Ontario

Design Criteria for
Sanitary Sewers, Storm Sewers and Forcemains for Alterations Authorized under Environmental Compliance Approval

Ministry of Environment, Conservation and Parks

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Version History

Version	Date	Comments
1.0	April 22, 2022	Initial Publication
1.1	July 28, 2022	Minor corrections in section 5 (Storm Sewers) 5.4.1: the minimum service connections shall be ~~100mm~~ 150mm 5.11.3: the minimum diameter of the catch basin lead is ~~250mm~~ 100mm
1.2	January 23, 2022	Minor update to clarify section 2 (Design of Sanitary Sewers) - Removed 2.9.1 (1) ~~The Sewer pipes, pipe joints, and connections shall be designed to withstand a pressure of at least 45 psi without leakage~~. - Removed 2.9.2 ~~Where the SHGWT is unknown, Sewers shall be designed with assumption that they are installed 0.6 m below SHGWT.~~ - Added 2.9.2: Where the SHGWT level is determined and supporting record is available, the Sewer pipes, pipe joints, and connections shall be designed to withstand a pressure of at least 1.25 times the pressure exerted by the groundwater above the sewer without leakage. - Added 2.9.3: Where the SHGWT is unknown and/or the supporting record is not available, the Sewer pipes, pipe joints, and connections shall be designed to withstand a pressure based on the equivalent of at least 1.25 times the pressure exerted by the groundwater being at the ground surface elevation above the Sewer without leakage. - Minor updates to numbering: 2.9.1(2) becomes 2.9.4 and 2.9.1(3) becomes 2.9.5 Minor update to Section 8 (Leakage Testing) 8.3.3 All *new and inactive* service laterals shall be plugged using plugs designed to withstand test pressures, plugs shall be suitably braced for additional safety. All inactive service connections shall be sealed.

Table of Contents

List of Tables

Appendices

Preface

The Design Criteria establish the minimum design requirements for Alteration to an existing Municipal Sewage Collection System and Municipal Stormwater Management System by adding, modifying, replacing, or extending Sanitary Sewers, forcemains, or Storm Sewers to satisfy one of the conditions imposed by the Director in Municipal Sewage Collection System ECA and Stormwater ECA authorizing future Alterations. Compliance with this Criteria and other conditions of the ECA negates the need for the Owner of the Municipal Sewage Collection System and Municipal Stormwater Management System to apply for an amendment to the ECA for the Alteration of Sanitary Sewers, forcemains or Storm Sewers within the collection system.

The existence of these Criteria does not preclude Alteration of Sanitary Sewers, forcemains or Storm Sewers that are not designed in accordance with these Design Criteria. However, any Alterations to collection systems that are either not designed in accordance with this Design Criteria or does not satisfy the conditions of the ECA are subject to the requirement to obtain an amendment to the ECA prior to proceeding with the undertaking.

Other approving authorities, such as municipalities in which the works are constructed or regional governments, may have servicing standards or criteria that are more stringent than the requirements outlined in the Design Criteria and they shall be considered acceptable for the purposes of complying with the requirements of the Design Criteria.

The Design Criteria document reflect program decisions that would be routinely made by the approving Director that issues ECAs under the authority of the Ontario Water Resources Act and the Environmental Protection Act. The Design Criteria may be updated from time to time by the Director or in order to conform to any future changes to the provincial policy, regulation or legislation that apply to Sanitary Sewers, forcemains or Storm Sewers.

Definitions

For the purpose of this Design Criteria, the following definitions apply:

“Adverse Effect(s)” has the same meaning as defined in section 1 of the EPA.

“Alteration(s)” includes the following, includes the following, in respect of the Authorized System, but does not include repairs to the system:

a) An extension of the system,

b) A replacement of part of the system, or

c) A modification of**,** addition to or enlargement of the system.

“Appurtenance(s)” has the same meaning as defined in O. Reg. 525/98 (Approval Exemptions) made under the OWRA.

“Authorized System” means the Sewage Works authorized under an Environmental Compliance Approval for a Municipal Sewage Collection System or an Environmental Compliance Approval for a Municipal Stormwater Management System.

“Collection System Overflow(s)” means a discharge (SSO or CSO) to the environment at designed location(s) from the Authorized System.

“Combined Sewer(s)” means pipes that collect and transmit both sanitary Sewage and other Sewage from residential, commercial, institutional and industrial buildings and facilities and Stormwater runoff through a single-pipe system, but does not include Nominally Separate Sewers.

“Combined Sewer Overflow(s)” or “(CSO)” means a combined sewer overflow which is a discharge to the environment at designated location(s) from a Combined Sewer or Partially Separated Sewer that usually occurs as a result of precipitation when the capacity of the Sewer is exceeded. An intervening time of twelve hours or greater separating a CSO from the last prior CSO at the same location is considered to separate one overflow Event from another.

"CWA" means the *Clean Water Act*, R.S.O. 2006, c.22.

“Design Criteria” means the design criteria set out in the Ministry’s publication “Design Criteria for Sanitary Sewers, Storm Sewers and Forcemains for Alterations Authorized under Environmental Compliance Approval”, (as amended from time to time).

"Director" means a person appointed by the Minister pursuant to section 5 of the EPA for the purposes of Part II.1 of the EPA.

“ECA” means an Environmental Compliance Approval.

"Emergency Situation" means a structural, mechanical, electrical failure, or operational health and safety incident, that causes a temporary reduction in the capacity, function or performance of any part of the Authorized System or an unforeseen flow condition that may result in:

a) Danger to the health or safety of any person;

b) Injury or damage to any property, or serious risk of injury or damage to any property;

c) Adverse Effect to the Natural Environment; or;

d) Spill.

"EPA" means the Environmental Protection Act, R.S.O. 1990, c.E.19;

"Event(s)" means an action or occurrence, at any given location within the Authorized System that causes a Collection System Overflow. An Event ends when there is no recurrence of a CSO or SSO in the Collection System at the same location in the 12-hour period following the last Collection System Overflow.

"Facility" means the entire operation located on the property where the Sewage Works is located;

"Licensed Engineering Practitioner" means a person who holds a licence, limited licence, or temporary licence under the *Ontario Professional Engineers Act* R.S.O. 1990, c. P.28.

"LID" means "low impact development" a Stormwater management strategy that seeks to mitigate the impacts of increased runoff and Stormwater pollution by managing runoff as close to its source as possible. LID comprises a set of site design strategies that minimize runoff and distributed, small scale structural practices that mimic natural or predevelopment hydrology through the processes of infiltration, evapotranspiration, harvesting, filtration, and detention of Stormwater.

"MTD" means manufactured treatment device;

"Minister" means the Minister of the Ministry or such other member of the Executive Council as may be assigned the administration of the EPA and OWRA under the *Executive Council Act*, R.S.O. 1990, c. E.25;

"Ministry" means the Ministry of the Minister and includes all employees or other persons acting on its behalf;

"Municipal Sewage Collection System" means all Sewage Works located in the geographical area of a municipality that collect and transmit sanitary Sewage and are owned, or may be owned pursuant to an agreement with a municipality entered into under the *Planning Act* or *Development Charges Act*, 1997, by:

a) A municipality, a municipal service board established under the *Municipal Act*, 2001 or a city board established under the *City of Toronto Act*, 2006; or;

b) A corporation established under sections 9, 10 and 11 of the *Municipal Act*, 2001 in accordance with section 203 of that *Act* or under sections 7 and 8 of the *City of Toronto Act*, 2006 in accordance with sections 148 and 154 of that Act;

“Municipal Stormwater Management System” all Sewage Works, located in the geographical area of a municipality, that collect, transmit, or treat Stormwater and are owned, or may be owned pursuant to an agreement entered into under the Planning Act or Development Charges Act, 1997, by:

a) A municipality, a municipal service board established under the Municipal Act, 2001 or a city board established under the City of Toronto Act, 2006; or

b) A corporation established under sections 9, 10 and 11 of the Municipal Act, 2001 in accordance with section 203 of that Act or under sections 7 and 8 of the City of Toronto Act, 2006 in accordance with sections 148 and 154 of that Act.

“Natural Environment” has the same meaning as defined in section 1 of the EPA;

"Nominally Separate Sewer(s)" mean Separate Sewers that also have connections from roof leaders and foundation drains, and are not considered to be Combined Sewers;

“Operating Authority” means, in respect of the Sewage Works, the person, entity or assignee that is given responsibility by the Owner for the operation, management, maintenance or Alteration of the Sewage Works or a portion of the Authorized System;

"Owner" means the owner of the Authorized System.

"OWRA" means the *Ontario Water Resources Act*, R.S.O. 1990, c. O.40;

"Partially Separated Sewer(s)" means Combined Sewers that have been retrofitted to transmit sanitary Sewage but in which roof leaders or foundation drains still contribute Stormwater inflow to the Partially Separated Sewer;

"Procedure F-5-5" means the Ministry document titled “F-5-5 Determination of Treatment Requirements for Municipal and Private Combined and Partially Separated Sewer System” (as amended from time to time);

“Sanitary Sewer(s)” means pipes that collect and transmit wastewater from residential, commercial, institutional and industrial buildings;

“Separate Sewer(s)” means pipes that collect and transmit sanitary Sewage and other Sewage from residential, commercial, institutional, and industrial buildings;

“Sewage” has the same meaning as defined in section 1 of the OWRA;

“Sewage Works” has the same meaning as defined in section 1 of the OWRA*;*

“Sewer” has the same meaning as in O. Reg. 525/98 under the OWRA;

"Significant Drinking Water Threat" has the same meaning as defined in section 2 of the CWA*;*

"Source Protection Plan" means a drinking water source protection plan prepared under the CWA;

“Spill(s)” has the same meaning as defined in subsection 91(1) of the EPA;

“Standard Operating Policy for Sewage Works” means the standard operating policy developed by the Ministry to assist in the implementation of Source Protection Plan policies related to Sewage Works and providing minimum design and operational standards and considerations to mitigate risks to sources of drinking water, as amended from time to time;

"Storm Sewer" means Sewers that collect and transmit, but not exfiltrate or lose by design, Stormwater resulting from precipitation and snowmelt;

“Stormwater” means rainwater runoff, water runoff from roofs, snowmelt and surface runoff;

“Stormwater Management Facility(ies)” means a Facility for the treatment, retention, infiltration or control of Stormwater;

“Stormwater Management Planning and Design Manual” means the Ministry document titled “Stormwater Management Planning and Design Manual”, 2003 (as amended from time to time);

“Stormwater Treatment Train” means a series of Stormwater Management Facilities designed to meet stormwater management objectives (e.g., Appendix A of ECA) for a given area, and can consist of a combination of MTDs, LIDs and end-of-pipe controls**;**

“Third Pipe Collection System” means Sewage Works designed to collect and transmit foundation drainage and/or groundwater to a receiving surface water or dry well;

“Uncommitted Reserve Hydraulic Capacity” means uncommitted reserve capacity as described in MECP’s Procedure “D-5-1 Calculating and Reporting Uncommitted Reserve Capacity at Sewage and Water Treatment Plants” (as amended from time to time);

1.0. INTRODUCTION

The Design Criteria establish the minimum design requirements for Alteration to a Municipal Sewage Collection System and Municipal Stormwater Management System to satisfy one of the conditions imposed by the Director in Environmental Compliance Approval (ECA) for a Municipal Sewage Collection System and ECA for a Municipal Stormwater Management System, authorizing future Alterations. The designers and proponents of such works are responsible to ensure that all the applicable federal and provincial requirements are incorporated in the design and construction of Sanitary Sewers, Storm Sewers, and forcemains. Where regulations and standards are referenced in this document, most recent version shall be used.

1.1. General Requirements

1.1.1. Alteration to an existing Municipal Sewage Collection System by adding, modifying, replacing, or extending existing sanitary or forcemains, and/or Appurtenances, is not permitted when such works;

1. Results in exceedance of hydraulic capacity of the downstream Municipal Sewage Collection System including Sewage pumping stations and Uncommitted Reserve Hydraulic Capacity of the receiving Sewage treatment plants;
2. Causes an Adverse Effect;
3. Any increase in Collection System Overflows and or deterioration of quality of the overflow discharge, that is not offset by measures; or
4. Adversely impacts the approved effluent quality of Sewage treatment Facilities, or its bypasses or overflows.

1.1.2. The existing Municipal Sewage Collection System may be altered by adding, modifying, replacing, or extending existing Sanitary Sewers or forcemains, Appurtenances, and other components of these systems that are pre-authorized in the ECA, subject to the following conditions;

1. The design for addition, modification, replacement, or extension of Sanitary Sewers, forcemains and/or Appurtenances;
    a. Has been prepared by a Licensed Engineering Practitioner;
    b. Has been designed to transmit but not to treat wastewater; and
    c. Satisfies or exceeds the minimum requirements specified in the Design Criteria.
2. Uncommitted Reserve Hydraulic Capacity calculations for the downstream Municipal Sewage Collection System and treatment Facilities including allowances for infiltration and inflow has been prepared and submitted by the proponent to the Owner with the supporting documentation as required by the Owner.
3. The Owner has a plan and process to forecast and track Uncommitted Reserve Hydraulic Capacity and verify the proposed Alteration of the system can be accommodated.
4. All required documentation detailed in this Design Criteria and/or in the ECA has been completed.

1.1.3. Alteration to an existing Municipal Stormwater Management System by adding, modifying, replacing, or extending existing Storm Sewers, and/or Appurtenances, is not permitted when such works;

1. Results in exceedance of hydraulic capacity of the downstream;
    a. Conveyance system;
    b. The receiving treatment / Stormwater Management Facilities;
2. Causes an Adverse Effect; or
3. Adversely impacts the approved effluent quality of Stormwater works.

1.1.4. The existing Municipal Stormwater Management System may be altered by adding, modifying, replacing, or extending existing Storm Sewers, Appurtenances, and other components of these systems that are pre-authorized in the ECA, subject to the following conditions;

1. The design for addition, modification, replacement, or extension of Storm Sewers, and/or Appurtenances;
    a. Has been prepared by a Licensed Engineering Practitioner;
    b. Satisfies or exceeds the minimum requirements specified in the Design Criteria; and
    c. Has been planned, designed and built to be consistent with the MECP's Stormwater Management Planning and Design Manual (March 2003).
2. All required documentation detailed in this Design Criteria and/or in the ECA has been completed.
3. Municipal Stormwater Management System should be designed using an integrated Stormwater Treatment Train approach used to minimize Stormwater management flows and reliance on end of pipe controls through measures including source controls, lot level controls, and conveyance techniques.

1.2. Design Considerations

1.2.1. All Sanitary Sewers, Storm Sewers, forcemains, maintenance holes, and chambers, shall be designed considering all relevant soil and hydrogeological conditions including groundwater elevations.

1.2.2. The design of all maintenance holes, chambers, and structures shall conform to all applicable requirements including, but not limited to: Occupational Health and Safety Act, Ministry of Labour Confined Space Guidelines and Fire Protection and Prevention Act.

1.2.3. All new maintenance holes and chambers shall be designed with explicit and documented consideration for future inspection, operation, and maintenance requirements.

1.2.4. All precast structures installed in frost-susceptible soils shall include necessary hardware to prohibit heave due to frost action unless alternative methods are employed to mitigate frost heaving.

1.2.5. Sewers, maintenance holes, and/or Appurtenances shall be avoided where possible in areas subject to flooding or in areas of high groundwater (regular and seasonal).

1.2.6. If Sewers, maintenance holes and/or Appurtenances are located in areas subject to flooding/high groundwater, Inflow and Infiltration reduction, and flotation prevention measures shall be included in the design.

1.2.7. The design shall include in the project specifications requirements for;

1. Mandatory inspection and testing as per Section 8 of this document; and
2. Adequate control of siltation and erosion during construction.

1.3. Protection of drinking water sources

1.3.1. An assessment of the proposed works shall be completed to determine if the works pose a Significant Drinking Water Threat and if they are, the design shall incorporate features that mitigate the threat to sources of drinking water, such as those included in:

1. Ministry's Standard Operating Policy for Sewage Works as amended from time to time; and
2. Source Protection Plan policies pertaining to the works.

Refer to Appendix I for Understanding Risks to Sources of Drinking Water.

1.4. Protection of Water Supplies

1.4.1. Sanitary Sewers, Storm Sewers, forcemains, and all associated Appurtenances and structures shall be designed with provisions to provide the required protection for drinking water supply systems in accordance with;

1. The MECP's F-6-1 Procedures to Govern Separation of Sewers and Watermains; and
2. Section 15 of the MECP's Watermain Design Criteria for Future Alterations Authorized Under a Drinking Water Works Permit.

2.0. DESIGN OF SANITARY SEWERS

2.1. Design Flows

2.1.1. Residential Flows

1. The average daily residential flows of 225 to 450 L/cap/day shall be used in the design for sizing the pipe.
2. Peaking factor can be calculated using either the Harmon Formula or Babbitt Formula. At minimum, a peaking factor of 2.0 shall be used in the design.

2.1.2. Commercial Flows

1. The minimum allowance for commercial flows shall be 28 m^3/ha/day. Actual flow monitoring data (covering at least 2 years) at the subject site or a similar site observed locally can be used.
2. The Sewage flows listed on Table 1 may be used in the design for individual commercial facilities, provided that the minimum flow capacity listed in 2.1.2.1 are maintained for the development.

2.1.3. Institutional Flows

1. Historical water use data at the subject site or a similar site (covering at least 2 years) of the facility or other similar facilities can be used to calculate average institutional flows. Where historical water use data is not available, the unit values for institutional flows listed in Table 1 can be used. The designer shall use professional judgement to select appropriate flow rate within the range.

2.1.4. Industrial Flows

1. Where available, actual sanitary flow monitoring data at the subject site or a similar site (covering at least 2 years) shall be used for accurate prediction of industry specific wastewater flows. Where actual flow data is not available, an average flow from 0.2 to 0.5 L/s/ha can be used.

2.1.5. Extraneous Flow (I&I)

1. A long-term (end-of-pipe life) peak inflow and infiltration (I&I) rate allowance of up to 0.28 L/s/ha shall be used in pipe sizing to maintain capacity throughout the designed life of the sewers.

Table 1 - Common Sewage Flowrates for Commercial and Institutional Uses

Description	Unit Sewage Flow (L/d)	Flow Unit Per
Shopping Centre (floor area in m^2)	2.5 – 5.0	Total floor area in m^2
Hospitals	900 – 1,800	Bed
Schools	70 - 140	Student
Travel Trailer Parks	340	Space (without water hook-ups)
	800	Space (with individual. water hook-ups)
Campgrounds	225 - 570	Campsite
Mobile Home Park	1,000	Parking space
Motels	150 - 200	Bed space
Hotels	225	Bed space

2.2. Friction Factors

2.2.1. Sanitary Sewers shall be designed using either the Chézy- Kutter, Darcy Weisbach, or Chézy-Manning's formula. Appropriate roughness coefficient shall be used according to the type of pipe used. The friction loss coefficient must be appropriate to the installed pipe, but not less than the equivalent of a Manning's equation "n" of 0.013 for all new smooth-wall Sewer pipes.

2.3. Pipe Diameters

2.3.1. The minimum size of the gravity Sewer in a Municipal Sewage Collection System shall be 200 mm in diameter (nominal pipe size). Sewer pipe 150 mm in diameter can be used if it is demonstrated in the design that there is no risk of clogging and the design is accepted by the Owner.

2.4. Flow Velocity

2.4.1. Gravity Sewers shall be designed with uniform slopes between the maintenance holes.

2.4.2. All gravity Sanitary Sewers shall be designed and constructed with slopes to provide at least 0.6 m/s of flow velocity, when flowing full to maintain solids in suspension.

2.4.3. In certain circumstances, such as rehabilitation/replacement of an existing Sewer where deepening of individual Sewer section will not be possible, design flow velocities of less than 0.6 m/s may be considered provided that appropriate measures are taken to facilitate frequent flushing and maintenance needs and the Owner accepts the increased maintenance requirements.

2.4.4. The maximum velocity in all Sanitary Sewers shall be less than or equal to 3.0 m/s at peak flows to minimize erosion.

2.5. Anchors/Restraints

2.5.1. Sanitary Sewers on 20 percent slope or greater shall be anchored securely with concrete anchors or equal.

2.5.2. Anchors and anchorage spacing shall be designed by a Licensed Engineering Practitioner based on Sewer material, anchor type and site conditions. Recommended maximum

anchorage spacing is 11 m on grades between 20 percent and up to 35 percent, 7.3 m on grades between 35 percent and up to 50 percent, and 4.9 m on grades that exceed 50 percent.

2.5.3. Where velocity in the Sanitary Sewers approaching or exceeding 3 m/s due to steep grades and providing a drop maintenance hole is not possible, receiving sewers shall be designed for protection against maximum scouring velocity and erosion control measures, that are acceptable to the Owner shall be taken.

2.6. Pipe Material

2.6.1. All material used in the addition, modification, replacement, or extension of Sanitary Sewers including pipes, fittings, valves, devices, and materials used for the rehabilitation shall meet all applicable quality conditions adopted by the Ontario Provincial Standards for Roads and Public Works and/or local municipal standards. Where applicable standards conflict, the more stringent standard shall apply.

2.6.2. Prior to specifying pipe material, soils shall be assessed for contamination and for the presence of compounds that may negatively impact the suitability of the proposed materials. Nitrile gaskets or equivalent shall be specified for soils contaminated with hydrocarbons unless soil remediation prior to construction provides satisfactory results.

2.6.3. If the material is used based on specific site conditions, the reasons for material selection shall be stated and location shall be identified in the record / as-built drawings.

2.7. Pipe Strength

2.7.1. The Sanitary Sewer pipe material selected for a particular application shall be able to withstand all the combinations of loading conditions to which the pipe is likely to be exposed, along with an appropriate safety factor.

2.8. Pipe Cover and Frost Protection

2.8.1. Sanitary Sewers shall be installed at sufficient depth (greater than local frost penetration) to prevent freezing. If this is not achievable, the Sewer shall be insulated to provide the required protection. Insulation must be designed or verified by a Licensed Engineering Practitioner or where available as per the local municipal standards acceptable to the Owner.

2.8.2. For Sanitary Sewers subject to traffic load, a loading factor in accordance with the regulations, codes, and by-laws of authorities having jurisdiction shall be considered for selecting depth of pipe cover. This includes but not limited to: Highway Bridge Design Code (for vehicular traffic), Railway Safety Act, and Transport Canada Act. Appropriate structural support shall be provided to the pipes as required.

2.8.3. Maximum pipe cover should be as per the manufacturer recommendations.

2.9. Sanitary Sewers and Maintenance Holes Installed Below Seasonally High Groundwater Table

2.9.1. Sanitary Sewer systems which are installed lower than 0.6m below the Seasonally High Groundwater Table (SHGWT) shall be designed to minimize infiltration.

2.9.2. Where the SHGWT level is determined and supporting record is available, the Sewer pipes, pipe joints, and connections shall be designed to withstand a pressure of at least 1.25 times the pressure exerted by the groundwater above the sewer without leakage.

2.9.3. Where the SHGWT is unknown and/or the supporting record is not available, the Sewer pipes, pipe joints, and connections shall be designed to withstand a pressure based on the equivalent of at least 1.25 times the pressure exerted by the groundwater being at the ground surface elevation above the Sewer without leakage.

2.9.4. The sanitary maintenance holes shall be externally wrapped with Waterproof membrane placed externally around all precast joints, including joints below the maintenance hole frame and cover, with a minimum 300mm wide strip.

2.9.5. Buoyancy of Sewers and maintenance holes shall be considered in the design, and where required, adequate provision shall be made to prevent flotation.

2.10. Sanitary Maintenance Holes

2.10.1. Maintenance holes shall be provided at the end of each Sewer line; at all changes in grade, size, or alignment; at all pipe intersections and/or at a distance not greater than 120 m for Sewers up to 400 mm in diameter, and 150 m for Sewers between 450 mm to 750 mm in diameter.

2.10.2. In circumstances where maintenance holes cannot be provided, an upstream maintenance hole is required at 30 m (max) from where a maintenance hole could not be placed to facilitate maintenance.

2.10.3. An additional straight-through maintenance hole with similar upstream and downstream sloped Sewers shall be provided between new subdivisions and the Municipal Sewage Collection System, or at other appropriate location(s) for the purposes of flow monitoring from new subdivisions. The maintenance hole must either include or allow for the insertion of flow monitoring equipment.

2.10.4. The minimum drop across maintenance holes shall be minimum 25 mm for straight runs and 50 mm for 90-degree bends. Alternately, Sewer grade may be maintained across maintenance holes provided minimum required flow velocity is maintained (as outlined in this document).

2.10.5. Where a smaller diameter Sewer line joins a larger one, the invert of the larger Sewer shall be lowered where practical, to maintain the same energy gradient, or the pipe obverts are matched.

2.10.6. A drop structure shall be provided for Sewers entering a maintenance hole at an elevation of 610 mm or more above the maintenance hole outlet pipe invert;

1. An external drop structure is recommended for all new maintenance holes. An internal drop structure can be used if;
    a. Accepted by the Owner;
    b. There is adequate space to allow for internal drop structure and unobstructed maintenance access; and
    c. The structure is provided with restraint straps or equivalent.
2. Where drop structure is not feasible, alternative methods of energy dissipation from falling flow and minimizing air entrainment and odors problems shall be specified.

2.10.7. Maintenance holes shall be located away from any route or ponding area. Grading around maintenance holes shall be benched to direct water away from the maintenance hole.

2.10.8. In cases where the sanitary maintenance hole cannot be located away from an overland flow route for a 25-year storm event or cannot be benched, an analysis must be completed to verify;

1. If the overland flow will submerge the maintenance hole. Watertight design, including water-tight covers, shall be specified for submerged sanitary maintenance holes, and
2. Where more than one consecutive sanitary maintenance hole requires sealing due to exposure to overland flow, appropriate ventilation shall be provided.

2.10.9. Frost straps (internal or external) shall be provided to hold maintenance hole sections together (at least two (2) between each section). External straps to extend vertically from top to bottom and for deep maintenance holes extended at least 1 m below frost depth.

2.10.10. Joints between maintenance hole sections, and inlet and outlet pipes shall be sealed with gasketed flexible watertight connections. Where works are cast-in-place, sealing is required only at the point of connection between individual components of the maintenance hole structures.

2.10.11. Maintenance holes shall be designed based on the pipe size, alignment, and inspection and maintenance needs. The minimum diameter of maintenance holes shall be 1200 mm (48 in). A minimum access diameter of 610 mm (24 in) shall be provided.

2.10.12. Safety platforms or alternate safety measures shall be employed for deep maintenance holes as per Occupational Health and Safety Act requirements and inspection, operation, and maintenance needs. Multiple platforms may be required based on the depth of the maintenance holes.

2.11. Inverted Siphons

2.11.1. Inverted siphons shall be designed with consideration of potential siltation, grease and debris accumulation, air locking, maintenance, and odor issues.

2.11.2. The minimum pipe size for inverted siphons shall be nominally 200 mm in diameter.

2.11.3. Pipes shall be sized such that a Self-Cleansing velocity between 1.1 m/s to 1.3 m/s is achieved at least once per day. Where the required velocities cannot be achieved alternate means of flushing shall be incorporated in the design.

2.11.4. Gravity drains or any other means of draining or dewatering the inverted siphon shall be incorporated to facilitate inspection and maintenance.

2.11.5. Air jumpers shall be sized to carry the required air flow between the inlet and outlet chambers. Maintenance measures for air jumpers shall be incorporated as required.

2.11.6. Inverted siphons shall be designed with at least two (2) parallel barrels to accommodate flow variations. If a double barrel siphon is not feasible, a single barrel inverted siphon is acceptable provided that additional arrangements are incorporated in the design to facilitate inspection, operation, and maintenance.

2.11.7. Inverted siphons shall be equipped with inlet and outlet chambers sized to facilitate inspection, operation, and maintenance.

2.11.8. Control valves/sluice gates shall be installed in inlet and outlet chambers especially on multi-barrel siphons to isolate or divert flows to each pipe.

2.11.9. Inverted siphons shall not be designed with sharp vertical or horizontal bends. The slope for the upward vertical leg shall be limited to 2:1 (H:V).

2.11.10. Ventilation is required at the Inlet and Outlet chambers.

2.12. Service Connections (Service Laterals)

2.12.1. All service connections shall be constructed to be watertight.

2.12.2. The minimum diameter for a service connection to main Sewer for gravity flow shall be 100 mm in diameter. Sanitary Sewer pipes shall be colour coded green to avoid cross connections. Color coding method includes pipe color, wrapping, demarcation tape, or stenciling.

2.12.3. Sanitary laterals and sanitary service connections shall be specified with a minimum 1% slope (2% slope is recommended).

2.12.4. Where required, the riser pipe on the sanitary service pipe should be installed at a maximum 1:1 slope where feasible, before transitioning to a nominally horizontal installation. The transition from the nominally horizontal section to the steep section should be completed with a long radius bend.

2.12.5. Cleanouts if installed, should be located at or near the property line to facilitate inspection, or as required by the local municipal standard.

2.12.6. Maintenance hole should be provided for commercial service connections, or residential service connection servicing more than five (5) buildings.

2.12.7. Tracer wire is recommended for service connections where feasible as determined by the design engineer.

3.0. DESIGN OF FORCEMAINS

3.1. Pipe Diameters

3.1.1. The minimum size for a Sewage forcemain shall be 100 mm in diameter.

3.1.2. A smaller diameter forcemain may be acceptable if it is used to maintain the minimum velocity in the forcemain (as outlined in this document). A grinder pump or equivalent shall be provided for such applications and Design Brief including detailed hydraulic calculations shall be prepared by a Licensed Engineering Practitioner.

3.2. Friction Factors

3.2.1. Forcemains shall be designed using Hazen-Williams formula or Darcy -Weisbach equation. Hazen- Williams formula is recommended for design of forcemains. Where data are not available, the forcemains shall be designed using the equivalent to Hazen-Williams C-factors listed in Table 2 for pipes made of traditional materials or their equivalent.

Table 2 - Hazen-Williams C-Factors

Material	C-Factor
Unlined Steel pipe, Concrete pipe	100
PVC, HDPE, lined ductile iron	120

3.3. Flow Velocity

3.3.1. Forcemains shall be designed for a cleansing velocity of at least 0.6 m/s.

3.3.2. The maximum velocity in the forcemains shall not exceed 3.0 m/s.

3.4. Anchors/Restraints

3.4.1. Restrained joints shall be installed at all tees, bends, end of forcemains, and connections for all forcemains. A Licensed Engineering Practitioner shall complete the calculation to determine the number of joints to be restrained beyond the bend, fitting, tee, etc.

3.4.2. In the case of non-restraining mechanical and/or slip-on joints, restraint shall be provided by adequately sized thrust blocks positioned at all plugs, caps, tees, line valves, reducers, wyes, and bends deflecting 22.5 degrees or more.

3.4.3. In designing thrust blocks or other restraint systems, transient pressures shall be added to the normal operating pressures when calculating the thrust forces.

3.5. Pipe Material

3.5.1. Forcemain material used in the addition, modification, replacement, extension, or rehabilitation including pipes, fittings, valves, devices, and other materials used shall meet the more stringent of quality standards adopted by Ontario Provincial Standards for Roads and Public Works or local Municipal standards.

3.5.2. Prior to specifying pipe material, soils shall be assessed for contamination and for the presence of compounds that may negatively impact the suitability of the proposed materials. Nitrile gaskets or equivalent shall be specified for soils contaminated with hydrocarbons.

3.5.3. If the material is used based on specific site conditions, the reasons for material selection shall be stated and location shall be identified in the record drawings.

3.6. Pipe Strength

3.6.1. The forcemain pipe material selected for a particular application shall be able to withstand, with a margin of safety, all the combinations of loading conditions to which the forcemain is likely to be exposed.

3.7. Pipe Cover and Frost Protection

3.7.1. Forcemains shall be installed at sufficient depth (greater than frost penetration) to prevent freezing. If this is not achievable, forcemains shall be insulated/or heat traced. Insulation/heat tracing shall be designed/verified by a Licensed Engineering Practitioner.

3.7.2. For forcemains subject to traffic loading, a loading factor in accordance with the regulations, codes and by-laws of authorities having jurisdiction shall be considered for selecting depth of pipe cover. This includes but not limited to: Highway Bridge Design Code (for vehicular traffic), Railway Safety Act, and Transport Canada Act. Appropriate structural support shall be provided to the pipes as required. If a protective sleeve is used, appropriate sleeve material shall be selected based on the site conditions.

3.7.3. Maximum pipe cover should be as per the manufacturer recommendations.

3.8. Termination

3.8.1. All forcemains shall be discharged to maintenance holes.

3.8.2. For flows greater than 30 L/s, transition maintenance holes shall be provided at forcemain discharge points to provide smooth flow transition into the receiving gravity Sewers.

3.8.3. The transition maintenance hole shall be designed based on the pipe size, alignment and inspection and maintenance needs. The minimum diameter of maintenance holes shall be 1200 mm (48 in). A minimum access diameter of 610 mm (24 in) shall be provided.

3.8.4. The forcemains shall enter the transition maintenance hole at a point not more than 0.3 m above the flow line. No other gravity Sewers shall enter the transition maintenance hole.

3.8.5. Protective coatings or corrosion resistant material shall be used in the maintenance holes to prevent deterioration due to presence of hydrogen sulfide or other corrosive chemicals.

3.8.6. The Sewer connecting the transition maintenance hole to downstream maintenance hole shall be sized to flow at half depth to ensure a smooth flow.

3.8.7. Safety platforms or alternative safety measures shall be incorporated in the designed for deep maintenance holes per Occupational Health and Safety Act and any other municipal requirements.

3.9. Identification

3.9.1. A Tracer Wire shall be installed for all non-metallic forcemains regardless of the size, identifier codes, or markings can be added to identify the use of pipe in conformance with local municipal standards. Where metallic pipe is used tracer wire shall be provided at the material transition point to ensure electrically conductive connection point for future detection.

3.10. Maintenance

3.10.1. All new forcemains longer than 150 m shall be provided with swab launching ports and/or flushing ports. Swab catching ports may be required.

3.10.2. Isolation valves shall be provided as required to facilitate maintenance. Non-return valves may be required when forcemains are connecting into a common forcemain.

3.10.3. Cleanouts/drain chambers shall be provided at low points of a forcemain.

3.11. Transient Pressures

3.11.1. A hydraulic transient analysis shall be undertaken as part of the design process considering the worst-case failure scenario involving the most critical pump and forcemain-in-service combination. The analysis shall be completed using hydraulic models based on the final sizes and layout of pumps and forcemains including locations of air/vacuum release valves. Based on the hydraulic transient analysis, provide devices, if necessary, to protect the forcemain such as, but not limited to, surge valves, surge tanks, etc.

3.11.2. The forcemains shall be designed so that pipes and joints are able to withstand the maximum operating pressure plus the surge pressure that would be created by stopping a water column moving at the higher of 0.6 m/s or the theoretical velocity in the forcemain.

3.11.3. The forcemains shall be designed such that pipes, joints, fittings, and valves are able to withstand full vacuum pressure.

3.12. Air and Vacuum Relief Valves

3.12.1. A combination of Sewage air and vacuum relief valves shall be placed at all high points in the forcemain to relieve air locking and to relieve negative pressures on forcemains.

3.12.2. At minimum, the Air/Vacuum relief valves shall conform to AWWA standard C512-15 Air Release, Air/Vacuum and Combination Air Valves for Water and Wastewater Service, as amended from time to time.

3.13. Drain Valves

3.13.1. Drain valves shall be placed at all low points in the forcemain to facilitate draining/cleaning.

3.13.2. Drain valves on the forcemain are to be flanged connections in valve chambers. Where possible, the valve chamber may be drained to the closest gravity Sanitary Sewer or maintenance hole or drained back into the wet well.

3.14. Service Connections

3.14.1. Minimum diameter of a forcemain for a service connection without grinder pumps shall be 100 mm in diameter.

3.14.2. A smaller diameter forcemain may be used for low flow applications provided that the grinder pump or equivalent is specified and the design brief including detailed hydraulic calculations are prepared by a Licensed Engineering Practitioner.

4.0. COMBINED SEWERS

4.1. Rehabilitation of Existing Combined Sewers

4.1.1. The design and rehabilitation of the Combined Sewer systems shall meet the requirements of the Ministry's Procedure F-5-5, Determination of Treatment Requirements for Municipal and Private Combined and Partially Separated Sewer Systems.

4.1.2. Sewers shall be planned, designed, installed, and operated to minimize or eliminate Combined Sewer Overflows.

4.1.3. New Combined Sewer systems are not permitted.

4.1.4. Addition or extension of an existing Combined Sewer is not permitted.

4.1.5. Rehabilitation, repair, and replacement of an existing Combined Sewer is permitted as per the conditions listed in the ECA.

4.1.6. Rehabilitation of existing Combined Sewer overflow structures is permitted including instrumentation and controls that are installed for the purpose of monitoring and reporting only.

4.1.7. Rehabilitation of existing CSO control structures is permitted including modifications that are intended only to improve the performance or optimize utilization of the existing control structures.

4.1.8. A Storm Sewer connection to a Combined Sewer is not permitted except for Combined Sewer separation project where the municipality plans a temporary storm connection to a combined system. This approach requires a detailed plan to disconnect and separate the Storm Sewer to a separated storm outlet according to an established schedule. Specifically, if it is demonstrated that such works will not result in an increase in CSO volume, frequency, duration, or by-pass of treatment during the schedule period.

4.2. CSO Detention Facilities

4.2.1. Construction of new CSO detention facility for an existing CSO control structure for the purpose of reducing volume, frequency, or duration of a CSO discharge and to improve quality of combined CSO discharges is permitted provided that;

1. Is not designed to replace an existing outfall to a watercourse;
2. Does not have a direct environmental discharge such as to watercourse, groundwater, or the ground from the detention structure;
3. Is controlled by an existing CSO control structure; and
4. It is demonstrated in a design brief by a Licensed Engineering Practitioner that such works has structural integrity to function as intended/designed.

5.0. STORM SEWERS

5.1. Design of Storm Sewers

5.1.1. Only Stormwater, drainage from foundations and roads, or LIDs shall be accepted or collected by Storm Sewers.

5.1.2. Sanitary Sewage or combined Sewage shall not be accepted or collected by Storm Sewers or transmitted or directed to a Stormwater works.

5.1.3. Storm sewers shall be designed, using the most recent rainfall intensity, duration, and frequency (IDF) curves available from the respective municipality for which the sewers are to be constructed. If the municipality does not have access to current IDF curves, adjacent jurisdictions shall be consulted for IDF curves, and the most stringent values shall be used in design.

5.1.4. In the design of conveyance drainage system, local climate data is to be used to establish design storm frequency criteria, at a 2-year return design storm or greater storm event can be used for minor system design.

5.1.5. Inlet times shall be calculated based upon the overland flow route modeled under fully developed system conditions as per the Official Plan.

5.1.6. Storm Sewer which are installed below seasonally high groundwater table shall be designed to minimize infiltration.

5.1.7. Storm Sewers design shall be verified (major system and minor system capacity analysis) accounting for the captured flows that enter the Storm Sewers (minor system) through inlets and the flow remaining at the surface (major system) at minimum under the following conditions;

1. No inlet capacity restriction; and
2. 50% inlet capacity restriction at depressions and roadway sags.

Maximum depths of flows at the surface and maximum hydraulic grade lines in the Storm Sewers shall be verified for up to the 100-year design storm.

5.2. Runoff Calculations

5.2.1. The peak rate of runoff from an area may be calculated using the following formula:

$$Q = 2.78\ C \cdot I \cdot A$$

Where Q is the Peak flow in liters per second, A is the area in hectares, C is run-off coefficient (dimensionless), and I is average rainfall in mm per hour for a duration equal to the time of concentration for a particular storm frequency.

5.2.2. Hydrologic and hydraulic simulation models can be used for systems to verify the capacity of the systems serving small or large areas or involving treatment and/or storage systems.

5.2.3. A Licensed Engineering Practitioner shall select the appropriate “C” values based on site conditions. The range of runoff coefficients shown in Table 3 may be used for design purposes.

Table 3 - Runoff Coefficients

Source	Runoff Coefficient (C)
Asphalt, concrete, roof areas	0.90-1.00
Grassed areas, parkland	0.15-0.35
Brick Roads	0.7-0.85
Sandy Soil	0.05-0.25
Playgrounds	0.2-0.35
Gravel	0.6-0.7
forest and dense wooded areas	0.10–0.25
Permeable pavements	0.15 to 0.25

5.2.4. For calculating runoff for less frequent, high intensity storms (e.g., 50 or 100-year storm) for particular type of area in Table 3, upper values of the range shall be used. The lower value of the range may be used for shorter (e.g., 2- or 5-year storm) recurrence interval storms under conditions of moderate to flat slopes. For urban areas the runoff coefficient may be increased to suit urban conditions.

5.3. Friction Factors

5.3.1. Storm Sewers shall be designed to transmit the required capacity when pipe is flowing full. Storm Sewer capacities can be calculated using the Manning's equation or Darcy–Weisbach equation. If Manning's equation is used for the roughness coefficient (n) as specified by the manufacturer or as listed in Table 4 or equivalent may be used for all new pipes.

Table 4 - Manning's Roughness Coefficient (n) for New Pipes

Pipe Material	Roughness Coefficient (n)
Smooth-walled pipe materials (HDPE, PVC, Concrete)	0.013
Corrugated metal pipe	
Plain Pipe	0.024
Paved Invert	0.020

5.4. Pipe Diameter

5.4.1. The minimum size of the Storm Sewer shall be 250 mm in diameter. For Storm Sewer laterals, the minimum service connections shall be 150 mm diameter color coded white. Color coding method includes pipe color, wrapping, demarcation tape, or stenciling.

5.5. Flow Velocity

5.5.1. The minimum flow velocity in the Storm Sewer shall be 0.75 m/s. Velocities in Storm Sewers shall not exceed 6 m/s.

5.5.2. Additional protection against erosion, scouring, and pipe displacement must be provided by a Licensed Engineering Practitioner where flow velocities exceed 4.5 m/s.

5.5.3. In certain circumstances, such as rehabilitation/replacement of an existing Sewer where deepening of individual Sewer section will not be possible, design flow velocities of less

than 0.75 m/s may be considered provided that appropriate measures are taken to facilitate frequent flushing and maintenance needs and the Municipality accepts the increased maintenance requirements.

5.6. Anchors/Restraints

5.6.1. Storm Sewers on 20 percent slope or greater shall be anchored securely with concrete anchors or equal.

5.6.2. Anchors and anchorage spacing shall be designed by a Licensed Engineering Practitioner based on Sewer material, anchor type, and site conditions.

5.6.3. Where velocity in the Storm Sewers approaching or exceeding 3 m/s due to steep grades and providing a drop maintenance hole is not possible, Sewers shall be designed for protection against maximum scouring velocity and erosion control measures, acceptable to the Owner shall be taken.

5.7. Pipe Material

5.7.1. All material used in the addition, modification, replacement, or extension of Storm Sewers including pipes, fittings, valves, and devices and materials used for the rehabilitation shall meet all applicable quality adopted by the Ontario Provincial Standards for Roads and Public Works and/or local municipal standards. Where applicable standards conflict, the more stringent standard shall apply.

5.7.2. Prior to specifying pipe material, soils shall be assessed for contamination and for the presence of compounds that may negatively impact the suitability of the proposed materials. Nitrile gaskets or equivalent shall be specified for soils contaminated with hydrocarbons.

5.7.3. If the material is used based on specific site conditions, the reasons for material selection shall be stated and location shall be identified in the record/ as-built drawings.

5.8. Pipe Strength

5.8.1. The Storm Sewer pipe material selected for a particular application shall be able to withstand all of the combinations of loading conditions to which the pipe is likely to be exposed along with an appropriate safety factor.

5.9. Pipe Cover and Frost Protection

5.9.1. Storm Sewers shall be installed at sufficient depth (greater than frost penetration) to prevent freezing, if this is not achievable, Sewers shall be insulated. Insulation must be designed/verified by a Licensed Engineering Practitioner.

5.9.2. For Storm Sewers that are subject to traffic loading, a loading factor in accordance with the regulations, codes and by-laws of authorities having jurisdiction shall be considered for selecting depth of pipe cover. This includes but not limited to: Highway Bridge Design Code (for vehicular traffic), Railway Safety Act, and Transport Canada Act. Appropriate structural support must be provided to the pipes as required.

5.9.3. Maximum pipe cover should be per the manufacturer recommendations.

5.10. Storm Maintenance Holes

5.10.1. Maintenance holes shall be provided at each change in alignment, pipe size, grade, material, and at all pipe junctions. For blind connections, an upstream maintenance hole at a distance of 30 m (max) is required to facilitate maintenance. Pre-manufactured bends may be acceptable if maintenance access is provided and is acceptable to the Owner.

5.10.2. Maintenance hole spacing depends on pipe size; spacing shall be in conformance to local municipal design guidelines. Where municipal design guidelines do not exist, the maximum spacing as listed in Table 5 should be used.

Table 5 - Maintenance Hole Spacing

Sewer Diameter (mm)	Maximum Spacing (m)
250 to 975	110
1050 to 1350	130
1500 to 1650	160
1800 and above	305

5.11. Catch Basins

5.11.1. Catch basins shall be provided at adequate intervals to ensure that the drainage is intercepted up to the capacity of the Storm Sewer.

5.11.2. Street catch basin spacing will vary with the street width, grade and cross fall, the location of pedestrian crossing points, intersections, low points, location of sanitary maintenance holes and driveway depressions. Maximum Catch basin spacing shall be per Table 6.

Table 6 - Catch Basin Spacing

Road Gradient (%)	Maximum Spacing (m)
0 to 3	110
3.1 to 4.5	90
Over 4.5	75

5.11.3. The minimum diameter of the catch basin lead is 100 mm and the minimum of 1% slope shall be provided for a catch basin lead.

5.12. Inverted Siphons

5.12.1. Inverted siphons shall be designed with consideration of potential siltation and air locking.

5.12.2. Inverted siphons shall be designed with water-tight joints, and to withstand hydrostatic pressure.

5.12.3. Gravity drains or any other means of draining or dewatering the inverted siphon shall be incorporated to facilitate inspection and maintenance.

5.12.4. The minimum pipe size for inverted siphons shall be nominally 250 mm in diameter.

5.12.5. Appropriate cover shall be provided above the inverted siphon based the type of crossing structure.

5.12.6. Pipes shall be sized such that a self-cleansing velocity between 1.1 m/s to 1.3 m/s is achieved in 25 mm storm event (First Flush). Where the required velocities cannot be achieved alternate means of flushing shall be incorporated in the design.

5.12.7. Inverted siphon shall be designed with at least two parallel barrels of same size, each capable of transmitting the design flowrate. Single barrel inverted siphons are acceptable provided that additional arrangements are incorporated in the design to facilitate inspection, and maintenance.

5.12.8. Inverted siphons shall be equipped with inlet and outlet chambers sized to facilitate inspection and maintenance.

5.12.9. Control valves/sluice gates shall be installed in inlet and outlet chambers especially on multi-barrel siphons to isolate or divert flows to each pipe.

5.12.10. Inverted siphons shall not be design with sharp vertical or horizontal bends, the slope for the upward vertical leg shall be limited to 2:1 (H: V).

5.13. Service Connections (Service Laterals)

5.13.1. The minimum diameter for a service connection shall be 150 mm in diameter.

5.13.2. Storm Sewer pipes shall be colour coded white to avoid cross connections. Color coding method includes pipe color, wrapping, demarcation tape, or stenciling.

5.13.3. Tracer wire is recommended for service connections where feasible as determined by the design engineer.

6.0. Third Pipe Collection System

6.1.1. Third Pipe Collection System shall be designed to collect water only from the foundation drains.

6.1.2. Foundation drain discharge collection system shall not receive water from any sites that are contaminated or suspected to be contaminated unless;

1. Environmental site assessment is completed to confirm that site is free from contamination;
2. Remediation work is undertaken prior to acceptance by the system; or
3. Pretreatment is in place to achieve acceptable results.

6.1.3. Foundation drain collection pipes shall be installed at sufficient depth (greater than frost penetration) to prevent freezing. If this is not achievable due to site specific condition, the pipes shall be insulated to provide the required protection.

6.1.4. The minimum size of the pipe in the foundation drain collection system shall be 150 mm in diameter (nominal pipe size).

6.1.5. The minimum slope for the gravity pipes within the foundation drain collection system shall be 1% where feasible.

6.1.6. Maintenance holes shall be provided for foundation drain collection system as required, maintenance hole spacing shall not be more than 150 m.

6.1.7. All material used in the foundation drain Sewers including pipes, fittings, valves, devices, shall meet all applicable quality standards adopted by the Ontario Provincial Standards for Roads and Public Works and/or local municipal standards. Where applicable standards conflict, the more stringent standard shall apply.

7.0. Documentation

7.1.1. The required documentation specified here in this document and in the ECA shall be completed.

7.1.2. A Design Brief shall be prepared by a Licensed Engineering Practitioner to demonstrate the proposed design is in conformance with all the applicable requirements of the Design Criteria and complies with all applicable Ministry policies, guidelines, and regulations. At minimum, the Design Brief shall include; hydraulic calculations; approval requirements, and completed pipe data form PIBS 6238e; additionally, the design brief shall include but not limited to the following for:

1. Sanitary Sewers/forcemain/conveyance ditches/swales;
    a. Hydraulic design sheets (applicable only to Sewers);
    b. A design report or equivalent detailing the engineer's design decisions and rationale, especially where high groundwater and/or other inflow and infiltration risk factors exist.
    c. "Forcemain or siphon: contingency plans for possible overflows (applicable to forcemain or siphon only)".
2. Municipal Stormwater Management System;
    a. Stormwater management report (including lot level and conveyance controls);
    b. A description of the water quality and quantity criteria;
    c. Hydraulic performance of the system verifying Storm Sewer capture rates and major and minor system capacities;
    d. "Oil / grit separators: design brief, calculations and manufacturers specifications (applicable to oil / grit separators only)".
3. Sewage pumping stations;
    a. Buoyancy calculations; forcemain hydraulic calculations; assessment of transient pressures; wet well and emergency storage tank sizing; design flows and firm capacity; headworks;
    b. Electrical systems including standby power; controls and instrumentation description including alarms;
    c. HVAC systems; and hazard ratings throughout station - risk assessment; and
    d. Contingency plans for Emergency Situations.

7.1.3. The forms referenced in the Environmental Compliance Approvals (ECAs) for Sewage and Stormwater are available in the Central Forms Repository at www.forms.ssb.gov.on.ca.

8.0. Inspection and Testing for Sanitary Sewers, Storm Sewers and Forcemains

8.1. General Requirements

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

8.1.2. All inspections and testing shall be performed as specified here in this document.

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

8.1.4. The Owner and the Operating Authority shall be notified and a confirmation of receipt shall be acquired at least five (5) business days or otherwise required by the Owner/Operating Authority prior to inspection or testing.

8.1.5. All inspection reports and test results shall be provided to the Owner in a format (e.g., printed copies, PDF copies and digital files) specified by the Owner or the Operating Authority.

8.1.6. A single testing plan can be used for similar tests on the same project; however, each test shall be recorded separately.

8.1.7. Seasonal variation (e.g., spring freshet) on groundwater conditions shall be considered on selecting appropriate testing method.

8.1.8. In special circumstances, specific inspection and testing requirements may apply, refer to MECP's Watermain Design Criteria for Future Alterations Authorized Under a Drinking Water Works Permit for additional inspection and testing requirements for Sanitary Sewers, forcemains, and associated Appurtenances when;

1. Installed within areas the works would pose a Significant Drinking Water Threat; and
2. If the required separation distance from watermains and associated Appurtenances cannot be achieved.

8.2. Inspections

8.2.1. All new Sanitary Sewers including connections, Storm Sewers, and associated Appurtenances shall be inspected to confirm alignment and to ensure that the Sewer pipe is free from obstructions, debris, and defects.

8.2.2. All maintenance holes/access structures shall be inspected for any defects, leaks, debris, and to ensure proper benching.

8.2.3. Acceptable inspection methods for Sanitary Sewers, Storm Sewers, and maintenance holes include;

1. Visual Inspections as per OPSS.MUNI 433;
2. Closed-Circuit Television (CCTV) Inspection as per OPSS.MUNI 409;
3. Zoom Camera Inspections as per OPSS.MUNI 432;
4. Sonar Inspections as per OPSS.MUNI 435; and
5. Laser Inspections as per OPSS.MUNI 434.

8.2.4. All new, replaced, and rehabilitated Sanitary Sewers, Storm Sewers, and maintenance holes shall be video inspected to evaluate the physical condition and to identify any obstructions or defects. Any issues identified in the inspections shall be corrected and the respective pipe segments and maintenance holes shall be re-inspected.

8.2.5. Sonar inspections can be used for Sanitary Sewers, and Storm Sewers under submerged and partially submerged conditions.

8.2.6. Laser inspections are recommended for more accurate measurement of defects and deflection in the Sanitary Sewers and Storm Sewers.

8.3. Leakage Testing

8.3.1. Leakage Test shall be performed on all new Sanitary Sewers and maintenance holes to ensure integrity of the conveyance system.

8.3.2. Prior to performing a leakage test, both active and inactive service connections and stubs shall be identified using dye testing or other equivalent methods.

8.3.3. All new and inactive service laterals shall be plugged using plugs designed to withstand test pressures, plugs shall be suitably braced for additional safety. All inactive service connections shall be sealed.

8.3.4. Pipe sections and associated components that are subject to pressure testing shall be fully restrained against movements in the event of failure. Component that are not intended to be pressurized shall be isolated.

8.3.5. Prior to leakage testing potential risks and hazards shall be identified and appropriate safety measure shall be taken. The procedure shall conform to all applicable health and safety requirements, including, but not limited to: Occupational Health and Safety Act, and Fire Protection and Prevention Act.

8.3.6. The following are acceptable leakage tests for Sanitary Sewers and maintenance holes:

1. Low Pressure Air Testing;
2. Water (Hydrostatic) Testing;
3. Vacuum Testing.

8.3.7. Groundwater elevations shall be considered for selection of the appropriate testing method.

8.3.8. Low pressure air test is not recommended when groundwater elevation is 600 mm or greater above the crown of the pipe being tested at the time of testing. Where groundwater elevation is less than or equal to 600 mm test pressure shall be adjusted to compensate for ground water pressure.

8.3.9. Low pressure air testing equipment shall include a pressure relief valve set to 9 psi (max) to avoid over pressurizing.

8.3.10. Low pressure air testing procedure shall conform to:

1. OPSS.MUNI 410;
2. ASTM F1417; or
3. ASTM C924M.

8.3.11. Water test procedure shall conform to:

1. OPSS.MUNI 410; or
2. ASTM C 969.

8.3.12. Vacuum testing procedure shall conform to:

1. ASTM C1244/C1244M

8.3.13. Clean water shall be used for hydrostatic testing. Water used in the hydrostatic testing shall be disposed as per all the applicable requirements.

8.3.14. If a segment of the system fails during leak testing, source of leakage shall be identified, and all defective material shall be repaired or replaced to the satisfaction of the Owner. The repaired or replaced sections shall be retested until results acceptable to the Owner are obtained. During retesting, maintenance holes shall be tested separately to pipe Sewers.

8.4. Deflection Testing

8.4.1. A deflection test shall be completed for all new flexible Sanitary Sewers and Storm Sewers at least 30 calendar days after backfilling but prior to paving.

8.4.2. Pipe segments failing the deflection test shall be removed and replaced.

8.4.3. Mandrel testing and laser profiling are acceptable tests for pipe deflection testing.

8.4.4. Mandrel test shall be performed in accordance with OPSS.MUNI 438.

8.4.5. Laser profiling shall conform to OPSS. MUNI 434.

8.4.6. Equipment used to perform Mandrel tests shall be specifically designed for the pipe material being tested.

8.5. Hydrostatic Testing

8.5.1. Hydrostatic testing shall be performed to all new and rehabilitated/repaired forcemains in accordance with OPSS.MUNI 412 (Ontario Provincial Standards Specification, published by Ontario Ministry of Transportation) at a minimum pressure of 1.5 times the maximum operating pressure.

8.5.2. Water used in the hydrostatic testing shall be disposed to Sanitary Sewers as per all the applicable requirements for disposal.

8.5.3. The maximum pressure shall be measured and recorded at the lowest point along the length of the pipe subject to testing.

APPENDIX I

Understanding Risks to Sources of Drinking Water

- Components of Sewage systems may present a risk to sources of drinking water, and therefore be subject to Source Protection Plans made under the Clean Water Act.
- Whether you are designing a new Municipal Sewage Collection System, expanding an existing system, or conducting normal operations and maintenance, it is important to be able to identify which components of your system (Sanitary Sewers, pumping stations, holding tanks, etc.) and the location where they may pose a significant risk, in order to plan and implement risk management measures as well as comply with any requirements for drinking water source protection within the ECA.
- Under the Clean Water Act, sources of water that are accessed by municipal drinking water systems are protected from threats to drinking water quality and quantity.
- A total of 22 specific activities are prescribed as **Drinking Water Threats** in Ontario Regulation 287/07, section 1.1. This includes "*the establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage*."
- The risk level of a prescribed drinking water threat is determined in accordance with:
    i. The **Directors Technical Rules** established under the Clean Water Act which set out the methods for delineating the shape and size of vulnerable areas (including wellhead protection areas (WHPA) and intake protection zones (IPZ) around municipal systems), determining the intrinsic vulnerability within those areas, and assessing the risk posed by drinking water threats.
    ii. The **Tables of Drinking Water Threats** (chemical and pathogen tables for water quality) identify the specific circumstances under which a drinking water threat poses a low, moderate, or significant threat to drinking water sources. The Tables of Drinking Water Threats are organized by subcategories of activities for the prescribed threats in O. Reg. 287/07, including different types of Sewage Works, and are available at Ontario.ca as well as through an interactive threats look-up tool.
- Activities may also be a Significant Drinking Water Threat if they are associated with a chemical or pathogen identified as a drinking water issue within an **issue contributing area** (ICA) in the Assessment Report.
- Activities may also be a Significant Drinking Water Threat if they occur within an **event-based area** (EBA) that represents an area modelled for Spills that would reach a surface water intake during extreme storm events (e.g., Sanitary Sewer trunk breaks, or wastewater treatment plant disinfection failure).
- The vulnerable areas and vulnerability scores for each source protection area are listed and mapped in local assessment reports and Source Protection Plans and available through the provincial Source Protection Information Atlas.
- If the Sewage Works are located in an area where they may pose a significant threat to drinking water sources (WHPAs, IPZs, ICAs, or EBAs), Source Protection Plan policy may apply.
- For additional information on Source Protection Plans and resources that can support the identification of threats to sources or drinking water, you may also refer to guidance from MECP and your local conservation authority.