City of Hamilton

Watermain Design Criteria

2024

Public Works – Engineering Services

Technical Working Committee

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Preface

This manual was compiled to serve as a valuable resource for City of Hamilton Staff, consultant firms, and contractors who are involved in design, maintenance, and construction of City of Hamilton infrastructure projects. The manual provides information and guidance on design of watermains, valve chambers, and appurtenances intended to address site-specific performance, serviceability, and safety requirements while satisfying project requirements. The information contained and methodologies presented are specific to the City of Hamilton and should not be used for other purposes.

This document is to be used in conjunction with other design guideline documents prepared by COH and other regulatory authorities including, but not limited to:

- *Sewer Design Criteria* (COH, 2024);

  This document provides requirements for the design of forcemains, storm sewers, and sanitary sewers in support of COH Capital and Maintenance works, infrastructure for which COH will assume Ownership upon completion, and works completed under a COH Permit and/or Approval.
- *Comprehensive Development Guidelines and Financial Policies Manual* (COH, 2019);

  This Council approved manual was prepared for use by City of Hamilton staff, developers, landowners, municipal engineers, planners, and architects to support municipal requirements related to subdivision and site plan approvals. The Comprehensive Development Guidelines and Financial Policies Manual will work in conjunction with this document and where there is overlapping information between these two documents, this document shall take priority; this pertains to Sewer/Watermain information only.
- *Construction and Materials Specifications Manual* (COH, 2022);

  This includes construction specifications, the Approved Products List, and standard drawings.
- *Water Outstation Design Manual (COH, in development);*

  This design manual provides design preferences by City of Hamilton staff for the following water outstations: Wells, Pumping Stations, and Storage tanks. It also includes design preferences for chlorination systems and standby power for these water outstations.
- *Water and Wastewater Master Plan (COH, 2006);*

  The Master Plan provides the City with a water and wastewater servicing strategy in support of the Growth Related Integrated Development Strategy.
- *Right-of-Way Utility Installation and Permit Manual* (COH, 2022);

  The Manual provides standards and processes for the design and installation of utilities within the municipal right-of-way to ensure that required safety criteria and procedures are being followed and adhered to, clearances and separations are maintained, and that physical space is optimally utilized.
- *Design Guidelines for Drinking-Water Systems* (MECP, 2023)

Revision History

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January 3, 2023	*1*	*First Draft*
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November 21, 2024	*4*	*Version 3*
December 2, 2024	*5*	*Final Version*

Table of Contents - Watermain Design Criteria

List of Appendices

List of Acronyms and Abbreviations

CL	Centreline
OPSS	Ontario Provincial Standard Specification
OBC	Ontario Building Code
O. Reg.	Ontario Regulation
QA	Quality Assurance
QC	Quality Control
AASHTO	American Association of State Highway and Transportation Officials
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
CLI ECA	Consolidated Linear Infrastructure Environmental Compliance Approval
COH	City of Hamilton
COH-DEV	City of Hamilton – Development Engineering
COH-BLDG	City of Hamilton – Building Department
COH-HW	City of Hamilton – Hamilton Water
COH PW	City of Hamilton – Public Works
COH-ENG	City of Hamilton – Engineering Department
COH-EMS	City of Hamilton – Emergency Medical Services
CPP	Concrete Pressure Pipe
CSA	Canadian Standards Association
DI	Ductile Iron
DWQMS	Drinking Water Quality Management Standard
EPDM	Ethylene Propylene Diene Monomer
HDPE	High Density Polyethylene
HGL	Hydraulic Grade Line
ID	Inner Diameter
LID	Low Impact Development
LRT	Light Rail Transit
MECP	Ministry of the Environment, Conservation and Parks
MTD	Manufactured Treatment Device
MTO	Ontario Ministry of Transportation
NACE	National Association of Corrosion Experts
NBR	Nitrile Butadiene Rubber
NFPA	National Fire Protection Association (U.S. Based)
NSF	National Sanitation Foundation
OD	Outer Diameter
OPSD	Ontario Provincial Standard Drawing
OPSS	Ontario Provincial Standard Specification
O. Reg.	Ontario Regulation
PVC	Polyvinyl Chloride
PVCO	Molecularly Oriented Polyvinyl Chloride
QA	Quality Assurance

QC	Quality Control
QP	Qualified Person
ROW	Right-of-Way
SDR	Standard Dimension Ratio
SLR	Surface Loading Rate
TBM	Tunnel Boring Machine

Definitions

“Third Party Utility” means Utilities not owned or operated by City of Hamilton

“City” or “COH” means The City of Hamilton

"Contractor" means a person, partnership, or corporation who contract to undertake the execution of work commissioned by the City to install or maintain watermains, sewers, private drain connections, maintenance holes, catch basins and other appurtenances.

"Engineer" means the City Engineer for the City of Hamilton or the City Engineer’s authorized representative.

"Water Service" means every water pipe installed from a connection on a main or private main to the meter location or, for a fire service, to the inside of the exterior wall of a structure.

“Post Hydrants” means mini hydrants installed at dead ends and are used for water quality flushing

“Mandatory Certify Level 1” means certified operator class I in accordance with O.Reg. 128/04

“ORO” means Overall Responsible Operator

“N-Value” means the number of blows needed for the Standard Penetration Test (SPT) standard tube to penetrate into the ground at the bottom of a borehole by blows from a slide hammer with standard weight and falling distance. N-values provide indication of the relative density of the subsurface soil.

“High Order Transit Guideway” means A physical or designated route that supports and guides trains or individual vehicles (for example, bus rapid transit or light rail transit).

“Right-of-Way” means A dedicated strip of land intended for the accommodation of public roads/guideways, utilities, drainage, and other similar public uses. The Right-of-Way extends from property line to property line on either side of a public road.

“Storm Sewer” means Sewers that collect and transmit, but not exfiltrate or lose by design, stormwater resulting from precipitation and snowmelt.

"Third Party Utility” means Utilities not owned or operated by City of Hamilton

“Distribution Main” means watermains that are 400mm in nominal pipe diameter and smaller.

“Trunk Main” means watermains that are 400mm in nominal pipe diameter and larger. Note: occasionally 400mm diameter watermains may be identified as Trunk mains serving a dual purpose.

“19mm” and “20mm” are used interchangeably when referencing stone diameter for granular material or pipe material due to industry practice to convert from ¾” in imperial units.

“Stray Current” refers to extraneous direct currents in the earth. For LRT projects it implies rail current leakage to its surroundings. Stray currents can produce corrosive reactions in LRT structures and facilities and in adjacent utilities.

“Inspector” means the City of Hamilton, Public Works, Engineering Services Contract Inspector or the City of Hamilton, Planning and Economic Development, Growth Management Inspections/Development Construction Coordinator who hold a minimum MECP, O.Reg. 128/04 Drinking-Water Operator Certificate.

List of Units and Measurements

°C	celsius
GHz	gigahertz
ha	hectare
hr	hour
J	joule
kg	kilogram
kJ	kilojoule
km	kilometre
kN	kilonewton
kPa	kilopascal
kPa/mm	kilopascal per millimetre
L	litre
L/ca/d	litre per capita per day
L/s	litre per second
L/s/ha	litre per second per hectare
MHz	megahertz
MPa	megapascal
m	metre
m/s	metre per second
m^3/s	cubic metre per second
µm	micrometres
mm	millimetre
mm/hr	millimetre per hour
min	minute
W	watt

WM 1 WATER QUALITY MAINTENANCE

WM 1.1 Principles of Water Quality

📖 The City of Hamilton Drinking Water Quality Management System Policy is:
The City of Hamilton owns, maintains and operates various drinking water systems. The City is committed to:
S: Safe, high quality, consistent supply of drinking water
A: Always improving the Drinking Water Quality Management System
F: Following and complying with applicable legislation
E: Effective and open communication concerning matters of drinking water quality

Provision and protection of clean and safe potable water at acceptable flow and pressure is the overarching mandate in the operation, planning, design, construction, and maintenance of the CITY Water Distribution system.

In keeping with the recommendations of the Walkerton Inquiry (2002) and previous good practices, the CITY of Hamilton shall continue to:

- deliver water with a level of risk so negligible that people feel safe drinking the water
- provide Source Water Protection in tandem with Water Treatment to achieve the highest level of Source to Tap protection possible
- be transparent and accountable to the Public and Governmental Authorities
- be committed to a regimen of monitoring, sampling, testing, measurement, training, education, planning and continuous improvement
- maintain a workforce of certified and accredited operators, inspectors, planners and designers

Source to Tap can be summarized into three primary tasks that CITY performs in order to sustainably provide quality water to our residents and business processes. Shared stewardship of the natural water system, quality water treatment and a safe/dependable distribution system.

Water Quality Testing is an integral part of the operation, planning, design, construction and maintenance of the system and ranges from microbiological (e.g. heterotrophic plate counts “bacteria”, coliforms, turbidity, pathogens, disinfectant residuals) to aesthetic (e.g. colour, taste, odour) and occurs throughout the process. This document will be restricted to a discussion of the measures related to linear water assets whereby secondary disinfection is maintained.

Mitigation of water quality degradation is addressed in the choice of Watermain products, disinfection chemicals and by providing a system that minimizes dead ends and maintains flows and turnover (use) of our water which in of itself promotes quality by mitigating aging of the water.

Appropriate and consistent Watermain sizing, maintaining positive pressure and the provision of valving and other water appurtenances enhances the ability of COH-HW to complete operations (e.g. flushing, swabbing) to address systemic limitations shall they arise.

Coupled with the reliable provision of quality water whether it be for consumption, use in a commercial or industrial process it is also incumbent on the system to reliably provide for fire protection.

Disinfection of watermains shall be done in accordance with ANSI/AWWA C651 – Disinfecting Water Mains, as amended by the latest MECP Watermain Disinfection Procedure and the City of Hamilton Form 400 - Appendix A: Procedure for the Disinfection, Testing and Connection of Watermains.

Where there is an alleged discrepancy between MECP Design Guidelines for Drinking-Water Systems and this document, the more rigorous requirement shall apply.

The design of watermains shall support the City's regulated responsibility defined in the Drinking Water Quality Management System (DWQMS) - Secondary Disinfection commitments.

WM 1.2 Drinking Water Quality Management System (DWQMS)

📖 CITY has been granted MECP Certificates of Accreditation for its five Drinking Water Systems (DWS) per third party evaluation and verification of the CITY Quality Management System (QMS).

The Safe Drinking Water Act, 2002, S.O. 2002, c. 32 (SDWA) requires Owners (City of Hamilton) and Operating Authorities (Hamilton Water) of municipal residential drinking water systems to have an Operating Authority which:

- establishes and maintains a Quality Management System (QMS) that meets the requirements of Ontario’s Drinking Water Quality Management Standard (DWQMS)
- requires that persons whose role may impact the quality of drinking water:
  - are aware of the Quality Management System (QMS) requirements
  - act in accordance with the QMS, DWQMS and other legislative requirements

Under the SDWA, Hamilton Water as the operator of the Drinking Water Systems has licenses to manage and operate the systems inclusive of the following:

- Permits to Take Water
- Drinking Water Works Permits
- Accreditation as an Operating Authority
- Operational Plan
- Financial Plan

The City's DWQMS Operational Plan document summarizes the City’s efforts to ensure that clean, safe and reliable drinking water is supplied to all City customers in accordance with MECP DWQMS. The City's DWQMS Operational Plan document is posted on the City’s website and can be found on the following URL:

https://www.hamilton.ca/sites/default/files/2024-10/waterdistribution-dwqms-operational-plan-summary-report-2023.pdf

Refer to *Appendix WM4: MECP Permit Application Process – Water* for watermain permits application process for BCOS (Form 1) and for Direct Application (Water) to MECP.

WM 1.3 Material Selection

All watermains, appurtenances, products, and chemicals in contact with the potable water shall be certified per the provisions of:

- AWWA Standards
- NSF International/ANSI/CAN 60: Drinking Water Treatment Chemicals - Health Effects
- NSF International /ANSI/CAN 61: Drinking Water System Components - Health Effects

For watermain and appurtenances products and materials refer to the City of Hamilton *Approved Products Listing*.

For selection of the watermain pipe material refer to *Appendix WM1: Watermain Pipe Material Selection Matrix*.

Suppliers and manufacturers shall provide confirmation of certification if requested.

WM 1.4 Lead Water Services and Watermains

In accordance with the City's Lead Reduction Program, it is the City's intent to improve the quality of water by reducing the lead concentration within the drinking water system to below the allowable limit of 10 µg/L (micrograms per litre, equal to parts per billion or ppb), as defined in the Ontario Regulation 169/03: Ontario Drinking Water Quality Standards.

Reuse of existing lead water services is not permitted.

Relining of existing lead water services is not permitted.

All existing lead water services shall be replaced for projects where the watermain connected to the existing services is being replaced. The existing lead water service shall be replaced from the watermain to the property line.

The City will replace lead services when encountered during watermain replacement projects and any other projects that involve excavation and exposing water services. The City typically notifies residents prior to road resurfacing projects taking place in an effort to undertake substandard or lead water service replacements before resurfacing takes place, only when requested by the property owners.

WM 1.5 Valve Operation and Connection Supervision

📖 Active valves shall only be operated by Certified COH-HW Staff.

For clarity, the Contractor is only authorized to exercise valves, 300mm and smaller, constructed in the project prior to connection to the existing Watermain system. This activity shall be done under the supervision of a Certified COH Staff. The COH staff shall have a Mandatory Level 1 – OIC certification for operating on a Live System or Overseen/Supervised if there are changes made to the flow of the system by manipulating valves, this is not required to exercise valve but needed to stop flow.

Refer to Valve Operation Section in Form 400 – Appendix A: Procedure for the Disinfection, Testing and Connection of Watermains and to Ontario Regulation 128/04 for additional information.

Refer to *Appendix WM3: Policies, Permits, Applications, Special Agreements, User Services, Fees/Charges* for connections to water systems for the purposes of Charging Operations and By-Pass Water Systems.

Refer to Section *WM 2.9.1 General* for watermain connections.

WM 1.6 Dead-End Watermains

For dead-end watermains generally 100 water service connections are permitted on an interim or phased watermain in order to maintain adequate water quality. Additional units will require a second point of supply.

Water quality on permanent cul-de-sacs shall be addressed with Watermain looping per:

- *WM-205.01* 50mm Dia. Watermain Looping in Cul-de-Sacs (20.0 m R.O.W.)
- *WM-205.02* 50mm Dia. Watermain Looping in Cul-de-Sacs (18.0 m R.O.W.)

Service connections (interim and ultimate) required for effective looping:

- desirable 8 water services
- minimum 5 water services
- maximum 20 water services

Residential/commercial Developments shall be phased such that two or more Watermain feeds are provided at each stage. In the absence of a second feed the number of lots shall be restricted to 100 water service connections except where approved by COH.

Where local conditions in a retrofit project dictate, the 50mm copper looping may be installed in a single trench. Water services connections will be balanced along the length of the copper looping.

Alternate looping configurations will be considered, where the following minimum criteria are addressed to the satisfaction of COH-PW:

- valving facilitates unidirectional flows in the system
- minimum flushing velocity of 0.8 m/s is met as required for flushing related to maintenance activities
- operational activities inclusive of swabbing are not negatively impacted

Water quality on interim or phased dead-end Watermains shall minimize flushing frequency and be addressed to the satisfaction of COH-HW in the following order of precedence:

- hydrant placed at the termination of the Watermain and a water service placed within 3.0m of the hydrant
- automatic flusher installed at the end of watermains where sewers are installed
- dead end Blow-Off per *WM-206*
- temporary looping

Flushing hydrants are in addition to, and shall not form part of, hydrant spacing criteria except where provided in *WM-205.01* and *WM-205.02*.

Flushing devices shall be sized to provide Watermain flows with a minimum velocity of at least 0.8m/s.

Automatic flushers shall be installed per drawing WM XXX and placed near a suitable discharge per the provisions of *WM 6.5 – Chamber Drainage.*

WM 1.6.1 Chlorine Residual Maintenance Plan

Minimum chlorine residuals throughout the distribution system, as mandated by the Ministry of the Environment, Conservation and Parks (MECP) are:

- 0.25 mg/L for combined chlorine (total chlorine residual minus the free chlorine residual)
- 0.05 mg/L for free chlorine

For developments approved under a Subdivision Agreement, the Consultant Engineer shall submit a Chlorine Residual Maintenance Plan with the penultimate drawing submission to COH-DEV, which shall be inclusive of:

- Consultant Engineer's stamp, seal, signature and license number
- location(s) of permanent dead-end Watermains
- location(s) of temporary (phased) dead-end Watermain
-

It shall further document at each location, the:

- recommended strategy for effective flushing
- volume of water per occurrence
- frequency of flushing

Performance Based flushing:

- manual flushing and residual confirmation shall be performed by a City of Hamilton Operator in Charge and the costs associated with these operations, inclusive of water usage, testing and staffing shall be charged to the Developer until final assumption of the Watermain system by the CITY.
- revisions to the frequency and removal of water quality mitigation measures shall be at the sole discretion of COH-HW.
- For developments, the Developer shall provide a Commitment Letter for Performance Based Flushing as per the template published in the Comprehensive Development Guideline - M.15. Appendix O - Fire Hydrant Flushing and Monitoring Program for Interim Water Quality Maintenance - and at the following link. *https://www.hamilton.ca/sites/default/files/2022-11/pedpolicies-developmentguidelines-financialpolices-manual_1.pdf*

Shall be per the provisions of *WM 2.7 Watermain Sequencing Plan*

WM 1.7 Backflow Prevention

WM 1.7.1 References

Designers shall refer to the following documents for selection, installation, and maintenance of backflow prevention devices:

- CITY By-Law 10-103 - Backflow Prevention and Amending By-Law 19-057, inclusive of:
  - Cross Connection Survey (water services 50mm and greater or a high hazard property) or
  - Self-Assessed Cross Connection Survey (water service 38mm, less than 38mm and pre-2014)
  - https://www.hamilton.ca/operating-business/commercial-water-sewer/backflow-prevention-program
  - Backflow Survey Requirements for Property Owners Self Assessed Survey
  - Cross Connection Survey
  - Backflow Device Installation Process
  - Backflow Prevention By-Law 10-103 and Amending By-Law 19-057
- CITY Permits and Approvals issued
- AWWA - Canadian Cross Connection Control Manual
- CAN/CSA-B64 SERIES-01 Backflow Preventers and Vacuum Breakers
- CAN/CSA B64.10-07 and CAN/CSA B64.10.1-07 - Selection, Installation, Maintenance and Field Testing of Backflow Preventers, B64.10S1-04/B64.10.1S1-04 - Supplement No.1
- AWWA - C510 - Double Check Valve Backflow Prevention Assembly
- AWWA - C511 - Reduced-Pressure Principle Backflow Prevention Assembly
- AWWA - Manual of Water Supply Practices (M14) - Backflow Prevention and Cross-Connection Control
- NFPA 13 Standard for the Installation of Sprinkler Systems
- NFPA 14 Standard for the Installation of Standpipe and Hose Systems

- USEPA White Paper - Health Risks - Contamination from Cross-Connections and Backflow
- Manufacturers specifications

WM 1.7.2 General

Backflow prevention devices shall be installed and maintained on water and fire services for:

- Industrial and commercial buildings
- Institutional buildings
- Multi-Residential buildings 3 stories for meter requirement; see WM-210.01 (except for buildings which fall within Part 9 of OBC)
- properties as identified by COH Backflow Prevention By-Law 10-103 and Amending By-Law 19-057

When directed by COH, site specific premise isolation backflow devices shall be provided at property line to address potential water degradation on private lands entering the CITY water system. Refer to WM xxxx for details.

Backflow prevention devices on water services shall be installed a maximum 3.0m downstream of the master water meter. The placement of a water meter chamber and the distance requirement may necessitate construction of a separate chamber or secured structure to house the device.

Backflow prevention devices shall be installed on fire protection systems and shall be installed where the fire protection service enters the building. The device shall be either a Double Check assembly or a Reduced-Pressure assembly inclusive of a detector meter capable of measurements in cubic metres.

“Reduced-Pressure Principle” type backflow devices shall not be chambered.

Common Premise Backflow Prevention Devices shall at least include the following elements:

- Reduced Pressure Zone Assembly (RP) and Reduced Pressure Detector Assembly
  - two independently acting check valves separated by a reduced pressure zone
  - check valves are fitted with a test cock for periodic testing
  - installed as a unit between two shut off valves
  - suitable for health hazards (toxic material and severely hazardous connections) such as hospitals and morgues
- Double Check Valve Assembly Backflow Prevention Device (DVCA)
  - two internally loaded check valves, force-loaded or internally weighted
  - check valves are fitted with a test cock for periodic testing
  - redundancy, where one check valve fails to close the other will prevent backflow
  - suitable for non-health hazards (non-toxic) connections such as fire sprinkler and irrigation systems
- Double Check Detector Assembly
  - two internally loaded check valves, force-loaded or internally weighted
  - check valves are fitted with a test cock for periodic testing

- redundancy, where one check valve fails to close the other will prevent backflow
- suitable for Moderate hazard Fire service connections.

Building permit is typically required for all backflow device installations. Permitting requirements, procedures, form and provisions of backflow prevention are detailed in the following the City of Hamilton web page for *Backflow Prevention Device Permits.*

WM 1.7.3 Approval Process

Site specific backflow prevention, location and chamber requirements shall be determined by persons with the credentials and per the process provided in CITY - Backflow Prevention By-Law 10-103 and Amending By-Law 19-057.

Review and Approval of identified backflow prevention within a building shall be provided by COH-BLDG as part of the issuance of a Building Permit and issuing Backflow Prevention Devices Permits.

Review and Approval of backflow prevention outside a building shall be provided by COH-DEV as part of the issuance of a Water Permit and issuing Backflow Prevention Devices Permits.

WM 1.8 Copper By-Pass

Shut valves shall be provided per *WM 6.13 Shut Valves and Pressure Districts* and shall be inclusive of 25mm copper piping to facilitate the movement of water and mitigate impacts to water quality. Anti-Stag valves on by-passes are typically only installed between Pressure Districts.

WM 1.9 Hydrant Drain Ports

Hydrant drain ports shall be plugged at locations where the water table may rise above the depth of cover on the Watermain, to eliminate the potential for frost damage and contamination to the potable water system. Hydrants that are plugged, shall be identified as “Plugged” on the hydrant. Approved ID brass tags to be installed on hydrant. Installation of programmable Anti-Stagnation device shall be required.

Hydrant drain ports shall be directed to the ground where soil conditions allow or to a dry well/drainage pit provided for that purpose in accordance with WM-203.09.

WM 1.10 Blow-Off on Industrial Water Services

Not in service industrial water service connections to existing live watermains shall be minimized. The designer shall provide the duration that the Industrial water service will be connected to the Watermain but not in service to the COH-HW. COH-HW will determine the requirements for placement of a 50mm diameter Blow-Off to facilitate flushing operations. The 50mm blow-off shall be installed in accordance with details WM-xxx.

WM 1.11 Drinking Fountains

To maintain the quality of the potable water system, any water that has been exposed to the outside environment is a waste product and shall be conveyed to the sanitary sewer.

The provision of drinking fountains shall be at the direction of COH-PW.

Drinking Fountain shall be:

- restricted to stainless steel models and provided with:
  - chemical anchors, stainless steel fasteners and brass fittings
- inclusive of a:
  - 20mm water service and meter chamber per WM-209.02
  - 150mm sanitary service with a P-trap
  - pet fountains and bottling stations as directed

Drinking fountains typically operate from May to October each year.

Drinking water fountains shall be equipped with reduced pressure backflow preventers.

Drinking water fountains shall be installed in accordance with WM xxxx.

WM 1.12 Drinking Water Haulers

Customers of potable water sourced from a Bulk Water Filling Station are ensured of safe and clean water through Public Health Inspections and the provisions of the Drinking Water System itself.

Public Health Services inspects drinking water haulage vehicles every year to prevent or reduce illnesses related to drinking water. Inspectors check operator requirements inclusive of:

- water is from a supply that meets the requirements of Ontario Regulation 169/03 under the Safe Drinking Water Act
- tank, equipment and connections used are:
  - safe and clean
  - sanitized before carrying water
  - labelled as “Drinking Water”
  - protected from contamination during storage, filling, transportation and delivery operations
  - protected from contamination from insects, rodents, chemicals or lubricants

Bulk Water Filling Stations shall be designed such that the above requirements are achievable.

Permits shall be per the provisions of *Appendix WM3: Policies, Permits, Applications, Special Agreements, User Services, Fees/Charges.*

WM 1.13 Sampling Stations and Pitometers

The designer should consider the provision of dedicated sampling stations within the distribution system to facilitate water quality monitoring.

Dedicated sampling stations and additional pitometer locations shall be per the direction of COH-HW.

Dedicated sampling stations shall be installed in accordance with WM xxx.

WM 2 WATER SYSTEM

WM 2.1 General

Pipe sizes provided refer to the nominal internal diameter or internal bore of the pipe in millimetres.

Re-use of Watermain infrastructure, inclusive of hydrants, valving and chamber appurtenances is not permitted.

Where replacement of existing drinking water system appurtenances is proposed, the designer shall confirm with the City if such appurtenances are to be salvaged. If hydrants, valves or other appurtenances are identified to be salvaged, the contractor shall deliver to a CITY Yard selected by the City.

Product and material selection shall be inclusive of a review of static and dynamic loadings, pressure ratings and pipe strength.

Reuse of lead water services and Watermain components and appurtenances is not permitted.

Field cutting of Watermain piping shall be minimized.

The staging of Watermain removals shall be at the sole discretion of COH-PW and shall be inclusive of:

- placement of By-Pass Watermain
- enabling Watermain works identified by COH-PW being in permanent service
- the provisions of this document

WM 2.2 Bedding and Backfill

Pipe bedding, cover and trench backfill shall be determined based on type of pipe (rigid or flexible), installation depth and soil conditions in accordance with Section 14 of Form 400. All granular bedding and cover materials physical and gradation properties shall meet the requirements of Form 600.

Material compaction shall meet the requirements of Form 900.

No type of slag inclusive of steel slag, blast furnace slag or nickel slag shall be used for bedding or backfill.

Ashes, cinders, refuse or organic material found at the bottom of the trench at the required pipe grade shall be excavated and replaced with Granular “A”.

Re-use of select approved excavated native materials shall be prioritized as trench backfill.

Unshrinkable fill per OPSS.MUNI 1359 shall be used where designated by COH and where normal procedures cannot produce the required degree of compaction of materials.

WM 2.3 Watermain

WM 2.3.1 Sizes

Permissible Watermain sizes (mm) shall be restricted to:

- 50[1] , 150, 200, 300, 400, 500, 600, 750, 900, 1050, 1200, 1500, 1800, 1950 and 2250.

[1]permitted per *WM-205.01* and *WM-205.02* for the provision of Watermain looping in the event of dead-ends.

Note: 250mm and 450mm Watermain are not approved for use and shall be replaced with the permissible sizes. Where requested, hydraulic modelling, fire flow studies and servicing requirements shall be provided to COH-HW to support the upsizing or downsizing the existing Watermains and water services.

The use of other watermain sizes other than the permissible sizes, shall be approved by COH-HW for cases such as: repairs or maintenance to existing watermains or in cases where the hydraulic analysis suggest otherwise. A Request to deviation from the design criteria shall be submitted and approved by COH-HW prior to finalizing the design.

Connections to existing:

- 250mm Watermains shall be achieved with 300mm fittings, valving and reducers.
- 450mm Watermains shall be achieved with 500mm fittings, valving and reducers.

Watermains in Industrial Areas shall be restricted to 200mm and greater.

Watermains shall be sized based on flow demands and pressure requirements. Watermain pipe diameters shall be such that a flushing velocity of 0.8m/s can be achieved for cleaning ad disinfection procedures.

Watermain sizing shall be such that the maximum velocity in the pipe shall not exceed 2.0m/s during maximum hour domestic flow conditions or 3.0m/s during fire flow conditions.

Maximum velocity in the Watermain under any flow conditions shall not exceed 5.0 m/s.

Hydraulic Modelling, fire flow studies and an inventory of properties with large diameter water services and/or which require water as part of a mechanical process shall be identified to COH-HW to facilitate Watermain sizing and supplementary valving.

WM 2.3.2 Materials

The selection of watermain pipe material shall per determined using *Appendix WM1 – Watermain Pipe Material Selection Matrix*.

Watermain pipe design shall be governed by the following pressures:

- 1034kPa (150psi) - Design and Field Test Pressures except in locations of higher operating pressures such as pumping station, discharge watermains, etc.

- 690kPa (100psi) – Internal Working Pressure
- Additional allowance of 690kPa (100psi) for Surge Pressure
  - Confirm surge pressure that would be created by stopping a water column moving at 0.6m/s
- External Live Loading per AASHTO Hwy. H-20 S16
- 100kPa (15psi) – Trench supported full vacuum

Pipe joints alone shall be capable of withstanding 1,035kPa (300psi) test pressure.

Factor of Safety for Pipe and Fitting Restraint - 2,070kPa (300psi) being 2 times the Design/Field Test Pressure

Manufactured tees and crosses are required for the connection of a Watermain and/or water service to a Watermain of the same size.

Refer to the *Approved Product List* for the watermain pipe material. The use other pipe material is subject to approval from COH-HW. A Request for deviation from the design criteria shall be submitted and approved by COH-HW prior to finalizing the design.

Refer to sections *WM 7.1 Thrust Forces, WM 7.2 Anchor and Thrust Blocks* and *WM 7.3 Mechanical Joint Restraint.*

WM 2.4 Water Services

📖 Water services are CITY Assets to the limits of the Right-of-Way.

WM 2.4.1 Sizes and Materials

The minimum size of service line for single-family residences shall be 25mm for new services and 20mm for existing reconnection services. Larger residences (larger than single-family) and buildings located more than 30m from the watermain connection shall have a 25 mm or larger service.

Permissible Water Service sizes (mm) and materials shall be restricted to:

- 20mm for reconnection and extension, Type “K” soft copper per Form 400 and the COH Approved Products List
- 25mm, 38mm and 50mm, Type “K” soft copper per Form 400 and the COH Approved Products List
- 100mm, 150mm, 200mm and 300mm per Form 400 and the COH Approved Products List

For Watermains 400mm and smaller, the water service material shall match the material of the watermain, for example: ductile Iron water service shall be connected to ductile iron watermains and PVC water services shall be connected to PVC or PVCO watermains.

Tapping of domestic water services from a Fire service shall be located within the COH Right-of-Way.

A 200mm fire service may be connected to a 150mm Watermain where approved by COH-HW. Otherwise water services shall not exceed the size of Watermain.

Plastic water services, inclusive of cross linked polyethylene (PEX), are not permitted within the CITY Right-of-Way.

WM 2.4.2 General and Location

Water services shall be connected to Distribution Mains. Water services are not permitted to be connected to Trunk Mains larger than 400mm.

Water services shall:

- consist of single service installation to each property or unit except for hospitals and multi-use residential properties where addition connection(s) is essential to the functionality of the property.
- conform to AWWA - C800: Underground Service Line Valves and Fittings
- not be connected to Watermains within easements, except where identified by COH-PW
- for copper water services: shall be housed in a non-solvent joint welded PVC sleeve that extends 0.3m beyond the outer limit of both ends of the 3rd party structure. The annular space to be filled with sand.

Domestic Water services may be connected to a Fire Service Line only where the service is a minimum one size smaller than the Fire Service Line and the connection is approved by COH-HW. All Fire Service Lines (single – dedicated or combined – fire and domestic) shall be provided with a single acting check valve housed in a chamber at property line downstream of the control valve.

Where buildings are directly adjacent to the back of sidewalk and the Watermain is 3.5m or less from building face, valving can be placed at the connection to the Watermain in lieu of property line with minimum 0.5m clear zone radius for the operation of water service valving.

Stubbed water services for upcoming development adjacent to a Capital project shall only be provided when:

- COH-DEV has provided an approved site plan and construction schedule for the future development
- COH-PW approves inclusion of the additional works

Where multiple Watermains exist, water services shall be connected to the Watermain identified by COH-PW.

Use of water services as an electrical ground by new building construction shall comply with the Ontario Electrical Safety Code and the Consultant Engineer shall verify electrical continuity to the satisfaction of COH-HW.

Water services for single detached residential lots shall be:

- located 1.0m from the centerline of the lot when installed for new housing
- installed perpendicular to the Watermain

- pipe diameter of the water service shall be per the approved site plan where available

All water services 50mm and less shall be:

- connected to the Watermain with a main stop
- continuous without joints
- separated from the private portion by the placement of a curb stop and box at street line except where dictated by *WM 6.7.1 Water Services (Supplemental Valving).*

NOTE: Reducing curb stops are not permitted

Full Watermain replacement and (re)construction projects shall be inclusive of full-length water service replacement to the limits of the Right-of Way per the following:

- Water services 20mm and smaller
- Water services with existing extensions
- Water services where the curb stop, and box is not at the limit of the Right-of-Way
- Where reconnection of 20mm copper and 25mm copper requires coupling or extensions

As exception to the above, water services shall be allowed to be extended:

- For existing 20mm or 25mm copper only and where the projects scope falls under the below description:
  - Standalone underground project where there is not road reconstruction.
  - Residential Roads or Collectors Roads without HSR or High Order Transit
- When existing 20mm or 25mm copper water services are extended or reconnected, couplings can be used and shall be wrapped in an approved corrosion protection tape system (Primer, Mastic and Tape).

Water services 100mm and greater:

- pipe and fitting shall be restrained from the Watermain to the greater of property line and/or building face.
- Water servicing for multi-unit developments requires the provision of pipe bedding sieve analysis and compaction testing to COH-HW, COH-BLDG and COH-DEV.
- shall be sized per AWWA Manual M22 Sizing Water Service Lines and Meters.

Additional valving on water services or on the watermain at the connection point shall be per Section *WM 6.7 Supplemental Valving.*

For High Order Transit:

- water services that cross the guideway shall be replaced full length.
- Sleeves shall be provided on water services under Heavy Rail and High Order Transit guideways / routes / stops to the satisfaction of COH-PW.
  - Concrete encased sleeves shall be provided for water services that cross underneath Third Party infrastructure per Section *WM 4.2.1 Vertical Clearances at Third Party Utilities Crossings*

- water services shall be wrapped with plastic (entire length from the watermain to the property line or building face) and secured at regular (600mm) increments via black electrical tape.

WM 2.4.3 Temporary Water Supply for Construction

Temporary water service connections for construction of a structure, associated with Growth Development or other temporary purpose, shall be per WM-209.04 and as approved by COH-HW. The temporary service shall be removed upon completion of the work, and shall be inclusive of a:

- Reduced Pressure Zone assembly (RP) Backflow Preventor, and;
- water meter which measures the volume of water consumed at, in or upon a property

In the absence of such a connection the Owner shall be charge a non-metered flat rate basis of 1m3 per day.

WM 2.5 Corrosion Control (Water Infrastructure)

📖 Corrosion control of Third-Party Utility infrastructure, inclusive of pipelines, shall not be connected to CITY infrastructure.

WM 2.5.1 General

All metallic components in the water systems shall be protected from corrosion.

Where ductile iron, steel or concrete watermain pipe are to be used, resistivity and corrosiveness of the soil must be completed by geotechnical investigation for the purposes of designing corrosion protection systems for these pipe materials. The corrosion protection systems for the watermain shall be designed by an engineer who is NACE (National Association of Corrosion Experts) Certified.

Consideration should be given to protection against galvanic corrosion when appurtenances and metal pipe of differing materials are connected. Flanged connections with dissimilar metals shall have full isolation gaskets to prevent corrosion.

Where metal fittings are used on PVC mains, an approved corrosion protection tape system (primer, mastic, and tape) and cathodic protection shall be installed on the fittings. The corrosion protection tape system shall cover the entire fitting, including restraints and bolts

Dielectric insulation shall be installed:

- at the points of connection to the existing system to isolate the works within an electrified corridor
- 3.0m from both limits of an overhead hydro corridor
- dissimilar metallic Watermains

Contractor shall not compromise existing electrical grounding system connected to a metallic water service.

In electrified High Order Transit corridors, subsurface metallic water infrastructure that is removed from service shall be excavated and disposed of in its entirety.

Zinc anode caps shall be provided on all valves located within chambers.

Protective coating systems for metal fittings and piping shall be considered additional to the corrosion control system.

Petrolatum Coatings meeting AWWA C217 are the preferred method of corrosion protection of metallic appurtenances both inside and outside of chambers.
Corrosion-resistant, fluoropolymer coated high-strength low-alloy steel (as per ANSI/AWWA C111/ A21.11) restraining rods and T-head bolt with nut shall be used inside chambers.
Accepted methods of installation for Cathodic Protection using sacrificial anodes are as follows:

- Existing Cast or Ductile Iron Watermains
  - Anodes shall be used to cathodically protect existing cast iron or ductile iron watermains.
  - All sacrificial anodes shall consist of a packaged magnesium casting with a minimum weight of 14.5 kg and a length of approximately 560 mm.
  - Anodes shall be installed along the entire length of existing watermain following the spacing requirements as per OPSS.MUNI. 442 Table 4.
- Water Service Connections:
  - Each copper water service connections shall be protected with Zinc anodes Type 2 (5.4kg and 10.5kg) per ASTM B-418: Standard Specification for Cast and Wrought Galvanic Zinc Anodes. Zinc anodes shall be installed in accordance with OPSS 442 and OPSD 1109.010 and 1109.011. Services larger than 50 mm diameter shall be considered metallic watermain.
  - All sacrificial anodes shall conform to ASTM B-418 Type II and shall be made of high grade electrolytic zinc 99.99% pure.

WM 2.5.2 Petrolatum Tape Systems

Petrolatum Coatings meeting AWWA C217 for all metallic appurtenances both inside and outside of chambers shall be used.

Metallic fittings, valves and joint restraints shall be wrapped end to end with an approved corrosion protection system inclusive of petrolatum prime, petrolatum moulding mastic, and low temperature petrolatum tape. Materials from a single manufacturer shall be used exclusively throughout a project.

WM 2.6 Tracing Wires

Non-metallic piping inclusive of Watermain, water services, and hydrant leads shall be installed with copper tracer wire which permits pipe tracing without signal loss or deterioration and without the transmitted signal migrating off the tracer per Form 400 and OPSD 1109.011.

Double reinforced tracer wire shall be installed as part of HDPE installations.

To eliminate interconnection between corrosion protection systems, tracer wire shall not be connected to metallic Watermain piping or fittings connected to a metallic Watermain.

Conductivity testing, of a manner acceptable to COH-PW, shall confirm the continuity, locatability and operation of the tracing wire system.

WM 2.7 Watermain Sequencing Plan

The designer shall prepare a draft Watermain Sequencing Plan in order to document and address the following for each construction phase to the satisfaction of COH-PW:

- water quality mitigation required for:
  - Watermains that do not have a backfeed
  - Watermains that are reduced to a single feed, inclusive of the length of Watermain that is beyond the last water service and/or hydrant
- water supply mitigation for areas with single or limited feeds
- source water points for commissioning and connection details
- impacts to system operability and redundancies
- impacts to fire flows within and adjacent to the corridor under construction
- pressure district boundaries and shut valves
- timing and duration of construction phases
- requisite valve closures and service impacts
- location, accessibility and spacing of hydrants remaining in service and those being taken out of service
- The map should show all existing watermains including: pipe sizes, manufacturer and material
- Identify valves to be: locked/tagged out, closed and installed.
- requirements of *WM 2.9.2 By-Pass Layout and Staging Plan* where applicable

NOTE: Watermain Sequencing Plan is subject to the written Approval of COH-PW and shall be inclusive of directions provided as part of that Approval.

The Watermain Sequencing Plan shall:

- clearly identify the existing water system impacted by the proposed works,
- show the proposed works,
- identify any lock out / tag out requirements,
- mark all existing valves to be open and/or to be closed,
- show all users connected to the water system impacted by the proposed works,
- clearly show the proposed sequence of events proposed by the contractor to construct the proposed works
- be drawn to scale representing actual lengths of watermains

When directed by COH, the Watermain Sequencing Plan shall identify if the Contractor shall schedule a systematic shut down of the individual Watermains within this project with COH-HW prior to works or the placement of By-Pass piping.
During design stage, the engineer shall confirm and identify which residences/businesses or properties are serviced off which Watermain and clearly show on the Watermain Sequencing Plan.

Shall be per the provisions of *WM 1.6.1 Chlorine Residual Maintenance Plan.*

WM 2.8 Connections

WM 2.8.1 General

Supply of potable water to residents and businesses shall be maintained except to facilitate a short duration connection of Watermains, valving, hydrants, water services or a By-Pass system to the system of under the supervision of Certified COH staff.

Connections of Watermains and water services to an existing Watermain shall be accomplished with the provision of manufactured fittings, crosses, and tees on the existing Watermain.

Water services shall not be connected to Watermains 500mm and greater, wherever possible.

Watermains and water services, 100mm or greater, shall be connected to 300mm or larger Watermains with a close coupled valve and manufactured tee. Provision of a chamber inclusive of additional valving per WM-233 shall only be provided at the direction of COH-PW.

Where COH-HW requires uninterrupted operation of a Watermains 400mm and greater, and existing pipe material Permits, tapping of 100mm to 300mm diameter Ductile Iron services off 400mm to 600mm diameter Watermains, shall be per WM-235 with the chamber omitted.

Where the existing Watermain is Concrete Pressure Pipe, a shutdown will be permitted to facilitate the connection of a Watermain and/or water service 100mm to 300mm. Connections shall be made per WM-207.04.

Shutdowns will not be permitted where COH-PW does not support the operational impacts to the existing Watermain and/or greater shutdown area.

Where a shutdown is permitted the connections of Watermain and/or water service 100mm and greater shall be provided per WM-235. Provision of a chamber shall be per the direction of COH-HW. In the absence of a chamber connections shall be provided per WM-207.05.

Water services 50mm and smaller shall be connected per WM-207.01, WM-207.06 and Form 400.

WM 2.8.2 Interconnections

In the absence of a tee or cross, and the direction of COH-HW, a connection from Watermains 500mm and greater to the distribution system shall be provided per *WM-xxx* to provide additional strength to and/or flexibility in the operation of the system.

Interconnection piping shall be the same size as the smaller Watermain, and the valve shall be connected to the larger Watermain with an anchor tee and be placed in an "open" or "closed" position as directed by COH-HW.

WM 2.8.3 Transitioning

Transitioning Watermains placed at standard depths, to shallower existing Watermains 400mm and smaller Watermains shall be per the following:

- place the point of connection and replacement valving at the deeper depth of cover and then transitioning to the shallower depth in the other legs by close coupling two vertical bends
- connecting the deeper Watermain by close coupling two vertical bends to the existing cross or tee after the placement of valving on the deeper Watermain

Bends shall be placed per the following order of precedence: 11.25°, 22.5°, 45°.

Transitioning Watermains 500mm and greater and/or connections to them shall be the direction of per COH-PW.

Contractor shall taper the bottom of earth trench with Granular "A" for 2m where it transitions to the bottom of a rock trench to mitigate differential settlement between the two bedding conditions.

Transitioning of Pipe materials shall be outside the valve chambers.

Shall be per the provisions of *WM 4.5 Insulation of Watermains*

WM 2.9 By-Pass Water Systems

WM 2.9.1 General

Where the watermain needs to be taken out of operation to perform the construction activities, the designer shall address the water shutdown by preparing a By-pass water system to provide necessary temporary provision of water to customers. All works and all costs associated with draining the watermain, dechlorinating and discharging the watermain, monitoring of discharges, obtaining necessary approvals from Hamilton Water and/or the MECP for the planned discharge of water as necessary and the setup of temporary bypass watermain shall be designed by the designer, and the costs shall be borne by the Owner of the project.

Connections for Charging Operations and By-Pass Water Systems shall be per the provisions of *Appendix WM3: Policies, Permits, Applications, Special Agreements, User Services, Fees/Charges*.

Testing shall be in accordance with latest MECP Watermain Disinfection Procedure and City of Hamilton Form 400 – Appendix A – Procedure for the Disinfection, Testing and Connection of Watermains.

Supply of potable water to residents and businesses shall be maintained except to facilitate short term connections to the system under the supervision of Certified COH-HW staff.

Watermains and water services shall:

- not be impacted prior to the By-Pass Watermain system being brought in to service.
- be returned to service prior to the requisite removal of the By-Pass Watermain and water services.

NOTE: By-Pass layout and staging is subject to the written consent of COH-PW and the final location and staging shall be inclusive of directions provided as part of that review.

By-Pass water systems shall:

- be designed for a working pressure of 860kPa
- be tested and disinfected prior to connection to the existing system
- only be in operation between May 1 to October 30 in a given year
- form a loop which is connected the existing system at a minimum of two locations outside of the valving that isolates the Watermain(s) being taken out of service
- at a minimum, provide one additional hydrant beyond the number being placed out of service
- be exclusively contained within the Pressure District
- conform to NSF 61 Standard

NOTE: the duration of By-Pass Watermain shall be minimized to the satisfaction of COH-PW.

By-Pass water services shall be:

- valved at both the Watermain and connection point to private plumbing system
- provided for each home
- connected to the building's hose bib with a wye and shall be inclusive of hose connection vacuum breaker (HCVB)
    - if a hose bib is not available the By-Pass water service shall be temporarily connected to the building's water service

Designers shall prepare a plan during design to temporarily maintain the required fire flows to a building's sprinkler system for the by-pass water system.

By-Pass water service sizing shall be per COH-PW and the following:

- water services 25mm and smaller require a 20mm By-Pass water service
- water services 40mm and greater require the same size of By-Pass water service, maximized at 150mm

NOTE: sizing shall be reviewed where the water service is to a user where water is used as part of a mechanical process

By-Pass Watermain sizing shall be per COH-PW. In general sizing will, be restricted to the following scenarios:

- 50mm pipe on one side and 100mm on the other side of the corridor
- 100mm pipe on one side and 100mm on the other side of the corridor
- 150mm pipe on one side and 100mm on the other side of the corridor
- 200mm pipe on one side and 100mm on the other side of the corridor

NOTE: maintaining existing Watermains connectivity, routing and network strength across a construction corridor shall be as per the direction of COH-PW. Adherence to this criterion shall be achieved through staging of Watermain works and/or the placement of temporary Watermains and/or bypass Watermain to maintain network strength

Where a temporary Watermain is provided in lieu of a By-Pass system, the size of the temporary Watermain shall be:

- a minimum of 150mm
- equal to the existing Watermain diameter

NOTE: Provision and sizing for a single temporary Watermain as a replacement for multiple Watermains will be considered by COH-PW on a project by project basis.

By-Pass crossing roads, sidewalks, private walkways, paths, trails and driveways shall be placed a minimum of 150mm below the adjacent surface, backfilled with Granular A and covered with 50mm of compacted hot mix asphalt.

By-Pass and temporary Watermain piping and materials shall be removed and restored as each portion of the system is returned to service.

WM 2.9.2 By-Pass Layout and Staging Plan

Watermain construction sequencing plans shall document and address the following for each phase to the satisfaction of COH-PW:

- source water points for By-Pass system and connection details
- location, accessibility and spacing of temporary hydrants inclusive of the sizing and manufacturer of the requisite Reduced-Pressure Principle Backflow Preventer
- By-Pass water service connections
- By-Pass pipe sizes, manufacturer and material
- buried By-Pass pipe locations and temporary restoration
- ramped By-Pass pipe locations and materials
- requirements of *WM 2.7 Watermain Sequencing Plan*

NOTE: By-Pass Layout and Staging Plan is subject to the written Approval of COH-PW and shall be inclusive of directions provided as part of that Approval.

Upon approval of the watermain by-pass plan, the contractor shall make formal application to Hamilton Water for rental of a fire hydrant adapter that will be installed on the approved hydrant or watermain (road adapter) that will serve as the source of water supply for the temporary watermain by-pass. The terms and conditions of such will apply as per City of Hamilton Waterworks By-law No. R84-026.

Any hydrant adapter (backflow preventer / meter) in a diameter above that which the City of Hamilton is able to supply shall be provided by the contractor in accordance with Form 400 accompanied by a backflow prevention test report. The Reduced Pressure Backflow Assembly test shall be carried out by a qualified person who holds a valid backflow prevention tester's licence, in accordance with the MECP Watermain Disinfection Procedure and CSA Standards B64.10 and B64.10.1.

Operation of the fire hydrant in order to charge the hydrant adaptor / backflow preventer with water shall only be made by a City of Hamilton MECP licensed Water Distribution Operator."

Refer to Form 400 – Appendix A Procedure for the Disinfection, Testing and Connection of Watermains for temporary connections and backflow preventers.

WM 2.10 Third-Party Utility Infrastructure (Water Infrastructure)

Pre-consultation with COH-HW and COH-ENG, as part of a Municipal Consent application, is required for Third Party Utility installations that:

- cross Watermains 300mm and larger
- do not meet minimum offset requirements to CITY subsurface infrastructure
- are part of a coordinated Third-Party Utility relocation in a corridor

COH preference is that every effort should be made to design third party infrastructure such that they will be at an elevation above City main line water infrastructure, both in horizontal and vertical alignment.

Where directed, Third Party Utilities shall field verify (by hydro-excavation) the location, depth to top of pipe, and obvert of the Watermain at the point of crossing during the design stage of the project. COH-PW will review and identify whether the installation shall pass under or over the Watermain or Forcemain. COH-PW will also identify if hydro-excavation shall be required during construction.

Where a Watermain is to be taken out of operation to facilitate construction of a Third-Party Utility, the designer of the Third-Party Utility shall obtain consent from COH-PW for the crossing and the duration of shutdown.

Clearance requirements for the construction of Third-Party Utility infrastructure in relation to water and sewer infrastructure are provided in *Right-of-Way Utility Installation and Permit Manual - Appendix J - Vertical and Horizontal Clearance Guidelines*

Insulation requirements of Third-Party Structures shall be per *WM 4.5 Insulation of Watermains.*

WM 2.11 Support of Watermains during Construction

All existing Watermains shall be temporarily supported when sewers, watermains, forcemains or Third-Party Utility are installed under them. The temporary support shall be designed by a licensed professional engineer practicing in the Province of Ontario from the contractor and submitted as a shop drawing in accordance with Form 400 for review by the COH-PW. The temporary support system shall be designed to achieve zero or no deflection to the existing watermain.

The existing Watermain must be permanently supported using unshrinkable fill before the temporary support is removed.

WM 3 HORIZONTAL ALIGNMENT

📖 Watermain alignments shall be inclusive of the desire to minimize the overall length of water services.

WM 3.1 General

Longitudinal bends on Watermains shall be placed per the following order of precedence: 11.25°, 22.5°, 45°. The use of 90° longitudinal or vertical bends for watermains should be avoided.

Where multiple Watermains are provided in a corridor, separation between the installations shall mitigate the impact of a Watermain break on an adjacent Watermain and shall be to the satisfaction of COH-PW. Where two Watermains are provided within a section of the High Order Transit corridor they shall be placed on opposite sides of the guideway/lanes when they are placed centrally in the Right-of-Way.

Midpoint of Watermain or water service pipes shall be centred at crossing points of CITY and Third-Party Infrastructure.

Watermains and retaining walls shall not be constructed such that a Watermain is behind the wall.

CITY underground infrastructure, inclusive of Watermains, valve chambers and valve boxes shall be placed such that maintenance and future replacement activities, using standard construction equipment and trench boxes can be fully achieved by excavation in either the road or the sidewalk/boulevard or without impacting multiple surface features and treatments inclusive of curbs.

Shifts in longitudinal alignments shall be minimized to the satisfaction of COH-PW.

Placement of watermain infrastructure shall mitigate impacts to the use of vehicular lanes during maintenance activities.

Watermain and Forcemain installations shall be provided with 2.5m separation from High Order Transit guideway and/or lanes where placed parallel to them.

Maintenance and Reconstruction costs, constraints and other considerations for CITY Infrastructure placed within the Trapezoidal Zone of Loading of Heavy Rail and High Order Transit guideways shall be addressed to the satisfaction of COH-PW.

WM 3.2 Horizontal Separation Requirements

Watermain, water services, and appurtenances shall be constructed in separate trenches from forcemains, sewers, sewer laterals and catch basin leads. Also, the joints of the two pipes shall be offset as per MECP – F-6-1 Procedures to Govern Separation of Sewers and Watermains.

Parallel installations of watermains or water services that are adjacent to forcemains, sewers and sewer laterals shall be addressed per the following order of precedence and inclusive of the requirements and restrictions of *WM 4.1 - Depth of Cover:*

- Minimum clear horizontal separation of 2.5m
- If the horizontal separation does not meet 2.5m, it should be maximized and the sewer shall be installed below the watermain with 0.5m minimum vertical separation
- If the horizontal separation does not meet 2.5m, it should be maximized and the sewer is installed below the watermain with a vertical separation of less than 0.5m, or the watermain is installed below the sewer with a vertical separation of 0.5m then:
    - The sewer shall be constructed of watermain quality pipe and fittings and pipe joints shall be certified and tested to 350kPa hydrostatic pressure
    - The sewer shall meet the requirements of OPSS 410 MUNI for Laser Profile or Mandrel Deflection Testing of Pipe Sewers

NOTE: Mandrel Testing Equipment shall be designed for the tested Pipe Material.

- The sewer shall meet the requirements of OPSS 410 MUNI for Low Pressure Air Testing (35kPa)
- Black on Green, 150mm Non-traceable “Caution Sewer Line” Warning Tape shall be installed on top of sewer pipe for the full length of the installation and affixed to the pipe sufficiently to prevent backfilling operations from dislodging it.

Selection of backfill materials shall be reflective of the potential for cross contamination.

In Watermain rock trenches, drainage shall be provided to minimize the effects of impounding surface water and/or the leakage from sewers to the satisfaction of COH-PW.

WM 3.3 Deflections and Bends

Deflections in Watermain, hydrant, and water service alignments and the use of horizontal bends shall be minimized to the satisfaction of COH-PW. Pipe joint deflection shall only be used where 11.25°, 22.5°, and 45° can’t achieve the required change in alignment and shall be restricted to full lengths of pipe. The use of 90° bends for watermains should be avoided.

Water services shall not be tapped on deflected PVC Watermains.

No more than two bends shall be provided on a water service.

Axial (Barrel) Deflection of PVC and PVCO piping is not permitted.

Deflection per pipe and number of pipes being deflected shall be annotated on Engineering Plans.

Permissible pipe deflections shall be restricted to 50% of the manufacturer’s recommendations.

Restrained PVC pipes shall not be deflected.

Deflection of the pipe barrel for changes in line or grade are not permitted.

Provision and location of bends, and their associated anchor blocks, on Watermains 500mm and greater shall be minimized and to the satisfaction of COH-PW.

WM 3.4 Local Streets and Private Roads

Watermains and private watermains shall be located on local streets and private roads per:

- RD-113.01 Typical Road Cross Section - Local Urban Residential (20.0 m Right-of-Way).
- RD-113.02 Typical Road Cross Section - Local Urban Residential (18.0 m Right-of-Way).
- RD-113.03 Typical Road Cross Section - Local Urban Residential (18.0 m Right-of-Way).
- RD-113.04 Standard Road Section for Private Townhouses.

WM 3.5 Building and Right-of-Way Clearances

Based on a 1.6m depth of cover, Watermains 400mm or smaller shall provide minimum of 2.0m offset (OD to building face, foundation wall and/or the limits of a Right-of-Way).

Offsets provided for Watermains larger than 400mm and/or those being placed deeper shall be addressed to the satisfaction of COH-PW.

WM 3.6 Easements

Easements shall be exclusive to the CITY.

Easements shall be unencumbered and of a width such that the extension of a 1:1 slope from the deepest point of an existing or proposed adjacent structure passes beneath the Watermain trench. Exceptions to this requirement shall be at the sole discretion of COH-PW.

Easements shall be as a minimum:

- 6m for single Watermain installations (400mm and smaller), Watermain centred
- 10m for single Watermain (400mm and smaller) and single sewer installation, 3m offset to Watermain and 2.5m separation from sewer
- 12m for dual sewer installation
- 12m for single Watermain and dual sewer installation

NOTE: COH-HW reserves the right to require additional width where adjacent structures, installation depths, topography, operational needs and/or pipe sizes warrant.

For watermains larger than 400mm and deeper than 3.7m:

- The width of easement shall be such that it permits installation to be made by conventional excavation methods and that the operation be totally contained within the easement. In general, for each meter of depth below 3.7 m the easement width should increase by 3 m.
- The designer shall confirm the required width of easement with COH-HW and COH-PW prior to confirmation of the watermain design.

Water services shall not be connected to Watermains within easements. Hydrant connections shall only be made per the direction COH-PW and where dictated by spacing requirements.

Widths of easements shall satisfy the City's operational, maintenance and reconstruction need in all cases. Minimum easements widths listed above shall be verified with COH-HW and COH-PW as meeting these primary needs on a case-by-case basis at the sole discretion of City staff.

WM 4 DEPTH AND VERTICAL CLEARANCES

WM 4.1 Depth of Cover

WM 4.1.1 General

Minimum depth of cover shall be 1.6m and shall be inclusive of Watermains, water services and hydrant leads. Measurement of depth on a water service shall be to the goose neck when vertical.

Depth of cover shall be measured from the crown of pipe, to the lower of the following:

- final road and/or ground elevation in the Project
- ultimate road and/or ground elevation[1] identified in documents inclusive of:
  - a preliminary design
  - an Environmental Assessment
  - a Masterplan

[1]Use of the elevations shall be at the direction of COH and independent of whether the documents are completed or in progress. Where the future profile of a rural road (collector or arterial) is undetermined the Watermain shall be provided with a minimum 2.0m depth of cover.

Minimum 2.0m cover shall be provided from the exposed slopes of ditches and road side grading

Perpendicular crossings of ditches and road side culverts shall be per the following:

- 1.8m cover on Watermains under roadside culverts 600mm and less
- 2.0m cover on Watermains under ditches
- 1.8m cover on water services and hydrant leads mains under ditches and roadside culvert

Staging shall be such that:

- a permanent reduction in depth of cover does not results from a temporary constraint
- Watermain depths remain constant and vertical conflicts between new and existing Watermains are addressed to the satisfaction of COH-PW

Depth of cover may be incrementally increased to a maximum of 3.0m when the following are addressed to the satisfaction of COH-PW:

- water services are not connected to the lowered section of Watermain
- hydrants are not connected to the lowered section of Watermain, except where the placement has been identified by COH-PW
- operability of associated chamber appurtenances
- chamber dewatering
- instances of low and/or high points in the Watermain profile, number of chambers and costs are minimized

- provisions of *WM 4.2 - Vertical Separation Requirements* are met

Depths of cover on Watermains and chamber piping greater than 3.0m shall be at the sole discretion of COH-PW upon review of alternate profiles and confirmation that depth does not compromise the operability of valves from outside the chamber.

Watermains 500mm and greater shall be constructed with a minimum 0.5% slope without Intermediate high points. Exceptions dictated by topography, excessive valving and Municipal and Third-Party Utility conflicts will be considered by COH-PW on a project by project basis.

WM 4.1.2 Conditional Exceptions

Designers to note that the COH desirable depth of cover for watermains is 1.6m. When existing conditions do not permit the 1.6m of cover then:

- Watermains 400mm and smaller may have the depth of cover incrementally reduced to 1.2m, if all of the following conditions are addressed to the satisfaction of COH-PW:
  - the length of the exception is minimized
  - provisions of *WM 4.2 - Vertical Separation Requirements* are met
  - provisions of *WM 4.5 – Insulation of Watermains* are met
  - there are no water services connected to the Watermain in the area of reduced cover
  - hydrants connected to the Watermain immediately transition to 1.6m

- Watermains 500mm and greater may have the depth of cover incrementally reduced such that the springline of the pipe is at 1.6m, where the following are addressed to the satisfaction of COH-PW:
  - Watermain is not dead ended
  - operability of associated chambers
  - instances of low and/or high points in the Watermain profile and the associated chambers and cost are minimized
  - provisions of *WM 4.2 - Vertical Separation Requirements*
  - provisions of *WM 4.5 – Insulation of Watermains*
  - minimum depth of cover is 1.0m
  - Watermains connected to these Watermains maintain 1.6m cover
  - hydrants connected to these Watermains maintain 1.6m cover
  - where ditch maintenance operations may compromise the cover on the Watermain
  - from the ditch and exposed slopes

WM 4.2 Vertical Separation Requirements

Where watermains or water services cross sewer pipes (inclusive of mainline piping, sewer laterals and catch basin leads), the following shall be addressed to the satisfaction of COH-PW:

- In general, all watermains shall cross over sewers
- where watermains cross over sewer pipes:
  - 0.5m desirable and 0.25m minimum vertical separation and meets MECP requirement for adequate structural support,
  - midpoint of full length Watermain and sewer pipes shall be centred at points of crossing
- where watermains cross under sewer pipes:
  - 0.5m minimum vertical clearance
  - The sewer shall be constructed of watermain quality pipe and fittings and pipe joints shall be certified and tested to 350kPa hydrostatic pressure
  - The sewer shall meet the requirements of OPSS 410 MUNI for Laser Profile or Mandrel Deflection Testing of Pipe Sewers

NOTE: Mandrel Testing Equipment shall be designed for the tested Pipe Material.

  - The sewer shall meet the requirements of OPSS 410 MUNI for Low Pressure Air Testing (35kPa)
  - Black on Green, 150mm Non-traceable “Caution Sewer Line” Warning Tape shall be installed on top of sewer pipe for the full length of the installation and affixed to the pipe sufficiently to prevent backfilling operations from dislodging it.
- midpoint of water services (50mm and greater) shall be centred at points of crossing
- crossings shall be perpendicular

Watermain lowerings shall be detailed in profile inclusive of wall thickness, clearances and the placement of pipes, restraints, fittings, anchor blocks and intermediate pipe joints as applicable.

WM 4.2.1 Vertical Clearances at Third Party Utilities Crossings

Minimum vertical separation from Third Party Utilities at points of crossing shall be:

- 0.5m desirable and 0.3m minimum, where the Watermain cross above that infrastructure and meets MECP requirement for adequate structural support.
- 0.5m minimum, where watermains cross below that infrastructure

In circumstances where a Third Party single or multi- utility structure is aligned parallel to a City watermain, a sleeve shall be provided to house any water service that passes under such structure with a length of 0.3m on either side beyond the horizontal dimension of the structure. In circumstances where such utility structure is in proximity to a building which is at or within 0.3m of property line, the sleeve housing the water service shall abut the entry point of the outside wall of the building.

Crossings shall be per the provisions of *WM 4.3 – Watermain Lowerings.*

WM 4.3 Watermain Lowerings

Vertical conflicts between Watermains which do not connect shall be addressed by lowering the smaller of the Watermains that is being constructed. Where the Watermains are equally sized the Watermain on the minor road shall be lowered.

Locations where Watermains or large water services cross and do not connect with CITY and Third-Party Infrastructure, shall be addressed to the to the satisfaction of COH-PW and per the following general order of precedence:

- Watermains 400mm and smaller or Water Services greater than 25mm:
  - cross above, 1.6m depth of cover and vertical clearances are met
  - cross above and insulate, where the depth of cover is between 1.2m and 1.8m and vertical clearances are met
  - cross above and insulate, minimum 1.2m depth of cover and vertical clearances are not met
- Watermains 500mm and greater:
  - cross above, 1.6m depth of cover and vertical clearances are met
  - cross above and insulate , depth of cover between 1.2m and 1.8m and vertical clearances are met
  - cross below, 1.2m depth of cover and vertical clearances are not met
- Water services 25mm or smaller:
  - cross above, 1.6m depth of cover and vertical clearances are met
  - cross above and insulate, where the depth of cover is between 1.2m and 1.8m and vertical clearances are met
  - cross below, minimum 1.2m depth of cover and vertical clearances are not met

The minimum depth below the bottom of a watercourse to the top of casing pipe shall be the greater of 2.0m and the Permit requirements associated with the works. Where a casing pipe is not provided the depths shall be measured to the top of the Watermain.

Lowerings for Watermains 500mm and greater shall be minimized. Adjustments to Third Party Utility infrastructure, to mitigate vertical conflicts, shall be incorporated to the satisfaction of COH-PW.

Provision and location of vertical bends and anchor blocks shall be per the provisions of *WM.7 – Pipe and Fitting Restraints* and to the satisfaction of COH-PW.

WM 4.3.1 Watermain Casing

The designer shall provide a casing around a watermain in the following situations:

- crossing right-of-way when the authority having jurisdiction requires a casing across its right-of-way e.g. railway corridors, MTO major roadways, high pressure gasmains
- crossing river/creek and culverts
- crossing major trunk sewers and major watermains as directed by COH
- Bridges attached to the side of bridge. Refer to section *WM 4.4 - Watermains Suspended on CITY Structures.*

The designer shall determine the material for the casing and its wall thickness considering the depth of casing, loading, and the outer dimeter of the carrier pipe. Depending on the length of casing and material of annular space, the minimum annular clearance all the way around at the largest outside pipe bell or harness

joint, to accommodate casing spacer system shall be minimum 200mm. If the casing size required by the authority having jurisdiction is larger than the size based on 200mm annular space, the larger casing pipe size shall be specified.
The designer shall confirm sizing with respect to future growth and future rehabilitation with COH-HW when considering upsize the carrier watermain inside the casing to allow for future lining of the watermain.

The designer shall select the casing pipe material most suitable for the casing and watermain installation. Steel casings are typically used of jack-and-bore installations. HDPE casings are typically installed for directional drilling installations. Metallic casing shall be catholically protected by means of suitable number of 14kg magnesium anodes.

Annular space grout shall be a 3 to 1 (3:1) sand to cement mix ratio unless otherwise stated in the approved Utility Crossing Agreement or required by the authority having jurisdiction requiring the casing across its right-of-way.

Casing ends shall be sealed wrapped with high quality rubber (or equivalent) around both the casing ends and the pipe and secured with Type 316 stainless steel bands to prevent entry of water or excess moisture.

Isolation valves and chambers are required on either side of an encased watermain.

The watermain (carrier pipe) must be installed as per the specifications of the manufacturer and shall be restrained along the entire length of the casing.

The design life of the casing spacer system shall be equal to or greater than the deign life of the casing. Casing spacers shall be used and runners shall be of ultra-high molecular weight polymer or equivalent.

For carrier pipe with external joint restraint, a spacer should be placed 0.3m from each end. Given the linear distance involved, a spacer should be placed adjacent to each side of the bell joint mechanical joint restraint and for the remaining pipe barrel they should not exceed 3.0m separation between each spacer. Each mechanical joint restraint should be cathodically protected by means of a City approved 3 part petrolatum system. For carrier pipe wit integral joint restraint, all of the above would apply but without the need for the need for barrier wrap protection.

Refer to Standard Drawing WM xxx.

Wood blocking is not permitted.

Tracer wires shall be installed along the carrier pipe per *WM 2.6 Tracing Wires*

WM 4.4 Watermains Suspended on CITY Structures

Where the grades and elevations of a sewer, or where the construction requirements and long-term maintenance impacts related to lowering a watermain under a Watercourse, Railway or roadway

adjacent to a CITY Bridge or large culvert are deemed unacceptable by COH-PW the watermain shall be suspended from the structure subject to approval from the owner of the structure.

Designer must demonstrate that the existing structure is capable of supporting the load and impacts from surge pressures during operation of the watermain. Any modifications to the structure will require the prior approval of the owner.

The designer shall select a watermain pipe material suitable for the installation and anticipated movement of the structure being supported on. The watermain pipe material shall conform to Form 400 and *Approved Product List*.

Restrained joints not permitted for suspended watermains.

Connection of the watermain to the structure will need to consider expansion of the pipe material, expansion of the bridge structure, and incorporation of flex couplings and/or expansion joints to accommodate this movement.

WM 4.5 Insulation of Watermains

Insulation of Watermains 400mm or smaller and water services where required, shall be provided using insulation boards per OPSD 1109.030 and amended by COH City approved products. The use of pre-insulated pipe is permitted.

To mitigate trench loads due to frost penetration, heaving and to prevent watermains from freezing, insulation shall be required where the provisions of *WM 4.1 – Depth of Cover* are not met. Insulation shall be reflective of OPSD-309.101 – Foundation (Frost Penetration Depths for Southern Ontario).

Insulation shall be minimum 50mm thick extruded polystyrene bord or polyurethane foam insulation to match or exceed the thermal and engineering characteristics of the GF Urecon U.I.P.® system of pre-insulated pipes (*https://www.urecon.com/applications/municipal_freeze.html*) or as designated by COH-PW. The designer shall provide temperature loss calculations to CoH-PW in support of the proposed insulation method. The equation for time to freeze is as follows:

$$\theta = \rho C_p \pi \left(\frac{D_1}{2}\right)^2 R_T \ln\left(\frac{t_i - t_a}{t_f - t_a}\right)$$

$$R_T = 12 \ln\left(\frac{D_3 \div D_2}{2\pi k}\right)$$

Where θ = Time for water to freeze (hours)
ρ = density of water (62.4lb/ft^3)
C_p = specific heat of water (1 BTU/lb°F)

D_1 = inside diameter of pipe (ft)
D_2 = inner diameter of insulation (ft)
D_3 = outer diameter of insulation (ft)
R_T = combined thermal resistance of pipe wall, insulation and exterior air film (ft°F hr/BTU)
k = thermal conductivity of insulation (BTU/hr ft^2°F
t_a = ambient air temperature (°F)
t_i = initial water temperature (°F)
t_f = freezing temperature of water (°F)

High density 35 Styrofoam widths of 100mm can be achieved by placing two 50mm pieces with 300mm of overlap at edges.

Those portions of the exterior walls of valve chambers or third-party utility vaults/chambers placed within 0.9m of the outside diameter of a watermain or water service shall be insulated. Insulation shall consist of 50mm of high density 35 Styrofoam (H100) insulation fastened with 50mm galvanized washers and 6mm diameter tapcon concrete anchors at 450mm centered from the obvert of the watermain or water service to the top of the exterior wall.

WM 5 HYDRANTS

📖 Hydrants are integral to the Fire Fighting and support COH-PW in Construction, Maintenance, Commissioning and Water Quality operations.

Hydrants on private lands shall be provided per the provisions of the Ontario Building Code and are subject to the Approval of COH-BLDG.

WM 5.1 General

📖 Hydrants shall conform to AWWA – C502: Dry-Barrel Fire Hydrants to mitigate freezing.

Hydrants shall be inclusive of the following:

- three-way hydrant
  - one 100mm pumper STORZ connection perpendicular to the street
  - two nozzles which are 180° to each other and parallel to the street
  - barrel, bonnet and hose nozzle caps painted red
- secondary valve close-coupled to hydrant barrel
- installed plumb per WM-203.01
- thrust blocks
- distance from the traffic breakaway flange to grade shall be between 75 and 150mm
- anti-tampering device provided, where identified by COH-HW
- Open counter-clockwise (left)
- With 25 mm top operating nut size
- All hydrants installed within subdivision developments shall have anti-tampering devices.
- Removal of anti-tampering devices following Acceptance and Assumption of Watermains

Hydrant placement in relationship to ditches shall be placed per the following order of precedence:

- between the road and ditch, where suitable
- behind the ditch with access provided per WM xxx.xx
- behind the ditch with access provided per WM 203.03

Depth of cover shall be per *WM 4.1.1 General.*

Where an extension is required to adjust the length of the barrel, it shall be placed between the lower section of the barrel and the boot connection.

Provision or respacing hydrants in a project without a Watermain component shall only be as directed by COH-PW.

Hydrants that are displaced in a road widening project without a Watermain component, shall be replaced to the main inclusive of valving per *WM 6.7.2 - Hydrant*.

For large diameter watermains (500mm and larger), two hydrants shall be provided along each isolatable segment of watermain to facilitate draining, flushing and sampling operations per the following provisions:

- when two blowoff valves are provided on both ends of the isolation chambers, only one hydrant is required to be installed on that segment providing a total of 3 access ports.
  - Note: If the isolation chambers do not have the ability to drain to the storm sewer system then two hydrants are required
- If the isolatable segment is less than 50m a hydrant is not required
  - Note: This does not apply to dead-end watermains, refer to *WM 1.6 – Dead-End Watermains*
- If the isolatable segment is less than 100m only one hydrant is required
- If the isolatable segment is greater than 500m, hydrants shall be placed at minimum 200m intervals
  - Note: This is for long length of Trunk Watermain where valve are place quite far apart and flushing times
  - if hydrants are placed for the purposes on fire protection in the area, then hydrants shall be spaced to the minimum spacing for fire protection.

Large diameter watermains (500mm and larger) shall have post-hydrants.

WM 5.1.1 Clear Zone

Hydrants shall be provided with

- 1.2m clear zone inclusive of residential driveways and the extensions of exterior garage walls
- 2.5m clear zone inclusive of driveways in Industrial Commercial Institutional areas

NOTE: Subsequent modifications to driveways that reduce the offset shall, at the direction of COH-HW, include the relocation of the hydrant at the Owners cost.

There shall be no temporary or permanent above ground infrastructure placed between a hydrant and the edge of road.

WM 5.1.2 Location

Impacts to future COH-HW maintenance operations and to the use of sidewalks, cycling facilities and vehicular lanes shall be addressed to the satisfaction of COH-PW:

- as such hydrants shall:
  - not be placed in the dripline of a CITY or Private tree where such placement impacts the tree
  - not be placed under CITY and Third-Party Utility aerial infrastructure
  - not be placed in sidewalks (opportunities to install them in a boulevard, behind the walk, on side streets or another unencumbered location shall be addressed to the satisfaction of COH-PW).

  - not be placed in Urban Braille clearways/shorelines
  - not be placed in sidewalks and boulevards where the desirable 1.8m clearway (minimum 1.5m) and 0.6m offset from face of curb is not provided
  - not be placed in sidewalks and boulevards, adjacent to High Order Transit guideways/routes/stops or corridors with higher pedestrian volumes.
  - not be placed adjacent to cycling facilities bounded by the roadway curbing and partial/continuous concrete curbing or barriers
  - not be placed adjacent to single lanes bounded by the roadway curbing and a central median or guideway
  - not be placed where the minimum distance to a stand-pipe (also commonly referred to as a Fire Department Connection (FDC)) is compromised
  - not be placed where they would reduce pedestrian clear widths beyond that provided adjacent to parking meters and CITY and Third Party Utility poles in that segment of sidewalk
  - not be placed in easements, except as required to achieve spacing requirements
- as such the placement of Valve and Person Access Covers shall be minimized:
  - in and within 30m of signalized intersections
  - in sidewalks, multi-use trails and cycling paths
  - within 3.0m of overhead utility wires
  - where impacts would extend to lanes on the street and side street
  - at transit stops where passenger access or egress is impacted
  - minimized in unsignalized intersections (inclusive of maintaining turning movements)
- as such the placement of valve and person access covers shall be prioritized on minor roads

Hydrants shall be placed:

- in their existing location in retrofit projects unless minimum hydrant spacing requirement are not met.
  - Note: for retrofit projects opportunities to improve visibility of the hydrant from adjacent buildings shall be maximized
- behind the walk, in boulevards, on side streets or other unencumbered locations
- to minimize impacts to street parking
- generally on the lot line between two properties
- to maximize offsets from CITY and Third-Party Utilities subsurface infrastructure
- to minimize the disruption to traffic resultant from Construction and Maintenance operations
- at low and high points on Watermains 400mm and smaller whenever possible
- placed to maximize visibility to the satisfaction of COH-PW and COH-EMS
- and protected from vehicles impacts when placed adjacent to parking lots and on private lands through the installation of bollards and as directed by COH-PW.
- on Watermains 500mm and greater, as identified by COH-PW, to address project/future shutdown, flushing, investigative and dewatering operations. Locations shall be reflective of valve locations and opportunities for chamber drainage.

- adjacent to Long Term Care facilities and other buildings with an identifiable pattern of frequent COH-EMS responses

Subject to the satisfaction of the aforementioned criteria, hydrants shall be placed:

- to minimize the length of the hydrant lead
- at the extension of lot lines
- on the same side as the Watermain in the corridor
- on the same side of the road
- on the opposite side of pole lines
- to minimize jogs in Urban Braille shorelines

Hydrant placement shall be per *CITY of Hamilton Watermain Fire Flow Requirement Design Guidelines Policy.*

Hydrant secondary valves shall not be installed in the road except per the provisions for an additional secondary valve in *WM 6.7.2 Hydrants*.

WM 5.1.3 Spacing

Hydrant spacing shall be measured along the watermain alignment and within the Right-of Way.

Hydrant spacing shall be as follows:

- maximum 90m to the furthest door of each dwelling unit in a residential structure inclusive of single family dwellings, apartments, condominiums, hotels and motels
- maximum 45m from Fire Department connections for a building's sprinkler system
- NOTE: a pre-existing spacing of 60m may be maintained subject to the Approval of COH-HW and COH-EMS

Additional hydrants shall be provided, as directed by COH-PW:

- to mitigate traffic disruptions, attributable to the placement of a fire hose across an arterial road, transit route or High Order Transit guideways/routes/stops
- adjacent to Long Term Care facilities and other buildings with an identifiable pattern of frequent COH-EMS responses

Flushing hydrants are in addition to, and shall not form part of, hydrant spacing criteria. Flushing hydrants or post hydrants shall be installed on all dead-end watermains. Flushing hydrants shall be tamper-proof.

WM 5.1.4 Identification

Fire flow testing of installed hydrants is mandatory.

Hydrants that are inoperable shall be black-bagged.

Reflective Hydrant disks are to be colour coded per NFPA 291 “Fire Flow Testing and Marking of Fire Hydrants.” Hydrant colour coding shall be based on the lower flow rate threshold validated through computer modelling and field data where available.

- Blue Class AA – capacity rating at 140 kPa residual 5,680 l/min or greater
- Green Class A – capacity rating at 140 kPa residual 3,785 to 5,675 l/min
- Orange Class B – capacity rating at 140 kPa residual 1,900 to 3780 l/min
- Red Class C- capacity rating at 140 kPa residual less than 1,900 l/min
- Red/White Post Hydrant – NOT for Fire Flow – with identification marker “Post Hydrant”

WM 5.2 Greenfield Projects

Hydrants and private hydrants shall be located per:

- RD-113.01 Typical Road Cross Section – Local Urban Residential (20.0 m Right-of-Way)
- RD-113.02 Typical Road Cross Section – Local Urban Residential (18.0 m Right-of-Way)
- RD-113.03 Typical Road Cross Section – Local Urban Residential (18.0 m Right-of-Way)

Without Sidewalk for Cul-De-Sacs

- RD-113.04 Standard Road Section for Private Townhouses
- WM-205.01 50mm Dia. Watermain Looping in Cul-De-Sacs (20.0 m R.O.W.)
- WM-205.02 50mm Dia. Watermain Looping in Cul-De-Sacs (18.0 m R.O.W.)

WM 5.3 Leads

Hydrant leads:

- shall be 150mm
- pipe material shall match the watermain pipe material
  - for concrete pressure pipe, hydrant leads shall be ductile iron or PVC
- shall be installed perpendicular to the Watermain

Hydrant leads shall not incorporate horizontal or vertical bends.

Hydrants leads, including valves and joints shall be fully restrained.

Additional valving on hydrants at the connection point to the Watermain shall be per *WM 6.7.2 Hydrants.*

WM 6 VALVES AND CHAMBERS

WM 6.1 General

📖 Valve chamber orientation shall be mirrored on the pipe axis and perpendicular to it to best suit surface and subsurface constraints.

To minimize the provision of chambers and simplify maintenance operations, the following opportunities for consolidation shall be addressed to the satisfaction of COH-PW:

- low and high points in a trunk Watermain profile located at Line Valve chambers
- Line Valve chambers located to incorporate Branch Watermains and associated valving and appurtenances
- placement near a suitable discharge per the provisions of *WM 6.5 – Chamber Drainage.*

The supply of pre-cast chambers shall be limited to plants identified Plant Prequalification Program by the Canadian Concrete Pipe and Precast Association.

For large diameter Watermains or pressure zone isolation valves, valved reduced By-Pass piping will be used to avoid local stagnation and assist with open/close operations. Refer to CITY – Construction and Materials Specifications Manual standard drawings

Provide by-pass around butterfly that are 500mm and larger, PRVs and check valves. The size of the by-pass shall be determined by hydraulic modelling or as recommended by the valve manufacturer.

Chambers, inclusive of service valves and access points shall be located to promote safe operation and mitigate traffic impacts associated with future maintenance. Placement shall prioritize minimizing impacts to the main road or as identified by COH-PW. Valve and person access covers shall not be located in the wheel path of vehicles.

Frost heaving of chambers shall be mitigated with the installation of frost strapping (per OPSD 701.100) or an alternate methodology to the satisfaction of COH-PW.

Additionally, the following shall apply:

- step down valving is not permitted
- chamber removals shall be full depth
- minimum 1.8m clear height within chambers
- valves on Watermains 400mm and larger shall be chambered as directed COH-PW
- maximum 500mm chimney height (finished ground to underside of chamber ceiling)
- thrust walls are required on both sides of chambers and shall be capable of withstanding the requisite thrust forces
- removable slabs are required on chambers roof slabs and are to be located above valves that are 500mm and greater for future valve replacements and where directed by COH-PW.

- chamber access hatches shall be lockable, where identified by COH-PW
- pipe transitions shall per *WM 2.8.3 Transitioning*
- connections to the distribution system from a Watermain 500mm and greater shall be per *WM 2.8.2 Interconnections*
- a full pipe length outside of chambers shall be installed at a grade of 0%.
- valving is not permitted in, or adjacent to the vehicular lane of a roundabout or traffic circle, COH-PW Approval is required for the placement of valving in the truck apron where such is provided

Where a CITY standard is not available for a requisite valve chamber, the design shall be inclusive of the following components of standard chamber installation:

- backflow preventers, couplings, curb stops, pitometers, fittings, flanges, valves, insulation, joint restraints, reducers, stainless steel flange bolts, main stops, corporation stop, service boxes, tracer wire, Adaptors, Line Valve, check valves, Blow-Off valve, Air Release and Vacuum Relief valves, main stops, pitometers, valve supports, tapping saddles, service saddles, waterproofing, piping, ladder rungs, safety grating, lifting hooks, valve stem extensions, grouting, concrete, frames and covers
- vertical and horizontal separations, clearances and offsets
- frames and covers at the point of person entry shall be 750mm diameter per OPSS 1850
- openings in the roof slab shall be manufactured or cored
- concrete adjustments shall be inclusive of bond breaker
- thrust walls inclusive of dimensions, concrete, dowelling and reinforcing steel in the WM-Series

CITY and Third Party Utility watermain chambers and vaults shall not be abandoned in place, they shall be removed full depth. Where the associated piping and ducts are not removed by construction operations the ends of piping and ducts shall be capped with concrete and backfilled with Granular “A”.

WM 6.2 Standards

Watermain Line Valves shall be per the following:

- Form 400 requirements
- installed in chambers if 500mm and greater (inclusive of 450mm replacements)
- installed in chambers if 400mm where an air valve is required at the same location
- valves 400mm or less shall provide access to the operating nut via a valve box and stem assembly
- 50mm operating nut
- 100mm to 400mm valves shall be non-rising stem resilient wedge gate design
- Under railway crossing consideration should be given for valve chambers at the two sides of the rail way crossing.

Chambers are not required for Line Valves and tapping valves on Watermains 400mm and smaller, even where located within the road pavement, unless directed by COH-PW.

Concrete valve chambers shall be provided:

- on Line Valves and tapping valves on Watermains 500mm and greater
- per WM-233
- as directed by COH-PW

Valve box and valve chamber covers shall be set flush with the finished grade.

Where chambers and valve boxes are located in the shoulder of the road, the shoulder shall be paved and constructed per RD-111.

Impacts of future COH-HW maintenance operations to the use of sidewalks, cycling facilities and vehicular lanes shall be addressed to the satisfaction of COH-PW:

- as such the placement of valve and person access covers shall be eliminated:
  - in crosswalks, Urban Braille clearways/shorelines and sidewalks adjacent to High Order Transit guideways/routes/stops or corridors with higher pedestrian volumes.
  - in cycling facilities that are bounded by the roadway curbing and continuous concrete curbing or barrier
  - adjacent to single lanes bounded by roadway curbing and a central median or guideway or station stops
- as such the placement of valve and person access covers shall be minimized:
  - in and within 30m of signalized intersections
  - in sidewalks, multi-use trails and cycling paths
  - within 3.0m of overhead utility wires
  - where impacts would extend to multiple lanes on the street and/or sidestreet
  - in unsignalized intersections (inclusive of maintaining turning movements)
  - at transit stops and in parking spots
  - in the wheel path of vehicles
  - minimized in unsignalized intersections (inclusive of maintaining turning movements)
- as such the placement of valve and person access covers shall be prioritized on minor roads

WM 6.3 Valve Placement

Valving at the connection points of Watermains 400mm and smaller shall be per the following:

- one valve on each Watermain, subject to a review of system operability inclusive of hydrant placement
- tee intersections – minimum two valves

NOTE: where the distance between tee connections to the same Watermain is less than 5m, the valving requirements shall be deemed to be those for a single cross intersection

- cross intersections – minimum three valves
- interconnections – three valves, completely isolatable Refer to *WM 2.8.2 – Interconnections*

- one valve on each side (two valves per connection) of water services of sensitive users such as: schools, old age facilities, medical facilities and daycares, in order to reduce loss of service to users during shutdowns.

In Greenfield Projects the minimum valving requirements are increased by one.

Valve boxes and hydrants on side street Watermains shall be placed a minimum of 10m metres beyond the ultimate Road Allowance of the corridor.

Line Valves shall be placed to mitigate future valve replacement and disruptions to service:

- Line Valves shall be placed on the upsized pipe and reducers placed on the field side of the Line Valve
  - where the Watermain is being connected to an existing Watermain that has been identified for future upsizing
  - where a Watermain upsizing is being phased

Exclusive of the preceding, and subject to the approval of COH-PW, valving schemes may prioritize placement on smaller Watermains to mitigate costs.

Shall be per the provisions of *WM 2.8.2 Interconnections*

Operating a maximum of four valves shall fully isolate section of Watermain 400mm and smaller.

Line Valve spacing for Watermains 400mm and smaller shall be:

- low density areas – maximum 240m
- commercial, industrial and institutional – maximum 150m

NOTE: A Watermain segment shall not have more than 100 Residential water services connections.

Line Valve spacing for Watermains 500mm (inclusive of 450mm replacements) and greater shall be per the following order of precedence:

- combine line valving with chambered Air Release and Vacuum Relief and Blow-Off locations to achieve a maximum Line Valve spacing of 600m
- where Blow-Off and Air Release and Vacuum Relief are not provided, construct line valving to achieve a maximum spacing of 600m.

Where a single distribution Watermain is provided, the placement of line valving based on spacing criteria shall be placed per the following order of precedence:

- hydrants are balanced between segments
- water services greater than 100mm are balanced between segments
- placed at the approximate midpoint between the valves

Where multiple distribution Watermains are provided, the placement of line valving based on spacing criteria shall be placed per the following order of precedence:

- hydrants and water services greater than 100mm are balanced between Watermains
- for each Watermain, hydrants are balanced between segments
- for each Watermain, water services greater than 100mm are balanced between segments
- hydrants are placed equidistant from each other and the intersection valving

Line Valves for Watermains and water services shall be chambered on the Dofasco Ingot Truck Route and at such locations as identified by COH-PW.

Valve tie downs shall be specified and designed for the watermain pipe and valve size for all PVC pipe with butterfly valves inside valve cambers. Designers shall follow valve manufacturer's recommendation for valve tie downs.

Valve chambers shall be placed to facilitate safe chamber access for workers/crew/maintenance vehicles considering traffic flow and movements in the surrounding area.

WM 6.4 Chamber Piping and Fittings

Watermain Chamber Piping shall be:

- Ductile Iron, minimum pipe Class 54 and per AWWA C151 and C104 for ductile iron watermain
- Prestressed Concrete Pressure Pipe per AWWA C301:
  - Concrete Steel Cylinder Pressure Pipe (Bar Wrap)
  - Prestressed Concrete Pressure Pipe, Lined Steel-Cylinder Type
  - Prestressed Concrete Pressure Pipe, Embedded Steel-Cylinder Type
- Stainless steel, minimum Schedule 40 (pipe thickness per chamber design), Grade 304L or 316L, Installation shall be inclusive of stainless steel piping for Blow-Off valves, Air Release and Vacuum Relief valves and pitometers. Consideration of stainless steel chamber piping shall be predicated on COH-PW review and acceptance of detailed piping layout drawings provided prior to shop drawing submission. Fittings shall be Stainless Steel per the provisions of AWWA C208.
- NOTE: stainless steel nuts, bolts and washers are required independent of chamber pipe material.
- Hot dip galvanized steel pipe is permitted if isolation between dissimilar metals is provided. E.g. neoprene pad between the pipe and metallic pipe support
- Minimum distance of 75mm from the bottom of the blowoff to the chamber floor

WM 6.5 Chamber Drainage

Chambers and related Automatic Air and Vacuum Release Valves shall:

- not be located at low points in the topography
- not be located in areas subject to surface flooding
- not be located in areas where the water table is higher than the chamber floor

Where placement per above the above restrictions can't be achieved, buoyancy and the infiltration of ground and/or surface water shall be mitigated to the satisfaction of COH-PW.

Watermain chambers shall:

- not be piped or connected to a ditch
- not be connected to a sanitary or combined sewer
- not be placed where the discharge would be directed by the topography to a watercourse
- not be connected to a storm sewer where the hydraulic grade line of the sewer is above the chamber floor
- not be piped or connected to a storm sewer where the sewer outlets to a watercourse

NOTE: Where permitted by COH-PW, and per the restrictions above, Watermain chambers may be connected to a storm sewer by a 150mm service with a backflow preventer, see *WM 1.7 Backflow Prevention*.

All chambers shall be inclusive of a sump.

WM 6.6 Limits of Works

Valving on side streets and at the project limits shall be cut-in at the beginning of construction operations to provide reliable control and mitigate unscheduled impacts to users outside of the project. Exception to these criteria shall be at the discretion of COH-PW.

Construction of side street Watermains 400mm and smaller from a corridor (inclusive of valving, hydrants and removals) shall as a minimum, extend to the greater of the following:

- 10m beyond the applicable back of walk in the corridor under construction
- beyond the side street catch basins
- beyond the curb return

Connection of side street Watermains 400mm and smaller to a corridor shall include the replacement of valve chambers 10m to either side of the point of connection. An exception to this requirement shall be provided when the valve within the chamber has been replaced within the 10-year period directly preceding construction of the connection.

Where a future Watermain upsizing has been identified by COH-HW, valves and hydrants shall be placed on the upsized Watermain prior to the placement of a reducer and/or horizontal and vertical bends.

On side streets where a future Watermain upsizing has been identified by COH-HW, valves and hydrants shall be placed on the upsized Watermain prior to the placement of a reducer at the project limits.

Watermain, 400mm and smaller, reconstruction shall be inclusive of the removal and replacement of valve chambers and hydrants located within 10m of the point of connection.

WM 6.7 Supplemental Valving

WM 6.7.1 Water Services

To mitigate disruption to Watermains, an additional secondary valve on water services, 100mm and greater, shall be close coupled to the Watermain where:

- Watermain is 400mm and greater
- length of the water service within the travelled portion of the road is 7.5m and greater

To mitigate disruption to servicing, additional valving on the Watermains shall be provided per *WM-xxx* (LRT detail) where:

- water service is to a sensitive user, as identified by COH-HW
- water service is to a user where water is used as part of a mechanical process
- adjacent water services (i.e. within a valved segment) are inclusive of those requiring water as part of a mechanical process and/or have been identified by COH-HW as sensitive users
- water service 100mm and greater passes under High Order Transit guideway and/or lanes

Water services that are looped within a site and longer than 50m, the Fire services require the provision of check valves on the site adjacent to the CITY Right-of-Way.

In areas where buildings are directly adjacent to the back of sidewalk and the Watermain is 3.5m or less from building face, placement of shutoff valve at the connection to the Watermain is permitted. Provide 0.5m clearance radius for the operation of the shutoff water service valve.

WM 6.7.2 Hydrants

To mitigate impacts to Watermain operation during hydrant maintenance and repair operations an anchor tee and additional valve on the hydrant lead shall be provide at the Watermain where:

- Watermain is 400mm and greater or
- long side services or
- a water service within the same valved segment requires supplementary valving

WM 6.7.3 Crossings and Lowerings

Chambered Line Valves and drainage opportunities shall be provided per the following:

- Watercourses – both sides of the crossing
- Railway – both sides of the crossing
- Provincial Highways (400 series) – both sides of the crossing
- High Order Transit – one side of the crossing or per COH-PW direction
- Road – one side of the crossing or per COH-PW direction
    - adjacent Watercourse, Railway or Provincial Highway, placement is required on both sides

To facilitate leak detection, a pitometer shall be located on both sides of the Line Valves.

Valving shall be located a minimum of one pipe length from:

- the terminus of the casing pipe
- the extension of a railway corridor
- a lowering

Provision of Line Valves and drainage opportunities shall be per *WM 6.5 – Chamber Drainage.*

Permanent taps or other provisions to allow insertion of a small meter to determine leakage and obtain water samples shall be made on each side of the Line Valve(s).

Sleeves shall be provided for Watermains and water services under heavy rail and High Order Transit Guideways/Lanes/Station Stops to the satisfaction of COH-PW and the Railway Authority.

WM 6.8 Air Release and Vacuum Relief

📖 Air Release and Vacuum Relief valves are provided at high points in the Watermain profile or spaced along significant lengths of pipe to mitigate the accumulation of air during their operation and the Watermain charging process.

Air Release and Vacuum Relief valves open against internal pressure, because the internal lever mechanism multiplies the float force to be more than the internal pressure.

WM 6.8.1 General

Chambers containing Air and Vacuum Release Valves shall:

- not be located in areas where submergence by surface waters could occur
- not be provided on 300mm and smaller Watermains except where identified by COH-PW
- not be connected to a sewer except where identified by COH-PW

NOTE: Watermains 300mm and smaller servicing adjacent lots do not require Air and Vacuum Release Valves as air escapes or enters through the Water Services.

Air and Vacuum Release Valves shall be chambered and provided:

- on the downstream side of chambered Line Valves
- on the field side of a Branch Watermains Line Valve, where such is provided.
- as directed by COH

NOTE: Where there is uncertainty about the profile of an existing Watermain, Air and Vacuum Release Valves shall be installed on the field side of the Line Valve(s).

Air Release and Vacuum Relief valves shall:

- conform to AWWA standard C512-15 Air Release, Air/Vacuum and Combination Air Valves for Water and Wastewater Service and this document
- be chambered and provided on Watermains at high points in the profile
- be provided on both sides of the chambered Line Valve and on the field side of the branch Watermain, where such is provided

Sizing of Air Release and Vacuum Relief valves shall be per the following:

- 400[1] to 500mm Watermain – 50mm
- 600 to 750mm Watermain – 75mm
- 900 to 1050mm Watermain – 100mm
- 1200 to 1500mm Watermain – 150mm

WM 6.8.2 Automatic vs Manual Operation

Where the need for an Automatic Valve is not clear, Manually Operated Valves shall be used initially. COH-HW will monitor Air Accumulations and substitute an Automatic Valve as required.

Manually Operated Valves, where drainage is provided:

- Air Release and Vacuum Relief piping shall be extended to the Top of the Chamber and provided with a Screened, Downward-facing Elbow to prevent Blockages and the Ingress of Water per WM-201.04.

Automatic Valves:

- Air Release and Vacuum Relief piping shall be extended a minimum 300mm Above Grade and be provided with a Screened, Downward-facing Elbow to prevent Blockages and the Ingress of Water per WM-201.04.

Discharge piping from Air and Vacuum Release Valves shall not connect directly to sewers or drain pipes.

WM 6.9 Blow-Offs (Drain Valves)

📖 Blow-Offs are provided at low points in the Watermain profile to facilitate draining in Maintenance, Inspection and Construction operations and shall be located near suitable discharge locations per the provisions of WM 6.5 Chamber Drainage.

Blow-Offs chambers shall be provided on Watermains 400mm and greater at low points in the profile and as directed by COH.

Blow-Offs shall not:

- be located near watercourses
- be provided on 400mm and smaller Watermains except where identified by COH-PW

- not be connected to a sewer except where identified by COH-PW

NOTE: 400mm and smaller Watermains are typically drained through hydrants using compressed air or pumping.

Blow-Offs valves shall be chambered and provided:

- on the upstream side of chambered Line Valves
- on the field side of a Branch Watermains Line Valve, where such is provided.
- per the provisions of *WM 1.10 Blow-Off on Industrial Water Services*
- where identified, as Dead end Blow-Off per *WM 1.6 Dead-End Watermains*
- as directed by COH

NOTE: Where there is uncertainty about the profile of an existing Watermain Blow-Offs shall be installed on the field side of the Line Valve(s).

Sizing of Blow-Offs shall be per the following:

- 400 to 500mm Watermain – 100mm
- 600 to 1050mm Watermain – 150mm
- 1200 Watermain – 200mm

NOTE: Sizing of Blow-Offs on Watermains greater than 1200mm shall be to the satisfaction of COH-PW.

For Watermains 500mm and larger at least one blow-off chamber shall be installed for an isolatable section of the watermain.

Every design effort should be made to drain all chambers that house a blow off to an accessible storm sewer.

Conditional Blow-Off requirements shall be per the provisions of *WM 1.10 Blow-Off on Industrial Water Services*.

WM 6.10 Isolation – Large Valve Replacements

There are 3 scenarios the COH has been utilizing to isolate larger diameter watermains for repairs or valve replacements. Designers shall be aware of these scenarios and provide details accordingly:

- Scenario 1 – Disinfection against a live valve in the closed position
  - Watermain isolated with valve closure
  - Repair or valve replacement undertaken
  - Repair or valve replacement completed
  - By pass installed around closed valve with backflow prevention (BFP)
  - Disinfectant injected at locations 1. and 2.
  - Existing watermain pressure continuously monitored at by-pass or hydrant
- Scenario 2 – Disinfection against a line stop

  - Line Stop installed
  - Repair or valve replacement undertaken
  - Repair or valve replacement completed
  - By-pass installed around line stop with backflow prevention (BFP)
  - Disinfectant injected at locations 1. and 2.
  - Existing watermain pressure continuously monitored at line stop location
- Scenario 3 – Blind Flange Assembly (positive physical separation)
  - Excavation, watermain shutdown, blind flanges installed, watermain recharged
  - Repair or valve replacement undertaken
  - Live side tap outlet of spool piece serves as flushing / chlorine monitoring point during construction
  - Repair / valve replacement completed
  - By pass installed around blind flange with backflow prevention (BFP)
  - Disinfectant injected at locations 1. and 2.
  - No need for existing watermain pressure to be continuously monitored
  - Upon activity completion – watermain shutdown, blind flanges removed, closure pieces installed, watermain recharged

WM 6.11 Line Stops

📖 Line stops can be used to provide temporary flow control where the disruption and costs of a Watermain shutdown using available valving are significant.

Designers shall specify the diameter of the watermain to be isolated using line stops. The installer shall determine the line stop size.

Insertion valves are permanent Line Valves installed on a live Watermain using a live tap methodology and are not permitted for use.

Line stop(s):

- are provided for temporary flow control
- interrupt the flow of water by inserting a plug into an existing Watermain through a tapping tee to facilitate repairs, maintenance or connections without disrupting service
- seal the opening with a blind flange as part of the plug removal process
- mitigates disruption to the operation of the adjacent Watermain system
- shall be installed as directed by COH-PW
- excavations shall be covered with steel plates for the resumption of vehicular flows and capable of supporting the requisite vehicular loading

WM 6.12 Valve Stem Extensions

Valve stem extensions and supports shall be provided for watermain valves and hydrant valves that are deeper than 2.5m in accordance with WMXXX.

WM 6.13 Shut Valves and Pressure Districts

📖 Shut valves are closed valves which maintain Pressure District boundaries and provide operational flexibility in other areas of the Water Distribution system.

Watermain construction and temporary By-Pass Watermain shall not cause water services or Watermain connections to move to another Pressure District.

Shut valves remain in the "closed" position and are used to provide operational flexibility in temporary and/or permanent situations. Shut valves shall be:

- Installed within valve chambers
- provided per the direction of COH-HW
- inclusive of copper By-Pass piping to mitigate water quality per *WM 1.8 Copper By-Pass*
- in accordance with WM-201.03.

COH has 25 Pressure Districts which are isolated through the provision of Shut Valves at their boundaries with each other. Temporary or permanent connections between Pressure Districts are not allowed. *Ref 1.1- System Pressures – CoH Pressure District Maps* (For internal use only).

WM 6.14 Pressure Reducing Valves

Pressure reducing or pressure sustaining valves are permitted in special circumstances and upon consultation and approval from COH-HW, where pressures within the system exceed 690 kPa and impacts to the rest of the water system are considered.

Where a Pressure Reducing Valve (PRV) is being used to feed a small system or sub-zone, the designer shall consider low flow as well as higher flows for fire protection. In most cases there should be 2 PRVs, a smaller one to handle the low flows and a larger one for fire protection.

The designer shall allow for redundancy so that maintenance can be performed on the PRV without effecting service to customers. All PRVs require isolation valves upstream and downstream from the PRV. On a sub-zone that is being fed by more than one feed, consideration of which PRV will be the lead PRV and which one will be the lag should be done during the design.

For water quality and maintenance purposes, a hydrant is required downstream from the PRV with an isolation valve further downstream to allow the PRV and hydrant to be isolated from the rest of the system. Where PRVs are being installed as a back-up and don't have water flowing through them on

a regular basis, anti-stagnation devices must be considered to keep water fresh. Also the ability to monitor water quality must be provided through sampling ports or hydrants.

WM 6.15 Pumping Station

It shall be incumbent on the Consultant Engineer and COH-DEV to promptly consult with COH-HW where the need for a Pumping Station and/or Elevated Tank has been determined so requisite design, operation and maintenance standards can be provided at the onset of the project.

Pumping Station and Elevated Tanks shall be designed and constructed as long-term facilities independent of their expected duration of use.

Relaxation of criteria for short-term facilities will at no time be given consideration.

WM 6.16 Valve Chamber Restoration

Existing valves chambers to be restored/rehabilitated for reuse shall rehabilitated in accordance with WM-238 including replacement of non-functional components and installation of thrust blocks as required.

WM 7 PIPE AND FITTING RESTRAINTS

📖 Pipe and Fitting restraint inclusive of anchor blocks, mechanical constraints, thrust blocks/walls/collars is provided to prevent pipe movement and associated joint failure in order to mitigate Watermain service interruptions and mitigate opportunities for contamination of the potable water system.

WM 7.1 Thrust Forces

For the purposes of joint restraint and the provision of anchor blocks, Thrust Forces shall be comprised of:

- operating, test and surge pressures (to Form 1 requirements)
- transient pressures

Designers shall determine thrust forces based on the watermain pipe diameter and the highest possible pressure.

WM 7.2 Anchor and Thrust Blocks

📖 Provision of Anchor and Thrust Blocks is applicable to rock installations and in soils with a bearing capacity of 2000 to 4000psf (15 to 30 blows/300mm penetration). Otherwise piping shall be inclusive of full mechanical restraint at fittings and pipe joints.

Use of Watermain crosses, in lieu of the provision of two tees with anchor blocks, shall be prioritized where impacts to potential utility corridors and bends are not increased.

Except where precluded above, anchor and thrust blocks shall be:

- mandatory in Watermain construction (smaller than 900mm)
- mandatory in water service construction (100mm and greater)
- mandatory in hydrant construction
- in addition to, and shall not reduce the requirements for, mechanical joint restraint, chamber restraint and/or thrust walls
- located outside of areas which have been disturbed by the construction of sub-surface installations in the 5-year term preceding the project
- located outside of areas which could be disturbed by the maintenance or construction of other CITY and Third-Party Utility sub-surface infrastructure
- placed against undisturbed soil. Where thrust blocks cannot be placed against undisturbed soil due to excessive excavation or fill conditions, mechanical joint restrainers may be used in conjunction with concrete thrust blocks.

Anchor and Thrust Blocks shall be composed of 30MPa concrete and shall be provided at horizontal and vertical bends, tees and plugs per:

- WM-204.01 - Concrete Anchor Blocks - 300mm and smaller

- WM-204.02 - 11.25°, 22.5° Anchor Block - 400 to 900mm D.I. Watermain
- WM-204.03 - 45° Anchor Block - 400 to 900mm D.I. Watermain
- WM-204.04 - 45° Anchor Block with Leg - 400 to 900mm D.I. Watermain
- WM-204.05 - 90° Anchor Block - 400 to 900mm D.I. Watermain
- WM-204.06 - 90° Angle Anchor Block with Leg - 400 to 900mm D.I. Watermain
- WM-204.07 - Tee Anchor Block - 400 to 900mm D.I. Branch Watermain
- WM-204.08 - Tee Anchor Block with Leg - 400 to 900mm D.I. Branch Watermain
- WM-204.09 - Thrust Block - 400 to 900mm Dia. D.I. Watermains
- WM-204.10 - Anchor Block - 100 to 300mm D.I. Watermains - 11.25°, 22,5° Vertical Bend
- WM-204.11 - Anchor Block - 100 to 300mm D.I. Watermains - 45° Vertical Bend
- WM-204.12 - Vertical Bend Anchor Block - 7.25° to 22.5° - 400mm D.I. Watermain
- WM-204.13 - Anchor Block - 100 to 300mm Watermain Lowering
- WM-204.14 - Vertical Bend Anchor Block 45° - 400mm D.I. Watermain

Thrust blocks shall be located such that thrust forces are not directly applied to:

- CITY and Third-Party Utility surface and subsurface infrastructure inclusive of servicing
- adjacent buildings

Vertical thrust blocks shall be located such that:

- water services that are located at the same elevation and are in the path of the thrust forces have a minimum 2.0m separation

Watermain pipe joints that are encased or partially encased in unshrinkable fill shall be provided with mechanical restraint within and to one joint beyond the encasement.

WM 7.3 Mechanical Joint Restraint

The requirement for joint restraining for watermains 400mmm and larger shall be determined by the designer.

Mechanical joint restraint is in addition to the provisions of *WM 7.2 - Anchor and Thrust Blocks*.

Watermains 300mm or less shall have valves and fittings, inclusive of fittings at dead ends, restrained a minimum of 18m in every direction.

Watermains and water services 100mm and greater installed within engineered fill shall be fully restrained.

Restraint of valves and fittings, inclusive of fittings at dead ends, on Watermains 500mm and greater shall be addressed to the satisfaction of COH-PW.

Watermains 400mmm and smaller, shall be fully restrained under Heavy Rail and High Order Transit guideways/routes/stops to the satisfaction of COH-PW.

Hydrant leads and water services 100mm and greater shall be provided with full length pipe and joint restraint.

Restraints shall be addressed per the provisions of *WM 2.5 - Corrosion Control (Water Infrastructure).*

WM 8 FIRE PROTECTION AND FIRE FLOWS

WM 8.1 Fire Protection

The principles of facilitating Firefighting and Fire Suppression, the Drinking Water System shall consistently provide:

- hydrants spaced such that overlapping coverage is available for the buildings and residences along the Right-of-Way
- valving that mitigates disruption of the supply of water
- a network of Watermains that supports fire flows that are appropriate to the adjacent land use, at hydrants and to Building sprinkler systems
- storage facilities capable of supplying the volume of water required

Drinking Water System shall be inclusive of the requirements of the following:

- Fire Protection and Prevention Act, 1997
- Ontario Regulation 388/97 - Fire Protection Fire Code
- COH - Watermain Fire Flow Requirement Design Guidelines Policy PW19-096 & PW19-096a
- AWWA - Manual of Water Supply Practices (M31) - Distribution System Requirements for Fire Protection

WM 8.2 Fire Flow Requirements

CITY - Watermain Fire Flow Requirement Design Guidelines Policy employs a two-level approach that ensures a robust and reliable trunk water distribution system and a reasonable level of service, at the local street level, by following an OBC and land-use targets strategy.

Policy provides:

- clarity for stakeholders
- assists staff in the review and processing of applications.
- aligns with the City's Open for Business mandate to create consistent, predictable, and customer-focused services that encourage investment

Domestic demand design flows shall conform to:

- Design Guidelines for Drinking-Water Systems (MECP)

Upon request COH-HW will provide (as is with no warranty) existing hydrant flow testing results.

Fire Flow Calculation sheet is provided at:
Comprehensive Development Guidelines and Financial Policies | City of Hamilton, Ontario, Canada

WM 9 COMMISSIONING, ACCEPTANCE AND ASSUMPTION

Disinfection of watermains shall be done in accordance with ANSI/AWWA C651 – Disinfecting Water Mains, as amended by the latest MECP Watermain Disinfection Procedure and City of Hamilton Form 400 – Appendix A – Procedure for the Disinfection, Testing and Connection of Watermains.

Final inspection of water services shall be completed and be included in the lot grading certification.

Watermains shall not connect to the existing system prior to successfully passing requisite testing.

Connections points to the existing system shall be physically separated from the installed Watermain.

WM 9.1 Commissioning

📖 Large diameter water services are considered branch connections and shall be pressure tested, chlorinated and sampled at the same time as the Watermain.

Hydrant Leads are not considered branch connections and shall be pressure tested and chlorinated. Sampling is not required.

Connection to the private water infrastructure will be completed only after the CITY system successfully passes the disinfection test.

Commissioning of watermains defined as when the watermain is installed and the following are conducted in accordance with the City's Construction and Material Specifications Manual:

- Charging of watermain
- Pressure leakage testing
- Swabbing
- Disinfection and Bacterial Testing
- Acceptance and Assumption of the watermain
- double signed Form 1 verified

WM 9.2 Temporary Charging

Connections for Charging Operations and By-Pass Water Systems shall be per the provisions of *Appendix WM3: Policies, Permits, Applications, Special Agreements, User Services, Fees/Charges*.

Field Testing shall be in accordance with Form 400 and per the provisions of *MECP Watermain Disinfection Procedure.*

WM 9.3 Testing Sequence

Contractor shall provide the requisite materials, equipment and personnel for testing which shall occur in the following order:

- Pressure and Leakage
- Swabbing
- Disinfection and Bacteriological testing prior to connection to the existing system

WM 9.3.1 Pressure and Leakage Testing

Minimum test pressure shall be 1035 KPa for Ductile Iron and PVC Watermains.

Leakage testing, minimum 2 hour duration, shall occur on the shortest valved section constructed.

Maximum leakage allowance shall be 0.128 L/mm of pipe diameter/km of pipe/2 hour period.

Contractor may elect to swab the Watermain to assist in the removal of air pockets prior to testing.

WM 9.3.2 Swabbing

The requisite placement of butterfly valves on Watermains 500mm and greater precludes swabbing given the inability of the swab to pass through the valve location. Refer to *WM 6.2 – Standards*

Watermains shall be cleaned with a minimum of 3 passes of a polyethylene swabs through the pipe and to such a point that the water is clear to the satisfaction of COH-PW

WM 9.3.3 Disinfection and Bacteriological Testing

In Accordance with Form 400, COH Inspector shall arrange for the collection of water samples and testing at the CITY laboratory which is only open on weekdays, from 8:30am to 3:30pm.

Disinfectant shall be added in sufficient quantity to obtain an initial minimum free chlorine residual of 50mg/litre and a minimum free chlorine residual of 25mg/litre, 24 hours after introduction into the pipe.

Approved disinfectants are inclusive of calcium or sodium hypochlorite that meets or exceed ANSI/AWWA B300 or liquid chlorine that meets or exceeds ANSI/AWWA B301.

Once the piping has been successfully disinfected, the system shall be flushed.

Potable water directly and indirectly discharging (inclusive of a storm sewer's ultimate outlet) to a ditch or watercourse shall be dechlorinated. Discharging to the surface shall minimize the potential for icing of surfaces used for active transportation and vehicles.

Chlorinated water shall be discharged per the following order of preference:

- to storm sewer using chamber drain, dichlorination and testing as dictated by ultimate outlet
- to storm sewer using catch basin, dichlorination and testing as dictated by ultimate outlet
- to sanitary sewer with a CITY permit
- to ditch or watercourse, dichlorination and testing mandatory

Valve chambers shall:

- not be piped or connected to a ditch
- not be connected to a sanitary or combined sewer
- not be placed where the discharge would be directed by the topography to a watercourse
- not be connected to a storm sewer where the hydraulic grade line of the sewer is above the chamber floor
- not be piped or connected to a storm sewer where the sewer outlets to a watercourse

Upon completion of the final flushing operation and "sitting period" in accordance with Form 400 COH Inspector will collect water samples for bacteriological testing at the CITY laboratory per the following:
a minimum of two samples taken for each Watermain twice, 24 hours apart

- at the end of each branch or stub
- at 350m intervals

Water infrastructure may be placed in service and connected to the existing water distribution system upon COH acceptance of satisfactory testing results. Consultant Engineer or COH-PW shall coordinate connections with COH-HW and provide a minimum 48 hours advance notice to affected users.

Shall be per the provisions of *WM 2.8 Connections.*

WM 9.4 Acceptance Requirements

Acceptance of the constructed Watermain infrastructure shall be subject to the following:

- COH-DEV, COH-HW and COH-ENG each in receipt of full set of As-Constructed drawings in ANSI D paper format
- COH-HW and COH-ENG each in receipt of the approved As-Constructed General Plan of Services in a georeferenced Microstation (preferred) or AutoCAD format
- Consultant Engineer has tested and certifies tracer wire systems are in working order
- Preliminary visual inspection of the Watermain works has been completed by the Consultant Engineer, Contractor, COH-DEV and COH-HW after the placement of Binder Course asphalt.
- Report documenting identified deficiencies and requisite remedies has prepared by COH-DEV and COH-HW and been submitted to the Consultant Engineer and Contractor.
- Consultant Engineer has submitted as-constructed information to the satisfaction of COH-DEV.

WM 9.5 Assumption Requirements

Prior to the Assumption of the constructed Watermain infrastructure the following are required:

- requirements for the Acceptance of Watermain infrastructure have been satisfied
- COH-DEV and COH-HW in receipt of the approved as-constructed drawing set in single document PDF format
- COH-ENG in receipt of the approved as-constructed drawing set in single sheet PDFs
- Consultant Engineer certification that subsequent inspection confirms that the:
  - identified deficiencies have been addressed in the prescribed manner
  - chambers are free of standing water
  - anti-tampering devices have been removed
- Consultant Engineer certifies that testing confirms the tracer wire system on PVC Watermain remains in good working order.
- CITY final inspection confirms deficiencies have been remedied and operability of the Watermain infrastructure is satisfactory to COH-HW.
- COH-ENG is in receipt of the approved as-constructed drawing set in PDF and archive quality mylar formats

WM 10 WATERMAIN HYDRAULIC ANALYSIS

WM 10.1 General

For the purposes of clarity:

- Average Day Demand is the total yearly amount of water demand divided by 365
- Maximum Day Demand is the highest daily water demand, midnight to midnight, within a year
- Maximum (Peak) Hour Demand is the highest hourly demand, excluding fire flow, in a day

Water Hydraulic Analysis Report shall generate design content including but not limited to:

- water distribution systems
- pressure zones
- water consumption - estimated consumption
- existing capacities of all watermains systems
- phasing
- net impact on the entire pressure district as per MECP Form 1 - Record of Watermains Authorized as a Future Alterations
- net impact due to proposed change in land use or development
- need for expansion and upgrades
- velocities verified for flushing (MECP requirements are met)
- system pressures required for watermain class selection
- fire flows required to verify the required pipe diameter

NOTE: Consultant Engineer will clearly state the assumptions made where there are unknowns (such as form of development, type of construction, etc.). Validity of assumptions shall be confirmed as the design advances and the Consultant Engineer shall revise the study and certify it is representative of the development. These revisions should be expedited in the Approval process.

Report shall confirm the following requirements are met by the proposed works for the current design period and accounting for future development to the satisfaction of COH:

- service pressures
- fire flows
- Pressure District distribution system maintains pressures above 140 kPa at ground level under maximum day plus fire flows
- transient pressures
- flushing velocity of 0.8 m/s

Report shall Identify the Pressure District in which the proposed works are located and serviced from.

WM 10.2 Report Structure

The Watermain Hydraulic Report shall be structured as a minimum per the following:

Cover Letter

Standard Declarations

1 - Introduction

2 - Criteria

- 2.1 - Domestic Demand
- 2.2 - Fire Flow Demand
- 2.3 - Boundary Conditions
- 2.4 - Subdivision Computer Model

3 - Analysis

- 3.1 - System Pressures and Available Fire Flow
- 3.2 - Transient Pressures
- 3.3 - System Flushing

4 - Conclusions

Figures

Figure xx - Subdivision Location Plan
Figure xx - Pass/Fail under Maximum Day Demand plus Fire Flow

Appendices

Appendix A - Demands and System layout
Appendix B - Model Results
Appendix C - Fire Flow Calculations

WM 10.3 Cover Letter

Cover letter shall be inclusive of the:

- Consultant Engineer's stamp, seal, signature and license number

The following statements shall be provided:

- *The analysis documented in this report includes individual hydraulic examination of the Average Day demand, Maximum Day plus fire flow and the Maximum (Peak) Hour demand of the development for the present (20__) and ultimate build-out (2031, 2041, 2051, etc.) demand conditions.*

- *The documents provided form a complete submission per CITY of Hamilton requirements.*

WM 10.4 Standard Declarations and Conclusions

The following statements shall be provided:

- *The proposed works, in both the existing (20__) and ultimate build-out (2031, 2041, 2051, etc.) conditions satisfy MECP and CITY requirements and provide:*
  - service pressures between ___ kPa and ___ kPa
  - requisite fire flows of ___ psi under Maximum Day Demands conditions
  - pressures at ground level (throughout Pressure District No. ___) of ___ kPa which meets the requisite 140 kPa threshold
  - minimum flushing velocity of 0.8 m/s

- *The proposed works, in both the existing (2021) and ultimate build-out (2031, 2041, 2051, etc.) conditions withstand transient pressure plus maximum operating pressure.*

WM 10.5 Screening Criteria

COH-DEV will perform a check that the values and variables used in calculations do not vary grossly from reasonable values. This review shall not be construed as acceptance by the CITY nor shall it transfer responsibility from the Consultant to COH.

The ability of the CITY to process a development application is directly related to the completeness and quality of the documents submitted. To avoid unnecessary delays and resubmissions the Consultant Engineer shall as a minimum:

- ensure the following:
  - Form 1, Part 2 identifies Street Name and “From/To” for each CITY pipe
  - deliverables are legible and in accordance with Form 1 documentation
  - cross referencing is complete and accurate
  - works are in compliance with the Official Plan, Secondary Plans, Block Servicing Plans, Draft Plan of Sub-Divisions, legacy conditions of Approval, etc.
  - existing and proposed works are clearly and explicitly differentiated
  - CITY infrastructure is clearly and explicitly differentiated from private infrastructure
  - standards applicable to CITY infrastructure are clearly and explicitly differentiated from those applicable to private infrastructure
  - consultation with COH-DEV and COH-HW is scheduled advance of a Form 1 submission to confirm Ownership of Watermain infrastructure located within easements (in some cases, Watermain infrastructure provided for the purposes of looping may be a candidate for CITY Ownership)
  - peak demand rates are calculated per the MECP fixed unit approach

  - units of measure are consistent and metric
  - model provided is appropriate for Form 1 purposes when modifications/extensions to the City's base model are made
  - Neighborhood LOS with installation of multi-unit high-rise developments

- ensure the following are documented:
  - the boundary conditions applied
  - analysis of the existing (20__) and of ultimate build-out (2031, 2041, 2051, etc.) conditions
  - analysis of additional interim condition(s) identified by COH-DEV in the Formal Consultation or as part early Development Application stage consultation where unknown/future infrastructure will be built to address future undefined growth
  - methodology used for calibration and validation of the hydraulic model and calculations
  - rationale supporting applicability of the hydraulic model to Form 1 requirements
  - use of the MECP Fixed-Unit Approach per section 3.4.3 Commercial and Institutional Water Demands of Design Guidelines for Drinking-Water Systems

- ensure that data used in each deliverable (report, chart et al) matches, inclusive of:
  - units of measure (metric)
  - street names and from/to limits
  - Subdivision/Site Plan Name inclusive of Phase identification
  - node and pipe nomenclature (node and pipe schematic(s) shall be fully labelled and inclusive of each node that forms part of the analysis)

WM 10.6 Required Fire Flow

Designer Engineer shall obtain the CITY System Wide base model for modelling purposes.

Fire flows shall be per *City of Hamilton Watermain Fire Flow Requirement Design Guidelines Policy (PW19096)*

References to ISO and Short methods in the RFF calculations are not permitted.

Required Fire Flow-RFF calculations shall, as a minimum for OBC Calculations, be accompanied by:

- Drawings illustrating:
  - building foot print and floor area
  - number of storeys
  - location and fire resistance rating of Fire walls, per National Building Code of Canada
  - provide documentation that supports fire resistance rating of vertical openings and exterior vertical communications
- Coefficient of Construction:
  - provide documentation that supports construction coefficient used

  - provide documentation that supports Percentage Credit Claimed for the sprinkler system
- Content Fire Hazard/Occupancy:
  - provide documentation that verifies content combustibility claim
- Exposure:
  - provide a plan which identifies separation distances and exposure charges on each side, sum of the values shall not exceed 75%

Consultant Engineer shall demonstrate how flushing velocity is achieved by each of the following strategies to the satisfaction of COH-HW:

- conventional - use of hydrants (e.g. single port, dual ports, multiple hydrants)
- uni-directional - closure of valves

Fire flows shall be per *CITY - Watermain Fire Flow Requirement Design Guidelines*

WM 10.7 CITY Comments - Tracking Table

In general, for all deliverables, the CITY will provide comments electronically via a standard Tracking Table per *Appendix WM2: City Comments - Tracking Table Template*. The table is meant to be a fluid working document which flows back and forth between the CITY and the design team. In addition to hard copies an electronic version shall also be submitted in native PDF format.

Appendix WM1:
Watermain Pipe Material Selection Matrix

City of Hamilton Watermain/Sewer Standards & Guideline Review
Appendix WM1: Watermain Pipe Material Selection Matrix
November 21, 2024

Pipe System / Material	Location / Condition:	Critical Mains	Stray Current (4)	LRT Guideway	Corrosive Soil	Hydrocarbons	Volatile Organic Compounds (VOCs)	High Groundwater table	Soil Conditions	Transients (Surge Pressures)	Trenchless Construction	Additional Protection for High Risk Areas (see table below for High Risk Areas)
	Description:	*Where impact/failure to water pipe system and resultant repair turnaround time is critical*		*Pipe located within LRT Guideway*	*Numerical Corrosivity Scale AWWA C105 large than 10 points*	*Presence of hydrocarbons in excess of allowable chemical parameters per O.Reg. 406/19 tables.*	*Presence of VOCs in excess of allowable chemical parameters per O.Reg. 406/19 tables.*	*Where Ground Water Table above Obvert/Invert of WM*	*Loose Soil (N-values < 10)*	*Section of pipe identified by transient analysis for higher than allowable surge pressures for pipe system*	*e.g. HDD, MTBM*	
	Applicable Pipe Size and Standards (1)											
Ductile Iron (DI)	*Pressure Class 350; 100mm – 300mm Thickness Class 52; 400mm – 1200mm*	**Acceptable** *- Localized failure mode (generally through hole)* *- Acceptable when repair turnaround time is critical*	**Acceptable** *- External pipe corrosion protection coating required per City standards* *- Polyethylene encasement*	**Acceptable** *- External pipe corrosion protection coating required per City standards* *- Polyethylene encasement*	**Not Suitable** *- Dependent upon the nature of the soil*	**Acceptable** *- Polyethylene encasement required* *- Nitrile gaskets required* *- Viton® gaskets required if aromatic hydrocarbons present*	**Acceptable** *- Nitrile gaskets required*	**Not Suitable** *- Welded joints are not achievable with DI*	**Acceptable** *- Restrained flexible joints required (Dependent on anticipated soil movement)*	**Acceptable** *- Allowable Surge of 690kPa (100psi)*	**Acceptable**	External corrosion protection coating, polyethylene encasement, and restrained joints
Pre-stressed Concrete Cylinder Pipe (PCCP)	*L-301 (500mm-1200mm) E-301 (>1200mm)*	**Acceptable** *- Localized failure mode* *- Long material wait time* *- Potentially lengthy repair time* *- For Large diameter pipes (>1200mm) Not Suitable in downtown areas due to difficulty to repair quickly.*	**Not Suitable**	**Not Suitable**	**Acceptable** *- Silica fume admixture and external coating required for protection*	**Acceptable** *- Additional protection required* *- Silica fume admixture and external coating required for protection* *- Nitrile gaskets required*	**Acceptable** *- Nitrile gaskets required*	**Acceptable** *- Welded joints*	**Acceptable** *- Restrained flexible joints required (Dependent on anticipated soil movement)*	**Acceptable** *- Ensure CPP is designed for the anticipated surge pressure*	**Acceptable**	Welded and grouted lap joints, silica fume admixture, nominal 50 mm mortar cover, polyurethane coating
Polyvinyl Chloride (PVC)	*AWWA C900 100mm-400mm; DR 18 500mm -750mm (as specified)*	**Not Suitable** *- Localized failure mode* *- Potential Catastrophic Failure* *- Acceptable when repair turnaround time is critical*	**Acceptable**	**Acceptable**	**Acceptable** *- Nitrile gaskets required metallic fittings / restrainers shall be protected with tape / denso wrap with cathodic protection*	**Not Suitable**	**Not Suitable**	**Acceptable** *- If fused PVC is AWWA accepted* *- Concrete anchorage system required*	**Acceptable** *- Restrained flexible joints required (Dependent on anticipated soil movement)*	**Acceptable** *- Allowable Surge of 120kPa for DR18* *- Not suitable when cyclic surges are present*	**Not Suitable**	Double gaskets at joints, restrained joints and Steel Encasement
Molecularly Oriented Polyvinyl Chloride (PVCO)	*AWWA C909 100mm – 300mm*	**Not Suitable** *- Localized failure mode* *- Acceptable when repair turnaround time is critical*	**Acceptable**	**Acceptable**	**Acceptable** *- Nitrile gaskets required*	**Not Suitable**	**Not Suitable**	**Not Suitable**	**Acceptable** *- Restrained flexible joints required (Dependent on anticipated soil movement)*	**Acceptable** *- Allowable Surge of 120kPa for DR18* *- Not suitable when cyclic surges are present*	**Not Suitable**	Double gaskets at joints, restrained joints and Steel Encasement
Spiral Welded Steel	*AWWA C200 Cement lined AWWA C205*	**Acceptable** *- Localized failure mode*	**Not Suitable**	**Not Suitable**	**Not Suitable**	**Acceptable**	**Acceptable**	**Acceptable**	**Not Suitable**	**Acceptable** *- Verify pipe wall thickness. Typically allows for 1.3 x working pressure*	**Acceptable**	Concrete encasement, cement mortar lining
High Density Polyethylene (HDPE) (Not Approved Product) (3)	*AWWA C906 DR 11 for PE3608 and DR 13.5 for PE4710*	**Not Suitable**	**Acceptable**	**Acceptable**	**Acceptable**	**Not Suitable**	**Not Suitable**	**Acceptable** *- Fused joints required* *- Concrete anchorage system required*	**Acceptable** *- Flexible pipe with allowable pipe bending*	**Acceptable** *- Total including surge pressure less than 2.0 (for occasional) and 1.5 (for recurring) times the pipe Pressure Rating.* *- PE pipes are very fatigue resistant - suitable for cyclic surges*	**Acceptable**	Continuous length, butt fused joints, Steel Encasement

Notes:
(1) Refer to Approved Product List for Applicable Pipe Size for each pipe system. Refer to Form 400 for Pipe Material Specifications.
(2) For pipe materials deemed "Not Suitable" may be acceptable under specific circumstances as determined by the City on a case-by-case basis.
(3) Refer to the latest Approved Product List on the City's website for the approved pipe materials for watermains.
(4) Stray current pertaining to underground pipelines are direct currents flowing through the earth from a source not related to the pipeline being affected.

Land Use Areas	Watermain Failure Rating		
	Collateral Damage	Ease of Repair	Value
High Risk Areas	Very High	Complex with Prolonged Delay	High
Hospitals / Schools / Universities Hydro Corridors, Rail Tracks Water Reservoirs / Pump Stations / Highways			

Note: There is no Tolerance for High Risk category. These are areas that are in close proximity to critical infrastructure and utilities with dense populations and no tolerance to disruption during construction and also has the high risk of 3rd party collateral damage, that could result in major interruptions to other public services. For reservoirs located in park areas High Risk area considered to extend to the first line valve away from reservoir

Appendix WM2:
City Comments - Tracking Table Template

City of Hamilton Watermain/Sewer Standards & Guideline Review
Appendix WM2: City Comments - Tracking Table Template
November 21, 2024

Project:	
Project Contract Number:	

Document being Reviewed

Title:	
Prepared By:	
Date:	
Revision:	

Comment ID	Date of Initial Comment (DD-MMM-YYYY)	Reviewed By	Report Section or Table/Figure/Drawing Number Reference	City Comment	Has the Comment Been Addressed? (Y/N)	Date Comment Addressed (DD-MMM-YYYY)	Response	Responded By
1								
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Appendix WM3:

Policies, Permits, Applications, Special Agreements, User Services, Fees/Charges

APPENDIX WM3: POLICIES, PERMITS, APPLICATIONS, SPECIAL AGREEMENTS, USER SERVICES, FEES/CHARGES

Disclaimer

Many of the link in this document are broken due to IT Incident and will be updated in the next addition.

List of Policies

The List of Policies governing Watermain and Sewer works is inclusive of the following:

PP-0004 *CITY - Water and Wastewater/Storm Arrears Policy*
Details account collection protocols for CITY provided services which are unpaid and past due.

PP-0011 *CITY - Water and Wastewater/Storm Extraordinary Circumstance Bill Adjustment Policy*
Provides Residential (exclusive of income producing), Not-for-Profits and Institutional customers limited financial assistance for high usage volumes which result from unexplained, extraordinary, or unusual circumstances which are not attributable to an identified leak.

PP-0014 *CITY - New Development Water Customer Attachment Billing Policy*
Provides criteria for the metering, removal and payment of water volumes associated with the construction of a structure, or other temporary purpose as may be approved.
Refer to *WM 2.4.3 Temporary Water Supply for Construction*

PP-0015 *CITY - Water and Wastewater/Storm Back-billing Policy*
Provides customers with a consistent and transparent procedure for the processing of Water and Wastewater/Storm back-bills for billing exceptions that have resulted from meter malfunctions, administrative errors and/or owner oversight.

BY-LAW NO. 23-241 *CITY - Water and Wastewater/Storm User Service Fees and Charges*
Provides a consistent, fair, equitable and transparent approach for establishing, managing and recovering User Fees and Charges from those who receive direct benefits from these services.

PILOT VERSION 01 *CITY - Watermain Fire Flow Requirement Design Guidelines Policy*
Provides the specifics of a two-level approach that ensures a robust and reliable trunk water distribution system and a reasonable level of service, at the local street level, by following an OBC and land-use targets strategy. Refer to PW19096 and PW19096(a) for the Council approved policy.

PP-0009 *CITY - Water and Wastewater Consecutive Estimated Accounts Policy*
Where the Owner refuses the installation of, or denies access to a water meter, the Owner shall pay the estimated amounts of water supplied to the property based on metered or non-metered rates per the provisions of the Policy.

BY-LAW NO. 03-272 *CITY - Sanitary Surcharge and Wastewater Abatement*
Provide Fees, Charges and potential Credits related to the use of CITY Sanitary Sewers.

Fire Flow Requirement Design Guidelines Policy

This policy employs a two-level approach that ensures a robust and reliable trunk water distribution system and a reasonable level of service, at the local street level, by following an OBC and land-use targets strategy.

Policy provides clarity for stakeholders and will assist staff in reviewing and processing applications.

Aligns with the City's Open for Business mandate to create consistent, predictable, and customer-focused services that encourage investment.

Calculation sheet for *Adequate Water Services - Required Fire Flow (RFF) and Available Fire Flow (AFF)*

Permits and Applications

According to Section 8.16 of the *Water Works System By-law No. 23-235*:
A Permit expires on the earlier of:

- if the Permit contains an expiry date, such date;
- if the Permit does not contain an expiry date, 365 days after the Permit was issued;
- on the date that the work is completed; or
- on the date that the Permit is revoked.

Approval of the servicing drawing is for material acceptability and compliance with municipal and provincial specifications and standards only. Approval and inspection by the City of Hamilton of the works does not certify the line and grade of the works and it is the Owner's responsibility to have their Engineer certify this accordingly.

Review of Permit applications and Inspection:

- limited to a compliance check in relation to the Approved Product and Materials List and the standards provided herein.
- is exclusive of any review of line and grade of the infrastructure.

Water Meter Accuracy Testing Application

Requests and the Authorization for Payment for a Water Meter Accuracy Test are submitted per the *Water Meter Test Request Form* which provides User Service Fees and Charges for each meter size.

NOTE: User Service Fees and Charges will be waived and refunded where the meter is registering values higher than the tested volumes by two percent (2%) or more. Specifics are provided in the form.

Backflow Prevention Device – Building Department

Shall be per the provisions of *WM 1.7 - Backflow Prevention*

Hydrant Use Application (Inclusive of Adaptor Assembly Rental)

Terms and Conditions:

- Adaptor is approved for non-potable water use only.
- Adaptor uses restricted to the location identified on the Form or as otherwise specified by COH-HW.
- Each relocation of the Fire Adaptor assembly is subject to submission of a Request Form, User Service Fees and Approval.
- Connection and Disconnections for non-Municipal works shall only be performed by a Certified COH-HW Operator or Inspector.
- Adaptor remains CITY property and shall be returned in its original condition. Applicant shall be responsible for damage costs which will be deducted from the deposit provided.
- Applicant shall remit payment for User Fees and Charges *per CITY - Water Distribution System* and shall be aware of time dependent charges contained therein.
- A random inspection may be conducted to ensure location compliance. Inspection fees per *CITY - User Fees and Charges* may be applicable.
- Winter Use - From December 1st to April 1st of the following year. Applicant shall provide a locked, secured and heated enclosure for the Adaptor Assembly and shall be responsible for the payment of a Mandatory Inspection per *CITY - User Fees and Charges*.
- DAMAGE - Applicant shall be aware that it is an offence to break, damage, destroy, deface or tamper with the Adaptor or other part of the Waterworks per CITY - By-Law No.R84-026 - Waterworks and that such actions are subject to the penalties identified in the Provincial Offences Act.
- For scheduling Connection and Disconnection requests please call 905-546-2489.

Private Hydrant Relocation Application

Requests to relocate a Private Fire Hydrant are complete through Development Permits.

Bulk Water Filling Stations and Drinking Water Haulers

CITY operates two Bulk Water Filling stations located at:

- 1422 Cormorant Rd, Hamilton, ON, L9G 4V5 (Community of Ancaster)
- 70 Dartnall Rd, Hamilton, ON, L8W 3N1

These facilities are open 24 hours a day, 7 days a week excluding Statutory Holidays.

Connections to the upper and lower arms, located on both sides of the station, require 75mm female cam lock fittings.

To facilitate online purchases of Bulk Water, users can register online for an account using this link *https://hamiltonwater.azurewebsites.net/account*. At the completion of the process users will be provided with a unique personalized Authorization ID and PIN.

Alternately, setting up an Account or the purchase of Bulk Water can be completed at 330 Wentworth Avenue North, on weekdays, between the hours of 8:30am to 4:30pm.

Drinking Water Haulers

Drinking Water Haulers are subject to annual inspection per the provisions of *WM 1.12 - Drinking Water Haulers.*

Temporary Water Supply Permit - Large Scale Construction

Shall be per the provisions of *WM 2.4.3 Temporary Water Supply for Construction*

Private Fire Protection Systems

According to Section 6 of the *Water Works System By-law No. 23-235*:

- No Person shall install or maintain any part of a Private Fire Protection System other than in compliance with Applicable Law.
- No Person shall use any water from any Private Fire Protection System which is connected to the Water Distribution System, for any purpose other than fire fighting or maintenance of the Private Fire Protection System except on written authority from the General Manager of Public Works.
- (1) No Person shall relocate an existing Private Fire Hydrant without a Permit issued under this By-law and such relocation, including the design of the Private Fire Hydrant, is in compliance with Applicable Law.

  (2) The applicant shall pay all costs and expenses associated with the relocation of an existing Private Fire Hydrant, and the installation of a new Private Fire Hydrant, if required.

Special Agreements

According to *Water Works System By-law No. 23-235*:

- Agreements for Water Supply - Section 11.7
- Connection Where Land Not Directly Serviced - Section 4.13

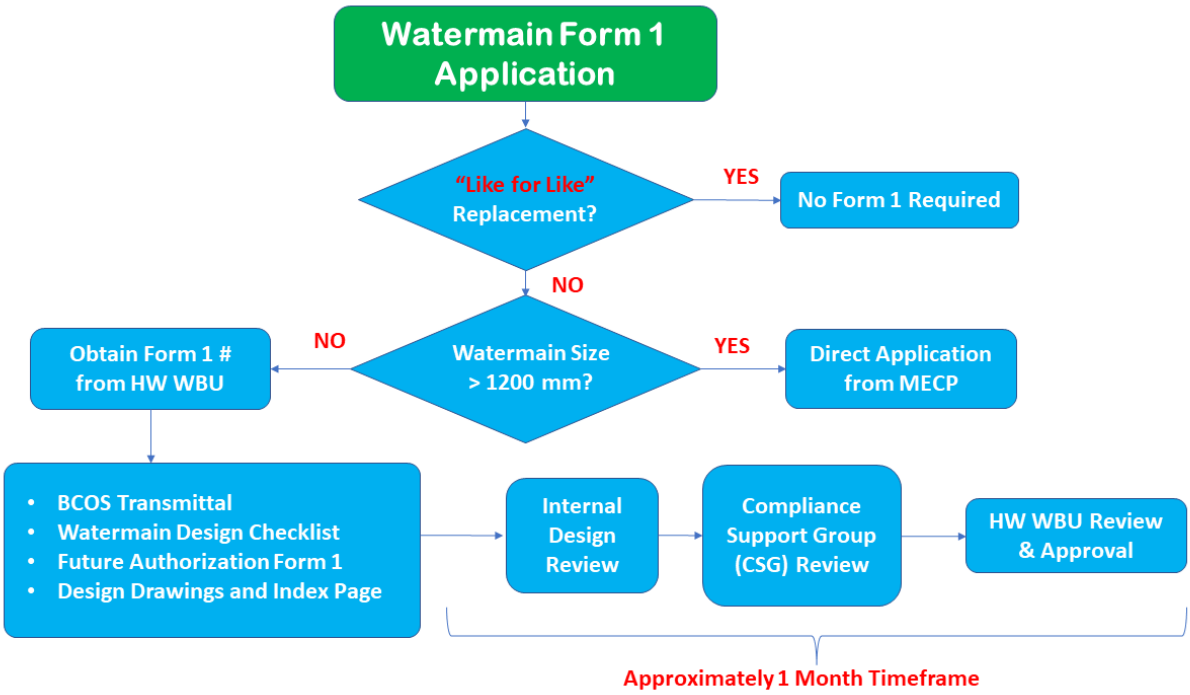
User Service Fees and Charges

User Service Fees and Charges shall be in accordance with the following:

- *CITY - By-Law No.15-058 - Building Permits*
  - Fees related to the processing of applications made in respect of building matters per Section 7 of the Building Code Act, 1992.
- *CITY - By-Law No.19-108 - Tariff of Planning and Growth Management*
  - Fees related to the processing of applications made in respect of planning matters per Section 69 of the Planning Act, R.S.O 1990, Chapter 13.
- *CITY - By-Law No.20-255 - Water and Wastewater/Storm*
  - User Service Fees and Charges related to the Discharge of Hauled Sewage and Overstrength.
- *CITY - Environmental Monitoring and Enforcement*
  - User Service Fees and Charges related to the Discharge of Hauled Sewage and Overstrength Discharges to Sewers.
- *CITY - Collection System Inspection and Maintenance*
  - User Service Fees and Charges related to staff Inspection, Investigation and Maintenance activities.
  - Sets maximum reimbursement rates available to an Owner in relation to the Sewer Lateral Management Program.
- *CITY - Water Distribution System*
  - User Service Fees and Charges related to Water Meters, Backflow Prevention, Hydrant Adaptors, Water Stations, Water Shut-offs and returns to service.
- *CITY - Wastewater Abatement*
  - User Service Fees and Charges related to the Wastewater Abatement (Credit) Program

Appendix WM4:
MECP Permit Application Process - Water

APPENDIX WM4: MECP PERMIT APPLICATION PROCESS – WATER



BCOS (FORM 1)

1. Eligibility Criteria: Modified watermain 150mm - 1200mm, not required Like for Like replacement.

2. Send to: Internal Design Review → Compliance and Regulations (CoH)

3. Documents to Includes:
   - BCOS Transmittal
   - Watermain Design Checklist
   - Future Authorization Form 1 (F1 - #Year - XXX, provided by Hamilton Water)
   - Design Drawings and Index Page

4. Timing Required: 1-month process

DIRECT APPLICATION (WATER)

1. Eligibility Criteria: Upsizing watermain larger than 1200mm, not required Like for Like replacement.

2. Send to: MECP Directly (Confirm Locations, Direct Sewer MECP has different location).

3. Documents to Includes:
    - MECP Direct Application Form (Drinking Water Works Permit and Municipal Drinking Water Licences)
    - Design Brief
    - Design Drawings and Index Page
    - Trunk Watermain Transient Analysis
    - Contract Watermain Specifications
    - Other support documents if required by MECP (e.g. NOC, EA)

4. Timing Required: 3-month process