
CONSTRUCTION AND MATERIALS SPECIFICATIONS MANUAL

REVISION # 8 – March 2018

NOTICE OF REVISION

March 14, 2018

Email Contact Information:

The City will only send notification of Manual revisions by email. If you would like to receive notifications of future revisions, send your email address to claudio.leon@hamilton.ca

Access to Hamilton Standards:

Each manual holder is responsible for determining implementation dates and directions for use of these revisions. It is recommended that you retain superseded versions of specifications for future reference.

All specifications and drawings are available free of charge online at the City of Hamilton website at:

<https://www.hamilton.ca/develop-property/policies-guidelines/construction-and-material-specifications>

Here you will find the latest versions of the published standards, archives of the previously published standards and Revision Information Sheets for currently published standards.

Hard-copy paper versions of the standards are available for a fee at our office located at:

Public Works Department – Reception
77 James Street North, Suite 320
Hamilton, Ontario, L8K 6E9
Call 905 546-2424, Ext. 4170.

Method of payment: Cash or company cheque payable to the City of Hamilton. Personal cheques must be certified.

Revisions to the Construction and Materials Specifications Manual:

Superseded / Cancelled (Remove)		Revised / New (Insert)		Comments
Document	Dated	Document	Dated	
Construction and Material Specification Manual Index	October 2017	Construction and Material Specification Manual Index	March 2018	Specification Dates Updated
Form 400, Specification for the Installation of Watermains	June 2017	Form 400, Specification for the Installation of Watermains	March 2018	Specification Revised
Form 800, Specification for Hot Mix Asphalt	October 2017	Form 800, Specification for Hot Mix Asphalt	March 2018	Specification Revised
Form 900, Specification for Standard Compaction Requirements	June 2017	Form 900, Specification for Standard Compaction Requirements	March 2018	Specification Revised
Approved Products List Section 1 - Watermains	June 2017	Approved Products List Section 1 - Watermains	March 2018	Updated
Approved Products List Section 2 - Sewers	June 2017	Approved Products List Section 2 - Sewers	March 2018	Updated
Approved Products List Section 5 – Parks Construction Products	June 2017	Approved Products List Section 5 – Parks Construction Products	March 2018	Updated
Standard Road Drawing Index	October 2017	Standard Road Drawing Index	March 2018	Updated
RD-124.03	October 2017	RD-124.03	March 2018	Drawing Revised

Revision Summaries:

These summaries are for information purposes and will highlight major or substantial changes only. Each revision and specification should be reviewed in its entirety.

Construction and Materials Specification Manual Index:

- References and specification dates updated.

Summary of Changes to Form 400 - Specification for the Installation of Watermains:

- Specification and standards references updated.

Section 400.20 – Hydrants – Revised to add the following:

Where the hydrant lead is longer than 5 metres, an additional gate valve shall be installed on the hydrant lead, at the main.

- Section 400.23.02 – Services – 100mm Diameter and Larger - Revised to add the following:
Long side services in excess of 5 metres shall have an additional gate valve installed on the service pipe at the main.
- Form 400 Appendix 'A'
 - Section 1.6 – Revised to add the following:
c) *Record of Watermain Break Form*
 - Section 2.5 – Disinfection of Watermains – Revised to add the Slug Method of Chlorination for the disinfection of Trunk/Transmission watermain.
 - Section 2.5.1 – Continuous-Feed Method of Chlorination – Revised upper limit of initial chlorine concentration to 120mg/L.
 - Section 2.7 – Bacteriological Sampling – Revised minimum time period between bacteriological sampling.
 - Section 4 – Water Services – Revised to delete requirement to disinfect water services less than 100mm.
 - Section 5 – Watermain Breaks – Revised to add the following:
The watermain break repair process is to be documented by completing a Record of Watermain Break Form attached to this document. A copy of the completed Form shall be sent to Hamilton Water Distribution.
 - Record of Watermain Break Form – Added.

Summary of Changes to Form 800 - Specification for Portland Cement Concrete:

- Specification and standards references updated.
- Section 800.02.01.06 – Asphalt Cement Requirements - Table 800-1 – Revised.
- Section 800.02.03.10 – Aggregate Gradation and Asphalt Cement Content Acceptance - Revised.
- Section 800.02.03.11 – Air Voids Acceptance for HMA Production - Revised.

Summary of Changes to Form 900 – Summary of Standard Compaction Requirements:

- Specification and standards references updated.
- Section 900.01 – Hot Mix Asphalt - Minimum Specified Compaction - Revised

Approved Products List Section 1 - Watermains

- List Updated

Approved Products List Section 2 - Sewers

- List Updated

Approved Products List Section 5 - Parks Construction Products

- List Updated

Standard Road Drawings:

- RD-124.03 – Details 10A iii – Dimensions Revised.

CONSTRUCTION AND MATERIAL SPECIFICATIONS MANUAL INDEX

<u>DATE</u>	<u>DESCRIPTION / TITLE</u>
<u>General Conditions</u>	
January 2011	Form 200 - General Conditions
June 2017	Form 300 - General Construction Requirements
<u>Standard Specifications</u>	
March 2018	Form 400 - Specification for the Installation of Watermains
June 2017	Form 500 - Specification for Sewer Pipe Materials and CCTV Inspection
June 2017	Form 600- Specification for Granular Fill Materials
June 2017	Form 700 - Specification for Portland Cement Concrete
March 2018	Form 800 - Specification for Hot Mix Asphalt
March 2018	Form 900 - Specification for Standard Compaction Requirements
June 2017	Form 1000 - Amendments to Ontario Provincial Standards
<u>Approved Products List</u>	
March 2018	Section 1 – Watermains
March 2018	Section 2 – Sewers
June 2017	Section 3 – Street Lighting
June 2017	Section 4 – Traffic Signals
March 2018	Section 5 – Parks Construction Products
<u>Standard Drawings</u>	
March 2018	RD Standard Road Drawings
June 2017	WM Standard Watermain Drawings
January 2011	SEW Standard Sewer Drawings
June 2006	PK Standard Park Drawings
March 2018	

TABLE OF CONTENTS

.01	SCOPE
.01.01	General
.01.02	Work Included
.02	RESPONSIBILITY FOR MATERIAL
.02.01	Material Furnished by the Contractor
.02.02	Material Furnished by the City
.02.03	Safe Storage
.02.04	Replacement of Damaged Material
.02.05	Disposition of Defective Material
.03	HANDLING OF MATERIAL
.03.01	Loading and Unloading
.03.02	Transporting, Unloading, Storing and Handling Pipe
.04	APPROVED WATERMAIN MATERIALS
.05	DUCTILE IRON PIPE WATERMAIN
.05.01	Ductile Iron Pipe Watermain – 100mm to 300mm
.05.01.01	Polyethylene Encasement of Ductile Iron Watermain
.05.02	Ductile Iron Pipe Watermain – 400mm and larger
.05.02.01	Submissions
.06	CONCRETE PRESSURE PIPE WATERMAIN (500mm and Larger)
.06.01	Submissions
.07	POLYVINYL CHLORIDE (PVC) PIPE WATERMAIN
.07.01	Polyvinyl Chloride (PVC) Pipe Watermain – 100mm to 300mm
.07.01.01	Service Connection Fittings and Appurtenances – PVC Pipe
.07.02	Polyvinyl Chloride (PVC) Pipe Watermain – 400mm to 750mm
.07.02.01	Submissions
.07.03	Installation of Pipes
.07.04	Jointing Polyvinyl Chloride (PVC) Pressure Pipe
.07.05	Changes in Line and Grade
.07.06	Polyvinyl Chloride (PVC) Pipe - Cathodic Protection
.08	TRUNK WATERMAIN DESIGN AND OPERATING PARAMETERS – 400mm AND LARGER
.09	VALVE CHAMBERS
.09.01	Chambers
.09.02	Valve Chamber Piping
.09.03	Ductile Iron
.09.04	Concrete Pressure Pipe
.09.05	Chamber Fittings
.09.06	Bolts
.09.07	Design
.09.08	Submissions

.10	VALVES
.10.01	Gate Valves
.10.02	Butterfly Valves
.10.03	Air Release and Vacuum Valves
.11	TRACER WIRE AND CONDUCTIVITY TESTING
.11.01	Tracer Wire
.11.02	Conductivity Testing
.12	TEMPORARY WATER SERVICE BY-PASS FOR CONSUMERS
.12.01	Submissions
.12.02	General Description
.12.03	By-Pass Pipe and Materials
.12.04	Service of Water to Feed By-Pass
.12.05	Temporary Connection to Customer
.12.06	Disinfection of Temporary Service Connections
.13	EXCAVATION AND PREPARATION OF TRENCH
.13.01	General
.13.02	Alignment and Grade
.13.03	Excavation to Grade
.13.04	Excavation in Poor Soil
.13.05	Excavation in Rock
.13.06	Preparation of Trench Bottom
.13.07	Preparation of Trench Bottom Below Grade
.13.08	Care of Surface and Excavated Material for Reuse
.13.09	Piling Excavated Material
.13.10	Interruption of Service, Shutting Down or Charging of Mains
.14	BEDDING AND BACKFILL OF WATERMAINS
.14.01	General
.14.02	Bedding
.14.03	Backfill
.14.04	Summary of Bedding and Backfill Materials
.14.04.01	Ductile Iron and Polyvinyl Chloride (PVC) Pipe Watermain
.14.04.02	Concrete Pressure Pipe Watermain
.14.04.03	Water Services
.14.04.04	Hydrants
.15	LAYING
.15.01	Laying Pipe
.15.02	Cutting Iron Pipe
.16	JOINTING MECHANICAL-JOINT PIPE
.16.01	Assembling Joint
.16.02	Bolting of Joint
.16.03	Permissible Deflection in Mechanical-Joint Pipe

- .17 JOINTING STEEL CYLINDER REINFORCED CONCRETE PIPE**

- .18 JOINTING TYTON-JOINT PIPE**
 - .18.01 Cleaning and Assembling Joint
 - .18.02 Preparation of Spigot on Site
 - .18.03 Electrical Conductors
 - .18.04 Permissible Deflection in Tyton-Joint Pipe
 - .18.05 Jointing Flange Pipe

- .19 SETTING VALVES AND FITTINGS**
 - .19.01 Valve Boxes
 - .19.02 Drainage of Mains
 - .19.03 Dead Ends

- .20 HYDRANTS**

- .21 BACKFLOW PREVENTERS**

- .22 ANCHORAGE**
 - .22.01 Anchorage for Fittings
 - .22.02 Metal Harness

- .23 WATER SERVICES**
 - .23.01 Services -19mm and 50mm Diameter
 - .23.02 Services - 100mm Diameter and Larger
 - .23.03 Curb Boxes
 - .23.04 Trench for Water Service
 - .23.05 Laying Water Service Pipe
 - .23.06 Leaks in Services

- .24 CONCRETE AND MORTAR**
 - .24.01 Materials
 - .24.02 Proportioning and Mixing of Mortars
 - .24.03 Jointing Old and New Work
 - .24.04 Placing in Water
 - .24.05 Forms
 - .24.06 Form Removal
 - .24.07 Curing of Concrete
 - .24.08 Finish
 - .24.09 Defects
 - .24.10 Reinforcing Steel

- .25 DISINFECTION, TESTING AND CONNECTION OF WATERMAINS**

APPENDICES

- 400 A PROCEDURE FOR THE DISINFECTION, TESTING AND CONNECTION OF WATERMAINS**

.01 SCOPE**.01.01 General**

This Specification covers the requirements for the installation of ductile iron, polyvinyl chloride, concrete and steel water mains. All water mains and water services shall be supplied and installed in accordance with OPSS.MUNI 441 – Construction Specification for Watermain Installation in Open Cut, as amended by this specification.

.01.02 Work Included

The Contractor shall, unless specified otherwise, furnish all equipment, tools and labour necessary to do the Work required under this Contract and unload, haul and distribute all pipe, fittings, valves, hydrants and accessories. The Contractor shall also remove the pavement as stipulated; excavate the trenches and pits to the required dimensions; excavate the bell holes; construct and maintain all bridges for traffic control; sheet, brace and support the adjoining ground structure where necessary; handle all drainage or ground water; provide barricades, guards and warning lights; lay and test the pipe, fittings, valves, hydrants and accessories; backfill and consolidate trenches and pits; restore roadway surface, unless otherwise stipulated; remove and dispose of surplus excavated materials as directed; clean the site of the Work; and maintain the street or other surface over trenches as specified.

.02 RESPONSIBILITY FOR MATERIAL**.02.01 Material Furnished by the Contractor**

Unless otherwise noted in the Contract Documents, the Contractor shall supply all materials required to complete the Works. This will include but not be limited to:

- a) The proposed watermain pipe(s) complete with all valves, connections, fittings, special appurtenances, thrust blocks, anchor blocks, tee's, bends, sleeves, and all lowerings in accordance with the elevations and grades shown on the Contract Drawings.
- b) Water for testing and disinfection shall be supplied by the Contractor from a location corresponding to the appropriate Drinking Water System. Hydrant usage will require the necessary permit and meterage charges. The Contractor shall be responsible for the transportation of this water from source of supply to point of use.
- c) The Contractor shall be responsible for all material furnished by them and shall replace all such material found defective in manufacture or damaged in handling after delivery by the manufacturer. This shall include the furnishing of all material and labour required for the replacement of installed material discovered defective prior to the final acceptance of the Work.
- d) In addition to Form 200.04.06, all materials supplied by the Contractor shall be in accordance with the applicable current Approved Products List or Contract specification. Any material used that is not approved or not appropriate shall be

removed and replaced by the Contractor at no cost to the City.

.02.02 Material Furnished by the City

Where the Contract Documents or Drawings indicate that the City will supply materials, the Contractor shall pick-up the required materials at the designated location and haul such materials to the site as required.

The Contractor's responsibility for material furnished by the City shall begin F.O.B. at the point of delivery to the Contractor. Materials already on the site shall become the Contractor's responsibility on the day of the execution of the Contract. The Contractor shall examine all material furnished by the City at the time and place of delivery to and shall reject all defective material.

.02.03 Safe Storage

The Contractor shall be responsible for the safe storage of material supplied by or to them and accepted by them and intended for the Work, until it has been incorporated in the completed project. The interior of all pipe, fittings and other accessories shall be kept free from dirt and foreign matter at all times. Valves and hydrants shall be drained and stored in a manner that will protect them from damage by freezing.

.02.04 Replacement of Damaged Material

Any material furnished by the City that becomes damaged after acceptance by the Contractor shall be replaced by the Contractor.

.02.05 Disposition of Defective Material

Prior to acceptance of responsibility for safe storage by the Contractor under Form 400.02.03, any material furnished by the City found to be defective shall be set aside and removed from the site or the Work by the City. All defective materials furnished by the Contractor shall be promptly removed by from the site.

.03 HANDLING OF MATERIAL

.03.01 Loading and Unloading

All pipe fittings, pipe, valves, hydrants, and accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall such materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.

.03.02 Transporting, Unloading, Storing and Handling Pipe

All pipe up to and including 600mm shall be delivered to the site with end covers and tamper evident seals in accordance with OPSS.MUNI 441.07.07.

.04 APPROVED WATERMAIN MATERIALS

All watermain pipe, fittings and other materials shall be as listed on the Approved Products List, as amended. Materials shall meet the current version of the applicable standards, including but not limited to CSA, ASTM, ANSI/AWWA, NSF Standard 61 and OPSS.

Acceptable pipe materials are ductile iron, polyvinyl chloride and concrete pressure pipe. Steel Pipe is acceptable in project specific applications only.

OPSS.MUNI 441.05.02	Ductile Iron Pipe – acceptable. Refer to Form 400.05.
OPSS.MUNI 441.05.03	Concrete Pressure Pipe – acceptable. Refer to Form 400.06.
OPSS.MUNI 441.05.04	Polyvinyl Chloride Pipe – acceptable. Refer to Form 400.07.
OPSS.MUNI 441.05.04.03	Molecularly Oriented Polyvinyl Chloride Pipe (PVCO) – acceptable. Refer to Form 400.07.01.
OPSS.MUNI 441.05.05	Polyethylene Pipe - not acceptable.
OPSS.MUNI 441.05.06	Steel Pipe – acceptable for special projects only per the Contract Documents.
OPSS.MUNI 441.05.07	Copper Pipe – acceptable. Refer to Form 400.23.
OPSS.MUNI 441.05.08	Composite Pipe - not acceptable.

.05 DUCTILE IRON PIPE WATERMAIN

All watermain materials shall be in accordance with AWWA C104, C105, C110, OPSS.MUNI 441, this specification and be selected from the Approved Products List, latest version.

.05.01 Ductile Iron Pipe Watermain – 100mm, 150mm, 200mm and 300mm

Ductile iron pipe shall be Pressure Class 350, cement lined, Tyton joint, for 300mm and smaller pipe as per OPSS.MUNI 441.05.02 with cement lined fittings.

All pipe and mechanical joints of pipe shall be protected by Polyethylene Encasement in accordance with this specification and the manufacturer's recommendation. Field cut pipe shall be kept to a minimum.

Anchor blocks and joint restraint shall be used at all fittings. Anchor blocks shall be constructed in accordance with the Contract Drawings and standard watermain drawings. Joint restraint shall be selected from the Approved Products List and

installed in accordance with the following:

All fittings and valves shall be restrained for a minimum of 18m in each direction.

All fittings at dead ends shall be restrained for a minimum of 18m.

All watermain joints and fittings within areas of engineered fill shall be restrained.

Joint restraints shall be installed in strict accordance with the manufacturer's specifications and recommendations.

All fittings on all water services 100mm or greater shall be restrained from the main to the service valve at the property line.

The connection of any proposed watermain or water service with a diameter equal to that of the existing watermain shall only be made using a manufactured "Tee".

All proposed or replacement water services, 100mm or larger, shall be constructed using a pipe material that is the same as the watermain material.

.05.01.01 Polyethylene Encasement of Ductile Iron Watermain

Polyethylene encasement shall be in accordance with ANSI/AWWA C105/A21.5 and the following:

- (i) Material to be Low Density, polyethylene film having a nominal thickness of 8 mil (.008 inch) in accordance with ANSI/AWWA C105/A21.5, Section 4.1.2.3
- (ii) Installation Method "A" only to be used. (Poly-Tube with overlap - No sheets)
- (iii) Direct service connection tapping through triple polyethylene adhesive tape & the polyethylene film is to be used for all service taps.
- (iv) Junctions between wrapped & existing unwrapped pipe - polyethylene wrap is to cover the adjacent pipe for a distance of at least 0.9m. Secure the end with sufficient circumferential turns of tape.
- (v) Attached service lines of dissimilar metals shall be wrapped with polyethylene or suitable dielectric tape for a minimum clear distance of 0.9m away from the ductile iron pipe.

.05.02 Ductile Iron Pipe Watermain – 400mm and Larger

All ductile iron watermain shall be designed in accordance with the Trunk Watermain Design and Construction Parameters given in Form 400.08.

Pipe shall be Class 52, ductile iron cement lined, with Tyton and/or restrained Joints as per OPSS.MUNI 441.05.02, with cement lined fittings. All pipe and mechanical joints of pipe shall be protected with Polyethylene Encasement in accordance with this specification and the manufacturer's recommendation. Field cut pipe shall be kept to a minimum.

Anchor blocks and joint restraint shall be used at all fittings in accordance with the City's standard drawings and Contract Documents.

Restrained Mechanical Joint for ductile iron pipe will be required at all fittings and for suitable length as recommended by the Supplier. Restraint shall be selected from the Approved Products List and shall be installed in strict accordance with the manufacturer's specifications and recommendations. Joints alone shall be capable of withstanding thrust up to 150psi test pressure.

All watermain joints and fittings within areas of engineered fill shall be restrained.

The maximum permissible joint deflection shall be less than or equal to 50% of the values recommended by the manufacturer.

Polyethylene encasement shall be in accordance with ANSI/AWWA C105/A21.5 and as described in subsection .05.01.01.

Closure pipe shall consist of Restrained Mechanical Joint Fittings and Solid Sleeve.

All dead ends on watermain shall be closed with cast iron plugs/caps or bulkheads that are adequately restrained for pressure testing and provided with a 50mm corporation main stop.

The connection of any proposed watermain or water service with a diameter equal to that of the existing watermain shall only be made using a manufactured "Tee".

.05.02.01 Submissions

The Contractor shall supply 2 copies of the following information to the Project Manager prior to installing any pipe:

- a) Letter confirming that the proposed pipe material, fittings and restraint are designed to operate as a complete system that meets all specified watermain design and operating parameters.
- b) Pipe layout drawings and schedules showing the location and type of all pipe, fittings, restrained lengths, valves, method of restraint, location and size of all anchor blocks;
- c) Drawings showing the proposed location of all valve chambers, including detailed dimensions and a listing of all internal components.
- d) Where the City has provided a standard valve chamber drawing (WM series) or Contract Drawing stamped by a Professional Engineer, the Contractor shall construct all valve chambers in accordance with the drawing provided. Any variations to the approved drawing will require a revised stamped valve chamber drawing submission by the Contractor.
- e) All submissions shall be stamped by an Engineer licensed by Professional Engineers Ontario (PEO) to practice in the Province of Ontario.

.06 CONCRETE PRESSURE PIPE WATERMAIN (500mm and Larger)

All concrete watermain shall be in accordance with AWWA C301 and/or C303, OPSS.MUNI 441, this specification and be selected from the Approved Products List, latest version. Non-cylinder pipe is not permitted.

400mm concrete pressure pipe will only be permitted for short repair sections or where specifically approved for use by the City. All concrete watermain shall be designed in accordance with the Trunk Watermain Design and Construction Parameters given in Form 400.08.

Restrained Joint Concrete Pressure Pipe will be required at all fittings and for suitable length as recommended by the manufacturer. Joints alone shall be capable of withstanding thrust up to 150psi test pressure. Joint restraint shall be in accordance with the manufacturer's recommendations. Welded joints will not be permitted.

All watermain joints and fittings within areas of engineered fill shall be restrained.

Joint restraints shall be installed in strict accordance with the manufacturer's specifications and recommendations.

Anchor blocks and joint restraint shall be used at all fittings in accordance with the City's standard drawings and Contract Documents.

Tracer wire shall be installed on concrete pressure pipe shall be light coloured, plastic coated and strapped to the pipe at 6m intervals and in accordance with Form 400.11.

Closure pipe shall consist of two lengths of pipe with a dresser coupling. The lengths of pipe shall be made to lengths measured in the pipe trench by the Contractor.

The maximum permissible joint deflection shall be less than or equal to 50% of the values recommended by the manufacturer.

.06.01 Submissions

The Contractor shall supply 2 copies of the following information to the Project Manager prior to installing any pipe:

- a) Letter confirming that the proposed pipe material, fittings and restraint are designed to operate as a complete system that meets all specified watermain design and operating parameters.
- b) Pipe layout drawings and schedules showing the location and type of all pipe, fittings, restrained lengths, valves, method of restraint, location and size of all anchor blocks;
- c) Drawings showing the proposed location of all valve chambers, including detailed dimensions and a listing of all internal components.

- d) Where the City has provided a standard valve chamber drawing (WM series) or Contract Drawing stamped by a Professional Engineer, the Contractor shall construct all valve chambers in accordance with the drawing provided. Any variations to the approved drawing will require a revised stamped valve chamber drawing submission by the Contractor.
- e) All submissions shall be stamped by an Engineer licensed by Professional Engineers Ontario (PEO) to practice in the Province of Ontario.

.07 POLYVINYL CHLORIDE (PVC) PIPE WATERMAIN

All PVC watermain shall be in accordance with OPSS.MUNI 441, AWWA C605, C900, C907, C909, this specification and be selected from the Approved Products List, latest version.

.07.01 Polyvinyl Chloride (PVC) Pipe – 100mm, 150mm, 200mm and 300mm

Pipe shall be in accordance with OPSS.MUNI 441.05.04, and the following:

OPSS.MUNI 441.05.04 Polyvinyl Chloride Plastic Pipe Products

PVC pipe in sizes 100mm, 150mm, 200mm and 300mm shall have cast iron outside diameters (CIOD) in all sizes. Pipe shall be joined by means of integral elastomeric-gasket joints conforming to ASTM D3139. Acceptable PVC materials are as follows:

- a) Polyvinyl chloride pipe (PVC) Class 235, DR18 conforming to AWWA C900 and CSA B137.3;
- b) Molecularly oriented polyvinyl chloride (PVCO), Pressure Class 235 (PC235) conforming to AWWA C909.

Fittings for 100mm, 150mm and 200mm PVC pipe shall be injection molded PVC conforming to AWWA C907. Fittings for 300mm shall be manufactured from segments of AWWA C900 PVC pipe, bonded together and over-wrapped with fibreglass-reinforced polyester to meet the requirements of CSA B137.3.

Where metal fittings are used on PVC mains, protective coatings (primer, mastic and tape) and cathodic protection must be installed to the satisfaction of the Project Manager.

Anchor blocks and joint restraint shall be used at all fittings. Anchor blocks shall be constructed in accordance with the Contract Drawings and standard watermain drawings (WM series). Joint restraint shall be selected from the Approved Products List and installed in accordance with the following:

All fittings and valves shall be restrained for a minimum of 18m in each direction.

All fittings at dead ends shall be restrained for a minimum of 18m.

All watermain joints and fittings within areas of engineered fill shall be restrained.

Joint restraints shall be installed in strict accordance with the manufacturer's specifications and recommendations.

All fittings on all water services 100mm or greater shall be restrained from the main to the service valve at the property line.

The connection of any proposed watermain or water service with a diameter equal to that of the existing watermain shall only be made using a manufactured "Tee".

.07.01.01 Service Connection Fittings and Appurtenances – PVC Pipe

OPSS.MUNI 441.05.12 Service Connection Fittings and Appurtenances

Add the following:

Service connections to 100mm, 150mm and 200mm PVC mains shall be made by using PVC molded tapped couplings, conforming to AWWA C907 and CSA B137.2, or using service saddles selected from the Approved Products List.

The connection of any proposed watermain or water service with a diameter equal to that of the existing watermain shall only be made using a manufactured "Tee".

All proposed or replacement water services, 100mm or larger, shall be constructed using a pipe material that is the same as the watermain material.

.07.02 Polyvinyl Chloride (PVC) Pipe – 400mm to 750mm

All PVC watermain 400mm to 750mm shall be designed in accordance with the Trunk Watermain Design and Construction Parameters given in Form 400.08.

OPSS.MUNI 441.05.04 Polyvinyl Chloride Pipe

Revised as follows:

PVC pipe in sizes 400mm to 750mm shall conform to AWWA C900 and shall be designed according to AWWA Manual M23: PVC Pipe-Design and Installation, 2nd Edition. All 400mm pipe shall be DR18. Joints alone shall be capable of withstanding thrust up to 150psi test pressure.

Fittings for 400mm through 750mm PVC pipe shall be manufactured from segments of AWWA C900 PVC pipe, bonded together and over-wrapped with fibreglass-reinforced polyester to meet the requirements of CSA B137.3.

Where metal fittings are used on PVC mains, protective coatings (primer, mastic and tape) and cathodic protection must be installed to the satisfaction of the Project Manager.

Joint restraint will be required at all fittings and for suitable lengths as recommended by the manufacturer. Joint restraint shall be selected from the Approved Products List and installed in strict accordance with the manufacturer's recommendations.

Anchor blocks and joint restraint shall be used at all fittings in accordance with the City's standard drawings and Contract Documents.

All watermain joints and fittings within areas of engineered fill shall be restrained.

The connection of any proposed watermain or water service with a diameter equal to that of the existing watermain shall only be made using a manufactured "Tee".

.07.02.01 Submissions

The Contractor shall supply 2 copies of the following information to the Project Manager prior to installing any pipe:

- a) Letter confirming that the proposed pipe material, fittings and restraint are designed to operate as a complete system that meets all specified watermain design and operating parameters.
- b) Pipe layout drawings and schedules showing the location and type of all pipe, fittings, restrained lengths, valves, method of restraint, location and size of all anchor blocks;
- c) Drawings showing the proposed location of all valve chambers, including detailed dimensions and a listing of all internal components.
- d) Where the City has provided a standard valve chamber drawing (WM series) or Contract Drawing stamped by a Professional Engineer, the Contractor shall construct all valve chambers in accordance with the drawing provided. Any variations to the approved drawing will require a revised stamped valve chamber drawing submission by the Contractor.
- e) All submissions shall be stamped by an Engineer licensed by Professional Engineers Ontario (PEO) to practice in the Province of Ontario.

.07.03 Installation of Pipes

OPSS.MUNI 441.07.14 Installation of Pipe

Add the following:

Excavation and Preparation of Trench shall be completed in accordance with the manufacturers recommendations and AWWA C605.

.07.04 Jointing Polyvinyl Chloride (PVC) Pressure Pipe

OPSS.MUNI 441.07.15.04 Polyvinyl Chloride Pressure Pipe – PVC and PVCO

Add the following:

PVC pipe shall be laid in accordance with AWWA C605. Pipe deflection shall be in accordance with subsection .07.05 Changes in Line and Grade.

Bell and Spigot Joints

The pipe shall be jointed in accordance with AWWA C605 and the manufacturer's specifications. If elastomeric gaskets are supplied separately, they shall be inserted into the groove of the bell end of the pipe.

Lubricant for gaskets shall conform to pipe manufacturers recommendations and shall be NSF-61 approved. Clean the gasket, the bell, the groove area and the spigot area with a clean rag to remove any dirt or foreign material before assembling. Insert the gasket into the groove and seal it firmly. Apply lubricant, as provided by the manufacturer, to the beveled spigot end. Push the lubricated end past the gasket into the bell until the reference mark is even with the bell.

.07.05 Changes in Line and Grade

OPSS.MUNI 441.07.17 Change in Line and Grade

Add the following:

All pipe joint deflections shall be less than or equal to 50% of the values recommended by the manufacturer. No deflection of the pipe barrel for changes in line or grade are permitted.

.07.06 Polyvinyl Chloride (PVC) Pipe - Cathodic Protection

The following are minimum requirements. Specific soil conditions may require changes to the cathodic protection system. The installation and placement of anodes and tracer wires shall be in accordance with OPSD 1109.011 and the following:

Cathodic protection shall be provided for all tracer wires on PVC watermain pipes. One (1) 5.4kg zinc anode will be provided for every 1000m tracer wire.

One (1) 5.4kg zinc anode is to be installed on all copper service connections, by means of a service ground clamp, coated with T.C. Mastic or wrapped with "Scotchfill" electrical putty or approved equal. The anode is to be placed at least 1.0m away from the water service and as deep as the service and within 1.0m of the curb stop.

One (1) 10.8kg zinc anode is to be installed on each hydrant. If PVC pipe is used between the hydrant tee and the hydrant boot, two (2) 10.8 kg zinc anodes shall be used.

One (1) 5.4kg zinc anode is to be installed on every line valve, and every metallic fitting connected to a PVC watermain. Fittings include bends, tees, crosses, sleeves, reducers, plugs, caps and couplings.

One (1) 14.5kg magnesium anode is to be connected to the first length of an existing metallic watermain pipe when connected to a new PVC watermain.

All sacrificial zinc anodes shall conform to ASTM B-418 Type II and shall be made of high grade electrolytic zinc, 99.99 % pure. Magnesium anodes shall

conform to ASTM B-107-Type M1.

For all anodes connected to new pipe, fittings or to existing metallic water mains, a Cadwelder and CA-15 or equivalent cartridge shall be used. All thermite weld connections to be coated with T.C. Mastic (Tapecoat of Canada), Roybond 747 Primer and Royston "Handy Cap" or approved equal.

Contractors are advised that there is no specific pay item for Cathodic Protection; all costs shall be included in all other appropriate items.

.08 TRUNK WATERMAIN DESIGN AND OPERATING PARAMETERS – 400mm AND LARGER

All trunk water mains shall be in accordance with the following requirements:

The pipe manufacturer shall calculate the joint restraint required based on the trench width, cover over the pipe, bedding and pressures indicated in this specification and on the Contract Drawings.

Water mains, fittings and restraint shall be designed and constructed for operation under the following parameters:

Design / Field Test Pressure	Working Pressure	Surge Pressure (Additional)	Additional External Loads
150psi	100psi	100psi	Hwy. H-20 S16

- a) The factor of safety for pipe and fitting restraint shall be 2 times the design / field test pressure (300psi).
- b) Pipe joints alone shall be capable of withstanding 150psi test pressure.
- c) Trench Type 5 shall be used.
- d) Proposed joint restraint shall be able to accommodate all operating, test and surge pressures independent of anchor blocks.
- e) Anchor blocks will be required in addition to joint restraint.
- f) All restrained joints shall be installed in strict accordance with the manufacturer's specifications and recommendations and shall include appropriate corrosion protection.
- g) Depth of bury shall be a maximum of 1.6m to top of pipe or less. Where drawings or documents indicate depth of bury less than 1.6m to top of pipe, that value will be used.

.09 VALVE CHAMBERS**.09.01 Chambers**

Valve chambers shall be in accordance with OPSS.MUNI 402, OPSS 1351, City standards and Contract Drawings. Chambers shall be capable of withstanding the required thrust forces and be selected from the Approved Products List.

Pre-cast chambers shall be supplied from a plant listed as Prequalified under the Plant Prequalification Program by the Ontario Concrete Pipe Association.

.09.02 Valve Chamber Piping

Chamber piping materials shall be ductile iron or concrete pressure pipe in accordance with the following:

.09.03 Ductile Iron

Ductile Iron Pipe shall be a minimum of Class 54, conform to AWWA C151 and be cement lined as per AWWA C104.

.09.04 Concrete Pressure Pipe

Prestressed Concrete Cylinder Pipe shall conform to AWWA C301.

.09.05 Chamber Fittings

Ductile Iron Fittings shall conform to AWWA C110.

Prestressed Concrete Cylinder Pipe shall conform to AWWA C301.

.09.06 Bolts

All nuts, bolts and washers shall be stainless steel. Bolt size, type and diameter shall be in accordance to AWWA C207. Bolt length shall be sufficient to accommodate flanges, gaskets and insulators. Protective coatings (primer, mastic and tape) shall be applied to all nuts and bolts inside chambers.

.09.07 Design

All pipe and fittings shall be designed to the values given in the Trunk Watermain Design and Operating Parameters – 400mm and Larger, subsection 400.08.

.09.08 Submissions

The following shall be in addition to the trunk watermain requirements outlined in Form 400, Sections .05.02.01, .06.01 or .07.02.01. The following information shall be submitted prior to ordering or installing any chamber components:

- a) Shop drawings, specifications and data sheets for all pipe specials;
- b) Valve type, catalogue data, actuator type (with input and output torque ratings), principal dimensions, schedule of parts and materials and expected

time of delivery;

- c) Layout drawings showing all chamber pipe and internal components. Itemized listing of chamber components including model names, numbers and all dimensions.

.10 VALVES

OPSS.MUNI 441.05.09 Valves

All valves shall be selected from the Approved Products List or as specified in the Contract Documents.

OPSS.MUNI 441.05.09.01 General

Revised as follows:

Valve types shall be in accordance with the following:

- a) All gate and butterfly valves installed within the boundaries of the former City of Hamilton are to be open right (clockwise), with the City's 25mm standard operating nut WM-203.04.
- b) All gate and butterfly valves in the remainder of the new City are to open left (counter clock-wise), with the City's 50mm operating nut.

The remainder of the new City of Hamilton shall be defined as the former municipalities of Ancaster, Dundas, Flamborough, Glanbrook and Stoney Creek.

- c) Track and roller option required for horizontal position valves.
- d) Bell end valves not acceptable.
- e) Fasteners including nuts, bolts and bolt studs shall be stainless steel.

.10.01 Gate Valves

OPSS.MUNI 441.05.09.03 Gate Valves

Add the following:

Valves 75mm to 400mm shall be ductile iron gate valves.

.10.02 Butterfly Valves

OPSS.MUNI 441.05.09.04 Butterfly Valves

Add the following:

- a) Valves greater than 400mm shall be butterfly valves selected from the Approved Products List.

- b) Torque ratings shall be as specified by the City. Contractor shall supply detailed actuator information upon request.
- c) Butterfly valves shall be installed so that the valve seat adjustment faces the spool piece side.

.10.03 Air Release and Vacuum Valves

OPSS.MUNI 441.05.09.05 Air Release and Air/Vacuum Valve

Revised as follows:

Air release and air/vacuum valves shall be double acting type selected from the Approved Products List.

.11 TRACER WIRE AND CONDUCTIVITY TESTING

.11.01 Tracer Wire

Tracer wire shall be installed on all new installations of polyvinyl chloride and concrete pressure pipe including mains, branches and services. The wire shall be positioned along the top of the pipe and fastened at 6 metre intervals. Tracer wire shall be as listed on the Approved Products List.

The wire is to be installed between each valve and/or the end of the new watermain. Joints in the wire between valves shall be avoided. At each valve and hydrant secondary valve, the tracer wire loop shall be brought up the outside of the valve box and inserted into the tracer wire opening in the upper section. Insertion point shall be clear of the lid and use a protective grommet. Tracer wire shall be secured to the outside of the valve box near the top prior to backfilling. The tracer wire shall also be connected to the cathodic protection system as required.

Splices in tracer wire shall be done using a splice kit approved for use in direct bury underground use.

.11.02 Conductivity testing

The Contractor will be required to conduct all tracer wire conductivity testing to ensure that the tracer wire is installed correctly and intact. Testing shall be conducted by authorized personnel using approved testing equipment and shall be supervised by the Contract Inspector or Project Manager. No payments for watermain works shall be processed until tracer wire testing is completed and accepted by the City. All costs for conductivity tests shall be included in the watermain item. If the tracer wire is not electrically continuous from valve to valve, the Contractor shall, at their expense, replace or repair the wire as required.

.12 TEMPORARY WATER SERVICE BY-PASS FOR CONSUMERS

Where called for or where needed, the Contractor shall provide, maintain and remove by-pass piping in accordance with OPSS 493, Appendix A attached to this specification and the following requirements.

12.01 Submissions

In order to evaluate the impact on the water network as a whole and the ability of the by-pass pipe to provide the volumes and flows required, the Contractor shall provide the proposed by-pass system layout proposal to the Project Manager for review and written approval. The Contractor shall not commence the installation of any by-pass materials in the absence of such written approval.

The Contractor will be required to revise the by-pass system and construction staging per the conditions provided in the written approval and shall provide revised drawings.

The Contractor shall have no basis for increased working time due to these requirements, revisions and/or conditions and all associated costs will be deemed to be included in the unit prices bid.

The Contractor shall supply 3 prints of the by-pass proposal a minimum of 3 weeks in advance of installation. Drawings of the system(s) being proposed shall be 1:500 metric scale (hard copy and PDF format) will be submitted to the Project Manager for approval. The Contractor shall provide By-pass Piping Submissions, for all phases of the bypass installation, in accordance with Form 400 and the following requirements.

- a) construction staging
- b) pipe sizes, manufacturer and material
- c) by-pass connection points/details
- d) back flow preventer size, location and manufacturer
- e) temporary hydrants connection points
- f) water services connection points
- g) horizontal location of the by-pass pipe in the road allowance
- h) locations and the materials used to ramp over the by-pass pipe
- i) locations where by-pass pipe is to be buried and the associated temporary restoration.

.12.02 General Description

Temporary by-pass pipe, where required, shall be laid above ground to supply water to consumers connected to a pipeline while that pipeline is out of service. An approved back-flow preventer shall be used by the Contractor whenever connecting to a hydrant.

Temporary by-pass shall include hoses and the necessary outlet/fittings to each house service connection. The Contractor shall maintain the temporary water lines in safe operating condition at all times. The Contractor shall be required to

mound over the by-pass wherever it crosses a street, driveway, or sidewalk, in order to prevent injury to vehicular and pedestrian traffic. Lights and barricades shall be furnished and maintained by the Contractor when required by the Project Manager. When a replaced section of watermain is restored to service, the Contractor shall remove any corresponding temporary pipe and house service connection and shall leave the street, sidewalk and adjacent property in a neat and orderly condition.

.12.03 By-Pass Pipe and Materials

The size, pipe, hose and other materials furnished by the Contractor for the temporary service pipe and connections to house services/branches, shall be approved by the Project Manager and be fully adequate to withstand the indicated pressures and all other conditions of use. The pipe and fittings shall provide adequate water tightness and be disinfected prior to being put into service.

.12.04 Service of Water to Feed By-Pass

The Contractor shall furnish all above and below ground connections required to provide the necessary pressurized water to feed the temporary by-pass line. All connections shall be at reasonably close and convenient locations and hydrants will be used whenever available.

.12.05 Temporary Connection to Customer

The Contractor shall make all shut-offs of consumers services and the final connections from the by-pass pipe to the consumer using flexible hose. Special connections requiring excavation, cutting or tapping shall be made by the Contractor. The Contractor shall notify the customer concerning this operation in advance. When the pipeline has been replaced, the Contractor shall clean the service by back-flushing with air or water. Once the pipeline is returned to service, the Contractor shall restore the consumer to service and disconnect the hose from the consumer connection. Where admittance to the customer's premises is denied or impossible, by virtue of absence, the connection cannot be cleared, it may be necessary to excavate and clear the service at the main. This shall be paid for on a unit price basis stated in the Form of Tender - Schedule of Quantities and Prices.

Where 100mm diameter Temporary Connections to the Consumers are called for, the length of the 100mm diameter piping required will be paid at the unit price for 100mm diameter Temporary By-Pass Piping. Cutting-in or tapping shall be provided by the Contractor and is included in the price bid.

All temporary service connection materials shall conform to the NSF 61 Standard. All hose used for individual property connections shall be minimum 20mm I.D., designed for a working pressure of 860kPa and be free from defects in materials and workmanship.

The pipe, hose and all other materials supplied by the Contractor for temporary servicing shall be approved by the Project Manager. Materials shall be fully adequate to withstand the pressures and other conditions of use and shall be of

material which does not impart any taste or odour to the water in accordance with NSF 61 Standard. The pipe and fittings shall provide adequate water tightness and care shall be exercised throughout the installation of any temporary pipe and service fittings to avoid the possible pollution of any City main/property services or the contamination of the temporary service pipe. Flushing of the private service connections and chlorination of the by-pass line prior to their use will be required. The temporary service connection shall be valved near the point of connection to the by-pass and also to the private plumbing system so that, except for the final connection, the by-pass line and private services may be chlorinated.

During freezing, stormy or inclement weather, no Work shall be done except that which is directed by the Project Manager. No by-pass service pipe or property service connections shall be installed during freezing or inclement weather and pipes already in use shall be removed or drained and services restored when directed by the Project Manager. Removal and re-installation of such pipes or services shall be done at the Contractor's expense.

Each home shall have its own temporary water service connection to the by-pass pipe and a connection to the private plumbing via a wye at an outside tap. The branching of wyes from a single spigot shall not be permitted; nor will connecting homes in series. An approved hose connection vacuum breaker (HCVB) shall be supplied on the open end of all wyes.

It shall be the responsibility of the Contractor to ensure an adequate water supply at all times. During the construction process, the Contractor is responsible for restoring a customer's water supply within two hours of notification from the Project Manager.

.12.06 Disinfection of Temporary Service Connections

Temporary service connections shall be chlorinated at the commencement of the Contract Works. Disconnection and relocation of service connections from one site to another within the Contract Works will not be subject to re-chlorination, unless otherwise directed by the Project Manager.

Where temporary service connections are disinfected in conjunction with the temporary by-pass watermain no physical connections to hose bibs will be permitted until after successful disinfection.

Where temporary by-pass service connections are disinfected offsite in a controlled environment, one set of samples shall be collected from every 350m of service hose connected in a series. One set of samples shall also be taken from the source and at each end of any hose group connected in series, regardless of the total length. Where temporary by-pass service connections are disinfected in conjunction with the temporary by-pass water main additional samples must be taken at the end of any two (2) temporary by-pass service connections for every 350m of temporary by-pass watermain disinfection.

.13 EXCAVATION AND PREPARATION OF TRENCH

.13.01 General

The trench shall be excavated only so far in advance of pipe laying as permitted. Removals shall be in accordance with Form 300 – General Construction Requirements.

.13.02 Alignment and Grade

Refer to OPSS.MUNI 441.07.14, 441.07.17, Form 200.02.05, 200.02.06 and 200.03.18.

.13.03 Excavation to Grade

Refer to OPSS.MUNI 441.07.08 and 441.07.14.

.13.04 Excavation in Poor Soil

Where the bottom of the trench at the required pipe grade is found to be unstable or to include material which, in the opinion of the Project Manager, should be removed, the Contractor shall excavate and remove such unsuitable material. Poor soil may consist of ashes, cinders, all types of refuse, organic or inorganic material.

Material shall be removed to the width and depth required to provide adequate support to the pipe and allow proper installation. The Contractor shall be allowed extra compensation for this work provided for in Form 200.

Where the bottom of the trench at subgrade is found to consist of material which, in the opinion of the Project Manager, cannot be removed and replaced with an approved material and thoroughly compacted in place to support the pipe properly, the Contractor shall construct a foundation for the pipe. Pipe foundation shall consist of piling, timbers, concrete or other materials. All plans for pipe foundation shall be approved by the Project Manager. Extra compensation will be allowed for such additional work as per Form 200.

.13.05 Excavation in Rock

Where excavation is made in rock or boulders, the trench shall be excavated to the width and depths that are required to provide for the granular bedding shown on plans.

In areas where the proposed watermain trench bottom varies from rock to earth, the Contractor shall taper the bottom of the earth trench over a two (2) metre length and supply, place and compact Granular "A" in this section to minimize any differential settlement between the two (2) bedding conditions.

.13.06 Preparation of Trench Bottom

The bottom of the trench at pipe grade shall be finished to within 9mm of a straight line between pipe joints or batter boards and all tolerances shall be above the specified grade. It will only be permissible to disturb the finished surface over a

distance of 450mm near the middle of each pipe for the withdrawal of slings or other lifting tackle.

.13.07 Preparation of Trench Bottom Below Grade

Where the trench has been excavated below pipe grade the Contractor shall place Granular "A" in 150mm layers to the required grade. Each layer shall be compacted by approved vibratory tampers to obtain 95% of the Standard Proctor Maximum Dry Density. The surface of the compacted granular material shall be finished to provide a continuous uniform support for the pipe at grade to the accuracy specified in subsection .13.06.

Unless otherwise specified, when the trench bottom has been excavated below the required pipe grade, the preparation of the trench bottom to pipe grade will be at the Contractor's expense. When the trench bottom is excavated below the pipe grade at the direction of the Project Manager, the preparation of the bottom of the trench to pipe grade will be allowed as extra compensation as provided for in Form 200.

.13.08 Care of Surface and Excavated Material for Reuse

Refer to Form 300.22.

.13.09 Piling Excavated Material

All excavated material shall be piled in a manner that will not endanger the Work and that will avoid obstructing sidewalks and driveways. Hydrants, valves, utilities and drainage courses shall be left unobstructed and accessible until the Work is completed.

.13.10 Interruption of Service, Shutting Down or Charging of Mains

OPSS.MUNI 441.07.21 Shutting Down or Charging Mains

Revised by the following:

No valves or other controls on the existing system shall be operated for any purpose by the Contractor. Only City employees will operate such valves, hydrants, blow-offs and curb stops. Refer to Form 300.20 Connecting to Existing Plant and Appendix A.

.14 BEDDING AND BACKFILL OF WATERMAINS

.14.01 General

OPSS.MUNI 401.07.10, 441.07.13 and 441.07.14 are revised by the following:

Bedding and backfill shall be conducted in accordance with the depths and widths specified on the standard drawings and/or on the Contract Drawings. No type of slag including steel slag, blast furnace slag or nickel slag will be permitted for bedding or backfilling of watermains or water service trenches. All granular bedding and cover materials shall meet the requirements of Form 600.

.14.02 Bedding

Bedding shall be Granular material conforming to Form 600, placed in accordance with WM-200.01 and 200.02. Granular material shall extend to a minimum of 300mm above the top of pipe. Bedding materials shall conform to Form 600 and shall be compacted in accordance with Form 900. Bedding shall be shaped and compacted adequately to support pipe barrel and bells as required.

No type of slag including steel slag, blast furnace slag or nickel slag will be permitted for bedding of watermains.

.14.03 Backfill

Unless otherwise specified on the Contract Drawings or documents, trenches may be backfilled with select, approved native excavated earth materials from trenches. Where these materials are unavailable or deemed to be unsuitable, granular backfill will be used. Where granular backfill materials are used, they shall conform to Form 600 and shall be compacted in accordance with Form 900.

No type of slag including steel slag, blast furnace slag or nickel slag will be permitted for backfilling of watermain trenches.

The use of unshrinkable fill shall be employed where normal means cannot produce the required compaction of the material.

.14.04 Summary of Bedding and Backfill Materials

Bedding and backfill of watermains shall be in accordance with the following:

.14.04.01 Ductile Iron and Polyvinyl Chloride (PVC) Pipe Watermain

Bedding and cover - Granular "A"

Backfill - Select approved excavated native materials or Granular "A" or "B"

.14.04.02 Concrete Pressure Pipe Watermain

Bedding and cover - Granular "A" or "B"

Backfill - Select approved excavated native materials or Granular "A" or "B"

.14.04.03 Water Services

Bedding and cover – Granular "D" (crushed stone)

Backfill: approved excavated native materials or Granular "A" or "B"

.14.04.04 Hydrants

Bedding and cover - 19mm washed crushed stone

Backfill approved excavated native materials or Granular "A" or "B"

.15 LAYING

.15.01 Laying Pipe

At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a suitable watertight plug. Before filling main with water in freezing weather, exposed pipe and fittings shall be covered with straw, or other approved means shall be taken in order to prevent freezing.

Refer to also OPSS.MUNI 441.07.14 and 441.07.15.

.15.02 Cutting Iron Pipe

Refer to OPSS.MUNI 441.07.16 Cutting of Pipe and the following:

The cutting of pipe for inserting valves, fittings or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or lining and so as to leave a smooth end at right angles to the axis of the pipe and in accordance with the manufacturer's recommendations.

The flame cutting of pipe by means of an oxyacetylene torch shall not be allowed nor shall the cutting of pipe with hammer and chisel be allowed.

.16 JOINTING MECHANICAL-JOINT PIPE

.16.01 Assembling Joints

Refer to OPSS.MUNI 441.07.15.

.16.02 Bolting of Joint

Refer to OPSS.MUNI 441.07.15 and all nuts shall be tightened with a suitable torque-limiting wrench. The torque for various sizes of bolts shall be as follows:

SIZE mm	RANGE OF TORQUE N-m
16	55-80
19	80-120
25	95-135
32	120-160

Nuts spaced 180° apart shall be tightened alternately in order to produce an equal pressure on all parts of the gland.

.16.03 Permissible Deflection in Mechanical-Joint Pipe

Refer to Table 4.1 in Form 1000 – Amendments to Ontario Provincial Standards Volume 1, Division 4 - Drainage and Tunnels.

.17 JOINTING STEEL CYLINDER REINFORCED CONCRETE PIPE

Refer to OPSS.MUNI 441.07.15 Jointing

.18 JOINTING TYTON-JOINT PIPE

.18.01 Cleaning and Assembling Joint

Refer to OPSS.MUNI 441.07.15 Jointing

.18.02 Preparation of Spigot on Site

Where spigots require preparation on site, the outside of the spigot shall be filed to produce an angle of approximately 30°.

.18.03 Electrical Conductors

"Lockwedges" or strap-type electrical connections supplied by the pipe manufacturer shall be provided at each joint to ensure electrical conductivity. A minimum of two wedges per joint shall be installed in accordance with the manufacturer's directions.

Strap-type electrical connections shall be connected at each joint in accordance with manufacturer's directions.

The wedges shall be installed only after the pipe has been laid to proper line and grade and shall be preferably located at 180° apart.

.18.04 Permissible Deflection in Tyton-Joint Pipe

Refer to Table 4.2 in Form 1000 – Amendments to Ontario Provincial Standards Volume 1, Division 4 - Drainage, Watermains and Utility

.18.05 Jointing Flange Pipe

Unless otherwise specified, the Contractor shall furnish all bolts, studs, nuts and gaskets required to completely connect up all flanged pipe, fittings, flanges and other appurtenances attached to the pipe.

All bolts and nuts shall have American Standard threads of the Coarse Thread Series, and shall conform to ASA B18.2. For sizes 28mm diameter and below, they shall be of the conventional type and the material shall conform to ASTM A-307 (Grade B). Materials for bolts and studs 31mm diameter and above shall conform to ASTM A-193 (Grade B-7) or to ASTM A-325 (S.A.E. Grade 5). Nuts shall conform to ASTM A-194 Grade 2H. Bolts shall have hexagonal heads and shall be held with hexagonal semi-finished nuts. The length of any bolt shall be such that it will not project beyond the nut more than 13mm or less than 6mm, and no bolt shall be less than the diameter of the hole in which it fits by more than 3mm.

Gaskets shall be red rubber full faced 3mm thick in accordance with dimensions given in the latest edition of ASA B16.21 for Non Metallic Gaskets for Pipe Flanges.

.19 SETTING VALVES AND FITTINGS**.19.01 Valve Boxes**

Valve boxes shall be used for secondary valves at hydrants and where indicated on the watermain plans and profiles. Valve boxes shall be centred and plumb over the wrench nut of the valve, with the box cover flush with the surface of the finished pavement or such other level as may be directed. Refer to Standard Drawing WM-202. Installed valve boxes over gate valves shall be staked and the marking on the stake shall read "Gate Valve".

.19.02 Drainage of Mains

Drainage branches, blowoffs, air vents and appurtenances shall be provided with gate valves. Drainage branches or blowoffs shall not be connected to any sewer, submerged in any stream or be installed in any other manner that will permit back siphon into the distribution system.

.19.03 Dead Ends

All dead ends on new mains shall be closed with cast iron plugs or caps and provided with a 19mm corporation main stop.

.20 HYDRANTS

Hydrants supplied shall be in accordance with OPSS.MUNI 441.05.10, as amended by City standards and must be selected from the Approved Products List. Hydrants shall be installed in accordance with OPSS.MUNI 441.07.19, as amended and the following:

The Contractor shall supply and install the standard 3-way hydrants complete with secondary valves. Hydrant extensions and connections to the proposed watermains shall be in accordance with drawing WM-203.01 and WM-203.02, in the locations shown on the Contract Drawings. All hydrant extensions shall be done from the bottom, at the boot. No extension from the top will be permitted.

Where the hydrant lead is longer than 5 metres, an additional gate valve shall be installed on the hydrant lead, at the main.

All proposed or replacement hydrant lead pipe material (DI or PVC) shall match the proposed watermain pipe material. Fittings at the watermain can be either DI or PVC.

The Contractor shall paint all parts of the hydrant above ground "Red", including caps and bonnets, using Exterior Gloss Alkyd type CGSB 1-GP-59 paint. Storz nozzles shall be painted gloss black.

The Contractor shall apply a minimum 2mm thickness in addition to the factory supplies primer and finish coat as required by Annual Supplies Specifications. The surface to be painted shall be clean, dry and free of grease.

For bedding and backfill requirements refer to Form 400.14.

.21 BACKFLOW PREVENTERS

OPSS.MUNI 441.05.11 Double Check Valve Backflow Preventers

All backflow preventers used on hydrants shall be supplied by the City in accordance with Appendix A, Section 2.1.

Where Contract Documents require the Contractor to supply a backflow preventer, the type shall be in accordance with City of Hamilton By-Law 10-103 and CSA B64-11.

.22 ANCHORAGE

.22.01 Anchorage for Fittings

All fittings shall be anchored according to the method shown on the standard drawings, the Contract Documents, or as otherwise directed. The concrete shall be placed such that the joints will be accessible for repairs.

.22.02 Metal Harness

Metal harness of tie rods or clamps of adequate strength to prevent movement may be used instead of concrete backing, or if directed. Steel rods or clamps shall be galvanized or otherwise rustproof treated, or shall be painted as shown or directed.

.23 WATER SERVICES

Water services shall be installed in accordance with AWWA C800, OPSS.MUNI 441 and be selected from the Approved Products List.

.23.01 Services – 19mm to 50mm Diameter

Refer to OPSS.MUNI 441.07.15.07 Service Connection Pipe and the following:

Water service pipe shall be Type "K" soft copper and include the connection at the main and a curb stop with rod.

19mm and 25mm water services shall be installed in accordance with WM-207.01.

50mm water services shall be installed in accordance with OPSD 1104.02.

Connections to ductile iron watermain pipe shall be in accordance with Form 400.05.

Connections to PVC watermain pipe shall use a service saddle and be in accordance with Form 400.07.

Service connections to 100mm, 150mm and 200mm PVC mains shall be made by using PVC molded tapped couplings, conforming to AWWA C907 and CSA B137.2.

Where a water service is connected to a 50mm copper watermain loop, the

connection shall be in accordance with WM-205.01 or WM-205.02.

Insulation of water services, where required, shall be in accordance with WM-207.03.

.23.02 Services - 100mm Diameter and Larger

Service connections shall be in accordance with OPSS.MUNI 441.07.15.07 Service Connection Pipe and the following:

Services shall be installed in accordance with WM-207.04 and WM-207.05, include the connection at the main, a reducer where required, a gate valve and valve box at property line.

Long side services in excess of 5.0 metres shall have an additional gate valve installed on the service pipe at the main.

Service pipe shall be either ductile iron or polyvinyl chloride in accordance with Form 400.05 or 400.07 and shall be constructed using the same pipe material as the proposed watermain.

The connection of any proposed watermain or water service with a diameter equal to that of the existing watermain shall only be made using a manufactured "Tee".

All fittings on all water services 100mm or greater shall be restrained from the main to the service valve at the property line.

.23.03 Curb Boxes

Curb boxes are to be located in accordance with standard watermain drawing WM-207.01 and WM-207.02 or as otherwise directed.

The Contractor shall indicate the positions of all water services installed in the following manner:

At each curb box location, a 1.83m, 50mm x 100mm wooden stake shall be planted and shall have a 1 metre bury. Stakes shall be painted white, and each shall bear, on its broad side, above ground, the words "WATER SERVICE", painted in black.

The Contractor shall be responsible for the preservation of all marker stakes. Where stakes are damaged or displaced in any way, the Contractor shall arrange to have the stakes replaced and accurately positioned, at their own expense.

.23.04 Trench for Water Service

The Contractor shall excavate and backfill the service trench from the watermain to the street line to a minimum depth of 1.6m below the proposed road grade whichever is the lower elevation unless otherwise directed.

.23.05 Laying Water Service Pipe

The Contractor shall lay the service pipe and install fittings to the street line. Soldered joints will not be permitted.

The service shall be bedded in accordance with Standard Drawing No. WM-200.01 and WM-200.02.

If laid over a sewer service or in a rock trench, the pipe shall be laid on a minimum of 150mm of tamped earth or sand. Service corporation fittings shall be installed into the watermain under pressure.

Valves in service pipe lines shall be properly braced before any pressure test is conducted.

Backfill for water service trenches shall be as specified for the watermain trench.

Service pipe at street line shall be temporarily plugged to prevent entrance of foreign material.

.23.06 Leaks in Services

All leaks that may develop in service lines laid by the Contractor within two years after date of completion of Contract shall be immediately repaired by the Contractor when notified by the Project Manager. Emergency repairs will be made by the City at the Contractor's expense.

.24 CONCRETE AND MORTAR

.24.01 Materials

Refer to OPSS.MUNI 441.05.13, 441.07.23 and OPSS Division 9. Concrete shall be Type HS High Sulfate Resistant in accordance with OPSS 1301 and Form 700.

.24.02 Proportioning and Mixing Mortars

Refer to OPSS.MUNI 441.05.14 and OPSS Division 9.

.24.03 Jointing Old and New Work

All joints between different sections of concrete masonry shall be made in an approved manner after the adjoining surfaces are cleaned, washed, roughened and coated with a neat cement grout, at locations approved of by the Project Manager, suitable provisions being made for the bonding of said joints.

.24.04 Placing in Water

No concrete shall be laid in water, except by permission of the Project Manager, nor shall water be allowed to rise and flow over newly placed concrete for a period of 24 hours.

.24.05 Forms

Forms shall be of such strength and rigidity and so supported that they will not

deflect objectionably under the weight of pressure of the wet concrete.

They shall be properly braced and tied together so as to maintain position and shape, and prevent leakage of mortar.

Forms shall be so constructed that the finished concrete will conform to the shapes, lines, grades and dimensions indicated on the plans.

The face adjacent to the exposed concrete face shall consist of dressed lumber, smooth and clean.

.24.06 Form Removal

Shoring and forms shall not be removed before the time determined by the Project Manager.

.24.07 Curing of Concrete

After concrete has sufficiently set, its exposed surfaces shall be kept continuously moist for a period of at least seven (7) days.

Effective means shall be provided for maintaining the temperature of the concrete at not less than 10° C for at least 72 hours after placing. The temperature shall then be reduced at a maximum rate of 5.6° C per day until that of the surrounding atmosphere has been reached.

No concrete shall be deposited on ground that is frozen or which contains frozen materials.

Hydrostatic testing shall not be carried out until concrete anchor or thrust blocks have a minimum of 5 days curing time.

.24.08 Finish

Special care shall be used to secure smooth, uniform finish to the exposed surface of concrete. After form removal, concrete surfaces shall be immediately rubbed smooth to a uniform, satisfactory finish, and all surfaces subject to wear shall be faced with facing mixture where shown on the plans.

.24.09 Defects

Should any voids or other defects be discovered in any part of the Work when the forms are taken down, or at any other time, the defective Work shall be removed and the space refilled with a suitable concrete mortar in a proper manner at the expense of the Contractor.

.24.10 Reinforcing Steel

The ties for reinforcing shall not show on the exposed face of the concrete. All steel for reinforced concrete shall be supplied by the Contractor.

.25 DISINFECTION, TESTING AND CONNECTION OF WATERMAINS

OPSS MUNI. 441.07.25 - Flushing and Disinfecting Watermains

Revised as follows:

All connections, flushing, hydrostatic testing, swabbing, and bacteriological testing procedures shall be in accordance with Form 400 - Appendix A and the Ministry of the Environment and Climate Change (MOECC) Watermain Disinfection Procedure.

APPENDIX A PROCEDURE FOR THE DISINFECTION, TESTING AND CONNECTION OF WATERMANS

1.0 INTRODUCTION

1.1 Scope: Watermain Installation and Testing Procedures

This procedure covers the cleaning, disinfection, hydrostatic testing and sampling of watermains. Unless specified otherwise this procedure applies to all new watermains, above ground by-pass watermains and relined watermains.

1.2 Definitions

Appurtenance means an appurtenance within the meaning of O. Reg. 170/03.

Category 1 Classification are watermain breaks with no evident or suspected contamination.

Category 2 Classification are watermain breaks with evident or suspected contamination.

Contaminant means foreign matter that is not intended to enter a watermain.

Contamination means the introduction of a Contaminant into a watermain.

Contractor means the person, partnership or Corporation undertaking the Work as identified in the agreement.

CHEL means the City of Hamilton Environmental Laboratory.

CSR means City of Hamilton Customer Service Representative.

CS&CO means City of Hamilton Customer Service and Community Outreach section.

Disinfectants means calcium or sodium hypochlorite that meets or exceeds ANSI/AWWA B300 or liquid chlorine that meets or exceeds ANSI/AWWA B301.

Flushing means post repair valve operation to restore secondary disinfection and discharge suspended materials by flowing water through the repaired section of watermain and out of the system. This definition does not include recharging the watermain or a requirement to achieve scouring velocity within the watermain.

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 MOECC, O.Reg. 128/04 Water Operator Distribution Licence.

LIMS means the City of Hamilton Environmental Laboratory work order database.

LWO Number means the City of Hamilton Environmental Lab Work Order Number.

MOECC means Ministry of the Environment and Climate Change

Neutralizing Agent means Sodium Thiosulfate that meets or exceeds Appendix C of ANSI/AWWA Standard C651.

Project Manager means the City of Hamilton, Public Works, Engineering Services Project Manager or the City of Hamilton, Planning and Economic Development, Growth Management Project Manager.

SDWA means the Safe Drinking Water Act of Ontario.

Service Pipe means a service pipe within the meaning of O. Reg. 170/03.

Specialist means a company specializing in regulated water systems or a company approved by the Project Manager, whose personnel hold a minimum MOECC, O.Reg. 128/04 Water Operator Distribution Licence.

NSF 61 means the National Sanitation Foundation, Standard 61.

1.3 References

These procedures are based on and shall be used in conjunction with, the following:

- Ontario Provincial Specifications (OPS),
- American Waterworks Association Standards (ANSI/AWWA C651 – Disinfecting Water Mains and Appendices A and B),
- Safe Drinking Water Act of Ontario
- Ministry of the Environment and Climate Change (MOECC) – Watermain Disinfection Procedure
- The City of Hamilton Design Criteria
- The Canadian Standard Association - CAN/CSA-B64.10
- Hamilton Water procedure PW-WW-P-013-007 entitled DWQMS Water Quality Testing for New Watermain Connections.

1.4 General Requirements for Watermain Installation

The Contractor shall keep pipes clean and dry and take precautions to protect the interiors of pipes, fittings and valves against contamination. End caps shall be installed when Work is not in progress and removed only when connecting the next pipe or appurtenance or continuing Work. Pipes shall not be laid directly in water. Existing watermains, which are dead ended during construction, shall have a minimum 25mm bleeder installed at the dead end. New watermains which are temporarily dead ended shall have a minimum 50mm blow off installed with a temporary cap if there is no hydrant downstream of the last water service on the watermain.

1.5 Connection and Testing Procedures Plan and Meeting

The Contractor shall provide a plan to the Project Manager and Inspector detailing the connection locations, swabbing locations, hydrostatic testing, chlorination and dechlorination methods, disposal of water and final connection methods prior to the commencement of such works. If the project is being constructed in phases, this plan shall detail each of these items for each phase.

A pre-watermain connection and testing meeting shall be held by the Project Manager prior to any commissioning procedures.

1.6 Forms

The following forms are attached to this document:

- a) Watermain Commissioning Form – Swabbing and Hydrostatic Testing Record
- b) Watermain Commissioning Form – Disinfection and Chlorine Residual Sample Record
- c) Record of Watermain Break Form

1.7 Supervision, Testing and Records

The Inspector shall witness all cleaning, swabbing, hydrostatic testing, disinfection and conduct sample collection. The Specialist carrying out the cleaning and disinfection shall take and record measurements in conjunction with the Inspector on the appropriate Watermain Commissioning Form.

1.8 Valve Operation

City of Hamilton Water Distribution staff must perform the operation of all existing valves inclusive of hydrant secondary valves. In the event of an emergency, the Inspector may operate or direct the Contractor to operate valves.

The opening and closing of any valve should be coordinated with the Inspector. All known affected residences or businesses shall be notified 48 hours prior to a planned disruption of water service.

2. WATERMAIN TESTING PROCEDURE

This document is to be read in conjunction with the forms attached to the end of this document. These procedures are to be used in conjunction with the Ontario Provincial Standard Specifications (OPSS), the American Waterworks Association Standards (AWWA) and the Safe Drinking Water Act of Ontario (SDWA), including the MOECC - Watermain Disinfection Procedure.

All required low-end chlorine residual tests shall be performed by the Specialist and confirmed by the Inspector utilizing an electronic tester such as a Hach Pocket Colourimeter or equivalent.

All Works associated with swabbing, pressure and leakage testing, chlorination, dechlorination and sterilization of the watermain are to be performed by a company specializing in this type of work or a company approved by the Project Manager and witnessed by the Inspector. The Inspector in charge of monitoring shall take and record measurements as per the Commissioning Forms attached herein.

Temporary by-pass piping shall meet all procedures and requirements of new watermain with the exception of hydrostatic pressure testing. A visual check shall be performed at line pressure on a temporary by-pass to ensure that it is leak free.

2.1 Temporary Connection and Backflow Preventer

The temporary connection is to be used for all water supplies to maintain continuous supply of water unless otherwise noted. The size of the temporary connection shall be 50mm diameter for watermains up to and including 200mm diameter and 100mm diameter for watermains 250mm diameter to 400mm diameter, inclusive. All materials for the temporary connections are to conform to the City of Hamilton Approved Products List. Watermains larger than 400mm in diameter shall be as per design standards.

For Public Works projects, the hydrant adapter (backflow preventer and meter) shall be a reduced pressure principle type and shall be supplied by the City of Hamilton upon receipt of request from the Project Manager.

For Planning and Economic Development projects, the hydrant adapter (backflow preventer and meter) shall be supplied by the City of Hamilton upon request from the Inspector on behalf of the Contractor.

The adapter shall be installed on a prescribed hydrant and charged by a City of Hamilton Water Distribution Operator. Hydrant(s) utilized as the source water for temporary by pass will be determined by the Project Manager in consultation with City of Hamilton Water Distribution staff.

The existing distribution system and backflow preventer shall be physically disconnected from the test section during all hydrostatic testing.

2.2 Charging of Watermains

The watermain is to be recharged via a temporary connection equipped with an approved backflow preventer.

2.3 Swabbing

The isolated section of watermain shall be charged or pressurized prior to the commencement of swabbing. The swabs shall be numbered and carefully controlled by the Specialist to ensure that all swabs that are introduced into the watermain are retrieved and accounted for. The Inspector shall record the number of swabs inserted and retrieved. All swabs must be inspected prior to insertion and immediately after they exit the watermain to ensure that they have remained intact and that pieces of the foam do not remain inside the watermain. New swabs shall be used for this procedure and under no circumstances will used swabs be allowed.

All watermain pipes must be swabbed with a minimum of THREE swabs plus a minimum of one swab shall be passed through each hydrant lead, large diameter water service, stub or blow-off. Additional swabs shall be used as directed by the Project Manager or Inspector should discharge water not run clear within ten seconds of the swab exiting the discharge point. No additional payment shall be made for subsequent swabbing.

Swabs shall be forced through the watermain using potable water at a minimum velocity of 0.6m to 1m per second. The Project Manager must approve all methods of disposal of the discharged water. The Contractor shall take all necessary precautions to minimize soil erosion and shall reinstate any affected areas upon completion.

The swabs must be new open cell polyurethane foam, having a density of 1.5 pounds per cubic

foot (24 kilograms per cubic metre) and are to be a minimum of 50mm larger than the nominal pipe diameter with a length at least one and a half times its diameter. Watermains 300mm or smaller may be swabbed through hydrants with the approval of the Project Manager. Procedures for swabbing watermains larger than 300mm must also be approved by the Project Manager.

2.4 Hydrostatic Testing

Leakage tests shall be carried out on the test section of watermain after swabbing operations have been successfully completed. The Contractor shall ensure that no air pockets are present in the test section of watermain. The existing distribution systems and the backflow preventer shall be physically disconnected from the test section during all hydrostatic testing. The test section shall be capped and the main filled with potable water under a pressure of 1035 kPa. After any visible leaks are stopped, leakage shall then be measured by a calibrated meter with readings taken at fifteen minute intervals for a period of two hours and recorded on the Watermain Commissioning form. The allowable leakage shall not exceed 0.128 litres per mm of pipe diameter per km of pipe for the 2 hour period. If the leakage exceeds this figure, the Contractor shall locate and repair all leaks and the test section shall be retested until a satisfactory result is obtained.

The watermain is to be tested in sections, where a section is a length of watermain between two valves or a valve and a dead end. Should the Contractor wish to test more than one section at a time, the Project Manager/ Inspector will calculate the allowable leakage for all sections within the tested portion and the smallest calculated leakage will become the allowable for the entire tested portion.

2.5 Disinfection of Watermains

Disinfection of watermains shall be done in accordance with ANSI/AWWA C651 – Disinfecting Water Mains, as amended by the MOECC Watermain Disinfection Procedure and this Form.

Water distribution watermains shall be disinfected using the continuous-feed method of chlorination.

Trunk/transmission watermains shall be disinfected using the continuous-feed method or the slug method of chlorination.

2.5.1 Continuous-Feed Method of Chlorination

Watermains shall be completely filled to remove air pockets and flushed to remove any particulates. After flushing is completed, the main shall be filled with potable water.

The chlorine solution shall be thoroughly mixed prior to pumping it into the system. Chlorine solution shall be injected into the system through the access point at the temporary connection. The chlorine solution shall be applied so that the initial chlorine concentration is a minimum of 50mg/L throughout the system and does not exceed 120mg/L.

The chlorine solution shall flow through each hydrant and blow-off. The high chlorine residual is to be measured and recorded by the Specialist at each sample location in conjunction with the Inspector.

The high chlorine concentration shall be left in the isolated system for a minimum of 24

hours. After the required contact time, the chlorine residual shall be measured and recorded at each sample location by the Specialist in conjunction with the Inspector. Flow required to take the chlorine residuals shall be provided through the temporary connection.

The maximum allowable decrease in chlorine concentration after 24 hours is 40% of the initial chlorine concentration, to a maximum decrease of 50 mg/L.

Table 1: Chlorine Concentration and Contact Time for Continuous-Feed Method of Chlorination		
Minimum Contact Time	Initial Chlorine Concentration	Maximum Allowable Decrease in Chlorine Concentration
24 hours	Minimum 50mg/L not to exceed 120mg/L	40% of the Initial Chlorine Concentration (to a Maximum of 50mg/L)

The following examples are provided to demonstrate the proper use of Table 1:

Example 1

When using the continuous-feed method of chlorination with an initial chlorine concentration of 50mg/L, the maximum allowable decrease in chlorine concentration is 40% of 50mg/L, or 20mg/L. Therefore, at least 30mg/L of chlorine must be present after 24 hours.

Example 2

When using the continuous-feed method of chlorination with an initial chlorine concentration of 150mg/L, the maximum allowable decrease in chlorine concentration is 50mg/L, because 40% of 150mg/L is greater than the maximum allowable decrease of 50mg/L. Therefore, at least 100mg/L of chlorine must be present after 24 hours. However, the initial chlorine concentration should not exceed 120mg/L.

If the chlorine residual meets the above Table 1 criteria after 24 hours, the chlorine is ready to be discharged. In the event that the chlorine residual is less than the allowable levels after 24 hours, the chlorine in the system is to be discharged and the system is to be re-chlorinated.

The Inspector has the authority to require further swabbing if the residual is less than the allowable levels after 24 hours. Once this has been achieved, the watermain shall be flushed and sampled for chlorine residual levels.

Minimum acceptable levels are 40% of the initial chlorine concentration to a maximum decrease of 50mg/L.

Note:

Where copper pipe is used for smaller diameter watermains (less than 100mm), Table 1 does not apply. Copper watermains shall be disinfected using the continuous-feed method, with an initial chlorine concentration of ≥ 50 mg/L. Due to the chlorine demand exerted by the copper, no minimum chlorine concentration is required following the 24 hour contact time, and the effectiveness of the disinfection process shall be demonstrated by the bacteriological testing.

2.5.2 Slug Method of Chlorination

Watermains shall be completely filled to remove air pockets and flushed to remove any particulates. After flushing is completed, the main shall be filled with potable water.

The chlorine solution shall be thoroughly mixed prior to pumping it into the system. Through the access point at the temporary connection, the system shall receive a dose of chlorine, fed at a constant rate such that the water will have not less than 100mg/L chlorine concentration, not to exceed 200mg/L.

The chlorine shall be applied continuously and for a sufficient period of time to develop a solid column, or slug, of chlorinated water that will, as it moves through the main, expose all interior surfaces to a concentration no less than 25mg/L of the initial chlorine concentration for at least 3 hours.

The chlorine residual shall be measured in the slug as it moves through the main. The duration of disinfection as well as the initial and residual chlorine concentration, at the end of the contact time, shall be measured and recorded by the Specialist at each sample location in conjunction with the Inspector.

If at any time the chlorine residual drops more than 25 mg/L, the flow shall be stopped; chlorination equipment shall be relocated at the head of the slug; and, as flow resumes, chlorine shall be applied to restore the chlorine in the slug to not less than 100 mg/L.

As chlorinated water flows past fittings and valves, related valves and hydrants in the isolated system shall be operated so as to disinfect appurtenances and pipe branches.

Table 2: Chlorine Concentration and Contact Time Slug Method of Chlorination		
Minimum Contact Time	Initial Chlorine Concentration	Maximum Allowable Decrease in Chlorine Concentration
3 hours	Minimum 100mg/L not to exceed 200mg/L	25mg/L

The following example is provided to demonstrate the proper use of Table 2:

Example:

When using the slug method of chlorination, with a minimum contact time of 3 hours, the chlorine concentration shall be measured in the slug at the beginning of the disinfection process, as the slug moves through the watermain, and at the point of discharge. If at any point the chlorine concentration has decreased by more than 25 mg/L, the flow shall be stopped and additional chlorine shall be added to restore the chlorine concentration in the slug to not less than 100 mg/L, not to exceed 200mg/L. For example, if the initial chlorine concentration in the slug is 150 mg/L, then the chlorine concentration must not decrease below 125 mg/L.

2.6 Removal/Disposal of Super Chlorinated Water

The Contractor shall dechlorinate the discharge water to protect receiving streams and other bodies of water, via catch basins or other points of entry, as per the MOECC regulations and ANSI/AWWA C651 as amended. If in near proximity to the sewer treatment plant, the plant is to be notified and must approve receiving the water. The Contractor shall be required to supply all labour, equipment and materials to dechlorinate the water including, but not limited to, dechlorination mats, diffusers and dechlorination chemicals. There shall be no separate payment for dechlorination.

2.7 Bacteriological Sampling

Bacteriological sampling shall be done in accordance with ANSI/AWWA C651, the MOECC - Watermain Disinfection Procedure – Section 1.1.2, and the following:

Before the watermain, or temporary above ground by-pass system can be approved for connection to the existing water distribution system, twenty four hours after the discharge of super chlorinated water, two (2) consecutive rounds of water samples, taken at least 16 hours apart, shall pass the appropriate chlorine residual (within the respective drinking water system – Woodward, Fifty Road and communal wells) and bacteriological testing requirements as per the City of Hamilton Laboratory testing procedures. Prior to chlorine residual and bacteriological testing, all other testing and disinfection shall be completed and any super chlorinated water removed from all portions of the watermain system under consideration including hydrant leads, stubs, branches, services, etc.

Twenty four hours after the discharge of super-chlorinated water, the Inspector shall field test for residual chlorine at each testing point of the new watermain to be no less than 0.25mg/L and to be no greater than 3.0mg/L. The Inspector will then take the bacteriological sample at each sample location and deliver it to the City of Hamilton Environmental Laboratory. The watermain test section shall be immediately shut down and must not be disturbed or flushed for the period between this sample round and the next bacteriological sample round at least 16 hours later. The watermain must remain continually pressurized through the approved backflow preventer from the start of the bacteriological testing until the connection to the existing system is undertaken.

Samples shall be taken from the end of every dead end and from every 360 metres or less of new watermain pipe. No hose or hydrant shall be used in the collection of bacteriological samples.

2.8 Sample Results

Once the new watermain is installed and pressure tested, the proper numbers of water samples are to be collected by the Inspector. The Inspector shall drop off sample bottles at CHEL along with the completed chain of custody form(s).

Lab staff will process and log in the bottle(s). Each chain of custody form will be assigned an LWO Number. In addition to the LWO, each sample bottle will be assigned a unique record number. Samples delivered after 3:30pm on working days will be set up the same day but may not be logged in until the next day. Samples delivered after 4:00pm on working days may not be set up for analysis or logged in until the next day.

Lab staff, using the LIMS database, will generate an email that will be sent to the Inspector. The email will contain the LWO and record numbers that can then be used by the Inspector when calling in to the lab.

Special arrangements can be made to bring sample bottles to the lab on a weekend. Inspectors are to call CHEL on the Friday and provide the sample location, account number and the project/permit number (if applicable). In this case, CHEL will pre-log the samples into LIMS.

Inspectors can call the CHEL after 24 hours and 48 hours to determine the status of water quality testing with the understanding that these results are provisional until they have gone through the data approval process. The new watermain cannot be put into service until the final

approved lab report from the CHEL has been obtained.

After the 48-hour testing period, data is entered into the LIMS database which will go through a data approval process. CHEL will create a PDF file of the final approved lab report for each LWO and save the file at the following locations:

- a) For CS&CO staff, the PDF file is saved at N:\Environmental Laboratory Reports\CSCO_WmRech
- b) For Planning and Economic Development, Growth Management, the PDF file is saved at N:\Environmental Laboratory Reports\Development Engineering
- c) For Public Works, Engineering Services, the PDF file is saved at N:\Environmental Laboratory Reports\Construction.

The files will be named as follows:

PRIVATE-ROADS_XXXXXX_ - ##### _YYYY-MM-DD HH-MM-SS Final Report.pdf

where:

XXXXXX represents the permit No. / Contract No., if supplied.

represents the LWO Number.

YYYY-MM-DD is the date that the PDF was created.

HH-MM-SS is the time that the PDF was created.

The pdf file of the final approved lab report is also emailed to the Inspector.

If changes are required to the staff permissions for the files above, the Lab Services Project Manager must be contacted at Ext. 1145.

Inspectors shall also contact a CSR 24 hours and/or 48 hours ahead of the proposed watermain shutdown, depending on the project, to facilitate the connection of the new watermain to the source watermain and inform the CSR of the following information: name of the Inspector, Contract No. or development site, where/when to meet WDO, duration of shutdown and LWO number.

The CSR will create a Service Request containing the information listed above. The CSR will also attach by OLE the corresponding LWO PDF file from the network drive N: \ environmental laboratory reports\CSCO_WmRech . The CSR will then create the Service Request for a WDO to connect the new watermain to the existing water distribution system.

If sample results are successful, the system will be put into service. A single failed bacteriological parameter will constitute a failure of the entire sampling round. If sample results do not meet requirements, the failed section must be flushed or re-disinfected as directed by the Project Manager/Inspector and re-sampled at the sample locations. Sampling will continue until two (2) consecutive sets of water samples, taken 24 hours apart, pass both the appropriate chlorine residual and bacteriological requirements as per the City of Hamilton Laboratory testing procedures.

3. CONNECTION TO EXISTING WATER DISTRIBUTION SYSTEM

Connections to the existing water distribution system shall be done in accordance with ANSI/AWWA C651 and the following:

Once the bacteriological tests have passed, the connection to the existing watermain shall be performed.

A sump, minimum 300mm depth, shall be excavated in the trench bottom and be filled with clear stone to provide a location to collect and pump water.

Watermains shall be cut back to remove any temporary taps. The Contractor shall disinfect the connection watermain pipe as outlined in section 3.1 and shall dewater the watermain and trench in a controlled manner as to not allow backflow of water into the watermain.

If trench water, dirt, or debris has entered the watermain during the final connection, the watermain shall be aggressively flushed and additional bacteriological samples shall be taken as directed by the Inspector. If contamination is evident or suspected, the procedures defined under Section 3 of the MOECC - Watermain Disinfection Procedure for Category 2 watermain breaks shall apply.

3.1 Connections and Tapping of Watermains

The new pipe, fittings and valves required for the connection shall be spray-disinfected and swabbed with a minimum 1% to maximum 12% solution of sodium hypochlorite immediately prior to being installed. The existing watermain being connected to shall also be cleaned in the immediate area of the connection and spray-disinfected with the same solution.

Where existing watermains are tapped, the drill/cutting/tapping bits and all surfaces of mainstops, service saddles, tapping sleeves and valves which will come into contact with drinking water shall likewise be cleaned and disinfected.

The Contractor shall make every possible effort to ensure that the final connection is no more than one pipe length.

4. WATER SERVICES

Service connections shall be tapped and connected under pressure. All connections shall be inspected to ensure they are drip tight prior to backfilling. The pipe shall be left exposed until directed by the Inspector, after which backfilling shall be completed.

Services 100mm in diameter and larger shall be considered mainline and shall meet all mainline procedures and testing requirements of Section 2.5 Disinfection of Watermains, and MOECC - Watermain Disinfection Procedure - 1.1 New Watermains.

For new services 38mm in diameter up to but not including 100mm diameter, sanitary conditions must be maintained during installation and shall be thoroughly flushed prior to connecting to the existing service. Required drill / cutting / tapping bits, and all surfaces of mainstops, service saddles, tapping sleeves and valves which will come into contact with the drinking water shall be cleaned and spray-disinfected with a minimum 1% to maximum 12% solution of sodium hypochlorite immediately prior to the connection.

If any of the disinfected surfaces come into contact with the soil and/or water in the excavation prior to use, the cleaning and disinfection procedure shall be repeated.

All by-pass services hoses to be used shall be of potable water grade and shall meet the requirements of NSF 61 Standard. Service hoses shall be capped on both ends with brass caps until installed. Service hoses shall not be installed on by-pass piping until the day of the change over from the distribution watermain to the above ground by-pass watermain, and shall be thoroughly flushed prior to connection.

5. WATERMAIN BREAKS

Watermain breaks shall be treated in accordance with the MOECC – Watermain Disinfection Procedure, Section 3. Watermain Disinfection Procedures for Emergency Repairs.

The watermain break repair process is to be documented by completing a Record of Watermain Break Form attached to this document. A copy of the completed Form shall be sent to Hamilton Water Distribution.

6. RELINING OF WATERMAINS

Relining of existing watermains shall be treated in accordance with the MOECC – Watermain Disinfection Procedure, Section 1.2 Relining of Watermains, and Section 2.5 of this document.

WATERMAIN COMMISSIONING FORM
Swabbing and Hydrostatic Testing Record

CONTRACT/SITE NAME:

DATE:	LOCATION:
TIME:	
PERFORMED BY:	WITNESSED BY:
No. SWABS INSERTED:	No. OF SWABS RETRIEVED:

DATE	WATERMAIN SECTION, LENGTHS AND DIAMETERS	TIME	LEAKAGE (litres)

0.128 L/mm of pipe diameter per kilometre of pipe for the 2 hour test period

PRESSURE TEST PASSED: YES NO

TABLE OF CONTENTS

.01	GENERAL	2
.02	SUPERPAVE MIXES	2
.02.01	Design Requirements	2
.02.01.01	Submission and Design Requirements	2
.02.01.02	Mix Requirements for Design Purposes – Hot Mix and Warm Mix.....	2
.02.01.03	Additional Design Requirements for Warm Mix Asphalt.....	3
.02.01.04	Submission Requirements – Warm Mix Asphalt	3
.02.01.05	Superpave Mix Verification	4
.02.01.06	Asphalt Cement Requirements.....	5
.02.02	Materials	5
.02.02.01	Aggregate	5
.02.02.02	Performance Graded Asphalt Cement (PGAC).....	5
.02.03	Construction	7
.02.03.01	Pre-pave Meeting	7
.02.03.02	Asphalt Plant Inspection	8
.02.03.03	Tack Coat	8
.02.03.04	Placement of Binder and Surface Course Asphalt	8
.02.03.05	Binder Course Asphalt – Temporary Ramping	8
.02.03.06	Use of Paving Equipment – Paving in Echelon	8
.02.03.07	Asphalt Material Transfer Vehicle.....	9
.02.03.08	Re-Heating and Compaction of Longitudinal Joints	9
.02.03.09	Review of Longitudinal Joint Quality.....	9
.02.03.10	Aggregate Gradation and Asphalt Cement Content Acceptance	9
.02.03.11	Air Voids Acceptance for HMA Production	12
.02.03.12	Asphalt Layer Segregation	12

.01 GENERAL

This specification covers the requirements for hot mix asphalt designed using the Superpave method, including warm mixes.

Unless otherwise amended herein, the design, materials, production and placement of hot mix asphalt shall conform to the following:

- OPSS.MUNI 310 – Construction Specification for Hot Mix Asphalt, including Appendix C
- OPSS.MUNI 1003 – Material Specification for Aggregates – Hot Mix Asphalt
- OPSS.MUNI 1101 - Material Specification for Performance Graded Asphalt Cement
- OPSS.MUNI 1151- Material Specification for Superpave and Stone Mastic Asphalt Mixtures.

.02 SUPERPAVE MIXES

Superpave types shall be as specified in the contract documents, shall be in accordance with Tables 1 and 2 of OPSS.MUNI 1151, and shall be approved prior to use.

The Performance Graded Asphalt Cement (PGAC) shall be in accordance with OPSS.MUNI.1101, as amended by this specification.

.02.01 Design Requirements

.02.01.01 Submission and Design Requirements

The design of Superpave mixes shall be in accordance with the requirements of OPSS.MUNI 1151 Material Specification for Superpave and Stone Mastic Asphalt Mixtures, as amended by this specification.

.02.01.02 Mix Requirements for Design Purposes – Hot Mix and Warm Mix

1151.04.01 of OPSS.MUNI 1151 is amended by the addition of the following:

Asphalt cement shall be performance graded asphalt cement and shall be as described in section .02.02.02.

The Contractor shall design, produce and place asphalt in accordance with the following:

- All surface and binder course asphalt produced and placed on or after November 1 of any year shall be a Warm Mix;
- Where weather conditions at the time of paving prevent the placement of Hot Mix asphalt in accordance with OPSS temperature requirements, a Warm Mix shall be used.

Warm mix asphalt shall be in accordance with section 02.01.03.

.02.01.03 Additional Design Requirements for Warm Mix Asphalt

OPSS.MUNI 310.04.01 of OPSS.MUNI 310 - Appendix 310-C is hereby deleted and replaced with the following:

The Contractor shall be responsible for the following:

- a) Using an approved WMA additive listed below:
 - i) Advera
 - ii) Evotherm
 - iii) Hyper Therm
 - iv) Sasobit
 - v) SonneWarmix
- b) Preparation of the mix design and reporting of all testing results in accordance with test method LS-318 Practice for the Design of Superpave Warm Mix Asphalt (WMA).
- c) Any WMA technology not listed in a) above shall be subject to review and approval by the City.
- d) The WMA mix design and the job mix formula at the anticipated WMA production temperature, both of which shall be according to the requirements of this specification.
- e) Ensuring that, during the development and verification of the WMA mix design, the WMA technology does not adversely affect the asphalt cement performance grade and the WMA mixture performance.
- f) Moisture content of the aggregate coming from the dryers shall not exceed 0.5%.

.02.01.04 Submission Requirements – Warm Mix Asphalt

OPSS.MUNI 310.04.02 of OPSS.MUNI 310 - Appendix 310-C is deleted and replaced by following:

A minimum of 4 weeks prior to paving with WMA, the following information shall be submitted to the Project Manager, in writing:

- a) The name of the supplier and the approved WMA technology selected.
- b) All test results required under LS-318 and any other details on how the requirements of this specification shall be met.
- c) If applicable, the type and dosage of WMA additives, how the additives are to be incorporated to produce the WMA, and the WMA technology supplier's established recommendations for usage.
- d) Where a proposed technology is not currently approved, the Contractor shall submit the following information a minimum of 4 weeks prior to proposed paving dates for review and approval:

- i) Name of process, manufacturer, type of process and the technology group;
- ii) Manufacturer's recommendations including:
 - a) Process description and mix design recommendations;
 - b) Required plant modification and hauling recommendations;
 - c) Mixing and compaction temperatures;
 - d) Construction aspects, if any differences from conventional HMA paving besides temperatures.
- iii) Projects where the process has been used including:
 - a) Client including contact information (telephone, email);
 - b) Mix designs;
 - c) Date and location of construction;
 - d) To date performance.

Where the proposed technology is not approved, the Contractor shall be required to supply and place an approved technology.

.02.01.05 Superpave Mix Verification

1151.04.02.02 of OPSS.MUNI 1151 is amended by the addition of the following:

After receiving the asphalt mix design from the Contractor's own laboratory or from a hired firm's laboratory, the Contractor shall provide asphalt mix verification test results in accordance with the following criteria:

- a) The tests must be performed by a laboratory independent from the firm producing the asphalt mix design.
- b) The laboratory performing verification testing must have a valid "Certificate of Conformance" issued by the Canadian Council of Independent Laboratories (CCIL) Asphalt Laboratory Certification Program and be qualified under the following categories:
 - i) Asphalt Mix Design – Marshall and Superpave Methods (Type A)
 - ii) Asphalt Mix Compliance – Marshall and Superpave Methods (Type B)

All verification testing must be reviewed and accepted by the City of Hamilton prior to the start of any paving operations.

The mix design shall be submitted for acceptance at least 4 weeks before construction. The mix design shall be reviewed and approved by the City. Prior to construction, a trial batch shall be submitted to the Project Manager for verification and approval.

The submitted mix design shall include the JMF and the documents listed in Section 1151.04.05 of OPS 1151 MUNI. The mix design that does not include the required documents will not be reviewed and accepted.

.02.01.06 Asphalt Cement Requirements

The asphalt cement content of the approved JMF shall be equivalent to or greater than those shown in Table 800-1.

**TABLE 800-1
Superpave Minimum Asphalt Cement Content**

Mix Type	Minimum Asphalt Cement Content for JMF
Superpave 9.5	5.5
Superpave 12.5	5.0
Superpave 19mm	4.8
Superpave 25mm or greater	4.6

.02.02 Materials

.02.02.01 Aggregate

Aggregates used shall be in accordance with OPSS.MUNI 1003 Material Specification for Aggregates – Hot Mix Asphalt.

.02.02.02 Performance Graded Asphalt Cement (PGAC)

Performance Graded Asphalt Cement shall be in accordance with OPSS.MUNI 1101 - Material Specification for Performance Graded Asphalt Cement, as amended by the following:

1101.05 of OPSS.MUNI 1101 is amended by the addition of the following:

The basic grade of asphalt cement shall be PG 58–28.

In accordance with ASTM M332 standard, the dynamic shear, T 315, $G^* \sin \delta$ carried out on the residue from pressurized aging vessel (PAV), shall be maximum 6,000 kPa for 58H,V, E -28.

1101.08.03 of OPSS.MUNI 1101 is amended by the addition of the following:

A sample of asphalt cement shall be taken at the beginning of the asphalt paving project. At the discretion of the Project Manager, more samples may be required, for instance to represent 1,000 tons of a particular asphalt mix.

Table 1 of OPSS.MUNI 1101 is deleted in its entirety and replaced with the following:

**Table 800-2
Additional testing requirements and acceptance criteria for PGAC grades**

Property and Attributes (Unit)	Test Method	Results Reported Rounded to the Nearest	Acceptance Criteria	Rejectable
Ash Content, % by mass of residue (%)	LS-227	0.1	≤ 0.6	>0.6
Non-recoverable creep compliance at 3.2 kPa (Jnr-3.2) (kPa-1) when PGAC 58H-28 is specified	Multiple Stress Creep Recovery (MSCR) testing according to AASHTO T 350 testing conducted at a temperature of 58 °C	0.01	≤ 2.0	> 2.0
Non-recoverable creep compliance at 3.2 kPa (Jnr-3.2) (kPa-1) when PGAC 58V-28 is specified		0.01	≤ 1.0	> 1.0
Non-recoverable creep compliance at 3.2 kPa (Jnr-3.2) (kPa-1) when PGAC 58E-28 is specified		0.01	≤ 0.5	> 0.5
Average percent recovery at 3.2 kPa (R3.2) (%)		0.1	$> \text{the lesser of } [(29.371) (\text{Jnr-3.2})^{-0.2633}] \text{ or } 55$	$\leq \text{the lesser of } [(29.371) (\text{Jnr-3.2})^{-0.2633} - 10] \text{ or } 45$
Percent difference in non-recoverable creep compliance between 0.1 kPa and 3.2 kPa, Jnr diff (%)		0.1	N/A Testing carried out only for information purpose	

For residential street pavements, regular PG58-28 asphalt cement will be used with no polymer modification and no MSCR testing required.

Guidelines for the selection of PGAC graded using Multiple Stress Creep Recovery (MSCR) test is given in Table 800-3 below.

**Table 800-3
Guidelines for Selection of PGAC Graded Using MSCR Test**

Road Type	Recommended PGAC Grade Using MSCR Test	Optional Grade Increase (Note 1)
Urban Freeway	58V-28	N/A
Rural Freeway Urban Arterial	58H-28	58V-28
Rural Arterial Urban Collector	Consider specifying 58H-28 if truck traffic is greater than 20% of AADT	58V-28
Rural Collector Urban/Suburban Collector	58-28	58H-28 or 58V-28
Toll Plaza Port Facility Dedicated Transit ways Truck Marshalling Yards (standing traffic)	58E-28	N/A
<p>Notes:</p> <p>A. It is recommended that MSCR graded PGAC is used in both surface and top binder courses, i.e. top 80 mm to 100 mm of hot mix.</p> <p>1. Consideration should be given to an increase in the high temperature traffic level for roadways which experience a high percentage of Trucks or bus traffic at slow operating speeds, frequent stops and starts, and historical concerns with instability rutting.</p>		

.02.03 Construction

The supply and placement of hot mix and warm mix asphalt shall be in accordance with the following:

- a) OPSS.MUNI 310 Construction Specification for Hot Mix Asphalt, as amended;
- b) OPSS.MUNI 310 - Appendix C for the placement of warm mix asphalt, as amended.

.02.03.01 Pre-pave Meeting

At least one (1) week prior to any scheduled milling or paving operation to occur, a mandatory Pre-pave meeting shall be held. The Contractor shall ensure that all required documentation relating to the milling and paving operations has been submitted for review and approved prior to the meeting. The items shall include, but are not limited to, the following:

- a) Approved mix designs and Job Mix Formulas;
- b) Proposed milling and paving dates and paving equipment to be used;
- c) Asphalt placement and compaction rolling patterns;

- d) Roadway, lane closures and vehicle access restrictions;
- e) Tack coat scheduling and application patterns.

.02.03.02 Asphalt Plant Inspection

The Contractor shall permit access to the City's inspector in order to monitor the asphalt mix production, particularly the amount of Reclaimed Asphalt Pavement (RAP) added. The stockpiles of aggregates and RAP shall be clearly labelled / identified.

The asphalt plant's health and safety procedures that may be required shall be provided by the Contractor in advance.

Upon request from the Project Manager, the Contractor shall supply copies of plant records during asphalt production that will allow a demonstration of the proportion of RAP added to the mix.

.02.03.03 Tack Coat

Prior to the application of any of surface or binder coarse asphalt, tack coat shall be applied. Hot-mix and warm-mix asphalt can be placed only after the tack coat is cured (changes the colour from brown to black and becomes sticky).

.02.03.04 Placement of Binder and Surface Course Asphalt

Any type of asphalt having a thickness of 80mm or more shall be placed in a minimum of 2 lifts unless otherwise directed by the Project Manager.

The finished elevation of the surface course asphalt shall be placed so as to be flush with the lower edge of curb at the depressed portion of all wheelchair ramps. The surface course asphalt shall slope down and away from the curb to form a gutter line in front of the wheelchair ramp.

.02.03.05 Binder Course Asphalt – Temporary Ramping

When the surface course asphalt is to be delayed or placed the following year, temporary asphalt ramps shall be placed at all wheelchair ramps and driveway approaches. The top of the temporary asphalt ramps shall be placed so as to be flush with the lower edge of curb at the depressed portion of all wheelchair ramps and driveway approaches. The temporary asphalt ramps shall be removed at the time of placement of the surface course asphalt at no additional cost.

.02.03.06 Use of Paving Equipment – Paving in Echelon

OPSS.MUNI 310.07.07 is amended with the addition of the following paragraph:

Paving in Echelon is mandatory for the placement of binder and surface course asphalt. The pavers shall be operated at the same time and maintain a distance of not more than 50m from each other so that a hot joint is obtained between the lanes of mixtures being placed. The Contractor shall supply sufficient personnel to adequately control both spreading operations simultaneously.

Where the entire width of the proposed pavement platform cannot be paved in echelon with 2 pavers, one longitudinal construction joint is permitted. Each half of the road shall be paved in echelon resulting in only one longitudinal joint in the binder and surface courses located at the centreline of the road. The joint shall be located to ensure that it does not align with the wheel path of traffic.

.02.03.07 Asphalt Material Transfer Vehicle

OPSS.MUNI 310.07.07 is amended with the addition of the following paragraph:

A Shuttle Buggy® Asphalt Material Transfer Vehicle (AMTV) is required for all paving operations, including paving using only one paver. The use of an AMTV will be paid for by the tonne.

.02.03.08 Re-Heating and Compaction of Longitudinal Joints

OPSS.MUNI 310.07.07 is amended with the addition of the following paragraph:

For surface course, the Contractor shall use an approved method of re-heating, re-working and compacting all centreline longitudinal cold joints. Pricing shall be based on an infra-red heating system capable of maintaining a minimum temperature of 93° C to produce a welded joint, without scorching or burning the mix.

All re-heating methods shall be approved prior to the start of any asphalt placement.

The density of the mix at any longitudinal joint shall be within 1.5 percent of the mainline mat density. Compaction of longitudinal joint shall be measured within 0.3 m from the joint.

.02.03.09 Review of Longitudinal Joint Quality

Prior to the expiry of the 24 month maintenance period, all joints in surface course asphalt shall be reviewed. The review will consider weld quality, proper compaction and separation. All joints showing signs of separation or poor welding shall be re-heated and compacted to achieve a welded joint. All repairs to longitudinal joints shall be at the cost of the Contractor.

.02.03.10 Aggregate Gradation and Asphalt Cement Content Acceptance

OPSS.MUNI 310.08.04 is deleted and replaced by the following:

If the HMA is borderline for aggregate gradation or asphalt cement content specified in Table 800-4, the Contractor shall take immediate corrective action through process control at the HMA plant. A total of three consecutive borderline test results for any attribute representing up to 1,000 tonnes of HMA production shall result in the work being deemed rejectable.

TABLE 800-4
Production Tolerances on the Job-Mix Formula
Aggregate Gradation and Asphalt Cement Content

Mix	Attribute	Tolerances on the Job-Mix Formula % (Note 1)		
		Acceptable	Borderline	Rejectable
Surface Course	DLS, 4.75mm sieve size	< 5.0	5.0 to 7.5	>7.5
	600 µm sieve size	< 3.5	3.5 to 5.0	>5.0
	75 µm sieve size	< 2.0	2.0 to 3.0	>3.0
Binder and Levelling Courses	DLS, 4.75mm sieve size	< 7.0	7.0 to 10.0	>10.0
	600 µm sieve size	< 4.5	4.5 to 6.0	>6.0
	75 µm sieve size	< 2.0	2.0 to 3.0	>3.0
All Mixes	Asphalt Cement Content	< 0.20	0.2 to 0.30	>0.30
Note 1: Tolerances on the job-mix formula apply as both plus and minus from the job-mix formula percent.				

Rejected HMA due to aggregate gradation, such as non-compliance on the DLS 4.75mm, 600 µm, or 75 µm sieve sizes, or non-compliance due to the asphalt cement content specified in Table 800-4, shall be subject to review and corrective actions, including but not limited to payment reduction, or material removal and replacement with acceptable HMA at the Contractor's expense.

The asphalt cement content and aggregate gradation shall be determined for each day's mix production for a given plant location on the basis of the sampling frequency criteria in Table 800-5.

Table 6 found in OPSS.MUNI 310 is hereby deleted and replaced by Table 800-5 below.

**TABLE 800-5
Criteria for HMA Sampling and Testing**

MIX TYPE	ASPHALT PLANT DAILY PRODUCTION FOR PROJECT	MINIMUM SET OF TEST SAMPLES
Surface Course	< 250 tonnes	3
	> 250 tonnes	One additional sample per 250 tonnes or part thereof
Binder Course	< 500 tonnes	3
	> 500 tonnes	One additional sample per 500 tonnes or part thereof
<p>Note:</p> <ol style="list-style-type: none"> 1. The Project manager may reduce the sampling/testing frequency for HMA that is consistently being produced to the specification requirements 2. A set of test samples are to include a QC sample(for the contractor), a QA sample (for The City) and a Hold (for The City) 		

Field samples for quality assurance and/or quality control testing shall be Quarter Master Samples obtained during asphalt placement and compaction procedures that meet the minimum sample size of 20 kg as given in OPSS.MUNI 310, Table 6. Samples obtained from the spreader hopper or truck box shall not be used for QA/QC testing.

Samples shall be taken and collected by the contractor at locations determined by the Project Manager or the City's representative. These samples shall be representative of the paving operations. At each location, three samples shall be taken and packed in separate cardboard boxes supplied by the paving contractor. The box samples shall be numbered in sequence for a given contract, and shall be marked to identify each individually. In addition, each sample shall be labelled to include the following minimum identification:

1. Contract Number;
2. Location of Sampling;
3. Date and Time of sampling;
4. Asphalt type;
5. Load number;
6. Load tonnage.

Two of the samples from each sample location shall be the property of The City.

.02.03.11 Air Voids Acceptance for HMA Production

The production of air voids for all HMA mixes shall be evaluated according to Table 800-6.

Table 9 found in OPSS.MUNI 310 is hereby deleted and replaced by Table 800-6 below.

**TABLE 800-6
Laboratory Air Void Criteria for Hot Mix Asphalt Production (LS-265)**

Mix	Air Voids (%)		
	Acceptable	Borderline	Rejectable
All Mixes	3.0 to 5.0	2.0 to 2.9 and 5.1 to 6.0	< 2.0 and > 6.0

If the HMA is borderline for air voids as specified in Table 800-6, the Contractor shall be notified in writing and shall take immediate corrective action through process control at the HMA plant.

If the HMA is deemed rejectable, the Contractor and Project Manager shall review and identify the limits of rejectable HMA that has been placed, which shall be subject to corrective actions, including but not limited to payment reduction, or material removal and replacement with acceptable HMA at the Contractor's expense.

.02.03.12 Asphalt Layer Segregation

All hot mix asphalt shall be inspected for segregation in accordance with the following:

.02.03.12.01 Types of Segregation

Segregation consists of areas with comparatively coarser texture than that of the surrounding pavement. All segregation is deemed to be deficient materials and/or workmanship, regardless of the type, location, cause or severity. The Contractor shall provide traffic control, as required, to conduct all segregation assessments.

Two main types of segregation are recognized:

Mid-lane Segregation: consists of any continuous or semi-continuous longitudinal mark or "streak", typically no greater than 300mm in width. Such segregation is often found in the middle of the lane, in the vicinity of a paver's gearbox, but may be located anywhere across the width of the lane.

Other Segregation: consists of discrete areas or patches of regular, irregular or chevron shape.

.02.03.12.02 Severity of Segregation

The severity of segregation is categorized as follows:

Slight Segregation: The pavement matrix is in place between the coarse aggregate particles; however there are slightly more coarse aggregate particles in comparison with the surrounding acceptable mix.

Medium Segregation: The pavement has significantly more coarse aggregate particles than the surrounding acceptable mat and usually exhibits some lack of surface matrix.

Severe Segregation: The pavement appears very coarse, with coarse aggregate particle against coarse aggregate particle and the pavement has little or no matrix.

.02.03.12.03 Paving Segregation

If the Contractor fails to prevent slight segregation in paving, the Project Manager will issue a written warning and request the Contractor to address the problem. The Contractor may be allowed to continue paving at the discretion of the Project Manager. If medium segregation is observed, the paving operation will be stopped. The Contractor shall prove to the satisfaction of the Project Manager that the paving can be continued without any medium segregation.

.02.03.12.04 Correction of Segregation

If the Contractor's actions fail to prevent continued slight to medium segregation from any source, the Project Manager may instruct the Contractor to cease paving until the problem has been corrected and the City shall not be held responsible for any additional costs that the Contractor may incur as a result.

From the time that the Contractor receives notification of mid-lane segregation, the Contractor will be allowed a maximum of 100 tonnes of mix to be placed on the Contract, in order to demonstrate the effectiveness of any repairs and/or adjustments that have been made to a defective paver.

The Contractor shall demonstrate the repairs and/or adjustments to the paver, which is acceptable to the Project Manager. If the Contractor is unable to eliminate segregation to the satisfaction of the Project Manager, by making repairs or adjustments to the paver within the allowable 100 tonnes of hot mix, then the Contractor shall discontinue the use of that machine and/or material.

.02.03.12.05 Mid-Lane Segregation

Medium to severe mid-lane segregation shall be repaired by removal and replacement at no cost to the City. Slight mid-lane segregation will be accepted into the work with no payment reduction.

.02.03.12.06 Other Segregation

The disposition of Other Segregation shall be as follows:

Slight Segregation: Slightly segregated mix will be accepted into the work with no payment reduction.

Medium Segregation: Medium segregation in all HMA lifts shall be repaired at the direction of the Project Manager at no cost to the City.

Severe Segregation: All severely segregated mix shall be repaired by removal and replacement at no cost to the City.

Levelling or padding courses with a total thickness which is less than that is normally placed in a lift of hot mix (i.e., usually 40mm), that is not machine-laid and any areas of "handwork" shall not be assessed on the basis of segregation but on the basis of other workmanship-related problems. However, if they deteriorate prior to being overlaid by another pavement course, the Project Manager will assess the causes of the deterioration before determining responsibility for the cost of repairs.

.02.03.12.07 Repairs

All repairs shall be subjected to the approval by the Project Manager.

Repairs shall consist of removal and replacement with new hot mix or a hot mix overlay, where permitted.

Repairs for segregated hot mix shall be full lane or shoulder width. However, localized repairs may be permissible for mid-lane segregation in binder courses provided hot joints are used or the mat is still hot.

A paver shall be used for all repairs except those where localized repairs are allowed.

Where localized repairs are allowed for mid-lane segregation in binder courses, these repairs shall be:

- Less than or equal to 300mm in width;
- To the full depth of the subject lift; and
- Entirely tack-coated.

Hot mix used in all repairs shall meet the requirements specified for the tender item in the Contract. All repairs shall be done in a workmanlike manner complying with all requirements for placing hot mix stated in the Contract. All repaired areas must be entirely tack-coated and all transverse joints in surface course repairs must butt up to a vertical face.

For surface and binder courses, all repairs for remedial work due to visually defective mix, including pavement removal and replacement, overlays where permitted, additional shouldering, traffic control and any other work which has to be redone such as line painting shall be made entirely at the Contractor's expense.

.01 SUMMARY OF STANDARD COMPACTION REQUIREMENTS

MATERIAL	LOCATION / USE	MINIMUM SPECIFIED COMPACTION	SPECIFICATION REFERENCE
Hot Mix Asphalt	Pavement Structures on Roads and Paved Parking Areas	92 % MRD	OPSS.MUNI 310
Granular "A" Base Course	Road, Curb, Sidewalk and Bikepath Construction	100 % SPMDD	OPSS.MUNI 501
Granular "B" Sub-Base	Road Construction	100 % SPMDD	OPSS.MUNI 501
Granular Backfill Form 600	Trench Backfill for Sewers, Watermains, Utilities, Catch Basins, Manholes, Valve Chambers	95 % SPMDD	OPSS.MUNI 401 OPSS.MUNI 402
Earth, Soils and/or Native Materials	Trench Backfill for Sewers, Watermains, Utilities, Catch Basins, Manholes, Valve Chambers	95 % SPMDD	OPSS.MUNI 401 OPSS.MUNI 402
	Embankment Fill and Subgrade Material for Pavements, Sidewalks and Bikepaths	95 % SPMDD	OPSS.MUNI 501
	General Fill for Landscaped Areas	90 % SPMDD	See contract documents
Granular Backfill around Structures	Fill next to Footings, Bridge Abutments and behind Retaining Walls	100 % SPMDD	OPSS.MUNI 401
Granular Bedding	Pipe Bedding for Watermains and Sewers	95 % SPMDD	FORM 600 OPSS.MUNI 441

- Notes:**
- [1] Unless otherwise directed, compaction will be assessed using a nuclear density gauge, as per ASTM D2922 and D3017.
 - [2] MRD refers to **Maximum Relative Density** as determined by laboratory test method LS-287
 - [3] SPMDD refers to **Standard Proctor Maximum Dry Density** as determined by MTO laboratory test method LS-706. Control Strips as outlined in OPSS.MUNI 501 may also be used to determine target density

.02 COMPACTION METHODS

All contract references to % compaction or maximum compacted densities by whatever method specified, shall be interpreted as being "The maximum dry density as determined by current City procedures".

Current City procedures shall mean the method described in the current Standards:

D.698-70 Moisture - Density Relations of Soils Using 5.5 lb. Hammer and 12 in. Drop

D.2922-71 Determining the Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D.2950-71T Density of Bituminous Concrete in Place by Nuclear Methods.

As an expedient the City may determine the (degree of compaction) maximum dry density by "the constant dry weight methods", as set out in D.H.O. Research Report No. 141, together with such variations of the above methods as the City may from time to time introduce.

Any such deviation between current City procedures and methods formerly specified or any modifications to current City procedures which may be introduced shall be for the purpose of increasing the reliability of the test results and speed in field testing and will result in no increase in the compactive effort required.

All backfill materials shall be placed in layers not exceeding 300mm (12") in depth and compacted to a minimum of 95% Standard Proctor Maximum Dry Density - see Standard Compaction Requirements in COH FORM 900.01 and Specifications for Materials and Testing.



PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION / MODEL No.
Backflow Preventers	FOR WATERMAIN COMMISSIONING PURPOSES ONLY	Watts	009 (16mm to 50mm)
			LF909 (75mm to 200mm)
Backwater Valve		Bibby-Ste-Croix	69060
Corrosion Protection	Zinc Anodes: 5.4 Kg and 10.5 Kg ASTM B-418, Type 2 Magnesium Anodes: 14.5 Kg - B-107, ASTM 843, Type M1 OPSS.MUNI 442		
	Protective coatings for metal fittings	Advanced Corrosion Solutions Inc.	ACS PetroGuard (primer, mastic and tape)
		Bren Technologies	Petro Coating Systems (PCS) (primer, mastic and tape)
		Denso North America	Denso Wrap (primer, mastic and tape)
		PetroWrap	PetroWrap (primer, mastic and tape)
	Trenton	No. 1 Wax Tape (primer, mastic and tape)	
Polyethylene encasement for ductile iron watermain pipe and fittings ANSI/AWWA C105 A21.5 - 8 mil low density Poly-Tube with overlap			
Couplings	Water Service Couplings 19mm to 50mm AWWA C800, NSF 61(Annex G) compression fit copper to copper connections	Cambridge Brass	118NL
		Ford Meter Box Co.	C44-Q-NL
		Mueller	H-15403N
	Water Service Couplings 19mm to 50mm AWWA C800, NSF 61(Annex G) copper to lead or alloy connection	Ford Meter Box Co.	Q14-NL, Q24-NL, Q34-NL with internal stop



PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION / MODEL No.
Couplings Cont'd...	Direct Buried Watermain Pipe Couplings AWWA C219 epoxy coated with stainless steel straps, nuts and bolts	Ford Meter Box Co.	FC1 and FC2A 100mm to 300mm DI and PVC
			FC2W-xx-SH 100mm to 400mm DI and PVC
		Robar Industries	1506 (4 or 5 bolt model) 100mm to 400mm DI and PVC
		Krausz Industries	Hymax Model No. 2000 100mm to 300mm DI and PVC
		Viking Johnson	MaxiFit (100mm to 1200mm)
	In-Chamber Watermain Pipe Couplings epoxy coated with stainless steel nuts and bolts	Victaulic	Style 31 400mm DI only
			Style 44 500mm and Larger Steel Pipe and CPP
		Style AGS W77 (used when specified in the contract documents) 500mm and Larger Steel Pipe and CPP	
Curb Stops	19mm to 50mm AWWA C800 NSF 61(Annex G) compression ends ball type, non-draining.	Cambridge Brass	202NL
		Ford Meter Box Co.	B44-Q-NL
		Mueller	300 B-25209N
Fittings	Ductile Iron Up to 300mm Pressure Class 350, cement lined, AWWA C104, C110 / A21.10, C153/A2.53, OPSS.MUNI 441, NSF 61	Bibby-Ste-Croix	
		Sigma	
		Star Pipe Products	
		Tyler/Union	DM, DFF and XM
	Ductile Iron 400mm and larger Class 52, cement lined restrained mechanical joint AWWA C104, C110 / A21.10, OPSS.MUNI 441.05.02	Bibby-Ste-Croix	
		Sigma	
		Star Pipe Products	
		Tyler/Union	DM, DFF and XM



PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION / MODEL No.
Fittings Cont'd...	PVC 100mm, 150mm, 200mm, injection molded AWWA C907, B137.3 OPSS.MUNI 441	Ipex	Blue Brute
		Royal	Royal
	PVC 300mm to 750mm CSA B137.3 shall use AWWA C900 pipe, bonded and over-wrapped with fiberglass-reinforced polyester	Ipex	Blue Brute, Big Brute
		Royal	Royal
Hydrants	3 way hydrants AWWA C502 CAN / ULC S-520 2-63.5 mm side ports, CSA standard thread, stainless steel nuts, bolts and studs 100mm "STORZ" pumper connection 25mm hydrant operating nut open left (counter clockwise) Extensions permitted at boot only	American AVK	Style 2780
		Clow Canada	Brigadier Series M -67
		Mueller	Darling B-50-B
Insulation	Extruded Polystyrene	Dow	Styrofoam Highload 100
		Owens Corning	Foamular 1000 (Pink)
Joint Restraint	Ductile Iron Pipe	Ebaa Iron	Mega-Lug Series 1100 Black epoxy coated wedges and nuts (100mm to 1200mm)
			Tru-Dual Series 1500TD (100mm to 300mm)
		Ford Meter Box Co.	Uni-Flange Series 1390 (100mm to 300mm)
		Smith-Blair	Cam-Lock Series 111 - epoxy coated wedges and nuts (100mm to 600 mm)
			Bell-Lock 115 and 165 (100mm to 300mm)



PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION / MODEL No.
Joint Restraint Con'd...	Ductile Iron Pipe Con'd...	Sigma	One-Lok - SLDE (100mm to 600mm)
		Star Pipe Products	Stargrip Series 3000 and 3100 (100mm to 1200mm)
		Tyler/Union	TUFGrip TLD (black)
	Polyvinyl Chloride Pipe (PVC) AWWA C900 ASTM F1674	Ebaa Iron	Tru-Dual Series 1500TD (100mm to 300mm)
		Ford Meter Box Co.	Uni-Flange Series 1390 (100mm to 300mm)
		Sigma	PV-Lok - SLC (100mm to 600mm)
		Star Pipe Products	Stargrip Series 4000 Top breakaway nut same size as the T-bolt (100mm to 750mm)
			Stargrip Series 4000G2 (100mm to 300mm)
			1000C - pipe to MJ or Push-On Fittings (100mm to 300mm); 1100C – Bell Joints (100mm to 300mm); 1200C – pipe to PVC Pressure Fittings with DI pipe OD (100mm to 300mm)
		1000G2C – pipe to MJ push-on fittings (100mm to 300mm); 1100G2C – Bell Joints (100mm to 300mm); 1200G2C – pipe to PVC pressure fittings with DI pipe OD AWWA C907 (100mm to 300mm).	
		9000C – pipe to MJ push-on fittings (100mm to 300mm); 9100C – Bell Joints (100mm to 300mm); 9200C – pipe to PVC pressure fittings with DI pipe OD AWWA C907 (100mm to 300mm).	
		Smith-Blair	Bell-Lock 115 (100mm to 300mm)
			Cam-Lock Series 120 (100mm to 600 mm)
		Tyler/Union	TUFGrip TLP (red).



PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION / MODEL No.
Joint Restraint Con'd...	Molecularly Oriented Polyvinyl Chloride (PVCO) AWWA C909	Sigma	PV-LOK: PWM - PVCO to MJ fitting PVPF - PVCO to PVC fitting PWP - PVCO bell and spigot.
		Star Pipe Products	Stargrip Series 4000 (100mm to 300mm)
			Stargrip Series 4000G2 (100mm to 300mm)
			9000C – pipe to MJ push-on fittings (100mm to 300mm); 9100C – Bell Joints (100mm to 300mm); 9200C – pipe to PVC pressure fittings with DI pipe OD AWWA C907 (100mm to 300mm).
			1000G2C – pipe to MJ push-on fittings (100mm to 300mm); 1100G2C – Bell Joints (100mm to 300mm); 1200G2C – pipe to PVC pressure fittings with DI pipe OD AWWA C907 (100mm to 300mm).
	Tyler/Union	TUFGrip TLP (red) - pipe to MJ fittings (100mm to 300mm)	
Main Stops (Corporations)	19mm to 50mm AWWA C800 NSF 61(Annex G) compression end, ball Type non-draining	Cambridge Brass	301NL - A3H3, A4H4, A6H6, A7H7
		Ford Meter Box Co.	FB1000 Series, Q Type
		Mueller	300 B-25008N
Pipe	Concrete Pressure Pipe 500mm and larger AWWA C301 and C303, OPSS.MUNI 441 Plant pre-qualified by ACPA	Forterra	
		Decast Ltd.	
	Ductile Iron Pipe 100mm to 200mm & 300mm Pressure Class 350, AWWA C104 / A21.4, C150 / A21.50, C151 / A21.51 OPSS.MUNI 441	Canada Pipe Company <i>(Includes polyethylene encasement of pipe and fittings AWWA C105 / A21.5)</i>	Tyton Joint Pipe TR Flex Joint Pipe



PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION / MODEL No.
Pipe Cont'd...	Ductile Iron Pipe, Thickness Class 52 AWWA C104 / A21.4, C150 / A21.50, C151 / A21.51 OPSS.MUNI 441	Canada Pipe Company	Tyton Joint Pipe 400mm to 1050mm
		<i>(Includes polyethylene encasement of pipe and fittings AWWA C105 / A21.5)</i>	TR Flex Joint Pipe 400mm to 900mm
	Ductile Iron Pipe 1200mm Pressure Class 350 AWWA C104 / A21.4, C150 / A21.50, C151 / A21.51 OPSS.MUNI 441	Canada Pipe Company	Tyton Joint Pipe
		<i>(Includes polyethylene encasement of pipe and fittings AWWA C105 / A21.5)</i>	
	Polyvinyl Chloride (PVC) 100mm to 200mm & 300mm AWWA C900 - DR18 OPSS.MUNI 441	Diamond Plastics Corp. (DPC)	AWWA C900
		Ipex	Blue Brute
		National Pipe and Plastics	AWWA C900
		Royal	Royal
	Molecularly Oriented Polyvinyl Chloride (PVCO) 100mm to 200mm & 300mm AWWA C909-PC235, OPSS.MUNI 441	Ipex	Bionax
	Polyvinyl Chloride (PVC) 400mm AWWA C900 – DR18 OPSS.MUNI 441	Ipex	Big Brute, Centurion
		Royal	Royal
	Polyvinyl Chloride (PVC) 500mm to 750mm AWWA C900, OPSS.MUNI 441	Ipex	Big Brute, Centurion
		Royal	Royal
Water Service Pipe 19mm to 50mm AWWA C800, OPSS.MUNI 441, ASTM B88, Type K Soft Copper	Great Lakes Copper Canada Ltd.		



PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION / MODEL No.
Repair Clamps	Direct Buried (clamps to be supplied with conductivity strip)	Robar Industries	5616, 5626, 5636
		Ford Meter Box Co.	Style FS1, FS2 and FS3
	In-Chamber	Straub Tadco	Straub-Flex, non-restrained up to 1200mm (modified for Hamilton)
Service Boxes	Slide adjustment type Stainless steel rods brass cotter pin	Mueller	H-10300 Series
		Clow Canada	"D" Series
Service Saddles	DI, PVC Pipe Outlet size: 19mm to 50mm	Cambridge Brass	403 and 812 Series
		Ford Meter Box Co.	FS202
		Robar Industries	2506 DS, 2616
		Smith-Blair	317
	Concrete Pressure Pipe Outlet size: 19mm to 50mm	Ayotte Enterprises	A-900 with A-571 thermoplastic coating (400 mm only)
Tapping Sleeves	Outlet size: 100mm to 400mm Protective coating shall be applied to all steel sleeves.	Ayotte Enterprises	A-600 with A-571 thermoplastic coating, stainless steel nuts and bolts - concrete pipe only
		JCM Industries	JCM 415 epoxy coated with stainless steel nuts and bolts, concrete pipe only
		Smith-Blair (Steel)	#622 epoxy coated (up to 750mm) Ductile Iron and PVC pipe
		Robar Industries (Steel)	6808 and 6906 epoxy coated (100mm to 500mm) Ductile Iron, C900 PVC only
		Romac (Steel)	FTS420 epoxy coated Ductile Iron pipe
Tracer Wire	Solid 12 gauge copper		TWU75 or RWU90XLPE



PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION / MODEL No.
Valves	<p style="text-align: center;">Butterfly Valve 450mm and Larger</p> <p>AWWA C504, Class 150B manual actuator - traveling nut type with external position indicator nuts, bolts, and bolt studs to be stainless steel</p> <p>Former City of Hamilton: 25mm operating nut, open right (clockwise)</p> <p>Former Municipalities: 50mm operating nut, open left (counter clockwise)</p>	Clow Canada	<p>M & H 504 (450mm to 500mm)</p> <p>M & H AWWA Large Diameter (600mm and larger)</p> <p>Valve seat adjustment to face spool piece side</p>
		Mueller	Lineseal
		Henry Pratt Company	<p>2FII (450mm and 500mm)</p> <p>Triton XR-70 (Flanged ends) 600mm and larger</p>
	<p style="text-align: center;">Gate Valve* Resilient Wedge 100mm to 300mm</p> <p>AWWA C509, C515 nuts, bolts, and bolt studs to be stainless steel, bronze pin top adjustment not permitted</p> <p>Former City of Hamilton: 25mm operating nut, open right (clockwise)</p> <p>Former Municipalities: 50mm operating nut, open left (counter clockwise)</p> <p>*includes hydrant secondary valves</p>	Clow Canada	F-6100, F-6102, F-6106
		Mueller	A2360-6, A2360-19, A2360-23
		American AVK Co.	Series 65



PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION / MODEL No.
Valves Cont'd...	Gate Valve Resilient Wedge 400mm AWWA C509, C515 nuts, bolts, and bolt studs to be stainless steel Former City of Hamilton: 25mm operating nut, open right (clockwise) Former Municipalities: 50mm operating nut, open left (counter clockwise)	Clow Canada	F-6102
		Mueller	A2361-6
	Combination Air Release and Vacuum Breaker Valves AWWA C512 with surge protection	A.R.I Flow Control Accessories	D-060 C HF NS
		Vent-O-Mat	Water RBX Series
	Tapping Valves 100mm to 300 mm AWWA C509	Clow	F-6106
		Mueller	A2360-19
	Tapping Valves 400mm to 600mm AWWA C509	Clow Canada	F-6106BG
		Mueller	A-2361-19
Valve Boxes	Sliding Type with 6mm pre-drilled tracer wire hole and grommet in upper section	Bibby-Ste-Croix	VB1000 Series
Valve Chambers	OPSS 407, 1351 Plant must be pre-qualified by the Ontario Concrete Pipe Association	Anchor	
		Co-Pipe	
		Con Cast	
		Decast Ltd.	
		Forterra	
		M-Con	
		Wilkinson	



PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION / MODEL No.
Valve Chamber Frame and Cover	OPSS 1850 OPSD 402.011 WM 212.03	Bibby-Ste-Croix	
		EJ (McCoy)	
		Mueller	
		R.B. Agarwalla	
	750mm cover OPSS 1850 10 - 25mm vent holes "WATER" cast into cover 4 lifting keyways	EJ (McCoy)	Frame 1220Z1, Product No. 00122016 Cover 1220B, Product No. 00122028
Water Meter Reader Enclosure		Hoffman Nema 4x, fiberglass	Includes internal mounting plate



PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION / MODEL No.
Catch Basins	CSA A257.4 Form 700 OPSS 407, 1351 Supplied from a plant prequalified by the OCPA	Co-Pipe	
		Con Cast	
		Forterra	
		M-Con	
		Decast Ltd.	
		Wilkinson	
Catch Basin Frames & Covers	OPSD 400.100 ASTM A48 OPSS 1850	Bibby-Ste-Croix	
		Domcast	
		EJ (McCoy)	"All in one" cover
		Govind Steel	GS
		Labco	
		Mueller	
		Prosperity Exim P.	MF
R.B. Agarwalla			
Couplings	CSA B182.2 CSA B182.4 OPSS 1841	Fernco Connectors	
		Kwik Connectors	
		Mission Rubber Co.	
		Pipe Conx	
		Preper-PLS Tech	
Culvert Pipe	Corrugated Steel (CSP) Riveted or Spiral CSA G401 galvanized or aluminized (Type 2) OPSS 1801 and 1841 up to 1000mm - 1.6 Gauge over 1000mm - 2.0 Gauge	Armtec	Hel-Cor, Ultra Flo
		Atlantic Industries	
		Canada Culvert	Steelcor
	HDPE and PVC OPSS 1840, ASTM F 894	Armtec	Big "O", Boss 2000
		ADS	ADS N12
Goss Traps	SEW-304	EJ (McCoy)	
		CB Trap	
Maintenance Holes	CSA A257.4-M92 Form 700 OPSS 1351 1200mm to 3000mm Supplied from a plant prequalified by the OCPA	Coldstream	
		Co-Pipe	
		Con Cast	
		Forterra	
		M-Con	
		Decast Ltd.	
		Wilkinson	



PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION / MODEL No.
Maintenance Hole Frames & Covers	OPSD 401.010 Type A and B ASTM A48	Bibby-Ste-Croix	
		Domcast	
		EJ (McCoy)	
		Govind Steel	GS
		Mueller	
		Prosperity Exim P.	LM
		R.B. Agarwalla	
Sewer Pipe	Vitrified Clay Pipe 150mm to 600mm CSA A60.1M-1976 Form 500	Logan	T-Tap (without flanges)
		Concrete Pipe - Reinforced 300mm or greater CSA A257.2 65-D, 100-D, 140-D Form 500 and 700 OPSS 1820 Supplied from a plant prequalified by the OCPA	Co-Pipe
		Con Cast Pipe	
		Forterra	Concrete Bell (mortared in)
		M-Con	
		Decast Ltd.	
		Polyvinyl Chloride Pipe (PVC) Smooth Wall 150mm – SDR 28 200mm to 600mm – SDR 35 CSA B182.2 Form 500 OPSS 1841	Ipex
		Diamond Plastics	SANI-21
		Next Polymers	NEXT Duraloc
		Royal	Royal
	Saddles / Connections	CSA B182.2 CSA B182.4 100mm to 300mm	ADS Canada
Ferco 100mm and 150mm			EZ Tap
Specialty Products 2000 Inc. (150mm)			Core Bell Adaptor
Valves	Combination Air / Vacuum Breaker AWWA C512	A.R.I	D-020 (stainless steel)



PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION / MODEL No.
Drinking Fountains	Wall-Mounted Drinking Fountain	Most Dependable Fountains	450 WMSS
	Single Pedestal Drinking Fountain	Most Dependable Fountains	400 SM/SMSS
			410 SM/SMSS
		Murdock Manufacturing	GRF34-37
			GRJ84-87
	Single Pedestal Drinking Fountain + bottle filler	Most Dependable Fountains	10135 SM/SMSS
		Murdock Manufacturing	GYM74-77
	Single Pedestal Drinking Fountain + pet fountain	Most Dependable Fountains	400 SM/SMSS with pet fountain option
			410 SM/SMSS with pet fountain option
		Murdock Manufacturing	GRF34-37 with pet fountain option
			GRJ84-87 with pet fountain option
	Single Pedestal Drinking Fountain + bottle filler + pet fountain	Most Dependable Fountains	10155 SM/SMSS
		Murdock Manufacturing	GYM74-77 with pet fountain option
	Double Pedestal Drinking Fountain	Most Dependable Fountains	440 SM/SMSS/SMSSFA
Murdock Manufacturing		GRM44-47	
Double Pedestal Drinking Fountain + bottle filler	Most Dependable Fountains	10145 SM/SMSS/SMFA/SMSSFA	
	Murdock Manufacturing	GYQ84-87	
Double Pedestal Drinking Fountain + pet fountain	Most Dependable Fountains	440 SM/SMSS/SMFA/SMSSFA with pet fountain option	
	Murdock Manufacturing	GRM44-47 with pet fountain option	
Geotextile	Non-Woven PK-0210.01	Terrafix Geosynthetics	270R
Ice Rink Hut	Precast Concrete Structure with 4/12 pitch roof, size 1800x2400x3100mm.	Hy-Grade	Easi-set
Lighting Fixtures	Outdoor ice rink light fixture (2 required per pole/bullhorn)	Holophane Canada, Inc.	Predator LED: #PMLED54K10AAS651KBPPCL1 PMLEDFV-BPP5
		Holophane Canada, Inc.	Predator LED: #PF40LMH12KN1KFL-PFWG-PDPR12



PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION / MODEL No.
Lighting Fixtures Cont'd...	Standard Park Light Fixture	Philips Lumec	Optima Series LED: Lamp#10-90WLED-120V Photoelectric Cell #ESC-124DS #OT10-80W48LED4K-R-ACDR-LE2A-120-DF10-HS-(PHS-017)-BKTX To be used with Phillips Lumec Pole: SPR5J-15-BKTX (below)
		StressCrete Group	K134 York: VL 1, 60 Watt, 120 Volt, LED: #K134R-B2PR-III-60(SSL)-1042-120:277-K14-PR To be used with StressCrete Group Pole: E200-APO-G-E11 c/w 140-35/35 (below)
	Sun Shelter Ceiling Light (Vandal Resistant)	Kenall Manufacturing	Millenium Round MR17 Series - Deep Profile Housing: #MR17FD-PP-MB-50L40K-120-BPC (black) #MR17FD-PP-MW-50L40K-120-BPC (white)
Lighting Poles	Outdoor ice rink / bocce court pole, (7.6m high, galvanized steel)	Valmont West Coast Engineering	Round Tapered Steel Pole with Double 180 Top Mount Bullhorn: Pole #B-RT-25-11B-2.0 Bullhorn #C17-BH2-01-01 7.6m high, round tapered, galvanized steel, black textured finish, steel anchor base with base cover.
	Standard Park Light Pole (4.6m high, steel)	Philips Lumec	Round Steel Pole: #SPR5J-15-BKTX carbon steel, black textured finish, aluminum base cover with finish to match pole. To be used with Philips Lumec Fixture: #OT10-80W48LED4K-R-ACDR-LE2A-120-DF10-HS-(PHS-017)-BKTX (above)



PRODUCT	SPECIFICATION	MANUFACTURER	DESCRIPTION / MODEL No.
Lighting Poles Cont'd...	Standard Park Light Pole (6.1m high, concrete)	StressCrete Group	Octagonal Class A - Light Duty Pole: #E200-APO-G-E11 c/w 140-35/35, black etched To be used with StressCrete Group Fixture: #K134R-B2PR-III-60(SSL)-1042-120:277-K14-PR (above)
Spray Pad Activator Buttons	Vandal Resistant Push Button with LED, Momentary	Polara	Bulldog Series III: #BDL3-X
Tree Guard	Plastic Forms 25cm high tree trunk wrap	Arboguard	
Tree Stake Tie	PK-1105.04	Treestrap	Vstrap, biodegradable cotton
		DeepRoot Canada Corp.	Arbor Tie - Trees <150mm Cal.: Arbor Tie Green (900lb. Break strength) - Trees ≥ 150mm Cal.: Arbour Tie White (2,500lb break strength)

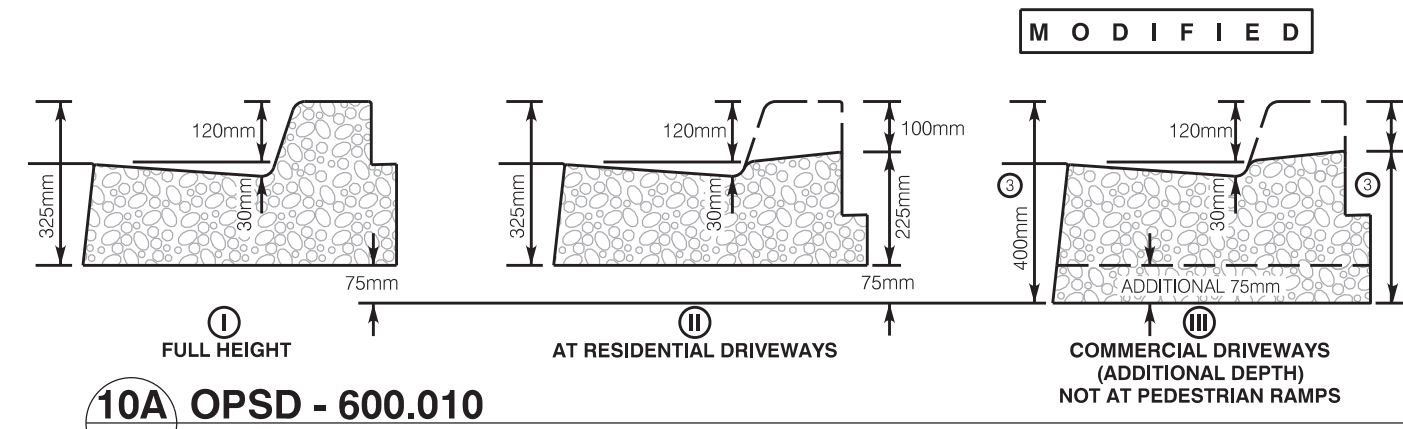
DRAWING No.	DATE	DESCRIPTION
RD-100.01	November 2005	Road Restoration Over Utility Cuts –Sheet 1of 2
RD-100.02	November 2005	Road Restoration Over Utility Cuts - Sheet 2 of 2
RD-101	November 2005	100 mm Dia. Perforated Drain Pipe Detail
RD-102.01	June 2017	Wheelchair Ramp Locations Without Inegrated Accessibility Treatment
RD-102.02	June 2017	Control Joints at Side Inlet Catch Basin Frame and Cover and Utility Pole Isolation Boxout
RD-103	January 2011	Combined Concrete Walk and Curb and Independent Concrete Walk
RD-104	January 2011	Asphalt Sidewalk
RD-105	November 2005	Interlocking Paving Stone Sidewalk
RD-106	June 2017	Standard Approach
RD-107	June 2017	California Style Approach
RD-108	June 2017	Asphalt Driveway Approach
RD-109	June 2017	Concrete Apron Approach
RD-110.01	June 2017	Offset Curb & Gutter Detail at Single Catchbasin
RD-110.02	June 2017	Offset Curb & Gutter Detail at Double Catchbasin
RD-111	June 2017	Shoulder Paving for Manholes and Chambers in Shoulders
RD-112	November 2005	Concrete Alleyway
RD-113.01	November 2005	Typical Road Cross Section - Local Urban Residential (20.0 m Right-of-Way)
RD-113.02	November 2005	Typical Road Cross Section - Local Urban Residential (18.0 m Right-of-Way)
RD-113.03	November 2005	Typical Road Cross Section Local Urban Residential - Without Sidewalk For Cul De Sacs (18.0 m Right-of-Way)
RD-113.04	November 2005	Standard Road Section For Private Townhouses
RD-113.05	June 2017	Rural Cross Section
RD-114	June 2017	Unsignalized Industrial & Commercial Entrance - Urban Section
RD-115	June 2017	Hammerhead Turning Movement Diagram
RD-116.01	November 2005	Permanent Cul-De-Sac For Local Residential Streets – Symmetrical (18.0 m Right-of-Way)

Note: 24" x 36" and 18" x 24" size drawings are not bound in this document

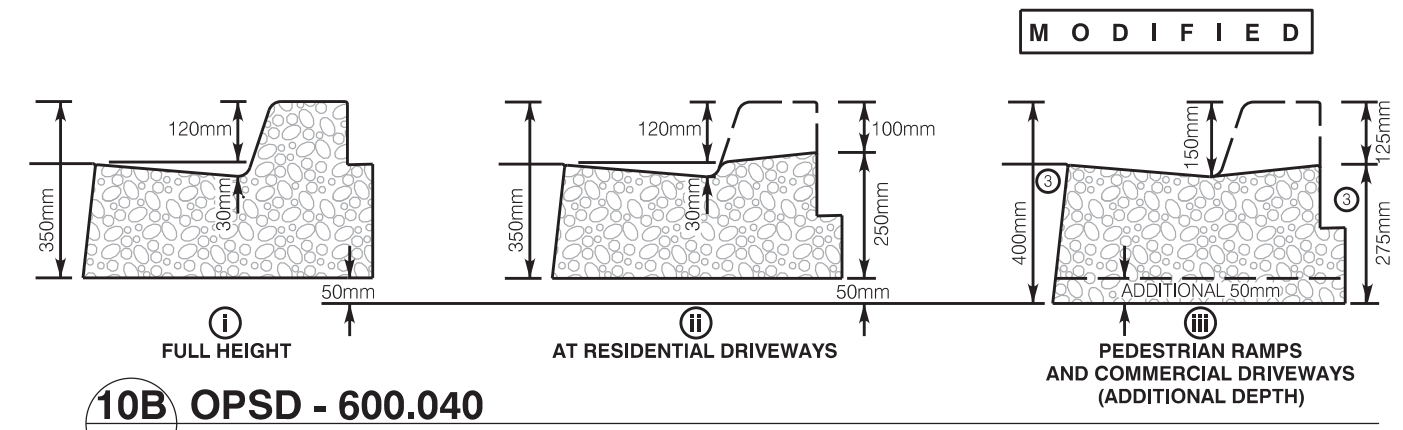
DRAWING No.	DATE	DESCRIPTION
RD-116.02	November 2005	Permanent Cul-De-Sac For Local Residential Streets – Offset Left (18.0 m Right-of-Way)
RD-116.03	November 2005	Cul-De-Sac For Industrial & Commercial Streets
RD-116.04	June 2017	Temporary Turning Circle (20.0 m R.O.W.)
RD-117	June 2017	Rural Residential Entrances
RD-118	June 2017	Rural Industrial & Commercial Entrances
RD-119.01	November 2005	Measurement for Payment Diagram – Road Reconstruction Only
RD-119.02	November 2005	Measurement for Payment Diagram – Road Reconstruction and Combined Walk and Curb Reconstruction
RD-119.03	January 2011	Measurement for Payment Diagram – Widening / Realignment /Narrowing
RD-119.04	November 2005	Measurement for Payment Diagram – Road and Independent Curb and Gutter Reconstruction
RD-120	June 2017	Typical Transit Shelter Pad for 1.2 m by 3.0 m Shelter
RD-121	November 2005	Rear Yard Swale Detail
RD-122	November 2005	Typical Toe of Excavation Swale & Berm Detail
RD-123.01	June 2017	Privacy Fence
RD-123.02	June 2017	Privacy Fence Details
RD-124.01	October 2017	Integrated Accessibility – Sidewalk/Urban Braille Guidelines (Size 24" x 36")
RD-124.02	October 2017	Integrated Accessibility – Sidewalk/Urban Braille Guidelines (Size 24" x 36")
RD-124.03	March 2018	Integrated Accessibility – Sidewalk/Urban Braille Guidelines (Size 24" x 36")
RD-125.01	November 2005	Heritage Poles and Details (Size 24" x 36")
RD-125.02	June 2017	Heritage Poles and Details (Size 24" x 36")
RD-126	November 2005	Irrigation – Typical Details (Size 24" x 36")
RD-127	June 2017	Typical Construction of Flagstone Wall on Slope
DT:0111-01	September 2015	Typical Installation of Underground Traffic Control Devices (Size 24" x 36")
DT:0111-02	September 2015	Typical Installation of Grounding and Bonding for Traffic Control Devices (Size 24" x 36")

Note: 24" x 36" and 18" x 24" size drawings are not bound in this document

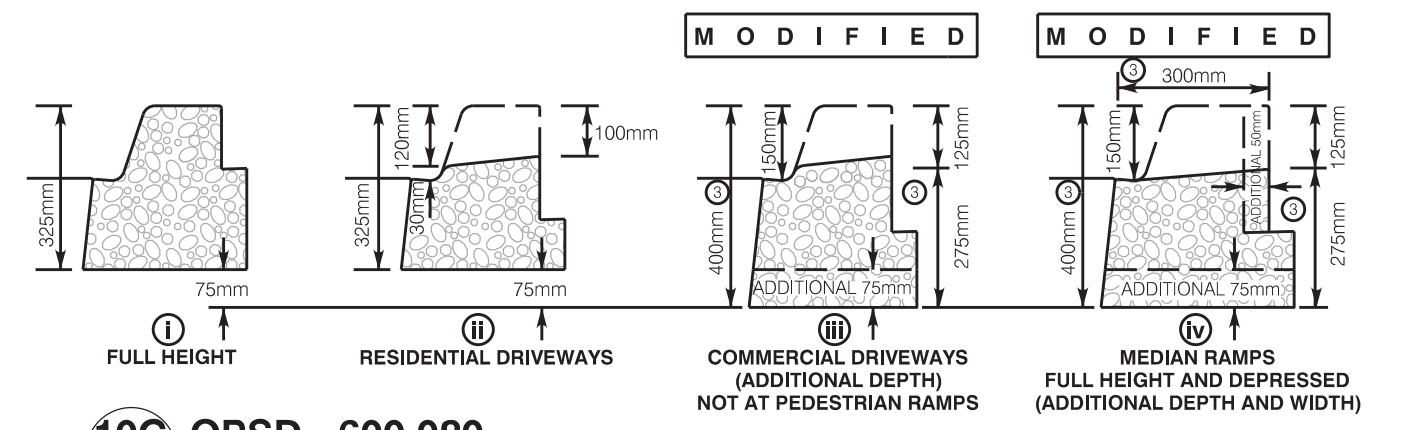
DRAWING No.	DATE	DESCRIPTION
DT:0119-01	January 2017	Standard Design for Speed Humps (Size 18" x 24")



10A OPSD - 600.010

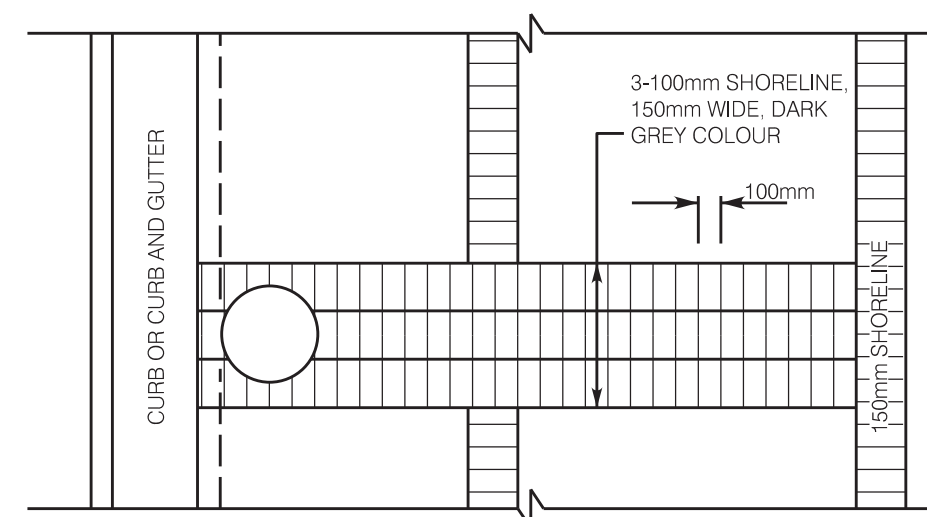


10B OPSD - 600.040

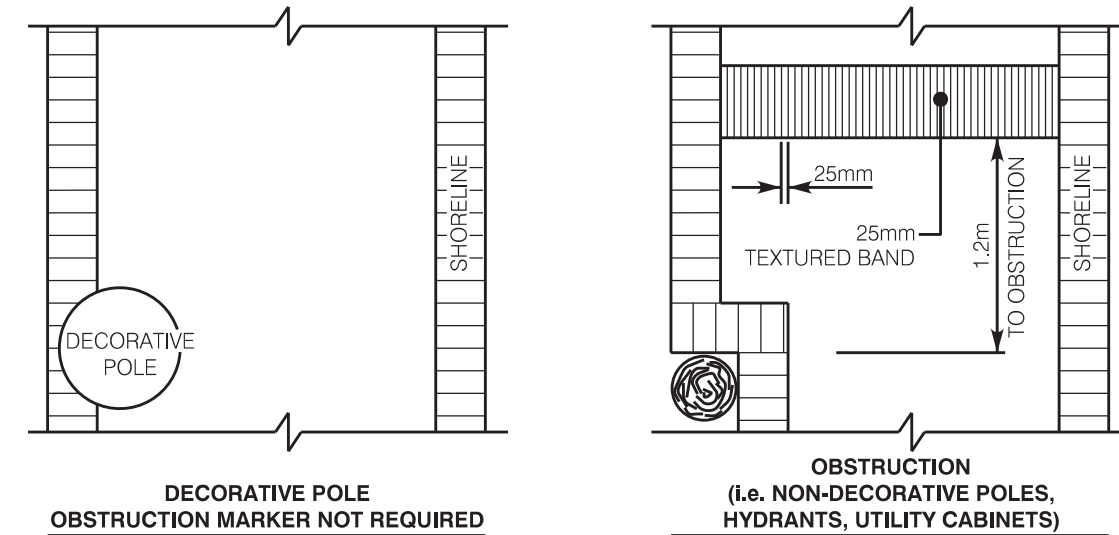


10C OPSD - 600.080

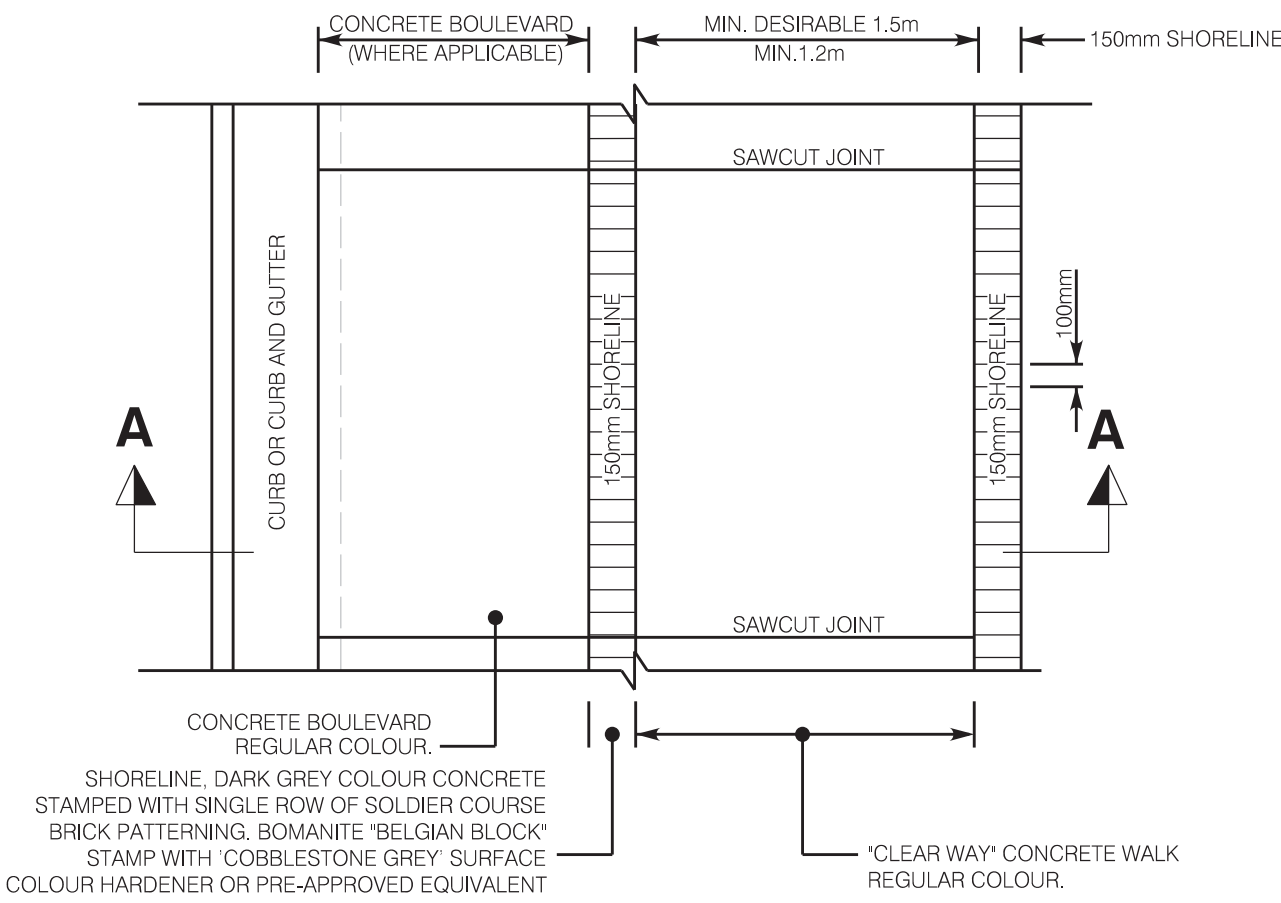
10 AMENDED OPSD CURB HEIGHTS WALK/MEDIAN/BLVD ADJACENT TO CURB



15 SHORELINES - TRANSIT STOP (450mm WIDE)

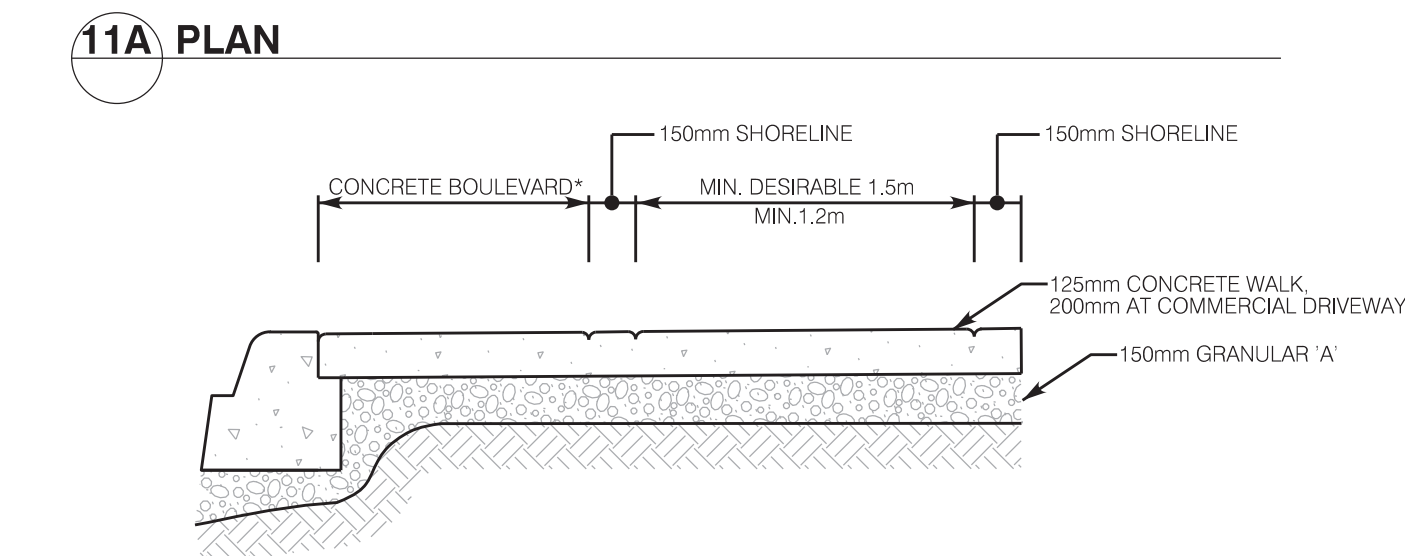


16 25mm TEXTURED BAND - OBSTRUCTIONS



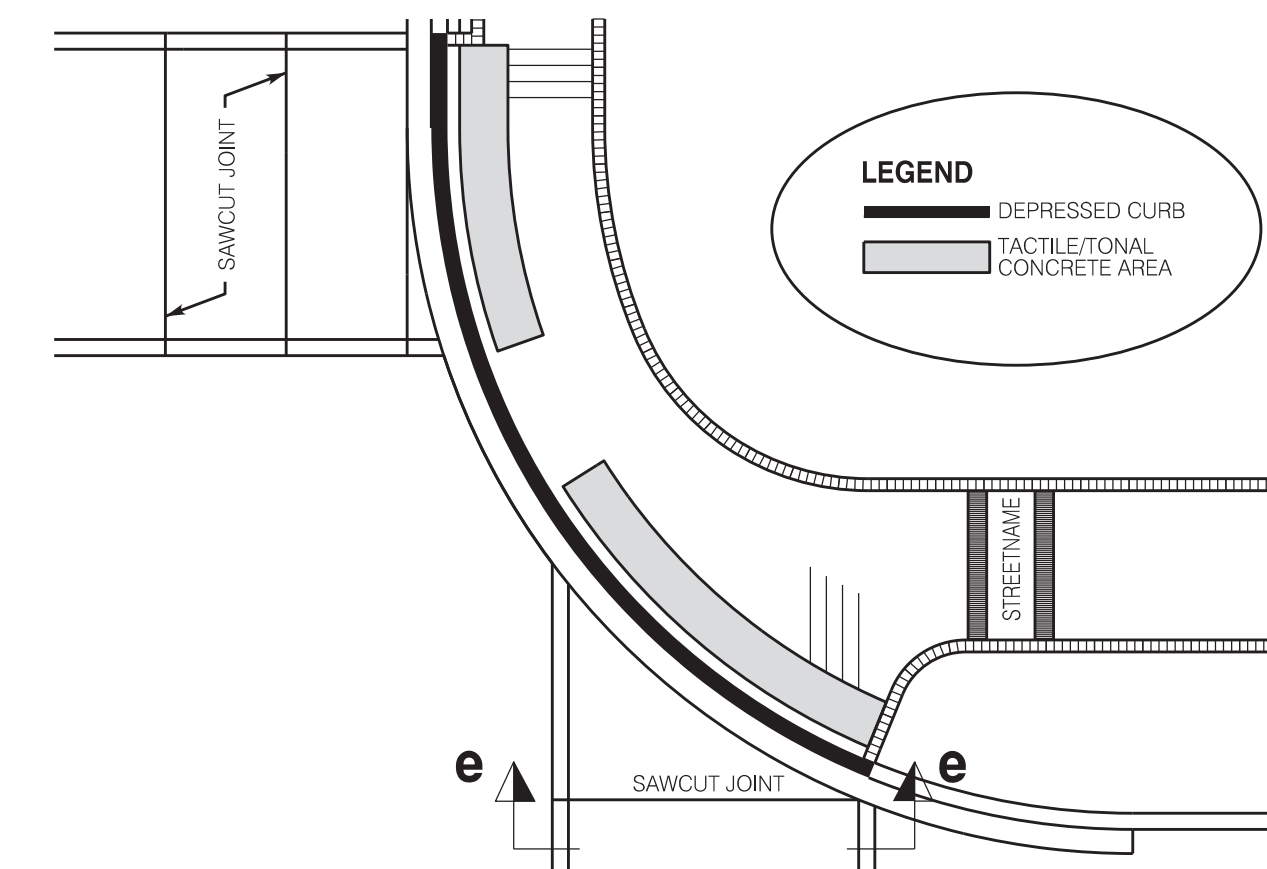
11A PLAN

- NOTES:
1. TEST POURS INDICATING FINISH, COLOUR, STAMP PATTERNS AND TECHNIQUE MUST BE APPROVED PRIOR TO INSTALLATION.
 2. FINISH AND COLOUR OF URBAN BRAILLE SIDEWALK AND BOULEVARD SHALL MATCH KING STREET EAST.
 3. FINISH SURFACE COLOUR HARDENER AND STAMP PATTERN ACCORDING TO BOMANITE METHODS AND SPECIFICATIONS OR PRE-APPROVED EQUIVALENT.
 4. HIGH PENETRATING ACRYLIC SEALER TO BE APPLIED AFTER APPROVAL OF FINISHED SURFACE.

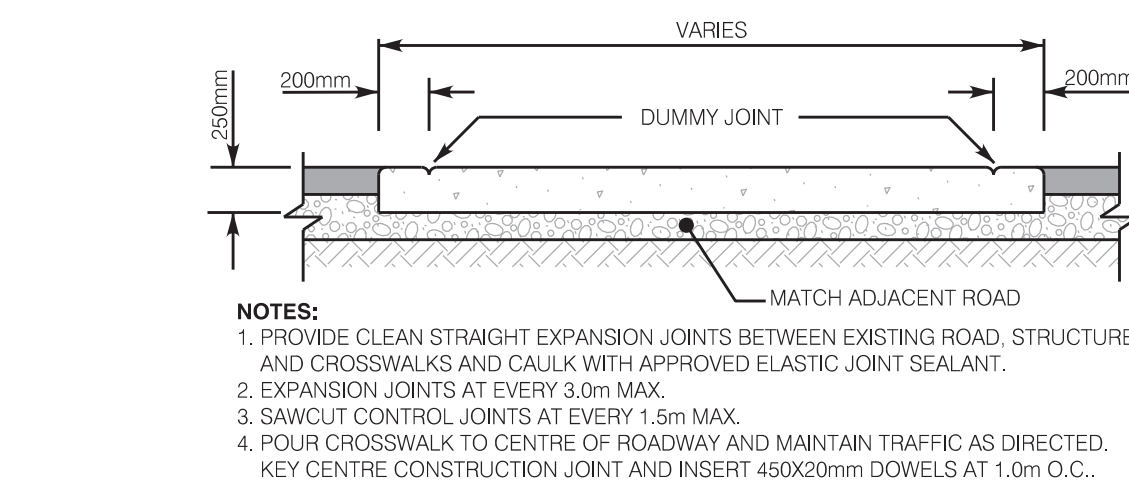


11B SECTION A-A

11 URBAN BRAILLE SIDEWALK/BOULEVARD SECTIONS AND DETAILS



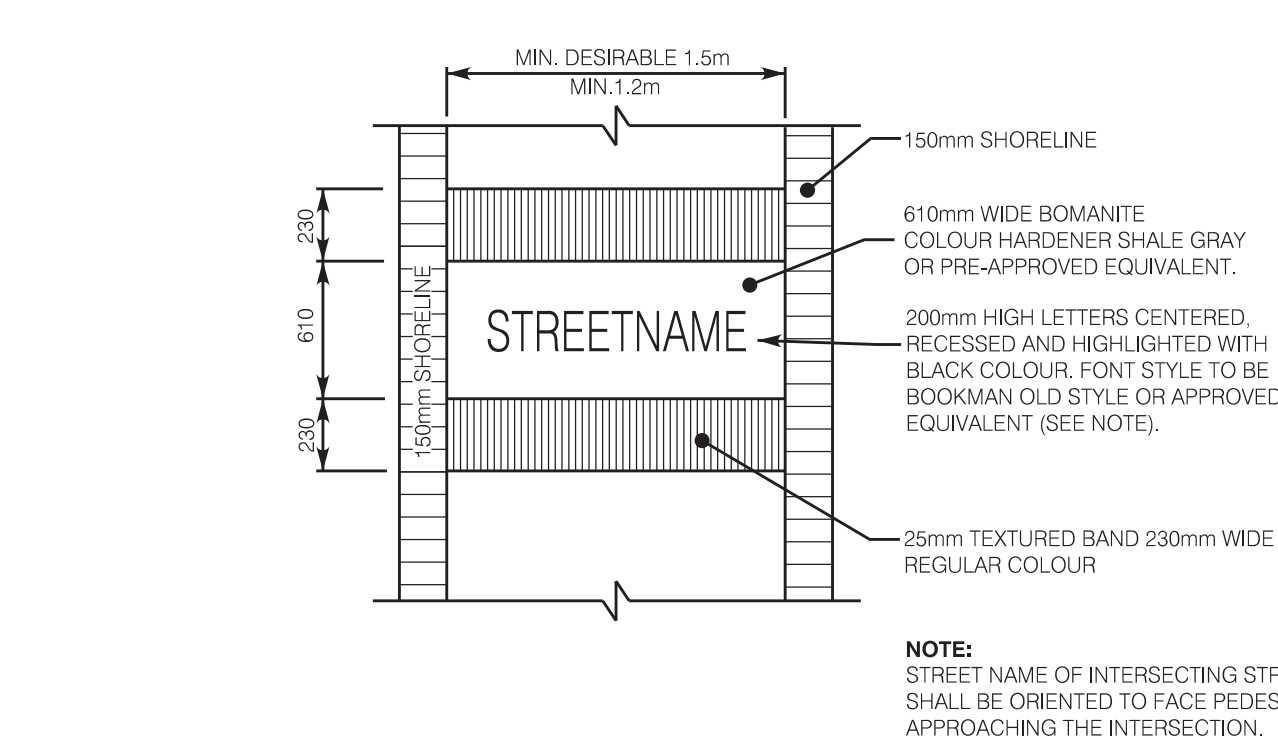
17A PLAN



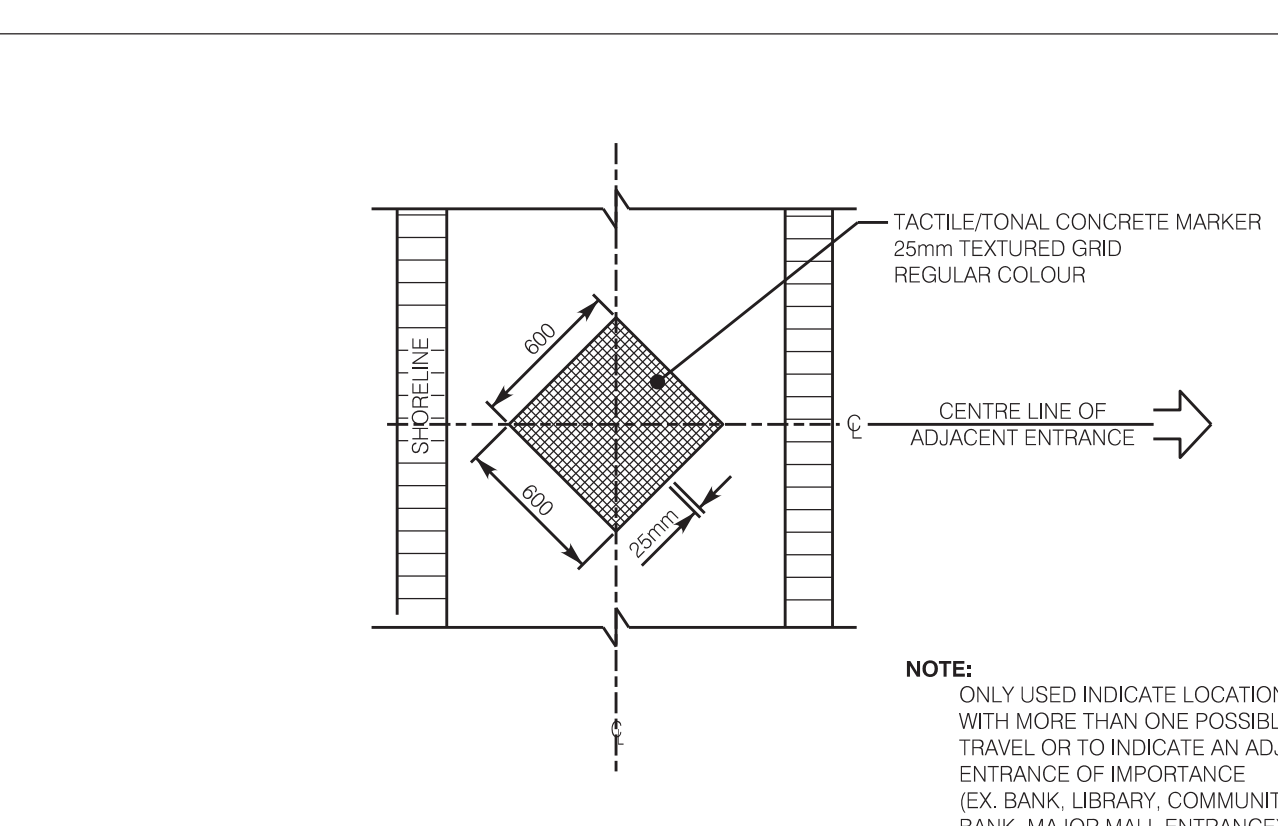
17B SECTION E-E

17 CONCRETE CROSSWALK

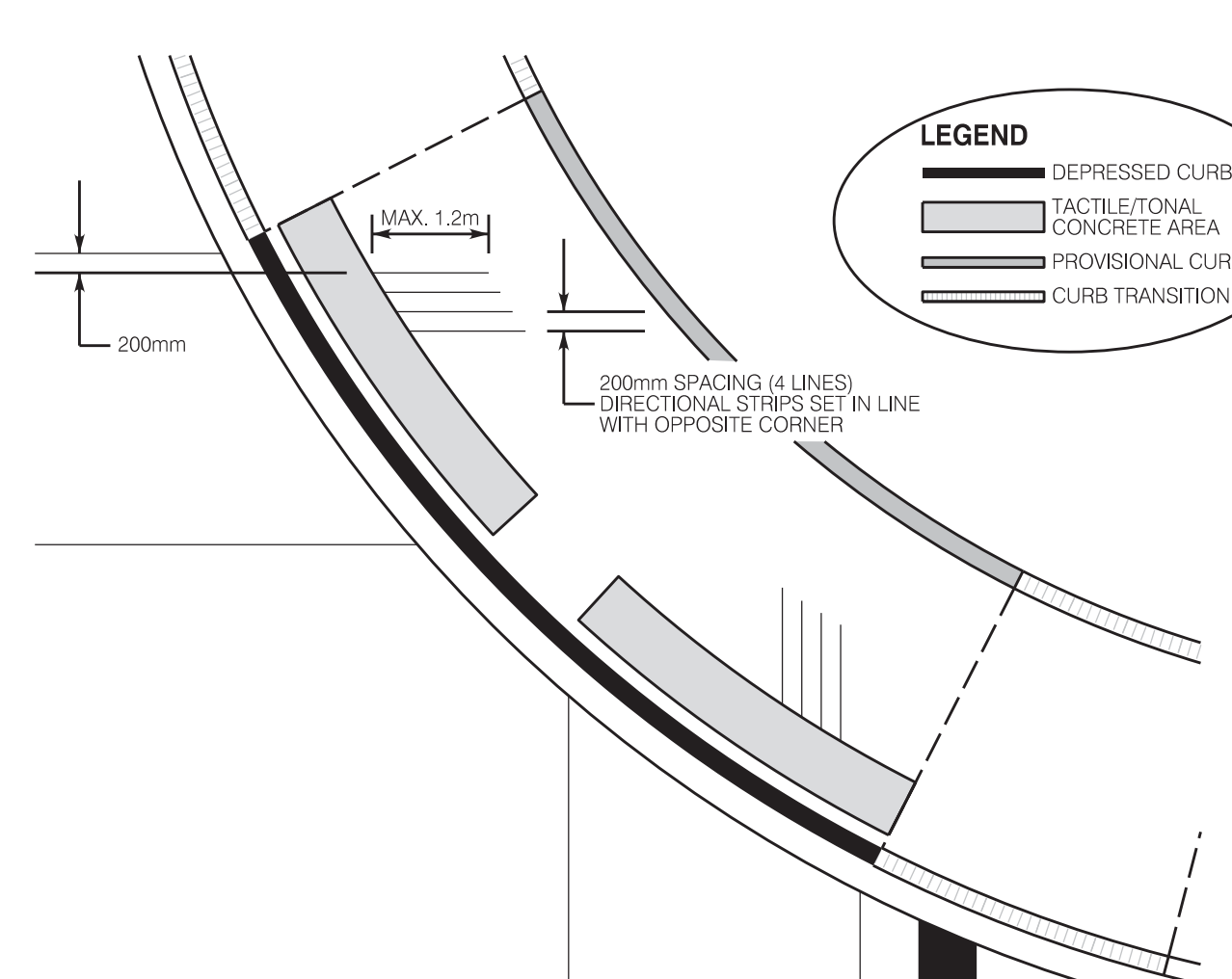
- NOTES:
1. PROVIDE CLEAN STRAIGHT EXPANSION JOINTS BETWEEN EXISTING ROAD, STRUCTURES AND CROSSWALKS AND CALK WITH APPROVED ELASTIC JOINT SEALANT.
 2. EXPANSION JOINTS AT EVERY 3.0m MAX.
 3. SAWCUT CONTROL JOINTS AT EVERY 1.5m MAX.
 4. POUR CROSSWALK TO CENTRE OF ROADWAY AND MAINTAIN TRAFFIC AS DIRECTED. KEY CENTRE CONSTRUCTION JOINT AND INSERT 450x20mm DOWELS AT 1.0m O.C..



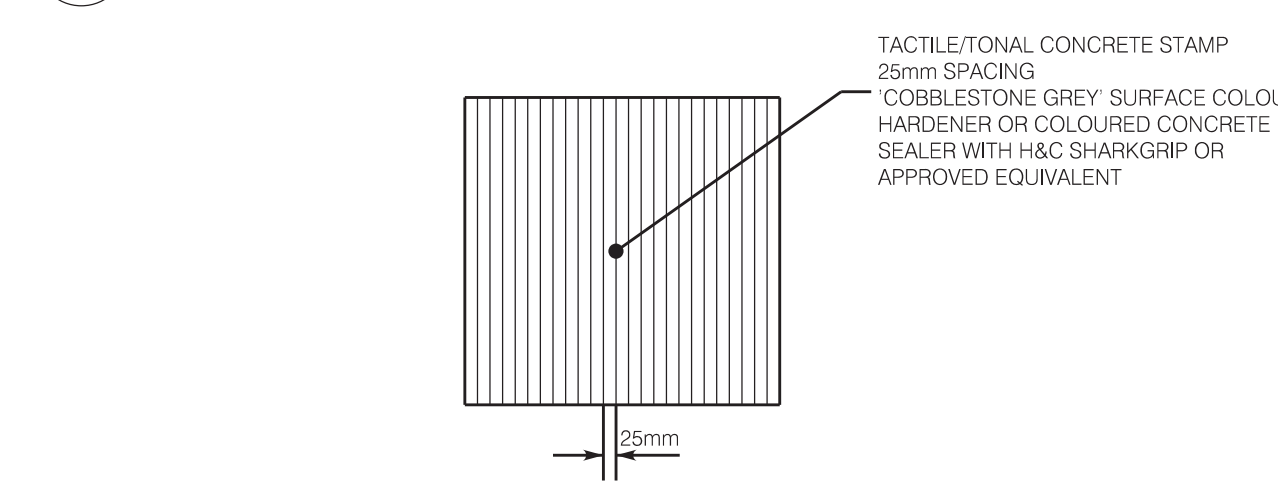
12 STREET NAME TABLET



13 ENTRANCE DIAMOND AND DECISION NODE MARKER

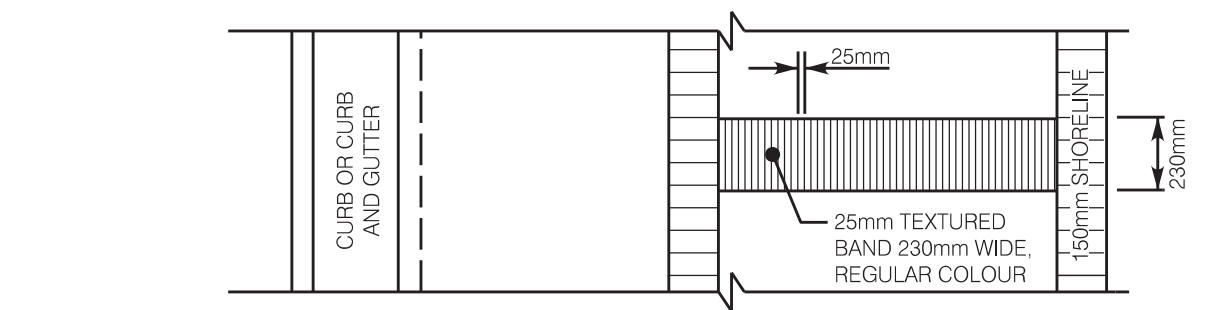


18A DIRECTIONAL LINES

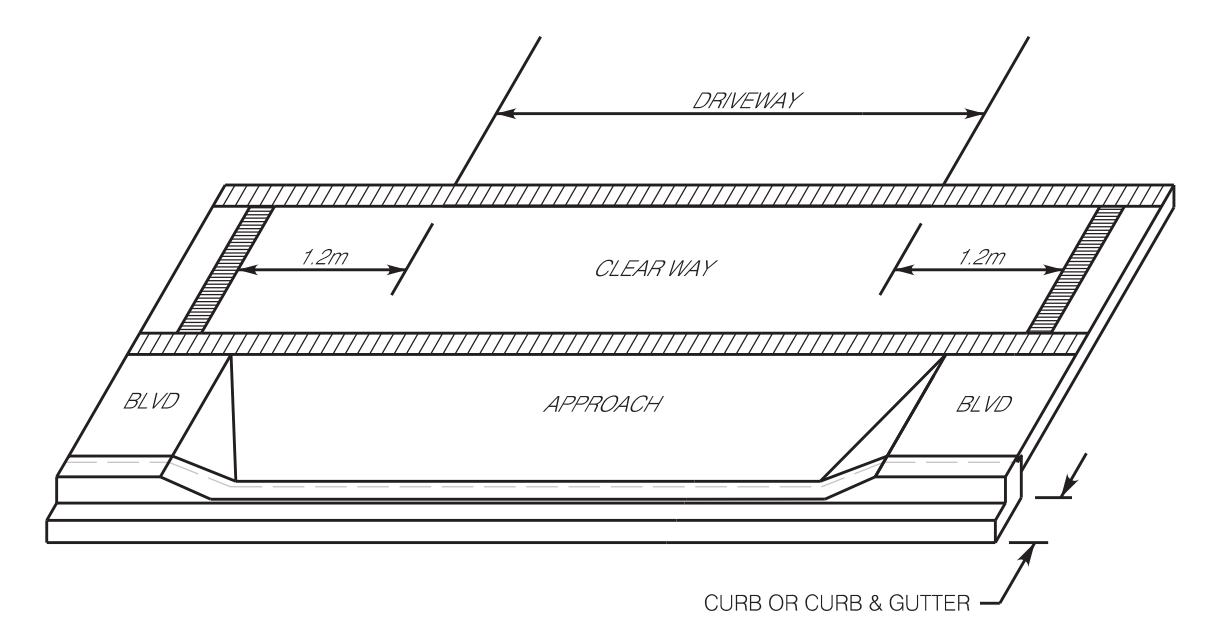


18B TACTILE/TONAL CONCRETE STAMP

18 DIRECTIONAL LINES AND TACTILE/TONAL CONCRETE STAMP

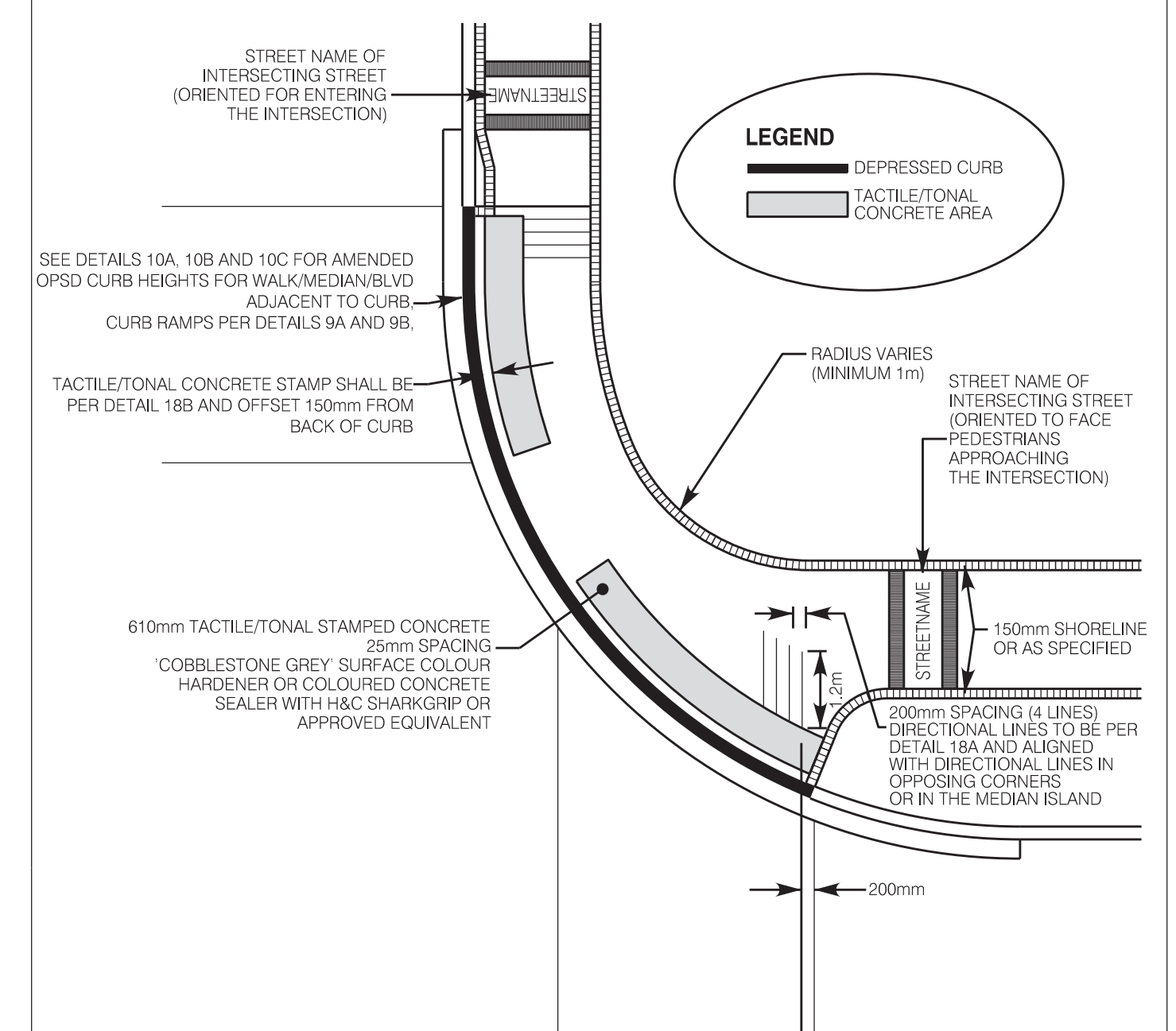


14A GENERAL



14B DRIVEWAY TREATMENT

14 25mm TEXTURED BAND - DRIVEWAYS



19 RAMP DETAIL AND DIRECTIONAL LINES