DEVELOPMENT REQUIREMENTS

SECTION 2 - DESIGN REQUIREMENTS

INDEX

2.0 INTRODUCTION

The purpose of this section is to outline the general design requirements for the construction of Municipal Services in the City of Mississauga. These requirements, however, are only general and do not relieve the Developer of the responsibility for submitting a finished product of competent Engineering design and construction.

For the approval of any deviation from minimum City Standards and requirements, such deviation(s) shall be specifically referred to by the applicant and/or his agent **with a copy of written approval of the City attached.**

2.01 STORM DRAINAGE

2.01.01 Storm Sewer Design

2.01.01.01 Run-off Calculations

Storm sewers shall be designed to drain all lands based on the Rational Method. The Rational Method calculations must be checked using a model approved by the Transportation and Works Department where the drainage area is greater than 10 hectares. The larger of the flows is to be used in the design of the sewer system.

$$Q = 0.0028\ C\ I\ A$$

where:
- Q = Flow in cubic metres per second
- A = Area in Hectares
- C = Run-off coefficient
- I = Intensity in mm/hr

Intensity of Rainfall: The intensity of rainfall is to be determined from the most recent City of Mississauga standard INTENSITY - DURATION - FREQUENCY RAINFALL CURVES. These curves were originally derived from rainfall data taken from the Pearson International Airport (City Standard Drawing No. 2111.010). The equations for these curves are as follows:

2 Year Storm $$I = \frac{610}{(T.C. + 4.6)^{0.78}}$$

5 Year Storm $$I = \frac{820}{(T.C. + 4.6)^{0.78}}$$

10 Year Storm $$I = \frac{1010}{(T.C. + 4.6)^{0.78}}$$

25 Year Storm $$I = \frac{1160}{(T.C. + 4.6)^{0.78}}$$

50 Year Storm $$I = \frac{1300}{(T.C. + 4.7)^{0.78}}$$

100 Year Storm $$I = \frac{1450}{(T.C. + 4.9)^{0.78}}$$

Time of Concentration: The minimum initial time of concentration is to be 15 minutes.

Pre-Development: To calculate the initial time of concentration (t_c) for upstream, undeveloped lands, the following formulae may be used: Bransby Williams, HYMO/OTTHYMO, SCS Upland Method, etc. The most appropriate method will be determined at the discretion of the Transportation and Works Department.

Post-Development: To calculate the initial external time of concentration (t_c) for external lands that are scheduled for future development, a straight line is to be drawn from the furthest point within the watershed to the proposed inlet. The top 50 metres shall have an initial t_c of 15 minutes and the remainder shall have a t_c as if the velocity in the sewer is $2ms^{-1}$. The summation of the two t_c's will give the future external time of concentration.
If the upstream area has adequate storm sewers, channels, or culverts, the velocity of the flow through these sewers, channels, or culverts shall supersede the $2ms^{-1}$ calculation.

Run-off Coefficient: Unless otherwise demonstrated, the runoff co-efficients noted below are to be used.

	Run-Off Coeff.
- Residential – single family, semi-detached	0.55
- Compact or dense housing (e.g. townhouses)	0.65
- High-rise residential	0.90
- Industrial and Commercial	0.90
- Neighbourhood Park	0.30
- Permeable Pavements	0.50
- Sodded Area	0.25
- All Other Surfaces	0.90

A minimum run-off coefficient of 0.55 is to be used for undeveloped upstream area external to the subdivision where future residential development is expected and 0.90, where future industrial or commercial development is expected.

In order to account for the increase in runoff due to saturation of the catchment surface that would occur for larger, less frequent storms, the adjustment factor below shall be used:

	Adjustment Factor.
- 10-year	1.0
- 25-year	1.1
- 50-year	1.2
- 100-year	1.25

Drainage Area: Drainage systems must be designed to accommodate all upstream drainage areas for interim and ultimate conditions, as determined by contour mapping and drainage plans.
Climate Change: Where storm sewers are being planned inclusive of a direct outlet to a receiving stream or watercourse, the City may consider an adjustment to the design flows (e.g. a +20% adjustment for IDF curves) to account for future climate change scenarios.

Hydraulic Grade Line: In infill scenarios the City may require a hydraulic grade line analysis (e.g. spreadsheet analysis based on sewer design). The purpose would be to demonstrate that existing properties and the subject development would not be impacted by any proposed changes.

2.01.01.02 Storm Sewer Requirements

Storm Sewer System

A storm sewer system shall be defined as the upper part of a drainage system draining areas less than 100 ha of land. Storm sewer systems shall be designed to accommodate a 10 year storm.

Trunk Sewer System

A trunk sewer system shall be defined as part of a drainage system that drains an area of 100 ha of land or greater. Trunk storm sewer systems shall be designed to accommodate a 25 year storm.

Pipe Capacities

Manning's formula shall be used in determining the capacity of all storm sewers. The capacity of the sewer shall be determined on the basis of the pipe flowing full.

The value of the roughness coefficient 'n' used in the Manning's formula shall be as follows:

-	Concrete Pipe	0.013
-	Concrete box culverts	0.013
-	Corrugated Metal 68 x 13mm corrugations	0.024
-	Corrugated Metal 25% paved invert	0.021
-	PVC Pipe	0.013

Design flow calculations must be completed on City of Mississauga forms shown on City Standard Drawing No.'s 2112.020 and 2112.030, for this purpose.

Flow Velocities (Flowing full)

For circular concrete pipes the:
Minimum acceptable velocity is 0.75 ms^{-1} and the
Maximum acceptable velocity is 4.0 ms^{-1}

Minimum Sizes

The minimum size for an on street storm sewer shall be 300mm.

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Depth of Storm Sewers:

Storm sewers shall be located a minimum of one (1) metre below basement floor elevations to allow for the installation of foundation and weeping tile connections.

Unless the Consultant is sure of the types of buildings to be incorporated along a street, it is suggested that storm sewers be placed with 3.2 metres of cover below the centre line of the road to ensure compliance with City requirements 2.01.01.050.

Location

The storm sewers shall be located as shown on the standard City of Mississauga road cross section drawings. This standard location is generally 1.5 metres south or west of the centre line of the right of way.

A minimum clearance of 500mm between the obvert of the sanitary sewer and the invert of the storm sewer must be provided if the sanitary sewer connections are required to go under the storm sewer.

Radius Pipes

Radius pipe shall be allowed for storm sewers 975mm in diameter and larger provided that a manhole is located at the beginning or at the end of the radial section. The minimum centre line radius allowable shall be in accordance with the minimum radii table as provided by the manufacturers

Limits of Construction

Sewers shall be terminated with a manhole at the subdivision limits when external drainage areas are considered in the design. The design of the terminal manholes must allow for the future extension of the sewer.

When external areas are not included in the sewer design, the sewer shall extend at least half way across the frontage and/or flankage of any lot or block in the subdivision.

Sewer Alignment

Storm sewers shall be laid in a straight line between manholes unless radius pipe has been designed. Joint burial (common trenching) with sanitary sewers will be considered when supported by the recommendations of a soils report prepared by a qualified Geotechnical Engineering Company.

Changes in Pipe Size

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

Standard Easement Requirements

The minimum width of easements for storm sewers shall be in accordance with the following guidelines:

Size of Pipe	Depth of Invert	Minimum Width of Easement
250 to 375mm	3.0 m maximum	3.0 m
450 to 675mm	3.0 m maximum	4.5 m
750 to 1500mm	3.0 m maximum	6.0 m
1650mm and up	4.0 m maximum	4.0 m plus 3 times O. D. of Pipe

Regardless of the above, all situations will be reviewed and judged on individual cases at the discretion of the Transportation and Works Department.

Pipe Classification and Bedding

The type and classification of storm sewer pipe and the sewer bedding type shall be clearly indicated on all profile drawings for each sewer length.

All storm sewer pipes shall conform to the requirements of the Canadian Standards Association.

The class of pipe and the type of bedding shall be selected to suit loading and proposed construction conditions. Details are illustrated in the City of Mississauga Standard Drawings 2112.040. In general, the Type "B" bedding (crushed stone base with granular over the sewer) shall be used for storm sewers in new developments, and the class of pipe will be selected to suit this bedding detail.

The use of City of Mississauga Standard No. 2112.110 “Sewer Bedding (6mm Washed Crushed Gravel)” is allowed on a per project basis. Approval in writing is required in advance before this material may be used.

The width of trench at the top of the pipe must be carefully controlled to ensure that the maximum trench width is not exceeded unless additional bedding or higher strength pipe is used.

Polyvinyl Chloride (PVC) Pipe

Manning's 'n' that will be used for the sizing of PVC pipes shall be 0.013. The Manning's 'n' that will be used to determine velocity and time of concentration is 0.009.

Pipe Manufacturer must be approved by the Transportation and Works Department.

Maximum allowable deflection of main line sewer is 5%. Deformation gauge (Pig) test may be required prior to acceptance.

Pipe shall meet the Canadian Standard Association requirement as noted within OPSS 1841. The basic material used in manufacturing of this pipe shall have a cell classification of 12454-B or 12454-C or ASTM Standard D-3034 and OPSS 1841.

Maximum PVC pipe size that will be allowed to be installed for the City of Mississauga shall be 450mm diameter. This maximum pipe size may increase based upon result of CSA test or CSA certification and City approval.

Bedding for all PVC pipes shall be in accordance with City Standard Drawing No. 2112.080, Detail A-A with the exception of material above the pipe, will be 19mm stone sewer bedding as well, not concrete. Sewer bedding shall conform with OPSS 1010 for Granular 'A' or City Standard Drawing No. 2112.110 or 2112.140 and sand cover shall conform with City Standard Drawing No. 2112.100. The compaction of all bedding and cover materials shall be a minimum of 95% Standard Proctor. Maximum cover shall be in accordance with OPSD 806.04 and 806.06. Special care must be given to contouring the bedding material to conform with the pipe bottom and projecting bells, along with proper compaction of the haunches in order to provide even support throughout the pipe. The use of any bedding material or backfill material with diameters larger than 4 cm will not be permitted around any flexible pipe. Backfill of all flexible pipes shall be in accordance with the manufacturers' specifications, City standards and OPSS 514.07.08.

Sewer service connection shall be in accordance with OPSD 1006.02.

Engineering Consultants are to provide the City with calculations and a certificate that an analysis has been completed, given:

a) The site conditions
b) Water table elevation
c) Trench width
d) Proposed bedding
e) Manufacturer H.D.B. rating identifying that pipe materials are stress rated

To ensure that all forms of flexible pipe failure have been addressed and that a factor of safety of 1.75 has been achieved. The typical types of pipe failure are as follows:

i) Wall thrust, i.e., buckling of walls at spring line
ii) Ring buckling - caused by hydrostatic pressures, normally identified as collapsing in the bottom quadrants of the pipe
iii) Joint failure
iv) Wall distress, i.e., strain cracking
v) Wall deformation
   a) Ring deflection, i.e., 5% elliptical deflection
   b) Irregular distortion normally identified as inverse curvature within the top of the pipe

2.01.01.03 Manhole Requirements

Manholes may be either precast or poured in place and shall be designed and constructed in accordance with the most recent Ontario Provincial Standard Drawings and Specifications.

Location and Spacing

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

Maximum spacing of manholes shall be 120m for sewers 600mm or less in diameter and 170m for sewers 675mm or greater in diameter.

Manhole Types

O.P.S.D. standard manhole details shall be used for manhole design. Although these standard drawings provide details for manholes up to certain maximum depths and sizes, the Consulting Engineer shall analyze, individually, each application of the standards related to soil conditions, loading and other pertinent factors to determine structural suitability. In all cases where the standard drawings are not applicable, the manholes shall be individually designed and detailed.

A reference shall be made on all profile drawings to the type and size of storm manholes.

Manhole Details

- Manhole chamber openings shall be located on the side of the manhole parallel to the flow for straight run manholes, or on the upstream side of the manhole at all junctions.

- The change in direction of flow in any manhole shall not be less than 90 degrees.

- Safety gratings shall be provided in all manholes when the depth of the manhole exceeds 5m. The maximum spacing between safety gratings shall not exceed 4.5m.

- The obverts on the upstream side of manholes shall not be lower than the obvert of the outlet pipe.

- Where the difference in elevation between the obvert of the inlet and outlet pipes exceed 1.2m, a drop pipe as indicated on City Standard Drawing No. 2113.010 shall be placed on the inlet pipe.

- Granular backfill material shall be placed to a minimum thickness of 300mm all around the manhole structure.

- Storm sewer manholes shall be benched to the obvert of the outlet pipe on a vertical projection from the spring line of the sewer.

- Manholes shall be located, wherever possible, a minimum of 1.5m away from the face of curb and/or any other service.

Head Losses and Drops

Suitable drops shall be provided across manholes to compensate for the loss in energy due to the change in flow velocity and for the difference in the depth of flow in the sewers.

In order to reduce the amount of drop required, the designer shall, wherever possible, restrict the change in velocity between the inlet and outlet pipes to 0.6 ms^{-1}.

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

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

The minimum drops across manholes shall be as follows:

Change of Direction	Minimum Drop (mm)
0^o	20
1^o to 45^o	50
46^o to 90^o	80

2.01.01.04 Catchbasin Requirements

Catchbasins may be either precast or poured in place and shall be designed and constructed in accordance with the most recent O.P.S.D. and O.P.S.S. requirements.

Location and Spacing

Catchbasins shall be selected, located and spaced in accordance with the conditions of design. The design of the catchbasin location and type shall take into consideration the lot areas, the lot grades, pavement widths, road grades and intersection locations.

The maximum area to be served by any catchbasin shall be 2000m^2 of paved area or 5000m^2 of sodded area.

Maximum spacing for catchbasins shall be as follows:

- Road grade @ 0.5% - 70m
- Road grade @ 0.5% to 3% - 90m
- Road grade greater than 3% - 70m

NOTE: For cul-de-sacs the distance is to be measured along the gutter.

Catchbasins shall be generally located upstream of sidewalk crossings at intersections and upstream of all pedestrian crossings. Catchbasins shall not be located in driveway curb depressions.

Catchbasins Types

Typical details for the single, double and rear lot type catchbasins are shown in the O.P.S.D. Standards.

Any special catchbasins and inlet structures proposed must be fully designed and detailed by the Consulting Engineer for approval by the Transportation and Works Department.

Double catchbasins are to be installed at the low point of any road as a minimum but the design should demonstrate sufficient protection to ensure the 100-year storm is contained within the municipal right-of-way.

Catchbasin Connection

For single catchbasins including rear lot catchbasins, the minimum size of connection shall be 250mm and the minimum grade shall be 1.0%.

For double catchbasins, the minimum size of connection shall be 300mm and the minimum grade shall be1.0%.

In general, catchbasins located in close proximity to a downstream manhole shall have their leads connected to the storm sewer. Long catchbasin connections (in excess of 20m) shall be connected to a manhole.

Rear lot catchbasin leads shall be installed as follows:

- Where the concrete pipe lead goes between houses, concrete encase the lead between the front building line and the rear building line.

- Where PVC pipe is used, concrete encase the entire line from the main sewer to the rear lot catchbasin.

Frame and Grate

The frame and cover for catchbasins shall be as detailed in the O.P.S.D. Standards. In general, the "bicycle proof" catchbasin grate shall be required for catchbasins located in roadway or walkway areas.

Catchbasins located within the travelled portion of a roadway, shall have the frame elevation wet flush with the surface of the future course asphalt. The adjustment and setting of the frame and cover shall be completed in accordance with the details provided in the O.P.S.D. Standards.

2.01.01.05 Roof Leaders, Foundation Drains and Storm Connections

Roof Leaders

All roof leaders must not be connected directly to the storm sewer system, and the following conditions must be complied with:

1) Roof leader down spout locations are to be indicated on site grading plans.

2) Roof leaders are to discharge onto concrete splash pads.

3) Split drainage lots are not permitted to discharge through adjacent lots which have back to front drainage. The roof leader must be located at the house corner closest to the catchbasin.

4) Houses located on corner lots have roof leaders(s) located at the corner(s) of the house, closest to the street lines.

5) The appropriate clauses for the conditions listed below are to be included in Schedule C of the Servicing Agreement, under Consulting Engineer.

   a)The Consultant is to certify, as part of the preliminary lot grading certificate, that the roof leader(s) are not connected directly to the storm sewer and are located in accordance with Transportation and Works Department standards.

   b) The Consultant is to certify as part of the final lot grading certificate, that the roof leader(s) have been installed in accordance with the preliminary lot grading certificate.

6) For further consideration on managing runoff volume on a site, please reference Section 2.01.03.02 – Stormwater Runoff Volume Reduction.

Foundation Drains

It is the Transportation and Works Department's policy to connect foundation drains by gravity to the storm sewer system provided that the elevation of the basement floor is at least 1.0 metre above the elevations of the storm sewer obvert at that point. If a gravity connection meeting the City's requirements is available it must be utilized.

Where the above provisions for gravity connection of foundation drains cannot be met, a sump pump system must be installed in the building and discharge to a location which is satisfactory to the Transportation and Works Department. The method of managing sump pump discharge is to be noted on all site/ grading plans. The Applicant shall acknowledge on the plans (i.e. provide a note) that the sump pump discharge will be managed within the site without a detrimental effect to adjoining lands including City ditches.

In cases of high ground water table where a sump pump could run continuously if a sump pump was implemented, the applicants should consider raising the basement elevation to be at least 1.0 metre above the elevation of the storm sewer obvert.

Storm Connections

Storm connections for foundation drains are to be sized in accordance with the following:

Sizes:

- Single family and semi-detached residential areas	- Minimum size 150mm diameter
- Multiple family residential block, commercial areas, and, industrial areas	- To be designed in accordance Section 2.01.01.02 - Min. size 300mm diameter

Joints and Bedding:

Joints and Bedding for connections are to be equivalent to joints and bedding as specified for storm sewer pipe.

Connections of Services to Main Sewer:

Double connections may be acceptable in residential areas where all other utilities can be accommodated and where the difference in the two connecting basement elevations does not exceed 600mm.

Manufacture of service tees at the main sewer shall be as follows:

- For storm main sewer pipe sizes 600 mm or smaller, pre-fabricated tees from the plant shall be utilized.

- For storm main sewer pipe sizes 675 mm to 900 mm, tees shall be manufactured in the field on top of the trench with the proper saddles and shall be inspected by the Consulting Engineer prior to installation.

- For storm main sewer pipe sizes 975 mm and larger, tees shall be manufactured in the trench with proper saddles.

In the cases above, the storm sewer shall be drilled or scribed at the plant rather than breaking through the pipe wall on site.

50mm x 50mm wooden markers placed from the invert of the service to 600mm above ground level shall be placed at the ends of each residential connection (at the street line).

The top 600mm of the markers are to be painted white.

Connection Application Requirements:

Application is to be accompanied with **four** folded site servicing drawings, or three if connection is existing.

The following are to be depicted on the site servicing drawings:

- Inverts of the connection at the street (property) line and at the main storm sewer system.
- The connection size, slope and class of pipe
- Information on the main storm sewer system (invert, obvert, size, slope and direction of flow).
- Municipal address, lot and registered plan number.
- A Key Plan
- A North Arrow
- Existing street services, sanitary, storm, water, manholes, etc. (obtainable from plan and profile drawings available in the Drafting section).
- A professional engineer must approve and stamp the design of the storm sewer connection.

If a subdivision has not been assumed by the City, the consulting engineer for the subdivision must certify the site servicing drawings.

Any basement elevation of a site **must** be one metre above the obvert of the adjacent municipal sewer system. If this criteria is not met, the installation of a sump pump will be required.

Connection invert at the street line **must** be equal to or above the obvert of the main sewer.

If the diameter of the connection exceeds one-half the diameter of the main sewer, then the connection must go into a new manhole or existing one if available and suitable to the City.

All storm connections are to be designed to City of Mississauga storm sewer standards.

2.01.02 Channel, Culvert and Overland Flow

For channel, culvert, bridge and/or erosion control projects the proponent is responsible for obtaining all necessary approvals from the governing agencies, such as the Conservation Authority, Ministry of Natural Resources and/or the Ministry of the Environment.

2.01.02.01 Culverts and Bridges

Road Classification	Design Flood Frequency
Arterial	1:100 Year to Regional
Collector	1:50 Year
Urban Local	1:50 Year
Rural Local	1:25 Year
Temporary Detour	1:10 Year
Driveway	1:10 Year

Driveway culverts must have a minimum size of 300mm with precast headwall.

Bridges and other major drainage structures shall require special designs as determined by the Transportation and Works Department. Hydraulic calculations will be required.

The frequency and magnitude of flooding or erosion should not be increased on upstream or downstream properties.

2.01.02.02 Outfall Channels

The proposed criteria for an open channel design shall be submitted to the Transportation and Works Department for approval prior to the actual design being undertaken.

Outfall channels shall be defined as major system overland flow channels, minor system outfall channels or natural channels.

Major system overland flow channel designs should accommodate the greater of the Regional storm or the 100 year storm for new development.

2.01.02.03 Watercourse Erosion and Bank Stability

Where erosion or bank instability is already evident in an area to be developed or re-developed, the City of Mississauga requires that the situation be stabilized by appropriate remedial and restoration measures. Where development will cause significantly increased downstream erosion, the City also requires the Developer to mitigate further damage by appropriate remedial measures.

Where designing remedial erosion or bank stabilization works, preservation of the watercourse dynamics and natural valley aesthetics must be secondary only to achieving a sound technical solution. Natural channel design principles and bio engineering should be used wherever feasible. A normal bank flow channel has a capacity of about the 1:2 year flood. Protection to this level will be adequate provided care is taken to prevent any damage by higher floods and provided that the channel bank is not coincident with a higher valley bank. In this latter case, it may be necessary to protect the bank to a level as high as the 1:100 year flood or even the flood resulting from the Regional Storm.

The proposed criteria for an erosion or bank stability design shall be submitted to the Transportation and Works Department for approval prior to the actual design being undertaken.

2.01.02.04 Overland Flow Routes

An overland flow route continuous to the nearest major channel must be established through all areas and shall be contained within either the road right-of-way or by easements. Positive major system overland flow is a paramount consideration to ensure a safe conveyance route is provided away from buildings.

The depths of flooding permitted on streets and at intersections during the 1:100 year storm are as follows:

- No building shall be inundated at the ground line, unless the building has been flood proofed.

- For all classes of roads, the product of depth of water (m) at the gutter times the velocity of flow (ms^{-1}) shall not exceed 0.65 m^2/s.

- For arterial roads, the depth of water shall not exceed the crown of the road.

Flow across road intersections shall not be permitted for minor storms (generally 1:10 year). To meet the criteria for major storm run-off, low points in roads must have adequate provision for the safe overland flow.

Analysis shall be submitted that demonstrates the above criteria have been met. Examples of this analysis include a spreadsheet style overland flow analysis such as that shown on City Standard Drawing No. 2112.031 or, in more complicated situations, a dual drainage modelling approach. Dependent on the condition of the downstream drainage system, the City may also require smaller developments to submit a dual drainage analysis. In any case, the analysis is to be fully documented, prepared and signed by a Professional Engineer.

2.01.02.05 Inlet/Outlet Structures

Inlet and outlet structures shall be fully designed on the engineering drawings. The details provided shall include the existing topography, proposed grading and the works necessary to protect against erosion.

Adequate structural means such as gabions, rip-rap or concrete shall be provided at all inlets to protect against erosion and to channel the flow to the inlet structure.

Gabions, river stone, rip-rap, concrete or other erosion protection shall be provided at all outlets to prevent erosion of the watercourse and to the area adjacent to the headwall. The extent of the erosion protection shall be indicated on the engineering drawings and shall be dependent upon the velocity of the flow in the storm sewer outlet, the soil conditions, the flow in the existing watercourse and site conditions.

The inlets and outlets must be protected to prevent unauthorized access and debris accumulation. In addition, backwater valves should be considered to prevent impacts of high-water levels impacting sewer function.

Outfall structures to existing channels or watercourses shall be designed to minimize potential erosion or damage in the vicinity of the outfall from maximum design flows.

The obvert of the outlet pipe is to be above the 25 year flood elevation of the receiving channel.

Where there is no servicing agreement in place or proposed, storm drains which outlet to a water course will have the following additional requirements.

- The Developer must enter into with the City "A Letter of Undertaking" for the works.
- Securities will be required for 100% of the storm connection works.
- The obvert of the storm sewer connection must be situated above the 25 year storm elevation of the creek.
- All basements and/or parking lot structures must be situated above the 100 year storm elevation for the creek.
- Plan and profile drawings must be submitted.

2.01.03 Stormwater Management Requirements

Stormwater management is required to control the changes in the pattern of runoff that occur after development to mitigate urban impacts to receiving watercourses. The measures adopted to achieve these requirements have advanced through the years. A development site that may have used a simple flow control device to meet quantity control requirements in the 1980's may now incorporate a number of measures such as enhanced grassed swales and infiltration galleries to meet runoff volume reduction requirements. An integrated design approach is now more prominent whereby engineers collaborate with landscape architects and other professionals from the onset. This collaboration makes it possible for small changes in site design to allow for larger benefits.

This evolution reflects the state of stormwater management and the importance of the treatment train approach where stormwater runoff is captured and treated at the source, in conveyance and at the end-of-pipe. The City's stormwater management requirements have also evolved in response to the changing industry standards as well as for consideration of other matters such as:

- Stormwater management criteria updates by the City's partner Conservation Authorities
- Coordination with the City's requirements outside of the Conservation Authority regulated areas
- Climate change and associated extreme weather events
- Infrastructure resiliency
- Ongoing maintenance considerations
- Introduction of the Stormwater Charge

In the context of development, these criteria are pertinent to provision of practices at the site level, in other words, at the source. The sub-sections that follow outline the City's stormwater management requirements which are summarized under the following elements:

- Stormwater Quality Control
- Stormwater Runoff Volume Reduction
- Stormwater Quantity Control
- Stormwater Management Reports

Applicants are advised that while these requirements are necessary for implementation at the site development stage, there is leverage for applications toward future credit on the stormwater charge that would be applicable to non-residential and multi-residential sites. In other words, the stormwater charge does acknowledge requirements on non-residential and multi-residential sites that are imposed by the City's development process.

The City will continue to review the stormwater management requirements in light of the above considerations on an ongoing basis. For clarifications on the requirements applicable to a particular site, call 311 to be directed to the Environmental Services Section with respect to stormwater management requirements.

2.01.03.01 Stormwater Quality Control

CONTEXT

The discussion of stormwater quality control in this section relates to the traditional definition which addresses total suspended solids removal. Urban runoff carries surficial sediments and debris into receiving streams and watercourses which degrades water quality and impacts aquatic habitat conditions. In addition, metals and other pollutants adhere to particulate matter found in the stormwater runoff column which further degrades water quality. The importance of stormwater runoff quality in Mississauga is underscored by the fact that it quickly finds its way to Lake Ontario which is the source of our drinking water.

REQUIREMENT

Stormwater quality control is to be implemented in accordance with the applicable Master Drainage Plan or Subwatershed Plan, the City's Stormwater Quality Control Strategy prepared by R.E Winter dated January 1996 and MOECC's Stormwater Management Practices Planning and Design Manual. However, if a site could involve potential spills (e.g. gas bars, fuelling stations) then an on-site device shall be provided for spill control.

CONSIDERATIONS

The City encourages the applicant to ensure the site's tenant or property manager is aware of any stormwater quality control measures installed on-site and ideally are provided with a maintenance document outlining the protocols for upkeep.

2.01.03.02 Stormwater Runoff Volume Reduction

CONTEXT

Stormwater runoff from developed sites impacts streams and watercourses by introducing erosive forces during frequent storms. In addition, the alteration of the hydrologic regime from raw land reduces the amount of water that would naturally evaporate, transpire or infiltrate essentially generating more runoff volume. These impacts are the target of the requirement outlined within this section with the goal being to reduce stormwater runoff volume from developing sites. Practices implemented to address this criterion may assist in mitigating erosion and water balance to address Conservation Authority requirements.

REQUIREMENT

The first 5mm of runoff shall be retained on-site and managed by way of infiltration, evapotranspiration or re-use. This is a minimum requirement whereas applicable Master Drainage Plans or Subwatershed Plans may carry a higher minimum requirement. Methods to achieve this can include measures such as permeable pavements, infiltration systems, rainwater harvesting tanks, bioretention systems or green roofs.

The exemption to this requirement is for individual single-family dwellings although even in this case the applicants are encouraged to do best efforts to reduce stormwater runoff from their lands. Recognizing that the City requires roof leader downspouts to be disconnected, other measures that can be implemented include:

- Incorporation of rain barrels at the roof leader downspouts or rain gardens to absorb flows
- Use of infiltration galleries, if soil conditions are conducive, located on the property considering Ontario Building Code requirements
- Incorporation of permeable materials within the driveway where permitted by applicable zoning by-law
- Increase of topsoil depth around the property to 300mm to allow for greater absorption

CONSIDERATIONS

LONG TERM OPERATION

To re-iterate the introductory statement relating to the stormwater charge, it is noted here that the credit process considers requirements on the site that are imposed by the City's development process. However the category of runoff volume reduction allows for credit even greater than 5mm. In other words, despite the City's requirement for 5mm the applicant may wish to look at opportunities for designing in larger on-site retention volumes as there is potential financial benefit in the longer-term life cycle for the site tenant or property manager.

DESIGN

When considering the engineering design of the site to meet the runoff volume reduction requirements, the applicant will consider the following:

- Fundamental drainage principles continue to apply so "self-containing" site drainage is still required to meet standard City grading and drainage requirements. Within the site itself, the conventional drainage system may be adjusted to integrate the low impact development measures utilized to meet the runoff volume reduction requirement so there remains the potential for infrastructure reduction dependent on the site grading and configuration

- The need for cost-effective back-ups should be included to ensure failure of the system would not create a drainage concern. A notable example would be an overflow pipe in a bottomless infiltration catchbasin or simply a safe overland flow route in case of blockage

- The City endorses the Low Impact Development Stormwater Management Planning and Design Guide (CVC & TRCA, 2010) as a design guidance document and would encourage its use by applicants in keeping with the commentary provided here

- While rain gardens are encouraged, particularly as noted above for individual residential properties, the City discourages draining large impervious surfaces (e.g. parking lot from commercial property) to any measure that promotes surficial ponding immediately adjacent to residential dwellings. In this instance, infiltration and other systems should be considered as an alternative

APPROVAL PROCESS & "VOLUMETRIC" CREDIT POTENTIAL

- Surficial works (e.g. "soft" treatments such as ground cover, shrubs, plants, etc.) on any low impact development measure on private lands are subject to the approval of Planning and Building – Development & Design. "Hard" elements of proposed low impact development measures (e.g. piping, soil medium, gravel/granular, etc.) are approved by Transportation & Works – Environmental Services. The City circulates submissions internally in order that the appropriate parties provide comment.

- Securities are typically informed through the provision of an estimate by the applicant and taken by the City to ensure measures are suitably installed. "Soft" treatments would be secured by Planning & Building. "Hard" elements relating to low impact development measures would be taken by Transportation & Works as part of a grading deposit. Certification is required upon request for release of securities.

An integrated design approach involving multiple disciplines (e.g. civil engineer & landscape architect) is considered beneficial to facilitating design decisions from the onset of a project which could allow stormwater management criteria to be more easily met. With respect to optimizing the infrastructure if site grading and configuration allow, there may be the potential to replicate the stormwater quantity control storage typically provided by way of "superpipes" within the low impact development measures. If this is the case, the City would consider a "volumetric" credit if:

- Engineering design demonstrates technical adequacy and sufficient storage such that pipe or surface storage are redundant, and;

- A stormwater charge credit application is submitted which obliges the site tenant or property manager to maintain the infrastructure and also allows the City ability to inspect and enforce should there be any concerns particularly since the credit discussed here links back to flood resiliency.

2.01.03.03 Storm Water Quantity Control

CONTEXT

Flooding that occurs through the storm drainage network, whether it be through a surcharged storm sewer or excess of flows backing up a creek, can cause impacts to large areas of public and private property. In order to help mitigate this and reduce the chance this may occur the City imposes stormwater quantity control requirements, which echo the Conservation Authority flood control requirements in many cases, to reduce stormwater peak flow runoff from developing sites.

REQUIREMENT

The stormwater quantity control requirement varies depending upon the watershed. A list of all pertinent watersheds within Mississauga and corresponding requirement is found below in **Table 2.01.03** and an illustration of the watershed boundaries is found within **Appendix A-1**. These requirements account for the most recent updates adopted by the Toronto Region Conservation Authority (TRCA) and Credit Valley Conservation (CVC).

CONSIDERATIONS

The following points are to be considered in conjunction with the quantity control requirement:

- In all cases, the storm sewer capacity constraints or downstream concerns may govern. In some instances the City may request analysis of the downstream sewer capacity to verify any constraints for quantity control
- Where “pre-development” is listed as part of the requirement, it is implied as raw land for which the run-off co-efficient is equal to 0.25 but will not exceed 0.50 for a site that may already be developed
- The “unit rates” prescribed to calculate pre-development flows for the pertinent branches of Etobicoke Creek are excerpted in **Table 2.01.04** from TRCA’s Hydrology Study:Etobicoke Creek Hydrology Update (MMM Group, 2013)
- Runoff coefficients utilized for the development shall be justified based on impervious cover (as noted earlier in the Storm Drainage section 2.01.01.01)

In undertaking the engineering design of the site to meet the stormwater quantity control requirement, the applicant will consider the following:

- The modified rational method, or equivalent, is to be used for the analysis
- A control device (orifice) must have a diameter of no less than 75mm in order to prevent clogging of the opening and shall preferably be an orifice tube or pipe
- Ponding limits and available storage are to be depicted on the engineering drawings, and the maximum ponding depth in parking areas is not to exceed 250mm
- An overland flow route shall be clearly marked and the grading of parking lots and landscaped areas must provide a safe overland flow path to the surrounding municipal right of way during storms exceeding the design storm event

FOR INSTITUTIONAL/COMMERCIAL/INDUSTRIAL SITES

- Flow control devices shall be installed on the upstream side of the manhole
- Storm connections from the building roof and foundation drains must be made downstream of the manhole and/or catchbasin inlet controls
- Roof drains should be selected to give a maximum discharge of 42 lps/ha of roof area.

TABLE 2.01.03.03a: STORMWATER QUANTITY CONTROL REQUIREMENTS

Note 1: In all cases, storm sewer capacity constraints or downstream concerns may govern

Note 2: Where "pre-development" is listed as part of the requirement, it is implied as raw land for which the run-off co-efficient=0.25 but will not exceed 0.50 for a site that may already be developed

Note 3: CVC-Credit Valley Conservation, TRCA-Toronto Region Conservation Authority, CH-Conservation Halton

Subwatershed Name (Conservation Authority)	Quantity Control Criteria	References & Notes
Applewood Creek (CVC)	100 Year Post to 2 Year Pre-development Control	-
Avonhead Creek (CVC)	100 Year Post to 2 Year Pre-development Control	Southdown District Master Drainage Plan (Totten Sims Hubicki, 2000)
Birchwood Creek (CVC)	100 Year Post to 2 Year Pre-development Control	-
Carolyn Creek (CVC)	Provide post to pre control for all storms (i.e. 2,5,10,25,50 & 100 year)	Master Drainage Study (Winter Associates, 1987)
Cawthra Creek (CVC)	100 Year Post to 2 Year Pre-development Control	Drainage diversion to Cooksville Creek and a very small area draining to creek.
Chappell Creek (CVC)	10 Year Post to 2 Year Pre-development Control	-
Clearview Creek (CVC)	100 Year Post to 2 Year Pre-development Control	Southdown District Master Drainage Plan (Totten Sims Hubicki, 2000)
Cooksville Creek (CVC)	100 Year Post to 2 Year Pre-development Control	Revised development standards via Mississauga Staff report to City Council
Credit River - Norval to Port Credit (CVC)	No control required	Subwatershed Study in progress (partially complete)
Cumberland Creek (CVC)	No control required	-
Etobicoke Creek - Main Branch & Lower Etobicoke (TRCA)	No control required in the City of Mississauga	Hydrologic Model: VISUAL OTTHYMO-Return period peak flows based on the AES - 12 hour design storm Hydrology Study:Etobicoke Creek Hydrology Update (MMM Group, 2013)

TABLE 2.01.03.03b: STORMWATER QUANTITY CONTROL REQUIREMENTS

Note 1: In all cases, the storm sewer capacity constraints may govern

Note 2: Where "pre-development" is listed as part of the requirement, it is implied as raw land for which the run-off co-efficient=0.25 but will not exceed 0.50 for a site that may already be developed

Note 3: CVC-Credit Valley Conservation, TRCA-Toronto Region Conservation Authority, CH-Conservation Halton

Subwatershed Name (Conservation Authority)	Quantity Control Criteria	References & Notes
Etobicoke Creek - West Branch (TRCA)	Provide post to pre control for all storms (i.e. 2,5,10,25,50 & 100 year) using unit rates	Hydrologic Model: VISUAL OTTHYMO-Return period peak flows based on the AES - 12 hour design storm Hydrology Study:Etobicoke Creek Hydrology Update (MMM Group, 2013)
Fletcher's Creek (CVC)	No control required in the City of Mississauga	Fletchers Creek Subwatershed Study Report (Paragon Engineering Limited, 1996) Subwatershed Management Strategy and Implementation Plan (AMEC Earth & Environmental, 2012)
Joshua Creek (CH)	100 Year Post to 2 Year Pre-development Control	Commentary from Conservation Halton in lieu of 1992 Watershed Plan
Kenollie Creek (CVC)	10 Year Post to 2 Year Pre-development Control	-
Lakeside Creek (CVC)	100 Year Post to 2 Year Pre-development Control	Southdown District Master Drainage Plan (Totten Sims Hubicki, 2000)
Levi Creek (CVC)	Provide post to pre control for all storms (i.e. 2,5,10,25,50 & 100 year) & Regional Storm	Hydrologic Model: GAWSER Model-Return period peak flows based on 24 hour SCS Type II distribution Gateway West Subwatershed Study (Gartner Lee Limited & Cosburn Patterson Mather, 1999) Gateway West Subwatershed Study Update by Kidd Consulting (Update in Progress)
Little Etobicoke Creek (TRCA)	Provide post to pre control for all storms (i.e. 2,5,10,25,50 & 100 year) using unit rates	Hydrologic Model: VISUAL OTTHYMO-Return period peak flows based on the AES - 12 hour design storm Hydrology Study:Etobicoke Creek Hydrology Update (MMM Group, 2013)
Lornewood Creek (CVC)	100 Year Post to 2 Year Pre-development Control	-

TABLE 2.01.03.03c: STORMWATER QUANTITY CONTROL REQUIREMENTS

Note 1: In all cases, the storm sewer capacity constraints may govern

Note 2: Where "pre-development" is listed as part of the requirement, it is implied as raw land for which the run-off co-efficient=0.25 but will not exceed 0.50 for a site that may already be developed

Note 3: CVC-Credit Valley Conservation, TRCA-Toronto Region Conservation Authority, CH-Conservation Halton

Subwatershed Name (Conservation Authority)	Quantity Control Criteria	References & Notes
Loyalist Creek (CVC)	East of Winston Churchill Blvd - Provide post to pre control for only 10 year design storm	Loyalist Creek Watershed Study (CBCL Limited, 1980)
	West of Winston Churchill Blvd - Provide post to pre control for all storms (i.e. 2,5,10,25,50 & 100 year)	Erin Mills West Loyalist Creek Drainage Report (Proctor & Redfern Group, 1985)
Mary Fix Creek (CVC)	10 Year Post to 2 Year Pre-development Control	-
Mimico Creek (TRCA)	Provide post to pre control for all storms (i.e. 2,5,10,25,50 & 100 year)	Hydrologic Model: VISUAL OTTHYMO-Return period peak flows based on the AES - 12 hour design storm Hydrology Study:Mimico Hydrology Update (Marshall Macklin Monaghan, 2009)
Moore Creek (CVC)	No control required	-
Mullet Creek (CVC)	Provide post to pre control for all storms (i.e. 2,5,10,25,50 & 100 year) & Regional storm	Hydrologic Model: GAWSER Model-Return period peak flows based on 24 hour SCS Type II distribution
	Consider storm sewer constraints outlined in Streetsville Area Drainage Study (Dillon, 1994)	Gateway West Subwatershed Study (Gartner Lee Limited & Cosburn Patterson Mather, 1999)
	□	Gateway West Subwatershed Study Update by Kidd Consulting (Update in Progress)
Sawmill Creek (CVC)	Provide post to pre control for all storms (i.e. 2,5,10,25,50 & 100 year)	Hydrologic Model: GAWSER Model-Return period peak flows based on 24 hour SCS Type II distribution Sawmill Creek Subwatershed Study (Proctor & Redfern Limited, 1993)
Serson Creek (CVC)	100 Year Post to 2 Year Pre-development Control	Large number of buildings (> 150) in the regulated flood plain

TABLE 2.01.03.03d: STORMWATER QUANTITY CONTROL REQUIREMENTS

Note 1: In all cases, the storm sewer capacity constraints may govern

Note 2: Where "pre-development" is listed as part of the requirement, it is implied as raw land for which the run-off co-efficient=0.25 but will not exceed 0.50 for a site that may already be developed

Note 3: CVC-Credit Valley Conservation, TRCA-Toronto Region Conservation Authority, CH-Conservation Halton

Subwatershed Name (Conservation Authority)	Quantity Control Criteria	References & Notes
Sheridan Creek (CVC)	100 Year Post to 2 Year Pre-development Control	-
Sixteen Mile Creek (CH)	East of Ninth Line, north of CN Rail (North 16 District) – Flows draining to a North 16 District stormwater quality/erosion control facility (Ponds Q1 & Q2) are to be controlled on-site to 75 l/s/ha for the 5-year storm event East of Ninth Line, north of CN Rail (North 16 District north-west quadrant) – Flows draining to Ponds Q3a & Q3b are required to provide storage for 25mm and 2-year storms at 300m^3/imp.ha and 380m^3/imp.ha, respectively, as well as release rates of 1.5L/s/imp.ha for the 25mm storm and 5L/s/imp.ha for the 2-year storm	North 16 District Scoped Subwatershed Study and Ninth Line District Floodplain Mapping (Philips, 2004); recommended Scenario 2B (Recommendation (v) on page 50) Master Servicing Study for the Mississauga Fire and Emergency Services Training Centre (Sernas, 2008) Detailed Design – Sanitary, Water & Storm Services, Mississauga Fire and Emergency Services Training Centre (Sernas, 2009); recommendations in Section 4.2 (page 13)
	East of Ninth Line between CN Rail and Britannia (Lisgar and surrounding area) - Provide post to pre flow control for all storms (i.e. 2,5,10,25,50 & 100 year) and volume control to pre-development conditions. No connections to FDC permitted.	-
	East of Ninth Line, south of Britannia Road (Churchill Meadows) - No connections to FDC permitted. No controls otherwise	Stormwater Management Design Report – Churchill Meadows Stormwater Management Facilities – Sixteen Mile Creek Watershed (RAND Engineering, 1997)
	West of Ninth Line - to be established through Ninth Line Lands-East Branch Subwatershed Study (ongoing)	-
Spring Creek (TRCA)	Provide post to pre control for all storms (i.e. 2,5,10,25,50 & 100 year) using unit rates	Hydrologic Model: VISUAL OTTHYMO-Return period peak flows based on the AES - 12 hour design storm Hydrology Study:Etobicoke Creek Hydrology Update (MMM Group, 2013)
Stavebank Creek (CVC)	10 Year Post to 2 Year Pre-development Control	-
Tecumseh Creek (CVC)	100 Year Post to 2 Year Pre-development Control	-
Turtle Creek (CVC)	10 Year Post to 2 Year Pre-development Control	-
Wolfedale Creek (CVC)	10-year post to 2-year pre	-

TABLE 2.01.03.03e: ETOBICOKE CREEK UNIT FLOWS

Subwatershed Name	Unit Flow Rates ($m^3/s/ha$)					
	2-year	5-year	10-year	25-year	50-year	100-year
Etobicoke Creek – West Branch	0.03241	0.04412	0.05220	0.06250	0.07021	0.07799
Spring Creek	0.03168	0.04318	0.05114	0.06135	0.06903	0.07679
Little Etobicoke Creek	0.03575	0.04746	0.05546	0.06559	0.07315	0.08075

2.01.03.04 Stormwater Management Reports

CONTEXT
The stormwater management report accompanying the submission may be provided as a letter brief, but must be stamped and signed by a licensed Professional Engineer. The engineering drawings that accompany the report must similarly be stamped and signed by a licensed Professional Engineer.

REQUIREMENT
The report itself should, at a minimum, document the following:

- Description and illustration of existing and proposed conditions including a figure showing drainage areas, existing storm drainage infrastructure and justification for the proposed runoff coefficient values being utilized
- Summarize the City's stormwater management requirements
- Provide a section outlining how each requirement has been met
- For Stormwater Runoff Volume Reduction: describe the measure(s) being proposed to meet the requirement and include supporting calculations and documentation
- For Stormwater Quantity Control: specify what criteria governs (e.g. storm sewer constraints or stormwater quantity control requirements), document the required stormwater storage and compare to the storage provided
- Describe how external flows will be accommodated, if applicable
- Hydraulic Grade Line and Overland Flow analyses
- Include or reference the engineering plans that depict the proposed measures

CONSIDERATIONS
When required, hydrologic studies shall employ an appropriate modelling technique with defensible parameter values. The study shall describe the modelling parameters and the criteria for their selection as well as input and output data. The consultant is to assume full responsibility for the proper application of the hydrologic models. The City recommends that the Consultant follow the **M.T.O. Drainage Management Technical Guidelines.**

In general, the SCS design storms should be used for determining the hydrographs for undeveloped watersheds and for checking detention storages required for quantity control. The Chicago design storms should be used for determining hydrographs in urban areas and also for checking detention storage. In many cases, the consultant will be required to run both sets of design storms to make sure that the more stringent is used for each individual element of the drainage system. The time step for discretization of the design storm can vary according to the size of the sub-watershed, but must not exceed the estimated time of concentration. To aim for consistency, ideally the models used in site design would be the same platform and use the same storm distribution as the watershed model.

In detailed design of storage structures, the operation must be checked for spring flood conditions due to combined snowmelt and rain. Wet ponds are to be checked for evaporative losses. Temperature data is to be submitted with these calculations. Operation of storage facilities must also be checked in order to verify that a sequence of storms is not more critical than a design storm.

2.02 ROADWAYS

2.02.01 Geometric Design

2.02.01.01 Roadways

Roadway geometric design will be in accordance with the City of Mississauga Geometric Design Standards as outlined on City Standard Drawing. Road widths and Right-of-Ways will be in accordance with the most recent City of Mississauga Standards:

2211.060 Minor Local Residential Road (8.0m pavement on 17m road allowance)
2211.070 Local Residential Road (new subdivisions) (8.0m pavement on 20m road allowance)
2211.080 Minor Residential Collector Road (10m road on 22m road allowance)
2211.090 Local Industrial Road (12.5m road on 24m road allowance)
2211.100 Industrial and Residential Collector Road (14.5m road on 26m road allowance)
2211.110 Minor Arterial Road (15.5m road on 30m road allowance)
2211.120 4 Lane Divided Arterial Road (2-8m lanes, 7.0m island on 35m road allowance)
2211.130 6 Lane Arterial Road (23m road on 35m road allowance)
2211.140 Buffer Road (8.0m road on 17m road allowance)
2211.150 5 Lane Residential Collector Road (17m road on 30m road allowance)
2211.151 Local Residential Road (Pavement offset, 8.0m road on 18m road allowance)
2211.152 Local Residential Road (Pavement offset, 8.0m road on 20m road allowance)
2211.153 City Centre Specific (14.5m road on 25m road allowance)

NOTE: Any development proposal that has non-standard widths or cross-sections should be referred to a P.U.C.C. meeting prior to a first engineering submission being made.

2.02.01.02 Driveway Entrances

Driveway entrances and curb cuts shall be in accordance with the most recent standard drawings for this purpose.

Special designs, dependent upon the expected usage, will be required for commercial and industrial driveways.

All new residential driveways must be paved with 50mm OPSS 1150 HL8 and topped with 25mm OPSS 1150 HL3F from curb to garage on a base of a minimum of 150mm Granular 'A' or 19mm crusher run limestone meeting the requirements of OPSS 1010.

Paving of the driveway is to be undertaken in two separate phases. Phase 1 being the grading of the granular, and the placing of 50mm of HL8 is to be completed at the time of sodding the lot. Phase 2, being the placing of the 25mm HL3F, which will be completed at the time of top course asphalt pavement on the roadway.

The grade of asphalt cement in residential and industrial driveways is to be PG 64-28.

Boulevard driveway slopes should not exceed 8% and should not be less than 2%. Widths of curb depressions for driveways are to be in accordance with the following.

- semi-detached and townhouses 3.8m (12.5 ft)
- detached dwellings under 12m (40 ft) frontage 5m (16.4 ft)
- detached dwellings over 12m (40 ft) frontage 6.5m (21.3 ft)

A minimum 0.6m separation at the curb shall be provided between driveways within cul-de-sacs and elbows along with corner lots and lots abutting walkways. Driveways are to be indicated on the above ground general plan.

The minimum clear distance between the edge of driveway and a utility structure or hydrant shall be 1.2m.

All new industrial driveways shall consist of a minimum of 40mm HL-3, 85mm HL-8 and 350mm of OPSS 1010 Granular 'A'.

For industrial commercial driveways, specific designs based on anticipated loads are required.

2.02.01.03 Special Designs

Special road designs, which are not covered by City of Mississauga Standards, shall be in accordance with the most recent provisions of the geometric design standards manual and urban street geometrics, as adopted by the Municipal Engineers Association.

i.e. Special Design will be required in high density residential, commercial and industrial areas.

Pavement design shall be in accordance with the most recent City of Mississauga Standards and the Ontario Provincial Standard Drawings and Specifications.

Complete mechanical analyses of the proposed sub-grade are to be taken at maximum intervals of 150m along proposed roads. On small sites, a minimum of two mechanical analyses will be required.

2.02.02 Pavement Design (Roadways)

A soil analysis must be conducted by a licensed Geo-technical Engineering firm that is acceptable to the City of Mississauga. Copies of the soil analysis, along with proposed road designs, shall be submitted to the City Transportation and Works Department.

Minimum thicknesses of asphalt and granular materials shall be as indicated on City Standard Drawing No. 2220.010.

The Granular “B” Type 1, shall have a maximum of 65% passing the 4.75mm sieve.

In all cases:

- Base course asphalt shall be O.P.S.S 1150 H.L.8 on residential roads and heavy duty binder course (HDBC) in accordance to OPSS 1150 and/or 1154 for industrial and arterial roads.

- The wearing course of asphalt shall be:

  - For Local Roads
Collector Roads
Industrial Roads O.P.S.S. 1150 H.L.3
  - For Arterial Roads O.P.S.S. 1150 H.L.I

- Asphalt job mix designs, approved by the developer’s Geo-technical consultant, shall be submitted to the City of Mississauga for review a minimum of 5 working days prior to the commencement of paving for review.

- The asphalt mix designs shall have a minimum asphalt cement content of 5.00% for H.L-8 asphalt, and 5.3% for H.L-3 asphalt

- The grade of asphalt cement for HL-8 and HL-3 asphalt on residential roads shall be PG 58-28. HL-8 asphalt may contain up to a maximum of 20% RAP. However mixes containing more than 20% RAP, will have PG 58-34 asphalt cement. No RAP is allowed in any Heavy Duty Binder Course (HDBC) or surface course asphalt mixes. The average A/C content of all tests must be no lower than the A/C content specified in the SMF.

- The grade of asphalt cement for industrial and arterial road mixes shall be PG 64-28

- O.P.S.S.1010 Granular "A" and Granular "B" materials are to be used for road construction in the City of Mississauga. The granular materials must not contain any crushed concrete or recycled asphalt pavement.

- Base asphalt thickness may be reduced by the developer if the requirements of Standard 2220.010 “Pavement and Road Base Design Requirements” are satisfied.

- The depth of Granular ‘B’ as indicated is applicable to situations where subgrade material and all trench backfill material had been placed and compacted as per OPSS and the water content is within 2% of optimum moisture content. Where the moisture content is above 2% of optimum, crusher run limestone shall be utilized in lieu of granular ‘A’ and ‘B’. However, if the water content is greater than 7.5% above optimum moisture content, road construction shall be deferred.

2.02.02.01 Placement of Top Course Asphalt within Subdivisions

Complete all sidewalk works.

Complete all curb works.

Complete all boulevard works.

Complete top course asphalt driveway paving.

Raise manhole frame and grates as well as catchbasin frame and grates and paint rims with orange flourescent paint to make them visible to drivers. Warning signs are to be placed at all access points to the subdivisions indicating that there are raised manholes and catchbasin frame covers ahead. Placement of top course asphalt shall be completed within two weeks of raising the frames and grates.

Flush and sweep surface prior to evenly applying tack coat.

2.02.03 Curbs and Gutters

All new streets shall have curb and gutter construction.

Curb and gutter is to be designed and constructed to the most recent City Standards and Ontario Provincial Standards.

Curb depressions are required at each intersection or pedestrian road crossing.

A driveway entrance is required for each lot as detailed within Section 2.02.01.02.

A minimum of 150mm of OPSS 1010 granular material compacted to 98% Standard Proctor Density will be required as a base for all types of curb installations.

Two-stage curb installation must be in accordance with City standard 2230.010

Minimum grade on curb is 0.75% on cul-de-sac bulbs and outside road elbows.

Concrete Specification

The concrete sidewalk shall be constructed according to OPSS 353, 904 & 1350. The concrete shall meet the most stringent requirements of OPSS or the contract documents. The concrete shall meet the requirements of the most current OPSS 1350, be a C-2 mix (32 MPA, 5 – 8% air content), as described in the most current CSA 23.1.

The expansion joints shall be constructed at locations described within the OPSS. Expansion joints shall be constructed where-ever the newly poured concrete meets a rigid object such as previously poured concrete, street poles, retaining walls, etc. The expansion material shall extend the full depth of the concrete.

The concrete shall be cured as per OPSS 904. The rate of application of the curing compound shall be as per the manufactures recommendation or at a minimum rate of 0.2 l/m² if not noted. All surfaces shall be covered shortly after finishing works are complete and when the surface will not be affected by the cover material (initial set). Uncured concrete will be rejected.

2.02.04 Sidewalks

2.02.04.01 Location

Sidewalks shall be constructed on City of Mississauga streets as shown on the City's Road Cross-Section Standards and should be located on the same side as the streetlight poles:

2211.060 Minor Local Residential Road
2211.070 Local Residential Road (new subdivisions)
2211.080 Minor Residential Collector Road
2211.090 Local Industrial Road
2211.100 Industrial and Residential Collector Road
2211.110 Minor Arterial Road
2211.120 4 Lane Divided Arterial Road
2211.130 6 Lane Arterial Road
2211.140 Buffer Road
2211.150 5 Lane Residential Collector Road
2211.151 Local Residential Road (Pavement offset, 18m road allowance)
2211.152 Local Residential Road (Pavement offset, 20m road allowance)

2.02.04.02 Specification

Sidewalks shall be designed and built according to the most recent City of Mississauga Standards and specifications, which include:

Concrete sidewalks shall normally be a minimum of 130mm thick and 180mm thick across commercial or industrial driveways respectively.

No special bedding requirements are normally necessary where sidewalks are constructed upon earth which has been properly consolidated to 98% Standard Proctor and has a bearing capacity of at least 75 kPa.

Sidewalks shall not be constructed on organic soils.

Where fill is required to bring the sidewalk to approved grade, the fill shall be OPSS- Granular 'A' material compacted to a minimum of 95% Standard Proctor Density.

The concrete sidewalk shall be constructed according to OPSS 351, 904 & 1150. The concrete shall meet the most stringent requirements of OPSS or the contract documents. The concrete shall meet the requirements of OPSS 1350, be a C-2 mix (32 MPA, 5 – 8% air content), as described in the most current CSA 23.1.

Expansion joints shall be installed every 6 metres and the expansion joint material shall extend to the full depth of the sidewalk with no concrete extending to the other each side of the joint. The expansion joints shall be constructed at locations described within the OPSS. Expansion joints shall be constructed where-ever the newly poured concrete meets a rigid object such as previously poured concrete, street poles, retaining walls, etc.

All utility structures are required to be isolated from the main concrete by "boxing out" the structure with forms. The formwork shall form a square box, and be no closer than 150mm from any point of the utility structure. Origination of the box shall be determined in the field by the city representative. The area inside the box, surrounding the structure shall be filled with C-2 concrete, or concrete that matches the concrete mix of the main concrete pour.

Expansion joint material shall be placed between the main concrete and the concrete surrounding the pole, as well as around the utility structure itself, or be constructed as per the detail shown in City Standard 2240.010.

The concrete shall be cured as per OPSS 904. The rate of application of the curing compound shall be as per the manufactures recommendation or at a minimum rate of 0.2 l/m² if not noted. All surfaces shall be covered shortly after finishing works are complete and when the surface will not be affected by the cover material (initial set). Uncured concrete will be rejected.

2.02.05 Transit Concrete Pads & Platforms

- Concrete is to conform to OPSS 351
- Concrete pads and platforms shall have a thickness of 180mm
- 100mm of OPSS Granular ‘A’ or 19mm crushed concrete meeting gradation requirements of OPSS Granular ‘A’ shall be placed and compacted to a minimum of 95% Standard Proctor Density.
- Final platform location to be approved by the City of Mississauga.
- For use with City of Mississauga Standards 2250.010, 2250.020 and 2250.030

2.03 REGIONAL SERVICES

2.03.01 Sanitary Sewers

Information regarding the design criteria and standards for sanitary sewers must be obtained from the Region of Peel, Public Works Department.

2.03.02 Watermains

Information regarding the design criteria and standards for watermains must be obtained from the Region of Peel, Public Works Department.

2.04 STREET NAME AND TRAFFIC SIGNS

2.04.01 Plan

A separate plan shall be submitted showing the proposed location of signs to be installed in the subdivision. The plan shall be part of the engineering drawings which must be approved by the Commissioner of Transportation and Works. The above ground plan may be used for this purpose provided the signs can be clearly shown without cluttering other details.

2.04.02 Street Name Signs

Street name signs shall be placed at every intersection and shall be double sided. These signs shall be placed in the locations and shall be of the type shown on City Standard Drawing No. 2420.010.

Temporary street name signs, approved by the Commissioner of Transportation and Works, must be erected at intersections upon completion of rough grading of the roadways. These signs must be maintained in legible condition until such time as the permanent street name signs are in place.

2.04.03 Traffic Control Signs

Traffic control signs shall be located as shown on City Standard Drawing No. 2420.010. Where the positioning is not covered by the standard drawing, the location must conform to the most recent versions of the Uniform Traffic Control Devices for Ontario or the Highway Traffic Act Regulations for Ontario.

Signs are to be located on the right-hand side of the roadway. Signs in any other position will be considered only as supplementary to the signs in the normal position.

Signs shall be mounted at right angles to the direction of and facing the traffic they are intended to serve.

Signs are to be aluminium, anodized both sides, according to the following requirements:

Sizes

600mm	-	1.6mm utility series
600mm - 900mm	-	2.0mm No. 65ST6
over 900mm	-	3.2mm No. 65ST6

All traffic control signs are to be made with high intensity type reflective sheeting approved by the Ministry of Transportation Ontario, the current standards of the Manual of Uniform Traffic Control Devices for Ontario, the Highway Traffic Act Regulation for Ontario and the Commissioner of Transportation and Works, including colours.

2.05 ROADWAY MARKINGS

The Developer will design pavement markings for all roadways over two lanes in width or as required by the Commissioner of Transportation and Works. The design shall be in accordance with the Manual of Uniform Traffic Control of Ontario and as approved by the Commissioner of Transportation and Works.

2.06 TRAFFIC SIGNALS

Traffic signal handwells, power service pedestals and conduit are to be designed in accordance with City Standard Drawing No.'s 2060.010 and 2060.110 and OPSD 2112.010 and 2122.020. Ministry of Transportation Ontario PHM-125 base plans are to be supplied to the City showing intersection geometrics, conduits and power service pedestals. Traffic signal power service pedestals are also to be indicated on the subdivision electrical drawing.

2.07 STREETLIGHTING

2.07.01 Lighting Levels and Uniformity Ratio

Streetlighting shall be supplied and installed on all streets and pedestrian walkways in the subdivision. Detailed design criteria and standards are contained within the City's most recent Street Lighting Design Manual and are based on ANSI|IES RP-8.

2.07.02 Light Source

The light source shall be High Pressure Sodium.

2.07.03 Light Fixtures

The light luminaire and pole shall be as approved the Commissioner of Transportation and Works and Enersource Hydro Mississauga.

2.07.04 Approval and Construction

Approval of plans for streetlighting must be obtained from Enersource Hydro Mississauga. The Developer must guarantee and maintain the lighting for one year after the electrical system assumption in accordance with the electrical subdivision agreement with Enersource Mississauga Hydro. Energy charges will be paid by the City upon energization of the streetlighting.

2.08 RESIDENTIAL LOT DRAINAGE AND SODDING

2.08.01 General

- Lots (including drainage ditches or swales) are to be completely topsoiled and sodded with a minimum depth of 100mm of topsoil and No. 1 Nursery Sod.

- Grade areas to:

  - Provide proper surface drainage and maximize usable land area.
  - Preserve existing trees where possible.
  - Direct drainage away from houses

- Minimum yard slope - 2%

- Minimum driveway slope 2% and all driveways must slope away from the dwelling.

- Maximum driveway slope -8% (from standard sidewalk location)

- Maximum grade between houses in any direction:

  -3 horizontal : l vertical, use steps and/or retaining walls if this requirement cannot be met.

- Provide a 0.60 m wide flat access strip (at 2%) along at least one side of the building where side yard setback permits. (Usually along the garage side or side door entrance).

- Clear stone rather than topsoil and sod are required for combined side yards between two buildings which are 1.20m or less. For side yards greater than 1.2m clear stone may be required at the discretion of the Commissioner of Transportation and Works.

- Overland Flow Route:

- Maximum ponding depth is 0.35m

- Where overland flow is directed between two dwellings, the depth and width of the swale must be such that the 100 year flow does not come in contact with the dwelling. Basement windows will not be permitted on the side of the dwelling abutting the overland flow route swale.

2.08.02 Type of Drainage Pattern

- Back to front drainage may be considered if the side yard building setback is a minimum of 1.2m for each lot totalling 2.4m of open space between the dwellings.

- Rear yards which drain through abutting lower back-to-front type lots are permitted where:

    - Sufficient fall is available between the adjacent streets to achieve desired grades for swales and yards.

    - Cut-off swales along the rear lot lines are to direct run-off from the upper lots into the lower lot side yard swales.

    - Down spouts on the upper lot do not direct flow to the lower lots.

    - No more than one upper lot shall drain into the lower lot side yard swales.

2.08.03 Rear Yard

- A minimum of 75% of the rear yard area is to be usable (2% to 4% slope).

- Retaining walls are to be employed where necessary to achieve the required rear yard areas.

2.08.04 Swales

- Longitudinal slope - minimum 2%

- Side slopes - maximum 3 horizontal to l vertical

- Rear Yard Swale To Rear Lot Catch Basin:
    - Maximum length of rear yard swale
        - On lots less than 12 m in frontage - three lots
        - On lots 12m and greater in frontage - two lots
    - Location of Centreline of swale - 1.0m maximum offset from rear lot line

- Maximum swale depth - 450mm

- Side Yard Swale~~:~~ Depth:

    - Maximum 250mm (450mm allowable if combined side yard is more than 3.6m)
    - Minimum 150mm

2.08.05 Retaining Walls

- Retaining walls are generally required where the difference in elevation exceeds 0.60m.

- Details of retaining walls over 0.60m are to be submitted with grading plans and stamped by a Professional Engineer. It is preferable that the Engineer who stamped the plan certifies the wall construction.

- Construct retaining walls entirely on the upper lot so that tie backs do not cross property boundaries.

- Certification by the consultant stating that the retaining wall is designed and constructed to meet the most recent design standards as to granular backfill, structural integrity, materials, tie backs, line and grade is required.

- For retaining walls 0.6m to 1.0m in height light weight pre-fabricated concrete retaining wall products may be utilized. For retaining walls greater than 1.0m in height, heavy block or wet walls are to be utilized.

- Fencing is required where retaining wall height exceeds 0.6m.

2.09 EROSION AND SEDIMENT CONTROL

2.09.01 General

In accordance with the City of Mississauga Erosion and Sediment Control By-law No. 512-91, as amended, an Erosion and Sediment Control Permit must be obtained prior to undertaking any land disturbing activities on development sites greater than one (1) hectare in size or on development sites of any size that are adjacent to a body of water. Copies of the By-law and the permit application package are available through the Infrastructure and Environmental Planning Section of the Transportation and Works Department.

All erosion and sediment controls are temporary applications constructed prior to any land disturbing activities on the site and shall be maintained throughout the duration of the construction period. *Permits can be issued based on Stage 1 - Earthmoving Operations and Stage 2 - Servicing Works.*

All activities on the site shall be conducted in a logical sequence to minimize the area of bare soil exposed at any one time.

All disturbed ground left inactive shall be stabilized by seeding, sodding, mulching or covering, or other equivalent control measure. The period of time of inactivity shall not exceed 30 days, unless otherwise authorized by the Commissioner of Transportation and Works.

All erosion and sediment controls should comply with the requirement of “The Erosion and Sediment Control Guidelines from Urban Construction,” issued by the Greater Golden Horseshoe Area Conservation Authorities.

2.09.02 Sediment Basins

Temporary sediment basins shall be constructed on sites having a disturbed drainage area of greater than 2 hectares or having an average slope greater than 12%.

The basin shall be designed to settle out soil particles that are 0.04mm in diameter or larger from surface water runoff and/or storm sewer flows, and shall meet the following requirements:

- The minimum basin volume shall be 125 m^3 per hectare of contributing drainage area.

  NOTE: The total basin volume consists of storage zone volume and the settling zone volume.

- The surface area of the basin shall be designed using the following equation:

$$A = \frac{1.2\,Q}{V_s}$$

,where V_s = Settling velocity (0.0021 m/s for 0.04mm diameter soil particle)
A = Surface area of basin (m^2)
Q = Peak inflow rate (m^3/s)

  NOTE: The peak inflow rate shall be calculated using a 1:10 year return period based on the City of Mississauga Standard Intensity Duration Frequency Rainfall Curves (City Standard Drawing No. 2111.010) *(Q=C x i x A)*

  The basin length to width ratio shall be greater than 2 and, if less than 10, a baffling system is required to be used to prevent "short circuiting" and to minimize "dead zones".

- The storage zone depth shall allow for one year of estimated sediment yield based on the Universal Soil Equation.

  The Universal Soil Equation is:

$$E = 2.24\,R\,K\,Ls\,Vm$$

where E = Amount of soil loss per unit area for the time interval represented by the factor R (tonnes/ha)
R = Rainfall factor (Joule/ha)
K = Soil Erodibility Factor (tonnes/Joule)
Ls = Topographic factor (dimensionless)
Vm = Erosion control factor (dimensionless)

NOTE: Factors used in the Universal Soil Loss Equation shall be in accordance with the most recent Ontario Ministry of Transportation published data.

To determine the volume of soil loss per unit area assume a soil density of 1 tonne/m^3.

The minimum storage zone volume of the basin shall be $50m^3$ per hectare of contributing drainage area.

- The ratio of the basin length to the settling zone depth is to be less than 40 to prevent scouring of the storage zone. The minimum settling zone depth shall be 0.6m.

- The outlet of the basin shall be designed to provide a minimum of 24 hours of detention time and to prevent turbulence and re-suspension of settled particles.

- The basin shall have a maximum side slope of 3:1.

- The basin shall have a minimum freeboard of 0.3m.

- The basin shall be provided with an emergency spillway

- 1.8m high chain link fence shall be erected along the perimeter of any sediment basin. A warning sign shall be attached to the security fencing stating that the area is off limits to the general public and advising that the basin is used for sediment control purposes and that the enclosed area is subject to flash flooding.

- For Subdivision the temporary sediment basins are not to be removed until 80% of the development has been developed and sodded.

2.09.03 Catchbasin Sediment Control

During construction, all catch basins shall be provided with sediment control, in accordance with the following requirements.

Catchbasin Sediment Trap

Catch basin sediment traps shall be provided for unpaved areas draining 2 hectares or greater and less than 4 hectares and shall be constructed in accordance with City Standard Drawing No. 2930.010.

Sediment removal is required when the depth from the underside of frame to top of the accumulated sediment is reduced to 300mm.

Catch basin Sediment Barrier

All rear lot catch basins or catch basins within unpaved areas draining less than 2 hectares shall be provided with a sediment control barrier in accordance with City Standard Drawing No.'s 2930.020 or 2930.030.

Roadway Catch Basin Sediment Control Device

Under appropriate drainage circumstances, all roadside catch basins shall be provided with sediment protection in accordance with City Standard Drawing No. 2930.040 or *2930.050*

2.09.04 Sediment Control Fence

Sediment control fences shall be placed along all downslope sides of a site along the edges of a drainage channel passing through the site, and along the perimeter of all other areas sensitive to sediment accumulation. The sediment control fence shall be constructed in accordance with City Standard Drawing No. 2940.010.

2.09.05 Vegetative Buffer Strips

A minimum 3m wide *undisturbed* buffer strip shall be *maintained* along the limits of the development adjacent to existing road boulevards. Where a sediment control fence is required, it shall be constructed in front of the buffer strip.

2.09.06 Topsoil Stockpile Protection

All topsoil stockpiles containing more than 100m^3 of material shall be located a minimum of 10m away from a roadway, drainage channel or an occupied residential lot. The maximum sideslopes for topsoil stockpiles shall be 1.5 horizontal to 1.0 vertical.

Runoff from all topsoil stockpiles shall be controlled by a sediment control fence or other approved devices. If remaining for more than 30 days, topsoil stockpiles shall be stabilized by vegetative cover, or other means.

2.09.07 Stone Pad Construction Entrance - Construction Access

In order to reduce the tracking of mud onto a paved street, a pad of crushed stone shall be constructed at the site entrance and exit leading onto any existing road. The stone pad shall be a minimum of 300mm thick, 15m long and 10m wide. The first 10m from the entrance/exit shall be constructed with 50mm clear stone. The remaining 5m shall be constructed with 150mm rip rap. This stone pad must be maintained as required given the site conditions to ensure mud tracking is kept to a minimum. *The Stone Pad Construction Entrance shall be constructed in accordance with City Standard Drawing No. 2970.010*

2.09.08 Rock Check Dam

Rock check dams are to be installed in ditches and swales in accordance with City Standard Drawing No. 2980.010.

2.09.09 Site Conditions/Inspection

All disturbed ground left inactive shall be stabilized by seeding, sodding, mulching or covering, or other equivalent control measure. The period of time of inactivity shall not exceed 30 days, unless otherwise authorized by the Commissioner of Transportation and Works.

All erosion and sediment control devices are to be inspected by the Consulting Engineer once per week and after each rainfall of 1 cm or greater to ensure that they are in proper working condition.

2.10 DRAWINGS

2.10.01 Specifications for Engineering Drawings

Size:	-	Drawings to be A1 Metric (594mm x 84lmm)
	-	Plans to have a minimum of 50mm waste material on right hand side of plan (next to title block)
Format:	-	Same as City of Mississauga Transportation and Works Department standard sheets unless otherwise approved.
Materials for Final Submission and "as-constructed" drawings	-	Translucent Mylar (.04mm matte)
	-	Black Ink (permanent), original 1st generation plots only
Materials for Preliminary Submissions	-	Mylar (0.4mm matte)
	-	Black Ink (permanent), original 1st generation plots only

2.10.02 General Drawing Requirements

Work on the drawings is to be done neatly and legibly.

Permanent black ink is to be used with the exception of the following:
- proposed utilities invert elevations, lot elevations, and profiles which may be done in pencil.
- existing conditions and profile grid which may be done in red ink (permanent)

Drawings are to include the signature and seal of the Professional Engineer responsible for the design.

The applicant is to relate all wording to a current and existing City of Mississauga benchmark value without applying any shift. Any submissions that show elevation values related to a datum other than the 1928 Canadian Geodetic Datum (i.e.the Mississauga Datum) will not be accepted.

Rubber stamps shall not be used except for the Engineer' seal.

Nothing shall be affixed to the drawing with tape or adhesive.

The drawings must contain a note indicating the submission phase to which they apply, and a space must be provided for the initials of the city staff who reviewed the submission. The caption for this space should read "reviewed by".

2.10.03 General Plans

2.10.03.01 Above Ground Plans

General plans showing aboveground services and appurtenances are to be drawn to a scale of 1 to 1000 or larger and shall indicate but not be limited to the following:

- School signs
- Street signs
- Future land use signs
- Barricades
- Fencing
- Retaining walls
- Rear lot/block catchbasins
- Screen planting
- Any required easements including dimensions and descriptions
- Driveway location for corner lots
- Driveway locations and building envelopes for detached dwellings less than 12 metres, Semi-detached dwellings and townhouse dwellings
- A typical detail showing building envelopes, driveway location and widths, driveway curb cut and dimension for detached dwellings less than 12 metres, semi-detached dwellings and townhouse dwellings
- Bus stop platforms
- Community mail box

2.10.03.02 Below Ground Plans

General plans showing all below ground services and appurtenances are to be drawn to a scale of 1 to 1000 or larger and are to include any required easements.

2.10.04 Storm Drainage Plans

Storm drainage plans are to be drawn to a scale of 1 to 1000 or larger (a scale not exceeding 1 to 5000 will be accepted for large external drainage areas) and are to indicate the total area to be drained by the proposed storm sewers. The storm drainage plan is to be compatible with the grading plan and the City's latest contour mapping. The storm drainage plan shall indicate but not be limited to the following:

- Existing contours
- Drainage patterns of adjacent lands
- Runoff coefficients and areas (ha) of tributary areas outside the development and for each section of the storm sewers within the development
- Direction of runoff
- Street names
- Manhole numbers
- Sewer sizes and slope
- Directions of flow in the sewers
- Any catchbasins or swales, on the lots or blocks, required to pick-up the runoff
- Temporary or permanent quantity and quality storm water management facilities
- Overland flow route
- Culverts and other drainage appurtenances

2.10.05 Grading Plans

Grading plans for lots and blocks are to be drawn to a scale of 1 to 500 or larger showing existing contours established from field elevations.

The grading plans shall indicate but not be limited to the following:

- Existing contours
- Proposed elevations at the following locations:
  - Along the centre line of any existing or proposed roads (maximum 30m apart)
  - Centre line of each lot at the front and rear building line
  - At the corners of each lot and block
  - At frequent intervals along block property lines
  - Proposed contours for grading within large blocks and parks
  - Any other points necessary to give proper picture of the proposed drainage scheme including tops of catchbasins, bottoms of swales and top and bottom of retaining walls
- Existing contours and elevations within the plan and at least 30 metres externally. The external contours are to be extended far enough to determine the existing drainage pattern. In addition to the above, grading plans for parks are to indicate existing contours at 0.5m intervals along with all existing trees, structures, watercourses, etc.
- Percent street grades for all roads within the development. The distance of the particular grade shall also be included.
- Overland flow route.
- Easements including dimensions and descriptions
- Fencing
- Retaining walls
- Drainage types in accordance with typical details
- Cut off swales and catchbasins to intercept interim block drainage and external drainage

2.10.06 Plan-Profile Drawings

Plan-profile drawings are to be drawn to a horizontal scale of 1 to 500 and a vertical scale of 1 to 50 and are to conform to the following:

- Where two or more sheets are required for one street, match lines must be used and there is to be no overlap or duplication of information

- Where intersecting streets are shown on a plan-profile, only the diameter of the pipe and direction of flow of the intersecting sewers are to be shown. This also applies to easements for which a separate plan-profile has been drawn.

- On plan-profile drawings the type of sewer (sanitary or storm), the diameter, length, grade and class of pipe are to be shown on the profile portion of the drawings only. Only the type and diameter are to be shown in the plan portion

- Where possibility of conflict with other services exists, connections are to be plotted on the profile

- Pavement/road base designs for the particular roadway are to be indicated on all plan-profile drawings

- The detail information from all borehole logs is to be plotted on the profile drawings and located on the plan. If this interferes with some other detail such as a manhole, the exact location may be altered sufficiently for clarity. Borehole information should contain a borehole plot plus a brief description of soils and the water level. The borehole log must extend a minimum of (1) metre below the lowest manhole in the vicinity.

- Gutter drainage details for temporary turning radii and cul-de-sacs

2.10.07 As-Constructed Drawings

2.10.07.01 General

Prior to final acceptance of a subdivision by the City of Mississauga, the Developer's Engineer shall produce a complete set of ”as-construct” drawings for the development and supply same to the Transportation and Works Department of the City of Mississauga. In addition, a complete set of Mylar reproductions (minimum 0.003 thickness, reverse reading, matte both sides, blackline) shall be prepared from the "as-constructed" originals and supplied to the Public Works Department of the Regional Municipality of Peel.

In addition to the above, the Region of Peel has additional requirements that consist of, “as-constructed” digital files in Microstation (DGN) format Version 5 or higher, after the following have been completed,

- One set of folded prints submitted for review prior to sending the originals
- CAD files on CD 1 each of the plan & profiles - including Regional drawing number to be submitted to the Public Works Department of the Regional Municipality of Peel

These drawings shall show the location both horizontally and vertically of everything which is on or under the lands to be accepted by the City.

These drawings shall be sealed and signed by a Registered Professional Engineer and stamped "As-Constructed" and dated.

2.10.07.02 Drafting Requirements for "As-Constructed" Drawings

Storm Sewers, Sanitary Sewers and Watermains shall be "as-constructed" in all cases. Other specialized "as-constructed" information may be required in certain instances. Direction will be given by the Transportation and Works Department on an individual project basis, as required.

2.10.07.03 Storm Sewers

All sewer invert elevations, if different than proposed, are to be indicated on the as constructed drawings. If the difference is greater than 150mm affected portions of sewer (in profile) to be redrawn. Hydraulic calculations are to be provided, reflecting these changes, for review and approval.

Any manhole locations which differ by more than 1.50m from proposed are to be redrawn in both plan and profile.

The following shall be indicated on the "as-constructed" drawings, if different than proposed:

Type of manhole

Pipe size

Grade of sewer

Type of sewer material

Class of pipe

Type of bedding

Stormwater Management

A topography survey is to be provided for the swim pond prior to servicing approval and/or prior to assumption of the swim pond.

2.10.07.04 Sanitary Sewers

All sewer invert elevations, if different than proposed. If difference is greater than 150mm affected portions of sewer (in profile) to be redrawn.

Any manhole location which differs by more than 1.50m from proposed to be redrawn both in plan and profile.

The following shall be indicated on the "as-constructed" drawings, if different than proposed:

Type of manhole

Pipe size

Grade of sewer

Tee chainage from downstream manhole

Type of sewer pipe material

Class of pipe

Type of pipe bedding

Original ground at centre profile to remain on all plans

Lateral ties and elevations

This section is duplicated in 4.02.09 Drafting Requirements for As Constructed Drawings

2.10.07.05 Watermains

All watermain elevations, if different than proposed. If difference is greater than 150mm, affected portions of watermain (in profile) to be redrawn.

All alignment changes greater than 150mm to have offsets revised in plan. If alignment changes exceed 1.5 metres, watermain to be redrawn in plan as well as indicating revised offsets.

All main valves are to be tied to permanent features, such as buildings, manholes, catchbasins, etc...

Ties and elevations to all stubs.

The following shall be indicated on the "as-constructed" drawings, if different than proposed:

Pipe size

Type and class of pipe

Type of bedding

All fitting changes (bends, reducers, blocking, etc...)

Type of valves and hydrants

Original ground profile over watermain (if applicable) to remain

This section is duplicated in 4.02.09 Drafting Requirements for As Constructed Drawings

2.10.08 Erosion and Sediment Control Plans

The erosion and sediment control plans are to be prepared in accordance with the requirements of Erosion and Sediment Control By-law No. 512-91, as amended. Copies of the By-law *and permit application package* can be obtained from the *Infrastructure and Environmental Planning Section* of the Transportation and Works Department.

Appendix 'A'

SUPPORTING DOCUMENTS

A-1 - Watershed Boundaries