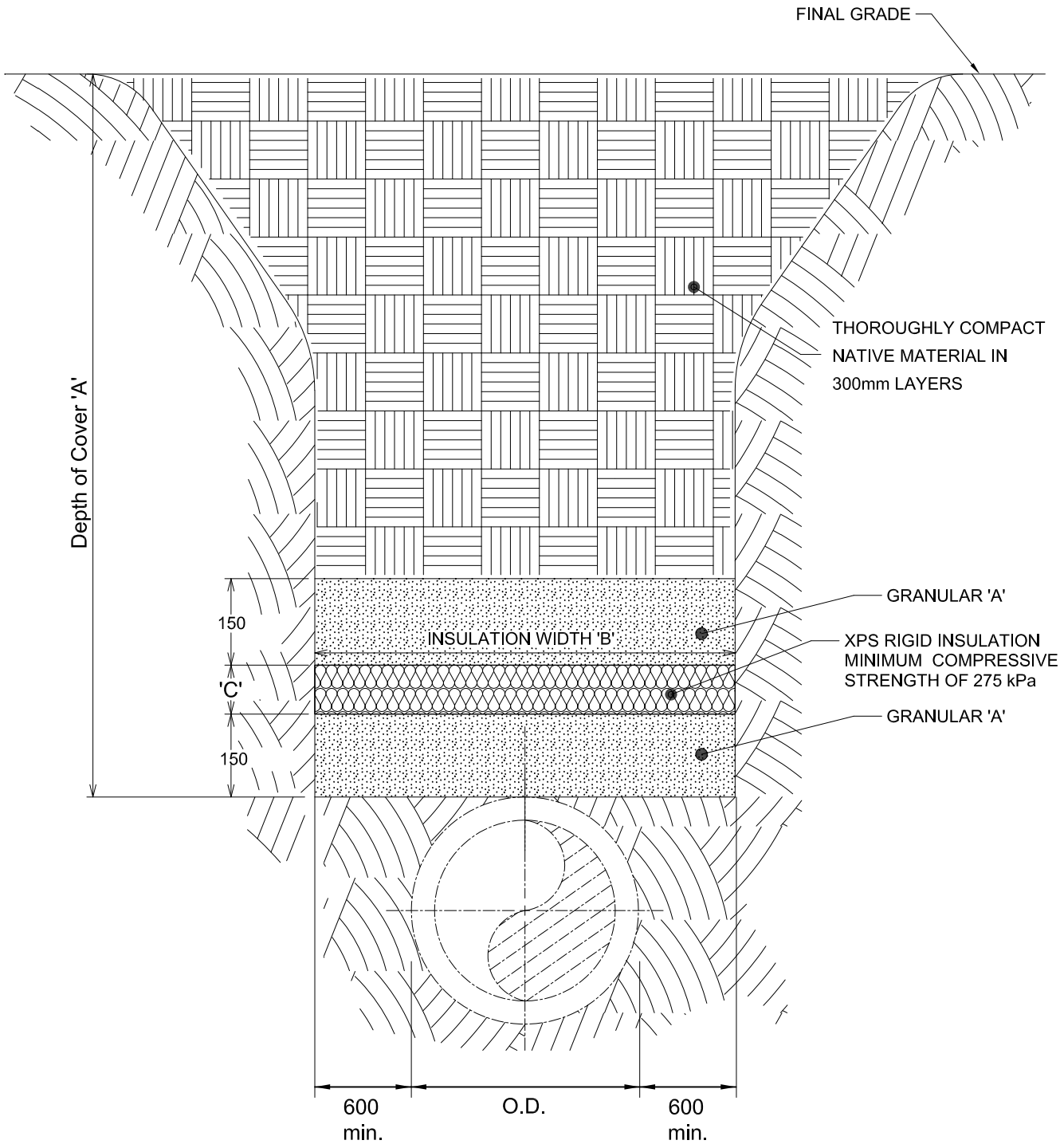
1) APPROVED CATCHBASIN FRAME AND GRATE OPSD 400.010 & 400.020

THE CORPORATION OF THE CITY OF BRANTFORD

CITY OF BRANTFORD
ENGINEERING SERVICES DEPARTMENT

OFFSET CURB & GUTTER DETAIL AT DOUBLE CATCH BASIN

DIMENSIONS SHOWN ARE IN MILLIMETRES UNLESS OTHERWISE NOTED	DRAWN BY:	DATE:	REV:	DWG NO:
	E.K.	FEB. 2020	JAN. 2022	RD-111



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

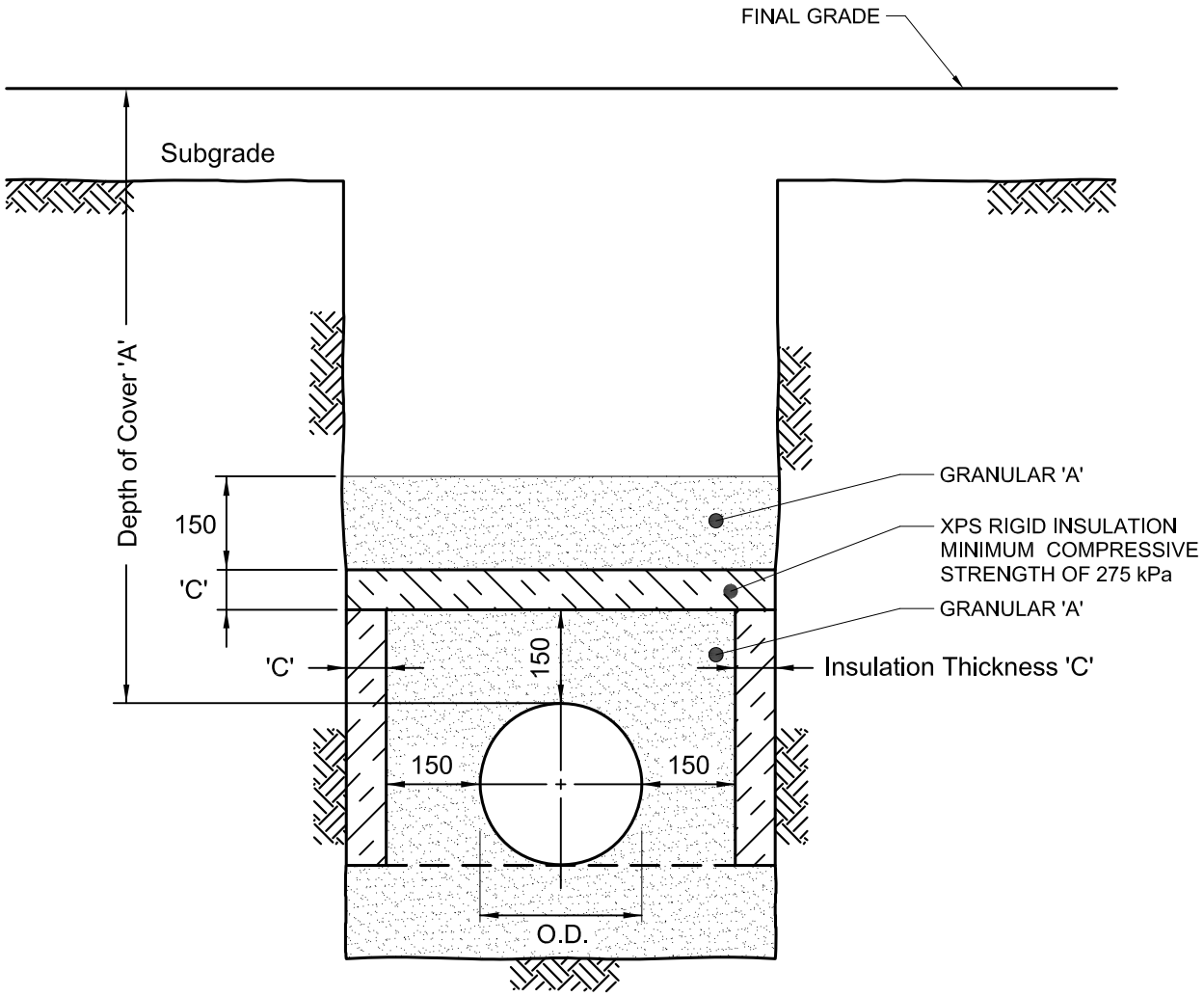
THE CORPORATION OF THE CITY OF BRANTFORD

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

ENGINEERING SERVICES DEPARTMENT

DATE: JAN. 1989	N.T.S.
REV: JAN. 2023	
W-312	DRAWN BY: A. SCHOEN

T:\WATER STANDARD DRAWING\SPECW300\REVISION\W-312(REV).DWG



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

THE CORPORATION OF THE CITY OF BRANTFORD

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

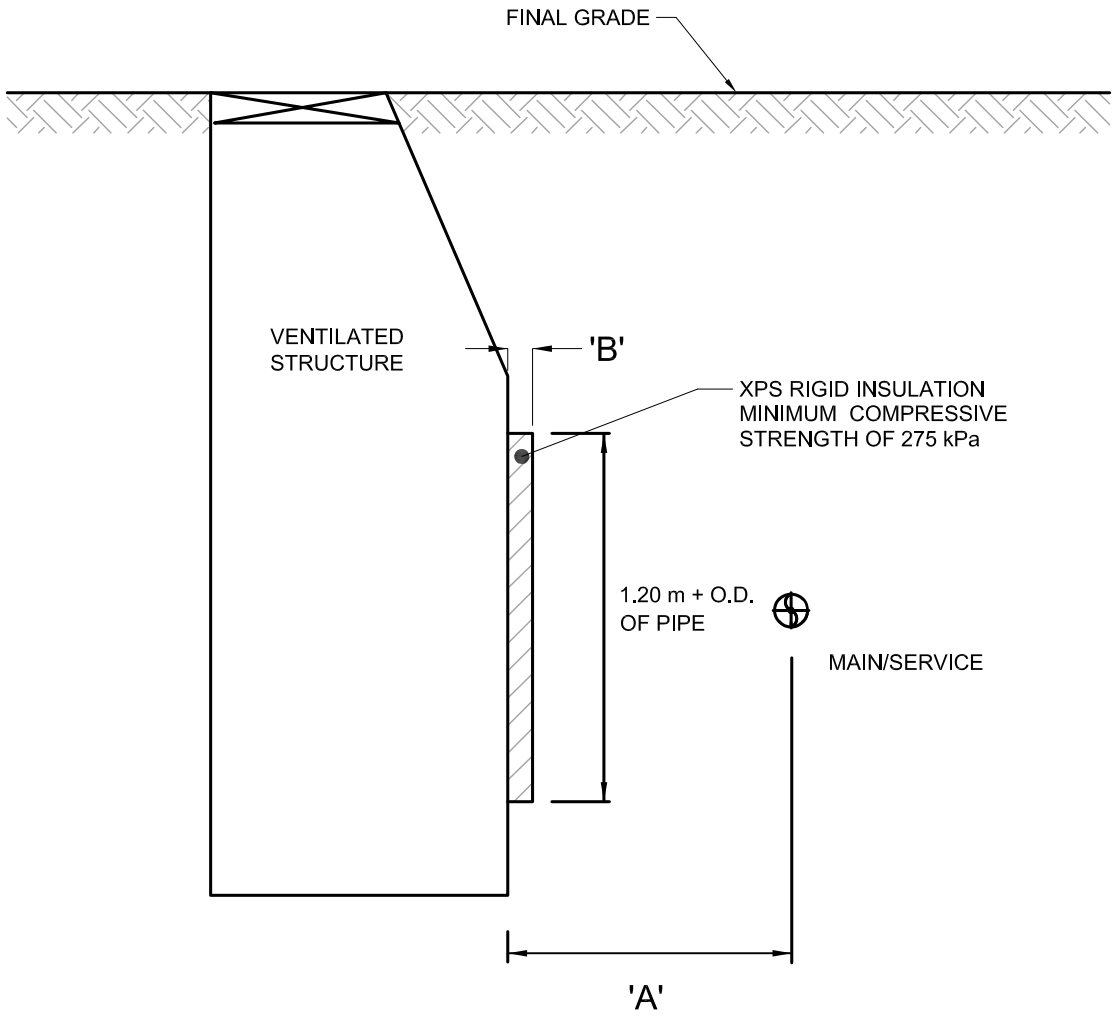
ENGINEERING SERVICES DEPARTMENT

DATE: DEC. 2021
REV: JAN. 2023
N.T.S.

W-312A

DRAWN BY: E. KERR

T:\WATER STANDARD DRAWING\SPECW300\REVISION\W-312(REV).DWG



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

THE CORPORATION OF THE CITY OF BRANTFORD

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

ENGINEERING SERVICES DEPARTMENT

DATE: DEC. 2021	N.T.S.
REV: JAN. 2023	
W-312B	DRAWN BY: E. KERR

T:\WATER STANDARD DRAWING\SPECW300\REVISION\W-312(REV).DWG

SANITARY AND STORM SEWER INSPECTION AND TESTING PLAN

SANITARY / STORM SEWER INSPECTION AND TESTING PLAN

PROJECT NAME:	
FROM - TO / DESCRIPTION	
CONTRACTOR NAME	
DATE SUBMITTED	
ANTICIPATED DATE OF TESTING	

GENERAL NOTES:

The Sanitary and Storm Sewer Inspection and Testing Plan:

- Must be submitted and approved by the City prior to any sewer installation;
- In accordance with the latest version of the Linear Design and Construction Manual, City of Brantford, and MECP Design Criteria for Sanitary Sewers, Storm Sewers and Forcemains;
- Testing activities shall be carried out by a Qualified Contractor, NASSCO Certification is required;
- The City does not provide water meters and backflow prevention devices for leakage tests; and
- Duplicate tables as needed.

1. VISUAL INSPECTION

Prior to visual inspection, all sewer pipes shall be cleaned and flushed. Visual Inspection of all Sewers and Maintenance Holes shall be completed as part of this stage of Inspection and Testing. Photo Logs shall be maintained and submitted to the City once completed to demonstrate that there are no defects, leaks, debris and to ensure proper benching of maintenance holes.

STAGE: Cleaning and Flushing of Sanitary and Storm Sewers	CITY COMMENTS	INITIAL
Sanitary Sewers: Street Name (From Street Name to Street Name) Street Name (From Street Name to Street Name) **Storm Sewers:** Street Name (From Street Name to Street Name) Street Name (From Street Name to Street Name)		
DESCRIPTION OF WORK: Contractor to Complete Works, Equipment to be used, Process to be Implemented		

STAGE: CCTV Videos and Reports	CITY COMMENTS	INITIAL
Sanitary Sewers: Street Name (From Street Name to Street Name) Street Name (From Street Name to Street Name) **Storm Sewers:** Street Name (From Street Name to Street Name) Street Name (From Street Name to Street Name)	- *CCTV Inspection shall be in accordance with OPSS.MUNI 409 and City of Brantford Linear Design and Construction Manual*	
DESCRIPTION OF WORK: Contractor to Complete Works, Equipment to be used, Process to be implemented	- *CCTV Videos to be submitted digitally, CCTV Report to be submitted digitally and in Hard Copy (1)*	

2. Deflection Testing

Upon completion of the visual inspection, cleaning and flushing and CCTV Videos, Deflection Testing is required for all flexible pipes (Storm and Sanitary). Deflection Testing shall be in accordance with OPSS.MUNI 438 or OPSS.MUNI 434.

STAGE: Deflection Testing	CITY COMMENTS	INITIAL
Sanitary Sewers: Street Name (From Street Name to Street Name) Street Name (From Street Name to Street Name) **Storm Sewers:** Street Name (From Street Name to Street Name) Street Name (From Street Name to Street Name)	- *Testing Results are to be provided to the City in Report Form (Digital and Hard Copy (1))* - *Laser profiling shall conform to OPSS.MUNI 434*	
DESCRIPTION Contractor to Complete Works, Equipment to be used, Process to be implemented, Method for Passing Mandrel (Pulled, Air Blower, etc.)		

DEFLECTION TESTING will be completed in accordance with OPSS.MUNI 438 or OPSS.MUNI 434:

1. Deflection Testing shall occur a minimum 30 Days after backfilling, but prior to paving.
2. City of Brantford Allowable Deflection shall be 5%.
3. Mandrel “Go No Go” proofing shall be completed in the presence of a City Inspector prior to performing the first mandrel tests.
4. The allowable deflection for PVC SDR 35 is provided below:

SDR 35 PVC

Nominal Pipe Dia. (mm)	Pipe Base Inside Dia. (mm)	Allowable Deflection 5% (mm)
100	98.40	93.48
150	146.50	139.18
200	196.11	186.30
250	245.16	232.90
300	291.86	277.27
375	357.25	339.39
450	436.64	414.81
525	514.77	489.03
600	579.11	550.15

3. LEAKAGE TESTING

Leakage testing shall be performed on all new Sanitary Sewers and maintenance holes to ensure integrity of the conveyance system, unless otherwise approved by the City. Prior to performing a leakage test, both active and inactive service connections and stubs shall be identified using dye testing or other equivalent methods. The following are acceptable leakage tests for Sanitary Sewers and maintenance holes:

A. Low Pressure Air Testing.
B. Water (Hydrostatic) Testing.
C. Infiltration Testing.

Complete ONE of the following tables below (based on test selected)

A. LOW PRESSURE AIR TEST

Low Pressure Air Testing shall be used as the preferred leakage test. Test pressure shall be adjusted to compensate for ground water pressure in accordance with OPSS. Test pressure shall not exceed 62 Kpa (9 psi) to avoid over pressurizing.

LOW PRESSURE AIR TEST							CITY COMMENTS	INITIAL
STREET	**TEST SECTION (MH#1 – MH#2)**	**PIPE DIAMETER (mm)**	**PIPE LENGTH (m)**	**GROUNDWATER ELEVATION (m) (above invert)**	**PRESSURE (kPa)**	**TEST DURATION (mm:ss)**		

TESTING WITH AIR will be completed in accordance with OPSS.MUNI 410:

1. All service laterals shall be plugged using plugs designed to withstand test pressures, plugs shall be suitably braced for additional safety.
2. A pressure relief valve is required and shall be set to 62KPa (9 psi) Max to avoid over pressurizing.
3. Air control equipment shall include a monitoring pressure gauge with pressure range from 0 – 60kPa with minimum divisions of 0.5kPa.
4. Test pressure shall be 24kPa where groundwater is not present.
5. If groundwater is above the pipe being tested, the air pressure shall be increased by 3.0kPa for each 300mm that the groundwater level is above the invert of the pipe.
6. The air pressure shall be stabilized for five (5) minutes and then regulated to maintain it to 20.5kPa plus allowance for groundwater, if any. After the stabilization period, the time taken for a pressure loss of 3.5kPa shall be recorded.

Minimum Time (mm:ss)		
Nominal Pipe Diameter (mm)	Time based on Minimum Length	Time based on per meter length
200ø	(<91m Length) = 3:47	Length times 2.493 seconds per meter
250ø	(<73m Length) = 4:43	Length times 3.893 seconds per meter
300ø	(<61m Length) = 5:40	Length times 5.606 seconds per meter

B. WATER (HYDROSTATIC) TEST

Testing with Water shall occur with a minimum head in the upstream maintenance hole of 600mm over the crown of the pipe or at least 600mm above the existing groundwater level, whichever is greater. The maximum limit differential head in the test section cannot exceed 8m. Water Testing shall not occur when freezing temperatures exist.

WATER (HYDROSTATIC) TEST		CITY COMMENTS	INITIAL
Pipe Segment:			
Length of test section			
Diameter of test section			
Allowable leakage volume for 1 hr (Pipe Segment + Manhole Allowance)			
Pipe Segment:			
Length of test section:			
Diameter of test section			
Allowable leakage volume for 1 hr (Pipe Segment + Manhole Allowance)			

TESTING WITH WATER will be completed in accordance with OPSS.MUNI 410 and shall use clean water:

1. If the City's watermain distribution system will be the source water, a tested and certified RPZ backflow preventer and water meter shall be installed at every connection.
2. All service laterals shall be plugged using plugs designed to withstand test pressures, plugs shall be suitably braced for additional safety.
3. During re-testing, Maintenance Holes shall be tested separately from Sewers.
4. Allowable Leakage Rate (Hydrostatic Testing): 0.075 Litres per millimeter of pipe diameter per 100 meters of pipe sewer per hour with an allowance of 3.0 litres per hour per meter of head above the invert for each maintenance hole included in the test section.
5. Water used for testing shall be disposed as per all applicable requirements.

C. INFILTRATION TEST

INFILTRATION TEST		CITY COMMENTS	INITIAL
Infiltration		*Testing to be in accordance with OPSS.MUNI 410 for Hydrostatic Testing*	
Length of test section			
Diameter of test section			
Allowable leakage volume for 1 hr			
***Infiltration**		*Testing to be in accordance with OPSS.MUNI 410 for Hydrostatic Testing*	
Length of test section			
Diameter of test section			
Allowable leakage volume for 1 hr			

*Infiltration Testing shall be conducted only when the groundwater level at the time of testing is 600mm or more above the crown of the pipe for the entire length of the test section.

Infiltration Testing will be completed in accordance with OPSS.MUNI 410:

1. All service laterals shall be plugged;
2. During re-testing, Maintenance Holes shall be tested separately from Sewers.
3. Allowable Infiltration Rate: 0.075 Litres per millimeter of pipe diameter per 100 meters of pipe sewer per hour.
4. Dewatering activities shall be discontinued for at least 3 days prior to conducting the test to allow for the groundwater level to stabilize.

4. ATTACHMENTS

Attach a drawing(s) or sketch(s) showing the entire sewer, testing sections (if more than 1 stage), test pressure and differential pressures (as applicable due to elevation change, etc.), procedures, equipment, schedule, safety requirements, and emergency response plan.

Inspection & Testing 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: