

1.0 Storm Flow Management

The objective of Storm Flow Management is to provide:

- The safe conveyance of stormwater to legal and adequate outlets
- Water quality control
- Flooding control to minimize health hazard, loss of life and property damage
- Minimize alteration of the local groundwater system and maintain base flows in receiving water courses
- Reproduce or improve pre-development hydrological conditions
- Solutions that are economically efficient to construct and maintain

The recommended strategy for development is to meet existing pre-development flow volumes where existing drainage conditions are ideal, and to improve storm flow conveyance where opportunities exist.

2.0 General

This document will be subject to revisions from time to time. The City of Quinte West reserves the right to make revisions having due regard for applications already in the review process. Individuals or groups affected accordingly will be notified by the City of Quinte West, and revisions will become effective on the date of notification.

(Contents of this document are subject to change without further notice)

3.0 References

In addition to the standards specified in this manual, storm flow management shall follow current standards and in conformance with the following standards, specifications or publications:

Publications

- Ontario Provincial Standard Specifications
- Ministry of the Environment Stormwater Management and Design Manual 2003
- Bay of Quinte Remedial Action Plan Guidelines
- Municipal Engineers Association Design Manual
- City of Quinte West Official Plan

- Master Drainage Plan or Stormwater Management Plan for the site, as applicable.

Standards

- City of Quinte West Standard Drawings
- Series 700 – Storm Sewer System

Permits/Approvals

- Lower Trent Conservation Authority
- Quinte Conservation Authority
- City of Quinte West Bylaw 08-30 "Site Alteration Bylaw"
- Ministry of the Environment

4.0 Table of Contents

<u>SECTION</u>	<u>PAGE</u>
5.0 Catchment Criteria _____	7-4
6.0 Submission Requirements _____	7-4
7.0 Formulas _____	7-4
7.1 Rational Formula _____	7-4
7.2 Capacity Flow _____	7-4
7.3 Manning Equation _____	7-5
7.4 Headloss Across Manholes _____	7-5
7.5 Catchbasin Inlet Capacity _____	7-5
8.0 Design Criteria – Subsurface Conveyance _____	7-5
8.1 Pipe Design _____	7-6
8.2 Minimum Pipe Sizes _____	7-6
8.3 Flow Design _____	7-6
8.4 Acceptable Materials _____	7-6
8.5 Separation Requirements _____	7-7
8.6 Depths _____	7-7
8.7 Manholes _____	7-7
8.8 Catch Basins _____	7-7
8.8.1 Cover _____	7-7
8.8.2 Location – Within Right of Way _____	7-7
8.8.3 Maximum Spacing of Catchbasins _____	7-8
8.8.4 Leads _____	7-8
8.8.5 Catchbasin Materials _____	7-8
9.0 Design Criteria – Surface Conveyance _____	7-8
9.1 Design _____	7-8
9.2 Location _____	7-8
9.3 Grade _____	7-9
9.4 Landscaping / Restoration _____	7-9
9.5 Piping _____	7-9
9.6 Culverts _____	7-9
10.0 Building and Lot Storm Drainage _____	7-10
10.1 Dry Wells or Infiltration Basins _____	7-10

10.2 Foundation Drainage	7-10
10.3 Sump Pumps	7-10
10.4 Roof Drainage	7-10

5.0 Catchment Criteria

Catchment Areas and collection volumes to be determined in accordance with the *City of Quinte West Engineering Design Manual – Stormwater Management Guidelines*.

While it is not the responsibility of new development to improve the drainage conditions of neighboring properties, consideration must be given to neighboring properties as to not negatively impact existing drainage and outlet patterns. As part of a submission package, ground elevations of neighboring properties may be requested to confirm design suitability.

6.0 Submission Requirements

A storm sewer design sheet shall accompany any submission for the conveyance of stormwater. Storm Sewer Design Sheets shall be provided in an industry standard format or as approved. Design criteria including sample calculations or formulas shall be provided with any submission.

All designs unless approved by the Director of Engineering and Environmental Services must be stamped by a Professional Engineer licensed in the Province of Ontario.

7.0 Formulas

7.1 Rational Formula

$$Q = 2.78 \text{ AIR}$$

Where:

- Q = Design flow in litres per second (L/s)
- A = Area in hectares (ha)
- I = Intensity in millimeters per hour (mm/hr)
- R = Runoff coefficient

Rainfall intensity to be based on the City of Quinte West standard intensity equation for a 5-year storm event:

$$I = \frac{2143}{t_c + 14.7}$$

See Section *Stormwater Management - Rainfall Intensity Formulas for additional Storm Event Frequencies*

Where: t_c = time of concentration in minutes

Minimum inlet time = 15 minutes. Where two drainage systems meet, the larger time of concentration is used to calculate the resultant downstream flow.

Minimum open channel flow velocity is to be 0.75 m/s; maximum flow velocity not to exceed 6.0 m/s.

IDF Curve data is available at the office of Public Works and Environmental Services

7.2 Capacity Flow

$$Q_{cap.} = \left(\frac{\left[\frac{D}{1000} \right]^{2.667} \left[\frac{S}{100} \right]^{0.5}}{0.211 * n} \right) * 1000 (L/s)$$

Where: D = Pipe size (mm)
S = Slope (grade) of pipe (%)
n = roughness coefficient

7.3 Manning Equation

$$V = \frac{1}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$$

Where: V = Velocity in meters per second (m/s)
n = Manning roughness coefficient (n = 0.013 for smoothed walled pipe)
R = Hydraulic radius in meters (m)
S = Hydraulic gradient in meters per meter (m/m)

7.4 Headloss Across Manholes

$$H = \frac{k(V_2^2 - V_1^2)}{2g}$$

Where: H = Headloss in meters (m)
k = Coefficient
V1 = Entrance velocity in meters per second (m/s)
V2 = Exit velocity in meters per second (m/s)
g = Acceleration due to gravity in meters per second (m/s)

7.5 Catchbasin Inlet Capacity

$$Q = CA\sqrt{2gH} \bullet 0.667$$

Where: Q = Flow (cubic meters per second)
C = Orifice Coefficient (dimensionless)
0.6 for square edged openings
0.8 for round edged openings
g = Acceleration due to gravity (meters per second per second)
H = Allowable head
A = Area of Openings (square meter)
0.667 = Clogging Factor

8.0 **Design Criteria – Subsurface Conveyance**

Storm sewers shall be designed to accept flows as indicated by the surface drainage requirements set forth in the *City of Quinte West Engineering Design Manual – Stormwater Management Guidelines* and as required by other approval authorities.

Surcharging is permitted subject to 1:50 year storms not backing into any connected building foundation drainage system so as to cause flooding.

8.1 Pipe Design

Storm Sewer Design Sheets shall be provided in an industry standard format or as approved. Design criteria including sample calculations or formulas shall be provided with any submission.

8.2 Minimum Pipe Sizes

- Storm sewers 250mm
- Catch basin leads
 - Single 200mm
 - Double 250mm
 - Rear Yard 250mm
- Foundation and Building Drains As per Ontario Building Code

A decrease in pipe size from a large size upstream to a small size downstream will not be allowed regardless of grade increases.

8.3 Flow Design

The maximum velocity at design flow shall not exceed 6 m/s.
The minimum velocity at design flow shall be not less than 0.75 m/s.

Minimum Grades for Pipes based on a roughness coefficient (n) of 0.013 is:

250mm	0.28%
300mm	0.22%
375mm	0.15%
450mm	0.12%
525mm	0.10%
600mm	0.08%
675mm	0.067%
750mm	0.058%
825mm	0.052%
900mm	0.046%
200mm leads	0.40%

8.4 Acceptable Materials

All sewers must be smooth walled conforming to OPSS. Approved products include:

- PVC SDR 35
- CSA approved high density corrugated exterior and smoothed walled Polyethylene
- BIG O Boss or equivalent as per OPSS 1840.
- OPSS specified concrete pipe.

Corrugated steel pipe is not permitted for storm sewers.

8.5 Separation Requirements

Sewers/sewage works and watermains located parallel to each other shall be constructed in separate trenches maintaining a minimum clear horizontal separation distance of 2.5 metres.

Design shall ensure that adjacent structures are not jeopardized by extra frost penetration from within a storm sewer, catchbasin or culvert.

8.6 Depths

The depth of storm mains shall be such to ensure that they can withstand soil dead load and traffic loading from an H20 live load. The minimum depth of bury shall be 1.2m measured finished grade to top of pipe.

8.7 Manholes

MH spacing shall be as follows:

250 to 450mm sewer	120m
500 to 750mm sewer	150m
Larger than 750mm	Considered on a case-by-case basis

8.8 Catch Basins

Private direct connections into the storm sewer system is not permitted. Roof drainage should be diverted to vegetated areas to give water the opportunity to soak into the ground.

Storm sewer leads, sized to convey peak runoff but not less than 300mm diameter, are to be installed to service commercial and industrial blocks.

8.8.1 Cover

Minimum cover on catchbasin leads is to be 1.0 meter or in accordance with pipe manufacturers specifications.

8.8.2 Location – Within Right of Way

Catchbasins are required at all low points in the road and at low grade points at intersections. Additional catchbasins shall be provided along the roadway as set out in the table below.

Catchbasins shall be provided on both sides of the street.

Catchbasins shall be located at the quarter point of the lot frontage to avoid conflict with driveways.

Catchbasins at intersections shall be located upstream of sidewalk crossings.

8.8.3 Maximum Spacing of Catchbasins

Road Grade (%)	Maximum Spacing
0.5 – 3.0	106 m (350 ft)
3.0 – 4.5	91 m (300 ft)
Greater than 4.5	76 m (250 ft) and; Double Inlet catchbasin required at intersecting streets.

Double inlet catchbasins or special catchbasins shall be used where the inlet capacity of a single catchbasin is exceeded.

8.8.4 Leads

Catchbasin leads within the Right of Way or Rear Yard shall be connected to the main sewer through a manhole or catch basin.

8.8.5 Catchbasin Materials

Structure

Catchbasins for depth up to 1.8 meters between ground level and invert shall be 609.60 mm square concrete conforming to OPS (precast).

For depths in excess of 1.829 meters a 1.219 m X 1.219 m catchbasin manhole shall be used conforming to OPS.

Frames

Grates are required on all storm inlets and outlets that are 375mm and larger.

Frames and grates shall be Canada Iron No. 579 with perforations, or approved equal for manholes and Canadian Iron No. 568 with dished grate, or approved equal for catchbasins as per OPS. 609.60 mm. (24") square "bicycle proof" catchbasin covers shall be for all streets.

9.0 **Design Criteria – Surface Conveyance**

9.1 Design

Ditches and culverts shall be sized to take the total expected storm run-off calculated by a recognized engineering method such as the rational method.

9.2 Location

Ditches shall be constructed on all roads as follows:

Distance centre to centre of ditches to be as required for the depth of ditch and side slopes.

Depth below finished centerline grade shall be:

- Maximum: 1.8 meters
- Minimum: 1.0 meters

Ditches through easements exceeding 1.2 meters in depth shall be fenced off with standard 1.8 meter high chain link fence.

9.3 Grade

Ditch grade shall be:

- Maximum: 6.0 %
- Minimum: 1.0 %

In exceptional cases and where ditches are on easements off the road allowance, ditches with grades greater than 6 percent may be allowed by the Engineer but these shall be suitably protected against erosion by such means as rip-rap or gabions.

9.4 Landscaping / Restoration

The minimum ditch protection on ditches shall be 3 inches of topsoil and seed (staked sod may be required on the side slopes and bottoms of ditches in certain cases subject to ditch gradients and as recommended by the Director of Public Works & Environmental Services or their designate).

9.5 Piping

Where considered necessary by the Director of Public Works & Environmental Services, ditches shall be piped.

9.6 Culverts

The City of Quinte West does not allow the private installation of culverts within its road allowance. A Road Entrance Application accompanied by any prescribed fees is required for private culverts within the road allowance.

Normal ditch to ditch road culverts shall be installed where required as follows:

Criteria	Specification
Minimum length	As required from centre of ditch to centre of ditch.
Minimum size	300 mm diameter (450mm for new developments).
Material	Standard galvanized corrugated pipe or approved equal.
Gauge	As recommended by manufacturer for highway loading, minimum 16 gauge.
Cover	1.0 meter minimum for road crossing and shall meet OPS.
Bedding	Culverts shall be bedded and backfilled with granular material in accordance with OPS.
End protection	All road and driveway culverts shall have the ends protected with gabions, rip-rap asphalt or metal headwalls.

10.0 Building and Lot Storm Drainage

Developed lands must have a primary and secondary outlets. For example, in residential developments this may include a catchbasin as a primary outlet and the road surface as a secondary outlet.

10.1 Dry Wells or Infiltration Basins

The use of dry wells or infiltration basins are encouraged to manage stormwater runoff. These may only be used as a secondary outlet. Dry wells shall not be used to reduce the catchment volumes in the design of conveyance systems.

10.2 Foundation Drainage

Foundation drainage shall be connected to a sump pump and discharged onto the Storm Sewer.

10.3 Sump Pumps

Direct connection to the storm sewer is not permitted. Sump pump outlets must be directed to surface drainage away from foundation walls and towards a legal and adequate outlet.

10.4 Roof Drainage

Downspouts shall be discharged onto the ground surface and directed away from foundations towards a legal and adequate outlet.