



City of Orillia
Engineering Design Criteria:
Water Distribution



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Engineering Design Criteria: Water Distribution

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1.0 INTRODUCTION

The City of Orillia Engineering Design Criteria: Water Distribution manual is intended to provide all stakeholders, including City staff, consultant engineers, developers, and the public with common design reference standards to facilitate consistent application of water distribution system design practices within the City of Orillia (City).

These standards are to be read in conjunction with the latest editions of the Ontario Provincial Standard Specifications (OPSS), the Ontario Provincial Standard Drawings (OPSD), the Ministry of the Environment, Conservation and Parks Watermain Design Criteria, for alterations authorized under the Municipal Drinking Water Licence (MDWL) and Drinking Water Works Permit (DWWP), the City of Orillia Material Specifications for Watermain, Sewer, & Appurtenances, and the City of Orillia Standard Drawings. In the case of a discrepancy, the City Standards shall prevail unless otherwise directed by the City.

It is the applicant's responsibility to obtain and check with the City of Orillia for new revisions to the design standards. Copies are available from the City of Orillia or can be downloaded from the web site at www.orillia.ca. Standard drawings are available in pdf format.

The criteria outlined in this manual is intended to be updated on a regular basis to remain consistent with other reference documents. Comments or questions regarding the Engineering Design Criteria can be submitted to infrastructureplanning@orillia.ca.

2.0 DEFINITIONS AND ABBREVIATIONS

The following definitions and abbreviations for terms are used throughout the Engineering Design Criteria manuals.

Definitions

City	City of Orillia.
City Representative / City Engineer	Any person, company, or organization, assigned to a project by the City to carry out work on their behalf. The name of the Representative shall be specified prior to the start of construction on any project.
Contractor	An independent company or individual acting as the Contractor and having entered into a legal contract to supply labour, material, equipment, management to construct, repair or install services.
Developer(s)/Owner(s)	The person(s) entering into the subdivision agreement / site plan agreement with the Corporation of the City of Orillia.

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Engineering Consultant	A competent Professional Engineer or Geoscientist or firm of engineers or Geoscientists employed by the Developer or City which is registered with Professional Engineers Ontario and/or Professional Geoscientists Ontario, possessing a current Certificate of Authorization to practice professional engineering or geoscience.
Non-Residential	Industrial, Commercial, and Institutional (ICI) properties
Private Road	Includes any Roadway that is not assumed by the City or the Province of Ontario.
Professional Engineer	A person licensed by Professional Engineers Ontario (PEO) under the Professional Engineers Act and legally authorized to practice professional engineering, use the protected title "Professional Engineer" or the designation "P.Eng.", and take public responsibility for engineering works.
Standard Drawings	Formal technical documents that use universally accepted conventions to communicate the specifications of a design.

Abbreviations

AWWA	American Water Works Association.
CSA	Canadian Standards Association.
MECP	Ontario Ministry of the Environment, Conservation and Parks.
NFPA 24	National Fire Protection Association Standard for the Installation of Private Fire Service Mains and Their Appurtenances.
OBC	Ontario Building Code.
OLS	Ontario Land Surveyor.
OPSD	Ontario Provincial Standard Drawings.
OPSS	Ontario Provincial Standard Specification.

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3.0 REFERENCE DOCUMENTS

The design and construction of all new watermains and associated appurtenances shall be completed in accordance with the latest version of this manual. The criteria outlined in this manual is intended as a supplemental specification that overrides other specifications. Where not overtly defined or overridden by the criteria outlined in this manual, design criteria to follow industry standards and best practices, including but not limited to the latest versions of the following:

- Ontario Provincial Standard Specifications (OPSS) and Ontario Provincial Standard Drawings (OPSD)
- Ministry of Environmental, Conservation and Parks (MECP) Design Guidelines for Drinking Water Systems
- Orillia Official Plan
- Drinking Water Works Permit (DWWP)
- Municipal Drinking Water License (MDWL)
- In accordance with manufacturer's specifications
- The Canadian Standards Association (CSA)
- American Water Works Association (AWWA)
- American Society for Testing and Materials (ASTM)
- Underwriters Laboratory (UL)
- Factory Mutual (FM)
- Fire Underwriters Survey (FUS)
- NSF International (NSF)
- National Fire Protection Association (NFPA)

3.1 Applicable Acts

The design and construction requirements for linear watermain systems outlined in this manual do not override or substitute any applicable legislative requirements. The design of new linear watermain systems must be completed in accordance with the most current versions of applicable legislative requirements, including but not limited to the following:

- Municipal Act
- Planning Act
- Ontario Water Resources Act
- Safe Drinking Water Act
- Clean Water Act
- Environmental Assessment Act
- Environmental Protection Act
- Accessibility for Ontarians with Disabilities Act (AODA)

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3.2 NSF Certification

All watermain, appurtenances, materials and hardware that comes into contact with the drinking water must be certified under NSF 60, 61, and/or 372, or food grade quality. Proper documentation of NSF certification must be available to the City upon request.

4.0 USE OF MANUAL

The intent of the City's Engineering Design Criteria manuals is to facilitate consistent engineering design and construction practices within the City. Moreover, the manuals are intended to:

- Integrate industry standards and best practices;
- Prioritize the health and safety of the public; and
- Reduce impacts to the natural environment and protect resources.

Each section of the manual should be read in conjunction with one another.

- City of Orillia Engineering Design Criteria: General Guidance
- City of Orillia Engineering Design Criteria: Wastewater
- City of Orillia Engineering Design Criteria: Water Distribution
- City of Orillia Engineering Design Criteria: Stormwater
- City of Orillia Engineering Design Criteria: Transportation

5.0 DESIGN

5.1 General Requirement

Section 5.0 outlines the minimum requirements pertaining to design of water distribution networks within the City.

The City is responsible for the supply, treatment and storage of treated water for the municipal water system. Watermains designed and constructed in accordance with the most recent requirements and specifications of the City are required on every street within all proposed plans of subdivision. Watermains shall be of adequate size to provide service for the development of adjacent lands designated by the City.

Exceptions to these guidelines may be allowed on a case-by-case basis but will require approval from the City.

5.2 Design Criteria

5.2.1 Design Water Demand

All watermains shall be sized to meet the greater of the following criteria:

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- Maximum day plus fire flow, or
- Peak hour demand.

The design water demand shall be calculated based on the Average Day Demand (ADD) multiplied by the appropriate factors.

Maximum Day Demand (MDD)

$$Q_{MDD} = Q_{ADD} \times \text{Max Day Factor}$$

Where:

$$\begin{aligned} Q_{MDD} &= \text{Maximum Day Demand Design Flow (m}^3\text{/s)} \\ Q_{ADD} &= \text{Average Day Demand Design Flow (m}^3\text{/s)} \end{aligned}$$

Peak Hour Demand (PHD)

$$Q_{PHD} = Q_{ADD} \times \text{Peak Hour Factor}$$

Where:

$$\begin{aligned} Q_{PHD} &= \text{Peak Hour Demand Design Flow (m}^3\text{/s)} \\ Q_{ADD} &= \text{Average Day Demand Design Flow (m}^3\text{/s)} \end{aligned}$$

5.2.1.1 Residential Water Demand

Residential water demand shall be calculated on the basis of an average day consumption rate of 300 L/cap/day.

The maximum day and peak hour factors shall be determined from the current MECP Design Criteria although the following are considered minimums:

- Maximum daily demand factor: 1.6
- Peak hourly demand factor: 3.0

Peak flows other than residential flows shall be determined on a case-by-case basis.

5.2.1.2 Non-Residential Water Demand

Non-residential water demands and peak factors shall be calculated or estimated by the proponent based on expected business activities.

Where available, actual water meter data at the subject site or a similar site (covering at least two years) shall be used for accurate prediction of ICI specific water demands.

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In the absence of any meter data, proponents may consult the current version of the Ontario Building Code (OBC) or other industry standard resources as approved by the City, to estimate appropriate demand for the ICI activity.

If the non-residential activity for the property is unknown, a design demand of 28 m³/gross ha/day average daily flow or as provided in Table 3-2 of MECP Design Guidelines shall be used for Institutional and Commercial properties, and 36 m³/gross ha/day for Industrial properties, using the property area being developed and not the floor area of the building. For mixed residential and non-residential developments, the residential portion of the development will be assessed by the number of units. The non-residential portion would be assessed by the lot areas as above, unless the proponent has calculated demand based on the expected business activities.

When using the above unit demands, maximum day and peak rate factors shall be developed and provided. For estimation of peak demand rates, a fixture-unit approach using the Ontario Building Code Table 7.6.3.2-A or Table 7.6.3.2-D shall be used.

Similarly, when using the above industrial unit demands, maximum day and peak rate factors will generally be 2 to 4 times the average rate depending on factors such as type of industry and production schedule.

Developers are to provide a rationale for all maximum day and peak hour factors used.

5.2.1.3 Fire Flow

Fire flow requirements for a particular structure or area shall be determined in accordance with the latest revisions of the Ontario Building Code, and the Ontario Fire Code, and the Fire Underwriters Survey. Assumptions made in fire flow calculations are to be conditions of building permit.

Hydrant flow tests must be completed and documented by a third party to confirm that adequate fire flows are available for the construction. Pressure drop between static and residual in hydrant flow test is *required* to be a minimum of 10% per NFPA 291. Note that City fire flow testing is conducted for internal information and usage, only. City fire flow results may be used to support conclusions for developments, but not as the basis for conclusions.

5.3 Watermain Design

Prior to the commencement of any design for new watermains within the City to support new developments, the applicant shall obtain confirmation from the City that adequate water supply exists for the development proposed.

5.3.1 Friction Factors

The Hazen-Williams equation shall be used to calculate the flow in watermains as follows:

$$Q_{Design} = 0.849 \times C \times A \times R^{0.63} \times S^{0.54}$$

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Where:

Q_{Design}	=	Design Flow (m^3/s)
C	=	Hazen-Williams friction coefficient
A	=	Cross-Sectional Flow Area (m^2)
R	=	Hydraulic Radius (m)
S	=	Slope of Energy Grade Line (m/m)

The C-Factors in Table 1 shall be used in the Hazen-Williams equation, for the design of water distribution systems.

Table 1: Friction Factors

Pipe Material	C-Factor
PVC	150
Ductile Iron	140
Cast Iron	100
Concrete	120

A C-Factor of 140 shall be used to calculate maximum velocities for transient pressure estimations, or for checking pump motor sizes for runout conditions.

In evaluating existing systems for expansion, the C-Factors shall be determined by actual field tests, wherever possible.

5.3.2 Watermain Size

Watermains are to be sized according to the anticipated water demand, including future developments projected to connect to the watermain. For all watermains designed to carry fire flows, the minimum sizing for watermains is shown within the Table below:

Table 2: Fire Flow Watermain Sizing

Land Use	Diameter (mm)
Residential	150
Commercial	200
Industrial	300

In general, the following standardized watermain sizes shall be used in the City: 150 mm, to 400 mm as per available standard pipe sizes. The use of larger watermain sizes requires City approval.

5.3.3 Watermain Material

All watermain materials must comply with the standards established by the following organizations:

- American Water Works Association (AWWA)

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- Canadian Standards Association (CSA)
- NSF/ANSI Standard for Drinking Water - Health Effects

Acceptable materials for watermain pipe up to and including 400 mm diameter are as follows:

- Polyvinyl Chloride Pipe (PVC), Ductile Iron (DI), and Concrete Pressure Pipe (CPP) manufactured in accordance with the current CSA and AWWA standards..
- Fittings shall be of cast iron or ductile iron, cement-lined, and shall be manufactured to AWWA C110. All fittings shall be supplied with mechanical joint ends.
- High Density Polyethylene (HDPE) pressure pipe shall be to OPSS 1842.

The class of pipe and the type of bedding shall be selected to suit factors such as thrust force, internal pressure, surge pressure, live load, dead load, soil type, trench conditions, and pipe manufacturer's recommendations.

Transmission watermains are to be designed on a case by case basis in consultation with the City.

5.3.4 Watermain Pressures

Flow, pressure and testing requirements shall be considered for watermain sizing under a range of operating conditions. Typical operating pressures are identified in Table 3 for new developments. Developments where the typical operating pressures may not be available in the distribution system, due to system configuration and/or topography, are subject to review and approval by the City. Internal pressure boosting, including pressure tanks and on-site storage, may be required to achieve adequate water pressure at subject locations and multi-storey buildings within the City.

Selection of pipe material and fittings shall be selected to withstand all surge and transient pressures.

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Table 3: Distribution System Pressure Guidelines

Scenario	Pressure Guidelines
Normal Pressure Range	345 – 620 kPa (50 – 70 psi)
Average Day Demand	Max. operating pressure: 700 kPa (101.5 psi) ¹
Maximum Day Demand	Min. operating pressure: 275 kPa (40 psi) ²
Peak Hour Demand	Min. operating pressure: 275 kPa (40 psi)
Maximum Day and Fire Flow Demand	Min. operating pressure: 140 kPa (20 psi)
Testing/Commissioning	Testing pressure range: to be in accordance with AWWA C651

Watermains shall be designed such that:

- Minimum flushing velocity of 0.8 m/s is achieved
- Maximum velocity does not exceed 1.5 m/s during peak hour conditions
- Velocity in transmission watermains shall not exceed 2.0 m/s

5.4 System Layout

Water distribution networks shall be designed to minimize the extent of an area affected by a shut-down and with flexible operation in mind. Section 5.4 e outlines minimum requirements pertaining to water distribution system layout.

5.4.1 Minimum Pipe Cover

Watermains shall have no less than 1.9 m of cover from final surface grade. Variations from this cover may be made only if approved on plans or in writing by the City Engineer.

Where 1.9 m of cover is not possible or infeasible, insulation shall be placed as per OPSD 1109.030 to prevent watermain (and associated appurtenances) freezing, subject to City approval.

5.4.2 Watermain Location

Watermains shall be located as shown on the standard City road cross-section. This location shall generally be on the north or east sides of the street.

¹ If distribution pressure at Average Day Demand in a localized area is modelled above the pressures permitted by the OBC, the pressure shall be confirmed by measurement (such as the use of pressure loggers), and a pressure-reducing valve shall be installed on each service connection within that area if pressures are found to be above 700 kPa, for any reservoir height.

² In areas where the minimum operating pressure does not meet 275 kPa internal pressure boosting may be considered or required for providing adequate internal building water pressure and/or compliance with regulatory requirements.

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Extra fittings shall be installed at any point on the watermains requested by the City to provide for future connections.

5.4.3 Horizontal and Vertical Separation

Watermains should cross above sewers with sufficient vertical separation to allow for proper bedding and structural support of the watermain and the sewer main wherever possible.

A minimum vertical clearance of 0.50 m shall be provided at the point of crossing between the outside of the pipe barrels of the sewers and watermains.

A minimum horizontal separation of 2.5 m shall be provided between the outside of the pipe barrels of the sewers and watermains. Refer to the MECP's F-6-1 Procedure for additional information if the minimum horizontal and/or vertical separations cannot be met.

When it is not possible for the watermain to cross above the sewer main, the watermain passing under a sewer shall be protected as follows:

- A vertical separation of at least 0.50 m shall be provided between the outside face of the sewer and the top of the watermain.
- The sewer shall be adequately supported to prevent excessive deflection of joints and settling.
- The length of watermain pipe under the sewer shall be centred at the point of crossing so the joints will be equidistant and as far as possible from the sewer. Watermain pipe joints shall be located 1.5 metres (minimum) from the centreline of the sewer (both sides).

Sewer and watermain crossings over or under other utilities shall be designed to meet the minimum clearances required by the respective utility owner. Minimum pipe cover for both sewer and watermain infrastructure shall conform to applicable City standards at all crossing locations.

5.4.4 Dead-End Watermains

Water distribution systems shall be designed in grid patterns or looped to avoid dead-end sections. Dead end watermains are not permitted unless unavoidable and shall be reviewed and approved at the City's discretion. All dead end watermains shall be equipped with a flushing appurtenance at the end of the main or with a 50 mm watermain loop for the last 90 m of the main. At the City's discretion, an at-grade flush-mounted automatic flushing station may be required to be installed.

Temporary dead-ends on watermains to be extended in the future shall be equipped with a fire hydrant at the end of the temporary dead-end main. The fire hydrant shall be immediately preceded by a valve to facilitate the future extension of the watermain without disruption to the existing users.

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Temporary dead ends created during construction shall have a 50 mm blow off installed for flushing purposes. Blow off can be removed once dead end is looped into the distribution system. The blow off shall be to the City's standard with brass ball valve, and service box.

Where a watermain ends in a cul-de-sac, a 50 mm watermain loop shall be installed from the watermain to the last fire hydrant around the cul-de-sac, where the loop reconnects back to the watermain.

5.4.5 Existing Watermains

Connections to existing watermains or water services to comply with the City's Watermain Commissioning Procedure, the MECP Disinfection of Watermains Procedure, AWWA C651, most current edition, and any other relevant standards.

Backflow prevention is required between source water and the new watermain in accordance with City of Orillia Chapter 1020 Drinking Water System Cross-Connection Control Program.

5.5 Fire Hydrants

5.5.1 General Requirements

Hydrants shall be located on the same side of the street as the watermain. Hydrants shall be perpendicular to both the street and watermain.

Hydrants and appurtenances shall conform to all applicable CSA and AWWA requirements. Hydrants and leads are to be restrained in accordance with Section 5.9 – Thrust Restraints, Joints and Fittings of this Engineering Design Criteria.

All hydrants installed on watermains up to and including 300 mm in diameter shall be installed with a 150 mm diameter branch valve attached to the watermain with an anchor tee.

All hydrants installed on watermains greater than 300 mm in diameter shall be controlled by a 150 mm diameter, branch valve directly secured to the supply main with a tapping sleeve complete with flanged fittings or restraining tie-rods.

Fire hydrants shall be non-rising stem, open left with 2 CSA hose ports, one pumper port, complete with traffic flange at no more than 100 mm above final grade. The hydrant lead shall be minimum 150 mm with resilient seated gate valve shut off "Open Left". The hydrants shall have all drain holes plugged and be installed as per OPSD 1105.010. Ports to have fire thread confirming to O. Reg. 213/07: FIRE CODE.

In all areas hydrants shall be equipped with 114 mm diameter Pumper ports and two - 64 mm diameter side ports. All hydrants to be equipped with Storz connection; the Storz connection pumper port shall face 90° to the fire access route.

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5.5.2 Hydrant Spacing and Location

Hydrants shall be installed on all watermains 150 mm in diameter and larger with the following maximum allowable spacing (measured along centerline of road):

- 150 m in residential areas, or to provide for a maximum hose length of 75 m.
- 90 m in industrial and commercial areas.

Hydrants shall be located on the projection of a lot line and offset from the street line in accordance with the standard cross-section.

Hydrants shall be located 1.20 m minimum distance from the edge of any driveway or house service connection.

A hydrant shall be placed at the end of every cul-de-sac and dead-end street as well as at the high points in roads.

5.5.3 Hydrant Lead Size

Hydrant leads shall be 150 mm in diameter and shall be connected to the watermain via anchor type tee and controlled independently by a 150 mm gate valve. The hydrant barrel shall have a minimum depth of 1.9 m. A maximum of one hydrant extension (300 mm or less for new developments) between the hydrant barrel and hydrant shall be permitted for deeper installations.

5.5.4 Hydrant Material, Colour, and Marking

Hydrants shall be painted/marked in accordance with the following:

- All hydrants shall be factory painted as specified on the standard detail drawings.
- The hydrant body shall be:
 - City Hydrants: Red
 - Private Hydrants: Yellow
- Each hydrant is to be provided with a standard marker attachable to the side port for easy identification in the winter. Markers must extend at least 1 m above the hydrant.
- Each hydrant to have an identification number to be assigned by the City.
- The hydrant numbering shall be 25 mm to 37 mm in height and white retroreflective of legible font.
- Hydrant bonnets and caps colour coding to be in accordance with NFPA 291 standard.

5.6 Valves

5.6.1 General Requirements

All valves must comply with AWWA standards and be NSF 61 & 372 certified.

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5.6.2 Valve Size and Type

All line valves shall be the same size as the watermain.

Gate valves shall be used on all watermains.

All valves shall be of the approved type with non-rising stem and a 50 mm square operating nut opening counterclockwise.

All valves in boxes shall have mechanical joint ends.

5.6.3 Number, Location and Spacing

Generally, three valves are required at a tee intersection, and four valves are required at a cross intersection with the valves being located at a point where the street line projected intersects the watermain. All valve boxes and valve chambers shall be located in boulevards and out of pavement areas wherever possible.

Line valves on distribution watermains shall be located so a maximum of 60 houses can be shut-off from another block and isolated from the system at any time. In no case; however, shall the valve spacing along a watermain exceed 100 m. Valve spacing on transmission watermains may be 300 m or greater with City approval.

5.6.4 Valve Boxes

All valves on watermains 400 mm in diameter and smaller shall have valve boxes and specified direct bury operators must be used.

All valve boxes shall be two-piece, multicomposite road leveller type.

5.6.5 Air Relief Valves

Air relief valves shall be installed at all significant high points of the water distribution system.

Air relief valves shall be double-acting type, combination air release/vacuum valve.

Air relief valves should be removable stand-alone, direct bury type whenever possible.

Where stand-alone type not possible, air relief valves shall be housed within a chamber; chamber shop drawings shall be provided for the City's review and approval. Access holes shall be designed accordingly to accommodate the size of pipe and air relief unit.

The creation of a new sub pressure zone utilizing an, or multiple, in-line pressure reducing valve(s) shall be considered only under exceptional circumstances and approval is at the City's sole discretion. The design shall be prepared by the Consulting Engineer in consultation with the City. Where a central pressure reducing valve is required, it shall be located in a water pumping facility or a suitably sized standard precast chamber. Pressure reducing valves shall

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be in accordance with the City's approved Material Specifications for Watermain, Sewer and Appurtenances document.

5.6.6 Drain Valves

The City's preference is to install hydrants rather than drain valves; drain valves should not be installed unless necessary.

If necessary, drain valves shall be located at the low points of all watermains 400 mm in diameter and greater. The location of these valves shall be coordinated such that they are located within a chamber already required for an isolation valve to minimize costs. For watermains 400 to 600 mm in diameter, the drain valve shall be 100 mm, for watermains greater than 600 mm in diameter drain valves shall be 150 mm. Chamber shop drawings shall be provided for the City's review and approval.

5.7 Service Connections

5.7.1 General Requirements

Individual service connections shall be installed to each lot within the development. Semi-detached lots shall be provided with two separate water service connections.

All services are to be a minimum bury of 1.9 m throughout the installation. The maximum bury at property line is to be 2.5 m. All requirements for separation of water and sewer must be followed for servicing as well.

5.7.2 Service Location

Water service connections shall be installed to the mid-point of the frontage of all single-family lots, except where this will place the curb-stop within the driveway. The service pipe must be installed at right angles to the main and in a straight line from the main to curb stop.

After construction, the end of the connection shall be marked by a suitable length of 50 mm x 100 mm lumber extending from the end of the connection to a point 0.9 m above grade. The top of this marker shall be painted blue.

5.7.3 Curb Stops and Boxes

Curb stops on all water service connections 50 mm in diameter and less shall be located at the property line. Curb stops shall not be located within a driveway.

An anchor tee and valve may be required for long services 100 mm and greater (i.e., main across the road from the property); however, a property line valve is also required. Appurtenances are to be appropriately restrained, as required.

Water service valve boxes shall not be located in driveways. In the event the designed driveway and water service box locations conflict as a result of the final house siting, the water service box shall be moved to a location to the satisfaction of the City.

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5.7.4 Connection to Main

Service connections for industrial, commercial, institutional or multiple dwelling uses will be considered on an individual basis. Fire connections may be required for industrial, commercial, institutional or multiple dwelling lots.

Connections to the main must be oriented appropriately, between 3 o'clock and 9 o'clock, with no installations allowed at 12 o'clock. All services must include a strain relief loop off the main.

5.7.5 Service Size

The minimum size of service connection permitted shall be 25 mm in diameter.

For other situations requiring a specific evaluation, the following factors shall be used to determine the minimum size of service connections:

- Peak water consumption of the building to be serviced.
- Total length of service required to reach the building.
- Elevation of the building with respect to the elevation of the watermain.
- Available head in the watermain.
- Loss of head in the service connection.
- Required head at the point of water usage.

Unless noted and approved by the City, one water service complete with water meter is permitted per lot, including residential (dwelling units, townhouses, row houses), commercial units and industrial malls.

Access to the water meter for maintenance and replacement must conform to Municipal code 1019.5.4 (c) No permanent fixtures or obstructions within 0.5m of meter.

New developments must provide sufficient space and accessibility for meter maintenance and installation per City Municipal Code Chapter 1019. The meter must be accessible for reading and maintenance and must be protected from freezing or damage.

5.7.6 Service Material

As specified by the City of Orillia. See "Material Specifications for Watermain and Appurtenances", Section 8 Item #6.

5.8 Bedding, Cover and Backfill Requirements

5.8.1 Bedding, Embedment and Cover

The class of pipe and the type of bedding shall be designed and selected to suit loading and proposed construction conditions. Pipe bedding and cover shall be granular material in accordance with OPSD requirements for rigid and/or flexible pipe.

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Embedment for flexible pipe shall be Granular A material in accordance with OPSS requirements. Bedding, embedment and cover materials shall be placed for the full width of the trench and compacted to 98 percent of Standard Proctor Maximum Dry Density (SPMDD), as specified by ASTM D698.

Alternate granular materials for pipe bedding may be specified, subject to the approval of the City, however clear stone bedding or high-performance bedding are generally not permitted. In areas where it is difficult to control the infiltration of ground water into the water service trenches clear stone bedding may be considered provided it is completely wrapped in a suitable geotextile, selected and installed in accordance with the manufacturer's requirement and at the direction of the geotechnical consultant.

Where poor soil conditions and high ground water levels are present, custom trenching and bedding designs shall be prepared for the City's approval including recommendations from the geotechnical engineer.

5.8.2 Trench Backfill

Trench backfill shall be considered as starting at 300 mm above the obvert of the watermain. Backfill shall be in accordance with OPSS and OPSD requirements including recommendations provided in the geotechnical report for the site.

5.9 Thrust Restraints, Joints and Fittings

Adequate restraint must be provided at all fittings and deflections in the water distribution system to prevent pipe movement and subsequent joint failure. Caution tape is to be secured around the watermain where deflection occurs prior to backfilling.

Mechanically restrained joints or concrete thrust blocks in accordance with OPSD shall be used for all watermains. The recommended type of restraint in the design will depend on anticipated soil conditions.

5.10 Corrosion Protection

All ferrous fittings, pipes, and tracer wires shall have corrosion protection provided by means of sacrificial anodes.

Sacrificial anodes shall be in the form of packaged zinc anode or zinc anode caps and meet ASTM B-418-73-type II.

Anode caps are to be installed on every valve, hydrant, and fitting bolts connected to ferrous and a non-ferrous watermain.

Fittings shall include bends, tees, crosses, sleeves, reducers, plugs, caps, joint restrainers and couplings etc.

Protection requirements not otherwise stated above are outlined in Table 4 below.

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Engineering Design Criteria: Water Distribution

Table 4: Corrosion Protection

Component	Petrolatum System	Cathodic Protection
Buried Metallic Fittings – on flanged surfaces, nuts, bolts, tie rods, clamps, valves, sleeves and couplings.	Required	Required
Mechanical Restraints	Required	Not Required
Valve Chambers – surface of pipes, valves and appurtenances	Required	Not Required
Metallic Forcemain – at each metallic component	Not Required	Required
PVC Watermain – 1.0 m horizontally from each metallic component	Not Required	Required
HDPE Watermain 1.0 m horizontally from each metallic component	Not Required	Required

5.11 Tracer Wire – Specification and Testing

A tracer wire shall be provided for all watermains to permit future field tracing. . Refer to the City's approved material specifications for tracer wire gauge and approved manufacturers.

5.12 Testing and Commissioning

Connections to existing watermains or water service connections shall not be made until the new watermain has been fully commissioned to the satisfaction of the City and written permission is received from the City. Testing and commissioning is to be on the entirety of the watermain system, including service connections to property line and hydrants.

Hydrostatic testing shall be performed in accordance with OPSS.MUNI 441, or NFPA 24, as applicable. Pressure indicators shall be calibrated annually by a third-party laboratory certified to ISO/IEC 17025. The Contractor shall provide all documentation to the City's.

Swabbing, disinfection, flushing and verification are to be performed in accordance with AWWA C651, the most recent edition, and the MECP's Watermain Disinfection Procedure. Backflow prevention devices used to fill the new main are to be in accordance with CSA-B61.10.

All sampling and testing to be completed in accordance with current City procedures.

5.13 Auto-flushers

Auto-flushers, if required, must meet the following requirements:

- Ground mounted
- Discharge to a storm sewer or ditch
- Maintain an air gap.
- Include programming capable of allowing for scheduling of flushing based on time of day.
- Supplied with 50 mm water service.

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- Located at the furthest practical location from a residential property to mitigate noise complaints.

5.14 Sample Stations

Sample stations will be required, at the City's discretion. Any development with more than 400 units must include one station per 400 units. Sample stations, where required, must meet the following requirements:

- Located near dead ends or areas of low flow.
- Installed at or near property line, in a location that is easily accessible for City staff, without flooding or icing private driveways in the winter.
- Have a patio stone splash pad located in front of the station to minimize gouging.
- Supplied with a 25 mm water service.
- Sample ports located a minimum of 1.5 m above grade.
- Secured appropriately to the ground to maintain plumb.
- Able to be secured with a padlock.

5.15 Asset Information Collection

Developers are required to obtain the most current templates and procedures from the Asset Care Team ahead of the completion of all works. The Developer will be required to complete all templates and submit in that form, to the Asset Care Team, prior to any assets being brought into service. These templates may include, but are not limited to, asset unique number, description, manufacturer, model, serial number, length, material, dimensions, in-service date, replacement cost, useful life, GPS location, address, location, or other details. Some of the attribute information may be provided by the City, such as asset unique number.

Additional information such as maintenance schedules, consumable parts list, and operations manuals may be required.