1.4 Sanitary Sewerage System

1.4.1 General

1.4.1.1 System Type

The sanitary sewer system shall be designed to carry domestic, commercial and industrial sewage for each area or subdivision under consideration. Flow is to be by gravity and pumping will be considered only where other alternatives are not possible and only with the approval of the City. No storm drainage system or downspout (rainwater leader) shall drain into a sanitary sewer.

1.4.1.2 Service Area

DESIGN PERIOD – The system shall be designed to service all areas within the subdivision to their maximum future development in accordance with the Official Plan and the City-Wide Water & Wastewater Master Plan.

TRIBUTARY AREA INFLOWS - Allowance shall be made for inflows from external lands within the drainage shed to the approval of the City.

CONNECTION LOCATIONS – The exact location for connecting sewers to adjacent sewers shall be approved by the City.

INFILL DEVELOPMENTS – Capacity of existing sewer system to be verified using historical design sheets (if available) and a complete analysis of the receiving sewer system (e.g., drainage maps, design sheets/computer modelling, flow monitoring, etc.) to the extent deemed appropriate by the City.

1.4.1.3 Drains

All floor drains are to be connected to the sanitary sewer. No foundation drains or roof drains shall be connected to the sanitary sewer.

1.4.2 Design Flows

1.4.2.1 Wastewater Flows

The sewers are to be sized for design flows plus an allowance for infiltration. Minimum velocities and slopes are to be determined for design flows without infiltration.

The average daily flow generation rate to be used for analysis purposes is 370 Lpcd (residential and employment).

- For sewersheds conveying flow to the Kleinburg WPCP (residential & employment): 450 Lpcd

Population estimates shall generally be based on the densities provided wherever sufficiently detailed information is available, otherwise estimates shall be in compliance with the City's Official Plan, the relevant Secondary Plan, Block Plan or other appropriate planning document.

Table 1-15 Population Density and Flow

Type of Unit or Land Use	Density
Single Family and Semi Detached Residential	4.0 persons/unit
Street Townhouses, Block Townhouses and Stack Townhouses	3.5 persons/unit
Apartments	2.5 persons/unit
Industrial	95 persons/ha
Commercial	75 persons/ha
Institutional	50 persons/ha
Parks & Recreational	50 persons/ha
School	0.30 persons/student
Hospital/Nursing Home	4.00 persons/bed
Hotel/Motel	225 Litres/bed
Office Commercial	115 persons/ha of floor
Shopping Centre	115 persons/ha of floor

Peak wastewater flows are to be determined by multiplying the average daily wastewater flow rate by the Harmon Peaking Factor (subject to a minimum K = 2.0 and maximum K = 4.0):

$$K = 1 + \frac{14}{4 + p^{0.5}}$$

where K is the Harmon Peaking Factor and p is the population (or equivalent) in thousands.

1.4.2.2 Infiltration Allowance

In addition to the peak wastewater flows, an infiltration allowance is to be included in determining the design flow (based on gross service areas):

- For all sewersheds excluding Kleinburg: 0.26 L/s/ha
- For sewersheds conveying flow to the Kleinburg WPCP: 0.23 L/s/ha

To satisfy self-cleansing requirements in sanitary sewers, assume dry weather infiltration reduces to zero for several days during dry months.

Consideration for actual infiltration rate shall be made when evaluating the existing sanitary sewer system. The City and the Region currently monitor the downstream systems and have monitoring stations at various locations throughout the city.

1.4.2.3 Sanitary Sewer Flows

The relevant figures are to be entered on the City of Vaughan Standard Sanitary Design Sheet (see Appendix D).

1.4.3 Sewer Design

1.4.3.1 Formula

Manning's formulae shall be used for determining the capacity of the sewers:

$$Q = \frac{1}{n} A \times R^{\frac{2}{3}} \times S^{\frac{1}{2}} \quad \text{and} \quad V = \frac{1}{n} R^{\frac{2}{3}} \times S^{\frac{1}{2}}$$

where Q is the full flow capacity of the pipe (m3/s)

V is the full flow velocity in the pipe (m/s)

n is Manning's roughness coefficient (dimensionless)

A is the cross-sectional area of the pipe (m2)

R is the hydraulic radius of the pipe (i.e., cross-sectional area ÷ wetted perimeter; m)

S is the slope of the pipe (i.e., slope of hydraulic grade line when flowing full; m/m)

For concrete or polyvinyl Chloride (PVC) sewer pipe a roughness coefficient (n) of 0.013 shall be used.

1.4.3.2 Minimum Size

The minimum size of sewers shall be 200mm diameter in residential areas and 250mm diameter in industrial areas.

1.4.3.3 Minimum Velocity

The minimum velocity for sewers operating partially full shall result in self-cleansing equivalent to that produced by flow in a 200 mm diameter sewer operating full at a velocity of 0.6 m/s. Reference should be made to Figure 1-4 and Table 1-16. In cases when the flow depth in the sewer will be 30 percent of the diameter or less, the actual flow velocity at peak flow should be calculated using a hydraulic elements chart and the slope increased to achieve adequate cleansing velocities. The required self-cleaning full flow velocity shall be determined by:

$V_s = 0.9885\, R^{1/6}$ (V_s in metres per second and R in metres)

Figure 1-4 Flow-Slope Relationship Necessary for Self-Cleansing

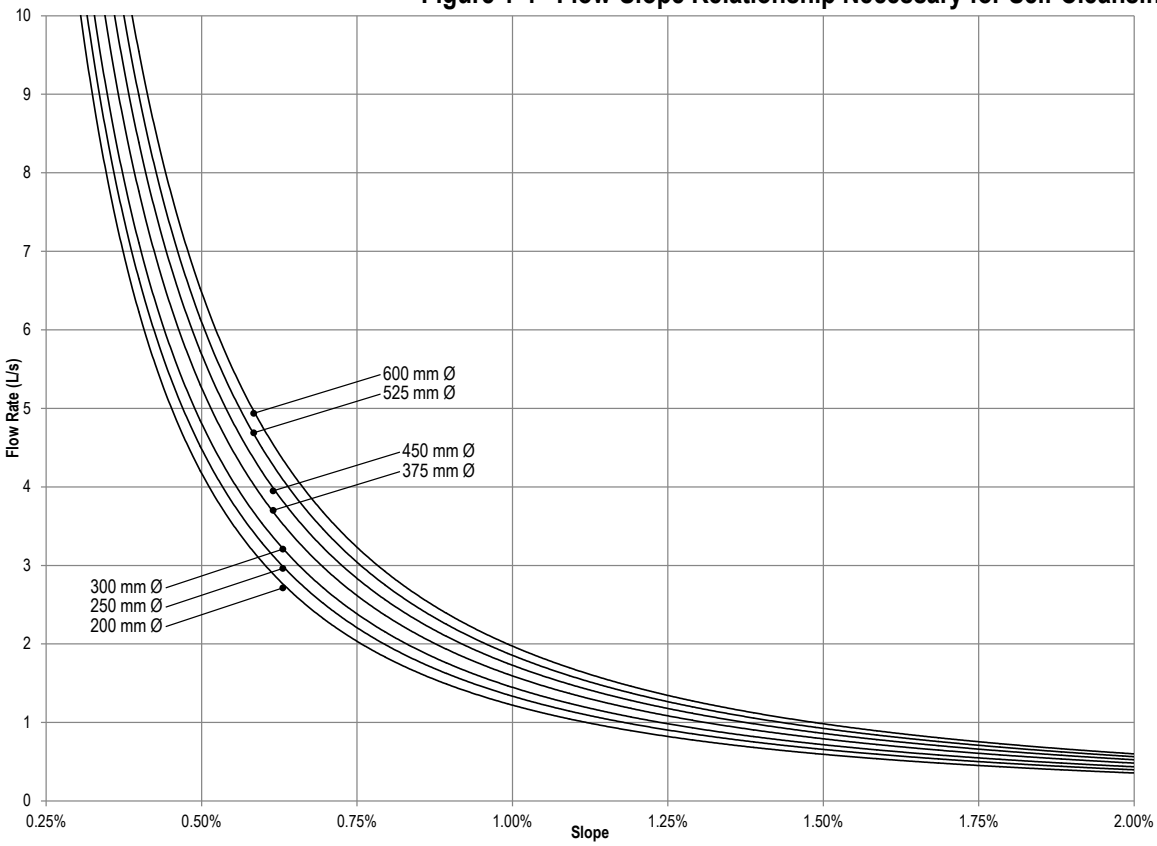

Table 1-16 Minimum Self-Cleansing Flow Rates (L/s)

Slope	200 mm Ø	250 mm Ø	300 mm Ø	375 mm Ø	450 mm Ø	525 mm Ø	600 mm Ø
0.3%	11.5	11.6	12.1	12.9	14.0	14.8	15.7
0.4%	6.3	6.7	7.1	7.7	8.4	8.9	9.5
0.5%	4.1	4.5	4.8	5.2	5.6	6.1	6.4
0.6%	2.9	3.2	3.5	3.8	4.1	4.5	4.7
0.7%	2.2	2.5	2.6	2.9	3.2	3.4	3.6
0.8%	1.8	2.0	2.1	2.3	2.5	2.7	2.9
0.9%	1.5	1.6	1.7	1.9	2.1	2.2	2.3
1.0%	1.2	1.3	1.4	1.6	1.7	1.9	1.9
1.1%	1.0	1.1	1.2	1.3	1.4	1.6	1.7
1.2%	0.9	1.0	1.0	1.2	1.3	1.3	1.4
1.3%	0.8	0.8	0.9	1.0	1.1	1.2	1.3
1.4%	0.7	0.7	0.8	0.9	1.0	1.1	1.1
1.5%	0.6	0.7	0.7	0.8	0.9	0.9	1.0
1.6%	0.5	0.6	0.6	0.7	0.8	0.8	0.8
1.7%	0.5	0.5	0.6	0.6	0.7	0.7	0.8
1.8%	0.4	0.5	0.5	0.6	0.6	0.7	0.7
1.9%	0.4	0.4	0.5	0.5	0.6	0.6	0.6
2.0%	0.4	0.4	0.4	0.5	0.5	0.6	0.6

1.4.3.4 Maximum Velocity

The maximum velocity shall be 3.0 m/s at full flow.

1.4.3.5 Allowable Grades

The grades for sewers shall be the grade necessary to meet the minimum and maximum velocity requirements. The first leg of a sewer shall be a minimum grade of 1.0%. The maximum sewer grade shall be 2.0% or not greater than the road grade where the road grade exceeds 2.0%.

1.4.3.6 Hydraulic Losses

A sufficient drop shall be provided across each maintenance hole to offset any hydraulic losses to a maximum change in velocity of 0.6 m/s in special cases. The obverts of inlet pipes shall not be lower than obverts of outlet pipes, and drop structures shall be used only when drops of more than 0.6 metres are necessary in accordance with OPSD 1003.010/ OPSD 1003.020.

1.4.3.7 Downstream Size

The downstream pipe diameter shall always be greater than or equal to the upstream pipe diameter.

1.4.4 Layout Details

1.4.4.1 Trunk and Local Sewers

1.4.4.1 (a) LOCATION – Sanitary sewers shall generally be located 1.5 metres north or east of the road centre line in separate trench or in a common trench. The minimum clearance between the outside wall of the adjacent sewer pipes shall be 800 mm. On crescent roads or roads with numerous bends the sewer position may generally follow the same relative side of the road allowance.

1.4.4.1 (b) DEPTH – A minimum cover of 2.8 metres below the centre line road elevation or sufficient depth for basement floor drains and frost cover. Where sewers are located within an easement, a minimum frost cover of 1.2 metres may be used, provided such sewers cross below watermains. The maximum height of fill shall be in compliance with OPSD 806.040, OPSD 806.060, OPSD 807.010, OPSD 807.030, or similar.

1.4.4.1 (c) CLEARANCES – Minimum clearances between services shall be provided in accordance with MECP guidelines.

1.4.4.1 (d) ALIGNMENT – Sanitary sewers shall generally be straight aligned between maintenance holes, however, curvilinear alignment through deflected sewer pipes or deflection at joints within the manufacturer's specifications are permitted for sewer pipes (675mm dia. and above) with the approval of the City.

1.4.4.2 Maintenance Holes

1.4.4.2 (a) LOCATION – Maintenance holes shall be placed at the top end or dead end of a sewer line or where changes in size, material, alignment, or grade occur.

1.4.4.2 (b) SPACING – The maximum spacing between maintenance holes shall be to the following:

Table 1-17 Sanitary Sewer Maintenance Hole Spacing

Sewer Diameter	Distance (m)
200 to 900 mm	110
≥ 975 mm	180

1.4.4.2 (c) DROP MAINTENANCE HOLES – Drop maintenance holes shall be sized in accordance with OPSD 1003.010 or OPSD 1003.020 and provided for all sewer junctions having an elevation difference in excess of 0.6 metres that cannot be eliminated by changing sewer grades.

1.4.4.2 (d) MAINTENANCE HOLE COVERS – Where maintenance holes are located in areas that are at risk of being flooded during major storm events, maintenance hole covers shall be of the sealed variety conforming to OPSD 401.030.

1.4.4.2 (e) TYPE – Maintenance holes shall be cast in place or precast concrete in accordance with all applicable OPSD and OPSS requirements.

Integrated / telescopic frame and cover maintenance hole systems shall be used for the following applications:

- sewer system and/or maintenance hole rehabilitation programs
- asphalt resurfacing and/or roadway reconstruction/renewal programs
- new developments

For sewer system/maintenance hole rehabilitation programs, asphalt resurfacing programs, and roadway reconstruction/renewal programs, necessary adjustment units for maintenance hole frame and covers shall be fabricated from a single precast concrete riser section (minimum height of 150mm). Stirrups are to be doweled to the existing concrete maintenance hole, around the single precast concrete riser section. A temporary (circular) form shall be placed around the single precast concrete riser section and pre-mixed non-shrink grout shall be applied between the riser section and the form. A telescopic frame and cover system that can be integrated within the final asphalt surface shall be used with a minimum material guarantee of 25 years to be extended by the manufacturer.

For new developments, a single precast concrete riser section (minimum height of 300mm) shall be used within a precast concrete maintenance hole tapered top that can accommodate the riser section. A pre-mixed non-shrink grout shall be used between the single precast riser section and the tapered top section. A telescopic frame and cover system that can be integrated within the final asphalt surface shall be used with a minimum material guarantee of 25 years to be extended by the manufacturer.

Precast Concrete Modular Adjustment Units for Maintenance Holes

The use of precast concrete modular adjustment units is generally not permitted. However, exceptions (generally up to two adjustment units) may be allowed on a case-by-case basis subject to the approval of the City to facilitate adjustments for placement of surface course asphalt only. Precast concrete modular adjustment units shall be mortared and parged using pre-packaged non-shrink grout (per ASTM C1107).

1.4.4.2 (f) MAINTENANCE HOLE WATERPROOFING - All maintenance hole joints in new developments shall be waterproofed with a minimum 1.0m-wide membrane centred over the joint.

Maintenance holes located within a floodplain, areas of concentrated runoff, and/or areas with high groundwater, defined as hydrostatic pressures greater than 103kPa (15psi) and/or where the sewer obvert is 0.6m or more below the seasonal high ground water table, are to be fully waterproofed. The entire external surface area of the maintenance hole including all walls, joints, adjustment sections, and roof slab shall be wrapped in an approved waterproofing membrane. Each waterproofing membrane layer shall overlap a minimum of 0.15m.

All maintenance hole waterproofing shall be installed from the outside with membranes conforming to ASTM D412, D903, C836, E154, D1970, E96, D1876, D5385 & D570, or the latest version thereof. Prior to installing membranes adhering surfaces shall be cleaned from debris/dirt and primed as per manufacturer's recommendation for priming if required. Adhering surfaces shall be free of dust, debris, and visible standing water. Primers shall be compatible with waterproofing membranes. Membranes and the associated primer shall be applied in accordance with manufacturer specifications.

Protection board, asphaltic or polypropylene, shall be installed over the entirety of the waterproofing membrane to ensure integrity during the backfilling procedures.

The protection board shall be a material of sufficient strength to protect the membrane from damage caused by backfilling and compaction activities. Alternately, the protection board may be substituted with a dimpled geocomposite drainage flexible board backfilled with a minimum 0.3m thickness of sand placed up against the dimpled geocomposite drainage sheet. A 0.3m layer of sand in lieu of a protection board, as approved by the local municipality, may be installed around the entire waterproofing section to protect the waterproofing membrane.

1.4.4.3 Service Connections

1.4.4.3 (a) LOCATION – Single or double connections for residential use, shall generally be located near the centre of lots or the common lot lines in accordance with Standard Drawings C-101 and OPSD 1006.010 (rigid main pipe) or OPSD 1006.020 (flexible main pipe). Service connections for commercial, industrial, institutional or multiple use are to be in accordance with Standard Drawing C-102 and OPSD 1006.010 (rigid main pipe) or OPSD 1006.020 (flexible main pipe). Connections will be considered on an individual basis if similar locations cannot be used. Non-standard locations must be detailed on plan and profile and lot grading plans. Park service may be required at the discretion of the city.

1.4.4.3 (b) DEPTH – Service connections at property line shall be located at a minimum depth of 2.6 metres. Service connections should cross under any watermains.

1.4.4.3 (c) TEST FITTINGS AND MAINTENANCE HOLES – All residential connections shall have test fittings and plugs according to Standard Drawing C-101. All industrial connections shall have maintenance holes and bulkheads in accordance with Standard Drawings C-102 and all applicable OPSD details. Connection requirements for other uses (commercial, institutional, etc.) shall be determined at the design stage for those individual blocks unless known.

1.4.4.3 (d) RESIDENTIAL SANITARY CONNECTIONS – Single sanitary connections shall be a minimum of 100 mm in diameter and double connections shall be a minimum of 125 mm

in diameter unless greater as required pursuant to the Ontario Building Code. The minimum grade shall be 2%. Adjacent lots with greater than 0.2 m basement elevation differences shall not be serviced by double lot sanitary sewer service connections. The pipe colour shall only be green for sanitary service connections and temporary end caps shall state "SAN".

1.4.4.3 (e) INDUSTRIAL SANITARY CONNECTIONS – Sanitary connections shall be a minimum of 200 mm in diameter unless greater is required pursuant to the Ontario Building Code. The minimum grade shall be 2%.

1.4.4.3 (f) Service connections are to be installed on the main sewer lines wherever possible.

1.4.4.3 (g) RE-DEVELOPMENT APPLICATIONS

1.4.4.3 (g)(i) In re-development applications, existing service connections can be reused subject to a condition assessment including, but not necessarily limited to, CCTV inspection to the satisfaction of the City. Any deficiency such as root intrusion, displaced joints or other physical defects including flow conveyance constraints will require replacement with a new connection, at the discretion of the City. Any re-development applications servicing more than one (1) unit on a single property must have a control maintenance hole in accordance with Standard Drawing C-102.

1.4.4.3 (g)(ii) For low-rise residential re-development, existing service connections may only be reused on a 1-for-1 basis with respect to the number of units serviced (i.e., number of units draining to service connection under re-development scenario cannot exceed the number of units previously draining thereto), subject to satisfactory condition assessment.

1.4.4.3 (g)(iii) Where existing service connections are to be reused, the hydraulic capacity of the connection to convey the design flow for the proposed development shall be verified by a Professional Engineer.

1.4.4.4 Infiltration/Inflow (I/I) Reduction Guidelines

- Industrial/Commercial/Institutional (ICI) Developments
  - Maintenance holes shall be located outside the surface ponding areas, preferably on islands or high ground areas.
- Stormwater Detention or Flood Prone Areas
  - Maintenance holes shall be located outside of Regional flood plain boundary.
  - Where a maintenance hole cannot be located outside the Regional flood plain boundary, then it shall be elevated to minimum 100-Year elevation and the top of the maintenance hole covers shall be watertight and anchored properly so that it cannot be easily displaced or shifted due to high flows.
- Municipal Roads/R.O.W.
  - Maintenance holes shall be placed in areas where storm water does not pond and also away from curb.
  - Bituminous seal tape shall be placed around rings on maintenance holes to prevent direct inflow by sealing it water tight.
- Municipal Roads/R.O.W. on High Groundwater Level

- Bituminous seal tape shall be placed around maintenance hole section joints.
- Clay/collar plugs shall be provided in bedding (at a minimum 40 m interval).
- Maintenance holes shall be watertight with rubber apron gripping the pipe.

1.4.5 Materials

1.4.5.1 Specifications

1.4.5.1 (a) Sanitary sewer pipe materials shall generally be polyvinyl chloride (PVC) pipe in accordance with the following specifications, unless otherwise noted:

1.4.5.1 (a) (i) 100 mm – 150 mm diameter: CSA B182.1, ASTM D3034, Min. DR 28

1.4.5.1 (a) (ii) 200 mm to 375 mm diameter: CSA 182.2, ASTM D3034, Min. DR 35

1.4.5.1 (a) (iii) > 375 mm (Max. 450 mm) diameter: CSA 182.2, ASTM F679 (T-1), Min. DR 35

1.4.5.1 (b) Concrete pipe and pipe joints shall conform to the latest revisions of OPSS 1820, CSA A257.2 and A257.3, ASTM C76 and C655.

1.4.5.1 (c) JOINTS – All sanitary sewers shall have waterlight joints

1.4.5.1 (d) BEDDING

1.4.5.1 (d) (i) Bedding type selection shall be based on depth of sewer, sewer material, trench width and configuration and soil conditions in accordance with OPSS and OPSD.

1. PVC pipe: bedding and cover material shall conform to OPSS 1010 Granular A and recycled materials are not permitted.
2. Concrete pipe: bedding material shall conform to OPSS 1010 Granular A and recycled materials are not permitted. Cover material shall be mortar sand conforming to OPSS 1010 Granular D.

1.4.5.1 (d) (ii) High Performance Bedding (HPB) is not an acceptable bedding material except in constrained installations where proper placement and compaction of granular bedding is not possible and as specifically directed by the City. Any requests for HPB are to be supported with a geotechnical engineer's justification.

1.4.5.1 (d) (iii) Pipe loading calculations shall accompany the design submission.

1.4.6 Forcemain Design

Wastewater forcemains shall generally be designed in accordance with the following considerations:

- Minimum velocity of 0.6 m/s, subject to a minimum diameter of 100 mm
- Maximum velocity of 3.0 m/s
- Friction losses should be based on Hazen-Williams formula or other methods acceptable to the City
- Air relief valves at high points
- Vacuum relief valves if necessary to relieve negative pressures
- To be located in the boulevard opposite the watermain, subject to MECP clearance guidelines
- Minimum cover of 1.8 m
- Cathodic protection of all metallic pipes, mechanical joints/fittings/restraints, etc. Sizing for high-purity anode to be determined by a geotechnical engineer subject to a minimum of 12 lb each
- Pipe materials may include:

- Polyvinyl Chloride (PVC) conforming to CSA B137.3 and ASTM D3139. Must be green in colour. To be installed with 8 gauge tracer wire. DR26 minimum.
- Polyethylene (PE) conforming to CSA B137.0, B137.1, ASTM D3035, D3350 or CG 5 Spec. 41-FP-25M. PE3408/3608. To be installed with 14 AWG tracer wire or, if in horizontal directional drilling (HDD) applications, 4×8 gauge tracer wire.

- Pressure rating (class) to be as per design, subject to minimums noted above
- Hydraulic transient (i.e., surge) analysis required to confirm pressure rating of pipe, surge protection devices and identify potential vacuum and other conditions to be mitigated. Pump cycle times should be designed to minimize pump starts and stops to the extent practical
- The hydraulic grade lines for the range of potential pumping rates (i.e.: minimum, average, maximum) shall be provided along the entire profile of the forcemain.
- Detailed calculations for the system curve shall be provided
- Bedding material to be mortar sand conforming to OPSS 1004 Granular D and placed in accordance with applicable OPS Drawings[10]
- Thrust blocks to be in accordance with all applicable OPSD details
- Additional requirements may be identified at the time of detailed design based on site-specific conditions, at the discretion of the City
- Valves must have stems extended to grade and be operable at grade without confined space entry or extension keys. Provide vehicle access to all valves. The updated Operation and Maintenance manual at time of assumption shall include instructions for valve operations-direction and number of turns, size and type, purpose, and recommended exercise schedule. As-constructed drawings must show plan and profile views of installed valves with valve details such as location, size, type, and depth.

1.4.7 Testing & Inspection

1.4.7.1 General

1.4.7.1 (a) All newly constructed sanitary sewers, maintenance holes and forcemains shall be watertight and free from leakage. The testing and commissioning of sanitary sewer system shall conform to York Region's Inflow and Infiltration Reduction Standard for Sewers Servicing New Development in effect at the time of construction.Detailed reports shall be prepared, signed and stamped by the Qualified Representative (e.g., Professional Engineer) describing the application of and conformity with the Region's requirements including testing procedures and results to the satisfaction of the City prior to acceptance.

1.4.7.1 (b) The Region's requirements represent a significant change from historical practice and are more onerous for project proponents, whether they be developers or the City for capital projects. The testing and acceptance requirements are intended to proactively control Infiltration and Inflow into the sanitary sewer system which consumes capacity thereby compromising system performance and constraining further growth and development the contributing service area.

1.4.7.1 (c) CCTV inspections are to be carried out by City forces at the cost of the developer/owner prior to acceptance. Additional inspections may be required as determined by the City, prior to placing top course asphalt and assumption of the service.

[10] Depending on pipe material and installation condition, the following OPS Drawings may apply: OPSD 802.010, 802.013, 802.014, 802.030, 802.031, 802.032, 802.033, 802.034, 802.050, 802.051, 802.052, 802.053 or 802.054.

1.4.7.1 (d) Tracer wire inspections and conductivity tests shall be conducted prior to acceptance of forcemains. Inspections are to ensure that tracer wire is visible in maintenance holes, at pumping stations, etc. Conductivity tests are to ensure that the tracer wire is appropriately connected and continuous over its entire length.

1.4.7.1 (e) A representative of the City is required to be present during any testing of services.

1.4.7.2 Cracked Sewer Service Connection Tee Fittings

1.4.7.2 (a) Any cracked service connection tee fittings discovered during CCTV inspections shall be repaired to the satisfaction of the City.

1.4.7.2 (b) In cases where top asphalt is not in place, the cracked sewer service connection tee fitting shall be excavated, removed and replaced.

1.4.7.2 (c) In cases where top asphalt has been placed, and subject to the approval of the City:

1.4.7.2 (c) (i) The cracked sewer service connection tee fitting may be repaired by means of a tee liner or other suitable trenchless technology approved by the City in accordance with City policy.

1.4.7.2 (d) In cases where top asphalt has been placed and it has been determined by the City that the sewer service connection tee fitting cannot be adequately repaired by installing a tee liner or other acceptable trenchless technology, then it shall be excavated, removed and replaced.

1.4.7.3 Air Testing Mainline Sewer and Service Connections

All service connections and mainline sanitary sewers within the public right-of-way shall be air pressure tested, after backfilling and prior to base asphalt as it pertains to new development projects.

No final interconnection of the public and private portion of a service connection shall be made to a building(s) until passing air pressure testing results are determined satisfactory by the local municipality, the local municipality's Qualified Representative and/or the developer's Qualified Representative. The developer's Qualified Representative should be a professional engineer licensed in the Province of Ontario and shall certify and stamp the test results.

In the event that the air pressure testing results are determined unsatisfactory by the local municipality, the local municipality's Qualified Representative and/or the developer's Qualified Representative, remedies shall be made to rectify the deficiencies until satisfactory air pressure test results are obtained. All deficiencies are to be rectified prior to occupancy permitted.

Standard practice for testing, equipment used and other specifications shall follow OPSS.MUNI 410, ASTM C924, ASTM F1417-11 and as noted herein. The Contractor is responsible for ensuring that the test is conducted in a safe manner and all applicable safety procedures are followed. Do not enter, or allow anyone to enter, the maintenance hole during testing. Low pressure air testing equipment shall include a pressure relief valve set to maximum 62 kPa (9.0psi) to avoid over pressurizing. Tests shall be conducted between two consecutive maintenance holes or to a stub end where the sewer does not terminate at a maintenance hole.

The test section shall be plugged at each end. The test section shall be filled slowly until a constant pressure of 24kPa (3.5psi) is maintained. If the groundwater level is above the sewer being tested, the air pressure shall be increased by 3.0kPa (0.45psi) for every 300mm of groundwater level above the pipe invert. If the groundwater table cannot be visually monitored in terms of the elevation from the pipe, the

Municipality or their Qualified Representative may request that the groundwater level be measured prior to testing. The air pressure shall be stabilized for five (5) minutes and then regulated to maintain it at 20.5kPa (3.0psi) plus the allowance for groundwater, if any. After the stabilization period, the time taken for a pressure loss of 3.5kPa (0.50psi) shall be recorded. The time taken for a pressure drop of 3.5kPa (0.50psi) shall not be less than the times shown in **Table 5** (Column B) for lengths equal to or less than the length shown in **Table 5** (Column C).

Table 5 Exfiltration test - low pressure air testing (OPSS.MUNI 410) (for flexible pipe materials)

Column A	Column B	Column C	Column D
Normal pipe size (mm)	Minimum time (min:sec)	Length of pipe for minimum time (m)	Time per unit for longer lengths of pipe (sec/m)
100	1:53	182	0.623
150	2:50	121	1.140
200	3:47	91	2.493
250	4:43	73	3.893
300	5:40	61	5.606
375	7:05	48	8.761
450	8:30	41	12.615
525	9:55	35	17.171
600	11:20	30	22.425
675	12:45	27	28.382
750	14:10	24	30.040
825	15:35	22	42.397
900	17:00	20	50.450

Note: If the length of the test section is greater than the length shown in Column C, the testing time shall be the product of the length of test section multiplied by the value in Column D (i.e., minimum time = test length x Column D)

Determination of acceptance

If the time shown in Table 5 for the designated pipe size and length elapses before the air pressure drops 3.5kPa (0.51psi), the section undergoing the test shall have passed and shall be presumed to be watertight. The test may be discontinued once the prescribed time has elapsed even though the drop of 3.5kPa (0.51psi) has not occurred.

Determination of failure

If the pressure drops 3.5kPa (0.51psi) before the appropriate time shown in **Table 5** has elapsed, the air loss shall be considered excessive and the section of pipe shall be determined to have failed the test.

In the event that air testing of the sanitary sewer system or any section thereof fails within an area of high groundwater (hydrostatic pressures greater than 103kPa (15psi) and/or where the sewer obvert is 0.6m below the SHGWT), the Contractor shall perform an additional CCTV inspection during the seasonal high groundwater window (typically between April and May) to visually investigate potential leaks. If site

conditions limit the tests (e.g., restricted access in environmentally sensitive areas during spring time), an alternative test should be sought by the Contractor and approved by the local municipality.

In the event that air exfiltration testing on the sanitary sewer system or any section thereof fails and/or leak repair is unsuccessful, the use of other test methodology at the discretion of the Municipality or their Qualified Representative may be permitted. The Municipality or their Qualified Representative can also request air exfiltration testing again once the repair is complete. During retesting, maintenance holes shall be tested separately from sewer pipes.

1.4.8 Decommissioning

1.4.8.1 Service Connections

Sanitary service connections shall be decommissioned by cutting and capping/plugging the connection at the main line and filling in any abandoned sections with a grout, lean concrete mix or other suitable material which must be approved by the City.

1.4.8.2 Maintenance Holes

Any sewer openings to the maintenance holes (MHs) are to be plugged from within the MH, the cone section of the MH is to be removed and the MH is to be filled with sand prior to backfilling and restoration of the surface.

1.4.8.3 Sewer Lines

Any abandoned sewer lines are to be plugged at the ends and filled with a grout, lean concrete mix or other suitable material which must be approved by the City's Environmental Services Department.

1.4.8.4 Forcemains

The following is required when decommissioning forcemains:

- Saw-cutting of existing pipe
- Removal and disposal off-site of existing pipes, fittings, thrust restraints and thrust blocks, as required
- Filling of abandoned main with grout
- Supply and placement of 15 MPa concrete plug in the ends of the existing forcemains that are to be abandoned in place. Minimum length of the concrete plug shall be 300mm
- Supply and placement of mechanical plug on existing forcemain to remain in service, where required.

1.4.9 Wastewater Pumping Stations

Pump stations shall generally adhere to the Region of York's standards for pump stations. This will include SCADA Standards, Process Control Narrative, Technical Specifications and Drawings. Below are additional requirements that will be reviewed during the design review process of the pump station:

- Grinders are required for all pumps and all instrumentations tied in to the City's PLC;
- Electrical shall include back up power and VFD drives for the pumps;
- Flow monitors and pressure control monitors shall be automated and tied into the City's PLC for outlet pipes with bypass capabilities;
- Stainless steel is required on all exposed materials and bolts in corrosion environments shall be Hilty

Bolts;

- Automatic blowers required in wet well areas, tied to an alarm system when the station is occupied;
- Contact cards and cameras are required at all entry points;
- Proof of all Factory Acceptance tests, I/O verifications and system calibrations;
- Operations manuals, certifications and calibrations, ECA's in the name of the City, including SOP's and Asbuilt drawings and P&ID's drawings;
- Materials list and spare parts with certificate of delivery;
- Process drawings and system schematics for the operation of the stations. These schematics are to be posted in a visible wall that the staff can reference the station layout;
- All cranes and heavy equipment must have the proper certificates prior to operations. All backup generators will require the TSSA approvals and load bank testing prior to approval;
- All manuals and drawings for the station, including electronic copy of all documentation;
- Copy of the design report for the station, including all installation manuals, geotechnical reports, and any changes or deviations to the original design during the construction of the station;

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