Municipal
Engineering Design
Manual

FINAL - November 2017

Pelham
NIAGARA

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0 GENERAL PREFACE

0.1 Preamble

The Town of Pelham (referred to herein as "the Town") is centrally located within Niagara Region and is an amalgamation of five historical communities, including Fonthill, North Pelham, Ridgeville, Effingham and Fenwick. The Town is part of a two-tier municipal government structure and is responsible for road networks and streetscaping, water distribution mains, sanitary collection system and stormwater systems and facilities.

As the Town is responsible for the ongoing operational practices, maintenance activities and growth of this infrastructure, it is essential that there is consistency in the quality of the designs by various Proponents. The Municipal Engineering Design Manual (referred to herein as "the manual") has been developed to achieve an accurate representation of the expectations and visions for the Town moving forward.

0.2 Introduction

This manual is to provide the Town, consulting engineers, contractors, developers and the general public with a common reference to ensure the consistent application of the design of infrastructure for proposed developments (subdivisions and individual sites) and retrofits of existing infrastructure. For construction requirements, Proponents shall refer to the Niagara Peninsula Standard Contract Document and the Town's supplemental provisions, as required.

The use of this manual does not absolve the Proponent from their professional obligations to apply sound engineering principles and industry best practices for a solution that is practical, efficient, safe and sustainable to operate and maintain by the Town.

This manual does not supersede, nor replace any legislation governing the design and construction of the linear municipal infrastructure. The Proponent shall be fully familiar with legislative requirements as they relate to the infrastructure including but not limited to the following:

- Municipal Act
- Environmental Assessment Act
- Ontario Highway Traffic Act
- Safe Water Drinking Act
- Ontario Water Resources Act
- Accessibility for Ontarians with Disability Act
- Construction Lien Act
- Environmental Protection Act.

This manual will be reviewed and updated periodically to stay current with the Town's Strategic Plan and industry standards and best practices as well as to remain compliant with regulatory requirements. It is the responsibility of the Proponent to ensure they are using the most recent version of this manual.

0.3 Other Reference Documents

The Proponent shall design the infrastructure in accordance with the latest version of this manual as well as latest versions of applicable plans, policies, industry standards and best practices, including but not limited to:

- Town of Pelham Strategic Plan
- Town of Pelham Planning Policy
- Town of Pelham Official Plan and Secondary Plans
- Niagara Region Official Plan
- Niagara Region Master Plans
- Town of Pelham Community Improvement Plan
- Town of Pelham Cultural Master Plan

- Town of Pelham Downtown Master Plan for Fenwick and Fonthill
- Town of Pelham Applicable Policies and By-laws
- Niagara Region Applicable Policies and By-laws
- Niagara Region Project Design Manual
- Ontario Provincial Standard Specifications and Drawings
- Ministry of Environment and Climate Change (MOECC) Design Guidelines for Sewage Works
- MOECC Regulations and Design Guidelines for Drinking Water
- MOECC Stormwater Management Planning and Design Manual
- MTO Highway Drainage Design Standards
- Niagara Peninsula Conservation Authority Guidelines and Policies
- Geometric Design Guide for Canadian Roads prepared by the Transportation Association of Canada
- Ontario Traffic Manual prepared by the Ministry of Transportation
- Roadway Lighting ANSI / IES RP-8 prepared by the illuminating Engineering Society of North America (IESNA)
- Guideline for Security Lighting for People, Property and Public Spaces, G-1-03 prepared by IESNA
- Ontario Regional Common Ground Alliance
- Standard Guidelines for the Collection and Depiction of Existing Subsurface Utility Data
- Urban Tree Foundation Specifications

In addition, the linear infrastructure shall comply with the latest versions of all applicable industry standards and specifications for quality management and quality control, including but not limited to:

- American Association of Transportation Highways Officials
- American Standard and Testing Materials
- American Water Works Association
- Canadian Standards Association
- Electrical Safety Authority
- Factory Mutual
- Fire Underwrites Survey
- NSF International
- Underwriters Laboratory

0.4 Proposed Design Changes and Deviations

The information provided is not intended to hinder innovation, rather is rooted on meeting performance requirements over the lifecycle of the infrastructure. The Proponent is encouraged to provide innovative solutions. In some instances, an alternative solution may be suitable or it may be technically infeasible to meet the specified criteria contained herein. In either case, the Proponent shall submit changes or alternatives for review and acceptance by the Town prior to implementation. The Proponent shall provide sufficient justification and supporting information to prove that the result will be comparable to standard application and is consistent with good engineering practices.

0.5 Use of the Manual

Each section of the manual is meant to be used in conjunction with one another, however, can be utilized independently if warranted by the work.

- General Preface
- Development Submission Requirements
- Design Requirements
  - Roads and Streetscape
  - Stormwater Sewers and Management
  - Sanitary Collection Systems
  - Drinking Water Distribution
  - Utilities
- Special Fire/Emergency Considerations
- Standard Drawings

0.6 Design Drawings and As-Built Drawings

All drawings shall be completed in AutoCAD Civil 3D and shall be in accordance with the latest version of the Niagara Peninsula CAD Standards.

Vertical and horizontal controls shall be in accordance with the CAD Standards. The submitted drawings and maps shall be in real 6-degree UTM coordinates, NAD 83 datum (GRS80 Ellipsoid).
Ground control points shall be shown in the drawing including the published geodetic point number, coordinates and elevation.
For lay-out and tie-in survey purposes, all drawing sheets will include ground scale dimensions to survey control points, monuments or bars.

Issued for Tender and Issued for Construction drawings (paper and electronic copies) shall be transferred to the Town prior to commencement of construction.

As-built drawings shall be transferred to the Town within three (3) months of project completion.

0.7 Permits and Approvals

The Proponent shall follow the requirements and seek approvals of other applicable approval authorities including but not limited to the following:

- Town of Pelham
- Niagara Region
- Ministry of Environment and Climate Change
- Ministry of Tourism, Culture and Sport
- Ministry of Natural Resources and Forestry
- Ministry of Transportation
- Niagara Peninsula Conservation Authority
- Canadian National Railway
- Utilities

All required permits and approvals shall be in place prior to commencement of construction.

0.8 Typical Right-of-way Cross Sections

Typical right-of-way (ROW) cross-sections are contained within the manual. The intent of the cross-sections is to illustrate infrastructure guidelines for various road classifications. Additional information regarding road classifications and standard widths are contained with the Roads and Streetscape section of the manual.

0.9 Definitions

TERM	DEFINITION
Anode	The electrode of an electrochemical cell where corrosion occurs and metal ions enter solution. An anode refers to a packaged anode consisting of the casting, chemical packing material, lead wire, tube and label.
Backfill	All materials placed at 300 mm or above the watermain or sewer.
Bedding, Embedment and Cover	All materials placed between the trench bottom and 300 mm above the watermain or sewer.
Binder Course	A Hot Mix Asphalt (HMA) course between a surface course and either a granular base course or stabilized base course, an existing pavement, or another HMA binder course.
Boulevard	Portion of the road allowance between the adjacent property line and the edge of the travelled portion of the highway or the edge of the shoulder, where such exists, furthest from the travelled portion of the highway.
Cathodic Protection	A technique to control the corrosion of a metal surface by making that surface the cathode of an electrochemical cell.
Corrosion Protection	Corrosion control of a metal surface either by coatings or cathodic protection or both.
Consulting Engineer	The Professional Engineer responsible for the planning and design of the municipal infrastructure, performing those duties with the standard of care prescribed by the Professional Engineers Ontario (PEO).
Contractor	Any person, persons or corporation undertaking the installation of municipal infrastructure and services in the Town.
Developer	A person, persons or corporation who has applied to subdivide and/or develop and/or service an existing parcel of land, whether as the developer or an agent for the developer of the land.
Easement	A right of use over the property of another. Common examples of easements include the right of a Municipal corporation to run a sewer line across a strip of an developer's land, often called a right of way. Easement requirements for infrastructure will be determined on an individual project basis.
HSU	A heavy single unit vehicle is a vehicle with a gross weight or registered weight of over 5,000 kg. Examples of heavy single unit vehicles are single unit trucks, tractors and buses.

TERM	DEFINITION
Hot Mix Asphalt	Hot mixed, hot laid asphaltic concrete. The terms are used interchangeable. HMA may include recycled or specialty mixes.
Inflow	Water from rainfall or snow melt that enters the wastewater collection system via direct routes such roof downspouts, cross-connections with storm drains, foundation drains and maintenance hole covers.
Infiltration	Groundwater that enters through holes and cracks in maintenance holes, laterals and sewer pipes
Maintenance Hole	Commonly called a manhole, it is an opening protected by a cast iron cover to access an underground sanitary sewer or storm sewer.
Petrolatum	A purified mixture of semisolid hydrocarbons obtained from petroleum jelly.
Population Equivalents	Population per unit for determining sanitary sewer flows and water demands based on land use
Photometric Plan	Plan that measures light, in terms of its perceived brightness to the human eye, for streetlight placement.
Proponent	User of this manual, i.e., consulting engineer, contractor and developer.
Restraint (Joint)	Mechanical assembly unit that holds together a pipe at the connection point and utilizes the pipe itself to counter the thrust force from the pressurized water.
ROW	Right-of-way includes all areas of Pelham that are the property of the Town. These include, but are not limited to hydrants, maintenance holes, street lights, hydro facilities, communication pedestals, trees, roads, sidewalks, walkways, bike lanes, driveway aprons, boulevards and curbs.
Road Allowance	An allowance for a road laid out by a Crown surveyor, including a road allowance shown on an original township survey and a road allowance included on a Crown plan of subdivision.
Top Course	Hot Mixed Asphalt wearing course of any flexible or composite pavement
Thrust Block	Plain unreinforced concrete that is used at bends and pipe junctions to prevent damage to the pipe by transferring the thrust force from the pressurized system to the undisturbed soil behind the thrust block.
Town	Town of Pelham
Transient Analysis	Method of flow analysis of a watermain or forcemain that considers changing flows or pressure conditions over time.

0.10 Abbreviations

ACRONYM	DESCRIPTION
AASHTO	American Association of Transportation Highways Officials
AODA	Accessibility for Ontarians with Disabilities Act.
ASTM	American Society for Testing and Materials.
AWWA	American Water Works Association.
ANSI	American National Standards Institute.
Backfill	All materials placed at 300 mm or above the watermain or sewer.
CSA	Canadian Standards Association
DWF	Dry Weather Flow
ESA	Electrical Safety Authority
FM	Factory Mutual
FUS	Fire Underwrites Survey
I/I	Inflow and Infiltration
IDF Curve	Intensity-Duration-Frequency Curve
OPSD	Ontario Provincial Standard Drawings
OPSS	Ontario Provincial Standards and Specifications
PVC	Polyvinyl Chloride pipe
PVCO	Polyvinyl Chloride Biaxially-Oriented Pipe
RDII	Rainfall Derived Inflow and Infiltration
TAC	Transportation Association of Canada
Town	Town of Pelham
UL	Underwriters Laboratory
WHMIS	Workplace Hazardous Materials Information System
WWF	Wet Weather Flow

1 SUBMISSION REQUIREMENTS – PUBLIC WORKS

General submission requirements will be prescribed through the Planning Department. The following section outlines information that may be required from Public Works for the review of a development application. The Town of Pelham reserves the right to alter any of these requirements within the text of each Development Agreement.

1.1 General Requirements for Submission

Development applications shall generally include the following, as applicable:

- Roads and transportation systems;
- Storm and sanitary sewers and services;
- Watermains, hydrants and water services;
- Underground utilities (hydro, telephone, gas, cable TV, etc.);
- Street lighting;
- Streetscaping;
- Landscaping;
- Grading;
- Pavement Markings and Signage;
- Street name and regulatory signage.

At the preliminary review stage or later, based on the nature and scope of the application, through the Director of Public Works, the Applicant may be required to submit:

- Design brief;
- Soils investigation;
- Details on coordination with utilities (gas, telephone, hydro, cable TV, etc.);
- Other studies/reports as required.

1.1 Design Brief

The Design Brief is a technical report summarizing the intent of the project and outlines the detail design, assumptions, calculations, supporting documentation and references to previous studies, for each component of the development. The supporting information may include, but not be limited to the following:

a) Road Network
- Traffic impact of the development on any roads within or abutting the development;
- Pavement/roadway design calculations;
- Preparation of Traffic Impact Study.

b) Sanitary Sewer System
- Drainage areas and proposed flows;
- Main sizing, location and capacity of outlets;
- Capacity analysis of the collection system.

c) Storm Sewers and Storm Water Management
- Drainage areas and proposed flows;
- Direction of flow and outlet;
- Storm water management facilities,
- Main sizing, location and capacity of outlet including downstream infrastructure.

d) Water System
- Main sizing, location and looping, including analysis of network;
- Pressure boundaries, booster station requirements and treatment facilities.

d) Geotechnical Report

1.2 Geotechnical Study

The geotechnical report will identify existing site conditions, design and construction considerations by providing specific information on subsurface soil, rock, and water conditions. A geotechnical report may include recommendations to ameliorate poor soil conditions or modify road design. A geotechnical report will be required if the nature of the proposed work involves excavation, infrastructure bedding, structural support.

1.3 Traffic Impact Study

There are a number of criteria under which a Traffic Impact Study (TIS) may be required. In general, a TIS may be requested if:

- A change in current use is proposed, that could impact traffic flow, in the opinion of the Town;
- As part of the proposed development, a new traffic signal is warranted;
- If the development has the potential to create unacceptable adverse traffic operational and/or safety impacts on the road network; or
- Existing points of ingress and egress are operating inefficiently or where traffic safety concerns exist.

1.4 Sanitary Drainage Area Plan

The sanitary drainage area plan shall be to a scale of 1:500, showing the following in accordance with the requirements in this Manual:

a) Proposed sanitary sewers, maintenance holes and appurtenances, indicating grade, pipe size, lengths and directions of flow; and
b) Drainage areas within the subdivision and the limits of areas outside the plan draining into the proposed system.

1.5 Storm Drainage Area Plan

The storm drainage area plan shall be to a scale of 1:500, showing the following in accordance with the requirements in this Manual:

a) Major storm system flow route along streets and easements including controlling elevations,
b) Limits of area outside the plan draining through the proposed major system;
c) Drainage areas within the subdivision and the limits of areas outside the Development draining into the proposed system; including area in hectares, direction of flow and runoff coefficient;
d) All existing drainage channels and the method of incorporating these channels into the proposed major system;
e) Location of catchbasins and other stormwater management facilities.

1.6 Plan and Profiles of Road

Plan and profile drawings must be drawn for all streets within the subdivision as well as for any mainline service easements. All chainages shall be calculated along the street centrelines. All appurtenances and construction details are to be referenced to applicable Town Standard Drawings or Ontario Provincial Standard Drawings (OPSD).

Any design details not covered by the above should be included as detailed drawings and attached with the contract plans with the approval of the Public Works Director or designate. Plan and profile drawings shall be drawn at a minimum horizontal scale of 1 to 500 and at a minimum vertical scale of 1:50, and shall show the following:

- Existing and proposed sewer, giving for each section the size, class, materials pipe grade, and bedding requirements;
- All sewer appurtenances. The maintenance holes must be numbered on both the plan and profile drawings. Designation between sanitary maintenance hole numbers and storm maintenance hole numbers must be shown;
- Details of maintenance holes such as number, standard, details and grate elevations must be shown;

- All maintenance hole inverts must be given and adequately described on the profile;
- Existing ground profile is to be indicated as a broken line;
- Proposed road profile (top of pavement), giving grades, chainage of P.V.I.'s and vertical curve data are to be shown;
- Radius and angle of intersection should be shown for all horizontal curves.
- Chainage of B.C., E.C. and P.I., etc. is to be shown on the plan and indicated as such;
- The names of streets are to be given outside and above the road allowance;
- Curb radii must be given at all intersections and on bends;
- Location and description of the nearest benchmark on each drawing.

1.7 Grading Control Plan

The Subdivision Grade Control Plan shall clearly illustrate the following:

a) legend, north direction, name of subdivision, location description and elevation of geodetic benchmark(s), date of preparation of plan and any subsequent revisions clearly identified in the revision column;

b) property boundaries and lot and block numbers or designations;

c) existing contours and elevations;

d) existing elevations and drainage from lands adjacent to the subdivision and, if the drainage from these lands is towards the proposed subdivision, the existing information shall be obtained to the high point of this drainage or at least to the adjacent street;

e) location of sewer maintenance holes, hydrants, sidewalks, trails, catch basins and rear yard catch basins;

f) proposed elevations at the centre line of the finished road and relative data showing distances and slopes between these elevations;

g) existing and proposed ground elevations at the corner of each lot or block with suitable intermediate elevations as required;

h) existing and proposed ground elevations at the house;

i) elevation and longitudinal slopes at the invert of swales together with rear yard catch basins elevations and drainage arrows showing the direction of swale drainage;

j) any drainage obstruction such as berms, retaining walls, sound barriers, silt traps, vegetation, etc.;

k) artificial or natural ponds;

l) existing trees and vegetation, as they affect proposed drainage and catch basin schemes and which are to be saved;

m) if any lots or blocks are not suitable for the construction of certain types of buildings or features (i.e. split-levels, walkout basements, etc.) because of the sanitary sewer depth, grading and drainage pattern, this should be clearly indicated on the plan.

2 ROADS AND STREETSCAPE

2.1 General

The geometric design of municipal roads shall conform with standards set out in the latest edition of the "Geometric Design Standards for Canadian Roads" issued by the Transportation Association of Canada, or as specified herein.

General street classifications are defined in **Table 2.1a** below:

	LANEWAY	**LOCAL**	**COLLECTOR**	**ARTERIAL**
Number of Through Lanes per Direction	<1	1	1	1-2
Posted Speed Range (km/h)	NA	50	50 – 60	60 – 80
Primary Design Vehicles	Passenger car	Passenger car	Passenger car, transit bus, snowplow, fire truck	Passenger car, transit bus, snowplow, fire truck
Low Frequency Design Vehicle (turning encroachment may be permitted)	Snow plow, fire truck	Snow plow, fire truck	Snow plow, fire truck, WB-20 (per TAC, where applicable for commercial/industrial areas)	Snow plow, fire truck, WB-20 (per TAC, where applicable for commercial/industrial areas)

2.1.1 Design Criteria

Design criteria for roads are defined in **Table 2.1b** below:

	LANEWAY	LOCAL ROAD	COLLECTOR ROAD	ARTERIAL
Minimum Grade With Curbs Without Curbs	0.4% 0.6%	0.4% 0.6%	0.5% 0.6%	0.5% 0.6%
Maximum Grade	8.0%	8.0%	6.0%	5%
Maximum Grade for Through Roads at Intersection	3.5%	3.5%	3.0%	3.0%
Maximum Grade for Stop Roads at Intersection	2.5%	2.5%	1.5%	1.5%
Minimum Curb Radius at Intersection with Arterial Road	9m	9m	13m	15m
Minimum Curb Radius at Intersection with Collector Road	9m	9m	13m	15m
Minimum Curb Grade	0.40%	0.40%	0.50%	0.50%
Minimum Curb Grade at Radius of Intersections	0.60%	0.60%	0.60%	0.60%
Cul-de-Sac Minimum Outside Curb Radius	N/A	15m	N/A	N/A
R.O.W. (minimum)*	8.5m	20m ++	20m	30m
Pavement Width (measured curb face to curb face)	7.0m	7.0m minimum	7.0m minimum	varies
Minimum Centreline Radius	60m **	60m **	85m	
Design Speed	15 kph	50 kph	50 to 60 kph	60 to 80 kph
Vertical Curve Minimum sight stopping distance LVC=KA (MTC Manual) K. for Sag K. for Crest	 65m 12 8	 65m 12 8	 85m 20 15	 85 to 140 9 or 16 13 or 36
Superelevation	None	None	None	None
Intersection Angle ***	70-110° at local, 80-100° at collector and arterial	70-110° at local, 80-100° at collector and arterial	80-100°	90°
Minimum Intersection Spacing (CL to CL)	34m	80m or approved	120m	250m
Minimum Stopping Sight Distance	-	65m	85m	-

* R.O.W. greater than minimums listed may be requested by Town.

** Except at 90° corners for crescents and courts.

*** All streets are to intersect at 90o unless existing road alignments or property restrictions required otherwise.
++ 18m R.OW may be considered, at the discretion of the Director of Public Works.

2.1.2 Road Pavement Design

The composition and construction of the road pavement shall be designed based upon the following factors as outlined in the geotechnical soils report:

a) Load bearing capability of the subgrade soil;
b) Drainage;
c) Frost susceptibility;
d) The future volume of class of traffic expected to use the pavement.

Pavements for all roads shall be designed for a minimum ADT - 1000 vehicles and an anticipated life of 25 years.

Laneway and Local
(Rural roads to be determined at time of application)
40 mm HL3 Surface Course
50 mm HL8 Binder Course
450 mm Granular 'A' Base

Collector
40 mm HL3 Surface Course
80 mm HL8 Binder Course
525 mm Granular 'A' Base

Arterial
The pavement design for arterial roads may be considered on an individual basis.
40 mm HL3 Surface Course
100 mm HL8 Binder Course
550 mm Granular 'A' Base

The above are minimum design requirements. The Developer may be required to engage a Geotechnical Consultant with experience in pavement design to confirm the minimum design based on results of local soils tests.

2.1.3 Transit – Road Design Elements

Consistent with OTM Book 18, where on-road bicycle facilities coincide with transit routes and stops (i.e. bus bays), the cycling facility should be delineated. If an in-boulevard active transportation facility is present, the facility should be designed to pass behind transit stops – if the space is available within the right-of-way width.

2.1.4 Traffic Calming

The primary function of Traffic Calming measures is to improve the liveability of neighbourhoods and improve public safety. In addition, well-designed and landscaped Traffic Calming measures can enhance a neighbourhood's appearance, quality of life for its residents and improve transportation mode split. Traffic calming measures may be incorporated into the planning of new neigbourhoods.

The following categories are several of the key types of Traffic Calming measures available to the Town of Pelham, as outlined in the TAC/ITE Canadian Guide to Neighbourhood Traffic Calming.

Horizontal Deflection – refers to two types of Traffic Calming measures.

1. The first type hinders the driver's ability to drive in a straight line by creating a horizontal shift in the road. This shift, forces drivers to slow their vehicles in order to safely navigate the measure.
2. The second type is designed to narrow the width of the travel lane. Doing so reduces the usable surface of the road causing drivers to slow their vehicles to maintain a comfortable driving condition. Horizontal deflection measures are mainly used to address speed concerns.

Vertical Deflection – refers to Traffic Calming measures that create a change in the height of the road. Vehicles must slow down over these measures in order to avoid unpleasant bumping

sensations. Vertical deflection measures are mainly used to reduce vehicle speeds, with minor effects on traffic volumes.

Physical Obstruction – refers to measures that prevent particular vehicle movements, thereby discouraging and eliminating cut-through traffic. The reduction in volume will depend on the nature of the Traffic Calming measure.

Signs and Pavement Markings – can be used as Traffic Calming measures that regulate traffic movements in lieu of physical changes to the road. These measures may produce the same effect as physical Traffic Calming measures. However, police enforcement may still be required.

Traffic calming measures may be required to be incorporated into an application at the discretion of the Town, based on speeding complaints, Council direction or other initiatives.

The following is a list of Traffic Calming measures and a description of each:

- Chicane: A series of curb bulb-outs staggered on alternating sides of the road, narrowing the travel lane and forces motorists to slow down as they navigate side to side through the chicane.
- Curb extension/bulb-out: An intrusion of the curb extending across a parking lane and narrowing the travel lane.
- Diagonal Diverter: Physical barrier placed across the centre of an intersection, prohibiting one direction of traffic.
- Lane Narrowing: Can be achieved through paint, barriers or curb
- Median Island: Prevents cutting through traffic between collector and local roads
- On-Street Parking: Allow vehicles to park parallel to the curb, reducing the travel portion of the road.
- Raised Crosswalks: This section of road is raised 75 mm (3 inches) to 150 mm (6 inches) above street grade.
- Raised Intersection: The section of road is raised 150 mm (6 inches) above the road.
- Right In/Right Out ("Pork Chop") Island: A raised island at an intersection that prevents left turns and through movements to and from an intersection.
- Semi-Diverter/Partial: Physical barrier blocks half the road prohibiting a Street Closure vehicle movement (one way in/out).
- Speed Cushions: A raised section of road, which deflects both the wheels and frame of a vehicle, forces vehicles to slow down over hump. Speed cushions have cutouts for emergency vehicle wheel base, to ensure larger wheelbased emergency vehicles can pass over without deflection.
- Street Closure: Extension of physical barrier across the width of a road creating a cul-de-sac and closing a road.
- Textured Crosswalks: A crosswalk designed of a different texture or pattern surface then that of the road, warns motorists they are entering a heavy pedestrian area.
- Traffic Circles: A raised island located in the middle of an intersection and forces vehicles to travel through the intersection in a counter-clockwise direction around the island.
- Turning Prohibition: Restrict specific turning movements into neighbourhoods, reduces cut-through traffic, enforcement required.
- Woonerf: Is a Dutch term for "living street". A shared space where pedestrians take priority and motorized traffic is restricted to a walking pace.

Bicycle Priority Streets/Bikeway Boulevard (OTM Book 18): A low-volume, low-speed Street that has been optimized for bicycle travel through treatments such as signage, pavement markings, intersection crossing treatments and restricting through travel by motor vehicles at some intersections.

Speed humps are not a preferred solution, as they may cause a wide range of other serious issues. This has resulted in their reduction in use and even removal in some municipalities. Speed humps reduce speed for all traffic including emergency vehicles and thus increase response times in emergencies. Speed humps have also been known to cause injuries. Speed cushions are a modified version of the speed hump.

2.1.5 Road Allowance Cross-Section

The typical road allowance cross-sections shall be as per **Standard Drawings**. Details shall be provided for any approved special provisions required due to unique physical conditions on the site or for existing or future design conditions such as retaining walls, slope protection, culverts, bridges or special crossfall conditions.

2.1.6 Road Sub-Drains

In general, sub-drains will be required to run continuous along both sides of all roads, as per OPSD 216.010.

Sub-drains will be required for a minimum length of 6m on the upstream side of all catch basins as per the recommendation of the Geotechnical Report.

2.2 Daylighting

When subdivision, condominium, or commercial / industrial streets intersect at any street or street intersection, land for daylighting triangles shall be required. The size of the daylighting required is based on the classification of the intersecting roads.

Private (multi-residence)to Local	2.5 m x 2.5 m
Private (multi-residence)to Collector	2.5 m x 3.5 m
Local to Local	3.5 m x 3.5 m
Local to Collector	5.0 m x 5.0 m
Collector to Collector	7.0 m x 7.0 m
Local/Collector to Arterial	12.0 m x 12.0 m

The Town may request additional daylighting above these requirements, if deemed necessary, notwithstanding Regional Government requirements.

2.3 Curbs

Barrier curb as shown on OPSD 600.040 shall be used on all streets with the exception of cul-de-sac bulbs and laneways. Saw cutting of curb or entrance depressions will be allowed. "Capping" of curb depressions will not be permitted. All depressions not used as property entrances shall be replaced with full barrier type curbing. Barrier type curbing shall be used on all Arterial, Collector, Local Collector roads and also residential streets where deemed necessary by the Town.

Mountable curbs as per OPSD 600.060 may be used in the curb section of the cul-de-sacs. Mountable curbing may also be used in specific situations and/or areas approved by the Town.

Any installations of curb faced sidewalk shall have full barrier burb installed as shown on OPSD 600.040. Installations of sidewalks closer than 2.9 m shall also have full barrier type curbing unless approved by the Town.

Poured two stage curb construction in accordance with OPSD 600.070 may be used with the approval of the Town. Where the curb cut does not match the driveway or replacement of the curb is required, the curb and gutter shall be replaced to the nearest construction or expansion joint for a minimum length of 3.0 m. Prior to placement of top asphalt, all curb repairs shall be completed.

2.4 Boulevards

The boulevard area (**Standard Drawings**) shall be excavated to a depth of 300 mm and backfilled with 175 mm clean fill material, free of stone, concrete, rocks and other extraneous material and compacted. The boulevard area shall then be filled with 150 mm of screened topsoil, compacted and sodded in accordance with Town requirements.

2.5 Sidewalks

Concrete sidewalks are required as specified by the Town.

Concrete sidewalks are not required along laneways, in the "Bulb" section of cul-de-sacs or along the longer side of crescents, unless otherwise specified by the Town.

The Sidewalk, also referred to as the Pedestrian Clearway, is the part of the boulevard dedicated to pedestrian movement. To promote active transportation and connectivity, sidewalks should be continuous and provided on both sides of the street where practical. The sidewalk should always be kept clear of obstructions and conform to Accessibility for Ontarians with Disabilities Act (AODA) specifications.

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- Sidewalks should be continuous and if possible connected to adjacent sidewalks.
- The location and design of crossings and curb cuts should conform to the AODA regulations. They should be clearly marked with surface markings or variation in treatment and be highly visible.

2.6 Bikeways Within the Road Right-of-Way

Bikeways form part of the transportation network for the Town of Pelham. Pelham's active transportation plan provides direction on potential cycling facility types to be implemented throughout the Town. Ontario Traffic Manual Book 18, TAC Bikeway Traffic Control Guidelines and the Town's cross-sections provide direction on the selection and design of preferred cycling routes and facilities.

In addition to the implementation of signed bicycle routes, there are three types of cycling facilities which could be considered within Pelham, as described in the Ontario Traffic Manual Book 18. They include:

- Conventional Bike Lane
- Separated Bike Lane
- Cycle Track

The selection of a preferred cycling facility will be determined based on a process which takes into consideration a set of consistent route selection criteria, context specific considerations and the function of the roadway. The final design including signage and pavement markings will be consistent with OTM Book 18.

2.7 Multi-Use Trails and Walkways

All walkways shall be a minimum of 3.0 m in width unless otherwise noted. They shall be excavated to a minimum depth of 300 mm. The excavation is to be backfilled with a minimum 225 mm compacted Granular "A" limestone plus 50 mm HL8 and 25 mm HL3A or HL2 asphalt. On either side of the walkway, the developer shall construct a 1.8 m high chain link fence consisting of Commercial type posts, wire coated in black vinyl, except such fence shall be 0.9 m high in any required front yard, unless otherwise agreed to with the Town. The optional 1.8 m high pressure treated board on board fence shall be located on private property. The posts shall be a minimum of 100 mm x 100 mm pressure treated wood and be

spaced no farther than 2.44 m and be located 50 mm inside the property line. All property bars that are disturbed by this construction shall be reset when construction has been completed.

2.7.1 In-Boulevard Facilities

The Town may select to implement a fully separated cycling facility in the form of an in-boulevard or an active transportation pathway (see OTM Book 18). These could include:

- One-way in-boulevard bicycle facility – this assumes that in addition to the one-way bicycle facility a sidewalk would be provided for pedestrians. Sidewalk to be off-set from the one-way bicycle facility by a minimum of 1.0m;
- Two-way in boulevard bicycle facility;
- Two-way in-boulevard shared facility.

2.8 Cul-de-Sacs

All local roads which permanently terminate at one end (dead end streets) shall be provided with a turning circle (cul-de-sac) of sufficient area to enable the turning of garbage trucks, snow removal equipment and other emergency vehicles. A road allowance with a 21.0 m radius will be required for a cul-de-sac with a pavement radius of 15.00 m.

All dead end streets longer than 100 m shall provide an emergency access for firefighting. A minimum width of 3.9 m; 225 mm compacted Granular "A" limestone; 50 mm HL8 and 25 mm HL3A or HL2 asphalt. Where a walkway is incorporated with the emergency access, the width shall be 4.5 m.

2.9 Laneways (Town-owned)

The function of laneways are to provide vehicular access to parking garages/areas located to the rear of a house/development that have frontages on another public street.

Drainage of laneways should be down the centre of the road and captured via catch basins when necessary. Refer to Standard Drawings.

Laneways are an important component of the circulation network, especially in downtown and urban areas, providing for access, loading, servicing and parking away from the main right of way, so that vehicle and pedestrian movement is not interrupted.

- Laneways should have 0.6 m setbacks from garages or any other structure.
- Storm sewers shall be required along the length of the laneways.
- Catchbasins shall be spaced a maximum of 100m apart.
- Permeable materials are encouraged for laneways where sufficient drainage exists.

2.10 Intersections

At the intersection of two roads, any transition of the minor classification road shall not interfere with the normal crossfall of the major road. Where possible intersections shall be utilized as the high point of the road.

All intersections meeting warrants for signalization or all-way stop control shall first be reviewed with the Town and analysed for the implementation of a roundabout prior to proceeding with intersection control design.

Channelization using traffic islands, medians and/or right-in / right-out “pork chop” islands shall meet warrants and be reviewed with the Town during design.

On roadways where cycling facilities pass through or approach an intersection, the Town should assess whether additional design

treatments to accommodate the movement of cyclists are necessary. Potential design treatments could include bike stencils, sharrows, bike boxes, dashed guide lines and green surface treatment. For additional details and design standards refer to OTM Book 18.

2.11 Driveways

Residential driveways shall be designed and constructed in accordance with OPSD 351.010. The width of curb cut for apartment, commercial and institutional driveways shall take into account the basic width of the driveway and the radius of curvature as further outlined below. Where mutual driveways are constructed between two adjoining properties, the curb cut-out shall be continuous. (i.e. where the barrier curb is less than 1.0 metre between driveways).

The radius of curvature from the road into apartment, commercial, institutional and industrial driveways shall be designed to accommodate the anticipated vehicular traffic without causing undue interference with the traffic flow on the street. As a minimum requirement, refer to OPSD 350.010.

The following minimum standards apply to driveway entrances:

*Asphalt (*OPSS 311 applies to this item)

i) Residential – 50 mm HL3F and 300 mm Granular 'A' base.
ii) Commercial – 40mm HL3, 50 mm HL8 and 375 mm Granular 'A' base.
iii) Industrial – 70 mm HL8 and 450 mm Granular 'A' base.

Driveways shall be located so that vehicles entering or leaving the establishment will not interfere with or create a hazard to the movement of traffic on the roadway. Where feasible, they shall be located where there are no sharp curves or steep grades and where sight distance is adequate for safe traffic operations. Driveways shall not be located within intersections, or adjacent turning radii. They shall be located so that they will not interfere with the placement of signs, traffic signals, or other devices that regulate traffic operations.

2.12 Traffic Control – Signs and Pavement Markings

2.12.1 Pavement Marking and Signs

A Pavement Markings and Signage Plan is to be prepared showing the location of all signs and markings to be installed on the road(s).

The location of all signs within the subdivision is to be included in the Pavement Markings and Signage Plan. A minimum of one interpretive sign per each stormwater facility and woodlot is required. Regulatory by-law signage is required at all open space frontages accessible by roads and trails, as well as all park entrances.

Pavement markings shall conform to the Ontario Traffic Manual, Book 11 (latest edition).

The following pavement markings are required:

a) Stop bars (0.3 m wide) at all intersections except local to local roads.
b) Lead-in lines (tails), 15 metres long, at all intersections except local to local roads.
c) Crosswalk lines and stop bars at 'all-way stop' intersections.
d) Directional arrows for all designated turn lanes at a signalized intersection.
e) Cycling facilities within the road right-of-way
f) Where boulevard multi-use trails are present, pavement markings crossrides at stop controlled and signal controlled intersections OTM Book 18.

2.12.2 Traffic Signals

Traffic signals shall comply with Niagara Region Standards.

2.13 Noise Barriers

In order to ensure attractive streetscape appearance, the Town discourages development layouts that require noise barriers. The heights of walls will be mitigated through the use of fence/berm combinations and landscaping. All aspects of installation must conform to Town policy.

It is important that continuity of appearance be achieved within neighbourhoods. Noise barrier walls shall be constructed of superior materials and may incorporate decorative masonry or pre-cast columns to provide design relief.

The maximum barrier wall height shall be 6.0 m, unless otherwise stated in a respective noise report. Greater height can be obtained using a combination of berm and wall to the satisfaction of the Town. Maximum height adjacent to rail lines shall be 6.0 m.

Barrier walls shall be located entirely on private property. Where the noise attenuation features include a berm and/or barrier wall, the noise attenuation feature shall be located entirely on private property.

The base of the street side of the wall should include a continuous planting strip mulched with shredded bark. The bed is to be planted with deciduous and coniferous shrubs and vines to provide year-round visual interest. Appropriate vines include Boston Ivy (Parthenocissus Tricuspidata Veitchii) and Virginia Creeper (Parthenocissus quinquefolia). Minimum spacing on centre for vines to be 5 m and for shrubs to be 1.2 m. The planting design should require low maintenance. The costs associated with installing any landscape maintenance systems will be the sole cost of the Developer or those necessitating the barrier if different. At the time of Assumption, the Developer may be required to remove the maintenance system and any unapproved plant material at their own expense.

Minimum grade for berms in turf areas that are to be mowed regularly shall be 4:1; naturalized areas are to be 3:1. 2:1 slopes may be allowed on low maintenance naturalized slopes. This will be assessed on a site-specific basis. Seed mixes for berms are to be selected from the recommended seed mixes, and may require approval from outside authorities.

2.14 Entrance Features

Entrance features are not a requirement of the Town except in identified areas of East Fonthill. A Developer may submit for approval a design proposal for entrance features which may consist of walls, gates, fences, trees, shrubs, flowers and other related components. Entrance features shall be located solely on private property.

2.15 Fencing

Fencing is required as follows:

a) 1.8 m high decorative pressure treated wood pressure or of a material approved by the Town prior to development, is required along rear or side yards flanking all public open spaces including walkways, parkland, watercourse blocks and woodlots, and to be located 0.05 m from property line on private property. This fencing shall be maintained by the property developer in perpetuity.
b) Black coated galvanized chain link fencing is required for sports field applications.

c) 1.8 m wood board-to-board privacy fence may be required in other locations where residential flankages and/or rear yards are adjacent to collector and arterial roads as deemed appropriate by the Town.
d) Fencing may be required for properties abutting utility corridors; Developer to consult with utility company.
e) Fencing will be required for properties abutting school board lands; Developers to consult with School Board.
f) Fencing may be required for entrances or natural features abutting the R.O.W.

The fencing materials used are to be consistent throughout a development.

Fencing is not required where noise barrier walls are to be installed.

Temporary and/or protective decorative fencing may be required to protect park blocks and/or open space corridors at the Town's discretion.

2.16 Landscaping

The Landscape Zone is indicated in every street type; however, its character may be significantly different depending on street type, adjacent uses and location. In general, the Landscape Zone includes space for street trees, planting boxes and/or a mix of soft and hardscaping. In urban or mixed-use areas, it may also contain street furniture and wayfinding and public signage to provide amenities for pedestrians, visitors and residents. In more rural settings, this zone will be primarily softscaped and consist of buffer planting, street trees or naturalized vegetation. The landscape zone is generally located between the curb and the sidewalk in order to provide an additional safety buffer between pedestrians and vehicles.

- The Landscape Zone includes street trees, other landscaping features such as planting boxes, street furniture and public wayfinding signage.
- This zone provides space for amenities that activate the street and create a more comfortable, accessible and appealing pedestrian environment. It also provides a safety buffer against car doors and mirrors, and can also accommodate road signage, snow storage, lighting and utility posts and/or below-grade utilities.
- This zone can be hardscaped or softscaped or, most commonly, a mix of the two. More rural or suburban areas will typically contain more softscaping, while Downtown and Urban Living Areas will contain more hardscaping.
- Both hardscaping and softscaping should be designed to be low maintenance and durable.
- On more suburban road typologies, low maintenance vegetation and trees can be planted to reduce wind speed and snow drifting and protect the soil on adjacent fields from erosion.
- In urban / town areas, street trees and planting areas can be used at the street edge to soften hard surfaces and buffer the pedestrian clearway from the road.
- Items in this zone shall not obscure sight lines or visibility, especially at intersections.

2.17 Trees

Street trees in urban settings provide a significant aesthetic, environmental and even financial benefit. Mature trees that develop a full canopy provide shade and UV protection, improve air quality, moderate climate, store and sequester carbon, and can increase property values and reduce energy costs. Trees planted in open pits can also reduce

stormwater run-off and need to be replaced less frequently than smaller trees in planters.

Trees shall be planted in accordance with "Urban Tree Foundation Specifications" for planting, staking and tree protection, found at http://www.urbantree.org/details_specs.shtml.

For optimal tree health:

- Trees should be planted 1.5 to 2 m from the curb if space allows.
- A soil cell system may be recommended by the Town in hard-surfaced downtown areas.
- 1 tree per lot, 2 trees/corner lot.
- Where possible, 1 tree per 15m on the frontage.
- Bio-swales or infiltration swales should be used to allow for natural watering of plant material and to reduce stormwater run-off.
- If trees are planted in a hard surface boulevard, tree grates, tree guards and underground utility boxes are recommended.
- Location and design of utility infrastructure (overhead wire, etc.) should ensure that it does not interfere with mature tree growth. Coordination with utility providers is important to minimize root and crown pruning during utility maintenance and to maximize tree pit and canopy size.
- Ensure that placement of street trees does not interfere with vehicle sight lines or with utility, water, sewer or storm infrastructure.
- Acceptable species for planting are listed in **Table 2.17a** and **Table 2.17b** below. Final selection is to be determined by the Town as factors such as availability, maturity, canopy size, functional area and maintenance are considerations for the Town.

TABLE 2.17A
RECOMMENDED STREET TREES

BOTANICAL NAME	COMMON NAME	NATIVE *	GROWTH HABIT	SIZE CLASS AT MATURITY	GROWTH RATE	CANOPY SIZE AT 20 YEARS
Acer x freemanii 'Celzam'	Celebration Maple		Excurrent	Medium	Med-Fast	5.5 m
Acer x freemanii 'Jeffersred'	Autumn Blaze Maple		Excurrent	Medium	Medium	9 m
Acer rubrum	Red Maple	*	Excurrent	Large	Fast	7.5 m
Acer saccharum ssp. nigrum	Black Maple	*	Decurrent	Large	Slow-Med	10 m
Acer saccharum	Sugar Maple	*	Decurrent	Large	Slow-Med	10.5 m
Amelanchier arborea	Common Serviceberry	*	Decurrent	Small	Slow-Med	4 m
Amelanchier laevis	Allegheny Serviceberry	*	Decurrent	Small	Slow-Med	3.75 m
Carya cordiformis	Bitternut Hickory	*	Excurrent	Large	Slow-Med	12 m
Carya ovata	Shagbark Hickory	*	Excurrent	Large	Slow	10 m
Celtis occidentalis	Hackberry	*	Decurrent	Medium	Med-Fast	11 m
Cercidiphyllum japonicum	Katsura Tree		Excurrent	Medium	Slow	4.3 m
Cercis Canadensis	Redbud	*	Decurrent	Small	Fast	9 m
Corylus colurna	Turkish Hazel		Decurrent	Medium	Medium	5.5 m
Gymnocladus dioicus	Kentucky Coffeetree	*	Decurrent	Large	Slow-Med	10 m
Juglans nigra	Black Walnut	*	Decurrent	Large	Med-Fast	14 m
Liriodendron tulipifera	Tulip tree	*	Excurrent	Large	Fast	12 m
Nyssa sylvatica	Blackgum tree	*	Excurrent	Large	Slow	10.6 m
Ostrya virginiana (Small understory tree good in a woodlot)	Ironwood	*	Excurrent	Small	Slow	5.4 m
Platanus occidentalis	American sycamore	*	Decurrent	Large	Fast	18 m
Platanus xacerifolia	London plane tree		Decurrent			
Quercus species (Alba, Rubra, Velutina, Bicolour, Macrocarpa, Shumardii, Muehlenbergii)	Oak	*	Varies	Large	Med-Fast	varies
Tilia americana	Basswood	*	Excurrent	Large	Medium	10 m

TABLE 2.17A RECOMMENDED STREET TREES						
BOTANICAL NAME	**COMMON NAME**	**NATIVE ***	**GROWTH HABIT**	**SIZE CLASS AT MATURITY**	**GROWTH RATE**	**CANOPY SIZE AT 20 YEARS**
Tilia cordata var.	Littleleaf Linden		Excurrent	Medium	Medium	6.4 m
Ulmus x 'Pioneer'	Pioneer Elm		Decurrent	Large	Medium	9.5 m

Ornamental pear may also be considered.

TABLE 2.17 B RECOMMENDED SPECIMEN AND FOUNDATION PLANTING TREES						
BOTANICAL NAME	**COMMON NAME**	**NATIVE ***	**GROWTH HABIT**	**SIZE CLASS AT MATURITY**	**GROWTH RATE**	**CANOPY SIZE AT 20 YEARS**
Acer grisium	Paperbark maple		Decurrent	Small	Slow	7.6 m
Amelanchier Canadensis	Downy serviceberry	*	Decurrent	Small	Medium	6 m
Cornus alternifolia	Pagoda dogwood	*	Decurrent	Small	Slow-Medium	6m
Cornus florida	Flowering dogwood	*	Decurrent	Small	Medium	6m
Cornus Kousa	Kousa dogwood		Decurrent	Small	Slow-Medium	6m
Hammamelis mollis	Chinese witch-hazel		Decurrent	Small	Slow	5.4 m
Hammamelis vernalis	Vernal witch-hazel	*	Decurrent	Small	Slow	5.4 m
Hammamelis xintermedia 'Arnold's Promise'	Witch-hazel		Decurrent	Small	Slow	5.4 m
Prunus maackii	Amur Chokecherry		Decurrent	Small	Slow	7.5m
Sambucus Canadensis	Common elderberry	*	Decurrent	Small	Fast	3 m
Viburnum lentago	Nannyberry	*	Decurrent	Small	Medium	3.6 m

2.18 Street Furniture

Street furniture design and placement should be part of a coherent strategy for the public realm that contributes to the creation of a sense of place and local identity. Throughout the Town of Pelham, there may be elements of a street furniture program that are consistent, as well as elements that change from village to village or neighbourhood to neighbourhood. Street furniture is an essential part of a pedestrian supportive streetscape and should be particularly concentrated in areas of high pedestrian activity, providing amenities for pedestrians and signalling to vehicle drivers that they should reduce speeds. Street furniture is most commonly located within the Landscaping Zone, where it does not impede pedestrian movement.

- Street furnishings can include benches, lighting, bicycle infrastructure and waste receptacles.
- Furniture should be placed in a coordinated manner that guides movement through the Town, but does not clutter streets and sidewalks.
- A consistent palette of street furniture should be used, but it should be deployed in a variety of ways and groupings to create interest on the street and respond to site-specific conditions.
- Each element should be made of durable materials that are long-lasting, easily maintained and comfortably used.
- Furniture should generally be located in the Landscaping Zone and should not obstruct the sidewalk area or hinder snow removal.

2.19 Street Lighting

Please refer to Illumination Section in manual.

2.20 Utility Installation

Location and installation details for utilities must be approved by the Town and utility provider prior to the installation.

All utility trenches within the road allowance are to be backfilled and compacted to 95% Standard Proctor Density. Backfill material shall be in accordance with the requirements of the Town and utility authority.

The Developer is responsible to ensure that there is no conflict of plants and appurtenances with other utilities, driveways, tree planting pits, etc.

The location of all street furniture locations shall be submitted with plans for driveway cut locations.

Joint utility trenches are required unless impractical and at the Towns discretion. Utility placement shall be as per **Standard Drawings** unless otherwise approved by the Town and utility provider.

2.20.1 Utilities

The impact of utility infrastructure on the streetscape should be minimized through design and placement. Where possible, this infrastructure should be located below-grade, and where this is not possible, it should be grouped, located away from public spaces and/or screened from public view.

- Utility infrastructure should be located below-grade or integrated into building design wherever possible.
- Where this is not possible, location and design should minimize the impact of this infrastructure on the streetscape and public realm.
- Where located above-grade, utilities should be grouped, located in discrete

locations or away from the public right-of-way, and/or screened from public view.

- If located below-grade, utilities should be located within the street right-of-way or a front yard easement in a joint utility trench (JUT) that can be accessed for repairs without disturbing street trees.

3 STORM WATER MANAGEMENT

3.1 General

Within the urban settlement areas, a storm sewer system shall be used to collect runoff from lots and within the right-of-way, and the storm sewer system shall be constructed on every street where curb and gutter is used.

The construction of all storm sewer system components and service connections in the Town of Pelham shall be in accordance with this document and latest revisions, as well as MOECC guidelines:

The Developer and/or Consultant shall meet with the Town prior to commencement of detailed design to establish the acceptable methodology for determination of stormwater design flows, required by the Town and to determine a suitable storm outlet. This may be achieved in a pre-consulting process.

Final approval for storm sewer systems and alterations to an existing watercourse as well as new outlets and stormwater management facilities are under the jurisdiction of the Ontario Ministry of Environment and/or Ontario Ministry of Natural Resources and/or the Niagara Peninsula Conservation Authority.

The Consultant should contact these agencies early in the design phase to obtain their requirements.

3.2 Design Requirements

3.2.1 Minor and Major Systems

The design of the storm drainage system shall comprise both the minor system and major system. Storm sewers shall be designed to convey run-off for the Town of Pelham's five (5) year design storm without surface ponding or surcharging.

Minor Drainage System - Consists of water conveyed by roof gutters, rainwater leaders, service connections, street gutters, catch basins, and storm sewers.

Major Drainage System – Consists of the natural streams, valleys, constructed swales, channels, ponds, and streets.

The major system shall convey the Town of Pelham's 100 year design storm overland within the right-of-way leading to the watersheds major outlet. Relief shall be provided in low points to prevent the depth of ponding at centre line from:

- 0.3m maximum on roads determined to be emergency access
- 0.2m maximum on local roads
- 0.15m maximum on collector roads
- 0.1m maximum on arterial roads

3.2.2 Rational Method

Where applicable, the design of the storm sewers for the minor system may be designed according to the rational formula where:

Q = 2.78 AiR
A = Area in hectares
i = Average rainfall intensity - mm/h
R = Run-off coefficient
Q = Run-off quantity in l/s

3.2.3 Watershed and Drainage Areas

The watershed area shall be determined from contour plans and shall include all areas that naturally drain into the system and shall also consider all lot grading plans for proposed developments.

A plan of the watershed area shall be prepared and shall include all affected streets, lots and watercourses. The proposed storm sewer system shall be shown on this plan including

each maintenance hole numbered consecutively for design reference. Maintenance holes shall be located at each and every change of pipe size, grade and alignment.

Maintenance holes shall be the tributary points in design. The areas tributary to each maintenance hole shall be clearly outlined on the storm drainage area plan with the area in hectares (to the nearest 100th) and run-off coefficient or parameter shown in a circle with a reference number.

$$\text{Thus} \quad \frac{4.6 \text{ ha}}{0.5}$$

In cases where areas of different run-off coefficients are tributary to one maintenance hole, the areas tributary to the maintenance hole shall be individually outlined. The tributary area and run-off coefficient for each area shall be shown as set out above.

In determining tributary areas to maintenance holes, the proposed grading of lots must be considered and taken into account in order to maintain consistency in design.

In the case of large tributary areas under single developership, such as shopping centres, apartment developments, schools, etc., the design shall be prepared on the basis of the whole area being tributary to a maintenance hole in an abutting storm sewer. When more than one sewer connection will be necessary to service the property in question, the appropriate area tributary to each sewer connection shall be clearly shown and taken into account in the design of the storm sewer.

At the Towns discretion, in lieu of precise information on development of the whole or any part of a watershed area, the latest approved Zoning By-law and Plans shall be used to select the correct values of the run-off coefficients and parameters to be used in the design and to determine the specific areas where they will apply.

3.2.4 Rainfall Intensity

The values of the rainfall intensity shall be determined using the IDF curves as described through the MTO IDF Lookup Tool which can be found on the MTO website using the following link:

www.mto.gov.on.ca/IDF_Curves

Storm frequency values for both the minor and major systems are as follows:

- Minor System – 5 Year Storm
- Major System – 100 Year Storm (for all watercourses)

Generally inlet time or initial time of concentration is to be 10 minutes.

IDF Curves and Storm Depths for Pelham are listed in **Table 3.24:**

Table 3.24 IDF Curves

Return Period (Yrs.)	A	B
2	22.5	-0.699
5	29.7	-0.699
10	34.5	-0.699
25	40.6	-0.699
50	45.1	-0.699
100	49.5	-0.699

$$I=AT^B$$

Where: A,B = above
I = Intensity (mm/hr)
T = Storm Duration (hr)

3.2.5 Run-off Coefficients

Values for the run-off coefficient "R" are listed below, these are recommended run-off coefficients, which may vary depending on lot coverage of impervious surfaces:

Parks	
• over 4 hectares	c = 0.20
• under 4 hectares	c = 0.20
Schools	c = 0.75
Single Family Residential	c = 0.40
Semi-Detached	c = 0.50
Maisonettes, Townhouses	c = 0.65
Churches	c = 0.80
Apartment	c = 0.80
Industrial	c = 0.85
Commercial	c = 0.90
Paved Area	c = 0.90 or 1.00

3.3 Maintenance Holes

3.3.1 General

All maintenance holes are to be supplied or constructed in accordance with OPSD 701 Series. Maintenance holes shall be constructed as per Town Standards Drawings, however, it is the responsibility of the designer to analyze each application of the standard (i.e. soil conditions, loading, etc).

3.3.2 Purpose

Maintenance holes shall be provided at each change in alignment, grade and pipe material.

3.3.3 Spacing

Generally, maintenance holes shall be spaced at:

- A maximum of 100 m for pipe sizes 250 mm diameter to 750 mm diameter;
- A maximum of 120 m for pipe sizes 825 mm diameter to 1,200 mm diameter;
- A maximum of 150 m for pipe sizes greater than 1,200 mm diameter.

3.3.4 Structures

Maintenance holes shall be constructed of poured or precast concrete as per OPSD 701 Series, with watertight connections.

3.3.5 Benching

All benching inside maintenance holes shall be as determined in OPSD 701.021, and be completed to obvert. Benching for large pipe diameters are to be indicated in a typical detail.

3.3.6 Diameter

The type and size of maintenance hole shall be specified on the profile of the engineering drawing, in accordance with manufacturer's recommendations.

3.3.7 Access

All maintenance hole chamber openings shall be located parallel to flow direction.

3.3.8 Change in Direction Flow

Storm sewer pipe shall not be turned more than 90° in any maintenance hole. The maximum change in direction of flow in maintenance holes shall be based on manufacturers' guidelines

3.3.9 Drop Across Maintenance Hole

When pipe size does not change through a maintenance hole and the upstream flow velocity does not exceed 1.5 m/s, the following allowances shall be made to compensate for hydraulic losses.

Alignment Change Required	Drop
• Straight run grade of sewer or	0.03m
• 14° < 45°	0.03 m
• 45° to 90°	0.06 m

When the upstream flow velocity exceeds 1.5 m/s or for all junction and transition maintenance holes the drop shall be hydraulically designed.

3.3.10 Drop Structures

The maximum drop allowed across a maintenance hole is 900 mm. If the design of the sewer is such that the difference in elevation between inlet and outlet exceeds 900 mm, a drop structure is then required. The drop structure shall be in accordance with OPSD 1003.010 or 1003.031. if a large drop occurs in a maintenance structure other types of structures to accommodate this drop shall be explored and approved by the Town. If a drop structure is necessary, by the designer, a 600 mm sump shall be accommodated to eliminate the possibility of erosion to the bottom of the structure.

3.3.11 Safety Grates

Safety grates shall be required in all maintenance holes greater than 5.0 m in depth. Safety grates shall not be more than 5.0 m apart and constructed in accordance with OPSD 404 Series. Platforms shall be installed at the halfway point.

3.3.12 Matching Obverts

Obvert(s) on the upstream side of a maintenance hole should in no case be lower than obvert(s) on the downstream side of the same maintenance hole. A design may be submitted for approval on an individual basis in relation to sewer installations. The Town may approve alternative designs with outlet issues.

3.4 Pipe Design and Materials

3.4.1 General

The class and type of pipe and type of pipe bedding shall be shown on the profile for all lengths of sewer. All storm sewers shall preferably be located as shown on the appropriate road cross-section standard. Generally, the pipe sizes shall not decrease from a larger size upstream to a smaller size downstream regardless of the increase in grade. Subject to the approval of the Town, radius pipe will be permitted to achieve changes in horizontal alignment for sewers 1,050 mm in diameter or larger. The minimum radius allowed for various diameters of pipe shall be as detailed in the manufacturer's specification. Pipe bedding and class shall be designed to suit ultimate loading conditions.

Pipe bedding and class of pipe shall be designed to suit ultimate loading conditions in accordance with OPS, latest version.

3.4.2 Sewer Design Capacity

Manning's Formula shall be used to compute the capacity of storm sewers. The capacity of the sewer shall be calculated on the basis of the pipe flowing full such that $Q_{Peak} \leq 0.8(Q_{Pipe\ Full})$

3.4.3 Roughness Coefficient

The roughness coefficient to be used for storm sewer pipes shall be:

a) Concrete Pipe: n = 0.013 for all sizes of pipes
b) PVC: n = 0.013 for all sizes of pipes
c) Corrugated Metal: based on MTO recommended roughness coefficient

3.4.4 Velocity, Grade and Size

The full flow velocity in storm sewers shall be generally limited to a minimum of 0.60 m/s and a maximum of 6.0 m/s, in accordance with MOECC Guidelines. The following are the minimum slopes in which shall be provided for storm sewers (in accordance with MOECC Guidelines):

Pipe Size	Minimum Slope (%)
200 mm	0.400
250 mm	0.280
300 mm	0.220
375 mm	0.150
450 mm	0.120
525 mm	0.100
600 mm	0.080
675 mm	0.067
750 mm	0.058
825 mm	0.052
900 mm	0.046
975 mm	0.041
1,050 mm	0.037
1,200 mm	0.048
1,350 mm	0.042
1,500 mm	0.036
1,650 mm	0.031
1,800 mm	0.028
1,950 mm	0.025
2,100 mm	0.023

3.4.5 Minimum Depth

The minimum cover to the top of pipe shall be 1.5 m. In all cases, the proposed storm sewers shall be installed at sufficient depth to service lands external to the site as determined by the Town.

3.4.6 Location

Where practical, storm sewers shall be located on the road allowance, as shown in Standard Drawings. If common trenching is required for the storm and sanitary sewer, the Consultant shall prepare special design standards and provide to the Town the specification for such requirements. Any non-standard design for locations will require the approval of the Town.

3.4.7 Crossings

Generally a minimum clearance of 150 mm shall be provided between the outside of the pipe barrels at the point of pipe crossing for sanitary sewers and other utilities except for watermain crossings, where the minimum clearance shall be no less than 500 mm. Wherever possible, the storm sewer shall be below the watermain. Requirements of section 5 will take precedence.

In the event that the minimum clearance of 200 mm cannot be obtained, then the pipes at the crossing shall be concrete encased to ensure that the pipes are properly bedded.

3.4.8 Pipe Materials

Mainline storm sewers shall be constructed of concrete pipe. High Density Polyethylene (HDPE) pipe may be used for culverts. The classification of pipe to be used shall be clearly indicated on the plans.

- Reinforced concrete sewer pipe 300 mm in diameter and larger shall be steel reinforced and shall conform to CSA Specification, or latest revision thereof, Class 50D, 65D, 100D or 140D, as required.
- The use of polyvinyl chloride pipe (PVC) is permitted for catch basin lead application only. The pipe shall be CSA B182.1M and B182.2M, and have a maximum SDR of 35.
- Corrugated steel pipe (CSP) shall conform to AASHO specification M218, M136, M190 and M167.
- Concrete and PVC pipes shall be jointed by means of approved rubber gaskets.
- HDPE pipe for culverts shall be one continuous piece if possible with a smooth inside walled pipe .

3.5 Inlet and Outfall Structures

Developers should contact the Niagara Peninsula Conservation Authority (NPCA) to ascertain permit requirements.

Inlet and Outlet structures including headwalls shall be fully designed and submitted in detail.

Grates shall be provided on all inlet and outfall structures 450 mm in diameter or greater and shall be fully designed and detailed including locks where applicable.

In general, inlet grates shall consist of vertical parallel bars or rods sloping approximately 45° away from and in the direction of the flow. Outfall grates shall consist of horizontal bars or rods placed perpendicular to the flow. Spacing between the bars or rods shall be as per OPSD 804.050.

3.6 Catch basins

3.6.1 General

Catch basins shall be precast and cast-in-place as per OPSD Series 700. The storm sewer connections to the main sewer shall be made with an approved manufactured tee for main sewer sizes up to and including 450 mm diameter and in accordance with Town requirements for larger sizes (i.e. when sewer diameter less than 2 x lateral diameter).

3.6.2 Catch basin Spacing

The maximum spacing of catch basins shall be as follows:

Road Gradient	Maximum Spacing
0.5 % to 3.0 %	90 m
3.0 % to 5.0 %	75 m
5.0 % to 6.0 %	60 m

3.6.3 Pipe Size

Storm sewer connections for catch basin leads within roads, multiple family and other blocks, Commercial and Institutional Areas – to be sized individually according to the intended use.

Single Catch Basins:
200 mm diameter at 2% slope minimum

Double Catch Basins
250 mm diameter at 1.0% slope minimum

3.6.4 Location

Where changes of grade occur, the average gradient shall determine the maximum spacing. Catch basins should not be located within 1.5 m of the curb depression for a driveway or sidewalk. At intersections, catch basins shall be installed so that no more than 15 m of gutter will drain past the upstream point of tangency.

In sags, when drainage is received from more than one direction, double catch basins shall be installed and the maximum length of gutter contributing from each side shall be 75% of the spacing permitted above.

Catch basins are required at the throat section of cul-de-sacs.

Private catch basins may be permitted in rear yards to permit drainage to the storm system on the street, but easements shall be required. Minimum 3m, registered on title, with restriction of use clause.

3.6.5 Private Rear Yard Catch basins

Rear yard catch basins (RYCB) and leads shall be included in the overall grading and drainage design to provide outlets for rear yard swales. The maximum distance from the swale high point to the RYCB or between the RYCB shall be the lesser of 50.0 m or four single family lots.

Easement requirements for RYCB and leads shall be a minimum width of 3.0 m as per **Section 3.8** herein and shall be conveyed in favour of the Town of Pelham for storm drainage purposes. Required easements shall be clearly shown on the drawings including a typical RYCB lead offset, minimum 400 mm from the easement line.

For the installation of connections to RYCB every effort must be made to install the lead so that it will outlet to a maintenance hole within the right-of-way.

Note: Private service maintenance holes to be located on private property.

3.7 Culverts

The minimum driveway culvert size shall be 400 mm diameter. Culverts required on major system watercourses shall be designed to convey the 1:100 year storm or the backwater effects for the 1:100 year storm flows must be determined.

3.8 Easement Requirements

Table 3.8
Easement Requirements

Size of Pipe	Depth to Obvert	Easement Width
250 to 375 mm	2.6 m maximum	3.0 m Minimum
450 to 1,500 mm	2.6 m maximum	6.0 m
1,650 mm and greater	2.6 m maximum	6.0 m plus 3 times O.D. of pipe

Regardless of the above Easement Requirements, all situations will be reviewed and judged on individual cases at the discretion of the Town.

The Developer must grant permanent easements for any drainage works which are not within the road allowance to the Town, when required by the Town.

3.9 Storm Sewer Service Connections

3.9.1 General

All sewer service connections shall be installed in accordance with OPSD 1006.010 or OPSD 1006.020. Sewer service connections may be installed in a common trench provided the trench detail is provided to and approved by the Town. No connections may be made directly to catch basins.

Sewer service connections shall be provided with suitable stoppers (airtight plugs for sanitary) 1.5 m inside the property line complete with 50 mm x 100 mm timber markers identifying such connections.

The following minimum pipe sizes are required for residential services:

Storm sewer services

150 mm PVC DR 28 for single service
150 mm PVC DR 28 for dual service and
150 x 100 Wye PVC DR 28 for dual service

Minimum grade 1.0% for 150 mm
Maximum grade 8.0%

Colour shall be white to reduce risk of cross connection.

3.9.2 Depth

The depth of service connections at the street line in residential areas, measured from the final centreline road elevation shall be:

Minimum 1.50 m
Maximum 2.50 m

Risers shall be used when the invert depth of the sewer main exceeds 4.0 m. Risers shall not exceed 3.0 m in depth.

3.10 Roof Leaders and Foundation Drains

Roof drain connections to the storm or sanitary sewer service connection are prohibited. Roof leaders shall discharge on grade at least 900 mm away from the building foundation walls with drain extensions or splash pads. Flows shall be directed away from the building towards side or rear yard swale without any erosion or impact to adjacent property.

Direct connection of foundation drains without sump pump system are not permitted.

Foundation drainage must be directed to sump pumps and discharged to grade or a storm sewer lateral is so installed fitted with a normally closed backwater valve.

3.11 Stormwater Management Facilities

a) All permanent pool/"wet" ponds shall be enclosed with a fence in
accordance with Town Standard Drawings, or as approved by the Director of Public Works.
b) Where a SWM pond is to be located adjacent to residences, a minimum 3.0m wide "flat" area will be
provided to serve as a groomed buffer area.
c) SWM ponds are to be fully graded, groomed and planted within three months of excavation/construction.
d) Underground storage tanks will only be considered in exceptional circumstances and must be supported by a thorough technical analysis to the satisfaction of the Director of Public Works or
designate.

The following section outlines some of the typical SWMP's used for treatment of road drainage. The SWMP's represented in this report are preferred by the Town of Pelham however other SWMP's as detailed in the MOECC 2003 Guidelines shall be considered where the Developer demonstrates the suitability of the preferred SWMP. All SWMP's shall be designed in accordance with the MOECC 2003 Guidelines and where applicable with consideration for the guidelines presented in the Toronto Region Conservation Authority and Credit Valley Conservation Authority 2010 Low Impact Development Guidelines (TRCA and CVC LID Manual).

3.11.1 Swales

Swales should be designed with a minimum longitudinal slope of 2.0% to provide adequate flow velocity. Swales are not to be designed according to natural channel design principles, but shall provide a flow conveyance function only. Swales may have 3:1 maximum side slopes. The maximum flow velocity within grassed swales should be 1.2 m/s to prevent erosion. Swales with flow velocities above 1.2 m/s should be designed with appropriate erosion protection. Within residential rear yards flow velocities should be minimized and have a maximum velocity of 1.2 m/s. Swales providing stormwater quality treatment should adhere to the MOECC 2003 Guidelines.

3.11.2 Bio-swales

Bio-swales provide the same quantity control as a typical swale, however they offer the added benefit of providing some quality control as well through the use of biological systems to remove pollutants from the runoff prior to entering the receiving system. Bio-swales providing stormwater quality treatment should adhere to the MOECC 2003 guidelines as well as the TRCA and CVC LID Manual.

3.11.3 Joint SWM Facility

Where a SWM Facility currently exists or is proposed to support future development the Town of Pelham will consider the opportunity to convey road drainage to be controlled in a Joint SWM Facility. Proponents will be required to show that grading of the road and SWM Facility allows safe and efficient conveyance of water from the road surface to the SWM Facility without negatively impacting the right of way. SWM Facilities should adhere to the MOECC 2003 Guidelines for criteria and design constraints.

3.12 Low Impact Development

Low Impact Development (LID) represents the application of a suite of BMPs normally related to source and conveyance stormwater management controls to promote infiltration and pollutant removal on a local site by site basis. These measures rely on eliminating the direct connection between impervious surfaces such as roofs, roads, parking areas, and the storm drainage system, as well as the promotion of infiltration on each development or redevelopment site.

The benefits from LID stormwater management practices are generally focused on the more frequent storm events (e.g. 2 year storm) of lower volumes as opposed to the less frequent storm events (e.g. 100 year storm) with higher volumes. It is also recognized that the forms of LID practices which promote infiltration or filtration through a granular medium provide thermal mitigation for storm runoff.

With respect to water quality and applying LID practices, all urban stormwater runoff is not equal, therefore the application of LID practices has to be considered carefully. Urban runoff water quality can vary depending on land use, age of development and existing stormwater management in place. Roads and/or parking lots have vehicular traffic and receive salt and sand during winter months. Roofs on the other hand typically produce relatively "clean "runoff, which can be directed to LID infiltration practices without pretreatment. Relatively clean runoff should be prevented from mixing with reduced quality runoff, which would make infiltration impractical.

Guidelines regarding the application of LID practices and techniques have been developed within various jurisdictions in the United States and Canada. The Toronto and Region Conservation Authority and Credit Valley Conservation have released the 2010 Low Impact Development Stormwater Management Manual, for the design and application of LID measures. Some LID techniques which have the potential to reduce or treat runoff from the right of way are detailed in the following sections.

The issues and challenges associated with the implementation of Low Impact Development BMPs relate primarily to the fact that these measures are typically "on-lot" within private control, outside of the direct control of the Municipality. Due to this basic circumstance, the question is raised by municipal managers as how best to ensure that the "on-lot" measures are maintained, working, and not removed by private landdevelopers and/or businesses. Clearly, by installing these Best Management Practices on private property, there will be an eventual loss of effectiveness, either through lack of maintenance and/or removal in their entirety. The question relates to what extent this "loss" will occur and will this vary by land use.

Notwithstanding, Low Impact Development Best Management Practices in developing subwatersheds, have the potential to reduce the scale and scope of conventional end-of-pipe stormwater management systems. The Town is supportive of the implementation of LID,

however, these measures are only effective with regular maintenance.

3.12.1 Enhanced Grassed Swales

The Town supports the use of enhanced grassed swales, where applicable, for stormwater quality treatment, provided that minimum length, velocity, flow depth and slope criteria are met for full functionality. The MOECC 2003 Guidelines provide design criteria for enhanced grass swales and should be incorporated into the swale design. Where it does not conflict with the MOECC 2003 Guidelines, the TRCA and CVC LID Manual should be used for detailed design.

3.12.2 Filter Strips

Filter strips are only considered appropriate for low-density development, roads and small drainage areas (< 2 ha). Vegetated filter strips should be located adjacent to watercourses and drainage swales, as these systems can receive the sheet flow produced by the filter strip. The MOECC 2003 Guidelines should be adhered to in the design of the filter strip. Where it does not conflict with the MOECC 2003 Guidelines, the TRCA and CVC LID Manual should be used for detailed design.

3.12.3 Buffer Strips

Buffer strips comprise natural areas located between development and the receiving water system or natural area. Buffer strips should be established and defined at the subwatershed planning level with input from the Conservation Authority, Town, Niagara Escarpment Commission and provincial agencies such as MNR.

3.12.4 Sand Filters

Sand filters shall be limited to a drainage area less than 5 ha. Sand filters shall require a form of pre-treatment and shall not be used as a stand-alone SWMP. The type of filter shall consider the surrounding soil condition and the possibility of being connected to the proposed storm system. The MOECC 2003 Guidelines outline the conditions and criteria for filters.

3.13 Other SWMP Options

The following section includes SWMP's which should be considered where the implementation of other SWMP's are not possible or practical.

3.13.1 Oversized (Super) Pipes

Super pipes provide subsurface storage to reduce post development peak flow rates to receiving storm sewer systems. The Town of Pelham may permit the use of oversized pipes to provide quantity control only for redevelopment, infill areas, and some smaller developments, when no other practical alternative exists. The Developer shall incorporate the MOECC 2003 Guidelines into the super pipe design.

3.13.2 Oil/Grit

Oil/grit separators are most appropriate for all land uses. Oil/grit separators typically serve impervious drainage areas under 2 ha and are predominantly encouraged by the Town to be used for spill control. In situations that involve spill management controls, effluent from oil/grit separators is governed by the local Sewer Use By-Laws. Oil/grit separators are also appropriate for providing water quality control for redevelopment, or infill areas which typically have space limitations. The MOECC 2003 guidelines shall be followed in incorporating an oil/grit separator as part of the water quality protection for a site. Oil/grit separator manufacturer's technical guidelines should be consulted in the sizing of a unit. Oil/grit separators should be located within an easement that allows access by Town staff for

the purpose of inspection and maintenance, if necessary.

4 SANITARY WASTE COLLECTION

4.1 General

The design and construction of all sanitary sewers and service connections in the Town of Pelham shall be in accordance with this document and latest revisions.

4.2 Design Requirements

4.2.1 Design Flows

Calculation of sewage design flows shall conform to the latest editions of the Regional Municipality of Niagara, Water and Wastewater Project Design Manual, latest version, and the Ontario Ministry of the Environment's " Design Guidelines for Sewage Works".

4.3 Maintenance Holes

4.3.1 General

All maintenance holes are to be supplied or constructed in accordance with OPSD 701 series. It is the responsibility of the designer to analyze each application of the standard (i.e. soil conditions, loading, etc).

In site plan applications, a 'service' maintenance hole if required shall be located on private property near the entrance of the service as close as possible to the property line as per the Niagara Regional Sewer Bylaw #27-2014.

4.3.2 Purpose

Maintenance holes shall be provided at each change in alignment, grade, pipe material and at all junctions, and at the points of connections of sewer over 200 mm in diameter where the size of connection is equal to or one size smaller than the Town sewer.

4.3.3 Spacing

Generally, maintenance holes shall be spaced at:

- a maximum of 100 m for pipe sizes 200 mm diameter to 750 mm diameter;
- a maximum of 120 m for pipe sizes greater than 750 mm diameter.

4.3.4 Structures

Maintenance holes shall be constructed of poured or precast concrete as detailed in the OPSD 701 series with watertight connections KOR-N-SEAL type or approved equal.

4.3.5 Benching

All sanitary maintenance holes shall be benched as per OPSD 701.021 and be completed to obvert.

4.3.6 Diameter

The type and size of maintenance hole shall be specified on the profile and a detail of the benching is to be shown on the plan portion of the engineering drawing. The minimum maintenance hole sizes shall be determined using OPSD 701.021.

4.3.7 Access

All maintenance hole chamber openings shall be located parallel to flow direction.

4.3.8 Change in the Direction of Flow

The maximum change in the direction of flow in a sanitary sewer maintenance hole shall be 90°. A change of flow direction at acute interior angles shall not be permitted.

4.3.9 Drop Across Maintenance Holes

When pipe size does not change through a maintenance hole and the upstream flow velocity does not exceed 1.5 m/s, the following

allowances shall be made to compensate for hydraulic loses.

Alignment Change	Drop Required
a) Straight run	0.03m or grade of sewer
b) 14° < 45°	0.03m
c) 45° to 90°	0.06 m

When the upstream flow velocity exceeds 1.5 m/s or for all junction and transition maintenance holes the drop shall be hydraulically designed.

4.3.10 Drop Structures

The maximum drop allowed across a maintenance hole is 0.9 m. If the design of the sewer is such that the difference in elevation between inlet and outlet exceeds 900 mm, a drop structure is then required. The drop structure shall be in accordance with OPSD 1003.010 or 1003.031. The Town prefers to avoid the use of drop structures wherever possible.

4.3.11 Safety Grates

Safety grates shall be required in all maintenance holes greater than 5.0 m in depth. Safety grates shall not be more than 5.0 m apart and constructed in accordance with OPSD 404 series.

4.3.12 Matching Obverts

Obvert(s) on the upstream side of a maintenance hole shall in no case be lower than obvert(s) on the downstream side of the maintenance hole.

4.4 Pipe Design and Materials

4.4.1 General

The class, type of pipe and type of pipe bedding shall be shown on the profile for each section of sewer and shall be CSA approved.

In general, no decrease of pipe size from a larger size upstream to a smaller size downstream will be allowed regardless of increase in grade.

Pipe bedding and class of pipe shall be designed to suit ultimate loading conditions in accordance with OPS, latest version.

Generally, service connections shall not be permitted to sanitary sewers exceeding 7.60 m in depth. Depth is measured from the final centreline finished road elevation to the top of the sanitary sewer.

4.4.2 Sewer Design Capacity

Sewer capacities shall be computed by using Manning's Formula on the basis of sewer pipe flowing full, however the actual flow depth and velocity at the design flow shall also be calculated and taken as the basis for design. Design flows should be in accordance with MOECC guidelines (Design Guidelines for Sewage Works 2008).

4.4.3 Roughness Coefficients

For all types of pipe, a roughness coefficient of n = 0.013 shall be used.

4.4.4 Pipe Velocity

All sanitary sewers are to be designed with a minimum full flow velocity of 0.60 m/s and a maximum velocity of 3.0 m/s when flowing full. The minimum slope in the highest, or starting, leg of a sanitary sewer shall have a slope of no less than 1%

4.4.5 Minimum Depth

Depth is measured from the final centreline finished road elevation to the top of the sanitary sewer at standard location.

For residential, commercial and institutional areas, the minimum depth is 2.5 m unless approved by the Town.

In all cases, the proposed sanitary sewers shall be installed at sufficient depth to service lands external to the site as determined by the Town.

4.4.6 Clearances

Horizontal and vertical separations between sanitary sewer and watermains shall be in accordance with MOECC F-6-1 Guidelines, latest version.

A minimum of 0.25m clearance shall be obtained at storm and utility crossings, using outside pipe diameter.

Sanitary shall also be 0.5m below any crossing, and must be below watermain.

In the event the minimum clearances cannot be obtained, then the pipes at the crossing shall be concrete encased to ensure that the pipes are properly bedded.

4.4.7 Location

Sanitary sewers shall be located within the road allowance as shown in **Standard Drawings**.

If common trenching is required for the storm and sanitary sewer, the Developer's consultant shall prepare special design standards and provide to the Town the specification for such requirements. Any non-standard design for locations will require the prior approval of the Town.

4.4.8 Pipe Materials

Sanitary sewer shall be constructed of polyvinyl chloride or concrete pipes.

a) Polyvinyl Chloride Pipe (PVC)

PVC pipe shall be solid wall manufactured in accordance with the latest revision of CSA B182.1 or B182.2 and green in colour.

The design of sanitary sewer systems using PVC pipe shall be based on the modified Spangler Equation for flexible pipe.

b) Concrete

Reinforced concrete sewer pipe 300 mm in diameter and larger shall be steel reinforced and shall conform to CSA A257 Specification, and be designated as, Class 50D, 65D, 100D or 140D, as required.

Concrete and PVC pipes shall be jointed by means of approved rubber gaskets.

Note:
For main sewers, the Standard Dimension Ratio (SDR) of the PVC pipe shall not exceed SDR 35. For service connections, the SDR of the PVC pipe shall not exceed SDR 28.

4.5 Easement Requirements

The minimum width of easements for pipes shall be determined by the developer's consulting engineer and approved by the Town to account for number of pipes, pipe size, depth, excavation of open cut method and location of proposed building foundations. In no case shall the easement width be less than 3.0 m.

The developer must grant permanent easements for any drainage works which are not within the road allowance, to the Town or respective/impacted neighbouring property and a restriction of use clause shall be registered on title restricting landscaping and fencing activities.

4.6 Sanitary Sewer Service Connections

All sanitary sewer service connections for single and semi-detached dwellings shall be individual services. The connection to the main sewer shall be made with an approved manufactured tee or approved saddle. In new developments, the service connections shall be installed in accordance with the Town Standard Drawings terminating at the property line. Under no circumstances will roof water leaders or foundation weepers be permitted to be connected to the sanitary sewer.

4.6.1 Pipe Size

a) Service connections for single family and semi-detached units shall be 125mm in diameter. Clean outs shall be placed every 15 metres.
b) Service connections for multiple family, commercial, institutional areas are to be sized individually according to the intended use.

4.6.2 Depth

The depth of the service connections for single family units and semi-detached units, at the street line, measured from the final centreline road elevation shall be:
a) Minimum - 2.50 metres
b) Maximum - 3.30 metres
Risers shall be used when the invert depth of the sewer main exceeds 4.60 metres. The riser connection shall not exceed 3.0 metres in depth.

4.6.3 Velocity and Grade

a) Minimum low flow velocity 0.60 m/sec
b) Minimum grade - 125mm dia. 2%
c) Maximum grade 8%
d) Minimum grade - 150mm dia. 1%

4.6.4 Sanitary Sewer Connections to Multiple Family Blocks

maintenance hole shall be required to be located either on private property, 1.50 metres from property line to centre of rim, or on the municipal main.

4.6.5 Sanitary Sewer Connections to Commercial and Industrial Blocks

A maintenance hole shall be required to be located on private property 1.50 metres from property line to centre of rim.

4.6.6 Materials for Sanitary Sewers Service Connections

a) Sanitary sewer service connections may be constructed using any of the materials suitable for main.

b) In order to avoid cross connections, all pipe used for residential sanitary laterals shall be the colour green.

4.6.7 Location of Service Connections and Cleanouts

Sanitary connections shall be located in accordance with Town Standard Drawings. Clean out spacing shall not exceed 15m, where applicable, on Town property. For institutional and commercial properties, or as per Town request, a cleanout shall be provided at the property line, and the Regional Sewer by-law requirements also applies.

4.6.8 Construction

Construction of all sanitary sewers and service connections shall be in accordance with the Niagara Peninsula Contract Documents.

4.6.9 Sanitary Forcemains and Siphons

Forcemains and siphons are strongly discouraged, and will only be considered in

exceptional circumstances when no other feasible option exists, including pumping stations. Any proposed use must be supported by a functional report prepared by a consulting engineer with significant experience in the design of such systems.

5 DRINKING WATER DISTRIBUTION

5.1 General

Infrastructure projects including, but not limited to, installation and repair of sewers, roads etc, may impact upon and necessitate that watermains are shut down or be disconnected and reconnected. It is imperative that such actions are supervised by an certified operator employed by the Town of Pelham and appropriate precautions are taken to ensure that contamination is not allowed to enter the drinking water system.

Any department and/or contractor that is undertaking capital projects or repairs or activities that require the operation of the any component of the drinking water system must ensure that certified Town of Pelham personnel are available and on-site.

All materials shall be as specified or equivalent as approved by the contract Administrator. **Lead or lead composite components are strictly prohibited**. All waterworks materials must meet AWWA current quality criteria standards and American National Standard ANSI/NSF Standard 61 no lead certification for waterworks materials products.

The construction of all watermains, appurtenances and service connections in the Town of Pelham shall be in accordance with the current and appropriate Ontario Provincial Standard Specifications (OPSS) and Standard Drawings (OPSD), the American Water Works Association (AWWA) Standards, the Niagara Peninsula Standard Contract Documents or as modified herein. All materials shall be as specified or equivalent, as determined by the Town.

Determination of the watermain design and design flows will be prepared in accordance with MOECC Guidelines:

- The maximum working pressure shall not exceed 690 kPa (100 psi). Pressure reducing valves are required where localized areas exceed 690 kPa.

- The minimum working pressure shall not fall below 275 kPa (40 psi) under normal operating condition nor fall below 150 kPa (22 psi) under fire flow and maximum day conditions. The water flow must support a minimum 'Bluetop Hydrant' with 5,675 lpm or 95 l/s (1,500 gpm) at 150 kPa. Any hydrant less than 5,675 lpm (1,500 gpm) must be approved by the Fire Chief and Director of Public Works.

- For new systems, or for major upgrades, minimum design flow of 80 L/s must be used.

- For new development adding 4 or more residential units, increases building height or should sub-standard flow or pressure be anticipated, a water distribution analysis may be required on the system. The result of such analysis complete with drawings and calculations shall be submitted to the Engineering Department for review and approval.

- Sizing a water distribution system shall be based on a uniform Pipe Friction Factor of 130 for any pipe size or pipe type. Field tests shall be made when calibrating the model of an existing system.

- Average consumption shall be based on **Table 5.1 Unit Consumption Rates**.

Table 5.1 Unit Consumption Rates		
Domestic	Average Day	
	Maximum Day	320 lpcd
	Peak Rate	570 lpcd
		860 lpcd
Fire Demand	Fire flow should be considered in accordance with the Insurer's Advisory Organization's (formally Canadian Underwriters Association) requirements.	

5.2 Hydraulic Design

5.2.1 System Pressures

The maximum sustained operating pressures shall not exceed 690 kPa (100 psi). Where the pressures in localized areas are above this level, pressure reducing valves shall be installed.

The distribution system shall be sized to meet normal peak demands. Under conditions of simultaneous maximum day and fire flow demands, the pressure shall not drop below 140 kPa (20 psi). Under normal operating conditions, the pressure shall not drop below 275 kPa (40 psi).

The Town may require the consulting engineer to verify the existing distribution system is sufficient to supply the system pressure design requirement to the development. This includes new development and where buildings exceed 3 storeys. The Developer is responsible for all associated costs for verifying the above.

All watermains shall be designed to withstand a maximum design pressures of 1,035 kPa (150 psi) regardless of the working pressure in the system or the rating necessary to meet the structural requirements of the trench condition. (Design Pressure = maximum sustained internal hydrostatic pressure to which the pipe is to be subjected, excluding transient pressures.)

5.2.2 Friction Factors

The following "C" values shall be used for the design of water distribution systems regardless of pipe materials:

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

The above C factors represent long-term values. A C factor of 130 shall be used to calculate maximum velocities for transient pressure estimations, and for checking pump motor sizes for run-out conditions.

5.3 Pipe Requirements

5.3.1 Sizes

Sizes and looping of watermains will be determined at the preliminary stage of the development. The following are the minimum size requirements.

a) Residential Areas

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

b) Commercial and Institutional Areas

Sized according to anticipated demand for commercial and institutional developments.

The distribution system shall be designed to eliminate dead-end sections. Where dead-ends cannot be avoided, with the prior approval of the Town, they shall be provided with a fire hydrant or flushing hydrant.

Water distribution systems shall be designed so that no more than eighty (80) units with individual water services and meters shall be serviced from a single source of supply. If the looped watermain is connected to a single watermain, a valve must be installed in the watermain to permit isolation of supplies.

5.3.2 Depth of Cover

The minimum depth of cover to watermains should not be less than the depth of frost penetration.

Generally the depth cover shall not be less than 1.70 m measured in a vertical plane above the pipe from the top of the pipe to the finished ground elevation.

It will be the responsibility of the Consulting Engineer to justify any reduction in the depth of cover less than 1.70 m by submitting a report outlining the reasons for the reduction and alternative frost protection measures to be taken. Frost protection measures should include installation of minimum 50mm rigid foam insulation at least 0.6m wide, running along the length of the affected area. Spray foam insulation may also be considered by the Town. The design shall be in accordance with Niagara Peninsula Standard Contract Document, Special Provisions Contract Items, Watermain.

5.3.3 Separation between Watermains and Sewers

Vertical Separation
Under normal conditions, watermains shall cross above sewers with sufficient vertical separation to allow for proper bedding and structural support of the watermain and sewer main. As a minimum, the vertical separation between the crown of the sewer and the invert of the watermain should be 0.3m, with an absolute minimum of 0.15m.

When it is not possible for the watermain to cross above the sewer, the watermain shall be protected as follows:
a) A vertical separation of at least 0.5m shall be provided between the invert of the sewer and the crown of the watermain.
b) The sewer and watermain shall be adequately supported to prevent excessive deflection of joints and settings.
c) The length of watermain shall be centred at the point of crossing so that the joints will be equidistant and as far as possible from the sewer.

Separation of Watermain and Sewers - Special Conditions
Under unusual conditions, where it is anticipated that severe dewatering problems will occur, or where congestion with other utilities will prevent a clear horizontal separation of 2.50 metres, a watermain may be laid closer to a sewer, provided that the elevation of the crown of the sewer is at least 0.50 metre below the invert of the watermain. Such separation shall be in-situ material or compacted backfill. Where this vertical separation cannot be obtained, the sewer shall be constructed of materials and with joints that are equivalent to watermain standards of construction and shall be pressure tested to assure water tightness.

Horizontal Separation
Under normal conditions, watermains shall be laid with a horizontal separation of at least 2.50 metres from any sewer. The distance shall be measured from the nearest edges.

5.3.4 Utility Crossings

Where watermains cross over or under utilities other than sewers, the clearance and type of crossing provided shall conform to the requirements of the particular utility involved and provide proper bedding and structural support of the watermain and utility. Generally, where watermains cross over utilities, a 0.3m

minimum clearance shall be provided, and where watermains cross under utilities, a 0.5m minimum clearance shall be provided.

5.3.5 Materials

The following materials may be used for watermains:

- Polyvinyl Chloride (PVC) can be used for sizes up to 600mm diameter when installed under roadways. In other locations this limit may be extended to 900mm diameter upon approval of the Town.
- Reinforced Concrete Pressure Pipe (RCPP) can be used for sizes 400mm and greater.

All pipe material and associated appurtenances must meet current American Water Works Association (AWWA) specifications and Ontario Provincial Specifications (OPSS). All watermain fittings, pipe and fixtures are to be "lead free" and shall comply with NSF/ANSI Standard 61: Drinking Water System Components – Health Effects (2007 as amended). All fittings must be certified as compliant by an industry recognized and accredited third party per the requirements of NSF/ANSI 61.

Allowable pipe material shall be 100mm – 400mm (4" – 16") DR18 PVC conforming to AWWA C900 or approved equivalent. For Site Plan applications, the pipe material shall be in accordance with the Ontario Building Code and acceptable to the Chief Building Official.

5.3.6 Tracer Wire

Watermain and Water Service Tracer Wire Specifications **(refer to OPSD Standard Drawings)**

General
All watermains shall include the installation of a continuous 10 gauge insulated wire, properly taped and fastened onto pipe. All hydrants shall include the installation of a continuous 10 gauge wire connected to wire at watermain and brought to the surface along hydrant lead and through conduit at hydrant, where it is to connected to the next tracer wire length, or connected to the hydrant flange bolts.

5.4 Cathodic Protection

Zinc Anode DZP-1100-24 anodes to be used at each hydrant, multiple fittings (up to 3) and on cast iron and ductile iron pipe where connections are made to the watermain.
Zinc Anode DZP-550-12 anodes to be used at each fitting (bend, reducer, cross, tee) and each water service.

5.5 Thrust Restraints

Better suited in an approved product list???

Specify criteria and standards here…
Thrust restraints are to be mechanical joint type:

- EBAA Iron Series 2000 PV
- Uni-Flange Series 1300
- Megalug
- Grip Ring Pipe Couplings
- Safety factor 2:1
- High strength ductile iron per ASTM A536, Grade 65-45-12 and ASTM 536-80
- Bolts and connecting hardware to be high strength low alloy per ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53 Per Uni-B-13-92, recommended Performance Specification for Joint Restraint Devices for use with PVC pipe.

Hydrants shall be equipped with both mechanical thrust restraints and thrust blocks, where allowed by the hydrant manufacturer.

5.6 Valves

5.6.1 Line Valves

Gate valves shall be used on all watermains 350 mm diameter or less in size.

All valves shall be of the approved type with non-rising stem and a 20 mm square operating nut opening counter clockwise.

5.6.2 Sizes

Sizes of line valves shall be the same size as the watermain.

5.6.3 Number, Location and Spacing

Generally, a minimum of three valves are required at a tee intersection and a minimum of four valves are required at a cross intersection.

Line valves shall be located with spacing approximately every 2 hydrants , and in no case shall the spacing exceed 300 m. Line valves on feedermains shall be located in accordance with existing and future servicing requirements. The maximum distance between valves shall not exceed 750 m.

5.6.4 Air Release Valves

An attempt shall be made to locate hydrants at high points or at dead ends, thereby eliminating the need for vacuum-air relief valves and/or blow-offs.

5.6.5 Drain Valves

Drain valves shall be located at the low points of all watermains of 600 mm diameter and greater.

5.6.6 Valve Boxes and Chambers

All valves 350 mm diameter and smaller shall have valve boxes and specified direct bury operators shall be used.

All valves 400 mm diameter and larger shall be installed in valve chambers.

The tops of valve boxes and valve chamber maintenance hole covers shall be set flush with finished grade. The top of the roof slab of valve chambers shall be at least 0.60 m below the profile of the finished pavement.

Chambers containing valves, blow-offs, meters or other such appurtenances to a distribution system shall not be connected directly to any sanitary or combined sewer, nor shall blow-offs or air-relief valves be connected directly to any such sewer.

In order to minimize the total number of chambers on any project, and avoided in intersections, care should be exercised in locating the line valves, air reliefs, drains, etc., with a view to combining these functions in a single chamber.

All connections through chamber walls shall be sealed with hydraulic cement.

Valve chambers must conform to OPSD 1101 Series.

5.6.7 Fittings

All pipe material and associated appurtenances must meet current American Water Works Association (AWWA) specifications and Ontario Provincial Specifications (OPSS). All watermain fittings, pipe and fixtures are to be "lead free" and shall comply with NSF/ANSI Standard 61: Drinking Water System Components – Health Effects (2007 as amended). All fittings must be certified as compliant by an industry recognized and accredited third party per the requirements of NSF/ANSI 61.

5.7 Fire Hydrants

5.7.1 General

Fire protection for institutional and commercial development shall be reviewed upon application.

5.7.2 Hydrants

Hydrant installation shall be located at the extension of the side lot line, away from the driveway.

5.7.3 Number and Spacing

Hydrants shall be installed on all watermains 150 mm diameter and larger in accordance with the MOECC Guidelines for the Design of Water Distribution Systems and/or with the following maximum allowable spacing:

a) 150 m in residential areas, measured along the watermain or to provide for a maximum hose length of 75 m.

b) 75 m in industrial and commercial areas measured along the watermain to provide for a maximum hose length of 37.5 m.

c) 300 m in rural areas where applicable.

All hydrants when installed in new subdivisions shall have a clearance of at least one (1) metre away from any boulevard apron as to not cause any conflict with ingress and egress of driveway access.

5.7.4 Branch Valves and Boxes

All hydrants installed on watermains shall be installed with 150 mm diameter anchor tee, secondary valve and box.

5.7.5 Hydrant Types

Where hydrants do not conform to the furnished ground grade the proper length extension will be inserted either at the drain ring flange before backfilling or the ground line flange with proper rod extension. Extension must be installed in strict accordance to manufacturer's specifications.

Should the hydrant require a shorter barrel due to a necessary grade change in the main the proper length barrel will be installed before backfilling the hydrant trench.

Hydrant specifications:

- Hydrants shall be self draining (unless otherwise specified), steamer port, 150mm branch valve and box, approved type.
- Manufactured in accordance with AWWA Standard C502, be of break flag traffic model type, and present a low profile with a modern design exterior;
- Depth of bury: 1.8m (6');
- Boot: to be epoxy coated internally and externally, 150mm (6") diameter mechanical joint;
- Colour: red with silver dome and caps or as approved;
- Boot to bottom flange with stainless steel bolts;
- Dry barrel, shall be epoxy coated in compliance with AWWA Standard C502;
- Pumper nozzle designation "SD" ro 33B, thread detail 5-3/4 O.D. x 4.
- Drain ring bolts and nuts: stainless steel type 304
- Hydrant shall include pumper nozzle storz connection

Secondary Valve Specifications:
Opening size: 150 mm (6") diameter
Joint: mechanical

Tee off watermain shall be anchor type. Secondary valve shall be bolted to the anchor tee. All piping required (from tee to valve to hydrant) shall be Class 150 PVC. Hydrant lead shall be less than 5.5m unless otherwise approved by the Town.

5.8 Water Sampling Station

Placement of any water sampling stations shall be as approved by the Town. Placement of water sampling stations within any new development or watermain rehabilitation project will be determined by the Town and shall be based on establishing the most optimal water quality monitoring program.

Where and when they will be installed is dependent on the most strategic location that will provide water quality data to efficiently monitor the distribution system based on surrounding sampling stations. Consultation with the Town shall be required in the determination of need and location.

5.9 Bedding, Cover Material and Backfill

Requirements of the Niagara Peninsula Contract Documents shall apply.

Backfill in roads and driveways shall be select native material and compacted to 100% SPD, at Town's discretion, which may require Geotechnical input.

5.10 Corrosion Protection

Requirements of the Niagara Peninsula Contract Documents shall apply.

5.11 Concrete Blocking and Anchoring

All valves and fittings shall be supported independently with concrete blocking and anchoring so that vertical and thrust loads are not transmitted to connected pipes.
All concrete support (OPSD 1103.010 and 1103.020) shall be manufactured using Type 20 Portland cement, poured against undisturbed ground with bond-breaker provided against all pipe, joints, valves, bolts and fittings. It shall be the Contractor's responsibility to ensure that all ground is suitable for pipe, valves and fittings support and shall bring to the Contract Administrator's attention any possible unsuitable conditions.

5.12 Backflow Prevention

There shall be no physical connection between a public and a private potable water supply system, nor between either a water system and a sewer or appurtenance thereto, which would permit the passage of private water or any sewage or polluted water into the potable public supply. In addition, no pipe, valve or fitting which has been exposed to raw sewage shall thereafter be included in a potable water system, either temporarily or permanently.

5.13 Water Service Connection

5.13.1 General

In new developments, the service connections shall be installed in accordance with the Standard Drawings terminating at the property line. Curb stops shall be located at the property line.

It is recommended that the designer determine the water service sizing based on flow requirements for water services which service single family homes which are estate lots, larger homes, have deep setbacks or where automatic lawn sprinkler systems or fire sprinkler systems are to be used.

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

Each dwelling unit in a private block of condominium must be serviced with a separate water service connected to a private watermain. Water services must front the dwelling unit they service. Bulk metering of the site at the point(s) where the water service enters the property will be required. Individual metering of dwelling units by the Town will not be provided.

All unutilized services shall be removed or abandoned, plugged at the main with the valve or service box removed.

Installation of watermain stubs, or pre-servicing for future development, should be avoided unless confirmation can be made stating that these undeveloped lands will be developed in the near future, complete with an approved site plan.

5.13.2 Service Pipe Size

- The minimum size for service connections shall be 20 mm diameter.
- Service connections for multiple family dwellings shall be sized to provide capacity equivalent to 25 mm diameter connection to each dwelling unit.
- Service connections for blocks, commercial and industrial areas shall be sized according to the intended use and fire flow.
- Greenhouse or agricultural connections maximum size is 25mm.

5.13.3 Service Materials

Water service connection 50mm diameter or less shall be type "K" soft copper. Water service connections larger than 50mm diameter shall be in accordance with **Section 5.3**.

5.13.4 Service Location

Water service connections shall not be located under a driveway, if possible. The location of water service connections for single family and semi-detached lots shall suit the house style in accordance with **Standard Drawings.**

Every effort shall be made to minimize the number of elbows, tees, valves, fittings and other obstructions in the piping system, and minimizing the number and size of bends, while simplifying the layout as much as possible.

5.13.5 Service Depth

Curb and Gutter Roads – water service connections shall be installed 1.70 m minimum below finished centreline road grade.

Open Ditch and Unimproved Roads – in no case shall the cover of the water service connection be less than 1.70 m.

Depth at property line shall not be less than 1.7m minimum.

5.13.6 Service Mainstops

All domestic water service connections shall have mainstops installed at the watermain equal to the water service connection diameter.

Mainstops shall be the same size as the service line, bronze, round way. All main stops consisting or containing bronze or brass material must conform to AWWA Standard C800-05 and ANSI/NSF61 compliant, with "LF" stamp clearly

shown or appropriate documents available for inspection.

For 25 mm diameter:
- service saddle is required;
- tapping must not exceed 15° from horizontal centre line of main.

For sizes 38 mm diameter and 50 mm diameter:
- service saddle is required;
- must be tapped at horizontal to centre line of main;
- AWWA standard thread inlet and female iron pipe thread outlet;
- Plastic pipe to iron coupling or adaptor.

5.13.7 Service Curb Stops and Boxes

All service connections shall have curb stops and boxes installed at the property line or an approved location.

Curb valve to be compatible (same size) as the service.

All curb stops on the open end must be protected with the use of a plastic cap or plug.

Curb valve to be compatible (same size) as new service:
- bronze type shall be "0" ring type with both ends compression
- ball – type valve only.

All curb stops on the open end must be protected with the use of a plastic cap or plug. All curb stops consisting or containing bronze or brass material must conform to AWWA Standard C800-05 and ANSI/NSF61 compliant, with "LF" stamp clearly shown or appropriate documents available for inspection.

Curb boxes are to be the extension type with regular ribbed cover marked "WATER", hexagon plug, 0.9m minimum height stainless steel operating rod, stainless steel cotter pin and suitable for a 1.5m (5') to 1.8m (6') trench.

For 25mm (1") curb stops, the curb box, Series D1 Style #8.
For 38mm (1½") and 50mm (2") curb stops the curb box, Series D-2 Style #8.

5.13.8 Tapping Sleeves for Services

All sleeves to be stainless steel, or epoxy coated both externally and internally complete with stainless steel bolts.

All tapping sleeves shall be Robar 6606 stainless steel tapping sleeve with T 304 stainless steel bolts or approved equivalent for C.I., A.C. and PVC pipe. Sizes 100mm (4") - 400mm (16") I.D.

5.13.9 Service Saddles

Any residential services installed on a PVC watermain will require the use of an approved service saddle. Service saddles are required for all services connected to concrete pressure pipe manufactured to the latest edition of AWWA C301 and AWWA C303 specifications for all tap sizes.

5.13.10 Coupling and Adaptors - Services

All couplings and adaptors shall be as follows:
(a) For PE Tubing - Bronze with one piece combination nut and tail, compression type with stainless steel insert (heat flaring of tubing is not allowed).
(b) For PVC pipe: Bronze, brass or PVC with spigot, bell compression joint or iron pipe thread ends or any combination of these:
- Bell to Bell - Johns-Manville PVC double bell coupling
- Bell to Male Iron Pipe - Johns-Manville PVC male adaptor (threaded)
- Spigot to Male Iron Pipe - 200mm (8") long schedule 80 grade 1 type 1
- PVC. nipple, one end with standard iron pipe thread, other bevelled 8° x 3/8".

Compression joints for 38mm and 50mm (1½" and 2") PVC, I.P. size is acceptable in the following fittings: curb stops, PVC to PVC compression couplings, PVC to I.P. male couplings, and PVC to I.P. female couplings.

Note: Couplings and adaptors employing heat fusion on PE tubing or solvent weld on PVC pipe may only be used if factory made. All couplings and adaptors consisting or containing bronze or brass material must conform to AWWA Standard C800-05 and ANSI/NSF61 compliant.

5.13.11 Pipe Fittings and Nipples - Services

All pipe fittings and nipples must be brass, bronze, PVC or stainless steel as follows:

Fittings
- screwed PVC, Grade 1 type 1, schedule 80
- bronze with one piece combination nut and tail, compression type joint with stainless steel insert, Class 160
- bell and spigot joint PVC, class 160

Threaded Nipples
- PVC, grade 1 type 1, schedule 80

NOTE: Cast bronze solder fittings are not acceptable. Teflon pipe thread tape must be used on all threaded PVC joints.
All pipe fittings and nipples consisting or containing bronze or brass material must conform to AWWA Standard C800-05 and ANSI/NSF61 compliant.

5.13.12 Metering Pit / Chamber - Services

To be installed and located immediately inside property line, shutoff valves for isolation. If service is greater than 50m, a pit or chamber may be required.

5.13.13 Service Connections Outside Urban Boundary

1) Dedicated service connections for irrigation, spray mixing, hauling or filling shall not be permitted.
2) The maximum service length shall be 60 metres as measured from the property line to the building wall.
3) The maximum service sizes shall be as follows:
- Single Detached Residential Dwellings - 25mm diameter
- Multiple Unit Residential, Commercial, Institutional and Industrial Buildings – 100mm
- Greenhouses and Other Agricultural Buildings – 50mm

4) Service lengths in excess of 30 metres shall only be allowed where an engineered design to the satisfaction of the Director of Public Works & Utilities demonstrates a residual pressure of 275 KPa under normal operating conditions and 140 Kpa under fire flow conditions can be maintained without mechanical aid.
5) The proponent shall provide all necessary testing, engineering calculations, design details and any other information as deemed necessary by the Director of Public Works & Utilities to assess a potential connection.

5.14 Water Service Installation

Requirements of the Niagara Peninsula Contract Documents shall apply.

All exposed foundation cracks are to be caulked or grouted in addition to the entrance hole for the service entering the building, where applicable.

5.15 Water Meters

Each municipal address shall have its own meter, and fire lines shall be metered. Water meters must be installed in all buildings prior to occupancy. Water meters must be purchased from the Town.

5.16 Fire Lines

In general, private fire lines may be allowed connection to the municipal system subject to the following criteria:
a) Properties requesting fire lines must have frontage on the watermain to which they are requesting connection.
b) Within the urban areas, fire lines will be allowed to new developments and redevelopments, including residential, commercial, institutional and industrial.
c) Outside of identified urban areas fire lines will only be permitted to existing commercial, institutional or industrial operations or similar redevelopments.
d) All technical details, inspection and testing pertaining to the design, construction and commissioning of the fire line shall be to the satisfaction of the Director of Public Works and the Fire Chief.
i) In addition to the above, the proponent must obtain the necessary permit from the Public Works Department, which outlines additional restrictions on use, maintenance reporting requirements, fees, etc.

6 ILLUMINATION AND ELECTRICAL

6.1 General

Lighting design criteria for roads and sidewalks within the Town of Pelham shall be based on the American National Standard Practice for Roadway Lighting, ANSI/IESNA RP-8-14, or latest revision thereof.

The lighting system shall provide the average maintained light levels and meet the recommended uniformities and veiling luminance ratios as indicated in **Table 8.1** and **Table 8.2**.

"Luminance" criteria may be used for determining light levels on straight and level roads that have a minimum length of ten luminaire mounting heights.

"Illuminance" criteria to be used for intersections, curvilinear road sections and sidewalks.

The Transportation Association of Canada (TAC) "Guide for Design or Roadway Lighting", Volumes 1 and 2 provides comprehensive design guidelines and may be used for lighting design for roadways and associated facilities.

Light fixtures shall be cut-off type to reduce light pollution and shall be dark sky compliant.

Light source shall be Light Emitting Diode (LED).

Power supply shall be coordinated and arranged with the Supply Authority from the nearest feasible location. Power supply shall be unmetered for street lighting loads and the street lights shall operate at 120 volts 60Hz AC. Where street lights are combined with receptacle loads, the power supply shall be metered. Maximum voltage drop at the end of the lighting circuit shall not exceed 5% of the supply voltage.

6.2 Design Approvals

All proposed lighting shall be reviewed and approved by the Town. Lighting design submissions must include:

- Design criteria used.
- Design calculations with photometric layouts utilizing approved computer lighting program AGI 32, AutoLux or equivalent.
- Contract drawings and specifications with cost estimate.

All drawings must be sealed by a registered qualified electrical Professional Engineer, licensed to practice in the Province of Ontario. Any attachments to hydro poles must have Hydro Authority approvals and comply with Regulation 22/04. All roadway lighting design and construction is subject to Electrical Safety Authority (ESA) inspection and approval.

6.3 Design Criteria

The design criteria requirements for luminance and illuminance in **Table 6.3a** and **Table 6.3b** are derived from ANSI/IES RP-8-14.

Table 6.3a
Luminance Method for Mid-Block Sections (Non-Intersection Areas)

Road Classification	Average Maintained Luminance	Maximum Uniformity	Luminance Ratios	Maximum Veiling Luminance Ratios	Pedestrian Conflict Area Classification
	L_{avg} (cd/m^2)	L_{max} to L_{min}	L_{avg} to L_{min}	L_v to L_{avg}	
Arterial Roads (IES Major)	0.6	6.0 to 1	3.5 to 1	0.3 to 1	LOW
Arterial Roads (IES Major)	0.9	5.0 to 1	3.0 to 1	0.3 to 1	MEDIUM
Collector (Minor) Roads (IES Collector)	0.4	8.0 to 1	4.0 to 1	0.4 to 1	LOW
Collector (Major) Roads (IES Collector)	0.6	6.0 to 1	3.5 to 1	0.4 to 1	MEDIUM
Local (Rural) Roads (IES Local)	0.3	10.0 to 1	6.0 to 1	0.4 to 1	LOW
Local Roads (Urban/Industrial) (IES Local)	0.5	10.0 to 1	6.0 to 1	0.4 to 1	MEDIUM

Table 6.3b
Illuminance Method for Intersection and Sidewalks

Road and Pedestrian Conflict Area Classification	Minimum Average Maintained Illuminance (horizontal only) (R2 & R3 Pavements) E_{avg} in lux	Maximum Illuminance Uniformity Ration E_{avg} to E_{min}
Illuminance Design Criteria for Roadways at Intersections		
Arterial Roads (IES Major-Low)	9	3 to 1
Arterial Roads (IES Major-Medium)	13	3 to 1
Collector (Minor) Roads-Low (IES Collector-Low)	6	4 to 1

Table 6.3b Illuminance Method for Intersection and Sidewalks		
Road and Pedestrian Conflict Area Classification	Minimum Average Maintained Illuminance (horizontal only) (R2 & R3 Pavements) E_{avg} in lux	Maximum Illuminance Uniformity Ration E_{avg} to E_{min}
Collector (Major) Roads-Medium (IES Collector-Medium)	9	4 to 1
Local (Rural) Roads-Low (IES Local-Low)	4	6 to 1
Local Roads (Urban/Industrial)-Medium (IES Local-Medium)	7	6 to 1
Illuminance Design Criteria for Sidewalks		
Rural and Semi-Rural Areas	2	10 to 1
Pedestrian Areas-Low	3	6 to 1
Pedestrian Areas-Medium	5	4 to 1

Intersections shall have an illumination level equal to the sum of the recommended average illumination levels for each of the intersecting roadways. If it is not practical to achieve this level due to geometric constraints, then a minimum level of 50% higher than the recommended level for the main roadway may be acceptable, subject to the Town's approval.

Light levels shall be increased by 50% through schools areas, railway crossings and bridges. The street lights shall typically be serviced with underground wiring in ducts between poles. The luminaires shall be alternated between circuits to maintain 50% illumination upon loss of one circuit feeder.

6.4 Street Lighting

Street lighting can contribute to the overall character of a street or neighbourhood, while also being an important element of creating safe and pedestrian friendly streets. Street lighting within the boulevard should illuminate building entrances, pedestrian walkways and public spaces, while also considering sustainability and reduced energy consumption.

- Street lighting should be located in the Landscaping Zone or integrated into building design.
- Downcast pedestrian lighting should be provided in high traffic pedestrian areas.
- Lighting on private property should ensure safe and well-lit entrances, parking areas and other pedestrian areas.
- In key areas, lighting can be used to accent special features or major destinations, with additional lighting in mixed-use or downtown areas, at intersections or trail crossings.
- Design and location of lighting should consider sustainability and the impacts of light pollution. It should be 'dark sky' friendly, and consider energy efficiency, directional lighting, inductions lighting, solar power, street reflectors and sensors to regulate brightness.

6.5 Recommended Lighting Configurations and Pole Offsets

- Roads with 3 lanes or less – single sided or staggered configuration with pole offset from EP as per TAC criteria or on shoulder rounding.

- Roads 4 lanes or greater – opposite configuration with poles offset as per TAC criteria.

- In urban areas behind the face or a barrier curb with design speed of 70 km/hr or less, pole offsets may be reduced to 1.5 m.

- Lights at signalized intersections should be combined with joint-use traffic signal poles wherever possible.

- On curved roads, position the light poles on the inside curve if possible. Alternatively, light pole locations in unprotected areas on the outside of curves should be kept out of the vehicle overrun areas.

- Lighting poles shall have a minimum clearance of 3 m from pad-mounted transformers, fire hydrants and trees.

- Street lights and power pedestals should be located on the extension side lot lines where possible. A minimum of 1 m clearance is required between light poles and driveways and a minimum offset of 0.5 m from sidewalks.

6.6 Materials

All materials used for street lighting must be CSA approved.

1. Electrical Handholes (Ground Mounted)
Precast concrete type complete with cover, 460 mm diameter, as per OPSD 2112.02.

2. Ducts
   - In boulevard, rigid PVC DB2 duct, CSA C22.2, No.211.1, 53 mm diameter.
   - Below roadways, rigid PVC Thickwall duct, CSA C22.2, No.211.2, 53 mm diameter.
   - Flexible duct (Polypipe CSA Standard B137.1, Series 75 or ENT CSA C22.2, No.227.1) to be used for protection of cables entering the wiring aperture in the concrete poles.

3. Cables
   - Power supply cables shall be 3-#2 AWG copper RWU90 (no ground wire), with cross-linked polyethylene insulation rated 600 volt, CSA C22.2 No.38.
   - Street light cables shall be 3-#6 AWG copper RWU90 as above with 1-#6 AWG strandard copper green ground.
   - Riser wires from pole handhole to luminaire shall be #12 AWG stranded copper type RWU90 insulation.
   - Insulation colour for line conductors for 1-phase, 3-wire 240/120V system shall be "Red" and "Black" and for 1-phase, 2-wire 120V system shall be "Red". Insulation colour of all neutral conductors shall be "White".
   - Cable connectors in pole handholes shall be compression connectors with insulating covers.

4. Fuses
   - Fuse holders in pole handholes shall be in-line break-away type rated 600V complete with 10 amp KTK fuse.

5. Grounding
   - Ground rods shall be solid steel, 19 mm diameter, 3.0 m long, copper clad for full length according to CSA C22.2 No.41. Ground plated may be used subject to soil conditions.

6. Poles

Standard Road Lighting Poles:

Direct Buried, Class "B" spun concrete, to CSA A14-M1979, tapered round with natural concrete smooth mold finish, complete with handhole cover plate, nameplate and ground lug. Tamper proof screws and warning label to be supplied with handhole cover plate. Pole nameplate to indicate manufacturers name, pole class and length, date of manufacture and CSA stamp.

- Arterial Roads – 12.2 m
- Collector Roads – 10.7 m or 12.2 m
- Local Roads – 7.6 m or 9.9 m or 10.7 m

Approved concrete pole manufacturers are StressCrete and U.S.I.

Decorative Road Lighting Poles:

Direct Buried, Class "B" spun concrete, to CSA A14-M1979, octagonal with black smooth mold finish, complete with handhole cover plate, nameplate and ground lug. Tamper proof screws and warning label to be supplied with handhole cover plate. Pole nameplate to indicate manufacturers name, pole class and length, date of manufacture and CSA stamp.

- Arterial Roads – 12.2 m
- Collector Roads – 10.7 m or 12.2 m
- Local Roads – 7.6 m or 9.9 m or 10.7 m

Approved concrete pole manufacturers are StressCrete and U.S.I.

7. Brackets

Standard Road Lighting Brackets:

Scroll arm aluminium brackets. The length of the bracket depends on offset from pavement and pole height.

- Arterial Roads – 2.4 m preferred, 3.0 m maximum
- Collector Roads – 1.8 m preferred
- Local Roads – 1.2 m preferred

Acceptable manufacturers:

- Aluminous: Single Bend Colonial
- King Luminaire: KA30
- or Reviewed Equivalent

8. Luminaires

LED Luminaires:

Luminaire – "Lantern" or "Pendant" style, type 2 or 3 distribution pattern, rugged die cast aluminium housing with surge and brown-out protection, LED drivers and electronic transfer switch.

Operating range from – 40 to +50C with light engines meeting the dust and moisture rating of IP-66. Luminaire design to meet CSA-C22.2 number 250 for 40C, wet location and to be ROHS compliant. Maximum total harmonic distortion to conform to AHSI C82.77 : 2002.

Solid state 120 volt 60 Hz electronic drivers with extended life to 100,000 hours minimum.

LED colour temperature 4,000 K nominal.

10 year limited warranty on LED light engine, LED drivers and all non-electrical components.

Acceptable manufacturers (Lantern Style):

- Cooper Lighting: SDL "Springdale"
- King Luminaire: K601
- or Reviewed Equivalent

Acceptable manufacturers (Pendent Style):

- King Luminaire: K822
- or Reviewed Equivalent

9. Power Supply Disconnects

Pole Mounted Disconnects

Pole mounted power supply disconnects shall be outdoor weatherproof type 240/120 V rated 100 amps with 60 amp 2 pole main breaker suitable for service entrance.

Approved manufacturer is Square 'D' (CQO) or approved equivalent.

Pedestal Mounted Disconnects

Pedestal Pedestal mounted power supply disconnect shall be outdoor heavy gauge galvanized steel with lockable removable front cover complete with precast concrete base.

Colour to be equipment green with powder coat finish.

Interior power supply disconnect shall be 240/120 V rated 100 amps with 60 amp 2 pole main breaker suitable for service entrance. Branch breakers to be 30 amps 1 pole 120V.

Approved manufacturer is Pedestal Solution Inc. or approved equivalent.

6.7 Installation

The installation of the street lighting system shall be in compliance with ESA, CSA and Hydro Supply Authority requirements and in accordance with the Town's specifications and standards and the manufacturer's installation instructions.

Shop drawing materials shall be reviewed by the Design Consultant prior to material order. The installation shall be inspected by the Design Consultant during stake-out and trenching, construction of footings prior to pouring concrete and at final installation completion. A final completion certificate shall be issued by the Design Consultant to verify that the installation is in compliance with the design and contract documentation.

- Ducts
  Ducts shall be solvent welded together in trenches with minimum cover of 760 mm.
  Ducts shall be surrounded by 80 mm of brick sand and warning tape to cover width of trench.
  Road crossings to be carried out by directional bore method using thickwall rigid PVC duct.
  Where open-cut road crossings are necessary, ducts shall be concrete encased.
  Installation as per OPSD 2100.06.
  Installation Specifications as per OPSS 603.

- Cables
  Cables to be continuous without splices and shall be installed after trenches are back-filled.
  Installation Specifications as per OPSS 604.

- Fuses
  Fuses in pole handholes as per OPSD 2255.020.
  Installation Specifications as per OPSS 617.

- Grounding
  Ground rods to be installed at power service disconnect (min. 2 roads) and at every 5th lighting pole and at the last lighting pole in each circuit.
  Installation Specifications as per OPSS 609.

- Poles
  Refer to Standard Drawings
  Installation Specifications as per OPSS 615.

- Brackets and Luminaires
  Refer to Standard Drawings
  Installation Specifications as per OPSS 617.

- Power Service Disconnect
  Refer to Standard Drawings
  Installation Specifications as per OPSS 614.

Where possible, place pole:
- Opposite lot of property lot lines
- Adjacent to main cable trench
- 3.5 m from property line
- Greater than 5m from a transformer

7 FIRE ACCESS AND EMERGENCY – SPECIAL NOTES

7.1 Emergency/Fire Access

a) Minimum clear width of 6.5 m excluding on-street parking widths. A minimum travel width of 3.25 shall be provided to the satisfaction of the Fire Department.

b) Centre-line turning radius of no less than 12m

c) Overhead clearance of 5m

d) Maximum grade 8% (12.5:1) over 15m

e) Designed to support the weight of all Emergency Response Vehicles

f) Cul-de-sacs exceeding 90m in length shall provide an adequate turnaround facility

7.2 Turnarounds

In the event that construction of the development is phased, or abuts future development land, an adequate turnaround facility (hammerhead or cul-de-sac) for fire vehicles at the applicable phase shall be provided and details submitted in the Plan of Subdivision.

The Municipality shall determine, at its sole discretion, whether it will require ownership or a temporary easement with respect to the turnaround.

7.3 Firebreak Lots

The lots in a Plan of Subdivision shall indicate the location of designated firebreak lots. Lots shall be designated by the developer and final layout approved by the Fire Chief.

N.B. No building permit shall be issued for designated firebreak lots until such time as the exterior finish cladding, roofing and windows on the buildings abutting the said designated firebreak lots have been completed, unless otherwise approved in writing by the Fire Chief.

In addition, prior to receiving a conditional permit for the construction of a model home, there shall be adequate access to the property for the purpose of fire suppression, together with an adequate water supply for fire suppression, as may be determined in the sole and absolute discretion of the Fire Chief and Chief Building Official.

7.4 Single Access Routes

A development which has only one roadway as an access point and exceeds 90m in length shall have all units in the development sprinklered as per NFPA 13, designs shall meet or exceed this standard and shall be approved by the Chief Fire Official.

8 LIST OF STANDARD DRAWINGS

Roads and Streestscape
201-rural road ROW 20.0m without parking
202-urban laneway ROW 8.5m without parking
203-local urban street ROW 16.0m with parking
204-arterial downtown ROW 20.0m without parking
205-arterial urban living area ROW20.0m without parking
206-collector urban main street ROW 20.0m with parking on one side
207-collector neighborhood main street ROW 20.0m without parking
208-collector mixed use main street ROW 22.0m with parking both sides
209-collector mixed use main street ROW 22.0m shared continuous paving
210-arterial collector ROW 30.0m with separated median
211-common trench detail for direct buried cables with gas main
212-concrete sidewalk
213-standard walkway access
220-tourist directional sign installation
221-standard board on board fence detail
222-regulatory sign and street name sign installation
223-standard chain link fence detail
224-standard bench
225-standard entrances high volume access
226-urban residential entrance
227-rural entrance to road with culvert installation
228-turning basins for terminated urban roadways
229-service installation in the roadway area (open cut method)

Storm Water Management
301-sump pump lateral connection
302-rear yard swale subdrain detail
303-urban lot grading type A back to front drainage
304-urban lot grading type B split drainage with walkout
305-urban lot grading type C back to front drainage with walkout
306-urban lot grading type D split drainage
308-sediment control fence

Sanitary Waste Collection
401-sewer lateral connections
402-standard service connections

Drinking Water Distribution
502-greenhouse water service installation schematic
503-water service installation details for 38mm and 50mm diameter sizes
504-water service installation details for 20mm and 25mm diameter sizes

506-50mm blow off installation
507-hydrant installation
509a-precast water meter chamber for 25mm diameter service connection and smaller
510-tracer wire detail