E1.00 HYDRAULIC DESIGN

E1.01 Confirmation of Capacity

Prior to commencement of any design for sanitary sewage works within the municipality, the Developer shall contact the municipality to ensure that adequate external trunk sewer and treatment plant capacity is available for the proposed development.

In accordance with MOE guidelines and Town policy, all urban and hamlet developments are to be serviced by municipal wastewater systems. Individual septic systems are only permitted in estate lot developments and where approved by MOE and the Conservation Authority.

E1.02 Sanitary Drainage Plan

The sanitary drainage plan shall be drawn to a scale suitable to show all the tributary areas that are being used to determine the design flows.

The design flow in each manhole and length of sewer shall be computed on the Town's standard sanitary design sheets, see Appendix H and shall be included in the drawing set on ISO A1 (594mm x 841mm) sheets. For each area entered on the design sheet, the manhole numbers, the size and grade of the sewers and the number of the detailed plan and profile for each section of the sanitary sewer shall be shown.

E1.03 Residential Sewage Flows

Peak domestic sewage flows are to be calculated using the following formula:

$$Q(d) = \frac{PqM}{86.4} + IA$$

Where:

- Q(d) = Peak domestic sewage flows (incl extraneous flows in L/s)
- P = Design population, in thousands.
- q = Average daily per capita domestic flow in L/cap/day (exclusive of extraneous flows).
- M = Peaking factor
- I = Unit of peak extraneous (infiltration) flows in L/ha/s
- A = Gross tributary area in hectares

The peaking factor shall be calculated based on the Harmon formula:

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

where

P = Population, in thousands

Maximum M = 4.0

Minimum M = 1.5

The design population shall be derived from the drainage area and expected population based on the Official Plan and the most current Master Servicing Study and Functional Servicing Report. The following design populations should be used:

Single Detached Dwellings	=	3.36ppu
Semi-Detached Dwellings	=	3.36ppu
Townhouses	=	2.83ppu
Apartments	=	1.64ppu

An average daily per capita flow of 250L/cap/day shall be used. In the absence of a proposed Plan of Subdivision, populations should be estimated based on drainage areas and the land uses identified in the Town's Official Plan or Master Servicing Studies.

The unit of peak extraneous flow shall be confirmed with the Town. Generally, areas serviced with sewers constructed prior to the year 2000 shall use an allowance of 0.5L/s/ha and areas serviced in 2000 and later shall use an allowance of 0.2L/s/ha.

E1.04 Industrial, Commercial and Institutional Sewage Flows

An average design flow of 28m^3/ha/day plus allowances for infiltration shall be used for the design of sewers on commercial sites, unless better information is available and approved by the Town. The area shall be based on the gross developable area. Maximum Day and Peak factors shall be generally in accordance with MOE guidelines and shall be confirmed with the Town.

Industrial sewage flows shall be determined in consultation with the Town. Light industrial flows shall be at 20m^3/ha/day and heavy industrial flow shall be at 35m^3/ha/day plus allowances for infiltration shall be used for the design of sewers on industrial sites.

A peaking factor shall also be incorporated into the design based on the gross development area as follows:

$M_i = 6.6604 \times Area^{-0.1992}$
where
M_i = industrial peaking factor
A = gross lot area (ha)
Alternatively a peaking factor of 2.5 can be used, subject to Town review and approval.

Institutional sewage flows shall be designed with a peak flow of 19.8m^3/ha/day plus allowances for infiltration, unless better information is available and approved for use by the Town.

The area shall be based on the gross area of the institutional site, unless more accurate information is available at the time of development.

The unit of peak extraneous flow shall be confirmed with the Town. Generally, areas serviced with sewers constructed prior to the year 2000 shall use an allowance of 0.5L/s/ha and areas serviced in 2000 and later shall use an allowance of 0.2L/s/ha.

E2.00 SANITARY SEWER DESIGN

E2.01 Location

All sanitary sewers shall be located as shown on the standard road cross-section. The standard location shall generally be 1.75m north and east of the centreline of the road allowance. Any sewers which are situated in off-road locations, shall be contained within easements. Such easements shall comply with the requirements noted under Appendix B.

E2.02 Pipe Capacities

Table 14 provides the allowable sanitary sewer capacities and gradients. This table shall be used to determine the maximum and minimum designs for sanitary sewers. Although the Manning's formula is to be used as a basis for sewer design, the values listed in Table 14 will supersede the results of Manning's calculations where applicable. In the case of partial pipe flow, the actual velocity is to be checked against the minimum allowable velocity at the design flow rate.

Pipe capacities shall be based on the following criteria:

$Velocity_{min}$	$Velocity_{max}$	$Slope_{min}$
0.60m/s	**3.0m/s**	**0.50%**

E2.03 Flow Velocities

Minimum acceptable velocity = 0.6m/s.

Maximum acceptable velocity = 3.0m/s.

E2.04 Minimum Size

The minimum allowable size for a sanitary sewer shall be 250mm in diameter.

E2.05 Minimum Grade

The minimum desirable grade for sanitary sewers is 0.5%. The minimum grade for the first upstream leg of any sewer shall not be less than 1.5%.

E2.06 Minimum Depths

The depth of the sewer shall be measured from the final centreline finished road elevation to the top of the sanitary sewer. The minimum depths of sewers for residential areas shall be 2.7m.

E2.07 Curved Sewers

The use of radius pipe or deflected pipe is not permitted.

E2.08 Limits

All sewers shall be terminated at the subdivision limits when external drainage areas are being considered in the design with suitable provision in the design of the terminal manholes to allow for future extension of the sewer.

E2.09 Storm Sewer and Watermain Crossings

Generally, a minimum clearance of 0.25m shall be provided between the outside of the pipe barrel at the point of crossing for storm and sanitary sewers. A minimum clearance of 0.5m shall be provided sewer and watermain crossings when the sewer crosses over the watermain.

In the event the minimum clearances cannot be obtained, then the work is to comply with MOE guidelines and the pipes shall be concrete encased to ensure that the pipes are properly bedded.

E2.10 Service Connections to Deep Sewers

No service connections will be permitted to sanitary sewers exceeding 7.60m in depth, measured from the finished centreline road elevation.

E2.11 Head Losses

The minimum drop for inverts in any manhole shall be 0.030m, to allow for hydraulic losses incurred at sewer manholes.

In order to reduce the amount of drop required, the designer shall, wherever possible, restrict the change in velocity between the inlet and outlet to 0.6m/s

Hydraulic calculations shall be submitted for all junction and transition manholes on sewers where the outlet is 1050mm in diameter or greater. In addition, hydraulic calculations may be required for manholes where the outlet pipe is less than 1050mm in diameter if, in the opinion of the Development Engineer, there is insufficient invert drop provided across any manhole.

Regardless of the invert drop across a manhole, as required by calculations, the obvert of the outlet pipe shall not be higher than the obvert of the inlet pipes at any manhole location.

E2.12 Changes in Pipe Size

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

E2.13 Pipe Bedding

The class of pipe and the type of bedding shall be selected to suit loading and proposed construction conditions. Standard details of the types of bedding are illustrated in the OPSD 802.010 and 802.030. The width of the trench at the top of the pipe must be carefully controlled to ensure that the maximum trench width is not exceeded unless additional bedding or higher pipe strength pipe is used. Any special conditions should be reviewed by a qualified engineer and appropriate recommendations made with respect to the class/type of bedding and pipe strength.

In order to mitigate infiltration at manhole junctions and groundwater flow along pipe bedding, “clay plugs” shall be incorporated into the trench bedding. Clay materials shall be used in the trench and be placed 2 to 3m upstream from any manhole where groundwater is suspected, with intermediate plugs where deemed appropriate.

E2.14 Maximum Depth of Cover for Flexible Pipe

The maximum depth of cover allowed on flexible pipe is 6.0m.

E3.00 MANHOLES

E3.01 Location

Manholes shall be located at each change in alignment, grade or pipe material, at all pipe junctions and at intervals along the pipe to permit entry for maintenance to the sewer.

E3.02 Maximum Spacing

The maximum spacing between manholes shall be as follows:

Pipe Size	Maximum Spacing
250mm to 750mm	100m
825mm to 1200mm	125m
1200mm and over	155m

E3.03 Manhole Types

Manholes shall be constructed of precast concrete. The Ontario Provincial Standard manhole details shall be used for manhole design where applicable. In all cases where the standard drawings are not applicable, the manholes shall be individually designed and detailed.

A reference shall be made on all profile drawings to indicate the type and size of all sanitary manholes. In the case of the standard 1200mm precast manhole, the size may be omitted and reference need only be made to the standard drawing number.

Precast manholes shall conform to CSA A257.4 and OPSD 701.010.

E3.04 Manhole Design

- All manhole chamber openings shall be located on the side of the manhole parallel to the flow for straight run manholes, or on the upstream side of the manhole at all junctions.
- The manhole shall be centred on the sanitary sewer main.
- The maximum change in the direction of flow in any sanitary sewer manhole shall be 90%. A change of flow direction at acute interior angles will not be permitted.
- Drop structures shall be used when invert levels of inlet and outlet sewers differ by 0.15m or more. Wherever feasible, sewer systems should be designed to avoid the use of drop structures. Internal drop structures are discouraged and will only be permitted in certain cases. Pre-cast external drop structures are permitted as per OPSD 1003.020 and 1003.010.
- All manholes shall be benched to the obvert as detailed in the Ontario Provincial Standard Drawings.
- Safety gratings shall be required in all manholes greater than 5.0m in depth. Safety gratings shall not be more than 5.0m apart and shall be constructed in

accordance with the OPSD details. Where practical, a safety grating shall be located 0.5m below the drop structure inlet pipe.

- All pipe connections at manholes shall be completed using Kore-N-Seal an approved rubber gasket assembly.
- Manholes located in low areas shall have water tight lids to mitigate extraneous inflows.
- Manhole riser rings and adjustment units are to be wrapped with mastic sealant (Denso or equivalent, see BWG Standard Drawing D115) at the direction of the Town for all manholes located in all areas.

E3.05 Grades for Manhole Frame and Covers

All manholes located within the travelled portion of the roadway shall have the rim elevation initially set flush with the base course asphalt. A minimum of 100mm and a maximum of 300mm height of concrete modular adjustment rings shall be used on all manholes in new subdivisions.

Prior to the placement of the final course asphalt, the manhole frame shall be adjusted to suit the final surface asphalt elevation. Steel and/or plastic manhole adjustment rings are not permitted to adjust the manhole to final grade (as per OPSD 704.010).

E4.00 SANITARY SERVICE CONNECTION

E4.01 General

All sanitary sewer service connections for single detached, semi-detached or linked dwellings shall be double service connections, with a "Y" connection at or near the property line. All connections are to have an Ipex or approved equivalent test fitting installed at the property line. Cast iron test fittings are not approved.

E4.02 Location

The proposed location of the sanitary sewer service shall be shown on the plan and profile drawings and generally be located in the vicinity of the common lot line between the lots being serviced. As per BWG Standard Drawings C101 and C102.

E4.03 Size

Service connections for single family and semi-detached (or linked) units shall be 125mm in diameter.

Service connections for multiple family blocks, commercial, institutional and industrial areas shall be sized according to the intended use.

E4.04 Connection To Main

The connection to the main sewer shall be made with an approved manufactured tee. Approved saddles shall be used for connecting to existing sewer mains.

A 125mm or 150mm service connection will be permitted to connect to a 250mm and 300mm main sewer providing an approved manufactured tee is installed and providing the invert of the service connection is above the spring-line of the main sewer.

No service connection of a size greater than half the diameter of the main shall be cut into the main sewer. A manhole shall be installed on the main sewer at the intersection of a service connection which has a size greater than half the diameter of the main sewer except as provided below.

E4.05 Depth

The depth of the service connections for single family units and semi-detached units at the property line measured from the finished centreline road elevation shall be:

Minimum	2.50m
Maximum	3.00m

Risers shall be used when the obvert depth of the sewer main exceeds 4.50m. The riser section shall not exceed 3.0m in depth.

E4.06 Grade of Lateral

Size of Pipe (mm)	Minimum Grade	Maximum Grade
125	2%	8%
150	1%	6%

E4.07 Connection to Multiple Family and Other Blocks

An inspection manhole shall be required on the private property (1.5m from P/L to centre of the rim) on all connections to multiple family and other blocks.

E4.08 Connection to Commercial/Industrial/Institutional Blocks

An inspection manhole shall be required on private property located 1.50m from the property line to the centre of the rim.

E5.00 TESTING

E5.01 General

An infiltration or exfiltration test shall be completed on all sewers at the discretion of the Town. The Town shall be the sole judge of which test is to be undertaken. All testing shall be done in the presence of the Town.

E5.02 Deflection Test

A deflection test shall be performed on all sewers constructed using flexible (i.e. PVC, etc) material. Said testing shall be generally in conformance with OPSS 410, except that the average inside diameter of the pipe shall used for the required calculation of the mandrel sizing (where the average inside diameter is as specified by the pipe manufacturer).

A suitably designed device shall be pulled manually through the pipe not sooner than 30 days after completion of the installation and backfilling operations. The device shall be provided as described by OPSS 410.

The device to be used shall have a minimum length in accordance with the following:

Nominal Pipe Size (mm)	Length (mm)
150	100
200	150
250	200
300	250
375	300
450	350

E5.03 Video Record

All newly constructed sanitary sewers shall be T.V inspected upon satisfactory completion of all other testing, prior to the municipality's issuance of Preliminary Acceptance. All sewer lines being inspected must be flushed immediately prior to the commencement of the inspection.

A permanent record in colour DVD video form shall be supplied, illustrating a continuous record of the sewer installations, service connection, manholes, etc. A report identifying any unusual or substandard conditions shall also be submitted. All CCTV work shall be performed with a colour camera equipped with a full-swivel head capable of examining lateral connections, manhole interiors and other key features of the sewer installation.

The Town will require Certification from the Developer's Consulting Engineer that they have reviewed the videos and have found the sewers to be acceptable and free of all defects. Any deficiencies should be clearly identified in the Engineer's letter and confirmation that all deficiencies have been rectified must be included with the Certification.

The CCTV inspection shall be carried out by an operator certified by NAAPI (or equivalent, to the satisfaction of the Town) and shall be carried out in accordance with OPSS 409.

All video records, reports and data provided from these inspections shall become the property of the municipality.

At the discretion of the Town, additional inspections and records may be required prior to “Final Assumption”.

E5.03 Sanitary Main Line Plugs

Prior to connecting to an existing sanitary sewer system the contractor shall ensure that a mechanical plug has been inserted into the first manhole downstream of the connection point.

The plug shall remain in place until prior to the first occupancy, or as directed by the Town. Prior to the removal of the plug the contractor shall be required to remove all debris in the pipe behind the plug.

E5.04 Sewer Laterals

All sewer laterals are to be inspected by the Town at the Owner/Applicant’s expense. Units are not to be occupied until a satisfactory inspection has been completed.