middlesex centre

in the centre of it all

INFRASTRUCTURE DESIGN STANDARDS

Created	June 2011	
Revision 1	April 2017	
Revision 2	January 2018	

Modification Table

The following table is a summary of all the changes to the Municipality of Middlesex Centre's 2018 Infrastructure Design Standards.

SECTION	MODIFICATION AND COMMENTARY
SECTION 1	**ROADWAYS AND TRANSPORTATION**
Fig 1.14	Added typical stop sign installation figure
Sec 1.1.34	Added note for stop sign installation & street names
Sec 1.1.30	Added requirement to install stop bars at stop signs
Sec 1.1.18	Added additional approved materials for driveway culverts
Fig 1.15-1.29	Added new figures - Figure 1.15 - Typical 4.0' Street Light Arm - Figure 1.16 - Typical 20.0' Aluminum Street Light Pole - Figure 1.17 - Typical U-Channel Post - Figure 1.17a - Typical Square Post and Anchor Post Installation Detail - Figure 1.17b - Sign Sheeting and Post Requirements - Figure 1.18 - Typical Sidewalk Detail - Figure 1.18a - Typical Sidewalk Abutting Curb and Gutter - Figure 1.18b - Concrete Sidewalk Ramps - Figure 1.18c - Combination Curb-Face Sidewalk - Figure 1.18d - Combination Curb-Face Sidewalk at Driveway Entrances - Figure 1.18e - Sidewalk Driveway Entrances Details - Figure 1.19 - Asphalt Bicycle Path - Figure 1.20 - Concrete Steps with Footings - Figure 1.20a - Concrete Steps without Footings - Figure 1.21 - Removable Post Detail - Figure 1.22 - Steel Beam Guide Rail & Steel Post Assembly Detail - Figure 1.22a - Steel Beam Guide Rail Post and Offset Block Details - Figure 1.23 - Steel Beam Guide Rail Embedded Connection for New Structures - Figure 1.24 - Concrete Island Bullnose - Figure 1.25 - Existing Gravel Driveway Restoration - Figure 1.26 - Pavement Reinforcement Detail for Road Widening - Figure 1.26a - Stepped Milled Joint Pavement Detail - Figure 1.27 - Pavement Cut Guidelines Matching New Construction to Existing Asphalt - Figure 1.28 - Types of Pavement Markings - Figure 1.28a - Types of Pavement Markings - Figure 1.29 - Signalized Intersection Markings - Figure 1.29a - Ladder Pavement Marking Detail - Figure 1.29b - Arrow and Pavement Marking For Bicycle Lanes - Figure 1.29c - Bicycle Sharrow Pavement Marking

SECTION 2	**SANITARY SEWER COLLECTION SYSTEMS**
Fig 2.15	Added PVC Vertical Riser Installation figure
Sec 2.13	Added clarification for use of pipe material that is not listed under the approved pipe materials section
Sec 2.15.4	Typographical error corrected
Sec 2.13	Typographical error corrected
Fig 2.16	Added new figures - Figure 2.16a - Typical Manhole Frame and Cover - Figure 2.16b - Typical Manhole Frame and Cover
SECTION 4	**STORMWATER COLLECTION SYSTEM**
Sec 4.12	Added clarification for use of pipe material that is not listed under the approved pipe materials section
Sec 4.13.4	Typographical error corrected
Sec 4.12	Typographical error corrected
Fig 4.20	Added new figure - Figure 4.20a - Typical Catchbasin Frame and Grate - Figure 4.20b - Typical Catchbasin Frame and Grate
SECTION 5	**WATER DISTRIBUTION SYSTEM**
Sec 5.5	Typographical error corrected
Sec 5.5.8	Added "Sampling Station" specification
Fig 5.18 & Fig 5.19	Added new figures - Figure 5.18 - Zinc Anode Installation - Figure 5.19 – Typical Sampling Station
SECTION 9	**INSTALLATION, INSPECTION OF SEWER AND WATER WORKS**
Sec 9.2.7	Added new section for pressure testing of sanitary and storm sewers following installation

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1 ROADWAYS AND TRANSPORTATION

1.1 ROADS DESIGN

1.1.1 Design Speed

Urban:

- The Maximum Design Speed for local urban roads shall be 60 km/h with a posted speed of no more than 50 km/hr.

Rural:

- The Maximum Design Speed for local rural roads shall be 90 km/h with a posted speed of no more than 80 km/hr.

1.1.2 Road Classifications

The following road classifications with associated road allowance shall apply within Middlesex Centre. Road Classifications shall be as noted in the Official Plan.

1.1.3 Centreline Radii

- Collector and Local Streets:
  - Collector roads and local streets shall have centerline horizontal curves in accordance with Figure 1.1 “Minimum Centreline Radii of Curvature for Roads in Subdivisions”.
  - Local Streets with bends of approximately 90 degrees are to have a minimum inside street-line radius of 9.0m.
  - Bends of 90 degrees are only permitted on local streets. Bends are to be in accordance with Figure 1.2 “ 90 Degree Curve – Local Street”
- Reconstruction Projects:
  - The reconstruction of existing roads is to have the centreline horizontal and vertical alignments reviewed by the Municipal Engineer.

1.1.4 Radii for Curb & Gutter

- Intersection Radii for curb and gutter should be measured at edge of pavement. The following chart illustrates the required radii.

		Arterial/Primary Collector	**Secondary Collector**	**Local**
From:	Arterial	15m	15m	12m
	Collector	15m	15m	9m
	Local	7.5m	7.5m	7.5m

- Intersection Radii Day-lighting Requirements

    - a 3.0m day-lighting triangle is required where a 15.0 m radius is needed at the intersection of a collector street to a collector street;

    - a 6.0m day-lighting triangle is required when on any road type connection to an arterial road.

- Cul-de-sacs

    - The minimum required radii of curvature for curb & gutters are to be in accordance with Figure 1.3 “Standard for Circular Cul-de-Sac.”

1.1.5 Local Residential Street – Urban Cross Section

- The standard cross section for local urban roadways is to be in accordance with Figure 1.4 “Typical Cross-Section Local Urban Residential Street”.

1.1.6 Local Residential Street – Rural Cross Section

- The standard cross section for local rural roadways is to be in accordance with Figure 1.5 “Typical Cross-Section Local Rural Residential Street”.

1.1.7 Multi-Lane Roadways and Channelized Intersections

- For multi-lane roads or channelized intersections, minimum lane widths shall be based on the following chart.

Description	**Width (m)**
Right Turn Lane	3.0
Left Turn Lane	3.0
Through Lane	3.5
2-way Left Turn Lane	4.0

NOTE:

In situations with higher design speeds or higher road classifications, wider lane widths may be required.

1.1.8 Right of Way and Pavement Widths

- Pavement widths and Right of Way widths shall be based on the following chart: (all measurements are edge of pavement to edge of pavement)

Category	Usage	R.O.W. (m)	Pavement (m)
Major	Arterial	36	Varies
	Primary Collector	26	Varies
Minor-Residential	Secondary Collector Local (Urban) Local (Rural)	21.5 20 20	9.5 8.0 7.0
Minor-Industrial and Commercial	Cul-de-sacs (less than 185m)	20	8.0

- The pavement width of Secondary Collectors shall be widened to 11m when they connect to Primary Collectors and Arterials. The storage length shall be 45m, taken from the end of the curb and gutter radii and the return taper should be 30m. The right-of-way at these widenings shall be increased to 22.5 m

- The pavement width of Local Roads serving 60 units or more shall be widened to 10m when they connect to Primary Collectors and Arterials. The storage length shall be 30m, taken from the end of the curb and gutter radii and the return taper shall be 30m. the right-of-way at these widenings shall be increased to 21.5m.

- Total number of units is based on number of units serviced by the local street including the window street units.

- For reconstructed local roads: If the measurement of the existing road width is less than defined in the previous chart, then use the chart width. If the measurement of the existing road width is greater than 8m, then reconstruct at 8m.

1.1.9 "K" Values

- On vertical curves, K factor shall be derived from the following table:

Design Speed (km/h)	**60**	**70**	**80**	**90**
Crest Vertical Curve Minimum K[1]	15	25	35	50
Sag Vertical Curve Minimum K[2]	18	25	30	40

*1. Source: Ontario Geometric Design Standards for Ontario Highways, Table C4-6;
2. Source: Ontario Geometric Design Standards for Ontario Highways, Table C4-8.

1.1.10 Maximum and Minimum Road Grades

- The maximum grades of any local road shall be 8%;
- The minimum road grades on all roads shall be 0.5%;
- The road cross-fall shall be 2.0%.

1.1.11 Vertical Curves

- When the numerical difference between two road grades exceeds 1% a vertical curve must be incorporated using the following criteria:
  - Use k value from Section 1.1.9;
  - Vertical curve length shall be numerically greater than or equal to the design speed;
  - When matching new vertical curves into existing ones, match the K values to provide continuity.

1.1.12 Drainage Issues

- Overland Flow Routes
  - The design of all road profiles for New Development Projects are required to accommodate and direct major overland flow routes (OLFR) to an acceptable outlet. This design element is to be considered at the earliest stages of design, coordinating with the Public Works and Engineering Department for information, assistance, review and acceptance, all to the satisfaction of the Municipal Engineer.
  - The design of all major road profiles for Capital Works Projects (i.e. existing rural roads, Transportation EA's, etc.) are required to consider major overland flow routes (OLFR) and where possible, accommodate and direct the OLF's to an acceptable outlet. This design element is to be considered at the earliest stages of design, coordinating with the Public Works and Engineering Department for information, assistance, review and acceptance, all to the satisfaction of the Municipal Engineer.
  - In reconstruction projects within existing developed areas of the Municipality, where the existing profile and driveway conditions cannot accommodate a formalized OLF Route, the proposed profile must provide for adequate road drainage and be acceptable to the Municipal Engineer.
  - In order of preference, OLFR should be directed along:

    a) arterial and primary collector roads;
    b) secondary collector roads;
    c) local streets;
    d) parks, open spaces; and
    e) rear yards.

- Culverts Under Roads

  - New culverts or culverts that are being redesigned, replaced or impacted by road works/road widenings must be designed to meet the hydraulic requirements established by MTO for inlet or outlet control culverts.

  - Municipal practice requires that culverts must convey the minimum storm events as specified below:

Classification of Road	**Minimum Storm Event To Be Conveyed By Culvert**
Local & Secondary Collector	25 Year Storm Event
Primary Collector & Arterial	50 Year Storm Event
Bridges	100 Year Storm Event or Regional storm event (250 year, subject to the Conservation Authority's conditions

  - Information, coordination and acceptance for this design element must be received and should be considered at the earliest stages of design.

1.1.13 0.3m Reserve Blocks

- 0.3m reserve blocks are required:

  - Along block frontages and at the rear and/or flankage of lots which are adjacent to arterial and collector roads;

  - At the dead end of proposed road networks which abut future proposed road extensions or networks; and

  - Where roads in a subdivision abut lands outside the subdivision;

1.1.14 Cul-de-Sacs:

- The maximum length of cul-de-sac without an emergency or secondary access is 215m.

- The minimum curb and gutter grade around a cul-de-sac shall be 0.5%;

- The maximum centre line road grade within a cul-de-sac shall be 3.0%;

- Cul-de-Sac to be in accordance with Figure 1.3 "Standard for Cul-de-Sac".

1.1.15 Temporary Turning Circles

- A temporary turning circle is required if there is no intersection street within 45 m of a dead end (as measured to the centerline of the intersection).

- No driveway shall connect with a temporary turning circle.

- Temporary turning circles to be in accordance with Figure 1.6 "Temporary Turning Circles".

1.1.16 Dead Ends

- Where a Temporary Turning Circle cannot be provided, then a dead end barricade is required in accordance with Figure 1.7 "Temporary Dead End Treatment."

- A turnaround driveway is to be provided for maintenance vehicles on the last lot of a dead end street.

1.1.17 Minimum Frontages

- At bends in streets or on cul-de-sacs, lots must be designed such that when side lines are projected to the fronting curb, an adequate frontage exists at the curb line to avoid conflicting driveway location. The minimum frontages at the curb line shall be;

    - 5.5 metres for single family lots;

    - 9.0 metres for semi-detached lots.

1.1.18 Driveways

Urban:

- Driveway locations are to be shown on the grading drawings for all non-standard situations such as along curves, at the ends of cul-de-sacs or adjacent to curb inlet catchbasins;

- Conflicts with surface utilities including streetlights, transformers, utility vaults, fire hydrants and catchbasins are to be avoided;

- Driveways are to be in accordance with Figure 1.8 “Standard Single and Double Driveway Entrance”.

- The maximum residential driveway width at the property limit is to be 6.0m.

Rural:

- The maximum residential driveway width at the property limit is to be 6.0m.

- Only one standard driveway is to be provided for each residential property. Properties with greater than 35m of frontage can apply for an additional driveway access. Such applications will be reviewed relative to local conditions and will be subject to municipal approval.

- Agricultural field access will be limited to one 12.0 m access or two 6.0 m accesses per 25 to 50 hectare parcel. Agricultural access for parcels less that 25 hectares will be limited to a single 6.0 to 12.0 wide access. All access widths are as measured at the property limit.

- Driveway culverts in settlement areas are to be sized to convey the 2 year municipal design storm unless the culvert forms part of a Municipal Drain system. Driveway culverts are not to be less than 300 mm in diameter.

- Driveway culverts shall be High Density Polyethylene (HDPE) maintain a cover of at least 300mm or Corrugated Steel Pipe (CSP) If less.

1.1.19 Rural Asphalt Lift Edge Taper

- On all rural road cross-sections, asphalt in all lifts shall be laid so that the edge of pavement is inclined at a 45-degree angle. Base lifts of asphalt shall be laid wider than surface lifts, so that a consistent slope is maintained.

1.1.20 Pavement Structure

- A geotechnical report is to be provided that contains recommendations for pavement design. In no case shall the recommended design be less than the minimum municipal standard provided below:

  Minimum Pavement Design:

Granular "B":	300 mm
Granular "A":	150 mm
HL 8 Base Asphalt:	50 mm
HL3 Surface Course Asphalt:	40 mm

1.1.21 Access and Sight Distance

- Site distances for local streets shall be 80 m or as determined from Figure E3-8 of the Geometric Design Standards for Ontario Highways.

1.1.22 Turning Lane Requirements

- Where warranted a traffic impact study is to be completed to determine requirements for turning lanes, storage and tapers. The length of the tapered and parallel portions of the turn lane shall be determined in accordance with the “Geometric Design Standards for Ontario Highways”.

1.1.23 Sidewalks

- As a minimum, sidewalks are to be provided as follow:

Local Street	- one side *
Collector/Arterial	- both sides
Cul-de-sacs	- subject to municipal review

  * In addition, the municipality may require additional sidewalks to provide linkages to parks, schools or any areas where an increase in pedestrian activity may be anticipated.

- Sidewalks to be in accordance with Figure 1.9 “Concrete Sidewalk”:
- Standard residential: 1.5m wide; 100 mm concrete; 100mm granular base;
- Commercial or heavy traffic entrance: 1.5m wide; 150 mm concrete; 100 mm granular base;
- Integrated with curb: 1.8m wide; 100 mm concrete; 100 mm granular base;

- Cross-fall: minimum 2%; maximum 4%;

- All sidewalk ramps terminating at a municipal ROW shall have cast iron tactile plates installed on them to meet the needs of AODA. as following:

Exterior paths of travel, curb ramps

In this section, “curb ramp” means a ramp that is cut through a curb or that is built up to a curb. O. Reg. 413/12, s.6.

Where a curb ramp is provided on an exterior path of travel, the curb ramp must align with the direction of travel and meet the following requirements:

1. The curb ramp must have a minimum clear width of 1,200 mm, exclusive of any flared sides.
2. The running slope of the curb ramp must,
    i. Be a maximum of 1:8, where elevation is less than 75 mm, and
    ii. Be a maximum of 1:10, where elevation is 75 mm or greater and 200mm or less.
3. The maximum cross slope of the curb ramp must be no more than 1:50.
    1. 4. The maximum slope on flared side of curb ramp must be no more than 1:10.
4. Where the curb ramp is provided at a pedestrian crossing, it must have tactile walking surface indicators that,
    i. Have raised tactile profiles,
    ii. Have a high tonal contrast with the adjacent surface,
    iii. Are located at the bottom of the curb ramp,
    iv. Are set back between 150 mm and 200 mm from the curb edge, and
    v. Are a minimum of 610 mm in depth. O. Reg. 413/12, s. 6.

Exterior paths of travel, depressed curbs

In this section, “depressed curb” means a seamless gradual slope at transitions between sidewalks and walkways and highways, and is usually found at intersections. O. Reg. 413/12, s.6.

Where a depressed curb is provided on an exterior path of travel, the depressed curb must meet the following requirements:

1. The depressed curb must have a maximum slope of 1:20.
2. The depressed curb must be aligned with the direction of travel.
3. Where the depressed curb is provided at a pedestrian crossing, it must have tactile walking surface indicators that,
    i. Have raised tactile profiles,
    ii. Have high tonal contrast with the adjacent surface,

iii. Are located at the bottom portion of the depressed curb that is flush with the roadway,

iv. Are set back between 150 mm and 200 mm from the curb edge, and

v. Are a minimum of 610 mm in depth. O. Reg. 413/12, s.6.

For tactile plate details, please refer to Middlesex Centre standard drawings 1.11 a) through 1.11 i). Approved manufacturers are as follows:

- East Jordon Iron Works Inc.
- Neenah Foundry Co.
- Or; approved equivalent

1.1.24 Bicycle Lanes

- 1.5m wide on-street bicycle lanes are to be incorporated into the road network. The designer is to review and confirm requirements with the Public Works and Engineering Department.

- The on-street bicycle lanes are to be as per the required pavement structure for the class of road on which the bicycle lane is being constructed.

1.1.25 Pedestrian Walkways

- Pedestrian walkways are to be designed and constructed in accordance with Middlesex Centre standard drawing 1.12 Standard Pedestrian Walkway.

- When designing a standard 3.0m or 4.6m width walkway, ensure that the full width of the walkway is sidewalk and no grassed area.

- Walkway sidewalk to have a crossfall of 20mm/m or alternative swales.

- Removable posts are to be installed at both ends of the walkway or as approved by the Municipal Engineer.

- Privacy screen wood board fencing shall be constructed from the rear lot line to the front face of abutting structures to a height of 1.8m. Black coated chain link fence shall be constructed along the balance length to the front property line.

- Pedestrian handrails are to be constructed on one side of the walkway in line with the removable posts where walkway grades exceed 8%. Hot dipped galvanized handrails are to conform with OPSD-915.01.

- Stairs with footings are to be constructed where walkway grades exceed 10%.

- Rise and Run Dimensions for Stairs in Walkways – Are to comply with the following:

  Minimum rise – 125mm
  Maximum rise – 200mm
  Minimum run – 255mm
  Maximum run – 380mm

- Intermediate landings (no less than 1.5m) are to be provided where the total change in grade exceeds 1.8m.

- Sidewalk and stair concrete to have at least a minimum strength of 30 MPa with 5% to 7% air entrainment and low slump.
- Stair reinforcement to be #15M diameter bars with 40mm of cover.
- Driveway locations to be located as far from the walkway as possible.
- A barricade and/or warning sign is required at the limit of a dead end street and/or end of a proposed sidewalk on an existing right-of-way where the sidewalk terminates (Refer to OPSD-906.01).
- A temporary sidewalk shall be constructed from the end of a proposed sidewalk to the adjacent road edge, at the curb & gutter and/or gravel shoulder as required by the Municipal Engineer.

1.1.26 Curb and Gutter

- Types and Applications
  - Residential subdivisions: semi-mountable per OPSD-600.06;
  - Arterial and primary collectors / commercial or industrial developments: barrier curb per OPSD-600.01;
- Transition/Termination
  - A transition of 3.0m is required between curb types.
  - Curb termination as per OPSD 608.01 shall be used within temporary turning circles and dead end streets or intersections which abut or are adjacent to a future phase of a subdivision.

1.1.27 Catch Basins (Road Works)

- Locations:
  - Upstream of any pedestrian crossing – centred on the lot line;
  - Upstream curb returns at intersections;
  - As otherwise appropriate at intersections located at curb returns;
  - At 90 metre intervals or maximum 90 metres from crest in the road.
  - Curb setback at catch basins is to be in accordance with Figure 1.10 “Concrete Curb Setback.”
- Types:
  - Curb inlet catch basins at all low points in the curb to be in accordance with OPSD 400.090.

- Standard 600 x 600 pre-cast road side catch basins to be in accordance with OPSD-705.010;
- Ditch inlet catch basins for ditch drainage, external drainage or temporary block drainage to be in accordance with OPSD-705.030 and OPSD-705.040.

- Leads:
  - Street: 250mm dia @ minimum grade of 0.69% (velocity 1.0 m/s);
  - Lot/Rear Yard: 300 mm dia @ minimum grade of 0.54% (velocity of 1.0m/s);
  - Catch basin leads less than 15 metres in length are to be connected into the adjacent storm sewer;
  - Catch basin leads between 15 metres and 30 metres in length can be connected to sewers 900 mm or larger; if the receiving sewer is less than 900 mm, a catch basin maintenance hole is to be used;
  - Catch basin leads longer than 30 metres require a catch basin maintenance hole;
  - Pipe and bedding to be in accordance with sewer pipe standard identified in Section 2.0.

1.1.28 Frame and Grates

- Standard: OPSD-400.02
- Curb Inlet: OPSD-400.09
- Ditch Inlet: OPSD-403.01

1.1.29 Sub-Drains

- Sub-drains are required for all roadside catch basins to facilitate road sub-grade drainage;
- Minimum of 3.0 metres sub-drain on each side unless otherwise recommended by geotechnical engineer;
- To consist of 150 mm dia perforated PVC pipe wrapped in geotextile (270 Terraxfix or equal) or manufactured geotextile knitted sock;
- Sub-drain ends to be capped at upstream end with a pre-manufactured end cap sized to fit pipe.

1.1.30 Pavement Markings

- Pavement marking locations shall be designed in accordance with the Ontario Traffic Manual – Book 11.
- Proposed designs shall be submitted to the municipality for review and acceptance prior to construction.

- Application shall follow completion of top coat asphalt, within 24 hours.

- All stop signs shall have a 40mm wide white reflective stop bar with a yellow centerline extending 15.0m back from the stop bar. *3M Stamark Series A440* or approved equivalent shall be used for stop bars, pedestrian crossings at intersections, pedestrian crossovers (PXO). and centerline.

1.1.31 Pavement Reinforcement

- Requirements for pavement reinforcements shall be addressed by the geotechnical engineer including all details.

1.1.32 Access Configurations

- **Single Family** accesses are to be in accordance with Middlesex Centre standard drawing 1.13 Single Family Driveway Entrances with Boulevard.

- Should a conflict occur between the location of a driveway and the location of a curb inlet catchbasin (CICB), then the Owner shall correct the conflict by either relocating the driveway, except when a parking plan governs, or replacing the CICB with a twin inlet catchbasin in the same location as the original CICB, all to the specifications of the Municipal Engineer and at no cost to the Municipality.

- **Development blocks for site plan approvals** access configurations shall be in accordance with Ontario Provincial Standard Drawing 350.010.

- No catchbasins, existing or proposed shall be located within the limits of site entrances. In situations where existing catchbasins would be within proposed site entrances, the access shall be realigned so to avoid catchbasins or the catchbasin shall be relocated outside the access curb return.

1.1.33 Roadside Protection

- Roadside protection shall be applied in accordance to the Ministry of Transportation's Roadside Safety Manual.

1.1.34 Regulatory / Road Signs

- Regulatory / Road Signs shall be applied in accordance to the Ontario Traffic Manual Book 5 and as supplied by Cedar Signs Incorporated, Cambridge, ON.

1.2 TRAFFIC CALMING

1.2.1 Application and Methodology

- Traffic calming measures are applied on primary and secondary collectors in residential areas, and occasionally on local roads. If traffic calming measures are deemed necessary, based on an engineering report, they will only be applied after the completion of a comprehensive traffic calming plan which will address all matters relating to traffic calming within a designated area and after extensive public consultation.

1.3 STREET LIGHTING

1.3.1 Warrants

- Street lighting shall be considered warranted on all roads in urban areas and consist of LED NXT™ Series Luminaire fixtures as manufactured by LED Roadway Lighting, or equivalent as approved by the Director, Public Works and Engineering.

- Street Light pole and arm shall be in compliance with Figure 1.15 and 1.16 or equivalent as approved by the Director, Public Works and Engineering.

- At isolated rural intersections with non-continuous lighting on the intersecting roads, street lighting shall be considered warranted if the roadway meets or exceeds the requirements of the warrant provided in the Transportation Association of Canada Illumination of Isolated Rural Intersections guide.

- Reconstruction of a substandard, isolated rural intersection should be considered before illumination. Street lighting may also be installed at isolated rural intersections at the direction of the Director, Public Works and Engineering. Situations when this is warranted may include but are not limited to the occurrence of rare but severe collisions, an inability to maintain adequate hazard markings for raised channelizing islands, or the presence of an unusual number of long combination vehicles with reduced accelerating and braking abilities.

1.3.2 Arterial, Primary and Secondary Collector Design

- Design of street illumination on all roads shall be designed, signed and sealed by a qualified Professional Electrical Engineer that meets the criteria identified in the Registry, Appraisal and Qualification System (RAQS), conform to the requirements set out by ANSI/IESNA RP-8. Secondary Collectors and Local Design

- Residential Street Light Designs should be completed based on the following and shall be submitted with the final subdivision drawing submission.

    - The drawings shall specify the type of pole, fixture, conduit, lamp wattage, and conductor being used. The drawings shall also show the location of the transformers and power disconnects.

- Once municipal approval has been obtained, the design is to be submitted to Hydro One for electrical approval and joint trench coordination. All costs associated with street lighting in new subdivisions is to be attributed to the developer.

- The light standard should be placed on one entire lot at the property line whenever possible.

- A disconnect is to be installed next to the first street light pole on the circuit. The orientation will be to install the pedestal as close as possible to the street light pole between the sidewalk and the pole or between the pole and the property line frontage if there is no sidewalk, with the access door facing the street for oncoming traffic.

- This pedestal orientation will affect the orientation of the street light pole installation. The street light pole will now need to be installed so that the access cover of the pole is positioned so that the contractor can remove the cover and view the oncoming near side traffic.

- The conductors from the transformer to the disconnect shall be installed in a 50 mm PVC duct.

- Existing street lights shall be shown as solid black circles.

- The street light cable should be indicated by a black line with an SL imposed on the line.

- Designers should be aware of driveway locations and living room windows when determining the location of lights.

- The design is to be drawn at a 1:250 scale.

- Final designs must be accepted by the Municipality.

1.3.3 Roundabout Lighting

- The lighting requirements for roundabouts shall be supported by detailed photometrics that meet the latest version of the RP-8 standard and the Transportation of Canada's Roundabout Lighting Standard. Center lighting should be avoided as this is difficult to maintain and may not provide adequate lighting in the roundabout.

1.3.4 Walkway Lighting Design

Walkway lighting designs shall be comprised of the following:

- 35W LED NXT-24S @ 450mA;.

- 4.6m pole (black powder coated galvanized square tapered steel or aluminum)

- The first light from the street should be 15m from the sidewalk or 15m from the edge of pavement if no sidewalk is present;

- Spacing of the light along the walkway should be approximately every 30m, noting most walkways require only one additional light usually located at the rear of the residential property line; severe bends or stairs may require tighter spacing;

- Walkway lights are to intersect street circuits at a junction box located at one end of the walkway;

- Street light wire shall be placed in a 50mm RPVC duct;

- The light is to be placed within 1m of the fence line in the walkway;

- Bollards located at either end of a lit walkway must be removable for maintenance purposes.

1.3.5 Residential Street Light Installation & Inspection Guidelines

- The same light standard must be used from one end of a street to the other regardless of how many phases of construction are involved.

- A power disconnect must be installed at the transformer. All installations must be inspected by the Electrical Safety Association (ESA). The Contractor is responsible for arranging inspection with ESA.

1.4 CONSTRUCTION SIGNAGE

1.4.1 Road Closures / Detours

- All road closures and detours must be pre-authorized by the Director, Public Works and Engineering.
- A minimum notice of 5 working days is required for all requested road closures.

1.4.2 Traffic Control

- Traffic Control is to be in accordance with the Ontario Traffic Manual – Book 7 – Temporary Conditions.

1.4.3 Pedestrian Safety

- Construction projects in proximity to high pedestrian areas, including schools, commercial areas and any other source of high pedestrian volumes should take extra precaution to separate construction activity from pedestrian movements.
- Sidewalks that are closed or removed should have signed alternate detour routes.
- Any material deliveries or construction vehicle movements crossing pedestrian areas should be carefully monitored by a traffic control person.
- Schools in close proximity to projects are to be notified in the preconstruction letters and kept informed of progress.

1.5 NOISE ATTENUATION BARRIER

1.5.1 Noise Assessment Study

- A noise study or report is required when a proposed subdivision is situated within certain design setbacks from a provincial highway or railway line. The noise study is to comply with the Ministry of the Environment “Noise Assessment Criteria in Land Use Planning”. All recommendations and details from the noise barrier wall studies/reports are to be reflected on the servicing drawings.

1.5.2 Application and Methodology

- Noise barrier walls for new developments and subdivisions are to comply with the Ministry of the Environment “Noise Assessment Criteria in Land Use Planning” requirements and approved by the Planning Division.

- Detailed fabrication and layout drawings of the proposed barrier, sealed by a Registered Professional Engineer, shall be submitted as part of the engineering drawings for acceptance prior to manufacture or construction.

1.5.3 Minimum Height

- The top of noise barrier walls are to be set a minimum 2.4 m above the ultimate centerline road profile.

1.5.4 Materials

- Masonry/concrete: with a surface density of 20 kg/sq.m.;
- Wood: surface density of 20 kg/sq.m. – tongue and groove;
- To be free of all gaps and holes

1.5.5 Return End Walls

- Required at wall ends and as identified in the noise study.

Summary of Referenced Roadways and Transportation OPSD Details*:

OPSD No.	Title	Reference Section	Date
400.020	Cast Iron, Square Frame with Square Flat Grate for Catch Basins, Herring Bone Openings	1.1.25 4.16.8	Nov-13
400.090	Cast Iron Curb Inlet Overflow for Catch Basins	1.1.24 1.1.25 4.16.8	Nov-13
403.010	Galvanized Steel Honeycomb Grating for Ditch Inlets	1.1.25 4.16.8	Nov-13
600.010	Concrete Barrier Curb with Wide Gutter	1.1.23	Nov-12
600.060	Concrete Semi-Mountable Curb with Standard Gutter	1.1.23	Nov-12
608.010	Method of Termination for Concrete Curb with Gutter	1.1.23	Nov-13
705.010	Precast Concrete Catch Basin 600 x 600mm	1.1.24 4.16.4	Nov-14
705.030	Precast Concrete Ditch Inlet 600 x 600mm	1.1.24 4.16.4	Nov-14
705.040	Precast Concrete Ditch Inlets 600 x 1200mm	1.1.24 4.16.4	Nov-14

*Note: The above summary of referenced OPSD is for convenience only and it is not intended to be a comprehensive listing of all applicable OPS Details.

2 WASTEWATER COLLECTION SYSTEM

2.1 DEFINITIONS

2.1.1 Public Wastewater Systems

- A piped collection system that transports wastes of domestic origins which is human body waste, toilet or bathroom waste, waste from other showers and tubs, liquid or water borne culinary and sink water or laundry waste, and such other waste as is suitable for treatment at a wastewater treatment facility.

2.1.2 Private Wastewater Systems

- A sewage system (or systems), with a total design capacity of 10,000 litres per day or less, shall be designed, constructed, operated and maintained in accordance with Part 8 of the Ontario Building Code.

- A sewage system (or systems), with a total design capacity greater than 10,000 litres per day, falls under the jurisdiction of the Ministry of the Environment.

2.2 NON-PERMITTED FLOWS

- Connections from foundation, weeping tile drainage, roof drainage or any hazardous wastes are not permitted to enter the wastewater system. (Hazardous wastes as defined under the Environmental Protection Act, Regulation 347.)

  All waste discharges to the municipal wastewater collection system are to be in accordance with the Municipality's current Waste Discharge By-law and Drainage By-law.

2.3 LOCATION AND ALIGNMENT

- Wastewater pipe is to be located in front of, or it to be in locations accessible to each lot and block facing a municipal street. Wastewater is also to be located 1.5 metres from the centreline of the road. Refer to Figure 1.4 "Typical Cross-Section – Local Urban Residential".

- Wastewater pipe is to be located on the inside loop of a proposed crescent with the maintenance hole located at a 1.5 metre offset from the centre-line of the road.

2.3.1 Wastewater on Private Property

- Wastewater pipes on private property are regulated by the Ontario Building Code (OBC).

- Where there are no specific regulations in the OBC, details from this manual will apply.

2.4 DRAINAGE/SUB-DRAINAGE AREA PLANS

- Drainage/sub-drainage area limits for which sewers are to be designed for are to contain and follow the lot/block lines to the proposed maintenance holes located on the R.O.W.

- All areas and populations are to be shown for each drainage/sub-drainage areas.

2.5 EXTERNAL WASTEWATER DRAINAGE LIMITS AND DRAINAGE AREAS

- When design abuts undeveloped or un-serviced areas, identify the external drainage areas to be designed for;

- All areas and populations are to be shown for all external drainage area limits.

2.6 DESIGN CHART

- Wastewater design calculations for approved drainage area plans are to be completed on the standard design chart. See Figure 2.1 “Wastewater Design Chart” for details and additional design information.

2.7 PEAKING FACTOR CALCULATION

- Peaking factor calculations are to be determined based on the Harmon formula:

Harmon formula

$$M = 1 + \frac{14}{4 + P^{\frac{1}{2}}}$$

Where

M = ratio of peak flow to average flow

P = tributary population in thousands

2.8 DESIGN CRITERIA

- For determining the peak wastewater flows contributing to wastewater, different criteria are followed depending on the size of the catchment area. These areas are defined as those less than 200 hectares and those greater than 200 hectares.

- Residential Commercial & Institutional Design Criteria:

i) Zoning

Low Density	=	30 Units/hectare @ 3 people/unit
Medium Density	=	75 units/ hectare @ 2.4 people/unit
High Density	=	150-300 units/hectare @ 1.6 people/unit

ii)	<u>Lot Basis</u>		
	Single Family	=	3 people/unit
	Semi-detached	=	6 people/unit
iii)	<u>Area Basis</u>		
	Single Family	=	30 units/hectare @ 3 people/unit
	Semi-detached	=	30 units/hectare @ 3 people/unit
	Multi-family	=	75 units/hectare @ 2.4 people/unit
iv)	Commercial/Institutional	=	100 people/hectare
v)	Elementary School	=	maximum design number of students and employees, with consumption at 30 Litres/person/day. In calculating the peak flow, it is assumed that the total daily flow will occur over an 8 hour day and an equivalent population will be determined by dividing the total flow by the standard per capita flow of 230 Liters/day. If the design number is not known, the population will be assumed to be 400
vi)	Secondary School	=	maximum design number of students and employees, with consumption at 30 Litres/person/day. In calculating the peak flow, it is assumed that the total daily flow will occur over an 8 hour day and an equivalent population will be determined by dividing the total flow by the standard per capita flow of 230 Liters/day. If the design number is not known, the population will be assumed to be 1500.
vii)	Church	=	100 people/hectare
viii)	Per Capita Flow	=	350 litres/capita/day
ix)	Uncertain Development Factor	=	1.1
x)	Peaking Factor	=	0.8 x Harmon
xi)	Infiltration Allowance	=	8640 litres/hectare/day (0.100 l/s/ha)

NOTE:

Densities may be adjusted subject to review by the Director, Public Works and Engineering as more information becomes available on specific areas.

2.8.1 Industrial Design Criteria:

i) Flow Allowance

Light Industrial	=	20,000 litres/hectare/day
Heavy Industrial	=	50,000 litres/hectare/day

NOTE:

The unit flow rates for industrial development may be adjusted if specific information is available on a particular use however, consideration must be given to potential future redevelopment.

i)	Uncertain Development	=	1.1
ii)	Peaking Factor	=	0.8 x Harmon
iii)	Infiltration Allowance	=	8640 litres/hectare/day (0.100 l/s/ha)

2.9 PEAK FLOW CALCULATION

- Peak flow calculations are to be determined based on the following formula:

Peak Flow (Q)	=	population X per capita flow X peaking Factor (H) X uncertain development factor + infiltration allowance

Where:

Peak Flow (Q)	=	L/s
Per Capita Flow	=	350 litres/capita/day
Peaking Factor (H)	=	Harmon (section 2.7)
Uncertain Development	=	1.0 or 1.1 (situation dependant)
Infiltration Allowance	=	8640 litres/hectare/day (0.100L/ha/s)

2.10 MANNINGS ROUGHNESS COEFFICIENT

- A coefficient of 0.013 is to be used for all concrete and PVC pipe for pipe sizes 200mm to 1650mm.
- A coefficient of 0.011 is to be used for all pipe sizes 1800mm or greater.

2.11 PIPE SIZE

- Pipe size is determined using the formula where the pipe design flow is equal to or greater than the calculated peak design flow:

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

Where:

Q	=	Design flow (m^3/sec.)
n	=	Manning's roughness coefficient
A	=	cross sectional area of flow (m^2)
R	=	hydraulic radius (area/wetted perimeter)
S	=	slope of pipe (m/m) %

- Notwithstanding the above, the minimum allowable size of a sanitary sewer shall be 200 mm.
- On private property, the minimum size for sanitary building sewer shall be 100mm, in accordance with Part 7 of the OBC.

2.12 FLOW VELOCITY

- Velocities in wastewater shall be calculated using the following formula:

$$V = Q/A$$

Where:

V	=	flow velocity (m/sec.)
Q	=	Design flow (l/sec)
A	=	cross sectional area of flow (m^2)

2.12.1 Minimum and Maximum Velocities

- The minimum velocity permitted in sanitary sewers is 0.6 m/sec.
- The maximum velocity permitted in sanitary sewers is 4.5 m/sec.
- To determine velocities based on actual flow, refer to Figure 2.2 "Hydraulic Elements Graph for Circular Sewers".

2.12.2 Minimum Grades

- The minimum grade on a 200 mm diameter wastewater pipe is 0.33%. Where there are only a few dwelling units connected to the upper section of a 200 mm sanitary sewer, the minimum grades shall be adjusted as follows:

1 to 5 units	0.61%
6 to 8 units	0.52%
9 to 12 unit	0.43%
13 or more units	0.33%

- The minimum grade on all other sewer sizes shall be established by determining the minimum grade necessary to achieve a velocity of at least 0.6m/sec.

2.13 PIPE MATERIAL

- Both rigid and flexible pipe are permitted in the construction of wastewater pipe including private drain connections in accordance with the following:
  - P.V.C. – Smooth Wall (CSA 182.2):
    - 100 mm to 600mm as manufactured by Ipex and Royal pipe or 100mm to 375 mm as manufactured by NEXT Duraloc.
  - P.V.C. – Ribbed Pipe (CSA 182.4):
    - 100mm to 600 mm as manufactured by Loc-Pipe or Ipex; 200 mm to 450 mm as manufactured by Royal Pipe (KOR-FLO); or 375mm,450mm, 600mm as manufactured by Rehau.
- Concrete Pipe:
  - non-reinforced – CAN/CSA 257.1 100mm to 600mm
  - reinforced – CAN/CSA 257.2
- All fittings shall be PVC fabricated and moulded and shall be C.S.A. certified.
- On private property, materials for sanitary building sewers and private sewers shall comply with Part 7 of the OBC.
- No other materials other than those listed herein may be used. Should any supplier or contractor wish to explore alternate materials, submission for approval is to be submitted to the Municipality. The review of a submission for approval of alternate materials may require a significant amount of time on the part of the Municipality. Parties making submissions should allow for such time requirements.
- The Municipality reserves the right to select any materials or product it deems appropriate for the application. It also reserves the right to remove from the specifications any product previously approved but found inappropriate for the application. This includes but is not limited to pipe material and fittings. The design engineer shall clearly indicate on drawings

and contract documents the materials which are acceptable for use in a particular application where the use of one or more of the approved materials list is not acceptable.

- All precast concrete pipe joints shall be sealed with a 12-inch wide exterior joint wrap meeting the Materials requirements of this specification and installed according to manufacturer's recommendations.

  Materials

  The external joint seal material shall meet or exceed the requirements of ASTM C-877, type II. Further, the external joint seals shall be Cretex Wrap External Manhole Joint Seals or pre-approved equal conforming to the following requirements.

  External joint seals shall consist of a collar 12-inch wide with an outer layer of polyethylene, with a minimum tensile strength of 4000 psi and a minimum tear resistance of 1500 psi, and an under layer of rubberized mastic that is reinforced with a woven polypropylene fabric. Two 5/8" steel straps shall be located within the collar ¾ inches from each edge. The straps shall be confined in tubes that isolate them from the mastic and allow them to slip freely with mechanically tightened and locked around the joint. The collar shall be furnished with a minimum of 6" overlap and a closing flap to cover any remaining exposed strap.

  The external joint seal wrap shall be Cretex Wrap by Cretex Specialty Products, Waukesha, WI, 1 800-345-3764, or pre-approved equal.

2.14 Private Drain Connections (PDC)

2.14.1 Materials

- Private drain connections shall be constructed of flexible pipe only.
- On private property, materials for sanitary building sewers and private sewers shall comply with Part 7 of the OBC.

2.14.2 New Pipe Connections

- Concrete Pipe:
  - core drilled KOR-N-TEE flexible connection (100 to 250mm);
- PVC Pipe:
  - fabricated tees

2.14.3 Connections to Existing Pipe

- Concrete Pipe:
  - core drilled KOR-N-TEE flexible connection (100 to 250mm);
- PVC Pipe:
  - core drilled with “Inserta T” or “Fowler” connector.

2.14.4 Location

- PDCs to single family and semi detached lots are to be located in accordance with Figure 2.3 “Standard Servicing Locations for Single Family and Semi-Detached Lots”.
- PDCs to multi-family (town housing, row housing and apartments), commercial and industrial blocks are to be connected to a maintenance hole on the R.O.W.
- PDC's shall be installed at 90° to the sewer main where possible. Under no circumstances will flow from the PDC enter the main against the flow in the main. Where horizontal or vertical bends are required, long radius sweeps shall be used. Short bends are not acceptable.
- Single family and semi detached lot sanitary PDC's shall NOT be connected to a maintenance hole.
- Where design constraints arise (ie: top end of cul-de-sac or crescent), PDCs may have to be located in reverse location and identified as such on the servicing drawings.
- PDC's for future sanitary sewers may be required by the municipality for lots that are to be serviced on septic systems.

2.14.5 Minimum Size and Grade

- The minimum diameter and grade of a PDC for a residential, single family and semi-detached lots is 100 mm @ 2.0%.
- The minimum diameter and grade of a PDC for a residential multi-family block is 150 mm diameter @1.0%.
- The minimum diameter and grade of a PDC for a non-residential block is 150 mm diameter @ 1.0%.

- The minimum diameter and grade of a PDC for a commercial block is 150 mm diameter @ 1.0%.

- The minimum diameter and grade of a PDC for an institutional block is 200mm diameter @1.0%.

- The actual size of the PDC required for multi-family, non-residential, commercial and institutional blocks is dependent on the flows.

2.14.6 Connections to Sewers/Maintenance Holes

- Residential

  - PDCs 100 mm and 150mm in diameter must be connected to the main sewer. No sanitary PDCs are to be constructed into any sanitary maintenance hole.

- Multi-family, Commercial, Institutional and Industrial

  - PDCs 200 mm in diameter and larger are to be connected to the main sewer with a new maintenance hole(s).

- Connections to Existing Sewers for Lot Infill Situations

  - Where a lot severance or lot infill condition exists, and a new sanitary service is to be connected to an existing sanitary sewer, the owner of the severance/infill must contact the Director, Public Works and Engineering for information to determine if the existing sanitary sewer has a history of surcharging. If it is determined that there is a surcharge risk, surcharge protection is to be provided by the owner of the severed or infill lot.

  - When connecting PDC's to existing sewers in a lot infill situation, connections are to be made utilizing an approved saddle or pre-manufactured tee, in accordance with OPSS 410, and as amended by these standards.

  - Connections will not be allowed into existing maintenance holes.

2.14.7 Vertical Clearance

- A minimum clearance of 150 mm under/over the storm sewer and watermain is to be provided.

- For PDCs that cross over or under a watermain larger than 450mm diameter, 600 mm clearance is required.

2.14.8 PDC Detail

- Typical PDC connection to the main shall be in accordance with Figure 2.4 "Private Drain Connection (Residential)".

2.14.9 PDC Risers

Type I — Required for sewer depths greater than or equal to 4.5 m and for excavations in stable bank conditions, see Figure 2.5 “Private Drain Connection Riser – Type 1 (Residential)” for details and additional design information. When the PDC is installed between 45° and 67.5°, an approved controlled settlement joint shall be installed at the tee.

Type II — Required for sewer depths greater than or equal to 4.5 m and for excavations in unstable bank conditions, see Figure 2.6 “Private Drain Connection Riser – Type 2 (Residential)” for details and additional design information. When the PDC is installed between 45° and 67.5°, an approved controlled settlement joint shall be installed at the tee.

2.14.10 PDC Cleanouts

- PDC cleanouts are required on all residential lots and be terminated within the right-of-way, they shall conform to Figure 2.7 “Private Drain Connection Cleanout (Residential)”. On private property, sanitary building sewers and private sewers shall be provided with cleanouts/maintenance holes, in accordance with Part 7 of the OBC. Cleanout/maintenance holes shall be located off of the right-of-way.

2.14.11 Marking and Recording PDC Service Connections

- Brown painted surface stakes 40mm X 90mm (standard 2” X 4”) shall be placed after trench restoration to mark the termination of sanitary PDC’s. These stakes shall extend from PDC invert to minimum 750mm above finished boulevard grade. Refer to Figure 2.8 “Private Drain Connection Marker (Residential)”.

- Plugged or capped service connections shall be marked on the top surface of the last 3m of the upstream end of the pipe with yellow PVC adhesive tape (50mm wide) labeled continuously in black lettering (40mm wide) “**CAUTION SANITARY SEWER**”

- New PDCs to Existing Properties – To be constructed to 1.2m inside the road allowance.

- PDCs to Parklands – The location and design to be reviewed and approved by the Director, Public Works and Engineering.

2.15 PIPE DEPTH AND BEDDING MATERIAL

2.15.1 Minimums

- The minimum depth of a wastewater pipe shall be 2.4 m from the finished ground elevation to the obvert of the pipe.

- Where frost protection is warranted, insulation is required in accordance with Figure 5.2 “Insulation Standard for Shallow Mains and Offsets”.

2.15.2 Maximum Depth of Cover/Pipe Strength Design

- Concrete Pipe
  - The maximum allowable cover permitted on concrete pipe is to be based on OPSD 807.01, 807.03, 807.04 and 807.05. Bedding Classes to be in accordance with Figure 2.9 “Bedding Standard for Rigid and Flexible Pipe”.
  - Where the pipe required exceeds the OPSD charts, the pipe strength requirements are to be calculated based on first principles with design variables subject to review by the Municipal Engineer.
- Flexible Pipe
  - The maximum allowable cover permitted on flexible pipe is 10.5 m. The following bedding types are to be used:

    up to 4.5 m ..... Type 1 Bedding
    up to 10.5 m ..... Type 2 Bedding

  - Bedding Types to be in accordance with Figure 2.9 “Bedding Standard for Rigid and Fexible Pipe”.
- Maximum Depth of Cover
  - Where trench conditions are expected to exhibit seeping ground water in silt or fine sand, specified bedding will be defined as 19mm crushed stone entirely surrounded by geotextile.

2.15.3 Crossing Clearances

- Minimum clearances required when wastewater pipes cross other services as measured from outside wall diameter to outside wall diameter:
  - over or under a storm sewer, 250 mm clearance is required;
  - over or under a watermain, 450 mm diameter or less, 0.50 m between the invert of the sewer or PDC and the crown of the watermain is required.

2.15.4 Minimum Distance between Wastewater Pipes

- The minimum horizontal distance between service pipes shall be 3.0 m from center to center. Special cases are to be reviewed for site specific design constraints and depths.

2.15.5 Trenchless Technologies

- When trenchless installation methods are being considered for new works, please refer to Section 11 – Trenchless Technologies (for New Construction).

2.16 MAINTENANCE HOLES

2.16.1 Spacing of Maintenance Holes

- The maximum spacing between wastewater maintenance holes shall be 99 metres measured horizontally or 110 metres measured vertically from the top of the maintenance hole, to the springline of the pipe, along the springline to the next maintenance hole and vertically to the top of the maintenance hole.

- When spacing of a maintenance hole dictates that the maintenance hole should be placed within the vicinity of a roundabout, sanitary maintenance holes are not permitted to be located within the grassed area of the roundabout. Sanitary maintenance holes must be located within the apron of the island, for maintenance purposes.

- Required where there is a change in the direction of the flow, slopes, a change in the diameter of sewers, and/or a lateral sewer connection.

2.16.2 Precast Maintenance Hole Sizing Criteria

- All sizing of precast maintenance holes are based on incoming and outgoing pipe sizes and should be sized and conform to Figure 2.10 “Maximum Pipe Sizes for Precast Maintenance Holes”.

2.16.3 Maintenance Holes

- Precast maintenance holes are to be in accordance with the applicable standard OPSD 701.010 through to OPSD 701.015 and OPSD 701.03 through to OPSD 701.08.

2.16.4 Maintenance Hole Tees

- Maintenance hole tees are not allowed for any wastewater collection system.

2.16.5 Maintenance Hole Frame and Covers

- Maintenance hole frames and covers to OPSD 401.01.

- Maintenance hole frames and covers are to be clear of curb and gutters on bends in the road for new construction. Maintenance hole frames and covers may be located in the curb and gutter on reconstruction projects, only as approved.

- Maintenance hole frames and covers and by association steps must be aligned to avoid being located in the wheel path of the street, and to be located above a benching platform, i.e. to avoid conflict with an inletting or outletting sewer pipe, respectively. Proposed location of maintenance hole frames and covers and by association steps must be shown in plain view on the engineering drawings, represented by a solid circle reflecting the above requirements.

- Refer to Figure 2.16 for a typical manhole frame and cover.

2.16.6 Use of Maintenance Hole Inserts Required During Construction

- The use of inserts in sanitary maintenance holes will be required in areas of new construction until such time as the roadway is paved with the top asphalt layer.

2.16.7 Watertight Maintenance Hole

- All precast concrete maintenance hole joints shall be sealed with a 12-inch wide exterior joint wrap meeting the Materials requirements of this specification and installed according to manufacturer's recommendations.

  Materials

  The external joint seal material shall meet or exceed the requirements of ASTM C-877, type II. Further, the external joint seals shall be Cretex Wrap External Manhole Joint Seals or pre-approved equal conforming to the following requirements.

  External joint seals shall consist of a collar 12-inch wide with an outer layer of polyethylene, with a minimum tensile strength of 4000 psi and a minimum tear resistance of 1500 psi, and an under layer of rubberized mastic that is reinforced with a woven polypropylene fabric. Two 5/8" steel straps shall be located within the collar ¾ inches from each edge. The straps shall be confined in tubes that isolate them from the mastic and allow them to slip freely with mechanically tightened and locked around the joint. The collar shall be furnished with a minimum of 6" overlap and a closing flap to cover any remaining exposed strap.

  The external joint seal wrap shall be Cretex Wrap by Cretex Specialty Products, Waukesha, WI, 1 800-345-3764, or pre-approved equal.

2.16.8 Watertight Maintenance Hole Lids/Covers

- Watertight maintenance hole lids to OPSD 401.030 are required when:

  - sanitary maintenance holes are located within overland storm flow routes such as: within flood plain areas; within gutter locations; and within easements and/or open space areas where overland flow is directly over and or adjacent to the maintenance hole lids;

  - under surcharge conditions.

2.16.9 Lockable Maintenance Hole Covers

- Lockable maintenance hole covers may be required by the Municipal Engineer in special circumstances and / or locations such as park blocks, open spaces, pumping stations, pollution control plants, etc.

- Where required by the Municipal Engineer they are to be provided in accordance with OPSD 401.06.

2.16.10 Maintenance Hole Steps

- Maintenance hole steps are required for access and are to conform with one of the following:

  - Maintenance Hole Steps Hollow See OPSD 405.010 for details and additional design information.

  - Maintenance Hole Steps Solid See OPSD 405.020 for details and additional design information.

- All steps are to be galvanized steel or aluminum;
- A detail or restoration plan is required for the relocation of maintenance hole steps within existing maintenance holes, where applicable;
- Maintenance hole steps shall be located to avoid conflict with an inletting or outletting pipes. Access to maintenance holes must be above the benching platform.

2.16.11 Maintenance Hole Drop Structures

- Drop structures are required when the difference in invert elevations between the upstream and outlet sewers in the maintenance hole is equal to or greater than 0.6 metres.
- Drop structure to be in accordance with Figure 2.11 “Maintenance Hole Drop Structure”.
- Internal drop structures will not be permitted under any circumstances.

2.16.12 Maintenance Hole Safety Landings

- Maintenance hole safety landings are required at the mid-point depth of the maintenance hole, when the depth of the maintenance hole is between 5.0 and 10.0 metres.
- Additional safety landings are required at third-point depths, when the maintenance hole is equal to or greater than 10.0m to 15.0m deep.
- Landing to be in accordance with OPSD 404.020;
- Incoming pipes are to be below safety landings, where possible.

2.16.13 Benching

- Benching is to conform to OPSD 701.021;
- Benching height should be increased to obvert to increase hydraulic benefit as required;
- Where benching is different from OPSD 701.021, a benching detail is required.

2.16.14 Steps in Benching

- Steps in maintenance hole benching are required when the pipe diameter is greater than 900 mm and benched to spring-line; and when the pipe diameter is greater than 450 mm and benched to crown.
- Refer to Figure 2.12 “Steps in Maintenance Hole Benching” for details and additional design information.

2.16.15 Adjustment Units

- Maintenance hole adjustment units to be to OPSD 704.010;
- The difference in grade between the maintenance hole lid and the first ladder rung is not to exceed 600 mm.

- Clay brick is not to be used for adjustment unit;

2.16.16 Head Losses

- When velocities in the downstream pipe from a maintenance hole exceed a velocity of 1.2 m/s, head losses must be accounted for in the design of the sewer. (This may be accomplished through improvements to benching, increasing the downstream sewer diameter or in lowering the crown of the outgoing sewer.);

- Drops in maintenance holes to compensate for Head Loss (HL) shall be calculated using the following formula:

$$HL = K_L \cdot \frac{V^2}{2g}$$

Where

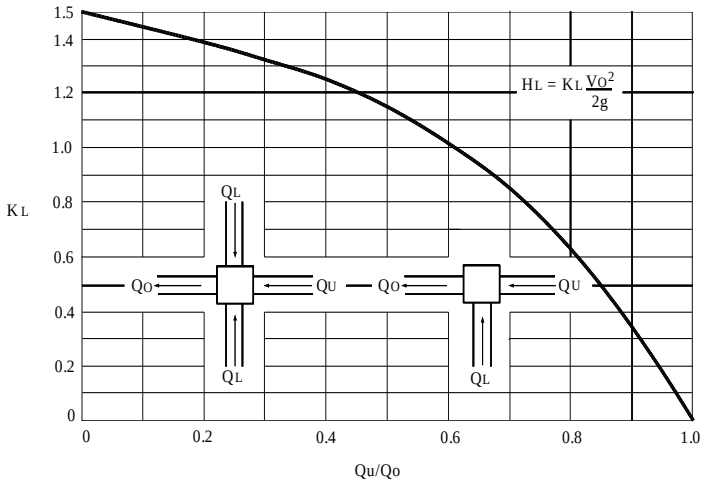
K_L = Head loss coefficient

V = downstream velocity

g = 9.8 m²/sec

- Refer to Figure 2.13 “Head Losses in Maintenance Holes”.

- Head loss coefficients (K_L) are to be applied as follows:



i) 90 degrees

No benching or deflector, or where they are only up to springline.

K_L =1.5

ii) 90 degrees

Benching or deflector to crown of sewers.

K_L = 1.0

iii) Less than 90 degrees

Multiply the head loss coefficient for a 90 degree bend by a head loss ratio factor from the following chart:

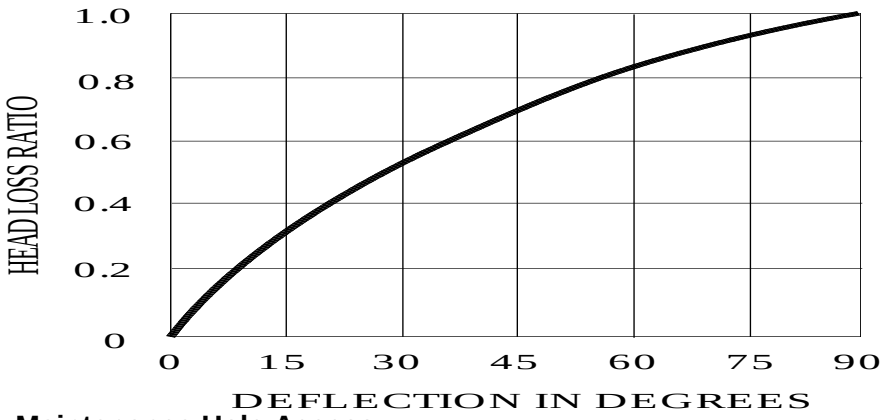
iv) Junctions

Tee

Outlet at right angles to inlets and no deflector between inlets.
$K_L = 1.5$

Deflector between inlets for full height and width of incoming flows.
$K_L = 1.0$

Side and cross junctions
Value of K_L is obtained from the following chart:



2.16.17 Maintenance Hole Access

- A 4.0m wide asphalt with granular base access is required for maintenance vehicles and equipment used to access and service maintenance holes within easements, open space areas, designated blocks and existing right-of-ways (i.e. boulevards).
- Adequate curves and turn-around facilities are required for maintenance vehicles to maneuver. Slopes (4% maximum), cross-falls 2% minimum to 4.5% maximum) and drainage of access roads are also to be addressed in the design.
- A 0.3m separation is required between the maintenance access and the top/bottom of any slopes; fences; and property line(s).
- All maintenance holes located within open space or park areas require hard surface access.
- Wherever possible, access roads in municipal parks and open spaces shall be integrated into the public open space pathway networks and respect natural heritage features.
- Where maintenance access is integrated with a pathway system, maintenance hole access lids are to be offset from the pathway.
- See Section 2.18 for easement requirements.

2.16.18 Maintenance Hole Construction Practices

- The void between the sewer pipe and the cored hole of the precast manufactured maintenance and pre-benched hole section shall be filled with cement bricks and approved non-shrinkable grout. Pre booted maintenance holes will be allowed.

- All precast maintenance hole section joints shall contain an approved rubber gasket. In areas of high groundwater, exterior joint collars or external wrapping (eg. 'Cretex' waterproofing or equivalent, installed as per manufacturer's specifications) of the maintenance hole joints will be required. This requirement may be waived if it can be demonstrated that, based on specific groundwater conditions, the standard rubber gasket is sufficient to prevent infiltration. All joints between bricks are to be completely filled with concrete mortar. Bricks are to be parged on the outside. Parging shall contain an approved bonding agent.

- All mortar and approved non-shrinkable grout shall be mixed and placed in accordance with the manufacturer's specifications.

- A minimum 300 mm vertical/horizontal clearance between openings on the inside of the maintenance hole is required for all sewer and PDC connections.

- Where surface asphalt is to be delayed more than four weeks, maintenance hole frame and covers are to be adjusted to base asphalt grade. Adjustment to finish grade is not to be completed until the placement of surface asphalt is imminent.

- Adjustment to the finished road grade by means of metal shims at each corner or by means of an approved precast adjustment ring. Metal shims are to be at least 75 mm x 200 mm (3" x 8") and their thickness is to be determined by the adjustment required. The space between the bottom of the maintenance hole frame and cover and the top of the precast maintenance hole is to be at minimum the thickness of one adjustment unit and at maximum 300 mm.

- Where adjacent maintenance holes are located in close proximity to one another, the area between the adjacent maintenance holes shall be backfilled in accordance with the specifications in the following table:

Distance Between Adjacent Maintenance Holes	**Material**
0.6 metres or less	concrete or crushed stone
0.6 metres to 2.4 metres	granular material
more than 2.4 metres	approved native material or granular material

- The above noted backfill shall be compacted to the standard Proctor Density specified in the soils report.

2.16.19 Private Drain Connections to Maintenance Holes

- Residential sanitary private drain connections are NOT to be constructed into any sanitary maintenance holes.

2.16.20 Sampling/Inspection Maintenance Holes

- Requirements
  - Sampling/Inspection maintenance holes are typically required where Institutional, Commercial and Industrial developments outlet to sanitary sewers owned and maintained by the Municipality. Sampling/inspection maintenance holes are required for all industrial and commercial sites.
- Location
  - If required, Sampling/Inspection Maintenance Holes shall be located on private property as close as possible to the property line, or as approved by the Director, Public Works and Engineering.

- Minimum Size

    - Sampling/Inspection Maintenance Holes shall be a minimum of 1200mm diameter. A larger diameter Maintenance Hole may be required if noted on the Building Permit Application Drawings.

    - Sampling/Inspection Maintenance Holes that have more than one inlet sewer shall be increased in size to ensure that there is a minimum of 0.9m benching length downstream of all inlet sewers.

    - Maintenance Holes shall be to OPSD standards.

2.17 EASEMENTS

- Easements are required for all sewers to be assumed by the municipality located outside a road allowance on privately owned property.

- Easements are to be of sufficient width to ensure the sewers or municipal services can be properly installed and maintained by the appropriate authority (municipality or private). An easement provides the right to use private land for a specific purpose which is in the public's interest.

- All maintenance holes located within easements require hard surface access.

2.17.1 Types of Easements

- Municipal (Servicing) Easements

    - Are required for watermains, sanitary and storm sewers, catchbasins, drains, stormwater management ponds, channels and/or access roads that cross a site and which are maintained by the Municipality.

- Utility Easement

    - Utility easements are required for telephone, hydro, gas and cable television services. Each utility company should be consulted for their specific requirements.

- Private Easements

    - Private easements are required for private sanitary sewers and access roads that cross a parcel of land to service other private lands. A joint access and maintenance agreement between the interested parties shall be required.

- Temporary Easements and Working Easements

    - Temporary easements are required for sanitary sewers and access roads that cross a site temporarily. The services in the easement are to be maintained by the owner of the services.

    - Working easements may be required, as necessary during construction, to allow for the safe construction and finishing of the surface restoration. Once construction is completed, the working easement is released.

2.17.2 Minimum Easement Width

- Easement widths are determined by the depth of cover from the centreline of the road/ground to the invert of a sewer or watermain.
- Easement widths are to be calculated in accordance with Figure 2.14 “Minimum Easement Widths”.
- The minimum width of a sewer easement at a depth of up 2.4 metres, shall be 4.8 metres (2.4 metres each side of sewer).

Summary of Referenced Sanitary Sewer OPSD Details*:

OPSD No.	Title	Reference Section	Date
401.010	Cast Iron, Square Frame with Circular **Closed or Open Cover** for Maintenance Holes	2.16.5 4.14.4	Nov-13
401.030	Cast Iron, Square Frame with Circular **Watertight Cover** for Maintenance Holes	2.16.7	Nov-13
404.020	Aluminum Safety Platform for Circular Maintenance Holes	2.16.11 4.14.8	Nov-13
405.010	Maintenance Hole Steps - **Hollow**	2.16.7 4.14.6 4.16.9	Nov-13
405.020	Maintenance Hole Steps - **Solid**	2.16.7 4.14.6 4.16.9	Nov-13
701.010	Precast Concrete Maintenance Hole **1200mm Diameter**	2.16.3 4.14.3	Nov-14
701.011	Precast Concrete Maintenance Hole **1500mm Diameter**	2.16.3 4.14.3	Nov-14
701.012	Precast Concrete Maintenance Hole **1800mm Diameter**	2.16.3 4.14.3	Nov-14
701.013	Precast Concrete Maintenance Hole **2400 Diameter**	2.16.3 4.14.3	Nov-14
701.014	Precast Concrete Maintenance Hole **3000 Diameter**	2.16.3 4.14.3	Nov-14
701.015	Precast Concrete Maintenance Hole **3600 Diameter**	2.16.3 4.14.3	Nov-14

OPSD No.	Title	Reference Section	Date
701.021	Maintenance Hole Benching and Pipe Opening Alternatives	2.16.12 4.14.9	Nov-14
701.030	Precast Concrete Maintenance Hole Components **1200mm Diameter** Tapered Top and Flat Cap	2.16.3 4.14.3	Nov-14
701.031	Precast Concrete Maintenance Hole Components **1200mm Diameter** Riser and Monlithic Base	2.16.3 4.14.3	Nov-14
701.032	Precast Concrete Maintenance Hole Components **1200mm Diameter** Base Slab	2.16.3 4.14.3	Nov-14
701.040	Precast Concrete Maintenance Hole Components **1500mm Diameter** Transition Cone and Slabs	2.16.3 4.14.3	Nov-14
701.041	Precast Concrete Maintenance Hole Components **1500mm Diameter** Riser and Bases	2.16.3 4.14.3	Nov-14
701.050	Precast Concrete Maintenance Hole Components **1800mm Diameter** Transition Slabs	2.16.3 4.14.3	Nov-14
701.051	Precast Concrete Maintenance Hole Components **1800mm Diameter** Riser and Base Slab	2.16.3 4.14.3	Nov-14
701.060	Precast Concrete Maintenance Hole Components **2400mm Diameter** Transition Slab	2.16.3 4.14.3	Nov-14
701.061	Precast Concrete Maintenance Hole Components **2400mm Diameter** Riser and Base Slab	2.16.3 4.14.3	Nov-14
701.070	Precast Concrete Maintenance Hole Components **3000mm Diameter** Transition Slab	2.16.3 4.14.3	Nov-14
701.071	Precast Concrete Maintenance Hole Components **3000mm Diameter** Riser and Base Slab	2.16.3 4.14.3	Nov-14
701.080	Precast Concrete Maintenance Hole Components **3600mm Diameter** Transition Slab	2.16.3 4.14.3	Nov-14
704.010	Precast Concrete Adjustment Units for Maintenance Holes, Catch Basins, and Valve Chambers	2.16.12 4.14.11 4.16.11	Nov-14
807.010	**Height of Fill Table** Reinforced Concrete Pipe - Confined Trench Class 50-D, 65-D, 100-D and 140-D	2.15.2 4.13.2	Nov-15

OPSD No.	Title	Reference Section	Date
807.030	**Height of Fill Table** Reinforced Concrete Pipe - Embankment Class 50-D, 65-D, 100-D and 140-D	2.15.2 4.13.2	Nov-15
807.040	**Height of Fill Table** Non-Reinforced Concrete Pipe Class 3	2.15.2 4.13.2	Nov-15
807.050	**Height of Fill Table** Horizontal Elliptical Concrete Pipe Class HE-A, HE-I, HE-II, HE-III, and HE-IV	2.15.2 4.13.2	Nov-15

*Note: The above summary of referenced OPS Details is for convenience only and it is not intended to be a comprehensive listing of all applicable OPS Details.

3 WASTEWATER PUMPING STATIONS

3.1 DEFINITION AND PURPOSE

- A pumping station is a component of the wastewater collection system that conveys domestic and other suitable wastewater to a wastewater treatment facility. The need for pumping wastewater arises when:
  - The existing topography and required minimum grades create deep sewers that have high construction costs. The sewage is raised and then conveyed by gravity.
  - Basements are too low to discharge to the main sewer.
  - Wastewater is to be conveyed over a ridge.
  - The sewage must be raised to get head for gravity flow through a treatment plant.
  - Discharge outlets are below the level of the receiving body of water.
  - An existing gravity system is not yet available. A pumping station will enable development and growth in accordance with the applicable Community Plan.

3.2 DESIGN CRITERIA

3.2.1 General

- The design peak sanitary flows are to be developed in accordance with the current Municipal Design Standards and the Ontario Building Code.
- Pumping station design is to be in accordance with MOECC Design Guidelines for Sewage Works 2008 or current version – Chapter 7 Pumping Stations except as revised within these standards.
- The building design, layout, construction materials and stand-by power requirements shall be to the satisfaction of the Director, Public Works and Engineering. Major design criteria elements should be approved by the Director, Public Works and Engineering at the preliminary engineering design stage and prior to proceeding to detailed design.

3.2.2 Site Layout and Servicing

- Pumping stations are to be located outside any regulatory 100-year flood limits.
- The site shall have good vehicular access and maneuvering area, and minimize potential adverse environmental impacts.
- The facilities layout shall allow for future expansion, and comply with front, rear and side yard set-backs according to the applicable zoning and site plan standard and requirements, and convenient location of portable generator.
- Building construction shall be architecturally pleasing, in relation to surrounding community, and low maintenance. Permanent structures shall be masonry or concrete construction. Cladding for temporary structures shall be of pre-formed FRP or pre-finished metal. Include provisions to protect the building from vehicles.

- Building insulation requirements, interior finish, and minimum interior building temperature control requirements shall be as directed by the Director, Public Works and Engineering.

- Facility design and layout shall have regards to making confined space entry user friendly, optimizing sight and retrieval lines and comply with OHSA regulation.

- Landscaping of the site shall be low maintenance and architecturally pleasing, well-graded, minimal grass areas and landscaped to the satisfaction of the Director, Public Works and Engineering. Site drainage shall not drain onto adjacent private property.

- Consideration is to be given to visual screening. The site and orientation of the facility is to be selected to minimize noise and odour impacts on adjacent properties.

- Fencing shall be 1.8m high chain link fence with lockable gates that are sized appropriately. Include warning and municipal address signage as per current municipal standards. Barbed wire fence shall be used as per current municipal fence by-law 2004-77, and as directed by the Director, Public Works and Engineering.

- Provide adequate exterior security lighting of the pumping station facilities such as access, and parking. Exterior lighting may be controlled by motion sensor or “photo-eye”. Consideration is to be given to shielding stray light into adjacent residential areas.

- Provide security hardware and alarms for all exterior doors, windows and exterior equipment.

- All control equipment and panels shall be indoors. Weather proof enclosures may be approved for smaller pumping stations.

- All utility meters such as gas, hydro, water meter reader, shall be mounted on the exterior of the building.

- Access to the site shall include provision for parking of maintenance vehicles and standby/emergency equipment. Roads shall be asphalt surfaced in parking and maneuvering areas and provide convenient removal and storage of snow, and turn around for trucks, tankers and heavy equipment.

- All utilities including phone and computer communications servicing the site shall be underground unless otherwise authorized by the Director, Public Works and Engineering.

- Design, installation and planning of services shall be according to requirements of applicable codes, regulations and the local utility authority.

3.2.3 Structural

- The pumping station shall be evaluated for uplift and resistance to all combined or single loadings considering soil conditions, ground water level, and frost action. Uplift shall be determined when the structure is completely empty and dry, free of equipment, roof slab removed, and the structure watertight. Design the base slab to withstand all earth loadings when the structure is completely filled to maximum level, roof slab on, and all equipment installed. Provide crane and hoist design including appropriately sized hatches for convenient pump and equipment removal.

- Location of crane, hoist, and hatches, and arrangement of piping, pumps and equipment shall be such to facilitate ease of removal and installation of equipment.

3.2.4 Flow Capacity

- The pumping station flow capacity shall be based on the peak hourly flow rate determined from the peak flow calculation in accordance with current municipal standards. Consideration is to be given to low flow conditions, future growth potential and potential staging of pumping capacity to match flows. The flow capacity of the pumping station should be able to maintain a desirable cleansing velocity of 0.9m/s with a minimum velocity of 0.60m/s, and a maximum velocity of 3.0m/s in all piping. The design of new pumping stations shall allow for future modification or expansion to meet the requirements of the tributary area of the pumping station.

3.2.5 Pumps

- Multiple pumps shall be provided and sized to provide firm capacity. When two pumps are used, firm capacity shall be maintained by one pump and shall be of the same size.

- When multiple pumps are used, firm capacity shall be maintained by the remaining pumps when the largest pump is out of service. The capacity of the largest pump will be equal to the required firm capacity. All pumps must undergo a hydrostatic and operating test performed by the manufacturer prior to installation.

- Pumps handling raw wastewater shall be capable of passing spheres of at least 76mm diameter. Pump suction and discharge openings shall be at least 100mm in diameter.

- Pumps shall be positioned so that under normal operating conditions, they will operate under a positive suction head. When the pump is a suction-lift type, it shall be a self-priming or a vacuum-priming type pump.

- Electrical equipment and components such as motors, lights, cables, conduits, switch boxes, control circuits, etc., shall comply with the Ontario Electrical Safety Code (OESC), CSA approved, and comply with the municipal requirements. Equipment located in wet wells, or in enclosed or partially enclosed spaces where there may be hazardous concentrations of flammable gases, vapours, or in the wet well shall also be suitable for use under corrosive conditions. Provide each flexible cable with a watertight seal and separate strain relief. A fused disconnect switch located above ground shall be provided for the main power feed for all pumping stations. Equipment exposed to weather shall be weatherproof, with lightning and surge protection. Include a 110-volt 15 amp receptacle for maintenance inside the control panel for lift stations that have control panels out of doors. Ground fault protection is required for all outlets located outdoors and in wet areas, on separate circuits with GFCI breaker for monthly testing and logging.

- Each pump shall have a separate intake. The configuration of the wet well and pump intakes shall prevent vortex formation and air locking.

- Dry well sump is to be equipped with two sump pumps to remove leakage or drainage and discharge above the maximum high water level of the wet well. Provide dual check valves and gauges on discharge and suction lines for each sump pump.

- Water ejectors are not be connected to a potable water supply.

- Provide drainage for all floor and walkway surfaces. Pump-seal leakage shall be piped or channeled directly to the sump. Size the sump pump to convey the maximum pump-seal water discharge that would occur in the event of a pump-seal failure and provide necessary alarm activation.

- Consideration is to be given to the use of variable pump delivery rates for larger pump stations (> 50 l/s) and pumping stations operated as part of treatment facilities.

- The minimum efficiency, duty life, type and materials of construction for pump and impeller shall be approved by the Director, Public Works and Engineering. Preferred voltage is 600 VAC, 3PH.

3.2.6 Channels

- Dual channels will be utilized and equipped to allow isolating and de-watering each unit. The channel invert shall be 75-150mm below the inlet of the sewer and the entrance to channels shall be designed for equal flow distribution. Design guards to protect maintenance personnel from equipment and drainage to prevent slippery floor areas are to be provided.

3.2.7 Pump Controls

- Pump controls and SCADA requirements are to be reviewed and approved by the Director, Public Works and Engineering at the preliminary design stage.

3.2.8 Valves and Fittings

- Provide suitable shut off valves on the suction line of dry pit pumps. Pump suction lines should be designed using 90 degree short radius down-turned flared elbows; wall pipe shall be flanged with water stop collar; all valves including eccentric reducer shall be flanged; all flanges welded; minimum pipe size shall be NPS-4. All isolation valves shall be located inside chambers for access.

- Shutoff and check valves with suitable guards are required on the discharge line of all pumps except screw type pumps. Locate check valves between the shut off valve and pump. Use appropriate check valves and install horizontally on the discharge piping. Ball checks may be installed vertically on the discharge pumping. All valves shall be capable of withstanding normal pressure and water hammer. All valves shall be operable from the floor level and be readily accessible for maintenance. Use outside levers for swing check valves with suitable guarding. All valves, valve operators, fittings, concentric increasers, elbows, double branch elbows, and risers shall be flanged, all flanges welded. Spacers shall be 150-300mm long with one flanged end and one grooved end for Victaulic coupling.

- Valves, check valves, drains, fittings and headers shall be of stainless steel, 316 or better, construction. Pipe materials shall be approved by the Director, Public Works and Engineering. Identification including flow direction of all piping is required. Painting of non-stainless piping is also required.

3.2.9 Flow Measurement

- Flow measurement devices are required for all pumping stations and properly located for accurate readings with valving and fittings for maintenance with minimum downtime. Flow monitoring equipment shall be able to determine and record rate of flow, duration, volumetric sum, and frequency for each pump and each bypass, and interface with Municipal SCADA requirements.

- Provide a spool piece for each mag meter and provide a spool piece for each bypass as directed by the Municipal Engineer. The spool piece depends on forcemain location and wet

well retention time. If it is determined that enough time is available to remove the forcemain and install a spool piece safely, then a forcemain by-pass would not be required.

3.2.10 Wet Wells

- The volume of the wet well shall be based on the design average flow with a filling time not to exceed 30 minutes unless the pumping station is designed to provide flow equalization. When the wet well is designed for flow equalization, provisions to prevent septicity shall be included. Factors to consider when determining the size are:
    - the volume required for pump cycling based on the pump manufacturer's duty cycle recommendations;
    - appropriate dimensions to minimize turbulence; vertical separation between pump control points;
    - sewer inlet elevation;
    - capacity required between alarm levels;
    - basement flooding and overflow elevations; and
    - the number, spacing and size of pumps.

- The high water level shall be set 300mm below the invert of the inlet sewer and the low water level shall be 300mm minimum or twice the pump suction diameter above the centre line of the pump volute.

- The wet well floor shall have adequate slope to the intake hopper and the horizontal area of the hopper shall be kept to a minimum.

- Provision for air displacement in wet wells shall be made by natural means consisting of 0.10% of the well cross-sectional area, or a minimum two 100mm diameter inverted "j" or gooseneck pipes with insect screens extending 900mm above finished grade. One vent pipe is to extend to within 300mm above the obvert of the inlet sewer. The other vent pipe should extend to the underside of the wet well roof slab.

- Wet wells are to be designed to be self-cleaning to minimize grit accumulation.

3.2.11 Ventilation

- Adequate ventilation, as per O.H.S., Building Code and NFPA shall be provided for all pumping stations. Underground dry wells and wet wells with screens or mechanical equipment require mechanical ventilation. The ventilating fan should be orientated to direct fresh air into the wet well at a point 900mm above the alarm level rather than just exhaust from the wet well. Interconnection between the wet well and dry well is not allowed and vents shall not open or be connected to any building ventilation system. Where continuous ventilation is required, air shall be pre-heated. Consideration for the installation of air scrubbers shall be made as directed by the Director, Public Works and Engineering.

- For dry wells, over 4.6m deep, multiple air inlets and outlets should be used. Dampers, fine screens or other obstructions are not to be used on exhaust or fresh air ducts.

- Switches and controls to operate ventilation equipment shall be conveniently located and marked. All intermittently operated ventilation equipment shall be interconnected with the respective lighting system. Consideration should also be given to automatic controls where

intermittent operation is used. The manual lighting and ventilation switch shall override the automatic controls.

- The fan blades shall be fabricated from non-sparking material. Automatic heating and dehumidification equipment shall be designed for all dry wells.

- Wet well ventilation may be either continuous or intermittent. Continuous or intermittent ventilation shall meet or exceed the number of complete air changes per hour as required by NFPA 820. Air shall be forced into the wet well by mechanical means rather than solely exhausted from the wet well. The air change requirements shall be based on 100 percent fresh air. When permanent ventilation equipment is not practical, portable ventilation equipment shall be designed for use at submersible pump stations and wet wells.

- Dry well ventilation may be either continuous or intermittent. Continuous or intermittent ventilation shall meet or exceed the number of complete air changes per hour as required by NFPA 820. A two-speed ventilation system may be used to conserve heat. The air change requirements are based on 100 percent fresh air.

3.2.12 Water Supply

- A potable water supply is to be provided to the station unless otherwise directed by the Municipal Engineer.

- Water supply shall be equipped with back-flow preventers to prevent contamination of the water system and all plumbing shall conform to the Ontario Building Code.

3.2.13 Access

- Provision shall be made to facilitate easy and efficient removal of pumps, motors, and other mechanical and electrical equipment. A suitable and safe means of access for persons wearing self-contained breathing apparatus shall be provided to wet and dry wells and valve chambers.

- Stairs shall be provided for vertical heights greater than 1.2 metres. Maximum vertical distance between work platforms and landings shall be 3 metres. Safety landings shall be constructed as work platforms.

- Provide davit base anchors where required for standard equipment that complies with confined space standards.

- Equipment such as access hatches, ladders, service platforms, guards, grates and handrails, shall be constructed of a suitable material when exposed to wet/and or corrosive conditions.

3.3 SUCTION-LIFT PUMP STATIONS

- Suction-lift pumps shall be of the self-priming or vacuum-priming type. Suction-lift pump stations using dynamic suction lifts exceeding the limits outlined in the following sections may be approved upon submission of factory certification of pump performance and detailed calculations indicating satisfactory performance under the proposed operating conditions. Such detailed calculations must include static suction-lift as measured from "lead pump off" elevation to centerline of pump suction, friction, and other hydraulic losses of the suction

piping, vapor pressure of the liquid, altitude correction, required net positive suction head, and a safety factor of at least 1.8 m.

- Self-priming pumps shall be capable of rapid priming and re-priming at the "lead pump on" elevation. Such self-priming and re-priming shall be accomplished automatically under design operating conditions. Suction piping should not exceed the size of the pump suction and shall not exceed 7.6 m in total length. Priming lift at the "lead pump on" elevation shall include a safety factor of at least 1.2 m from the maximum allowable priming lift for the specific equipment at design operating conditions. The combined total of dynamic suction-lift at the "pump off" elevation and required net positive suction head at design operating conditions shall not exceed 6.7 m.

- Vacuum-priming pump stations shall be equipped with dual vacuum pumps capable of removing air from the suction-lift pump automatically and completely. The vacuum pumps shall be adequately protected from damage due to wastewater. The combined total of dynamic suction-lift at the "pump off" elevation and required net positive suction head at design operating conditions shall not exceed 6.7 m.

- The pump equipment compartment shall be above grade or offset and shall be effectively isolated from the wet well to prevent a hazardous and corrosive sewer atmosphere from entering the equipment compartment. Wet well access shall not be through the equipment compartment and shall be at least 1m by 1m clear opening with spring-loaded, shock assist hatches. Gasketted replacement plates shall be provided to cover the opening to the wet well for pump units removed for servicing. Valving shall not be located in the wet well.

3.4 SUBMERSIBLE PUMP STATIONS

- Submersible pumps and motors shall be designed specifically for raw wastewater use, including totally submerged operation during a portion of each pumping cycle and shall meet the requirements of the Ontario Hydro Electrical Safety Code and CSA for such units. An effective method to detect shaft seal failure or potential seal failure shall be provided.

- Submersible pumps shall not exceed 30 Hp. The pumps shall be readily removable and replaceable without dewatering the wet well or disconnecting any piping in the wet well. Location of crane, hoist, and hatches, and arrangement of piping, pumps and equipment shall be such to facilitate ease of removal and installation of equipment.

- Electrical supply, control, and alarm circuits shall be designed to provide strain relief and to allow disconnection from outside the wet well. Terminals and connectors shall be protected from corrosion by location outside the wet well or through use of watertight seals.

- The motor control center shall be located outside the wet well, be readily accessible, and be protected by a conduit seal or other appropriate measures meeting the requirements of the Ontario Hydro Electrical Safety Code, to prevent the atmosphere of the wet well from gaining access to the control center. The seal shall be so located that the motor may be removed and electrically disconnected without disturbing the seal.

- Pump motor power cords shall be designed for flexibility and serviceability under conditions of extra hard usage. They shall meet the requirements of the Ontario Hydro Electrical Safety Code standards for flexible cords in wastewater pump stations. Ground-fault interruption protection shall be used to de-energize the circuit in the event of any failure in the electrical integrity of the cable. Power cord terminal-fittings shall be corrosion resistant and constructed

in a manner to prevent the entry of moisture into the cable. They shall also be provided with strain relief appurtenances and be designed to facilitate field connecting.

- Valves shall be located in a separate valve chamber. Provisions shall be made to remove or drain accumulated water from the valve chamber. The valve chamber may be dewatered to the wet well through a drain line with a gas and watertight valve. Check valves that are integral to the pump need not be located in a separate valve chamber if the valve can be removed from the wet well in a convenient and efficient manner.

- Separate valve chambers shall be insulated and heated to prevent freezing.

3.5 ALARM AND MONITORING SYSTEMS

- Pumping station alarms and equipment shall comply with Municipal SCADA Standards.

- Integration to the SCADA system includes the alarm and operator interface screens. All doors, windows and building security alarms shall comply with the Municipal requirements.

3.6 EMERGENCY OPERATION

- The objective of emergency operation is to prevent the discharge of raw or partially treated wastewater to any waters and to protect public health by preventing back up of wastewater and subsequent discharge to basements, streets, and other public and private property.

3.6.1 Emergency Power

- Emergency power is required for all pumping stations. There shall be sufficient capacity of emergency power to start up and maintain the total confirmed pumping capacity of the station, the SCADA system and all other electrical equipment.

- All pumping stations shall be equipped with an onsite generator. In addition, a gen-set plug compatible with existing Municipal generators may be required as directed by the Director, Public Works and Engineering. The pumping station is to be equipped with an automatic transfer switch to accommodate the "power-on" condition when normal power is returned to the facility.

- Generators shall be capable of running full station load powered by natural gas or diesel as directed by the Director, Public Works and Engineering. The design of generators shall meet all applicable regulations.

3.6.2 By-pass Overflows

- By-pass overflow shall be provided by gravity to existing storm sewer system or allow for emergency pumping to other gravity outlet. Emergency sanitary sewer overflow (SSO) outletting upstream of a SWM facility or directly to a SWM facility is not permitted.

- By-pass and overflow monitoring and totalization is required.

3.6.3 Instructions and Equipment

- Wastewater pumping stations and portable equipment shall be supplied with a minimum of two complete paper sets plus one digital copies of all operational instructions, including emergency procedures, maintenance schedules, and such tools and spare parts as may be necessary.

- An 11x17" plastic laminate fact sheet, mounted to the wall of the pumping station or in an exterior control panel is to be provided for each station. The fact sheet is to contain the following information: overflow pipe data including size, location, and flow rates at 25, 50, 75 and 100% pipe capacity; lowest basement elevation; the hydraulic grade line for the pumping station and forcemain; process flow diagram indicating valves and interlocks.

3.7 FORCEMAINS

- At design pumping rates, a desired cleansing velocity of at least 0.90 m/s shall be maintained. The minimum force main diameter for raw wastewater shall not be less than100 mm.

- Air relief valves shall be provided at high points in the force main to prevent air locking. Vacuum relief valves may be necessary to relieve negative pressures on force mains. The force main configuration and head conditions should be evaluated as to the need for and placement of vacuum relief valves. Fittings and isolation valves shall be stainless steel.

- Forcemain design shall include transient analysis and consider the provision of water hammer relief.

- Force mains should enter the gravity sewer system at a point not more than 200 mm above the flow line of the receiving maintenance hole.

- The functional design details regarding the design of the forcemain are to be reviewed and approved by the Director, Public Works and Engineering at the preliminary engineering design stage for the pumping station.

- An assessment of residency time within the forcemain and the potential for hydrogen-sulphide generation is to be undertaken having regard for low flows due to underdeveloped tributary areas. Where warranted treatment measures are to be identified and their implementation approved by the Director, Public Works and Engineering.

- Pipe and joints shall be equal to water main strength materials suitable for design conditions. The force main, reaction blocking, and station piping shall be designed to withstand water hammer pressures and associated cyclic reversal of stresses that are expected with the cycling of wastewater pumping stations.

- Forcemain pipe materials shall be approved by the Municipal Engineer.

- Force main construction near streams or water works structures and at water main crossings shall meet applicable requirements.

- Friction losses through force mains shall be based on the Hazen and Williams formula or other acceptable methods. When the Hazen and Williams formula is used, the following value for "C" shall be used regardless of pipe material:

Pipe Diameter	**C-Factor**
100-150mm	100

200-250mm	110
300-600mm	120
Over 600mm	130

- When initially installed, force mains may have a significantly higher "C" factor.
- The force main shall be appropriately identified when they are constructed of material that may cause the force main to be confused with potable water mains.
- Force main shall be tested to ensure there is no leakage. Pressure and leakage tests to be completed to AWWA standard tests for watermains.

3.8 SAFETY

- The design of the pumping station shall give due regard to safety for the protection of maintenance personnel and visitors from hazards.
- The station site is to be enclosed with 1.8m chain link fence, lockable gates, designed to discourage entry by unauthorized persons and animals; provide safety, unauthorized entry and municipal address signage.
- Handrails and guards are to be installed around tanks, trenches, pits, stairwells, and other hazardous areas.
- Gratings are to be installed over areas where access for maintenance is required.
- Confined space entry shall comply with OHSA regulations. Facility design and layout shall have due regard to make confined space entry user friendly, optimizing sight and retrieval lines.
- Gas detection and monitoring equipment are to be provided where required. Where gas alarms are provided, install an indicator light outside the building so that the operator can check gas levels before entering the building.
- Portable ventilation and blower equipment, intrinsically safe, with sufficient hose, where required.
- Portable lighting equipment intrinsically safe, where required.
- Appropriately placed warning signs for slippery areas, non-potable water fixtures, low head clearance, open service maintenance holes, hazardous material storage areas, flammable fuel storage areas, etc.
- Adequate ventilation in pumping chambers.
- Provisions for lockout and tag-out of mechanical and electrical equipment.
- Eyewash fountains and safety showers where required.
- Fire extinguishers and emergency lighting are to be provided.

4 STORMWATER COLLECTION SYSTEM

4.1 GENERAL

- Stormwater collection systems are typically closed conduit drainage systems below the surface of the ground that collect surface water created from rainfall or other forms of precipitation. However, stormwater systems may also consist of one or any combination of pipes, ditches, culverts, open channels and stormwater management facilities that convey stormwater flows.

- Stormwater Management design and implementation is to be undertaken in accordance with the latest edition of the "Stormwater Management Policy Manual of the Municipality of Middlesex Centre".

4.2 PERMITTED USES

- Storm sewers shall be designed to collect storm water discharge from pervious and impervious areas both on private lands and public lands via catch basins and storm private drain connections. Indirect connections of foundation drains (footing tile) via sump pumps to storm PDCs are permitted. Direct connections of foundations drains to storm sewers are not permitted.

- All storm sewer connections must be in accordance with Municipality of Middlesex Centre current Waste Discharge By-law and Drainage By-law.

- Storm drainage on private property requires a building permit before installation.

4.3 LOCATION AND ALIGNMENT

- Generally stormwater pipes are to be located in front of, or are in locations accessible to each lot and block facing a municipal street and are to be located 1.5 m from the centre line of the road (Refer to Figure 1.4 "Typical Cross-Section – Local Residential Street").

- Stormwater pipes are to be located on the outside loop of a proposed crescent with the maintenance holes at a 1.5 m offset from the centre line of the road.

- Where a maintenance hole is designed to be located within the area of a roundabout, storm maintenance holes are permitted to be located within the grassed area of the roundabout, provided any proposed landscaping does not hinder the access to the maintenance hole.

4.3.1 Storm Sewers on Private Property

- Stormwater collection systems on private property are regulated by the Ontario Building Code (OBC). Where there are no specific regulations in the OBC, details from this manual will apply.

4.4 DRAINAGE/SUBDRAINAGE AREA PLANS

- Drainage/sub-drainage area limits are to be designed in accordance with final grading and drainage limits.

- All areas and coefficients are to be shown for each drainage/sub-drainage areas.

4.5 EXTERNAL WATERSHED LIMITS AND DRAINAGE AREAS

- When design area abuts undeveloped areas, identify the external watershed limits to be included in the drainage area.

- All areas, coefficients and time of concentrations are to be shown for all drainage areas within external watershed limits.

- Storm drainage areas are to have regard for potential future development in accordance with the Municipality of Middlesex Centre Official Plan.

4.6 DESIGN CHART

- Stormwater collection system design calculations are to be completed on the standard design chart. See Figure 4.1 "Stormwater Collection System Design Chart" for details and additional information.

4.7 PEAK FLOW CALCULATION

- Flows shall be calculated using the formula:

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

Where

Q	=	peak flow (l/s)
A	=	area (hectares)
C	=	runoff coefficient
I	=	average rainfall intensity (mm/hr)

4.8 DESIGN CRITERIA

4.8.1 Storm Design Curve

- The criterion used in the design of stormwater design is generally to be based on the 1 in 2 year rainfall intensity curve provided in Figure 4.2 "Rainfall Intensity - Duration Curves for Stormwater Design". Major overland flow routes are to be designed for storms greater than a 2 year storm in accordance with Section 6.2.

4.8.2 Time of Concentration

- The time of concentration for residential areas at the upstream end of a system shall be 19.0 minutes. For all other areas refer to Figure 4.3 "Average Runoff Coefficient to Time of Concentration".

- The time of concentration is to be adjusted when lateral flows account for 50% or more in the design flows.

- The adjusted time of concentration shall be calculated using the formula:

$$T_{c\text{-}adj} \qquad \frac{(T_{ct})(Q_t) + (T_{cl})(Q_l)}{(Q_t + Q_l)}$$

Where

$T_{c\text{-}adj}$	=	adjusted time of concentration (min.)
T_{ct}	=	time of concentration in the trunk sewer (min.)
Q_t	=	design flow in the trunk sewer (l/s)
T_{cl}	=	time of concentration in the lateral sewer (min.)
Q_l	=	design flow in the lateral sewer (l/s)

- The adjusted time of concentration is used downstream of the junction maintenance hole.

4.8.3 Runoff Coefficients

- Runoff coefficients are based on the amount of impervious area for a particular land use:

Parks, open space and playgrounds	0.20
Single family/semi detached	0.35 / 0.50
Townhouse/rowhouse	0.65
Apartments	0.65 0.70
Commercial, institutional and industrial	0.70 0.90
Densely built, paved	0.90

NOTE:

0.35 to be used for rural or estate residential; standard SFR subdivisions to be 0.50.

4.8.4 Intensity

- Rainfall intensity is to be taken from Figure 4.2a) “Rainfall Intensity Duration Curve for Stormwater Design”. Also, see 2 Year Rainfall Intensity Chart Figure 4.2b).

4.9 MANNINGS ROUGHNESS COEFFICIENT

- A coefficient of 0.013 is to be used for all concrete and PVC pipe for pipe sizes 300mm to 1650mm. A coefficient of 0.011 is to be used for all pipe sizes 1800mm or greater.

4.10 PIPE SIZE

- Storm sewer pipe sizing is based on the following formula, where the pipe design flow is equal to or greater than the calculated peak sewage flow:

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

Where

Q	=	Design flow (l/sec.)
n	=	Mannings roughness coefficient
A	=	cross sectional area of flow (m^2)
R	=	hydraulic radius (area/wetted perimeter (m))
S	=	slope of pipe (m/m) %

- Notwithstanding the above, the minimum size storm sewer pipe permitted is 300 mm.
- On private property, the minimum size for storm building sewer shall be 100mm, in accordance with Part 7 of the Ontario Building Code.

4.11 FLOW VELOCITY

- Velocity shall be calculated using the following formula:

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

Where

V	=	flow velocity (m/sec)
Q	=	Design flow (l/sec)
A	=	cross sectional area of flow (m^2)

4.11.1 Minimum Velocity

- The minimum velocity permitted in storm sewers is 1.0 m/sec.

4.11.2 Maximum Velocity

- The maximum velocities permitted in storm sewers are:
- 4.5 m/sec for 300 mm to 825 mm diameter sewers, and
- 6.0 m/sec for 900 mm diameter and larger storm sewers.

- To determine velocities based on actual flow, refer to Figure 4.4 “Hydraulic Elements Graph for Circular Pipe”.

4.11.3 Minimum Grades

- The minimum grade on a 300 mm diameter storm sewer is 0.54%.
- The minimum grade on all other sewer sizes shall be established by determining the minimum grade necessary to achieve a velocity of at least 1.0m/sec.

4.12 PIPE MATERIAL

- Both rigid and flexible pipe are permitted in the construction of storm sewer systems including private drain connections and catch basin leads. These materials include concrete, polyvinyl chloride and high-density polyethylene in accordance with the following:
- P.V.C. – Smooth Wall (CSA 182.2):
  - 100 mm to 600 mm as manufactured by Ipex and Royal pipe or 100 to 375 mm as manufactured by NEXT Duraloc;
- P.V.C. – Ribbed Pipe (CSA 182.4):
  - 100 mm to 600 mm inclusive, as manufactured by Loc-Pipe or Ipex; 200 mm to 450 mm as manufactured by Royal Pipe (KOR-FLO); or 375mm to 450 mm as manufactured by Rehau.
- Concrete Pipe:
  - 100mm to 600 mm non-reinforced – CAN/CSA 257.1
  - reinforced – CAN/CSA 257.2
- All fittings shall be PVC fabricated and moulded and shall be C.S.A. certified.
- On private property, materials for storm building sewers and private sewers shall comply with Part 7 of the OBC.
- No other materials other than those listed herein may be used. Should any supplier or contractor wish to explore alternate materials, submission for approval is to be submitted to the Municipality. The review of a submission for approval of alternate materials may require a significant amount of time on the part of the Municipality. Parties making submissions should allow for such time requirements.
- The Municipality reserves the right to select any materials or product it deems appropriate for the application. It also reserves the right to remove from the specifications any product previously approved but found inappropriate for the application. This includes but is not limited to pipe material and fittings. The design engineer shall clearly indicate on drawings and contract documents the materials which are acceptable for use in a particular application where the use of one or more of the approved materials list is not acceptable.

4.13 PIPE DEPTH AND BEDDING MATERIAL

4.13.1 Minimums

- The minimum depth of a storm sewer shall be 1.5 m from the finished ground elevation to the obvert of the pipe. Where minimum depths cannot be achieved and therefore frost protection is warranted, insulation is required as per Figure 4.5 "Insulation Standard for Shallow Mains and Offets."

4.13.2 Maximum Depth of Cover

- Concrete Pipe
  - The maximum allowable cover permitted on concrete pipe is to be based on OPSD 807.01, 807.03, 807.04 and 807.05. Bedding Classes to be in accordance with Figure 4.6 “Bedding Standard for Rigid and Flexible Pipe”.
  - Where the depth of pipe required exceeds the OPSD charts, the pipe strength requirements are to be calculated based on first principles with design variables subject to review by the Municipal Engineer.
- Flexible Pipe
  - The maximum allowable cover permitted on flexible pipe is 10.5 m. The following bedding types are to be used:

    up to 4.5 m ..... Type 1 Bedding
    up to 10.5 m ..... Type 2 Bedding
- Bedding Types to be in accordance with Figure 4.6 “Bedding Standard for Rigid and Flexible Sewer Pipe.
- Where trench conditions are expected to exhibit ground water in silt or fine sand, specified bedding will be defined as 19mm crushed stone entirely surrounded by geotextile.

4.13.3 Crossing Clearances

- There are minimum clearances required when storm sewers cross other services. In all cases this is measured from outside wall diameter to outside wall diameter.
  - Crossing over or under a sanitary sewer, 230mm clearance is required;
  - Crossing over or under a watermain, 450mm diameter or less, 0.50m clearance between the invert of the sewer or PDC and the crown of the watermain is required;
  - Crossing over or under a watermain greater than 450mm diameter, 0.60m clearance is required.
- All clearances are from outside of pipe to outside of pipe.

4.13.4 Minimum Distance Between Sewers

- The minimum horizontal separation between parallel sewers shall be 3.0 m from center to center.

4.13.5 Trenchless Technologies

- When trenchless installation methods are being considered for new works, please refer to Section 11 – Trenchless Technologies (for New Construction).

4.14 MAINTENANCE HOLES

4.14.1 Spacing of Maintenance Holes

- The maximum spacing between storm maintenance holes is dependent on the pipe size. The maximum spacing between maintenance holes for sewers from 300mm to 975mm diameter inclusive shall be 99m measured horizontally or 110m measured vertically from the top of the maintenance hole to the spring-line of the pipe, along the springline to the next maintenance hole and vertically to the top of the maintenance hole.

- Following are the maximum allowable horizontal spacing for the corresponding pipe sizes, larger for 300 dia., pipe and larger:

Length	Sewer Diameter
99 m	300 – 975 mm
130 m	1050 – 1350 mm
160 m	1500 – 1650 mm
305 m	1800 mm and larger

4.14.2 Pre-cast Maintenance Hole Sizing Criteria

- All sizing of storm pre-cast maintenance holes are based on incoming and outgoing pipe sizes and should be sized and conform to Figure 4.7 “Maximum Pipe Sizes for Precast Maintenance Holes.”

4.14.3 Maintenance Holes

- Pre-cast maintenance holes are to be in accordance with the applicable standard OPSD 701.010 through to 701.015 and OPSD 701.03 through to 701.08.

- Maintenance Hole Tees are not permitted.

4.14.4 Maintenance Hole Frame and Covers

- Maintenance hole frames and covers are required for all maintenance holes and shall conform with OPSD 401.01.

- Maintenance hole frames and covers and by association steps must be aligned to avoid being located in the wheel path of the street, and to be located above a benching platform, i.e. to avoid conflict with an inletting or outletting sewer pipe, respectively. Proposed location of maintenance hole frames and covers and by association steps must be shown in plan view on the engineering drawings, represented by a solid circle reflecting the above requirements.

- Note, maintenance hole frame & covers are to be clear of curb & gutters on bends in the road.

- Refer to Figure 2.16 for a typical manhole frame and cover.

4.14.5 Lockable Maintenance Hole Cover

- Where requested by the municipality lockable maintenance hole covers may be required to reduce access by the public. Such locations may include areas through park blocks, open space blocks, pumping stations or treatment facilities. Where required, Lockable Maintenance Hole Covers are to be installed in accordance with OPSD 401.06.

4.14.6 Maintenance Hole Steps

- Maintenance hole steps are required for access and are to conform with one of the following:
    - Maintenance Hole Steps – Hollow See OPSD 405.010 for details and additional design information.
    - Maintenance Hole Steps – Solid See OPSD 405.020 for details and additional design information.
- All steps are to be galvanized steel or aluminum.
- A detail or restoration plan is required for the relocation of maintenance hole steps within existing maintenance holes, where applicable.
- Maintenance hole steps shall be located to avoid conflict with an inletting or outletting sewer pipe. Access to maintenance holes must be above the benching platform.

4.14.7 Maintenance Hole Drop Structures

- Storm drop structures are required when the difference in invert elevations between the upstream and outlet sewers in the maintenance hole is equal to or greater than 0.9 m.
- Drop structures to be in accordance with Figure 4.8 “Maintenance Hole Drop Structure.”
- Internal drop structures will not be permitted under any circumstances.

4.14.8 Maintenance Hole Safety Landings

- Maintenance hole safety landings are required at the mid-point depth of the maintenance hole, when the depth of the maintenance hole is between 5.0m and 10.0m.
- Additional safety landings are required at third-point depths, when the maintenance hole is equal to or greater than 10.0 m to 15.0 m deep.
- Landings to be in accordance with OPSD 404.020.
- Incoming pipes are to be below safety landings, where possible.

4.14.9 Benching

- Benching is to conform with OPSD 701.021.
- Benching height should be increased to obvert to increase hydraulic benefit as required.

- Where benching is different from OPSD 701.021, a benching detail is required.

4.14.10 Steps in Benching

- Steps in maintenance hole benching are required when the pipe diameter is greater than 900 mm and benched to spring line, and when the pipe diameter is greater than 450 mm and benched to crown.

- Refer to Figure 4.9 “Steps in Maintenance Hole Benching” for details and additional design information.

4.14.11 Adjustment Units

- Maintenance hole adjustment units to be in accordance with OPSD 704.010;

- The difference in grade between the maintenance hole lid and the first ladder rung is not to exceed 600 mm.

- Clay brick is not to be used for adjustment units.

4.14.12 Head Losses

- When velocities in the downstream pipe from a maintenance hole exceed a velocity of 1.2 m/s, head losses must be accounted for in the design of the sewer. (This may be accomplished through improvements to benching, increasing the downstream sewer diameter or in lowering the crown of the outgoing sewer.)

- Drops in maintenance holes to compensate for Head Loss (HL) shall be calculated using the following formula:

$$HL = K_L \cdot \frac{V^2}{2g}$$

Where

K_L = Head loss coefficient

V = downstream velocity

g = 9.8 m²/sec

- Refer to Figure 4.10 “Head Losses in Maintenance Holes”..

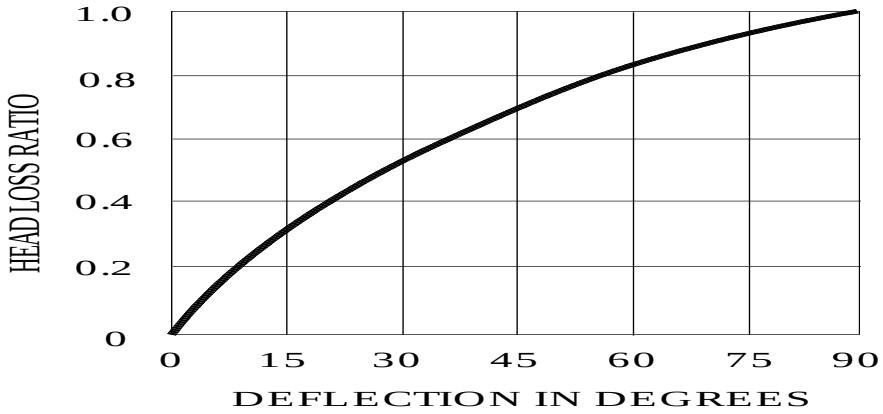
- Head loss coefficients (K_L) are to be applied as follows:

i) 90 degrees
No benching or deflector, or where they are only up to springline.
K_L =1.5

ii) 90 degrees
Benching or deflector to crown of sewers.
K_L = 1.0

iii) Less than 90 degrees

Multiply the head loss coefficient for a 90 degree bend by a head loss ratio factor from the following chart:



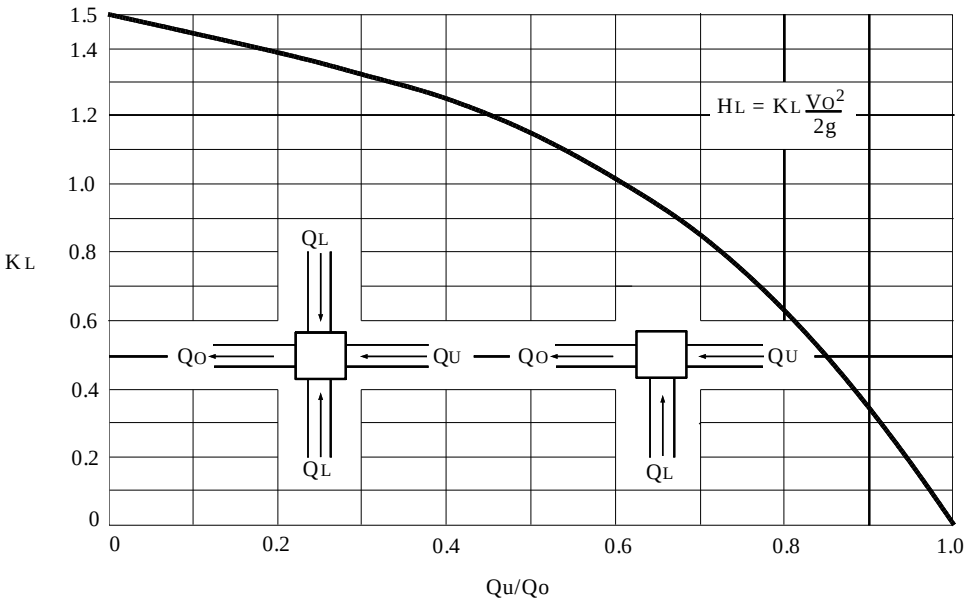
iv) Junctions

Tee

Outlet at right angles to inlets and no deflector between inlets.
$K_L = 1.5$

Deflector between inlets for full height and width of incoming flows.
$K_L = 1.0$

Side and cross junctions
Value of K_L is obtained from the following chart:



4.14.13 Maintenance Hole Access

- A 4.0m wide topsoil and sodded access without trees, plantings or other obstructions is required for maintenance vehicles and equipment used to access and service all storm maintenance holes with easements, open space areas, designated blocks and existing right-of-ways (i.e. boulevard). Adequate curves and turn-around facilities are required for maintenance vehicles to maneuver. Slopes (10% maximum), cross-falls (2% minimum) and drainage of access ways are also to be addressed in the design.

- A 0.3m separation is required between the maintenance access and the top/bottom of any slopes; fences; and property line(s).

4.14.14 Maintenance Hole Construction Practices

- The void between the sewer pipe and the cored hole of the precast maintenance and pre-benched hole section shall be filled with cement bricks and approved non-shrinkable grout. Manufactured pre booted maintenance holes will be allowed.

- All pre-cast maintenance hole section joints shall contain an approved rubber gasket.

- All joints between bricks are to be completely filled with concrete mortar. Bricks are to be parged on the outside. Parging shall contain an approved bonding agent.

- All mortar and approved non-shrinkable grout shall be mixed and placed in accordance with the manufacturer's specifications.

- A minimum 300 mm vertical/horizontal clearance between openings on the inside of the maintenance hole is required for all sewer and PDC connections.

- All maintenance hole frame and covers shall be adjusted to the finished road grade by means of metal shims at each corner or by means of an approved pre-cast adjustment ring. Metal shims are to be at least 75 mm x 200 mm (3" x 8") and their thickness is to be determined by the adjustment required. The space between the bottom of the maintenance hole frame and cover and the top of the pre-cast maintenance hole is to be at minimum the thickness of one adjustment unit and at maximum 300 mm.

- Where adjacent maintenance holes are located in close proximity to one another, the area between the adjacent maintenance holes shall be backfilled in accordance with the specifications in the following table:

Distance Between Adjacent Maintenance Holes	**Material**
0.6 metres or less	concrete or crushed stone
0.6 metres to 2.4 metres	granular material
more than 2.4 metres	approved native material or granular material

- The above noted backfill shall be compacted to the Standard Proctor Density specified in the soils report.

4.14.15 Sampling/Inspection Maintenance Holes

- Requirements
    - Sampling/Inspection Maintenance Holes are required where Commercial, Industrial and sometimes Institutional developments outlet to storm sewers owned and maintained by the Municipality. The requirement for sampling/inspection maintenance holes will be reviewed on a site specific basis, by the Director, Public Works and Engineering Department.
- Location
    - If required, sampling/inspection Maintenance Holes shall be located on private property as close as possible to the property line, or as approved by the Director, Public Works and Engineering Department.
- Minimum size
    - Sampling/Inspection Maintenance Holes shall be a minimum of 1200mm diameter. A larger diameter Maintenance Hole may be required if noted on the Building Permit Application Drawings.
    - Sampling/Inspection Maintenance Holes that have more than one inlet sewer shall be increased in size to ensure that there is a minimum of 0.9m benching length downstream of all inlet sewers.
    - Maintenance Holes shall be to OPSD standards.

4.15 PRIVATE DRAIN CONNECTIONS (PDCs)

4.15.1 Location

- PDCs to single family and semi-detached lots are to be located in accordance with Figure 4.11 “Standard Servicing Locations for Single Family and Semi-Detached Lots.”
- PDCs to multi-family (townhousing, rowhousing and apartments), commercial and industrial developments are to be connected to a new maintenance hole or sewer on the right-of-way.
- PDCs shall be installed at 90 degrees to the sewer main where possible. Under no circumstance will flow from the PDC enter the main against the flow in the main. Where horizontal or vertical bends are required, long radius sweeps shall be used. Short bends are not acceptable.
- Where design constraints arise (ie top end of cul-de-sac or crescent) PDCs may have to be located in reverse location and identified as such on the servicing drawings.

4.15.2 Minimum Size and Grade

- The minimum diameter and grade of a PDC for a residential, single family and semi-detached lot is 100 mm @ 2%.
- The minimum diameter and grade of a PDC for a residential multi-family block is 300mm diameter @1.0%.
- The minimum diameter and grade of a PDC for a non-residential block is 375mm diameter @ 1.0%.
- The minimum diameter and grade of a PDC for a commercial block is 300mm diameter @ 1.0%.
- The minimum diameter and grade of a PDC for an institutional block is 375 mm @ 1.0%.
- The actual size of the PDC required for multi-family non-residential, commercial and institutional blocks is dependent on the flows.

4.15.3 Connections to Sewers/Maintenance Holes

- Residential
    - Storm PDCs 100mm, 150mm, 200mm and 250mm in diameter are to be constructed to the main sewer, except in cases where a maintenance hole is located at the top end of a system (i.e. cul-de-sac). No storm PDC's are to be connected into any storm maintenance hole.
- Multi-family, Commercial and Institutional
    - Storm PDCs 300mm in diameter and larger are to be connected to the main sewer at a new maintenance hole, except in cases where the main sewer is 900 mm in diameter or larger, in which case the PDC may be connected directly into the sewer.
- Connections to Existing Sewers for Lot Infill Situations
    - Where a lot severance or lot infill condition exists and a new storm service is to be connected to an existing storm sewer, the owner of the severance/infill must contact the Director, Public Works and Engineering to determine if the existing storm sewer is a combined or poorly separated sewer and/or if there is a risk of surcharging. If it is determined that there is a surcharge risk, surcharge protection is to be provided by the owner of the severed or infill lot.
    - When connecting PDC's to existing sewers in a lot infill situation, connections must be made utilizing an approved saddle or pre manufactured tee, in accordance with OPSS 410, as amended by the these standards.
    - Connections will not be allowed into existing maintenance holes.

4.15.4 Vertical Clearance

- The designer shall refer to the Ministry of the Environment Procedure F-6-1, Procedures to Govern the Separation of Sewers and Watermains.

- A minimum clearance of 0.5 m under/over the watermain is to be provided.

- For PDCs that cross over or under watermains larger than 450mm in diameter, 0.6 m clearance is required.

4.15.5 PDC Detail

- Typical PDC installation to the main shall be in accordance with Figure 4.12 "Private Drain Connection (Residential)".

- PDC Risers

Type 1 Required for sewer depths greater than or equal to 4.5 m and for excavations in stable bank conditions, see Figure 4.13 "Private Drain Connection Riser – Type 1 (Residential)" for details and additional design information. When the PDC is installed between 45^{o} and 67.5^{o}, an approved controlled settlement joint shall be installed at the tee.

Type 2 Required for sewer depths greater than or equal to 4.5 m and for excavations in unstable bank conditions, see Figure 4.14 "Private Drain Connection Riser –Type 2 (Residential)" for details and additional design information. When the PDC is installed between 45^{o} and 67.5^{o} an approved controlled settlement joint shall be installed at the tee.

4.15.6 PDC Cleanouts

- Where PDC cleanouts are required within the right-of-way, they shall conform to Figure 4.15 "Private Drain Connection Cleanout (Residential)". On private property, storm building sewers and private sewers shall be provided with cleanouts/maintenance holes, in accordance with Part 7 of the OBC. Cleanout/maintenance holes shall be located off of the right-of-way.

4.15.7 Marking and Recording PDC Service Connections

- Green painted surface stakes 40mm X 90mm (standard 2" X 4") shall be placed after trench restoration to mark the termination of storm PDC's. These stakes shall extend from PDC invert to minimum 750mm above finished boulevard grade. Refer to Figure 4.16 "Private Drain Connection Markers (Residential)."

- Plugged or capped service connections shall be marked on the top surface of the last 3m of the upstream end of the pipe with orange PVC adhesive tape (50mm wide) labeled continuously in black lettering (40mm wide) "**CAUTION STORM SEWER**"

- New PDCs to Existing Properties – To be constructed to 1.2m inside the road allowance.

- PDCs to Parklands – Location and design to be reviewed and approved by Director, Public Works and Engineering.

4.16 CATCH BASINS

- Catch basins are to be provided to collect drainage from both pervious and impervious areas. The following are the general guidelines to be used in the provision of catch basins and catch basin leads.

4.16.1 Location

- On street corners and intersections, the catch basin is to be located 0.6 m from the BC or EC of the curvature, and/or located on the line or 1.5m from the centre of the lot to avoid conflicts with driveway and lot servicings respectively.

- Lot/Rear Yard

  - The catch basin and lead are to be located 0.6 m from the property line, entirely on one lot or block.

  - Easements are not required for rear yard catch basins within new subdivisions as they are to become the property and responsibility of the private property owner.

- Parks

  - Catch basins are to be located to minimize flow across pathways and provide positive drainage from park facilities.

4.16.2 Minimum Lead Diameter and Grade

- Street

  - The minimum diameter and grade of a catch basin lead on a street is 250 mm @ 0.69% (velocity of 1.0 m/s).

- Lot

  - The minimum diameter and grade of a catch basin lead in a rear yard is 300 mm @ 0.54% (velocity of 1.0 m/s).

- Parks

  - The minimum diameter and grade at the catch basin lead in a park is 250mm at 0.69% (velocity of 1.0m/s).

4.16.3 Spacing

- The desired maximum distance between catch basins or from a crest in a road to a catch basin is 90 m, measured along the curb line for each side of the road.

4.16.4 Types of Catch Basins

- Catch basin 600 mm x 600 mm

- Catch basins (CB) are to be constructed on all streets and some rear yards. Refer to OPSD 705.010 for details and additional design information.

- Curb Inlet Catch Basin

  - Curb inlet catch basins (CICB) are to be constructed at all low points in the curb and gutter on local, secondary collector and primary collector roads. Curb inlet catch basins are to be constructed exclusively on all arterial road networks. Refer to Figure 4.17 "Precast Concrete Curb Inlet Catch Basin" for details and additional design information.

  - Driveway locations are to be identified where curb inlet catch basins are required.

- Catch Basin-Maintenance Hole

  - Catch basin maintenance holes (CBMH) are to be constructed in rear yards. Refer to Figure 4.18 "Precast Concrete Catch Basin Maintenance Hole" for details and additional design information.

- Ditch Inlet Catch basins

  - Ditch inlet catch basins (DICB) are to be constructed for ditch drainage along arterial roads, where arterial grading cannot be provided. They are also to be constructed for temporary block drainage and for outlets/inlets within a stormwater management pond. See OPSD 702.040 and OPSD 702.050 or OPSD 705.030 and OPSD 705.040 for details and additional design information.

- Twin Inlet Catch Basins

  - Twin Inlet catch basins (OPSD 705.020) are to be used in lieu of curb inlet catch basins under specific circumstances such as:

    - at a sag in a street with no curb and gutter;

    - in industrial subdivisions where barrier or mountable curb is specified, where driveway locations are not determined.

4.16.5 Depth of Cover

- The minimum depth of cover over a catch basin lead is to be 1.5 m within the road allowance and 1.2 m off the road allowance.

- Where minimum depths cannot be achieved and therefore frost protection is warranted, insulation is required in accordance with Figure 4.5 "Insulation Standard for Shallow Pipes".

4.16.6 Allowable Ponding

- No surface ponding is allowed to develop under a 2 year design storm event.

- Ponding on major overland flow routes allows for 300 mm on street catch basins and 450 mm on rear year catch basins. See Grading Section 6 for further design information.

- In new developments, flat see-saw profiles (identical high and low points) are not preferred for either road profile designs or rear yard swale designs. See-saw profiles should be designed in a manner that allows major storm flows (Overland Flows) to drain along the road or lots to an acceptable Overland Flow Outlet.

- Where required by the Municipality, hydraulic modelling of major overland flow routes is to be undertaken and submitted to the municipality for review and approval.

4.16.7 Requirements for Length of Catch Basin Leads

- Standard catch basins (600mm x 600mm), maintenance hole catch basins and maintenance holes are to be constructed/connected in accordance with the following:

    - Catch basins within 9.0 m of a maintenance hole are to have their leads connected into the maintenance hole.

    - Catch basin leads 9.0 to 15.0 m may have their leads connected into the main sewer.

    - Catch basin leads 15.0 to 30.0 m in length may be constructed by:

        - having a catch basin at one end and the other connected into a maintenance hole or a sewer 900 mm in diameter and larger, or by

        - having the lead connected into a sewer 825 mm in diameter or smaller at one end with a maintenance hole catch basin at the other end.

- Catch basin leads over 30.0 m in length, are to be connected into a maintenance hole or a sewer 900 mm in diameter or larger at one end and have a maintenance hole catch basin at the other end.

4.16.8 Catch Basin Frame and Grates

- Catch Basin Cast Iron Frame and Flat Square Grate for standard 600 x 600 mm to be in accordance with OPSD 400.02.

- Catch Basin Cast Iron Curb Inlet Overflow Plate for curb inlet catch basin to be in accordance with OPSD 400.09.

- Ditch Inlet, Galvanized Steel, Honey Comb – Grating for ditch inlet catch basins to be in accordance with OPSD 403.01.

4.16.9 Catch Basin Steps

- Maintenance Hole Steps – Hollow to be in accordance with OPSD 405.010.

- Maintenance Hole Steps – Solid to be in accordance with OPSE 405.020.

4.16.10 Catch Basin Connections

- Catch Basin Connection Rigid Pipe Sewer for standard 600 x 600mm catch basin to be in accordance with OPSD 708.010.

- Catch Basin Connection Flexible Pipe Sewer for standard 600 x 600 mm catch basin to be in accordance with OPSD 708.030.

4.16.11 Maintenance Hole Adjustment Unit

- Maintenance hole adjustment units to be in accordance with OPSD 704.010;
- The difference in grade between the maintenance hole lid and the first ladder rung is not to exceed 600 mm;
- Clay brick is not to be used for adjustment units;

4.16.12 Catch basin Lead Material

- Both rigid concrete and flexible P.V.C. pipes are permitted for the construction of catch basin leads.

4.16.13 Concrete Curb Setbacks

- Concrete curb setbacks are to be constructed in conjunction with all catch basins (600 mm X 600 mm and curb inlet catch basins) located within curb and gutter on the right-of-ways.

4.16.14 Catch Basin Subdrains

- Pipe subdrains shall be provided on both sides of all catch basins installed in hard surface areas. Subdrains are not required in rear lot catch basins or in catch basins located in grassed areas.
- All subdrains shall be 150mm diameter, minimum 3.0m long, and constructed of perforated PVC pipe with manufactured filter sock and manufactured end caps. In lieu of filter sock the pipe may be wrapped in a Terrifix 270R filter cloth or equal.
- Perforations shall consist of 6mm holes in four rows positioned at 4, 5, 7 and 8 o'clock and 75mm apart longitudinally.
- Pipe subdrains shall be connected to the 200mm knockout provided in the catch basin pot, typically at subgrade elevation, shall be laid parallel with the curb, and at the same grade as finished road grade. Pipe subdrains shall be capped at the upstream end with a pre manufactured end cap.
- Where pipe subdrains are required for use as a French drain in lot drainage situations, pipe subdrains shall be fully bedded in 19mm stone, which, in turn, will be completely surrounded by geotextile.

4.17 EASEMENTS

- Easements are required for all sewers outside of the road allowance or on privately owned property where the sewer is to be assumed or operated by the municipality.
- Easements are to be of sufficient width to ensure that the sewers or municipal services can be properly installed and maintained by the appropriate authority (municipality or private). An

easement provides the right to use private land for a specific purpose which is in the public's interest.

- All maintenance holes located within easements require surface access.
- Easements are not required for standard rear lot catch basins unless there is a significant external drainage component or where the catch basin is designed to receive runoff from municipal lands, parklands or open spaces.
- Maintenance vehicle access is not required for rear lot catch basin maintenance holes.

4.17.1 Types of Easements

- Municipal (Servicing) Easements
  - Are required for watermains, wastewater & stormwater collection systems, catch basins, drains, stormwater management ponds, channels and/or access roads that cross a site and which are maintained by the Municipality.
- Utility Easement
  - Utility easements are required for telephone, hydro, gas and cable television services. Each utility company should be consulted for their specific requirements.
- Private Easements
  - Private easements are required for private storm sewers, access roads and other private services that cross a parcel of land to service other private lands. A joint access and maintenance agreement between interested parties shall be entered into.
- Temporary and Working Easements
  - Temporary easements are required for watermains, sanitary & storm sewers, drains, stormwater management ponds, channels and/or access roads that cross a site temporarily. The services in the easement are to be maintained by the owner of the services.
  - Working easements may be required, as necessary during construction, to allow for the safe construction and restoration of the disturbed surface area. Once construction is completed, the working easement is released.
  - Temporary easements are required for storm sewers and access roads that cross a site temporarily. The services in the easement are to be maintained by the owner of the services.

4.17.2 Easement Widths

- Easement widths are determined by the depth of cover from the centerline of the road/ground to the invert of a sewer or watermain.
- Easement widths are to be calculated in accordance with Figure 4.19 "Minimum Easement Width".

- The minimum width of a sewer easement at a depth of up to 2.4 metres shall be 4.8 metres (2.4 metres on each side of the sewer).

4.18 STORM SEWER INLET AND OUTLET STRUCTURES HEADWALLS

- Headwalls are required at the end of all storm sewer systems which provide for a transition from the storm sewer to an open channel, river, creek, SWM pond or other receiving body of storm water. In some cases headwalls are required at the inlet of a storm sewer and/or large storm drain.

4.18.1 Types of Headwalls

- The following headwall designs are based on the velocity and in certain cases the diameter of the storm sewer: (taken from Municipal Works Design Manual (Municipal Engineers Association – MEA, and Ontario Provincial Standard Drawings.)

    - Under 1.3 m/s with pipes diameters under 600 mm see OPSD 804.03 for details and additional design information.

    - Under 2.1 m/s – MEA Type I (using OPSD 804.04 where applicable, or detail design modifying OPSD 804.04)

    - 2.1 m/s to 2.7 m/s MEA Type II (using OPSD 804.04 where applicable, or detail design modifying OPSD 804.04; and 1 baffle post)

    - 2.7 m/s to 4.6 m/s MEA Type III (using OPSD 804.04 where applicable, or detail design modifying OPSD 804.04; and 3 baffle posts)

    - 4.6 m/s to 10.0 m/s MEA Type IV (stilling basin), or detail design.

    - All headwalls are to have a swale at the top of the structure to allow for surface drainage.

4.18.2 Concrete Strength

- The concrete for all headwalls is to have a minimum strength of 30 MPa with a 5% to 7% air entrainment and 70 to 90 mm slump.

4.18.3 Chamfers

- All exposed corners of all headwalls should be chamfered 25 mm or more depending on the size of the headwall.

4.18.4 Weeping Tiles

- Weeping tiles are to be provided on each side at the base of the sewer outlet and extended through the headwall. On larger headwalls they are placed on the side or wing walls.

4.18.5 Baffle Posts

- Baffle posts are to be provided for sewer flow velocities between 2.1 m/s and 4.6 m/s. The location of the posts is per the type of headwall. The height of the baffle posts should be equal to the full depth of flow. Sizing of the posts are 1/6 the size of the pipe diameter together with reinforcing bars.

4.18.6 Grill/Grates

- Hot dipped galvanized grills/grates are to be placed over the storm outlets horizontally or vertically as required and should be fixed to the headwall with anchor bolts. Grills and grates shall comply with OPSD 804.05.

4.18.7 Railing

- Railings are required on all headwalls which exceed 1.0 m in height from the top of the headwall to the proposed top of slope in accordance with OPSD 980.101.

4.18.8 Rip Rap/Rock Protection

- Rip rap is to be constructed at the end of all headwalls of all storm sewer systems and is to be placed in accordance with OPSD 810.01 and the following design criteria:
    - On the bottom and sides up to design water levels;
    - Downstream until the projection of the side walls meet the channel side slopes at half the design water depth of flow; and
    - For headwalls at creeks and rivers, extend rip rap or gabion protection to creek or river.
    - Protection is to provide a smooth hydraulic flow for headwall discharge and creek or river flows.
    - Rip rap design information etc. is to be in compliance with OPSS-1004. The minimum size of rip rap is 100 mm and the maximum size is 200 mm. Rock protection shall be well-graded in sizes ranging from 100mm to 500mm.

Summary of Referenced Sanitary Sewer OPSD Details*:

OPSD No.	Title	Reference Section	Date
400.020	Cast Iron, Square Frame with Square Flat Grate for Catch Basins, Herring Bone Openings	1.1.27 1.1.28 4.16.8	Nov-13
400.090	Cast Iron Curb Inlet Overflow for Catch Basins	1.1.27 1.1.28 4.16.8	Nov-13
401.010	Cast Iron, Square Frame with Circular **Closed or Open Cover** for Maintenance Holes	2.16.5 4.14.4	Nov-13
401.030	Cast Iron, Square Frame with Circular **Watertight Cover** for Maintenance Holes	2.16.7	Nov-13
401.060	Cast Iron, **Circular Locking Cover** for Maintenance Holes	2.16.8 4.14.5	Nov-13
403.010	Galvanized Steel Honeycomb Grating for Ditch Inlets	1.1.28 4.16.8	Nov-13
404.020	Aluminum Safety Platform for Circular Maintenance Holes	2.16.11 4.14.8	Nov-13
405.010	Maintenance Hole Steps - **Hollow**	2.16.9 4.14.6 4.16.9	Nov-13
405.020	Maintenance Hole Steps - **Solid**	2.16.9 4.14.6 4.16.9	Nov-13
701.010	Precast Concrete Maintenance Hole **1200mm Diameter**	2.16.3 4.14.3	Nov-14
701.011	Precast Concrete Maintenance Hole **1500mm Diameter**	2.16.3 4.14.3	Nov-14
701.012	Precast Concrete Maintenance Hole **1800mm Diameter**	2.16.3 4.14.3	Nov-14
701.013	Precast Concrete Maintenance Hole **2400 Diameter**	2.16.3 4.14.3	Nov-14
701.014	Precast Concrete Maintenance Hole **3000 Diameter**	2.16.3 4.14.3	Nov-14

OPSD No.	Title	Reference Section	Date
701.015	Precast Concrete Maintenance Hole **3600 Diameter**	2.16.3 4.14.3	Nov-14
701.021	Maintenance Hole Benching and Pipe Opening Alternatives	2.16.12 4.14.9	Nov-14
701.030	Precast Concrete Maintenance Hole Components **1200mm Diameter** Tapered Top and Flat Cap	2.16.3 4.14.3	Nov-14
701.031	Precast Concrete Maintenance Hole Components **1200mm Diameter** Riser and Monlithic Base	2.16.3 4.14.3	Nov-14
701.032	Precast Concrete Maintenance Hole Components **1200mm Diameter** Base Slab	2.16.3 4.14.3	Nov-14
701.040	Precast Concrete Maintenance Hole Components **1500mm Diameter** Transition Cone and Slabs	2.16.3 4.14.3	Nov-14
701.041	Precast Concrete Maintenance Hole Components **1500mm Diameter** Riser and Bases	2.16.3 4.14.3	Nov-14
701.050	Precast Concrete Maintenance Hole Components **1800mm Diameter** Transition Slabs	2.16.3 4.14.3	Nov-14
701.051	Precast Concrete Maintenance Hole Components **1800mm Diameter** Riser and Base Slab	2.16.3 4.14.3	Nov-14
701.060	Precast Concrete Maintenance Hole Components **2400mm Diameter** Transition Slab	2.16.3 4.14.3	Nov-14
701.061	Precast Concrete Maintenance Hole Components **2400mm Diameter** Riser and Base Slab	2.16.3 4.14.3	Nov-14
701.070	Precast Concrete Maintenance Hole Components **3000mm Diameter** Transition Slab	2.16.3 4.14.3	Nov-14
701.071	Precast Concrete Maintenance Hole Components **3000mm Diameter** Riser and Base Slab	2.16.3 4.14.3	Nov-14
701.080	Precast Concrete Maintenance Hole Components **3600mm Diameter** Transition Slab	2.16.3 4.14.3	Nov-14
702.040	Precast Concrete Ditch Inlet Maintenance Hole **Type A - 1200 x 1200mm**	4.16.4	Nov-14
702.050	Precast Concrete Ditch Inlet Maintenance Hole **Type B - 1200 x 1200mm**	4.16.4	Nov-14

OPSD No.	Title	Reference Section	Date
704.010	Precast Concrete Adjustment Units for Maintenance Holes, Catch Basins, and Valve Chambers	2.16.14 4.14.11 4.16.11	Nov-14
705.010	Precast Concrete Catch Basin 600 x 600mm	1.1.27 4.16.4	Nov-14
705.020	Precast Concrete Twin Inlet Catch Basin 600 x 1450mm	4.16.4	Nov-14
705.030	Precast Concrete Ditch Inlet 600 x 600mm	1.1.27 4.16.4	Nov-14
705.040	Precast Concrete Ditch Inlets 600 x 1200mm	1.1.27 4.16.4	Nov-14
708.010	Catch Basin Connection for **Rigid** Main Pipe Sewer	4.16.10	Nov-16
708.030	Catch Basin Connection for **Flexible** Main Pipe Sewer	4.16.10	Nov-16
804.030	Concrete Headwall for Pipe Less Than 900mm Diameter	4.18.1	Nov-06
804.040	Concrete Headwall for Sewer and Culvert Pipe Outlet	4.18.1	Nov-06
804.050	Grating for Concrete Endwall	4.18.6	Nov-13
807.010	**Height of Fill Table** Reinforced Concrete Pipe - Confined Trench Class 50-D, 65-D, 100-D and 140-D	2.15.2 4.13.2	Nov-15
807.030	**Height of Fill Table** Reinforced Concrete Pipe - Embankment Class 50-D, 65-D, 100-D and 140-D	2.15.2 4.13.2	Nov-15
807.040	**Height of Fill Table** Non-Reinforced Concrete Pipe Class 3	2.15.2 4.13.2	Nov-15
807.050	**Height of Fill Table** Horizontal Elliptical Concrete Pipe Class HE-A, HE-I, HE-II, HE-III, and HE-IV	2.15.2 4.13.2	Nov-15
810.010	Rip-Rap Treatment for Sewer and Culvert Outlets	4.18.8	Nov-13
980.101	Pedestrian Barricade Installation	4.18.7	Nov-09

*Note: The above summary of referenced OPS Details is for convenience only and it is not intended to be a comprehensive listing of all applicable OPS Details.

5 WATER DISTRIBUTION SYSTEM DESIGN

5.1 DEFINITION AND PURPOSE

- These specifications shall apply to all water services and to all water mains up to 450 mm diameter including appurtenances which are located within the Municipal road allowance, or on property which will be transferred to the Municipality. These specifications shall also apply to all water meter placements.

- The designer shall design to Middlesex Centre Specifications and also make reference to the Ministry of the Environment "Design Guidelines for Drinking-Water Systems" and to the Ministry of the Environment "Watermain Design Criteria for Future Alterations Authorized Under a Drinking Water Works Permit". If there is a discrepancy between Middlesex Centre Specifications and the MOE Guidelines then the Public Works and Engineering Department shall be contacted to resolve the issue.

- Any deviation from these specifications must be submitted in writing to the Public Works and Engineering Department for approval.

- For water mains larger than 450 mm diameter and for any other water system installation, special specifications must be prepared for and approved by the Director, Public Works and Engineering. These specifications are to be used as a supplement to all other specifications approved by the Director, Public Works and Engineering for water system installation.

- The water distribution system is for the purpose of supplying and distributing water, and does not include plumbing or other works to subject to the Ontario Building Code.

- "Water Distribution System" means watermains with connections to feeder watermains, feed watermains within subdivision lands, private watermains, water services, fire hydrants, and shut-off valves and all other appurtenances thereto.

- A water distribution system may exist for the purpose of distributing potable or non-potable water, however water distribution systems for potable and non-potable water may not be intermixed or cross-connected. Private supplies of potable water may not be cross-connected to the municipal or public water distribution system.

5.2 PERMITTED USES

- Permitted and non-permitted uses of water are identified by By-law number 2012-064 being a by-law to provide for the REGULATION OF WATER SUPPLY IN THE MUNICIPALITY OF MIDDLESEX CENTRE.

5.3 WATERMAIN DESIGN

5.3.1 Pressure and Flow Requirements

- Watermains shall be sized to maintain the greater of:

    - Maximum day demand plus fire flow at a pressure not less than 140 kPa (20 psi) at any hydrant lateral or potential fire service connection.

- Maximum hourly demand at a pressure not less than 275 kPa (40 psi) in residential areas and not less than 310 kPa (45 psi) in industrial areas.
- Average day demand at a pressure not less than 275 kPa (40 psi) in residential areas.
- Maximum residual pressure should not exceed 550 kPa (80 psi) and a minimum residual pressure shall not be below 275 kPa (40 psi).

- Pressures to be taken at the most critical locations.

5.3.2 Design Water Demands

- Average day domestic (residential) unit demand for design shall be 350 litres per capita per day.

- Minimum day, maximum day and peak hour peaking factors are to be in accordance with Ministry of Environment Peaking Factors of Municipal Water Supply System, Appendix L. An excerpt is provided below for convenience.

Population			***Minimum Rate Factor (Min. Hour)***	***Maximum Day Factor***	***Peak Rate Factor (Peak Hour)***
500		*1,000*	0.40	2.75	4.13
1,001		*2,000*	0.45	2.50	3.75
2,001	*to*	*3,000*	0.45	2.25	3.38
3,001		*10,000*	0.50	2.00	3.00
10,000		*25,000*	0.60	1.90	2.85

Any deviations from the above require written authorization from the Director, Public Works and Engineering.

- For design purposes, the following densities shall be used:

Type Of Use	**People / Unit**
Low density residential	3 people per unit
Medium density residential	2.4 people per unit
High density residential	1.6 people per unit

- **Commercial, Institutional and Industrial:** These demands vary greatly with the type of water using facilities or process present in the development. Demands may be based on the specific use however consideration also needs to be given to the potential redevelopment of the site. If specific use data is not available, demands are to be based on the Ministry of Environment "Guidelines for the Design of Water Distribution Systems" or other suitable reference. The designer can also provide typical demand and peaking factor data.

5.3.3 Friction Factors

- The following Hazen-Williams "C" values shall be used for design, regardless of material:

Pipe Diameter	C-Factor
100 and 150 mm	100
200 and 250 mm	110
300 to 600 mm	120
Over 600 mm	130

5.3.4 Fire Demands

- To estimate the fire flow requirements for an area of the Municipality, the designer should refer to the guide "Water Supply for Public Fire Protection A Guide to Recommended Practice" (latest revision) prepared by Fire Underwriters Survey, Insurers' Advisory Organization.

- On private property, adequate water for firefighting shall be determined in accordance with the Ontario Building Code.

5.3.5 Minimum Pipe Sizes/Acceptable Pipe Sizes

- The minimum size for watermains shall be 150 mm diameter except beyond the last hydrant on cul-de-sacs where smaller diameter pipe shall be used which is designed for domestic and maximum hour demands only.

- Accepted pipe sizes are 50mm and 100 mm (see above), 150mm, 200mm, 250mm, 300mm, 400mm, 450mm.

5.3.6 Water Quality

- Watermains and watermain networks shall be designed so that water shall not remain unused in the watermain for more than three (3) days under average day demand. To demonstrate a three (3) day turnover, the designer shall provide a hydraulic analysis as outlined in Subsection 5.14 of this document. The hydraulic analysis shall also provide calculations to determine if and where automatic flushing devices are required and determine the appropriate size of the automatic flushing device (25mm or 50mm).

- The Municipality has primary responsibility to ensure that the minimum chlorine residuals are maintained in the distribution system and therefore reserves the right to require watermain looping and/or automatic flushing devices and/or blow-offs to facilitate the maintenance of the chlorine residual.

- On private property, where there is concern that a (3) day water turn-over cannot be achieved, the Municipality reserves the right to require premise isolation. This shall consist of appropriate backflow protection to the risk posed and shall be installed at the property line and at the owners expense.

5.3.7 Maximum Velocities

- The watermain shall be sized so that the maximum velocity in the pipe shall not exceed 1.5 meters per second during maximum hour domestic flow conditions or 2.4 meters per second during fire flow conditions.

5.3.8 Boundary Conditions

- For the purposes of hydraulic analysis the designer shall contact the Director, Public Works and Engineering Department for appropriate boundary conditions rather than using information from fire flow test directly.

5.4 LAYOUT OF WATERMAIN

5.4.1 Watermain Location within Road Allowance

- Watermains are to be located in the standard location as indicated on Figure 5.1 “Standard Servicing Locations for Single Family and Semi Detached Lots.” unless otherwise approved.

- On bends, the watermain may deviate from the standard location by up to 1.0 m, provided that the deviation is towards, or closer to the street line.

5.4.2 Watermain Pipe Depth

- Urban Sections (w/ curb and gutter) - Watermains shall have no less than 1.7m or more than 1.9m of cover from final surface grade.

- Rural or unimproved roads - Watermains shall be laid 2.1m minimum below road grade or 1.1m below the bottom of the ditch, whichever is greater. On unimproved roads within developed areas, the designer should also review the vertical alignment of the road in order to assure that future road improvements will not result in an unacceptable watermain depth, as defined in this specification.

5.4.3 Pipe Insulation

- Where the pipe to be laid with less than 1.5 m of cover, insulation shall be placed to prevent freezing in accordance with Figure 5.2 “Insulation Standard for Shallow Mains and Offsets”.

- Where storm drains or culverts cross over or under a watermain, insulation is required per Figure 5.2 unless there is a minimum 1.5m separation.

5.4.4 Pipe Offsets/Bends/Deflection

- Offsets where required are to be completed in accordance with Figure 5.3 “Standard Mechanical Joint Offset Installation”. Use of offsets must be indicated on the approved plans or in the case of unforeseen obstructions found after approval of the watermain design, written approval of the Municipal Engineer must be obtained.

- For watermain diameter up to 400 mm, the maximum bury depth of 2.3 m shall apply.

- If using joint deflection, full lengths of pipe must be used. The allowable maximum deflection for various pipe materials to be 50% of the manufacturer's recommended maximum deflection. Where it is not possible to lay pipes to the required radius to utilize allowable joint deflection, manufactured pipe bends must be used. Axial deflection (bending of the pipe barrel) is prohibited for any pipe. Any change in the direction of the watermain in excess of the pipe joint deflection tolerance shall be made using an appropriate fitting. Thrust or joint restraint shall be provided per Section 5.3.7.

5.4.5 Termination of Watermains

- Watermains shall be terminated opposite street lines or property lines.

5.4.6 Blow-Offs / Automatic Flushing Devices / Addressing Water Quality

- The design of the watermain shall be undertaken to ensure adequate water quality requirements are met. Refer to Section 5.14 for requirements relating to Hydraulic Modelling.

- Dead ends of watermains shall be provided with a blow-off in accordance with Figure 5.4 "Standard 50mm Blow-Off Installation". Where caps and plugs are installed without a blow-off to provide for future watermain extension, a 20 mm watermain stop shall be tapped into the watermain no further than 0.5 m from the cap or plug to release trapped air/pressure from the watermain prior to removal of the cap or plug.

- On cul-de-sac or similar streets, blow-offs, when required, shall terminate in the boulevard. Blow-offs must be operable without the necessity of excavating.

- Dead end watermain which are part of an interim phase of a subdivision build-out shall meet water quality requirements by:

  i. demonstrating adequate turnover by use; or

  ii. strategic valve location. It should be noted that this means that additional valves shall be placed where temporary dead ends or stubs are installed for future watermain extension. The additional valving shall be located immediately at the point where the temporary dead end connection to the water system such that there are two valves in place which shall be closed to protect the municipal water system from potential contamination. Alternately cutting and capping immediately at the point of connection of the dead end will be required; or

  iii. installation of an automatic flushing device.

- Where an automatic flushing device is used to maintain water quality, (Figure 5.5 "9800 Automatic Flushing Device Detail" and Figure 5.6 "Metered Automatic Flushing Device Detail"), a water meter (in a meter pit) shall be installed to measure the volume of water discharge. The owner will be charged for the water used. The designer shall provide calculations which indicate the volume of water to be discharged by the automatic flushing device and the sizing of the automatic flushing device as well as indicate the timer settings to be used. This information shall be clearly indicated on the drawings. The Owner's contractor shall initially set up the automatic flushing device to the indicated settings.

- Automatic Flushing Devices – Notes for Designers with Respect to Limitations on Locations Where Automatic Flushing Devices Can be Used:

  i) Automatic flushing devices may not be used to discharge directly to a ditch or to the natural environment as municipal water contains chlorine.

ii) Any water discharged from an automatic flushing device must have a total chlorine residual less than 1.0 mg/L in accordance with the Wastewater and Stormwater Discharge By-Law for discharges to storm sewers.

iii) Normal Conditions for the use of an automatic flushing device it is assumed that the device discharges to a storm sewer which in turn discharges to a storm water management pond where the remaining chlorine can be dissipated before being released or discharged to the natural environment. In any situation where there are large volumes of water potentially being discharged from an automatic flushing device, or where the receiving storm system is a sensitive system, further consultation must take place to confirm if the use of an automatic flushing device is appropriate in the situation. Consultation should be with the Public Works and Engineering Department.

- Where an automatic flushing device is not required to maintain water quality a standard 50mm blow-off will be required to allow flushing to take place.

- On cul-de-sac or similar streets, blow-offs, when required, shall terminate in the boulevard. Blow-offs must be operable without the necessity of excavating.

5.4.7 Thrust Restraints

- Thrust restraints shall be designed to adequately provide the minimum amount of pipe/joint restraint required by mechanical joint restraint device alone.

- All restrained lengths shall be clearly shown on the construction drawings.

- Concrete thrust blocks are not an accepted method of thrust restraint.

- Thrust restraint shall be provided at all fittings, bends, tees, valves, hydrants, crosses, reducers, and plugged or capped dead ends in accordance with Figure 5.7 “Typical Restraint Details”.

- Thrust restraints shall be designed to be adequately provided by mechanical restraint devices. The following chart displays the minimum restraint length for horizontal bends and can be used to assist in design of mains of a maximum diameter of 300mm. For mains larger than 300mm diameter or installation situations not included in the table, the restrained length shall be shown on the shop drawings as recommended by the pipe manufacturer.

Diameter of Main Φ (mm)	**Minimum # of Steel Rods**	**Minimum Length to be Restrained on Each Side of Fittings (m)**				
		11¼°	**22½°**	**45°**	**90°**	**Dead End**
100	2	4.0	4.0	4.0	4.0	20.0
150	2	4.0	4.0	4.0	5.5	20.0
200	2	4.0	4.0	4.0	7.0	20.0
250	4	4.0	4.0	4.0	8.5	20.0
300	4	4.0	4.0	4.0	10.0	20.0

- Further to the above mentioned design criteria the following requirements must also be met when designing thrust restraints:

  - All branch valves shall be treated as dead end watermains and shall be restrained according to the above mentioned dead end watermain criteria.

- For watermains larger than 300mm or installation situations not included in the above, the restrained lengths shall be shown on the construction drawings as recommended by the pipe manufacture and reviewed and or approved by the Director, Public Works and Engineering.
- Hydrostatic test pressure is 1035kpa (150psi)
- For poly wrapped DI pipe refer to AWWA C600
- For PVC pipe refer to AWWA C900, UNI-BELL and pipe suppliers manuals
- Depth of bury is at a minimum of 1.7m (5.5ft)
- Stainless steel rods are to be a minimum of 20mm in diameter
- If any joint is encountered in the above restrained lengths it must be restrained also
- Fire hydrants shall be restrained as shown on Figure 5.8 “Hydrant and Valve Installation.”
- Tie rod and clamp assemblies shall be installed in accordance with Figure 5.3 “Standard Mechanical Joint Offset Installation”. All bolted assemblies must be free of concrete encasement.

5.4.8 Watermain and Other Utilities Separation

- Designers should refer to Ontario Ministry of the Environment Guidelines for the Design of Water Distribution Systems (latest revision) and the Ontario Plumbing Code (latest revision) regarding the location of watermains and water services relative to sewers and to the Public Utilities Act of Ontario regarding the location of watermains relative to other utilities.
- Encroachment of utilities, structures, sewers and/or any utility appurtenances, which may impact the watermain, the integrity of its bedding, and/or structural capabilities, shall have design consideration(s) applied to adequately protect the watermain.

5.4.9 Parallel Installations of Watermains and Sewers

- Sewers and watermains located parallel to each other should be constructed in separate trenches maintaining the maximum practical horizontal separation.
- Under normal conditions, watermains shall be laid with at least 2.5 m horizontal separation from any sewer or sewer maintenance hole, or other appurtenance. The distance shall be measured from the outside diameter of each pipe.

5.4.10 Crossings of Watermains and Sewers

- The designer shall refer to the Ministry of the Environment Procedure F-6-1, Procedures to Govern the Separation of Sewers and Watermains.
- Watermains shall cross above sewers and Private Drain Connections (PDC’s) with a minimum vertical separation of 0.50 meters to allow for proper bedding and structural support of the watermain, sewer or PDC.

- If the watermain is less than 1.5 meters below grade at the crossing, the watermain shall be insulated.

- Where it is not possible for the watermain to cross above the sewer or PDC, the watermain shall pass under a sewer or PDC and shall be protected by providing:

    - A vertical separation of at least 0.5 meters between the invert of the sewer or PDC and the crown of the watermain; and

    - That a minimum 5.0 meter length of water pipe shall be centered at the point of crossing so that the watermain joints will be equidistant and as far as possible from the sewer or PDC.

    - Adequate structural support for the sewers to prevent excessive deflection of joints and setting.

5.4.11 Crossings of Existing Watermains Larger than 450 mm Diameter

- It is desirable for new servicing, sewers or PDC to cross above existing trunk watermains wherever possible. The watermain shall be protected by providing:

    - Vertical separation of at least 0.60 meters between the invert of the sewer or PDC and the crown of the watermain; and

    - Adequate structural support for the sewers to prevent excessive deflection of joints or settling, and

    - That the crossing is not within 2.0 m of a joint in the watermain.

- Where it is not possible to cross above the watermain, the sewer or PDC shall pass under the watermain, and the watermain shall be protected by providing:

    - A vertical separation of at least 0.60 meters between the crown of the sewer or PDC and the invert of the watermain; and

    - Adequate structural support for the watermain must be provided during construction, and post construction to support the structure and prevent excessive deflecting of the watermain or joints.

    - For either situation (crossing over or under an existing watermain) details of the crossing proposed and the method of reinstatement to be used must be approved by the Director, Public Works and Engineering prior to construction.

5.4.12 Looping of Watermain/Supply Redundancy

- Water distribution systems shall be designed to exclude any dead-ended pipe unless meeting the requirements in Section 5.4.6. Water distribution systems shall be designed so that no more than fifty (50) units with individual water services and meters shall be serviced from a single source of supply. If the looped watermain is connected to a single watermain, a valve must be installed in the watermain to permit isolation of supplies.

- For requirements for looping for private property, see section 5.9.3.

5.5 WATERMAIN PIPE MATERIAL

5.5.1 Reference Specifications

- All waterworks material used shall be new and shall conform to the latest revision of the Standards of the American Waterworks Association (AWWA).

- No other materials other than those listed herein may be used. Should any supplier or contractor wish to explore alternate materials, submission for Approval is to be submitted to the Municipality. The review of a submission for approval of alternate materials may require a significant amount of time on the part of the Municipality. Parties making submissions should allow for such time requirements.

- The Municipality reserves the right to select any materials or product it deems appropriate for the application. It also reserves the right to remove from the specifications any product previously approved but found inappropriate for the application. This includes but is not limited to pipe material, valves, or fittings. The design engineer shall clearly indicate on drawings and contract documents the materials which are acceptable for use in a particular application where the use of one or more of the approved materials list is not acceptable. Unless otherwise specified, the watermain test pressure shall be 1035 kPa (150 psi).

5.5.2 Transitions in Pipe Materials – Watermains

- Transitions from one pipe material to another must be made at a valve or tee.

- Where PVC pipe is used, a tracer wire must be provided along the entire pipe and CAD welded to the valve and terminated at grade elevation.

5.5.3 Watermains

- Polyvinyl Chloride (PVC) pipe up to and including 300 mm dia shall conform to AWWA C900, bell wall thickness shall conform to AWWA C900 to be certified by the Canadian Standards Association to CSA Standard B137.3, shall be Class 150, DR 18 with Cast Iron outside diameter dimensions and, the words ‘Factory Capped’ shall be included in the print line of every pipe.;

- Approved AWWA C900 Pipe (100 mm to 300 mm):

    - Ipex Blue Brute,
    - Royal Pipe Royal Seal,
    - Next Polymers Aqualoc.

- Polyvinyl Chloride (PVC) pipe sizes 400 mm diameter to 600 mm diameter shall conform to AWWA C905 Class 165, DR 25 (minimum) as determined by the Design Engineer, bell wall thickness shall conform to AWWA C905 to be certified by the Canadian Standards Association to CSA Standard B137.2 and have Cast Iron outside diameter dimensions and the words ‘Factory Capped’ shall be included on the print line of every pipe. Pipe greater than 600 mm dia is not approved for use in Middlesex Centre.

- Approved AWWA C905 Pipe (400 mm to 600 mm):

    - Ipex Centurion,
    - Royal Pipe Royal Seal,
    - Next Polymers Aqualoc (400 mm)

- Tracer wire shall be #12 AWG Copper Clad Steel, High Strength with minimum 450 pound break load, with minimum 30 mil HDPE insulation thickness supplied along the full length of the pipe to provide electrical continuity for location purposes.

- All PVC pipe and PVC fittings are to be blue in colour.

- Fittings shall be PVC injection moulded fittings with push on joints (for use with PVC and PVCO pressure pipe conforming to AWWA C900, CSA B137.3, having cast iron O.D)., shall conform to AWWA Standard C907, shall be UL listed and FM approved, and shall be certified by the Canadian Standards Association to CSA Standard B137.2;

- Approved AWWA C907 Fittings:

    - Ipex,
    - Royal,
    - Harco

- Ductile Iron push-on fittings are not approved for use with PVC pipe;

- Mechanical joint Ductile Iron AWWA C110 fittings shall be used when they are an integral part of the restraining system.

    - Ductile Iron watermain pipe is not approved for use in Middlesex Centre

5.5.4 Valves

- To be gate valves to AWWA C-509, or resilient seat gate valves conforming to AWWA C-509/C-515 standard iron body, bronze mounted, non-rising stem, double-disc for buried service;

- Valves are to **OPEN** counter-clockwise;

- An extension rod and screw type valve box are to be supplied for every valve; extension rods are to extend to 150mm to 300mm below finished grade;

- Valves typically are to be located in line with the extension of the property limit line.

- Valves 100 to 200mm dia to have bell ends; valves 250 to 450m to have mechanical joint ends;

- Valve flanges, bonnets, nuts, bolts and washers to be protected from corrosion using Denso paste, mastic and petrolatum tape.

5.5.5 Hydrants

- Hydrant to AWWA C-502 for dry barrel with push on joints to ANSI/AWWA C111/A21.11; with break flange;

- Hydrants are to **OPEN** counter clockwise;

- Each hydrant to be controlled by a gate valve located in front of the hydrant;

- Hydrants to have chrome yellow high gloss exterior paint over quick dry red oxide primer;

- To be installed minimum 1.5 m from any driveway; minimum bury of 1.7 m and maximum 1.9 m; flange to be graded minimum of 100mm and maximum of 300 mm from finished grade;
- All underground metallic surfaces to be protected from corrosion using Denso paste, mastic and petrolatum tape
- Approved hydrants:
  - Canada Valve Century
  - McAvity Hydrant M-67

5.5.6 Services

- Residential services to be 25mm dia; type Rehau Municipex or Ipex Blue 904
- Services greater than 25mm to 50mm dia; type Rehau Municipex or Ipex Blue 904
- Services to be installed in accordance with Figure 5.10 “Standard Installation of < 50mm Water Service”;
- Services 100mm and larger to be PVC pipe, Figure 5.10 Schematic Layout of 100mm and Larger Services;)
- Service saddle to be provided for: all PVC pipe; 25mm service to 100 mm DI; and 40mm to 50 mm services to any DI and CI main;
- Curb stops to be located 300 mm from property line on street side; curb stops to have stainless steel cotter pins;
- Main cock and curb stop to **OPEN** counter clockwise;
- All underground metallic surfaces to be protected from corrosion using Denso paste, mastic and petrolatum tape
- Approved curb and main stops:
  - Cambridge Brass
  - Ford
  - Mueller

5.5.7 Tracer Wire

- Tracer wire shall be installed on all non-metallic watermains, hydrants laterals and water services except where such water service pipe is of copper material. The wire shall be installed in such a manner as to be able to properly trace all watermains, hydrant laterals and water services without loss or deterioration of signal or without the transmitted signal migrating off the tracer wire.
- Tracing wire shall be Direct Burial #12 AWG Solid (.0808” diameter), 21% conductivity annealed copper-clad high carbon steel high strength tracer wire, 452lb average tensile break load, 30 mil. high molecular weight Tracing wire shall be Direct Burial #12 AWG Solid (.0808”

diameter), 21% conductivity annealed copper-cladhigh carbon steel high strength tracer wire, 452lb average tensile break load, 30 mil. high molecular weight high density polyethylene jacket (Blue) complying with ASTM-D-1248, 30 volt rating. Approved tracer wire for open cut application: Copperhead 12.30 BHS.

- For trenchless installations refer to OPSS 450. #12 AWG Solid (.0808" diameter), steel core hard drawn extra high strength horizontal directional drill tracer wire, 1150lb. average tensile break load, 45 mil high molecular weight-high density Blue polyethylene jacket complying with ASTM-D-1248, 30 volt rating.

- All tracer wire welds onto existing cast of ductile iron pipe shall be completely sealed with the use of Chace/Royston Handy Cap IP. In all cases, the pipe is to be properly cleaned and material shall be applied in accordance with the manufacturer's instructions.

- All slices or repaired wire connections in the tracer wire system shall be made using waterproof connectors specifically rated for underground applications. Tracer wire shall have a Zinc anode installed as per OPSS 442 Table 5. Tracer wire shall be terminated as per Figure 5.9 "Tracer Wire Installation."

5.5.8 Sampling Station

- All sampling stations shall be installed as per the manufactures specifications.

- Approved Sampling Stations:

    - Model Eclipse #88 as manufactured by Kupferle with the Extreme cold climate option.

5.6 COMMISSIONING OF WATERMAINS

- Hydrostatic testing, swabbing, flushing, disinfecting and bacteriological testing of watermains are to be carried out in accordance with the Ontario Watermain Disinfection Procedure and AWWA C651 (current version) and witnessed by the Municipal Inspector. A watermain commissioning plan must be submitted to the Municipality for review and acceptance by the Director, Public Works and Engineering at least 10 business days prior to any connection to the existing municipal system.

5.6.1 Hydrostatic Testing

- Hydrostatic testing shall be conducted under the supervision of the Municipal Inspector upon completion of the watermain including services and backfilling.

- Hydrostatic testing of new watermain and appurtenances (fire hydrants and laterals, etc.) including water services to the curb box shall be done on new subdivision watermain infrastructure only. All other hydrostatic testing of new watermain replacements shall include the testing of all appurtenances including the installed service saddle 25mm main stops only. All services over 25mm shall be tested to the curb box.

- All caps and / or plugs used for testing process to be supplied, same for tap and ball valve.

- Hydrostatic pressure and hydrostatic leakage tests may be conducted either simultaneously or separately.

- Duration of test shall be two (2) hours or longer if so directed by the Municipal Inspector, if tests are performed simultaneously.

- If two tests are performed separately, conduct hydrostatic pressure test before hydrostatic leakage test. Duration of pressure test shall be one (1) hour or longer if so directed by the Municipal Inspector. Duration of leakage test shall be two (2) hours or longer if so directed by the Municipal Inspector.

- The Contractor shall assume all responsibility when testing against existing or new line valves. The Contractor is to provide all bulkheads, taps, fittings and pipe thrust restraint necessary to undertake pre-qualification or final testing.

- Testing for Polyethylene Pipe shall be in accordance with the manufactured specifications and AWWA M55.

- The Contractor is to provide means of obtaining water.

- Fill test section slowly with water making sure that all air is removed from pipeline. Allow a period of 24 hours before starting test. Subject test section to continuous test pressure specified for one hour or as directed by the Municipal Inspector and in accordance with the Contract Administrator.

- Test pressure shall be 1035 kPa or as specified in the Contract. No pressure drop is allowed during the hydrostatic pressure test period.

- Examine all parts of test section while under pressure. If test pressure is maintained with no pressure drop for specified test duration, test result is satisfactory.

- If test result is not satisfactory, repair all deficient parts of section and retest until satisfactory result is attained.

- The temporary connection shall include an a reduced pressure zone assembly that is tested and shall be disconnected from the new main during the hydrostatic pressure test.

5.6.2 Swabbing and Flushing

- Watermains shall be swabbed and flushed in a sequence and in accordance with procedure accepted by the Municipality and in accordance with the Contract Administrator. The contractor must submit a swabbing, flushing and disinfection procedure to the Municipal Inspector for approval two (2) weeks prior to the operation for approval.

- Swab to be a minimum 4” (100mm) larger than the diameter of the watermain being swabbed or as directed by the Municipal Inspector.

- All watermains up to 450 mm diameter shall be cleaned by the use of a minimum of four (4) foam swabs introduced at special entry sections or as directed by Municipal Inspector and forced by water pressure through the main to exit points approved by the Municipal Inspector and in accordance with the Contract Administrator. Cleaning shall be repeated until 2 consecutive clean swabs (no discolouration of swab) and the discharge water is clear and approved by the Municipal Inspector and in accordance with the Contract Administrator.

- Hydrants laterals shall be manually swabbed using a chlorine slurry as directed by the Municipal Inspector.

- Method for swabbing watermains larger than 450 mm in diameter shall be as specified in the Contract.

- Mains shall be cleaned or flushed before hydrostatic testing and disinfection is done.

5.6.3 Disinfection

- The main shall be disinfected according to instructions listed in AWWA C651, Watermain Disinfection Procedure and the "Procedure for Disinfection of Drinking Water in Ontario" as adopted by reference by Ontario Regulation 170/03 under the Safe Drinking Water Act. Sections 4.3.9 Backflow Protection and 4.6 Final Connections to Existing Mains of AWWA C651 are required and are not optional. The backflow device certification is to be witnessed by the Municipal Inspector and/or Contract Administrator. The Contractor must supply all labour and materials necessary for the sterilization of the pipe. Places where flushing may be done, rates of flushing and location of drainage points must be approved by the Municipal Inspector and in accordance with the Contract Administrator prior to the operation as noted above.

- The Municipal Inspector may permit or require the swabbing, flushing and disinfection to be carried out in stages as sections of the system are completed. Swabbed, flushed and disinfected sections shall be protected from contamination.

- The system shall be left charged with the chlorine solution for 24 hours. Samples shall be taken by the Municipal Inspector. If there is indication of contamination, the disinfection procedure shall be repeated.

- After final flushing and before the new watermain is connected to the distribution system, two (2) consecutive sets of acceptable samples, taken at least twenty four (24) hours apart, shall be collected from the new main.

- The new watermain will not be connected to the Municipal distribution system until all samples show the absence of Total Coliform, E. Coli and Background. Once all sampling is to the satisfaction of the Operating Authority, clearance will be given to connect to the Municipal distribution system.

- The contractor will not be reimbursed for any down time associated with awaiting test results.

5.6.4 Management and Disposal of Excess material

- Management and disposal of excess material shall be according to OPSS 180.

- All chlorinated water used for testing, flushing and disinfecting watermains shall be disposed of safely. Acceptable means of disposal are by discharge to storm sewer or open environment (drainage ditch or receiving water) with a free chlorine residual of 0.0 mg/L (i.e. no detectable level of chlorine).

- Discharge of chlorinated water directly to sanitary sewer is not acceptable.

- When discharging to the open environment or storm sewer, it will be the responsibility of the contractor to ensure the effectiveness of the dechlorination process. The contractor shall provide a written plan for the dechlorination process which is to be submitted to the contract administrator and approved. As a minimum this shall include:

i. The chemical proposed to be used to dechlorinate, the proposed equipment and methodology\for dechlorination, and the proposed point of discharge and the receiving body (i.e. storm sewer, open environment, ditch, drain, water course).

ii. The process proposed and how it will ensure adequate dosing and mixing of the dechlorination compound prior to discharge.

iii. Ensuring that there are appropriate measures in place to avoid erosion at the point of discharge and downstream.

iv. There is a location for monitoring (and a method of monitoring) to ensure no chlorine residual remains downstream of the point of discharge.

- The contractor shall also be responsible for documenting the dechlorination and monitoring process. These records will be made available to the Municipal Inspector as required.

- Use of Chemicals for Dechlorination of Water

- There are several chemicals which can be used to dechlorinate effectively. The following comments are offered with respect to potential impacts of each on the receiving body*:

Chemical	**Comments / Impacts**
Hydro Peroxide	This is the best chemical when discharging to an environmentally sensitive watercourse. An overdose will only add more oxgen.
Sulphur Dioxide	This will slightly lower the pH in the receiving water.
Sodium Thiosulphate	Will cause some sulphur turbidity, but an excess is harmless.
Sodium Sulphite	Excess will lower dissolved oxygen.
Sodium Pyrosulphite (Sodium Metabisulphite)	Excess will lower dissolved oxygen.

- Adequate mixing and dosage of the chemical with chlorinated water must be ensured.

5.7 LOCATION AND SPACING OF VALVES

5.7.1 Location and Spacing of Watermain Valves

- In accordance with the Ministry of the Environment, Watermain Design Criteria for Future Alterations Authorized Under a Drinking Watermain Works Permit, Table 2: Shut-Off Valves.

- In residential developments, valves shall be located so that any section of watermain serving up to a maximum of fifty (50) residential water services can be isolated by operating not more than four (4) valves. Phasing of developments should be considered and valving should be logical (i.e. at intersections). In residential areas, valves shall be spaced no more than 250 m apart.

- In high density residential, industrial and commercial areas, valves shall be located to be no more than 150 m apart.

- Feeder watermains (400 mm, 450 mm and 600 mm) should have valves at 400 m intervals.

- At intersections where smaller watermains connect to larger feeder watermains, each smaller watermain shall be valved with an isolation valve whereas the larger watermain shall be valved as required above.

- Valves shall be installed on looped services or private watermains to isolate buildings or groups of buildings so that no more than fifty (50) individual water services or apartment complex containing 150 dwelling units or more are on any one valved section. The Owner shall install a valve on the street watermain between connections to a looped private watermain if there is not an existing valve, at no expense to the Municipality.

- Watermains crossing rivers, railways and controlled access highways shall be valved on each side of the crossing.

- Valves shall be located on all hydrant laterals in accordance with Figure 5.8 “Hydrant and Valve Installation”.

- Where possible, valves shall be located in line with the extension of street property lines.

- Water valves may be placed within the raised roundabout island where possible. However, if placement of the valves creates a potential conflict with the curb & gutter of the island, then the valves are to be placed in the boulevard clear of the curb and gutter of the approaching streets.

- All valves shall be provided with valve boxes and extension rods.

- The location and number of valves should take into consideration reducing shutdowns and inconvenience to customers during the construction of additional phases. Valves may be installed on a temporary basis and relocated in order to accomplish this.

- For watermain 400 mm in diameter and below, valves shall be sized to be the same size as the watermain on which the valve is installed.

5.8 FIRE HYDRANTS AND FIRE DEPARTMENT CONNECTIONS

- All fire hydrants situated within the road allowance are the sole property of the Municipality of Middlesex Centre and shall be maintained by and operated by the Municipality of Middlesex Centre.

- Hydrant and valve installations shall be in accordance with Figure 5.8 “Valve and Hydrant Installation”.

- All new PUBLIC hydrants installed are to be flow tested and colour coded in accordance with the requirements of NFPA 291. Colour coding is for the purpose of indicating available fire flows at 20 psi residual pressure. Colour coding shall be by means of placing round 0.090 thick HDPE material fabricated using 3M high intensity reflective vinyl applied as per the NFPA 291 Colour Chart and adhered to the reflectivity standards of ASTM D-4956 Type IV retro-reflectivity markers on each of the two 65 mm hydrant outlets as manufactured by B.M.R. Manufacturing Inc.

Class	Rated Capacity		Colour
	Usgpm	**Litres/min**	
AA	1500	5680 or >	Light Blue
A	1000 to1499	3785 to 3780	Green
B	500 to 999	13900 to 3780	Orange
C	500	1900 or <	Red

5.8.1 Location/Spacing of Hydrants on Public Streets

- The location of hydrants is subject to the requirements and approval of the Municipal Fire Department in accordance with the Ontario Building Code. As a general guide, hydrants must be located not more than 170 m apart along the length of the watermain and should be located at intersections where possible.

- For a more detailed discussion of hydrant spacing requirements refer to Fire Underwriters, "Water Supply for Public Fire Protection a Guide to Recommended Practices" (latest edition).

- For use with sprinkler or standpipe systems, hydrants must be located not more than 45 m from the Fire Department connection.

- Hydrants should not be located on dead-end streets unless such streets exceed 90 m in length. Where located on dead-end street the hydrant shall be located at 90 m from the end and a smaller size watermain (minimum 100mm) shall be used beyond the hydrant so that water quality is maintained.

- Regardless of hydrant location shown on accepted subdivision plans, additional hydrants may be required or existing hydrants may have to be relocated due to circumstances unknown at the time of plan acceptance such as the position of a structure, Fire Department connection, driveway or landscaping feature. Such addition and/or relocation shall be requested when the Municipality approves the service plan and must be done at the expense of the Owner of the subdivision or, if the subdivision has been assumed, at the expense of the Owner of the property for which the additional or relocated hydrant is required.

5.8.2 Hydrants on Private Property

- Hydrants on private property are to be strongly discouraged however, where absolutely necessary to meet spacing in accordance with the requirements of the Ontario Building Code hydrants may be located on private property. Approval for hydrants on private property is to be obtained from the Director, Public Works and Engineering.

- All PRIVATE hydrants installed are to be flow tested and painted high gloss RED in accordance with the requirements of NFPA 291. Colour coding is for the purpose of indicating available fire flows at 20 psi residual pressure. Colour coding shall be by means of placing round high intensity reflective sheeting markers on each of the two 65 mm hydrant outlets. The Hydrant reflectors shall be a circular TC-FHR Fire Hydrant Reflector, HDPE Poly with 3M™ High Intensity Sheeting as manufactured by B.M.R. Manufacturing Inc., (*www.bmr-mfg.ca*).

- Service mains on which hydrants are located, are to be sized to ensure that sufficient fire flows and pressures can be provided;

- Hydrants shall be installed at location and grades such that they are readily accessible to the fire department;

- For average conditions, fire hydrants shall be placed at least 12.2 m from the buildings being protected, in accordance with NFPA 24. Exception: When hydrants cannot be placed at this distance, they shall be permitted to be located closer, or wall hydrants used, provided they are set in locations by blank walls where the possibility of injury by falling walls is unlikely and from which people are not likely to be driven by smoke or heat. Usually, in crowded plant yards, they can be placed beside low buildings, near brick stair towers or at angles formed by substantial brick walls that are not likely to fall.

- Fire hydrants shall be located a minimum distance of 3.0 m from a fence or other such obstruction.

- Fire hydrants shall not be placed near retaining walls where there is danger of frost through the wall, in accordance with NFPA 24.

- Where municipal water is not available, and an on-site water supply is utilized for firefighting purposes, a fire hydrant shall not be installed, but instead a standpipe connection, meeting the requirements of the Municipal Building Division. On-Site Water Supply for Fire Fighting shall be provided in accordance with the requirements of the Ontario Building Code and the Municipal Building Division.

- All cost associated with the supply, installation and maintenance on private property are the property owners responsibility. Hydrants installed on private property are to be maintained in accordance with NFPA 291.

- Fire Department connection requirements are to be in accordance with the Ontario Building Code.

5.8.3 Protection of Hydrants

- If the placement of a hydrant on public or private property is such that it will be susceptible to damage by vehicular traffic, bollards are to be installed, at the owners cost, in sufficient number to protect the hydrant. Minimum spacing between any bollard and a hydrant shall be 1.0 meter, and bollards shall be a minimum of 1.0 meter in height. Bollards shall be painted hydrant chrome yellow. Bollard construction to be steel with concrete fill.

5.9 WATER SERVICES, FIRE SERVICES AND PRIVATE WATERMAINS

5.9.1 Water Services

- For all water service pipe and fire service mains on private property, the Ontario Building Code shall apply. It shall be noted that water quality requirements are not addressed in the Ontario Building Code. Where there is a concern that there may be a degradation of water quality in the private servicing that has the potential to enter the municipal water supply system, the Public Works and Engineering Department reserves the right to require premise isolation. Premise isolation shall consist of appropriate backflow prevention measures to the

risk posed, and shall be installed at the property line at the owners expense. The following section applies to the water services on public property up to the property line.

- The Owner will be responsible for water service sizing. The Public Works and Engineering Department is to be consulted for available pressures and flows at the watermain under design conditions.

- On private property, adequate water required for fire protection shall be determined in accordance with the Ontario Building Code. Fire flow and hydraulic calculations shall be reviewed by the Municipality's Building Division.

- It is a requirement to provide fire flow information (i.e. hydrants on private property and fire sprinkler requirements) in conjunction with site plan submissions for water servicing in order to determine the correct water service sizing.

- The minimum size permitted for water services is 25 mm diameter.

- Larger than 25 mm diameter water services may be required for estate lots, larger homes, deep setbacks or where automatic lawn sprinkler systems or fire sprinkler systems are to be used. In general, service connections over 30 m in length between the main and the building, will require a 25 mm service or larger depending on the length of service.

- In accordance with the Ontario Building Code and NFPA 24, the minimum size for fire service mains and water service pipes, combined with fire service mains, shall be 150mm;

- For mains that do not supply hydrants, sizes smaller than 150mm may be used, subject to:

    - the main supplies only automatic sprinkler systems, open sprinkler systems, water spray fixed systems, foam systems or Class II standpipe systems;

    - hydraulic calculations demonstrate that the main will supply the total demand at the appropriate pressure. Systems that are not hydraulically calculated shall have a main at least as large as the riser.

- Acceptable water service sizes are 25 mm, 40 mm, 50 mm, 100 mm, 150 mm, 200 mm, 250 mm, and 300 mm diameter.

- Where the main pressures within the municipal system exceed 690 kPa (100 psi), pressure reducing valves are to be installed by the owner at no cost to the Municipality.

- Residential water services to be installed in accordance with Figures 5.10 "Standard Installation 20mm to <50mm Water Service,; and Figures 5.11 "Schematic Layout of 100mm and Larger Services."

- Cathodic protection is to be provided where connection is made to steel mains in accordance with Figure 5.12 "Cathodic Protection Assemblies for 50 mm Water Services" and Figure 5.13 "Cathodic Protection for 100 mm and Larger Water Services".

5.9.2 General Requirements Water Services

- Water service shall mean the pipe, fittings and shut off valve that convey potable water from a connection on a watermain or private watermain to the meter location.

- Water Services to Residential Dwelling Units (Detached, Semi-detached, Townhouses, Row-housing).

  - Each dwelling unit in a detached, semi-detached, townhouse or row house block, must be serviced with a separate water service connected to a watermain or private watermain. Water services must front the dwelling unit they service unless otherwise approved.

- Water Services to Commercial/Industrial Malls

  - Each structure in a commercial or industrial mall may have one water service connected to a watermain or private watermain. Units in such a mall may have an individual water service connected to a watermain or private watermain outside the unit.

- Water Services to Swimming Pools/Lawn Sprinkler Systems

  - Swimming pool facilities and lawn sprinkler systems must be serviced by connecting to the metered side of a water service that is within a heated structure.

  - Connections to lawn sprinkler systems are to have backflow prevention devices in accordance with CAN CSA B64 and are subject to the approval of the Chief Building Official. Direct Pool Makeup Water Connections are to have backflow prevention devices in accordance with CAN CSA B64 and are subject to the approval of the Chief Building Official.

- Water Services to Other Structures

  - Unless otherwise approved by the Director, Public Works and Engineering, all structures not covered in the above including commercial, industrial and institutional shall have one water service connected to a watermain or private watermain.

- Engineer to Designate Watermain to Provide Service

  - When there are two (2) watermains on a road allowance, the water service shall be laid from the structure to the watermain which, in the opinion of the Director, Public Works and Engineering, provides adequate flow and/or pressure. Water services shall not be tapped off transmission watermains.

- Water Services to Residential Apartment Buildings (5 dwelling units or more)

  - Apartment buildings (5 dwelling units or more), shall have one water service connected to a watermain or private watermain. Alternately, if individual metering of each unit is to be provided, the meters shall be placed in a common utility room which is located immediately inside the building exterior face and is accessible to the Public Works and Engineering Department and their designates for meter reading and maintenance. Each service shall be:

    - clearly marked to indicate the unit served, and

    - equipped with a lock-out type shut off valve.

    The plumbing to service each unit beyond the water meter shall meet with the requirements of the Ontario Building Code.

- Water Services to Residential Dwelling Units in Townhouse/Condominium Blocks

  - Each dwelling unit in a private block must be serviced with a separate water service connected to a watermain or private watermain. Water services must front the dwelling unit they service unless otherwise approved in writing by the Engineer.

  - Where it is proposed that servicing of individual dwelling units is not in accordance with the standard above, bulk metering of the site at the point(s) where the water service enters the property will be required. Individual metering of dwelling units by the Municipality will not be provided in this circumstance.

- Water Services to Multi Family Residential Buildings

  - This section will describe the requirements for individually servicing/metering new or converted multi-family (4 residential units or less) residential buildings. This may include but is not limited to the following configurations:

    1. An existing single family home that has been converted to a multi-family residence such as a duplex, triplex or a fourplex. The newly created units may have several different layouts such as side by side, upstairs/downstairs units, front/back, etc.

       - In this case, the building must be supplied by a water service pipe from the municipal watermain in the street to the property line that is adequately sized for the intended use of the building. The Municipal of Middlesex Centre minimum water service pipe sizing is 25mm PEX.

       - The internal plumbing of the building must be arranged in such a manner that each residential unit must have a separate hot and cold water supply that can be isolated by a main valve and not interfere with the water supply of the other units.

       - The Municipality of Middlesex Centre allows one water service pipe from the municipal watermain to the property line with a shut off valve located 300mm from the property line on the Municipality right-of-way. Once the water service pipe crosses the property line it can be branched off in to two - four separate water services, one for each new customer. Each branch is to have a shut off valve located at 300mm from the property line on private property. A meter pit will have to be installed for each unit which will house the Municipality of Middlesex Centre water meter. From this point the water service pipes will enter the building and be connected to the building plumbing system.

    2. Similar to item 1 above but newly constructed building purpose built multi-family residence.

       - As described above, each dwelling unit may be serviced by a meter pit located at the front of each unit.

    3. Other multi-family (that may or not be stacked) residential condominium or rental units that cannot be serviced as described in the previous sections (5.9.2).

       - Each residential unit may be individually serviced by a meter pit located in front of the residential unit it is servicing. The developer is to ensure that there is adequate space to locate the meter pits and associated valving in the front and that the meter pit is accessible for maintenance. Regardless of the configuration of the building, it is important to understand that each metered

water service consists of a water service pipe, an isolation valve and a water meter. The meter pits are to be located in the front of the residential unit being serviced and the must be accessible for maintenance.

5.9.3 Looped Water Servicing Required

- A looped water service connected to a public or private watermain or watermains must be installed:
  - When one water service will not supply the required flow for domestic use and fire protection or,
  - For an apartment complex containing one or more structure and more than 150 dwelling units or,
  - For a townhouse, condominium or similar complex having more than fifty (50) units with individual water services and meters.
- The looped water servicing must be installed to service the private development from two sources. If the looped watermain is connected to one public watermain, an isolating splitter valve must be installed in the public watermain to permit isolation of supplies, at no cost to the Municipality.
- Material type shall be an approved material type to the property line. On private property, material for water service pipes and fire service mains shall comply with Part 7 of the Ontario Building Code.

5.9.4 Layout of Water Services

- The standard residential water service stub will be located in accordance with Figure 5.1 “Standard Servicing Locations for Single Family and Semi-Detached Lots”.
- The water service pipe must be installed at right angles to the watermain and in a straight line from the watermain to the water meter.
- Water services connected to a private watermain are subject to the same requirements as water services connected to a public watermain.
- Water services shall have no less than 1.7m nor more than 1.9m of cover from final surface grade.
- Water services and private watermains are to be located so that “berm” or “mound” type landscaping will not cause excessive cover over water services.

5.9.5 Approved Deviations in Location of Water Services

- Deviations from the above may be approved by the Director, Public Works and Engineering for the following conditions:
  - Cul-de-sacs, Street Curves and Bends:

    On cul-de-sac streets and on street curves and bends the water service stubs may be installed at other than right angles to the watermain and not necessarily through the

midpoint of the lot frontage. The water service must be in a straight line from the watermain to the meter.

- Water Service Cannot be Located in Line with the Centre of Lot Frontage:

  Where the water service cannot be located in line with the centre of the lot frontage, the water service stub may be installed at any point on the lot/frontage but must be at right angles to the watermain and in a straight line from the watermain to the meter.

- Water Service Cannot Extend in a Straight Line from the Watermain to the Water Meter

  If the water service stub has been installed on the lot frontage but the water service cannot be in a straight line from watermain to water meter then the water service extension may be installed in a straight line from the curb stop to the meter provided the meter is inside the front wall of the structure.

- Water Meter to be Located at the Side of a Structure

  Where the water service entrance must be located at the side of a structure, the water service stub must be located on the lot frontage such that the water service extension can be installed in a straight line from the watermain to a point outside the structure adjacent to the meter. Such a water service should be at least 1.5 m from the structure and centered about a 3.0 m clear space.

- Porch or Cold Cellar on Front of Building

  Where there exists a porch or cold cellar on the front of the building and the water service stub has been installed in the standard location on the lot frontage, the water service extension may be installed under the porch or cold cellar in a straight line from the watermain to inside of the first heated wall. A maximum distance of 2 meters of water service pipe may be located under the porch or cold cellar floor slab

5.9.6 Nonconforming Installation of Water Service or Private Watermain

- If the water service stub is to be extended and it is found that the water service will not conform to the required locations the water service stub shall be disconnected from the watermain and a new stub installed which will conform with the requirements.

- If a water service stub, a water service or a private watermain is installed that is not in accordance with these specifications or with the service drawing approved by the Municipality, such installation will be required to be removed and relocated to conform with the specifications or approved drawings.

- If an existing water service cannot conform to the above location requirements, or is of lead or other unsuitable material, a new water service must be installed which will conform to the requirements. If a Demolition Permit was issued for an existing structure on the lot, then the existing water service must be abandoned and capped at the watermain and a new water service installed to service the structure.

- All relocation work required above shall be at the expense of the Owner or Contractor. The Owner will be responsible, upon approval of the demolition permit, to cut and cap the existing water service(s) at the watermain at no cost to the Municipality.

5.9.7 Fire Service Design

- The determination of fire service requirements and the sizing of supply piping shall be the responsibility of the Owner. If a domestic water service is combined with a fire supply service, the Owner is responsible to ensure that the supply pipe is large enough to carry the combined demand. Design and installation of sprinkler and standpipe systems and their supply services shall conform to the requirements of the Ontario Building Code, Section 3.2, and the Fire Code. The design of Fire Services must be approved by the Municipality.

- The designer should obtain information from the Engineer regarding flows and pressures available for fire systems. If the flows and pressures required are in excess of the minimum design standards and in excess of the actual capacity of the system the Owner shall install booster pumps and/or storage to satisfy the required demand.

5.9.8 Separated Water and Fire Services

- Domestic water, sprinkler and standpipe services may be installed as a separated services from the watermain to the structure. Sprinkler and standpipe services may be combined. The Owner is advised to consult with the Insurance Underwriter before combining these services.

5.9.9 Combined Water and Fire Services

- A domestic water service may be combined with a sprinkler or standpipe service or with a combined sprinkler/standpipe service. The Owner is advised to consult with the Insurance Underwriter before combining these services.

- The owner/designer is advised that water quality should be considered; domestic water demands may not achieve a sufficient turnover rate to prevent poor water quality.

5.9.10 Water Service Size or Location not Determined

- Where water service stub size and/or location for any block cannot be determined prior to street construction the Director, Public Works and Engineering Department will not approve installation of the water service stub.

5.9.11 Water Services Valves

- All water services shall be equipped with a corporation stop and a curb stop. The curb stop shall be provided with a curb box.

- All water service valves and curb stops shall be installed with valve boxes and operating rods.

5.9.12 Location of Water Service Valves

- On water services less than 50mm diameter, a main stop or corporation stop shall be installed at the watermain and a curb stop shall be installed 0.3 m from, and on the street side of, the property line. (Figure 5.9)

- For water services of 100 mm diameter and larger, water service valves shall be placed in accordance with Figure 5.10 “Schematic Layout of 100 mm and Larger Services”.

- Where the watermain cannot be closed off for the water service connection, a tapping sleeve and valve will be required at the watermain. It should be noted that size on size taps (ie 150mm x 150 mm tap) is not allowed and a tee will have to be cut in.

- Where the watermain can be closed and a tee cut into it, or where a new watermain is being installed, a valve shall be installed 0.3 m from and on the street side of the property line.

- The requirement to use a tapping sleeve and valve or to cut in a tee will to make the service connection may be made at the discretion of the Director, Public Works and Engineering.

- Water services to structures in a complex that are to be connected to a private watermain shall have the curb stop or valve placed 3 meters (10 feet) from the face of the building, If this distance locates the curb stop in the paved portion of the complex, a deviation in the curb box location may be requested.

- The layout for water services must be such that the curb stop or valve can be easily found by referring to two directional dimensions from a plaque located on the building where the water service enters.

- The Owner shall ensure that water service control valves on their property are not covered by “mound” or “berm” type landscaping.

5.9.13 Water Service Entrances

- Water services of all sizes shall enter through the building wall or under the wall footing into a heated area, leaving sufficient pipe and working space for meter installation.

- A length of between 0.3 and 0.45 metres shall be exposed above the finished floor. The pipe shall enter the building not less than 0.15m and not more than 0.3m from the wall.

5.9.14 Protection from Contamination

- Connections to the municipal potable water system shall be designed and installed so that non-potable water or other substances that may render the water non-potable, cannot enter the system in accordance with the requirements of the Ontario Building Code.

- The Owner may be required to install a backflow preventer on the water service to prevent backflow into the watermain in the event of a loss of pressure in the system. The Owner will be responsible for the supply, installation and maintenance of all backflow preventers and protective devices, at no cost to the Municipality.

5.9.15 Electrical Grounding

- Electrical systems of all new developments shall not be grounded to the water system. Refer to Ontario Hydro Electrical Safety Code (Section 10) for grounding requirements.

- Where an existing watermain is replaced or upgraded, the grounding of electrical systems to the water service may not be adequate. It will be the Owner’s responsibility to ensure grounding is adequate after the watermain is installed.

5.10 CORROSION PROTECTION

- For new installations, soil samples shall be taken on each street to identify soil class and resistivity for pipe design and this information is to be provided within the geotechnical report.

5.11 EASEMENTS

- Easements are required for any publicly/municipally owned watermain which is located outside a road allowance on privately owned property.

- The minimum width of easement shall be 6.0 m for a single watermain only. When the easement is 6.0m, the watermain will be installed 2.0m from one side of the easement to provide an adequate working area to access and repair infrastructure placed within the easement. Where there is more than one utility, adequate width of easement and separation of utilities for both construction and future access and maintenance shall be provided.

- Where a watermain is installed on an easement which is located on private property or between private properties which have or may have a building(s) located on the property(ies) in the future, the watermain shall be installed in a casing.

5.12 INSTRUMENTATION

- For design and installation standards related to instrumentation and control equipment, the Designer must consult the Director, Public Works and Engineering for current “Scada and Instrumentation Standards”.

5.13 WATER METERS

5.13.1 General Requirements

- All domestic water services must be metered.

- Fire services are not metered with the exception of sprinkler systems located in individually metered dwelling units.

5.13.2 Supply of Water Meters and Water Meter Remote Read Registers and Meter Strainers for Services 150 mm and Larger

- The Municipality will supply and install all water consumption meters that are used for billing process.

- Strainers for 75 mm and larger installations where required shall be supplied by the Municipality.

5.13.3 Location of Water Meter

- The water meter shall be installed on the water service immediately inside the point of entry of the water service into the building. Any variation from this location must be approved in writing by the Director, Public Works and Engineering.

- The Owner shall provide sufficient space for installation and maintenance of the meter. The meter must be accessible for reading and maintenance and must be protected from freezing and other damage.

- The meter or piping shall be no closer than 1 m to any electrical panel or above or below any electrical panel unless provided with a meter enclosure.

5.13.4 Meter Pits Requirements

- Meter pits will be allowed only with approval of the Director, Public Works and Engineering when no other suitable location is feasible. Meter pit design and installation must be submitted for approval meeting the Materials requirements of this specification. All costs associated with the supply and installation of the meter pit will be the responsibility of the Owner.

  Materials

  Meter pits shall consist of an appropriately sized and configured PVC cylinder coiled pit setter complete with an insulating foam disc and cast iron flat locking lid.

  The meter pit shall be a Ford Coil Pit Setter by The Ford Meter Box Co., Inc., Wabash, IN, 260-563-3171, or pre-approved equal.

5.13.5 Water Meter Enclosures

- Water meters may be installed in electrical rooms provided a shield is installed between the water meter and any electrical panel located within one (1) meter. The shield must be of metal construction (or approved alternative) and affixed securely to the wall and must be of sufficient width to isolate the water meter from the electrical panel. It must not impede the maintenance of the water meter.

5.13.6 Installation of Water Meters

- Water meters up to 20 mm size for single family residential units with individual water services, will be supplied and installed by the Municipality.

- Water meters larger than 20 mm in size shall be supplied and installed by the Municipality in accordance with AWWA C700, C701 or C702.

5.13.7 Water Meter Valving

- All new and replacement installations shall require a valve on each side at the meter.

- The Owner must supply and install the valves for all sizes of meters and the inlet valve when the water service piping is over 25mm diameter. The Owner will be responsible for maintaining and keeping the meter inlet and outlet valving operational and in good working order.

- All meter setting valves must open left (counter clockwise).

5.13.8 Meter Strainers

- Meter strainers shall be supplied and installed by the Municipality on 75 mm size and larger meter installations. The Owner shall consult the Engineer regarding dimensions of supports required for the meter and strainer.

5.13.9 Water Meter-by-pass Requirements

- A meter bypass is not permitted.

5.13.10 Meter Sizing

- The size of meters will generally be one size smaller than the water service. Owners should obtain advice from the Engineer on meter sizing. Meter ratings are as follows:

Meter Size	**Maximum Rating**	**Continuous Rating**
(mm)	*(l/min)*	*(l/min)*
16	76	38
20	114	57
25	189	95
40	378	189
50	606	303
Compound Meters	**Maximum Rating**	**Continuous Rating**
(mm)	*(l/min)*	*(l/min)*
75	1136	568
100	1893	946
150	3785	1893

5.14 HYDRAULIC MODELING

5.14.1 General

- Hydraulically water distribution system modeling is required for all new developments unless otherwise exempted by the Director, Public Works and Engineering. Modelling reports and the results of the analyses are to be submitted to the Municipality for review as part of technical submissions for subdivision review. An electronic version of the hydraulic model is to be provided to the Municipality for review and for incorporation into the Municipality's overall hydraulic model.

- The model is to include all watermains 50mm diameter and larger, control valves (pressure reducing valves and flow regulating valves), reservoirs and pumping stations.

- For phased developments, submit updated hydraulic models incorporating the distribution system for all phases at the first phase stage. The conditions for each phase of development is to be modeled independently.

- The Municipality may require hydraulic analyses beyond the development boundaries in situations where the operation of water system facilities such as control valves, reservoirs and pumping stations, are influenced by changing demands in the new development.

- The model shall also include calculations to ensure water quality in any dead end watermain at the end of a phase and specify the installation of automatic blow-offs or flushing devices,

as required in accordance with Figure 5.14 “Note to Designers with regard to Automatic Flushing Devices Discharge Rates.”

- The Municipality has adopted EPANET as its standard for hydraulic modelling. Other software packages may be used for analysis and reporting but all model input files provided must be directly compatible to EPANET without modification.

- As a minimum, steady-state hydraulic analyses for each proposed development phase is to be provided for the following demand conditions:

    - Average day
    - Peak hour
    - Maximum day plus fire flow (fire flows to be modeled at critical locations)
    - water quality detention time

  All Hydraulic reports shall include detailed maps/layouts of the watermain system (valves, hydrants, etc.) and shall clearly show the pipe and node numbering.

5.14.2 Submission Requirements

- Submit electronic versions of the following files in EPANET format:

    - Model input file
    - Model Input File In Text Format With Tab Separation
    - Map Or Shape File

- Submit a report, sealed by an Ontario Professional Engineer, including:

    - Summary of demand scenarios and points of connection to the Municipal system
    - Network map which identifies node and link numbers
    - Node tables for all scenarios listing node numbers, elevation, demands, and pressures
    - Link tables for all scenarios listing link numbers (with up and downstream nodes indicated), diameters, lengths, roughness, velocities, flows, head losses, and age of water calculations
    - For multi-phase developments, provide model data and summaries for all phases as part of the first phase submission.

- Reports containing results that indicate operating parameters outside the acceptable Design Criteria will be automatically rejected without further review and returned to the Owner for correction.

5.14.3 Review by the Municipality

- The Municipality will review the report and advise on the need for any further analysis to be carried out. All costs associated with the development of the model, report submissions and any modifications will be at the Owner's cost

5.14.4 Water Distribution System References

Fire Underwriters Survey

Water Supply For Public Fire Protection, A Guide to Recommended Practice, 1981

Ontario Water Resources Act

Public Utilities Act

Ontario Building Code

Municipality of Middlesex Centre

Comprehensive Zoning By-Law 2005-005

Water By-Law 2012-064

Regulation of Water Supply In The Municipality of Middlesex Centre

Ministry of the Environment

Design Guidelines for Drinking-Water Systems (Latest Revision)

http://www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/std01_079818.pdf

Watermain Design Criteria for Future Alterations Authorized Under a Drinking Water Works Permit

http://docs/livelink/livelink.exe/fetch/2000/3140304/3140307/3140488/16396579/16464169/Watermain_Design_Criteria_March_2009.pdf?nodeid=16464024&vernum=-2

Form 1 – Record of Watermains Authorized as a Future Alteration

http://docs/livelink/livelink.exe/fetch/2003/3140304/3140307/3140488/16396579/16464169/Future_Authorization_Form_1_-_Fillable_and_saveable_-_May_2009.pdf?nodeid=16464105&vernum=-2

6 GRADING

6.1 GRADING REQUIREMENTS FOR VARIOUS SITUATIONS

- Grading in a plan of subdivision, site plan (guidelines where applicable) and infill lots is to be designed by a Professional Engineer and certified by a designated professional as per the requirements of the Subdivision Agreement and is to be completed in accordance with the following standards:

6.1.1 Subdivisions

- Developments created by a draft plan of subdivision shall conform to the following lot grading standards;

- Grading and drainage are not to adversely affect abutting or adjacent properties.

6.1.2 Site Plans

- Developments subject to site plan approval are to be graded and drained internally;

- Grading and drainage are not to adversely affect adjacent properties;

- Grading and drainage shall conform to the overall drainage pattern of the adjacent lands as certified by the design engineer at the time of the permit for each building.

- On site grading is subject to the Municipality's Site Plan Design Manual Guidelines.

6.1.3 Severances, Lifting of Part Lot Control & Infill Lots

- Developments created by severance, lifting of Part Lot Control and infill lots for residential lots, shall conform to the lot grading standards in a plan of subdivision;

- Grading and drainage are not to adversely affect the abutting and/or adjacent properties.

6.1.4 Blocks

- Development on blocks within registered plans of subdivision are subject to site plan approval.

- Grading and drainage of such blocks shall conform to the accepted overall subdivision design and shall be certified by the site design engineer.

6.1.5 Capital Projects

- When grading is required on municipal capital projects, the designer shall determine match points that appear to naturally blend proposed design grades with existing topography;

- Consideration shall be given to transitions with intersecting streets, driveway profiles, drainage, utilities, existing retaining walls, potential impacts on trees and other landscaping features.

- Wherever possible, the designer shall take every opportunity to eliminate or reduce the size of existing retaining wall owned and maintained by the Municipality.

- Consideration is to be given to maintenance and aesthetics of grassed areas such as lawns and boulevard areas.

- Grades should not be altered around trees on the basis of 30cm of distance from the stem for each 3cm of trunk diameter at breast height C1.5m above ground.

- While a 4:1 slope or greater is desirable from a maintenance perspective, a maximum 3:1 slope is acceptable.

- Proposed driveway grades are not to exceed 10%.

6.1.6 Parks and Open Space

- Overall grading of Park and Open Space Blocks within new plans of subdivision shall conform to the master grading plan for the subdivision and must accommodate overland flow routes, etc.

- Detailed grading within Parks and Open Space areas will be subject to review by the Community Services Department.

6.1.7 Variations / Modifications

- There will be site specific situations where all the criteria may not apply. Proposed grading that does not conform to the appropriate grading requirements standards will be reviewed taking into account the mitigating circumstances that require the proposed variations or modifications.

- Any variations from these standards are subject to approval by the Municipal Engineer.

6.2 MAJOR / MINOR STORM DESIGN

- Stormwater collection systems (referred to the minor system), are to be designed to accommodate storm runoff from the 2 year storm event. The lot grading for new development is to be designed to safely convey runoff from storm events in excess of the 2 year storm up to the 250 year Chicago 3 Yr Storm (per City of London a,b,& c design parameters);

- It shall be the designers responsibility to complete hydraulic modelling to ensure that appropriate conveyance capacity exists within all overland flow routes;

- When designing overland flow routes the following criteria shall apply:

    - Preference is for major overland flows to be routed within road allowances;

    - The maximum allowable ponding at gutters on roads is 300mm; the maximum allowable ponding within rear yard swales at catchbasins and within open space areas is 450mm;

    - Building opening elevations adjacent to overland flow routes on roadways shall be at least 300mm above the maximum flow elevation for the major design flow;

    - Building opening elevations adjacent to overland flow routes through lots or blocks shall be at least 450mm above the maximum flow elevation for the major design storm;

- Both existing and proposed overland flow routes are to be identified with directional arrows on all grading drawings;

6.3 GRADING REQUIREMENTS ALONG PROPOSED/EXISTING ROADS

- The grading along the development property limits adjacent to existing or proposed municipal roads is to be graded to blend in with the future road grades.

- Where future grades have not yet been established and approved by the Municipality, the developer is to retain the services of a Professional Engineer to obtain and or develop the necessary information to establish the future centre-line road profile and property line grades, and have such approved by the Director, Public Works and Engineering.

6.4 GRADING STANDARDS

- The following standards are to be considered when designing lot and adjacent boulevard grading:

6.4.1 Drainage

- The boulevard and a minimum 6.0m at the front of any residential lot must drain towards the abutting road.

- The location and direction of drainage along the rear and side lot lines is to be shown on the grading drawings. One drainage direction arrow for each change in grade for all lots is to be provided.

- The drainage from single-family lots in the same subdivision may be drained between other single-family lots (ie back to front drainage).

- The drainage from impervious areas on lots in a new subdivision is not to flow across existing lots abutting the new subdivision.

- The drainage from single-family and semi-detached lots is not to drain onto Multi-family, Commercial or Institutional blocks (with the exception of the overland flow routes).

- All multi-family, commercial and institutional block drainage is to be self-contained.

- Where a new subdivision abuts an existing development or undeveloped land, the existing ground elevations at the common property line are to remain unchanged and existing drainage of abutting lands is not to be disturbed, or obstructed, unless written permission is granted by the affected land owner.

- Localized surface drainage from abutting properties, to be developed in future, may be discharged onto the proposed lots in a subdivision.

- Identify existing vegetation and set grades to retain where possible.

6.4.2 Elevations

- Show existing elevations by contours. Contours are to extend a minimum of 30m beyond the limit of the site plan, or subdivision.
- Show existing spot elevations at all lot/block corners along the boundary of the development, and along all major overland flow routes.
- Show existing centre-line of road elevations every 30m for existing, abutting and connecting streets.
- Show existing spot elevations around existing house/units and at house/unit openings for new proposed major overland flow routes through existing developments.
- Show proposed elevations on ALL corners of the proposed lots.
- Show finished ground elevations around house/unit.
- Show final centre-line road elevations, every 30m as well as at break points and high and low points in the road profile. Identify (label) the break points, high/low points.
- Show proposed elevations at all high points or break points where the direction of drainage along rear and side lot lines changes.
- Show proposed bottom of swale elevations at pertinent intervals, and at property lines.
- Show proposed elevations at the top and bottom of all steep slopes (3H: 1V, max.).
- Show proposed top and bottom retaining wall elevations.
- Show proposed top and bottom noise barrier wall elevations.

6.4.3 Slopes

- Yard surfaces shall have a minimum slope of 2%.
- Front yard surfaces shall have a maximum slope of 10%.
- Rear yard/side yard (walkouts/back splits) surfaces including swale cross-falls shall have a maximum slope of 3H: 1V .
- Berms shall have a maximum slope of 3H: 1V.
- Road and boulevard surfaces shall have a minimum cross-fall grade of 2% and a maximum cross-fall grade of 4% in new subdivisions.
- Driveway surfaces shall have a minimum grade of 2% and a maximum grade of 10%.
- Specify stepped foundations, side to side for lots fronting streets with a road grade of more than 3%.

6.4.4 Swales

- Drainage flows which are carried around houses are to be confined in defined swales, located as far from the house as possible.
- Minimum swale grade is 2%.
- Maximum of 16 lots draining to a rear yard swale, out-letting to a rear yard catch basin.
- Maximum length of swales permitted is 76m, out-letting to a rear yard catch basin.
- The maximum flow allowable in a side yard swale or a swale discharging across a boulevard onto a Municipal Right-of-Way shall be that from 4 backyards.
- The side yard swale is to be a minimum of 150mm lower than the finished ground elevation at the house.
- The average rear yard swale depth is 225mm. The minimum swale depth allowed is 150mm. The maximum swale depth is variable, but is dependent on location and safety considerations.
- Show the location and direction of flow in swales by means of arrows. Show at least one arrow at the rear of each lot.

6.4.5 Catch Basins

- The maximum length of swales permitted to drain to a catch basin is 76m.
- A maximum of 16 lots draining to a rear yard catch basin is allowed.
- Front yard catch basins are not permitted, except in unusual circumstances where a rear-yard catch basin cannot be provided.
- No surface ponding is allowed during a two year design storm event.
- Under a 100 year design storm event, 300mm surface ponding is allowed at catch basins on roads, and 450mm surface ponding is allowed at rear yard catch basins.
- Flat see-saw profiles (identical high and low points) will not be allowed in either road profile designs or rear yard swale designs. See-saw profiles must slope in a cascade that allows major storm flows (Overland Flows) to drain along the road or lots to an acceptable Overland Flow Outlet.
- In reconstruction projects within existing developed areas of the Municipality, where the existing profile and driveway conditions cannot accommodate a cascading see-saw profile, the proposed profile must provide for adequate road drainage and be acceptable to the Municipal Engineer.

6.5 ADDITIONAL INFORMATION TO BE SHOWN ON PLAN

- Grading Plans shall be designed in accordance with the standards listed above, and will contain the following information where applicable:

REQUIRED INFORMATION	**WHERE APPLICABLE INFORMATION**
Standard Middlesex Centre Title Block North Arrow P. Eng. Stamp Street Names Lot and Block Frontages Lot and Block Numbers 0.3m Reserves Existing Features (trees, fences, houses, etc.) Sediment and Erosion Control Measures Delineation of Proposed Unit/house Maintenance Holes and Fire Hydrants Catch Basins	Sidewalk Ramps Sewer Easements and Widths Building Setbacks for Rear Yard Catch Basin Leads Steep Slope Lines (3:1 desirable) Sidewalks to be Constructed Headwalls (inlets/outlets) Channels Pedestrian Walkways (fencing, posts, width and driveways) Noise Barrier Walls and Details Swales percentage of slopes and extension of outlets Culvert sizing diameter and invests where applicable

6.6 GRADING NOTES

- The following notes are to be included on the Grading Drawings:
  - Existing drainage of abutting lands is not to be disturbed.
  - Localized surface drainage from abutting properties to be developed in future may be discharged onto the proposed lots in this subdivision.
  - Basement openings to be minimum 300mm above the centre-line of road unless otherwise approved by the Director of Public Work and Engineering.
  - Ground elevations at houses abutting overland flow routes are to be 225mm above overland flow route elevations.
  - Retaining walls, 1.0m high or greater, are to be designed by and constructed to the specifications of a registered professional engineer in accordance with the Ontario Building Code.
  - For Subdivisions: Sump pump discharge must be directed to the storm sewer via the storm PDC.
  - Where there are no storm PDC's, sump pump discharge must be directed away from driveways and sidewalks and must not extend beyond property limits.

7 SEDIMENT AND EROSION CONTROL

7.1 INTRODUCTION

- Construction sites, by their nature, result in the disturbance of the onsite natural materials, as well as impacting on the surrounding areas. Sediment and erosion control measures are to be used on ALL construction sites to limit the effects of the proposed construction on the surrounding areas and infrastructure. The extent and durability of the required measures is determined by the sensitivity of the area that is to be protected.

7.2 REFERENCE

- The following guidelines shall apply in conjunction with the Ministry of Natural Resources Guidelines on Erosion and Sediment Control for Urban Construction Sites.

7.3 GENERAL INFORMATION REQUIREMENTS

- Sediment and erosion control measures are to be identified on all lot grading plans, stormwater management ponds, channels, plan & profile drawings and on detail drawings.

- Where extensive measures are required because of the sensitivity of the surrounding area, or the scale of the drawing is such that the measures are not clear, then the sediment and erosion control measures are to be identified on a separate plan.

7.4 CONSERVATION AUTHORITIES

- Approvals are to be obtained from the applicable Conservation Authority for works which are in or adjacent to floodlines, fill lines and hazardous slopes, prior to the construction of services and final approval of the engineering plan.

7.5 PARKS AND OPEN SPACES

- Approvals are to be obtained from the Planning Division for sediment and erosion control measures adjacent to any open space areas – flood plain, environmentally significant areas, natural areas, ravines, parks, etc, prior to any site alteration, construction of services or final approval of engineering plans.

7.6 TYPICAL APPLICATIONS

7.6.1 Silt Fence

- Silt Fences are to be constructed with an approved geotextile fabric along rear/side lot lines and top/bottom of steep slopes.

7.6.2 Straw Bale Filters

- Straw Bale Filters are to be constructed around drain inlets/outlets for temporary short term control measures.

7.6.3 Rock Check Dam

- Rock Check Dams are to be constructed in conjunction with an approved geotextile barrier within open drainage systems.

7.6.4 Straw Bale Check Dam

- Straw Bale Check Dams are to be constructed across low flow swales or ditches.

7.6.5 Rip Rap

- Rip Rap is to be constructed with an appropriate geotextile barrier within inlet/outlet structures, over flow protection, channel banks, gabions and rockfill structures.

7.6.6 Rock Protection

- Rock Protection is to be constructed in conjunction with an approved geotextile barrier within inlet/outlet structures, over flow protection, channels banks, gabions and rockfill structures.

7.7 SPECIFICATIONS

7.7.1 Rip Rap

- Rip Rap is to be graded in sizes ranging from 100mm to 200mm, as per Ontario Provincial Standard Specification (OPSS)-1004.05.06.01 (concrete rubble is not acceptable).

7.7.2 Rock Protection

- Rock Protection is to be graded in sizes ranging from 100mm to 500mm, as per Ontario Provincial Standard Specification (OPSS)-1004.05.06.02 (concrete rubble is not acceptable).

Types of Applications	**Required Geotextile Functions**	**Recommended Geotextile**	**Properties and Characteristics**
Subdrains French Drains Foundation Drains Trench Drains Blanket Drains	Filtration Drainage	200R 240R 270R	Good lateral drainage Suitable for wide spectrum of soil permeabilities
		300R 360R	Used in weaker soil conditions Used in conjunction with coarser drainage materials
Gabion Lining Retaining Walls Drop Structures Ditch Lining	Filtration Drainage	200R 240R 270R	High Permeability Medium tensile strength at high elongation Good filtration
		360R	medium puncture resistance good lateral drainage withstands more severe hydraulic conditions
Revetments Channel Linings	Filtration Drainage Reinforcement	270R	300mm maximum rip rap size not to be used under severe hydraulic conditions

Types of Applications	Required Geotextile Functions	Recommended Geotextile	Properties and Characteristics
Rivers / Creeks		400R	medium tensile strength at low elongation woven scrim reinforcement 600mm maximum rip rap size
		360R	450mm maximum rip rap size medium tensile strength at high elongation
		270R	under sub-ballast in drainage ditches
		1000R 1200R	highest strength non- woven geotextile manufactured recommended use with armour stone in excess of 2.72 tonnes highest level filtration

NOTE: All of the above information was taken from Terrafix Geosynthetics Inc.

7.8 SEDIMENT CONTROL MEASURE NOTES

- The following sediment control measure notes are to be shown on the construction drawings, either on the plan that details the sediment and erosion control measures, or on the notes and details drawing. Please note that the following sediment control measure notes are examples only, and may vary to suit the individual project.

    - Protect all exposed surfaces and control all runoff during construction.
    - All erosion control measures are to be in place before starting construction and remain in place until restoration is complete.
    - Maintain erosion control measures during construction.
    - All collected sediment must be disposed of at an approved location.
    - Minimize area disturbed during construction.
    - All dewatering must be disposed of in an approved sedimentation basin.
    - Protect all catch basins, maintenance holes and pipe ends from sediment intrusion with geotextile (Terrafix 270R).
    - Keep all sumps clean during construction.
    - Prevent wind-blown dust.
    - Straw bales to be used in localized areas as shown and as directed by the engineer during construction for works which are in or adjacent to floodlines, fill lines and hazardous slopes.
    - Straw bales to be terminated by rounding bales to contain and filter runoff.

- Obtain approval from applicable Conservation Authority prior to construction for works which are in, or adjacent to floodlines, fill lines and hazardous slopes.

- All silt fencing and details are at the minimum to be constructed in accordance with the Ministry of Natural Resources Guidelines on Erosion and Sediment Control for Urban Construction Sites.

- All of the above notes and any sediment & erosion control measures are at the minimum to be in accordance with the Ministry of Natural Resources Guidelines on Erosion and Sediment Control for Urban Construction Sites.

7.9 HYDRAULIC SEEDING

- Seed, fertilizer, and water shall be thoroughly mixed in the hydraulic seeder and mulcher into a homogeneous water slurry. When thoroughly mixed, the water slurry shall be applied to the prepared earth areas by the nozzle sprayer or extension hose.

- The Contractor shall ensure that the seeding equipment is properly calibrated to provide the proper seed coverage. The Contractor shall ensure there is a uniform dispersal of the mixed material over the entire area designated for seeding and that the spray does not dislodge soil or cause erosion.

- All cover materials shall be applied as a separate operation immediately following the application of seed and fertilizer.

- The Contractor shall ensure that the hydraulic seeder and mulcher is properly calibrated to provide the coverage as specified for each of the hydraulically applied cover materials.

- Approved Products: Flexterra HP-FGM™

- Comply with Manufacturers installation instructions and recommendations, using approved hydrospraying machines with a fan-type nozzle.

- For Erosion Control and Revegetation: To ensure proper application rates, measure and stake area. For maximum performance, apply HP-FGM™ in a two-step process:

    - Step One: Apply fertilizer with specified prescriptive agronomic formulations and 50% of seed with a small amount of HP-FGM™ for visual metering.

    - Step Two: Mix balance of seed and apply HP-FGM™ at a rate of 50 lb per 125 gallons (23 kg/475 liters) of water over freshly seeded surfaces. Confirm loading rates with equipment manufacturer. Do not leave seeded surfaces unprotected, especially if precipitation is imminent.

- Depending upon site conditions HP-FGM™ may be applied in a one-step process where all components may be mixed together in single tank loads. Consult with Manufacturer for further details.

8 TREE PLANTING

8.1 PREPARATION OF A PLANTING PLAN SUBMISSIONS

All developers will provide planting plans prepared and stamped by an Ontario Registered Professional Forester or a certified member of the Ontario Association of Landscape Architects. The planting plan must be included on a standard plan of subdivision drawing or a grading plan which illustrates lots dimensions (particularly frontages), as prepared by the consulting engineer. The plans will then be submitted to the municipality's plan reviewer for review, comment and final acceptance.

As with any Landscape Plan submission, the following components must be included on the planting plan submission:

- North Arrow and appropriate scale;
- Title Block including: drawing title, drawing number, key map, address of property, draft plan number, application number;
- Signed and Stamped by a Professional Landscape Architect or an Ontario Registered Professional Forester who is certified and licensed in the Province of Ontario;
- Property lines, adjacent streets, adjacent land uses, driveways, sidewalks and parking;
- Location of easements, daylight triangles, 0.3m reserves, land dedications;
- All utilities and services (eg. fire hydrants, streetlights, telephone poles, transformer vaults, guy wires, above ground service boxes, bell, cable tv, gas, hydro, sewer and watermain easements etc.)
- Any existing vegetation to remain;
- Design and location of streetscape elements (street trees should be shown at 75% of the mature canopy size),
- A detailed plant list showing key, numbers of plants, botanical and common names and plant size at installation date; and
- Dimensions between trees and hydro facilities. Note that setback dimensions have been outlined below to ensure long-term conflicts are minimized.

8.2 STREET TREE PLANTING DESIGN OBJECTIVES

When designing appropriate street tree planting plans, designers should consider site location, the physical and biological requirements of each tree, species diversity and the elements of design. Street trees are to be located on the public right-of-way and adhere to the design objectives, spacing and locations requirements of this document.

- One tree should be planted for each residential lot at a maximum interval of 10.0m on centre spacing.
- The planting plan should accommodate a tree planting scheme which is mirrored on both the sides of the street. A maximum of 5 of any one species or variety is to be

shown on one side of the street in a row. To provide a 'closed canopy effect', trees with a similar shape or form (e.g. vase, upright, oval) are to be selected and grouped.

- To ensure the health and vitality of street trees, ensure that sufficient soil volume and areas are provided. Quality soils capable of supporting tree growth should be used in all cases.

- Select plant material that is suitable for the space and context. As large canopied trees provide greater public benefit, these trees should be chosen over medium and small canopied trees assuming no conflicts exist.

- In cases of subdivision phasing, the planting plan should reflect the character of adjacent phases.

- User safety should be deemed a priority and ensure that visibility and accessibility are achieved.

8.3 STREET TREE SELECTION

It is important for the health of a tree that the microclimate, soils, sun, moisture, budget, maintenance environment and design intentions are met when planting. Therefore, the site conditions must be fully analyzed and understood prior to plant selection.

It should be recognized that not all listed species are suitable for all locations. Species should be carefully selected based on characteristics best suited for the environmental conditions of each site. Tree species should be selected from the approved list in Figure 8.2.

Consideration of the following should be given when selecting appropriate species:

- **VARIETY** - to avoid tree mono cultures, which are more susceptible to insect and disease problems, planting plans should provide a variety of tree species. No single species shall dominate the total street tree population and a maximum of 15% of each species shall be accepted. The following table illustrates a minimum percentage for tree species within a given number.

Total Number of Proposed Trees	**Maximum % of Any Tree Species**
10-19	50
20-39	40
40-59	30
60 +	15

- **STRESS** – consider tolerance of the species to site conditions such as compacted soil, diseases, drought, insects and road salt spray.

- **DISEASE** – consider the species potential for the spread of disease and subsequently tree mortality and costly removal. Large replacement programs also generate public

and political complaints. Such trees could potentially be Norway Maple (Verticillium wilt), American Elm (Dutch Elm Disease) and Austrian Pine (Diplodia tip Blight). To help combat the rapid spread, avoid mass planting of single species.

- **NATIVITY** - consider the suitability of trees indigenous to the region and context.

- **TIME** - consider the time of the year that are best for transplanting or moving particular species (e.g. Spring only for species such as Red Maple).

- **FRUIT** – consider the characteristics of fruit produced by some species (e.g. size, season) which may deem them less suitable for certain locations. Trees with large or messy fruit may be planted only in limited situations; trees with large thorns are not permitted. Coniferous needle-bearing trees or other species will not be planted on the right of way where they will cause sight line obstructions but may be considered if the location supports placement of this type of tree.

8.4 STREET TREE SPACING AND LOCATION REQUIREMENTS

These specifications are to serve as a standard for the planting of all Street Trees. All tree planting in the public right of way will be submitted for and landscape plans are to be accepted by the municipality's plan reviewer prior to installation.

- One tree should be planted for each residential lot at a maximum interval of 10.0m on centre spacing. Since large trees provide the most benefits, the largest tree that fits the space should be considered. Minimum tree spacing should be determined by mature canopy size.

- Trees should not be planted in areas where there inadequate space for healthy root growth. Trees should not be planted in spaces with less than 1.5 metre width, such as planting areas defined by two curbs, curb and fence, or sidewalk and fence.

- Trees should be centered in the boulevard planting strip, unless conflict with utilities exists. Where the sidewalk is curb-faced and no boulevard exists, the trees should be planted 1.0 metre behind the sidewalk and no more than 2.0 metres behind the sidewalk within the public right of way.

- At roadway intersections or vehicular access points, street trees should not be planted within the 18.0 metre sight triangle along the boundary of the intersecting roadway - measured from the point of intersecting curb lines, except where engineering standards indicate otherwise.

- Trees should be planted along the flankage of all lots outside the sight triangle using the same spacing interval required for frontages. A minimum of two trees should be planted at each corner lot, unless conflict with site features exists.

8.4.1 Lot Width Considerations

Refer to Figure 1 Below –

- Where the lot width is less than or equal to 9m (30 ft), plant one tree per lot selecting an ornamental or medium sized tree, depending on special constraints, from Figure 8.2 Approved Street Trees list. (Refer to Figure 1 below)
- Where lot width is between 9m (30ft) and 15M (50ft), plant one tree per lot selecting a large shade tree species from Figure 8.2 Approved Street Trees list. (Refer to Figure 1 below)
- Where lot width is 15M (50 ft) or larger, plant one tree per lot selecting a large shade tree from Figure 8.2 Approved Street Trees list. (Refer to Figure 1 below)

		Lot Width		
		<9.0 m. (<30')	9 - 15 m. (30 - 50')	> 15.0m. (> 50')
Boulevard Width	> 2.0 m. (.6 ft)	Ornamental or Medium Shade	Medium or Large Shade	Large Shade
	1.5-2.0 m. (4' - 6')	Ornamental or Medium Shade	Medium Shade	Medium Shade
	1.5 m. (<4')	**NO TREE**	**NO TREE**	**NO TREE**
No Sidewalk		Ornamental or Medium Shade	Medium Shade	Large Shade
Overhead Hydro Present		Ornamental	Ornamental	Ornamental

8.4.2 Site requirements

- Trees will not be planted in a direct line with a drainage swale between lots
- The minimum distance from the centre of a tree to the following infrastructure is:
    - Street Light Pole – no closer than 6.0 m. (20 ft) (anticipated mature canopy)
    - Fire Hydrant– no closer than 6.0 m. (20 ft)
    - Stop Sign or Traffic Signal – no closer than 15.0 m. (50 ft) and in accordance with sight triangle and mature canopy size
    - Hydro Pole - no closer than 3.0 m. (10 ft) (anticipated mature canopy)
    - Driveway, Lead Sidewalk going into a property – no closer than 2.0 m. (6 ft)
    - Hydro Transformer - no closer than 2.0 m. (6 ft)
    - Watermain – - no closer than 2.0 m. (6 ft)
    - Gas Main - no closer than 2.0 m. (6 ft)
    - Underground Services - no closer than 2.0 m. (6 ft)
    - Property Boundary - no closer than 1.0 m. (3 ft) (ownership conflicts)

- Utility and Telecom. Trench- - no closer than 1.0 m. (3 ft)

- Beneath high voltage overhead utility wires, only ornamental tree varieties shall be planted. Large and medium shade trees are suitable near single phase, street light cable and homeowner service cables. The tree leader should not be located directly beneath such wires.

- For cul-de-sac island and roundabout surfaces, trees and all any other landscape features are required on the planting plan. The planting of all trees, shrubs and perennials and installation of any other streetscape feature should take place simultaneously. If some planting is required before the majority (i.e. for model homes) the developer should be in contact with Municipality staff to discuss alternative arrangements prior to installation.

8.5 PLANTING STANDARDS AND SPECIFICATIONS

- Refer to Figure 8.1 Landscape Details Deciduous Tree Planting.

- Plant material shall conform to the most recent version of *Canadian Standards for* Nursery Stock. Plant material and shall be of standard quality, true to name and type, and first class representative of their species or variety.

- Plant material shall be nursery grown for at least two years under climatic conditions similar to the planting region. Proposed sources of nursery stock and origin of seed or cuttings used should be available upon request.

- Stock Type:

  - Street Tree Planting should be balled & burlapped, bare root or container grown and shall only be pruned to promote strong branching i.e. remove dead or poorly structured branches. Trees with multiple leaders, unless specified, will not be accepted nor will trees that have been clipped back or topped.

  - Root balls of balled and burlapped trees shall be wrapped with non-synthetic, untreated, biodegradable burlap around a solid standard sized ball and secured with similar rope or twine.

  - Root ball of container grown trees should be well established with a root system that has developed sufficiently to retain its shape when removed from the container. Plants shall not be pot bound, nor have kinked, circular or bent roots.

  - Root ball of bare root trees shall be healthy and well branched. Bare root trees should be dug and planted when dormant and the ground is not frozen.

- The minimum size of trees at time of planting shall have a caliper of 50mm DBH (diameter at breast height). . Larger sizes may be required to provide a landscape effect. In addition, the tree should be clear of branches to 1.5 metres and have a minimum of 6 scaffold branches.

8.6 GUARANTEE AND REPLACEMENT

All plant material is required to be guarantee for two (2) growing seasons from the date of provisional acceptance. The guarantee does not include vandalism, storm storage damage, animal damage or mechanical damage unrelated to the contractor's activities. All replacements shall be of the same kind and size as specified in the plant list. Replacement costs shall be borne by the party responsible for planting the tree (the name on the planting permit). After two growing seasons the plant material will be required to show active growth. Merely surviving will not be acceptable; a minimum of two inches of annual twig extension will be required.

9 Installation, Inspection of Sewer and Water Works

- The following addresses specifications and requirements to be met by the Owner or Contractor for the installation and construction of sewer and water works.

9.1 Approvals of Sewers and Watermains

- Prior to installation of sewers and watermains, the Owner must have obtained:

  - Final Approval from the Director, Public Works and Engineering,
  - Environmental Compliance Approvals from the Ontario Ministry of the Environment and Climate Change for all sewer work,
  - Form 1 Record of Watermains Authorized as a Future Alteration approved by the Director, Public Works and Engineering, and
  - the execution of all required agreements with the Municipality.

- Installation shall be in accordance with applicable OPSS and Municipality of Middlesex Centre Infrastructure Design Standards.

9.2 Inspection of Sewers & Watermains

- A Municipal Inspector shall, at all times, have access to the work. At least 24 hours before commencing installation, the Owner or Contractor shall apply to the Public Works and Engineering Department for inspection and the Engineer shall determine the extent of inspection required.

9.2.1 Owner's Supervision

- The provision of inspection by the Municipality is not to be considered a substitute for supervision by the Owner or Contractor.

- A Consultant's Inspector engaged by the Owner to inspect the sewer and watermain installation must have successfully completed the five day OGRA & MEA Inspector's Course called “Sewer and Watermain Construction Inspection (TM43)” or a consultant may obtain approval from the Engineer upon written request for use of Inspectors with a minimum of ten (10) years related construction experience in lieu of MEA/MOE Inspector's Course.

- The Owner or Contractor shall provide and leave a competent and reliable agent or foreman in charge for him and such person shall be considered as acting in his place and all notices, communications, instructions or orders given, sent or served upon such person shall be taken as served upon the Owner or Contractor.

9.2.2 Revisions to Plans

- Any changes required by the Owner to plans which have received final approval must be resubmitted to the Municipality for approval before the inspector will permit such changes to be made during installation.

9.2.3 Municipal Inspector's Authority

- A Municipal Inspector may stop the work entirely if there is not a sufficient quantity of suitable and approved material on the site to carry out the work properly, if approved drawings and Specifications are not on the site, or if material or workmanship that is contrary to the plans or Specifications is being used.

- If the Owner or Contractor covers or permits to be covered, work that has been designated for tests, inspections or approvals before such tests, inspections or approvals are made, given or completed, he shall, if so directed, uncover such work to have the inspections or tests satisfactorily completed and make good such work at his own expense.

9.2.4 Inspection Costs

- When an Owner or Contractor is required to have a Municipal Inspector on the job, they shall be charged at the prevailing rate plus a fleet charge. In the event the Municipal Inspector is required outside of normal working hours, the applicant shall be charged at current overtime rates.

9.2.5 Emergency Repairs to Sewer and Water Service by Municipality prior to Assumption

- Prior to assumption, where maintenance of water service to the consumer or consumers is required, or where, in the opinion of the Engineer or their representative, a faulty or damaged installation may cause inconvenience or further damage, the Municipality will act immediately to make safe the condition for consumers after which the owner will be contacted and advised of the problem and given the opportunity to immediately affect repair. If the owner chooses not to respond forthwith or cannot be contacted, immediate repairs will be undertaken by the Municipality. The cost of such repairs will be charged to the Owner. The decision of the Engineer or their representative will be final as to the necessity of repairs done or required and the amount expended for these repairs.

9.2.6 Inspection and Certifications

- In general, the Municipality will not undertake development inspections nor issue assumption certificates between October 15th and April 30th of that year once the Municipality's winter maintenance protocols have been established.

9.2.7 Storm and Wastewater Systems Testing

- The Contractor shall undertake a video inspection in compliance with O.P.S.S. 409 for all sewers installed. Video Inspections shall be submitted to the Municipality on a CD, in .mpeg or .mpg format, capable of being viewed with Windows Media Player.

- All sanitary and storm sewers that are PVC material within new subdivisions which are to be constructed are to be subject to an Infiltration Test, an Exfiltration Test or Low Pressure Air Test as determined by the Municipality and the Contractor based on the situation. Detailed results of the testing are to be provided to the Municipality. Where the sewers constructed are within new subdivisions, detailed testing results are to be provided to the Municipality for review and acceptance as part of the

Conditional Inspection process prior to receiving a Conditional Certificate of Approval.

10 TRENCHLESS TECHNOLOGIES (FOR NEW CONSTRUCTION)

10.1 APPLICATION

- Trenchless applications allow for the installation of the infrastructure with minimal disturbance of the surface area.

- The Design Engineer shall be qualified to design and oversee (certify) the specific types of technology being proposed.

10.2 GEOTECHNICAL BASELINE REPORT (GBR)

- A Geotechnical Baseline Report (GBR) is required when a Trenchless installation is being considered. The GBR will provide detail information related to the anticipated groundwater and soils conditions, including defining and assigning the various risks and liabilities to the Owner and/or the Contractor associated with the possible changes in ground conditions that may be encountered on the proposed alignment.

- The Design Engineer should provide necessary design parameters for the trenchless installation.

10.3 TRENCHLESS DESIGN REQUIREMENTS

10.3.1 Items to be Considered by the Design Engineer as Part of the Design Process

- As a minimum, the Design Engineer is to give due regard for designing the following elements of an appropriate Trenchless Installation:

i) Pipe design (casing and/or carrier pipe as applicable)
   a) Material, along with specific characteristics of this material
   b) Dimensional Ratio (pulling forces, live loads, dead loads – as applicable)
   c) Diameter
   d) Alignment
   e) Radius of Curvature (if applicable)
   f) Grade

ii) Adequate room for staging areas, pipe assembly, entry and exit portals (as appropriate)

iii) Blocking and grouting requirements (of carrier pipe within a casing pipe)

iv) Slurry/spoil disposal

v) Erosion/Sediment Control Measures

vi) Bore Geometry

vii) Annular Space Plug

viii) GBR Recommendations

ix) Define the need for Dewatering and/or Permit to Take Water (if applicable)

x) Timing as it relates to other activities, i.e. order of operations

xi) Prequalification of the contractor

10.3.2 Information to be Included on the Construction Servicing Drawings/Tender Documents

- This information is to be shown on the engineering drawings and/or form part of the Tender Documents:

  i) Pipe design (casing and/or carrier pipe)
     a) Diameter
     b) Alignment
     c) Grade (plus or minus if applicable and acceptable)

  ii) Adequate room for staging areas, pipe assembly, design of entry and exit portals

  iii) Erosion/Sediment Control Measures

  iv) GBR Recommendations

  v) Define the need for Dewatering and/or Permit to Take Water (if applicable)

10.3.3 Items to be Considered in the Contract Tender Documents

- Consideration should be given to addressing and/or including the following items as part of the contract tender:

  i) A tender item for a 911 emergency shaft

  ii) A tender item for “Frac Out” mitigation measures

  iii) Cutter head requirements

  iv) Over cut dimensions

  v) Swab run (depending on diameter and site specifics)

  vi) Bentonite lubrication

  vii) Machine launch & retrieval (groundwater impacts)

  viii) Annular space grouting

  ix) Settlement/heave

  x) Mitigation/contingency plans

  xi) Damaged Pipe

  xii) Tracking requirements

  xiii) Spoil/slurry disposal

  xiv) Methods of restraint against pull-back (as applicable)

  xv) Complete GBR

  xvi) Quality control (i.e. – videos, joint testing, etc. as appropriate for the technology being installed)

10.3.4 Record Drawing

- As part of the Record Drawing submission, at the conclusion of the project, the drawings are to be updated to show what was installed including:

  i) Identify method of installation

ii) Pipe design (casing and/or carrier pipe as applicable)

a) Material

b) Dimensional Ratio

c) Diameter

d) Alignment

e) Grade

iii) Blocking and grouting measures (as applicable)

iv) Location of staging areas, entry/exit portals – in case of settlement issues later