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(REVISED MAY 2020)

SECTION 5 – WATER DISTRIBUTION SYSTEM
DESIGN CRITERIA

5.01 SCOPE

.1 Waterworks design shall follow accepted engineering principles, the Provincial Health Branch requirements, the Fire Underwriters Survey Guidelines and the following design criteria:

5.01A WATER DEMAND

.1 The water distribution system shall be designed according to the following minimum demands:

(a) Residential:

Average daily per capita	455 L
Maximum daily per capita	1135 L
Maximum peak per capita	1820 L

(b) Commercial and Industrial:

Commercial and other non-residential water demands are normally included in the per capita design consumptions for the overall Community. Heavy industrial, industry parks, and shopping centers must be accounted for separately in any proposed development which includes such zoning.

(c) Fire:

Watermains servicing fire hydrants shall be sized to provide Fire Flows in accordance with the recommendations of the Fire Underwriters Survey publication 'Water Supply for Public Fire Protection' 1999 edition. Calculations supporting the theoretical fire flow available are to be submitted with the design drawings.

Fire flow requirements for a development with a sprinklered building under the Building Code shall be determined in accordance with the water supply requirements in National Fire Protection Association (NFPA) 13.

All fire hydrants shall be installed on a looped water system unless otherwise approved by the City Engineer. Water distribution systems shall also be designed to ensure that fire flow, as required by the Insurers' Advisory Organization (IAO), is available for the required duration.

The maximum allowable reduction to a calculated fire flow for a sprinkler system, as determined in Part 3 of Appendix H3 – Fire Flow Calculation Sheet shall be fifty percent (50%).

Design for fire flows shall consider present available flow and anticipated ultimate available fire flow from the City of Nanaimo's water system.

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New water distribution piping shall be capable of delivering the required flows with a minimum of 75 l/s during Maximum Day Demand, a residual pressure at all flowing hydrant(s) is 150 kPa (22 psi) and no other point in system less than 35 kPa (5 psi). The hydrant fire flow for new piping shall be the value in Table W-1 “Hydrant Fire Flows by Land Use Zone” for all properties served by the new piping. ***(REVISED MAY 2020)***

For new developments, a balance of pipe size, water quality and existing fire flows at the main will be considered. If the fire flow requirements, as calculated above, cannot be supplied by the existing water distribution system at time of development, available fire flows shall be reviewed with the City Engineer. The developer will be required to either upgrade portion of the system at their own cost or modify the proposed development to match existing fire flows at the main.

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TABLE W-1: HYDRANT FIRE FLOWS BY LAND USE ZONE

LAND USE ZONE (BYLAW 4500)		Hydrant Flows at main (ℓ/s)
R1-3	Single Dwelling Residential	75
R4	Duplex Residential (not sprinklered)	150
R5	Three & Four Unit Residential	110
R6	Townhouse Residential	130
R7	Row House Residential ((s) for larger buildings)	90
R8	Medium Density Residential	240
R9 *	High Density (High Rise) Residential	300
R10	Steep Slope Residential (SFD / (s) for Multi)	75 / 175
R11	Recreational Vehicle Park	120
R12	Mobile Home Park Residential	120
R13	Old City Duplex Residential	180
R14	Old City Low Density (Four plex) Residential	115
R15	Old City Medium Density Residential	140
AR1	Rural Resource	75
AR2	Urban Reserve	75
COR1	Residential Corridor	230
COR2 *	Mixed Use Corridor	300
COR3 *	Community Corridor	300
CC1	Local Service Centre	105
CC2	Neighbourhood Centre	200
CC3 *	City Commercial Centre	300
CC4 *	North Nanaimo Urban Centre	300
CC5	Hospital Urban Centre	240
CC6	Commercial Recreation Centre (s)	----
DT1	Core ((s) for high rise)	230
DT2	Fitzwilliam	300
DT3 *	Wallace	300
DT4	Terminal Avenue	210
DT5	Chapel ((s) for high rise)	240
DT6 *	Port Place ((s) for high rise)	300
DT7	Quennell Square	225
DT8	Old City Mixed Use	140
DT9	Old City Central	150
DT10	Old City Infill Business Commercial	170
DT11	Old City Infill Service Commercial	170
DT12	Gateway	215
PRC1/2/3	Parks, Recreation and Culture One, Two, Three (s)	----
I1	Highway Industrial	225
I2 *	Light Industrial	300
I3 *	High Tech Industrial	300
I4 *	Industrial	300
CS1/2/3	Community Service One, Two, Three (s)	----
W1	Waterfront	75
W2 *	Harbour Waterfront	300
W3	Newcastle Waterfront	285
W4 *	Industrial Waterfront	300
CD1 – CD6	Comprehensive Development	----

Land uses marked * require limitation to 300 ℓ/s
Land uses marked (s), and all high rises require site specific calculations

5.02 WATER PRESSURE

.1 Minimum design distribution pressure in all areas at peak hour demand 300 kPa (44 psi) based on design low reservoir level. With the combination of maximum daily demand and the specified fire flow, the minimum residual water pressure at all flowing hydrant(s) is 150 kPa (22 psi) and no other point in the system less than 35 kPa (5 psi). Where these minimum design pressures cannot be maintained due to an increase in elevation or distance from the point of connection, a booster pump station and/or emergency storage shall be provided as part of the distribution system. ***(REVISED MAY 2020)***

.2 The maximum allowable distribution line pressure is 860 kPa (125 psi) static, except where individual connections are permitted directly from trunk mains and where special precautions are taken. Otherwise, where distribution pressures will exceed 860 kPa (125 psi) static due to a drop in elevation, a pressure reducing station shall be installed as part of the distribution system. Where distribution pressures exceed 550 kPa (80 psi), occupants of existing houses in the area shall be advised to install individual pressure reducing valves. ***(REVISED MAY 2020)***

5.02A VELOCITY

.1 The maximum desirable velocity at maximum peak hour flow shall not exceed 2.0m/s.

.2 The maximum desirable velocity during fire flow conditions *plus* the maximum day rate shall not exceed 3.5 m/s. ***(REVISED MAY 2020)***

5.03 DESIGN POPULATION

.1 Design populations used in calculating water demands shall be computed in accordance with the City of Nanaimo's population predictions or with the planned development in the area to be served, whichever is larger. In the absence of detailed design population information, the following minimum design population densities shall be used.

Land Use	Population Density
Single Family	36 persons per hectare
Low Density multi-family	48 persons per hectare
High density multi-family	120 persons per hectare
Industrial & Commercial	36 persons per hectare

5.04 HYDRAULIC NETWORK

.1 Depending on the complexity and extent of the proposed distribution system, the City may require, for new developments, a hydraulic network analysis diagram showing maximum design flows and pressures. If this information is required, it shall be stated at the time of the feasibility review and shall be submitted by the applicant with the detailed design application. The hydraulic network shall be designed to distribute the maximum design flows in accordance with Section 5.02 – Water Pressure and Section 5.02A – Velocity.

.2 Field testing of design flows and existing network capacity may be required by the City Engineer.

5.05 WATER DISTRIBUTION PIPING

.1 The general requirements for the distribution piping are as follows:

(a) Numerous trunk lines and secondary feeders shall be installed throughout the system. Mains must be adequate to deliver consumption and fire flow demands for the area served, and should be spaced not more than 1000 m apart and looped. For extensions to the distribution network, all water distribution piping shall be looped. When looping is not feasible, temporary or permanent dead ends shall be approved at the discretion of the City Engineer.

(b) Pipes on a grid system in residential areas shall be a minimum of 200 mm dia., except that 150 mm dia. may be allowed for short interconnecting streets, or short dead ends not over 100 m long. Where dead ends or poor grids are likely to last over two years, greater pipe diameters may be required and shall be evaluated for peak hour and fire flow requirements. Minimum pipe size to the fire hydrant shall be 200 mm dia. ***(REVISED MAY 2020)***

(c) Lines furnishing domestic supply only, and not serving hydrants, may be 100 mm in dia.. Where a watermain ends in a dead-end or a valve is normally closed, a fire hydrant or flushout shall be provided for flushing purposes. No flushout shall be connected to a sewer.

(REVISED MAY 2020)

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(d) All pipes shall be designed for the maximum pressures and earth loading to which the pipe will be exposed. ***(REVISED MAY 2020)***

(i) For PVC, the minimum Dimension Ratio shall be DR18. If design warrants, a thicker wall thickness may be required. ***(REVISED MAY 2020)***

(ii) For HDPE (PE4710) the minimum Dimension Ratio shall be DR11. If design warrants, a thicker wall thickness may be required. (REVISED MAY 2020)

(e) Design criteria for any watermain piping 350 mm or greater in dia. requires City Engineer approval. ***(REVISED MAY 2020)***

5.05A EXTERNAL PIPE/FITTING CORROSION REPORT ***(REVISED MAY 2020)***

.1 At the request of the City Engineer a pipe corrosion report shall be prepared by the Engineer, at the Applicants expense, on prevention of corrosion of ductile iron, copper, grey iron and/or steel pipe and fittings used for construction of the infrastructure. ***(REVISED MAY 2020)***

.2 The corrosion report shall be subject to an engineering analysis of the potential of external pipe corrosion due to graphitization, pitting corrosion, galvanic corrosion, microbiologically influenced corrosion, corrosion due to dissimilar electrolytes and/or

stray current corrosion. The report shall outline the construction methods to provide maximum corrosion protection requirements based on the latest best management practices. ***(REVISED MAY 2020)***

.3 A geotechnical report may also be required for sites with adverse soil conditions, contaminated soils, groundwater, or other such conditions which, in the opinion of the City Engineer, require special attention. ***(REVISED MAY 2020)***

.4 All recommendations provided in the report shall become requirements for design and subsequent construction. ***(REVISED MAY 2020)***

5.05B CORROSION PROTECTION REQUIRED FOR BURIED METALS ***(REVISED MAY 2020)***

.1 Design and construction shall provide for external corrosion protection of all buried metals, pipe fittings and restraints. As a minimum, corrosion protection shall be with a petrolatum based wax and tape coating system approved for potable water per AWWA C217. ***(REVISED MAY 2020)***

.2 At the request of the City Engineer, other corrosion protection systems may be required. ***(REVISED MAY 2020)***

5.06 SERVICE CONNECTIONS

.1 All services greater than 50 mm dia. require Backflow Prevention Assemblies in accordance with the City of Nanaimo's Cross Connection Control Program Specifications outlined in Section 5.0 - Water Distribution System, Cross Connection Control, unless approved otherwise by the City Engineer. ***(REVISED MAY 2020)***

.2 Design drawings shall show the arrangement for water service connections. The minimum size of service connection to be specified is 25 mm dia. for polyethylene service tubing and 19 mm dia. for copper. All components shall be the same size as the service pipe to which they are connected, except for 25 mm dia. polyethylene service tubing, where the corporation stop, curb stop and water meter shall be 19 mm dia. All lots shall be provided with their own water service.

.3 The maximum length of water service connections from the watermain to the property line shall be 30 m unless otherwise approved by the City Engineer.

.4 For all services greater than 50 mm dia., a gate valve complete with valve box shall be provided at the watermain tee. There shall also be a gate valve located 300 mm from property line within the right-of-way complete with valve box. The service gate valve shall be a minimum 100 mm and service pipe shall be a minimum 100 mm dia. DR18 PVC as specified for watermain. ***(REVISED MAY 2020)***

(a) Where the meter is located in a chamber or vault, the gate valve immediately after the meter shall suffice as the gate valve at the property line. ***(REVISED MAY 2020)***

(b) Where the meter is located in a mechanical room, the gate valve at the property line is required. ***(REVISED MAY 2020)***

.5 Water service connection locations shall be coordinated with gas, cable, hydro and telephone utilities to avoid any conflict with their installations at the property lines of lots.

.6 Each lot shall be serviced by one only service connection for domestic water.

.7 Domestic and fire services shall be separate. The domestic water meter shall be downstream from the separation point. Combined lines may be considered with the approval of the City Engineer.

.8 The City of Nanaimo Water Meter Sizing Calculation Sheet in Appendix H4 shall be used for sizing of water meters.

5.07 HYDRANTS

.1 The minimum hydrant connection size shall be 150 mm.
The minimum depth of cover shall be 1.20 m.
Drain outlets shall be provided.

.2 Hydrants shall be constructed in accordance with Standard Drawing No. W-5 – Hydrant Connection. The bottom flange of the hydrant shall be located between 150 mm to 200 mm above final grade.

.3 Hydrant spacing shall be the most conservative of the following:

(a) B.C. Building Code requirements for sprinkler systems and the Fire Underwriters Survey Guide.
(b) The maximum lineal distance between hydrants shall be 140 m in single family and duplex land use zones where sprinklers are not required.
(c) The maximum spacing of hydrants in commercial, industrial, institutional and multi-family residential zones shall be 90 m.

.4 Two gate valves shall be provided at a watermain tee servicing a hydrant assembly: ***(REVISED MAY 2020)***

(a) A hub x flange (HxF) gate valve on the lead to the fire hydrant. The gate valve shall be a flange connection at the watermain tee. This flanged gate valve shall service the hydrant lead only. Hydrant bowls shall be a bell end pipe connection to the hydrant lead and shall not be flanged. ***(REVISED MAY 2020)***
(b) A hub x flange (HxF) gate valve inline with the watermain. The gate valve shall be a flange connection at the watermain tee. The location of this valve shall be on the upstream side of the watermain. ***(REVISED MAY 2020)***

.5 Hydrant access crossings shall be provided for hydrant installations adjacent to open ditches as per Standard Drawing No. W-7.

.6 Hydrants shall be located as per the offsets shown on the Standard Drawings in Section 8.0 - Transportation, and where possible at property corners. Hydrants shall be located 2.0 m (minimum) from the edge of present and future vehicular traveled areas;

a minimum of 3.0 m from lamp standards, hydro poles, or other obstructions; and shall not be constructed closer than 1.0 m from front property line. ***(REVISED MAY 2020)***

.7 The maximum design flow per hydrant shall be 100 l/s. Where greater flows are required, additional hydrants shall be provided within a distance approved by the Fire Department.

.8 Preferably, hydrants shall be located on low points in the pipe system in conjunction with hydrant spacing for fire control.

5.08 VALVES

.1 In general, valves shall be located as follows:

(a) In intersections either in a cluster at the pipe intersection or at projected property lines to avoid conflicts with curbs, gutters and sidewalks. Normally, 3 valves will be required at an "X" intersection of mains, and 2 valves at a "T" intersection of mains.
(b) Distance between valves shall not be more than 150m.

.2 Unless otherwise permitted, valves shall be the same size and class as the pipe in which they are installed. Resilient seat gate valves shall be used up to and including 300 mm dia. Valves may be rubber seated butterfly valves if approved by the City Engineer.

.3 Thrust blocking or other restraints shall be provided on valves.

.4 Use of butterfly valves requires approval by the City Engineer. Butterfly valves shall not be direct buried. Chambers shall be provided for all butterfly valves.

5.09 THRUST BLOCKS AND JOINT RESTRAINTS

.1 Provide concrete thrust/reaction blocks or restraints on all tees, bends, (>5 degrees), valves, caps and fittings. For pipes equal to or less than 300 mm nominal dia., refer to Standard Drawing No. W-8 for the minimum thrust/reaction block dimensions. Thrust/reaction and restraint calculations shall be completed by the Design Engineer and details shall be shown on the design drawings in the following cases:

(a) For sizes larger than 300 mm dia.
(b) Where pressures exceed 1035 kPa (150 psi). ***(REVISED MAY 2020)***
(c) Where allowable soil bearing is less than 96 kPa (14 psi). ***(REVISED MAY 2020)***
(d) Where vertical thrust/reaction blocking is required.
(e) Where joint restraints are used.

.2 For sizes larger than 200 mm dia., restraint fittings must be mechanical joints. ***(REVISED MAY 2020)***

.3 Thrust calculations for joint restraints shall be done in accordance with the manufacturer's specifications. The type of joint restraint and length of pipe to be restrained shall be clearly indicated on the design drawings. All tie rod and joint restraints shall be protected with an approved petrolatum protection coating meeting AWWA Standards.

.4 Tie rods and joint restrains shall be provided, as a minimum for the following locations:

(a) Hydrants
(b) Blow-offs
(c) Temporary caps
(d) Fittings or pipes larger than 300 mm
(e) Carrier pipe in casings
(f) Connections to valves outside PRVs and other chambers
(g) Any other location required by the Design Engineer or City Engineer.

5.10 WATERMAIN LOCATION, DEPTH AND GRADE

.1 The minimum depth of cover shall be 1.20 m unless otherwise permitted by the City Engineer. Minimum cover over watermain pipe crossings under ditches shall be 0.5 m.

.2 Unless otherwise approved by the City Engineer, tolerances for pipe alignment and grade shall be: ***(REVISED MAY 2020)***

Alignment	±50 mm
Grade	±25 mm

.3 Watermains shall be located not less than 3.0 m clear distance horizontally and 0.45 m clear distance vertically from all sewer lines, unless otherwise permitted by the City Engineer and the Provincial Health Department. Normal watermain offsets are shown in the standard drawings for roadways.

.4 If pipe alignment is not feasible as a means of establishing required separations due to conflict with existing services, crossings shall be arranged such that the crossover occurs on nominal pipe length centers and all joints within 3 m of the crossing shall be secured with concrete encasement (as per Standard Drawing No. T-5), petrolatum tape, shrink wrap or approved equivalent in accordance with the Ministry of Health permit requirements.

.5 Watermains shall be designed with a rising grade (minimum 0.1%) wherever possible, to minimize high points in the main. Where a high point is unavoidable, an air release valve shall be installed in accordance with Section 5.14.

.6 For trench dam design, refer to Section 4.18 – Trench Dams. ***(REVISED MAY 2020)***

5.10A UTILITIES IN PRIVATE LANDS

The following shall be considered in the design of utilities crossing private lands:

.1 The design of utilities shall avoid crossing private lands as much as possible.

.2 Utilities following property boundaries across private lands shall generally be offset a minimum 2.0 m from the property boundary.

.3 Appurtenances such as valves, etc. shall not be located on property boundaries.

.4 Utilities shall not cross private parcels in such a manner that they render the property unusable. Special consideration must be given to ensure the location of the utility crossing minimizes the limitations on the future use of the property.

.5 For minimum widths of statutory right-of-way and working widths refer to Appendix D.

.6 For a sample statutory right-of-way condition sheet, refer to Appendix C, Standard Drawing No. RW-2.

.7 For an Easement Release and Inspection Form Following the Construction of the Utility, refer to Appendix C.

5.11 PRESSURE REDUCING STATIONS

.1 A pressure reducing station shall be required where the static pressure in the proposed distribution system will exceed 860 kPa (125 psi). In general, the pressure reducing station shall be located at the elevation where the static pressure initially exceeds 860 kPa (125 psi). ***(REVISED MAY 2020)***

.2 General requirements for pressure reducing stations shall be as follows:

(a) A valved bypass shall be provided.

(b) A downstream surge of relief shall be provided to release pressure in the event of a failure of the pressure reducing valve(s). The surge relief valve may be incorporated into the pressure reducing station or may be located at some other suitable location within the distribution system. The surge relief valve shall drain to an adequate storm drainage facility, as approved by the City Engineer. Upstream surge relief valves shall be provided as required.

(c) Pressure reducing valves shall be sized to provide adequate pressure control through all ranges of design flows. If necessary, two or more pressure reducing valves of varying sizes shall be provided in one station. Pressure reducing valves shall be equipped with valve stem position indicators.

(d) Each pressure reducing and surge relief valve shall be provided with isolating valves and shall be installed so that individual components may be easily removed for repair or replacement.

(e) The pressure reducing station equipment shall be enclosed in an above ground kiosk. Underground vaults may be considered with the approval of the City Engineer. If approved, the pressure reducing station equipment shall be enclosed in a watertight reinforced concrete vault designed to CS600 loading with a standard manhole cover or other opening large enough to remove the largest single piece of equipment in the station. Station floors shall be sloped at 2.0% towards a floor drain assembly in accordance with Section 5.16 – Floor Drain Assembly Chamber Design. ***(REVISED MAY 2020)***

(f) Pressure gauges complete with snubbers and isolating valves shall be installed to register both upstream and downstream pressure. Gauges shall be mounted so they may be read from the manhole access lid without entering the chamber.

(g) Adequate strainers shall be supplied on the water used for controlling the regulating valves and on the main intake.

(h) Pressure reducing stations shall be located outside of the travelled portion of any street and must be vented to promote air circulation.

(i) Inside walls, floors and ceilings of stations to be painted with a white water soluble cement base pain manufactured for the purpose of sealing concrete.

(j) Exterior wall below grade shall be black damp-proofed (tar coated) to prevent leakage.

5.12 -NOT USED-

5.13 METER CHAMBERS/VAULTS AND BOXES ***(REVISED MAY 2020)***

.1 All water services must be metered and all meters must be contained in an approved chamber or meter box normally located in:

(a) the road right-of-way at the property line of the lot served for services 50 mm dia. or less. ***(REVISED MAY 2020)***

(b) a statutory right-of-way on private property for services larger than 50 mm dia.. Chamber shall be as close to property line as possible. ***(REVISED MAY 2020)***

(c) Alternate locations may be considered with the approval of City Engineer.

.2 Larger strata developments are to have a single meter at the property line with a privately owned watermain. A City owned watermain with individually metered units may be considered for small strata developments with the approval of the City Engineer.

.3 For small services, 50 mm in dia. or less, manufactured meter service boxes in accordance with Section 5.30 – Water Service Connections, clause 5.30.4 are adequate. For larger services, the meter shall be contained in a chamber or vault designed to accommodate the meter arrangement including associated piping, isolation valves, and bypasses and shall be in accordance with this Section including Standard Drawing No. W-11 and Section 5.34 including Standard Drawing No. W-11A. ***(REVISED MAY 2020)***

.4 The meter shall be installed in a horizontal plane.

(a) Avoid locating meter boxes, Hydro, telephone, cable vaults and junction boxes in sidewalks.
(b) If sidewalk location unavoidable, situate box to maximize unobstructed walking corridor.

.5 Isolation valves shall be provided on both sides of meters 50mm dia. and larger. Valves for fire line services shall be in accordance with NFPA regulations.

.6 The following requirements are to be applied in the design of meter chambers.

(a) The chamber shall be sized so that the meter and associated piping are accessible for meter reading, servicing and inspecting. A minimum of 600 mm clearance shall be provided between the walls and the meter including associated piping. At least 600 mm of head space shall be provided from the highest point on the meter including associated piping to the bottom of the vault cover, and a minimum of 450 mm of clearance provided above the chamber floor. Overall inside height of the chamber shall not be less than 1.8 m.
(b) The meter shall be protected against freezing, mechanical damage and tampering.
(c) Bypass and isolation valves may be in approved valve boxes outside the chamber to minimize chamber/vault size. If bypass is installed within the chamber, exposed valves shall be approved by the City Engineer. ***(REVISED MAY 2020)***
(d) The chamber shall be constructed of reinforce concrete designed to withstand CS600 loading with a standard manhole cover or other approved opening large enough to remove the largest single piece of equipment.
(e) The meter chamber shall be designed as a vault in accordance with Standard Drawing No. W-11. The meter chamber can be designed as a manhole with a precast circular manhole barrel only when the meter and associated piping can be installed allowing for the required clearances to the chamber wall and approved by the City Engineer.
(f) Chambers, either vaults or manholes, that contain valves, flushouts, meters or other appurtenances shall allow for adequate room for maintenance including headroom and side room. Access openings must be suitable for removing valves and equipment.

(g) The chamber shall not be located or constructed such that it is an obstacle or hazard to the customer or public safety.
(h) The lid of the chamber shall be flush with the surrounding grade and the ground surface shall be graded to direct drainage away from the chamber.
(i) An adequate floor drain assembly shall be provided and designed in accordance with Section 5.16 – Floor Drain Assembly Chamber Design.
(j) A safe permanent access ladder shall be provided which meets the WorkSafeBC requirements for fixed ladders.
(k) Exterior walls below grade shall be watertight.
(l) Interior surfaces of chambers for meters 50 mm dia. and larger to be painted with white, waterproof masonry wall coating that penetrates and seals pores in masonry surface.

.7 A valved bypass shall be provided for meters 38 mm dia. and larger to avoid service shutdown during meter maintenance. For combination fire service and domestic meters, the bypass shall be size for the largest flow rate. In the absence of the flow rate, the bypass shall be the same diameter as the service.

.8 The City has a Cross Connection Control program that requires all new developments to install Premise Isolation. The Premise Isolation will be privately owned. Refer to CSA B64.10, BC Building Code and appropriate City of Nanaimo bylaws.

5.13A BACKFLOW PREVENTION ASSEMBLIES CHAMBERS/ CONTAINMENT STRUCTURES ***(REVISED MAY 2020)***

.1 Unless otherwise approved by the City Engineer, all new developments and revisions to existing properties shall install Premise Isolation in accordance with the Specifications under Section 5.0 - Water Distribution System, Cross Connection Control. The owner of a property subject to Premise Isolation shall be the owner of all Backflow Prevention Assemblies, Associated Chambers/Containment Structures and associated appurtenances. ***(REVISED MAY 2020)***

(a) Backflow Prevention Assemblies shall be installed in accordance with Section 5.77 - Installation Standards for Backflow Prevention Assemblies for Premises Isolation. ***(REVISED MAY 2020)***

(i) Services including residential services greater than 50 mm dia. shall have a Backflow Prevention Assembly installed immediately after the service meter in a separate chamber/vault/containment structure, (such as mechanical rooms), located on the private property or parcel. ***(REVISED MAY 2020)***

5.14 AIR VALVES

.1 Combination air valves shall be provided at all high points of the watermain or where a closed valve creates a high point. (i.e. closed valve to isolate pressure zone) and located off the travelled portion of the road.

.2 Combination air valves shall be a minimum of 25 mm dia..

.3 For mains 300 mm dia. and larger, the air valve type, (combination, release or vacuum) and size shall be determined by the Design Engineer and the details shall be on the design drawings.

.4 Combination air valve chambers shall be drained to ensure that the chamber does not flood.

.5 Combination air valves shall be vented to an appropriate above-grade location to eliminate potential cross-connection in a flooded or contaminated chamber. ***(REVISED MAY 2020)***

5.15 FLUSHOUTS

.1 Flushouts shall be provided at the ends of all dead end mains whether permanent or temporary.

.2 On all mains greater than 350mm dia., flushouts shall be installed at the lowest points in the watermain network.

.3 Above-ground flushouts shall only be installed in areas where high ground water tables prohibit the installation of below-grade flushouts.

.4 Above-ground flushouts shall be located as per the offsets shown for hydrants on the Standard Drawings in Section 8.0 - Transportation. Flushouts shall be located 2.0 m (minimum) from the edge of present and future vehicular traveled areas and shall not be constructed closer than 0.6m from front property line. ***(REVISED MAY 2020)***

.5 Where practical, and with the approval of the City Engineer, hydrants may also be used in a secondary role as a flushout.

5.16 FLOOR DRAIN CHAMBER ASSEMBLY ***(REVISED MAY 2020)***

.1 Chambers are to be designed to include a drain to a storm sewer or ditch.

.2 Floor drain assemblies shall be designed in accordance with Section 7.0 – Stormwater Management with adequate capacity to keep the chamber dry at all times.

.3 Floor drain systems shall provide no risk of flooding of the chamber.

.4 Sumps shall be provided at the low point of the meter chamber for all floor drain assemblies.

.5 The design of floor drain assemblies shall consider the following options in the order presented:

(a) Sump drain to an adequately sized and normally dry rock pit or gravity flow to daylight.
(b) Where ground water tables permit, a perimeter drain around the base of the meter chamber with gravity connection to storm sewer mains. The City Engineer

may approve raising the perimeter drain to the bottom of the water pipe to provide sufficient grade for a gravity connection.

(c) Alternatives require approval by City Engineer.

SECTION 5 – WATER DISTRIBUTION SYSTEM SPECIFICATIONS

5.20 SCOPE

.1 This specification refers to pressure pipe and appurtenant fittings for water distribution piping and water service connections. Only those products approved by the City Engineer and listed in the City of Nanaimo Approved Products List will be accepted for installation.

5.21 MATERIALS TESTING

.1 The Engineer shall arrange for a certified materials testing firm to carry out tests to determine whether the applicable standards and specifications have been met. Where initial testing indicates inadequacies, additional testing shall be required. ***(REVISED MAY 2020)***

5.22 WATERMAIN PIPE

.1 The sizes and types of pipe to be used shall be shown on the drawings.

.2 Ductile Iron Pipe

(a) Standard Specifications:

Ductile iron pipe shall conform to AWWA C151 and AWWA C150.

(b) Supplementary Data:

Unless otherwise specified on the construction drawings, all pipe shall have a minimum pipe class as follows:

Pipe Size	Class
75 – 300	350
350 – 500	250

An affidavit of compliance with the standard specifications and supplementary data shall be submitted from the supplier.

All pipe supplied shall bear the underwriter's label.

Joints shall be a mechanical type conforming to AWWA C11 or shall be rubber gasket, bell and spigot, Tyton joint, or as approved.

The class or nominal thickness, net weight without lining, and casting period shall be clearly marked on each length of pipe. Additionally, the manufacturer's mark, country where cast, year in which the pipe was produced, and the letters "DI" or Ductile" shall be cast or stamped on that pipe. ***(REVISED MAY 2020)***

(c) Protective Coatings:

Ductile iron pipe shall be cement-lined conforming to AWWA C104.

A cathodic protection system shall be provided where warranted by soil conditions.

Polyethylene Encasement to AWWA C105 where warranted by soil conditions. ***(REVISED MAY 2020)***

Petrolatum Corrosion Protection system shall be installed to AWWA C217 where warranted by soil conditions. ***(REVISED MAY 2020)***

.3 Steel Pipe ***(REVISED MAY 2020)***

(a) Standard Specifications:

Steel pipe, fittings and specials, shall conform to the following standard specifications:

(REVISED MAY 2020)
AWWA C200 – Standard for Steel Water Pipe 150 mm and larger ASTM A36
AWWA C205 – Standard for Cement – Mortar Protective Lining and Coating for Steel Water Pipe 4 in. (100 mm) and Larger-Shop Applied
AWWA C206 – Field Welding of Steel Water Pipe ***(REVISED MAY 2020)***
AWWA C207 – Standard for Steel Pipe Flanges for Waterworks Service Sizes 4 in. through 144 in. (100 mm through 3,600 mm)
AWWA C208 – Standard for dimensions for Steel Water Pipe fittings.
AWWA C606 – Standard for Grooved and Shouldered Joints

(b) Steel pipe may be allowed in limited circumstances. Subject to pre-approval, the City Engineer will provide detailed specifications and requirements on a strict site by site basis. ***(REVISED MAY 2020)***

.4 Polyvinyl Chloride (PVC) Pipe:

(a) Standard Specifications:

100 to 350 mm dia. PVC pressure pipe for water:
Pipe shall conform to AWWA C900, certified to CSA B137.3 and shall be cast-iron pipe equivalent outside diameter (CIOD).
Pipe DR shall be:
DR 18 with pressure rating of 1620 kPa (235 psi), or
DR14 with pressure rating of 2100 kPa (305 psi), or as otherwise approved. ***(REVISED MAY 2020)***

(b) Supplementary Data:

An affidavit of compliance with the standard specifications and supplementary data shall be submitted from the supplier. All pipe shall be ULC Listed. Joints for PVC pipe shall have a mechanical seal formed by a preformed rubber gasket in a bell or coupling. It is mandatory that the push-on integrally thickened bell and spigot type conform to ASTM D3139 Clause 6.2 with single elastomeric gasket to ASTM F477. Couplings shall be of a class and strength equivalent to the pipe. ***(REVISED MAY 2020)***

All PVC water pipe shall be blue in colour.

.5 High Density Polyethylene (HDPE) Pipe ***(REVISED MAY 2020)***

(a) Standard Specifications:

HDPE pipe to be used for watermains shall be, at the discretion and approval of the City Engineer. (HDPE pipe shall not be used for services.) ***(REVISED MAY 2020)***

Projects in which HDPE pipe is proposed shall be accompanied by complete HDPE specifications for approval.

HDPE pressure pipe shall conform to AWWA C906 (Standard for Polyethylene Pressure Pipe & Fittings, 100 mm through 1575 mm for Water Distribution and Transmission) and shall: ***(REVISED MAY 2020)***

(i) be PE grade 4710 at a minimum DR11 with a pressure class of 1375 kPa (200 psi); ***(REVISED MAY 2020)***
(ii) be COID, meet ASTM D3350, and ***(REVISED MAY 2020)***
(iii) installed with electrofusion fittings and/or conventional (butt) fusion fittings. ***(REVISED MAY 2020)***

1. Joints shall be fused in strict accordance with manufacturer's instructions meeting ASTM D3261. ***(REVISED MAY 2020)***
2. Compatible mechanical joint fittings and valves without special adapters may be considered under approval by the City Engineer. ***(REVISED MAY 2020)***

(iv) Be certified to NSF 61 and clearly marked by the manufacturer with a permanent colour marking designation for the entire length of pipe meeting AWPA Uniform Colour Code Blue for potable water. ***(REVISED MAY 2020)***

(REVISED MAY 2020)

(b) Fittings:

Fabricated HDPE mitered fittings shall meet AWWA C906. ***(REVISED MAY 2020)***

Molded HDPE fittings shall meet ASTM 3261. ***(REVISED MAY 2020)***
Fittings shall be as recommended by the manufacturer for the PE grade and pressure rating of the pipe with no downrating of pipe pressure. ***(REVISED MAY 2020)***

(c) Supplementary Data:

An affidavit of compliance with the standard specifications shall be submitted from the supplier. All pipe and fittings shall bear the underwriters label. ***(REVISED MAY 2020)***

5.23 WATERMAIN FITTINGS

.1 All fittings for ductile iron and PVC pipe shall be:

(REVISED MAY 2020)

(a) Asphalt coated ductile iron compact fittings manufactured to AWWA C153, designed for a minimum working pressure of 2415 kPa (350 psi), and cement mortar lined to AWWA C104. ***(REVISED MAY 2020)***
(b) Asphalt coated ductile iron fittings manufactured to AWWA C110, designed for a minimum working pressure of 2415 kPa (350 psi) and cement mortar lined to AWWA C104. ***(REVISED MAY 2020)***

.2 The design pressure rating of all fittings shall meet or exceed the pressure class of the pipes they are connected to.

.3 Single rubber gasket for push-on bell and spigot type joint and/or mechanical pipe joints to ANSI/AWWA C111/21.11 (Tyton). All push-on joint hubs to be equipped with tie rod lugs. ***(REVISED MAY 2020)***

.4 Flanged joints on fittings shall be flat faced conforming in dimension and drilling to ANSA B16.1.

.5 Ends shall be flanged or belled to suit pipe ends.

.6 Thrust blocks or joint restraints shall be provided as shown in the drawings.

.7 In areas where the static pressure exceeds 1380 kPa (200 psi), fittings shall be as approved by the City Engineer. ***(REVISED MAY 2020)***

5.24 WATERMAIN VALVES

(REVISED MAY 2020)

.1 Unless otherwise approved by the City Engineer, valves conforming to the following specifications shall be installed in the distribution system: ***(REVISED MAY 2020)***

(REVISED MAY 2020)

(a) Resilient Wedge Gate Valves:

(i) Valves shall conform to the latest revision of AWWA C509 and AWWA C515 Resilient Seated Gate valves and shall be UL listed and FM approved. ***(REVISED MAY 2020)***

(ii) Valves shall be non-rising stem, open left (counter-clockwise) and have a 50 mm square operating nut.

(iii) The wedge shall be ductile or cast iron completely encapsulated with urethane rubber.

(iv) The rubber shall be permanently bonded to the wedge and meet ASTM D429 for test for rubber metal bond.

(v) Stems for non-rising assemblies shall be cast bronze with integral collars or stainless steel in full compliance with AWWA. The non-rising stem stuffing box shall be the O-ring seal type with two rings located above the thrust collar; the two rings shall be replaceable with the valve fully open and subjected to full rated working pressure.

(vi) There shall be two low torque thrust washers located above and below the stem collar. The stem nut shall be made of solid bronze. There shall be a smooth unobstructed waterway free of all pockets, cavities and depressions in the seat area.

(vii) The body and bonnet shall be coated with fusion bonded epoxy both interior and exterior meeting AWWA C550. Each valve shall have the manufacturer's name, pressure rating and the year of manufacture cast on the body. Prior to shipment, each valve shall be tested by hydrostatic pressure equal to twice the specified working pressure. ***(REVISED MAY 2020)***

(viii) Every valve will have a positive stop to prevent distortion to the wedge.

(ix) Valve operating nuts greater than 1.2 m below finished grade require a valve nut extension rod complete with valve riser guide. Valve nut extension rods shall be a minimum 600 mm below finished grade. Refer to Standard Drawing No.W-16.

(x) Single rubber gasket for push-on bell and spigot type joint and/or mechanical pipe joints to ANSI/AWWA C111/21.11 (Tyton). All push-on joint hubs to be equipped with tie rod lugs. Valves shall have flange connection to fittings. ***(REVISED MAY 2020)***

(xi) Valves larger than 400 mm shall be complete with bypass gate valve. Subject to approval by the City Engineer, a butterfly valve conforming to ANSI/AWWA C504 in a chamber complete with bypass may be used. ***(REVISED MAY 2020)***

(b) Rubber Sealed Butterfly Valves:

Butterfly valves for water service shall be short body flanged type or wafer body type conforming to AWWA C504, suitable for a maximum non-shock shut-off pressure of 1035 kPa (150 psi). Valve construction shall be as follows, or as approved. ***(REVISED MAY 2020)***

(i) Body material shall be ductile. ***(REVISED MAY 2020)***
(ii) Disc material shall be ductile or cast iron.
(iii) Valve seats shall be of new natural or synthetic rubber.
(iv) Valve shaft material shall be 18-8 stainless steel type 304 or 316. Shaft shall be pinned to the disc. Shaft sizing shall be in accordance with AWWA C504.
(v) Body shall be complete with shaft bushing and location lugs for flange bolts.
(vi) Valve operators shall be worm gear type totally enclosed and waterproofed and equipped with adjustable stops. All valves shall be equipped with a standard 50 mm square operating nut and the operator shall be located on the side of the valve with the spindle in a vertical position.
(vii) Valve shall be designed for the extreme maximum flows for both opening and closing.
(viii) Valve ends shall suit the pipe.
(ix) Valves shall open to the left (counter-clockwise).
(x) Shaft seals shall be of the o-ring type.
(xi) A reinforced concrete chamber (designed to meet CS600 loading requirements) shall be provided for each butterfly valve as shown on the drawings. Valves shall not be direct buried.

5.25 WATERMAIN VALVE BOXES.

.1 Where valves are located in the roadway, valve boxes shall be MR Type of cast iron and telescoping so that surface loads are not transmitted to the valve body or pipeline. A minimum of 450 mm of adjustment shall be available on all valve boxes. PVC valve hoods shall be used on all 200 mm and larger underground valve installations. ***(REVISED MAY 2020)***

.2 Valve box lids shall have a non-rocking fit and extend 75 mm into the valve box from the lid seat as shown on Standard Drawing W-16.

.3 Minimum requirements for valve box risers in traveled and untraveled areas shall be DR18 pipe.

5.26 WATERMAIN VALVE MARKERS

.1 Valve markers are required to indicate the locations of the valves.

.2 Where valve boxes are located outside the paved portion of a road, these markers shall be constructed of 50 mm steel pipe panted blue and set in a concrete base. They shall extend one 1.0 m above the ground surface. The markers shall be located at a safe and reasonable location determined by the Engineer opposite the valve and the distance to the valve is to be painted in black figures on a flattened upper portion of the marker. ***(REVISED MAY 2020)***

.3 Where valve boxes are located in the paved portion of the road, valve tag markers shall be installed in a nearby reasonable location.

5.27 HYDRANTS

.1 Installed fire hydrants shall meet the following specifications:

(a) Hydrants shall be compression type complying fully with AWWA standard C502 for dry barrel hydrants. ***(REVISED MAY 2020)***
(b) Hydrants shall be clockwise opening and have a standard pentagonal operating nut with a circle diameter of 44.5 mm.
(c) The inlet connection shall be 150 mm dia. and made of the same material as the mainline piping. The hydrant shall have a bell and a preformed rubber gasket suitable for connection to the pipe being used.
(d) Hydrants shall have two nominal 65 mm dia. hose outlets without independent cut-off. The 65 mm dia. hose outlets shall conform to the B.C. Fire Hose Thread Standards, nominal 65 mm I.P., 75 mm O.D. male, 8 threads per 25 mmm tapering from 75.72 mm minimum O.D. to 82.63 mm maximum O.D.
There shall also be one nominal 100 m dia. (120 mm O.D.) pumper outlet. The 100 mm pumper outlet shall conform to the B.C. Fire Hose Thread Standards, nominal 100 mm I.P., 117.5 mm O.D. male, 6 threads per 25 mm.
(e) Hydrant bodies shall be painted with red rust paint above the bury line. Hydrant ports and bonnets shall be painted with a base coat of aluminum rust paint and a top coat of bright yellow rust paint.
(f) Self-draining with drain outlet provided. ***(REVISED MAY 2020)***
(g) Depth or bury shall be as required to provide the specified minimum cover on the connecting pipe and the required position of the hydrant flange relative to the finished ground elevation.
(h) For new installations, fire hydrant extensions will require approval from the City Engineer. ***(REVISED MAY 2020)***
(i) Subject to discretion of the City Engineer, hydrant flow test on all new hydrants, in accordance with NFPA 291, may be required.

.2 Tie Rods and Nuts:

(a) Tie rods to be continuous threaded, quenched and tempered alloyed steel to ASTM A354, Grade BC. To be zinc plated to ASTM B766. Tie rod sized to be minimum 19 mm dia. or greater as shown on the Contract Drawings.
(b) Nuts and internally threaded couplings to be heavy hex finish to ASTM A563. Washers to be flat hardened steel to ASTM F436. All to be zinc plated to ASTM B633 or cadmium plated to ASTM B766.

(c) All tie rods, nuts and washers shall be coated with approved petrolatum corrosion protection.

.3 Hydrant Access Crossings:

(a) Culvert headwalls shall be as specified in Section 7.35B – Culvert Headwalls.
(b) Culverts shall be as specified in Section 7.35A – Culverts.
(c) Gravel surfacing shall be as specified in Section 9.31 – Road Base Gravel Course. ***(REVISED MAY 2020)***

5.28 FLUSHOUT

.1 All piping and fittings shall be 65 mm dia. iron pipe thread, galvanized steel pipe.

.2 Shut-off valves shall be a 65 mm cast iron gate valve meeting all specifications for main line valves.

.3 Vertical section of flushout above ground shall be supported by a 100 x 100 mm cedar post, painted white with a red top and extending 1.20 m above finished grade.

.4 Above ground flushout bodies shall be painted with red rust paint above the grade line. Flushout caps shall be painted with a base coat of aluminum rust paint and a top coat of bright yellow rust paint.

.5 The valve box shall be a MR type of cast iron and telescoping so that surface loads are not transmitted to the valve body or piping. A minimum of 300 mm of adjustment shall be available. The 65 mm dia. fire hose connection and cap shall meet standard B.C. Fire Hose Thread Requirements.

.6 Below grade flushouts shall conform to Standard Drawing No.W-2B.

5.29 AIR VALVES AND FITTINGS

.1 All air valves shall be combination air release valves meeting AWWA C512. Bushings, reducers and unions to be used in the valve connection shall be brass manufactured to ASTM B62. Nipples shall be standard brass and threaded at both ends. ***(REVISED MAY 2020)***

.2 Service valves for use in air valve assemblies shall have screw ends and shall be brass or bronze. All packing shall have each ring cut to fit, with staggered joints. Continuous (spiraled) packing shall not be used. Gate valves 100 mm or less in dia. shall be wedge disc type with non-rising stem, hand wheel and stuffing box glands, as specified for 1380 kPa (200 psi)water (860 kPa (125 psi)steam) service. ***(REVISED MAY 2020)***

.3 All air valves shall have two 12 mm ball-type drain valves as shown on Standard DrawingNo.W-4.

.4 Air valves for watermains greater than 300 mm dia. shall be as approved by the City Engineer.

5.30 WATER SERVICE CONNECTIONS

.1 Service Up to and including 50 mm Diameter: ***(REVISED MAY 2020)***

Services up to and including 50 mm dia. (2 inch) shall conform to AWWA C901, CSA B137.5 and meet NSF 61. Service shall be compatible with AWWA C800 valves and fittings (service brass). ***(REVISED MAY 2020)***

(a) Tubing shall be: ***(REVISED MAY 2020)***

(i) Class 200 polyethylene tubing to AWWA C901 complete with manufacturer recommended stainless steel insert required to stiffen pipe. ***(REVISED MAY 2020)***

(ii) Tubing shall be installed complete with color coded (APWA Uniform Colour Code Blue for potable water) warning tape placed one foot above the tube in the trench. ***(REVISED MAY 2020)***

(b) Tracer wire shall be installed with all polyethylene service tubing and shall be: ***(REVISED MAY 2020)***

(i) Certified as tracer wire for direct burial, ***(REVISED MAY 2020)***

(ii) Affixed to the tube every 1.0 m with electrical tape and placed in the same orientation along the side of the tube and not wrapped around the tube. ***(REVISED MAY 2020)***

(iii) One end of the tracer wire terminated to a grounding anode approved by the tracer wire manufacturer, the other end terminated in the meter box with a coiled pigtail, ***(REVISED MAY 2020)***

(iv) Inspection and testing by the Engineer with City Engineer upon completion of the service. Inspection and testing required by conductivity test and locate prior to project approval. ***(REVISED MAY 2020)***

.2 Corporation Stops:

(a) Corporation stops shall be full port, no lead bronze conforming to ASTM B62, AWWA C800 with AWWA standard male threaded inlet (MIP) and compression outlet for copper or plastic tubing (CTS). ***(REVISED MAY 2020)***

(b) Shut-off head shall be solid tee head type.

(REVISED MAY 2020)

(REVISED MAY 2020)

.3 Curb Stops:

(a) Curb stops shall be full port, no lead bronze conforming to ASTM B62, AWWA C800 with compression inlet and AWWA standard female threaded outlet (FIP). ***(REVISED MAY 2020)***

(b) Shut-off head shall be solid tee head type.

(c) Stop and drain type curb stops are prohibited. ***(REVISED MAY 2020)***

.4 Service Fitting: ***(REVISED MAY 2020)***

(a) Service fittings shall be full port, no lead bronze conforming to ASTM B62, AWWA C800. ***(REVISED MAY 2020)***
(b) Service fittings may be compression, MIP, FIP, specifically excluding flairs. ***(REVISED MAY 2020)***

.5 Service Connections Greater than 50 mm Diameter: ***(REVISED MAY 2020)***

(a) Shall be minimum 100 mm dia., full restrained, and as specified for watermain pipe. ***(REVISED MAY 2020)***
(b) Mainline connection shall be with an inline tee complete with a flange connected gate valve leading to the service. ***(REVISED MAY 2020)***
(c) The service shall be fully restrained from the mainline tee to the meter chamber, and through the meter chamber to the Backflow Prevention Assembly. ***(REVISED MAY 2020)***

.6 Meter Service Boxes, Box Extensions and Lids:

(a) Service boxes for water services 25 mm dia. and smaller shall be 300 mm x 500 mm concrete meter boxes complete with cast iron traffic cover marked "water". Where approved by the City Engineer, plastic meter service boxes may be used in existing landscape areas. They are not to be used in existing, proposed or future driveway locations. ***(REVISED MAY 2020)***
(b) Services boxes for 38 – 50 mm dia. water services shall be 425 x 750 mm concrete boxes complete with steel traffic covers marked "Water".
(c) Service boxes or chambers for water services larger than 50 mm dia. shall be specified as per Section 5.34 – Meter Chambers.
(d) Meter box lid shall be suitable for mounting of a "touch pit read" register unit.
(e) Box shall be of adequate depth to provide 450 mm depth as measured from the underside of the lid to sub surface ground elevation. Meters shall be installed at the ground elevation at the bottom of the box. ***(REVISED MAY 2020)***

.7 Pipe Saddles:

(a) Tapping threads to be tapered to AWWA C800.
(b) Saddles shall be compliant with NSF61.
(c) Gasket shall be styrene butadiene rubber (SBR) to ASTM D2000 specifications or other approved gasket material. The Design Engineer shall specify the appropriate gasket material.
(d) Saddle for ductile iron pipe:

(i) Saddles for 19 mm to 50 mm services to have a ductile iron body to ASTM A536.
(ii) Anti-corrosive coating to AWWA C219, AWWA C210, or AWWA C213.
(iii) Two high strength low alloy steel straps to AWWA C111, or Type 304 stainless steel U-bolt straps, with minimum width per strap of 50 mm.

(e) Saddles for PVC pipe: ***(REVISED MAY 2020)***

(i) To provide full support around circumference of pipe, saddles with lugs or U-bolt straps that may gouge or deform the pipe are not allowed.

(ii) Saddles for 19 mm to 50 mm services shall be:

1. Bronze body to ASTM B62 and two stainless steel straps to ANSI T304 with minimum width per strap of 50 mm.
2. All-stainless steel broadband saddle to ANSI T304; for services less than 37 mm dia., saddle shell must be a minimum of 125 mm wide and have double bolts; for services 37 mm to 50 mm, saddle shell must be a minimum of 190 mm wide and have double bolts. Saddles to come with donut style gasket and stainless steel shell must be minimum 18 gauge thickness. All stainless steel to be fully passivated to ASTM A240.

(f) Pipe saddles shall be installed on all pipe at service junctions up to and including 50 mm dia. service tube. ***(REVISED MAY 2020)***

.8 Meters:

(a) Meters shall be compatible with "Sensus Touch Read" automated meter reading and billing system. Meters installed in meter chambers shall be equipped with a Touch Read Pit Lid register mounted on a bracket as per Standard Drawing No. W-12.

(b) All meters shall be equipped with encoder type remote – registers and provide at least 8 digit visual and encoded registration.

(c) For single family servicing, meters shall be 19 mm minimum positive displacement meters.

(d) For duplex servicing, meters shall be 25 mm positive displacement meters.

(e) All meters larger than 25 mm require approval from the City Engineer.

(f) All meters 100 mm and larger shall be equipped with a test port or test tee and be plumbed with the appropriate isolation valves and bypass to facilitate in-situ testing of the meter.

(g) All meters used for a fire line service shall be UL listed and FM approved.

(h) All meters shall read in cubic meters.

.9 Backflow Prevention Assemblies: ***(REVISED MAY 2020)***

(a) Section 5.70 – Water Distribution System, Cross Connection Control. ***(REVISED MAY 2020)***

.10 Pipe in Chambers: ***(REVISED MAY 2020)***

(a) All pipe 50 mm dia. up to and including 75 mm dia. shall be corrosion resistant material. Only compression or threaded joints shall be permitted. ***(REVISED MAY 2020)***

(b) All pipe greater than 75 mm dia. shall be Schedule 10 Stainless Steel with flanged, treaded or compression joints. ***(REVISED MAY 2020)***

.11 Gate Valves Domestic Service:

(a) Gate valves shall be as per Section 5.24. ***(REVISED MAY 2020)***

.12 Gate Valves Fire Line Service:

(a) All valves shall be in conformance with NFPA regulations and shall be UL listed and FM approved. ***(REVISED MAY 2020)***
(b) Resilient wedge valves shall be in conformance with Section 5.24 – Watermain Valves. ***(REVISED MAY 2020)***
(c) Valves installed in chambers shall be of the indicating type as approved by the City Engineer. ***(REVISED MAY 2020)***

(REVISED MAY 2020)

5.31 PRESSURE REDUCING STATIONS

.1 Valves:

(a) Pressure reducing valves shall be hydraulically operated, pilot controlled diaphragm-type globe or angle valves.
(b) The main valve shall have a resilient disc and a removable seat ring.
(c) The main valve shall be stainless steel.
(d) The valve stem on 50 mm and larger valves shall be guided at both ends.
(e) All repairs shall be possible without removing valve from main line.
(f) All wetted surfaces on main valve shall be coated with an epoxy protective coating.
(g) All PR valves shall have a position indicator.
(h) All PR valves shall have Y strainers or basket strainers installed upstream of the main valve and upstream of the control pilot.
(i) All PR valves shall have speed controls between the pilot and main valve body.
(j) All PR valves use for fire line service shall be UL Listed and FM approved.

.2 Gauges, pressure snubbers, isolation valves for gauges:

(a) All pressure gauges shall have a 90 mm minimum dial size with a 6.5 mm NPT bottom connection.
(b) All gauges shall be installed with a piston-type snubber.
(c) All gauges shall be installed with a brass gate valve for isolation.
(d) All gauges in pressure reducing chambers shall be mounted so they can be read from the manhole lid access.
(e) Small diameter piping up to 60 mm shall be copper, or brass.
(f) Piping over 75 mm shall be flanged steel pipe.

5.32 FLANGE ADAPTERS AND JOINT RESTRAINTS

.1 Flange adaptors and joint restraints shall conform to AWWA C219 and be UL listed and/or FM approved. Flanged joints shall conform to AWWA C110 and ANSI B16.1, Class 125.

.2 Flange adapters and joint restraints shall be ductile iron conforming to ASTM A536 with an anti-corrosion coating on the interior and exterior rings conforming to AWWA C219.

.3 Bolts and nuts shall be high strength steel low allow steel conforming to AWWA C111, or stainless steel conforming to ASTM F593 and F594. Rolled threads, fit and dimensions shall be AWWA C111.

.4 Tie rods shall be continuous threaded, quenched and allowed steel conforming to ASTM A345, Grade BC and hot-dipped galvanized in accordance with ASTM A153. Coarse threads shall have Class 2A tolerance before galvanizing.

.5 Compression gaskets shall conform to AWWA C219.

.6 Flange adapters and joint restraints shall be designed to be suitable for the type pipe for which they are installed.

5.33 FLOOR DRAIN ASSEMBLIES

.1 Pipe and fittings for gravity connections shall conform to Section7.22A – Piping, Fittings and Services, clause 7.22A.5.

.2 Pipe and fittings for 19 mm to 100 mm dia. sump pump connections shall conform to Section 5.30 – Water Service Connections.

.3 Service junctions at the storm main, where permitted, shall conform to Section7.23 – Service Junctions.

.4 Sump drainer assemblies, if required, shall consist of backflow preventer, ejector pump, foot valve, strainer and float assembly connected to the watermain with a saddle and corporation stop conforming to Section 5.30 – Water Service Connections.

.5 Sumps shall have minimum dimensions of 300 x 300 x 150 mm.

.6 Perimeter drains shall consist of:

(a) 100 mm dia. PVC certified to CSA B182.1. Includes drain rock and geotextile wrap.

5.34 METER CHAMBERS

.1 Precast Manhole Sections:

(a) Unless otherwise approved, all manholes sections shall be precast reinforced concrete conforming to ASTM C478.
(b) All precast sections shall be complete with ladder rungs.
(c) O-ring rubber gaskets shall conform to ASTM C443.

.2 Precast Manhole Bases:

(a) Precast manhole bases shall be reinforced concrete in accordance with ASTM C76 Class III or better.

.3 Manhole Tops:

(a) Manhole tops shall be flat slab, precast concrete. Tops shall be reinforced to meet CS600 loading requirements. Precast tops shall conform to ASTM C478 with approved offset opening for frame and cover.

.4 Manhole Covers and Frames:

(a) Covers and frames shall be cast iron and certified to meet CS600 loading requirements with the bearing faces of the cover to be frame machined for a non-rocking fit.
(b) Patterns, dimensions and weights shall be in accordance with the Standard Drawings. Covers shall have “CITY OF NANAIMO WATER” permanently embossed on the covers.
(c) Standard manhole frame and cover shall conform to Standard Drawing No. W-19 – Manhole Frame and Cover.
(d) Utility chamber manhole frame and cover shall conform to Standard Drawing No. W-20 – Utility Chamber, Manhole, Frame, Ring and Cover.
(e) A watertight manhole frame and cover, if required, shall conform to Standard Drawing No. W-21 – Watertight Manhole Frame and Cover.
(f) Covers located in statutory rights-of-way shall be permanently embossed with the additional wording “DO NOT COVER”.
(g) Refer to Section 5.58 for frame and cover installation.

.5 Manhole Steps:

(a) Steps shall conform to ASTM C478 for manhole steps and ladders and shall be a 19 mm dia. aluminum alloy conforming to CSA S157.
(b) All steps shall be complete with approved polyethylene anchor insulating sleeves and installed in 25 mm to 26 mm dia. precast or drilled holes in a manhole section.
(c) Refer to Section5.58 for manhole steps installation.

.6 Concrete:

(a) All concrete work for cast in place manhole bases shall conform to Section 11.0 – Cast In Place Concrete Works. ***(REVISED MAY 2020)***

.7 Precast Concrete Grade Ring:

(a) A precast concrete grade ring conforming to ASTM C478 shall be used.

.8 Touch Read Meter Bracket

(a) Touch read meter bracket shall conform to Standard Drawing No. W-12.

5.35 -NOT USED-

5.40 TRENCH EXCAVATION, BEDDING AND BACKFILL

.1 Refer to Section 4.0 – Excavation, Trenching and Backfill for installation requirements. ***(REVISED MAY 2020)***

5.41 PIPE ALIGNMENT

.1 The pipe shall be laid on line and grade in accordance with the construction drawings. Each pipe shall be checked for line and grade as it is installed. Methods to maintain pipe alignment and grade shall be approved by the Engineer.

.2 The following methods shall be used when a main is to be installed on a curve to maintain a constant offset within the road allowance:

(a) Deflection of Joint as per Section 5.46 – Deflection.

For: Ductile Iron Pipe, as per AWWA C600/82
For: PVC Pipe, as specified in the Uni-Bell Handbook of PVC Pipe

(b) Manufactured 5 PVC bends.

Arching or bending of the pipe is not permitted.

.3 Refer to Section5.10 – Watermain Location, Depth and Grade for design criteria.

5.42 PIPE CUTTING

.1 Pipe cutting shall be done in the manner recommended by the pipe manufacturer employing tools designed for this purpose.

.2 Cutting of asbestos pipe shall conform to WorkSafe BC requirements.

5.43 PIPE INSTALLATION

.1 Pipe shall be installed in strict accordance with the manufacturer's recommended practice.

.2 Pipe shall be checked before being lowered into the trench to ensure that no foreign material, manufacturer's defects, or cracks exist that might prevent the proper jointing of the pipe or its operation.

.3 The open end of the pipe in the trench shall be suitably covered to prevent entrance of trench water and other material during periods when pipe is not being installed.

.4 Precautions shall be taken to ensure that displacement of the pipe in the trench does not occur through soil displacement or floatation due to the presence of trench water. Pipe that has been displaced shall be removed from the trench and re-laid.

5.44 JOINTS AT RIGID STRUCTURES

.1 A flexible joint shall be provided at locations where the pipe is held in fixed position by a rigid support or structure. The distance from the support or structure shall depend on the diameter and type of pipe being installed and shall be in accordance with the pipe manufacturer's recommended practice. The purpose of the flexible joint is to prevent pipe failure due to uneven support under the pipe. Approved flexible joints include rubber gasket bell and spigot connections and dresser couplings.

5.45 HORIZONTAL AND VERTICAL CURVES

.1 Pipe on horizontal and vertical curves shall be laid true to the curve of the radius shown on the drawings and in accordance with field line and grades for each curve supplied by the Engineer. Variations in vertical curves and grades within the allowable joint deflection may be allowed where approved by the Engineer.

5.46 DEFLECTION

.1 Unless otherwise specified, the amount of pipe deflection at joints and couplings shall not exceed the limit as specified by the manufacturer.

5.47 PIPE RESTRAINT

.1 All fittings shall be restrained either by concrete thrust blocks as per Standard Drawing W-8 or joint restraints as indicated on the construction drawings, as directed by the Engineer.

.2 Concrete thrust blocking shall be placed between undisturbed ground and the fitting to be anchored. The area of thrust block bearing on pipe and on ground shall be as shown on the Standard Drawings or as otherwise indicated on the construction drawings. Concrete shall be so placed that pipe and fitting joints are accessible for repair. Bolts on flanged fittings shall not be encased in concrete. A polyethylene plastic barrier shall be provided between all fittings and concrete for thrust blocking. Concrete specification shall be as per Section 11.0 – Cast In Place Concrete Works. ***(REVISED MAY 2020)***

.3 Joint restraints shall be installed in accordance with the manufacturer's specifications. The length of pipe to be restrained shall be as shown on the construction drawings.

5.48 FITTINGS

.1 Fittings shall be installed at the locations shown on the drawings or as directed by the Engineer. Fittings shall be flanged to valves unless otherwise directed by the City Engineer. ***(REVISED MAY 2020)***

5.49 CONNECTIONS TO EXISTING PIPING

.1 All connections to existing piping services, and appurtenances shall be made by the City of Nanaimo forces unless otherwise authorized by the City Engineer.

.2 All connections to existing piping and services shall utilize a manufactured rubber gasket bell and spigot joint or dresser coupling designed for types of pipes to be connected.

5.50 VALVES

.1 All valves shall be set plumb directly on the centreline of the pipe and installed in accordance with Standard Drawing No. W-16.

.2 Valve boxes in unpaved areas shall have a 1.0 m wide, 50 mm thick asphalt apron around the valve box.

.3 Abandoned Valve Box Removal:

(a) Cut asphalt around valve box. Remove valve extension, mud and debris from valve riser box prior to filling with pea gravel. Valve box shall not be pulled prior to filling with pea gravel.
(b) Existing riser pipe must be minimum 300 mm below final grade. Riser pipe shall be cut down where necessary so that the existing riser pipe is a minimum 300 mm below finished grade.
(c) The minimum 300 mm grade difference shall be backfilled with 25 mm crush gravel and compacted to City of Nanaimo standards. Temporary cold mix asphalt to be used where necessary.

5.51 VALVES MARKERS

.1 All valve markers shall be installed in accordance with Standard Drawing No. W-9.

5.52 HYDRANTS

.1 All hydrants shall be installed in accordance with Standard Drawing No. W-5.

.2 Hydrant Installation:

(a) Hydrants shall be installed at the locations shown on the construction drawings and as specified in Section 5.07 – Hydrants, clause 5.07.6.
(b) Hydrant installation shall be in general accordance with AWWA manual M17.
(c) Tie rods shall be in accordance with Section 5.27 – Hydrants, clause 5.27.2.
(d) Hydrants shall be set plumb and such that the pumper nozzle faces, and is at right angles to, the road centreline unless otherwise directed by the City Engineer. ***(REVISED MAY 2020)***
(e) Hydrants shall be set with the ground flange 150 – 200 mm above finished ground or sidewalk surface unless otherwise directed by the City Engineer. ***(REVISED MAY 2020)***
(f) Care shall be taken in installing the connection pipe from the main to the hydrant to ensure that the hydrant is set at the specified level.
(g) Drain rock shall be placed as shown on the Standard Drawing for a hydrant connection to a level above the hydrant drain openings. The drain rock shall be covered with filter cloth before backfilling to prevent plugging up of the drainage pit.

(h) After installation, hydrants shall be covered with firmly secured black plastic bag until they are put into service.

.3 Hydrant Thrust Blocking:

(a) Hydrant Thrust Blocking shall only be used in situations where installation of tie rods is not acceptable as determined by the Engineer in consultation with the City Engineer. Approval by the City Engineer is required. ***(REVISED MAY 2020)***
(b) Care shall be taken to ensure that concrete for thrust blocking does not interfere with the operation of flange bolts and nuts or prevent proper operation of hydrant drains.
(c) Thrust block bearing areas shall be as shown on the drawings.

.4 Hydrant Access Crossings:

(a) Culverted hydrant access crossings shall be constructed as shown on the Standard Drawings.
(b) Culvert headwalls shall be constructed in accordance with Section 7.66 – Culvert Headwalls.
(c) Culverts shall be constructed in accordance with Section 7.65 – Culvert Installation.
(d) Gravel surfacing shall be constructed in accordance with Section 9.47 – Placing and Compacting Aggregates. ***(REVISED MAY 2020)***

5.53 FLUSHOUT INSTALLATION

.1 All flushouts shall be installed in accordance with Standard Drawing No.'s W-2A and W-2B and located as directed by the Engineer in consultation with the City Engineer. ***(REVISED MAY 2020)***

.2 Flushouts shall be set plumb.

.3 Care shall be taken in installing the piping, drain hole, and drain rock to ensure that the flushout will drain when the 65 mm dia. gate valve is closed.

5.54 AIR VALVE INSTALLATION

.1 All air valves shall be installed in accordance with Standard Drawing No.W-4 and located as directed by the Engineer in consultation with the City Engineer. ***(REVISED MAY 2020)***

5.55 FLOOR DRAIN ASSEMBLY INSTALLATION

.1 Drain assemblies shall be installed as shown on the construction drawings.

.2 Drain assembly connections to storm sewer mains, where approved by the City Engineer, shall be in accordance with Section7.61 – Service Connection Installation.

5.56 WATER SERVICES CONNECTION INSTALLATION

.1 All water service connections up to and including 50 mm dia. shall be installed in accordance with Standard Drawing No. W-1.

.2 All water service connections great than 50 mm diameter shall be installed as shown on the drawings.

.3 Location of Water Service Connections:

(a) Install service connections to the locations and depths as shown on the drawings. ***(REVISED MAY 2020)***

(b) Water service connections to each individual property shall have their own independent connection to the watermain.

.4 Water Service Connection Installation:

(a) Trenches shall be excavated where possible so that the pipe can be installed at right angles to, and in a direct line from, the main pipe to the terminus of the service.

(b) The trench shall be excavated to provide a minimum cover of 1.2 m over the service connection pipe and raised for the curb stop as shown on Standard Drawing No. W-1 for services up to and including 50 mm dia. in size.

(c) In rock, the trench is to be extended 3.0 m into the property to facilitate future extension of the service connection.

(d) The trench bottom shall be graded to form a continuous support along the service pipe. All rocks or projections within 150 mm of the service tubing shall be removed.

(e) When a service box is to be installed in a driveway, a 150 mm wide x 150 mm deep concrete apron shall be installed around the concrete service box in addition to the 25 mm minus crush gravel base structure.

(f) For services up to and including 50 mm dia., the pipe shall be connected to the corporation stop and a gooseneck formed as shown on the drawings.

(REVISED MAY 2020)

(g) Copper pipe shall be cut with square ends and reamed with the proper tools. Care shall be taken to prevent the pipe for kinking or buckling on short radius bends. Joints shall be made using the specified couplings. Sweated joints shall not be made.

(h) Pipe installed in an augered hole shall be protected with a cap or plug to prevent the entrance of foreign material into the pipe.

(i) A gate valve complete with valve box shall be provided at the main on all services over 50mm dia.

(j) After installation, water service connection locations shall be marked with a 50 mm x 100 mm pressure treated wood marker take painted blue and located at the terminus of the water service next to the service box. The stake shall extend from a point approximately 600 mm above ground to 600 mm below ground

except in locations where the extension of the stake above ground surface would be hazardous, in which case the stake shall be place at a location satisfactory to the Engineer and City Engineer. ***(REVISED MAY 2020)***

.5 Tapping Main Pipe:

(a) Taps shall be made in the main pipe by workmen using tools in good repair with the proper adapters for the size of main being tapped. Pipe shall be tapped while under internal water pressure unless otherwise approved by the Engineer and City Engineer. The minimum distance of a tapping shall be 1.0 m from a pipe end or joint, or 2.0 m from a pipe end equipped with a flushout and a minimum of 1.0 m from an adjacent tapping unless a greater distance is specified by the pipe manufacturer. ***(REVISED MAY 2020)***

(b) Service connections tapped to 100 m dia. main pipe and AC and PBC main pipes (all diameter) shall have approved pipe saddles for hot tapping.

.6 Curb Stop and Service Box Installation:

(a) The curb stop shall be installed as shown on the drawings or in the locations directed by the Engineer and City Engineer and shall be provided with a plastic plug to prevent the entrance of foreign material. ***(REVISED MAY 2020)***

(b) The service box shall be installed when the service is installed from the main to the property line. The service box shall be installed plumb with the center of the top of the lid 25 mm above finished grade in untraveled areas and 0 – 6 mm below finished grade in travelled areas as shown on Standard Drawing No. W-1.

5.57 WATER METERS

.1 Water meters shall be installed by City of Nanaimo forces unless otherwise authorized by the City Engineer.

.2 Install meters in accordance with the manufacturer's recommendations.

5.58 METER CHAMBERS

.1 All meter chambers shall be constructed in accordance with Standard Drawing No. W-11 unless otherwise shown on the construction drawings.

.2 The floor drain system shall be installed in accordance with Section 5.55 – Floor Drain Assembly Installation.

.3 Install valves, fittings and meters according to manufacturer's recommendations at the locations shown on the construction drawings.

.4 Support valves, fittings and meters by means of steel pipe supports.

.5 Install touch read meter bracket between the first and second ladder rung in accordance with Standard Drawing No. W-12.

.6 If required by the Engineer, meter chambers shall be tested for leakage after the installation of equipment by filling the chamber to the underside of the roof slab with water. The test duration shall be a minimum of three hours. No leakage will be allowed.

.7 Precast Manhole Sections:

(a) Precast manhole barrel sections shall be placed plumb.
(b) Joints between the top riser and the cover slab shall be made watertight with cement mortar. Prior to placing sections, the mating faces shall be thoroughly soaked with water and a layer of cement mortar shall be spread on the lower face. After sections are placed, excess mortar which has been squeezed out shall be removed and the joint made flush inside and out.
(c) Joints between precast manhole barrels must utilize O-ring gaskets and shall conform to the manufacturer's specifications. The inside surface of the precast barrel at the O-ring joints shall be filled with cement grout to a smooth finish.
(d) Damaged O-ring manhole joints require removal and replacement of damaged manhole section. Mortar patching of damaged area if approved by the Engineer, shall require the removal of the O-ring gasket and installation as per Section 5.58.7(b).
(e) Refer to Section 5.34 for precast manhole section specifications.

.8 Manhole Concrete Bases:

(a) All water shall be removed from the excavation prior to placing base concrete. The base shall be constructed such that the first section of a precast section can be set plumb with uniform bearing throughout its full circumference.
(b) If material in the bottom of the trench is unsuitable for support, the bottom shall be over excavated to firm base as determined by the Engineer and backfilled to the required grade with thoroughly compacted base gravel as specified for trench bottom stabilization under the applicable item included in Section 4.0 – Excavation, Trenching and Backfill. ***(REVISED MAY 2020)***
(c) Where overexcavation and backfill with base gravel is not practical, special structural support shall be provided as specified for trench bottom stabilization under the applicable item included in Section 4.0 – Excavation, Trenching and Backfill. ***(REVISED MAY 2020)***
(d) Concrete manhole bases shall be constructed as shown on the drawings.
(e) Refer to Section 5.34 for precast manhole bases section specifications.

.9 Precast Manhole Bases:

(a) Installation of precast manhole bases shall conform to 5.58.8.
(b) Precast manhole bases shall be placed on 150 mm thick base of 40 mm drain rock.
(c) Use of precast concrete bases requires approval by the City Engineer. ***(REVISED MAY 2020)***

.10 Concrete

(a) Cast In Place Concrete work shall conform to Section 11.0 – Cast In Place Concrete Works. ***(REVISED MAY 2020)***

.11 Frames and Covers

(a) Frames shall be set on precast concrete grade rings to bring the cast iron manhole frame up to grade as shown on the Standard Drawings. Contractor to install a minimum of two (2) 62.5 mm thick concrete grade rings to a maximum of four (4) 62.5 mm thick grade rings. The concrete grade rings shall be laid in common bond with raked mortar joints and shall be mortared inside and outside the manhole.

(i) Fine grade elevation adjustments of frames shall be done with a minimum of 3, steel only, shims equally spaced.

(b) Manhole covers shall be installed:

(i) for unpaved areas, covers shall have a 1.5 m x 1.5 m, 50 mm thick asphalt apron. Covers shall be set flush with the asphalt surround.
(ii) for paved areas, covers shall be flush with finished pavement grade with a maximum allowed variance of 6mm lower than the finished pavement grade. Covers shall not protrude above the finished pavement.

(c) Steel manhole riser rings shall be used in easements only.
(d) Refer to Section5.34 for manhole covers and frames specifications.

.12 Manhole Steps

(a) Manhole steps shall be installed in manhole sections by the manufacturer unless the circumstance dictates otherwise, in which case approval must be received from the Engineer.
(b) The distance from the top of the chamber manhole, to the first manhole step shall conform to WorkSafe BC requirements.
(c) Refer to Section5.34 for manhole step specifications.

5.59 -NOT USED-

5.60 PRESSURE REDUCING STATIONS

.1 Pressure reducing stations shall be installed in accordance with the construction drawings and supplementary specifications.

5.61 PRESSURE AND LEAKAGE TESTING

.1 Pressure and leakage tests shall be performed on all installed pipes, hydrants, valves, fittings and service connections.

.2 Pressure and leakage tests can be commenced upon completion of all underground utility installation. Prior to testing, concrete thrust blocking shall be sufficiently cured to restrain fittings, valves and hydrants.

.3 Testing procedures shall be submitted to the City Engineer for approval prior to commencement of testing.

.4 Hydrant lead valves and service corporation stops shall be fully opened during the test. As a preliminary step, the entire system may be pressure and leakage tested at one. Pressure and leakage tests shall be carried out between valved sections of the installation such that every valve in the system is tested for leakage in the shut-off position.

.5 Pressure and leakage testing shall be conducted in the presence of the Design Engineer, and the City of Nanaimo Inspector. ***(REVISED MAY 2020)***

.6 Pressure and leakage tests for ductile iron piping shall be in accordance with AWWA C600.

.7 Testing of welded steel piping shall be in accordance with AWWA C206. No leakage shall be allowed.

.8 Pressure and leakage tests for PVC pipe shall be performed in the following manner:

(a) Fill the section to be tested slowly with water and expel all air from the section.
(b) If air relief valves are not required at the high points of the test section, the pipe shall be tapped to release all air and approved plugs inserted upon completion of testing.
(c) Pump water into the test section until the static pressure reaches 1035 kPa (150 psi) or 1.5 times the average system operating pressure at the point of test, whichever is greater. ***(REVISED MAY 2020)***
(d) Maintain the test pressure in the pipe to ± 70 kPa (10 psi) throughout the duration of the test by the addition of a measured quantity of water. The duration of the test shall be a minimum of one hour. ***(REVISED MAY 2020)***
(e) The quantity of water required to maintain the test pressure shall be considered to be the leakage.
(f) The allowable leakage shall be determined from the following formula:

$$L = \frac{SD \times \text{square root of } P}{715{,}317}$$

in which L = allowable leakage (liters/hour)
S = length of the test section, in meters
D = nominal diameter of the pipe run in mm
P = average test pressure during the leakage test in kPa

(g) Should testing disclose leakage above the maximum allowable leakage, the contractor shall locate and repair or replace the defect and retest the section until test results are satisfactory.

(h) A copy of the leakage and test pressure report shall be forwarded to the City Inspector. ***(REVISED MAY 2020)***

(i) Prior to accepting the work, all valves shall be checked to ensure they fully open.

5.62 FLUSHING, CHLORINATION AND BACTERIAL SAMPLING

.1 Prior to chlorination, all piping and appurtenances shall be flushed with a minimum velocity of 1.0 m/s. Dispose of flushing water only to drainage works capable of carrying the flows. When flushing the watermain into a sanitary sewer, the downstream capacity shall be reviewed with City of Nanaimo Operations staff.

.2 The Design Engineer shall arrange, undertake and ensure all piping and appurtenances are flushed, chlorinated, flushed of chlorinated water and tested for bacteria according to the latest edition of AWWA C651.

On completion of chlorination, the entire piping system shall be thoroughly flushed and filled with potable water prior to bacterial sampling.

Flushing chlorination and bacterial sampling shall be conducted in the presence of the Design Engineer and the City of Nanaimo Inspector. ***(REVISED MAY 2020)***

.3 Chlorinated water shall be disposed of in a way that will not cause harm or damage to vegetation or aquatic life in bodies of water or water courses. Points of discharge are to be approved by the Engineer in consultation with the City Engineer. ***(REVISED MAY 2020)***

5.63 NOTIFICATION TO CITY ENGINEER – SYSTEM TESTS AND FINAL CONNECTION ***(REVISED MAY 2020)***

.1 The City Engineer and the City of Nanaimo Inspector shall be given 48 hours written notice in advance of all system tests and pipe chlorination by the Contractor. ***(REVISED MAY 2020)***

.2 On new water systems no physical connection (tie-in) to the public system shall be made until the new system passes:

(a) flushing,
(b) pressure testing,
(c) disinfection,
(d) satisfactory bacterial testing results by an accredited certified lab.

.3 Upon satisfactory passing, the Design Engineer shall submit copies of all of the above noted test results to the City Engineer with their written recommendation on connection to the Public Water Supply.

.4 The City Engineer will review the provided test results and recommendation from the Design Engineer and if acceptable may grant Approval to Connect to the Public Water Supply. Under no circumstances shall a connection to the Public Water Supply be undertaken without an Approval to Connect issued by the City Engineer.

.5 Once Approval to Connect is granted, the time to connect (tie-in) to the Public Water Supply shall be no greater than 7 calendar days, otherwise bacterial testing results will be invalid and will need to be redone. The short spool pieces, fittings and couplers required to complete the connection shall be cleaned and disinfected to AWWA standards. All final connections (tie-ins) shall be reviewed by the Design Engineer. Once final tie-in is complete and the system is in operation, the tie-in shall be reviewed by the Design Engineer for water leaks prior to backfilling and covering up.

.6 Tie-in and connection shall be conducted in the presence of the Design Engineer and the City of Nanaimo Inspector. ***(REVISED MAY 2020)***

.7 Final Connections:

(a) If Connection is 1 pipe length or less (6 m or less) spray or swab disinfect all parts just prior to connection.

(b) If connection is greater than 1 pipe length (plus 6 m), the pipe must be set up above ground, disinfected and bacterial samples taken as described in AWWA C651 Section 5.0. Ends of pipe must be sealed watertight until installed.

SECTION 5 – WATER DISTRIBUTION SYSTEM
CROSS CONNECTION CONTROL *(REVISED MAY 2020 – NEW SECTION)*

5.70 LEGAL AUTHORITY

.1 Legal Authority for the City of Nanaimo Cross Connection Control Program is provided by the City of Nanaimo Bylaw No. 7249 – A Bylaw Respecting Cross Connection Control and the British Columbia Plumbing Code, Division B, Part 2, Section 2.6.2, which requires potable water to be protected from contamination.

.2 This Cross Connection Control Program is:

(a) In compliance with the Island Health Authorities Permit to Operate a Water System as provided under the Drinking Water Act, Part 2, Section 8.0, and
(b) Follows recommended practices of the most current editions of AWWA Canadian Cross Connection Control Manual and CSA B64.10 & B64.10.1.

.3 Section 5.70 – Water Distribution System Cross Connection Control shall govern the public water supply for Premises Isolation of private property and parcels. Private property and parcels shall be governed under the British Columbia Plumbing Code.

5.71 OWNER'S RESPONSIBILITY

.1 The Owner of a property subject to Premise Isolation shall be the Owner of all Backflow Prevention Assemblies, associated chambers, vaults, containment structures such as mechanical rooms and associated appurtenances.

(a) For testable Backflow Prevention Assemblies, testing, maintenance and repairs shall be required at specified intervals and documented on the forms and tags provided by the Cross Connection Control Coordinator.

.2 All tests, repairs, overhauls, replacements and plumbing system improvements shall be at the expense of the Owner of the Backflow Prevention Assemblies. Reports on all testing, maintenance and repairs shall be documented on the specified forms and tags provided by the City of Nanaimo.

(a) Tags shall be placed on Backflow Prevention Assemblies with associated forms submitted to the Cross Connection Control Coordinator.
(b) When the installation of a Backflow Prevention Assembly for Premises Isolation creates a closed piping system, the Owner is required to assess the plumbing system to protect against an increase of pressure due to thermal expansion.

.3 Chambers, vaults and other containment structures such as a mechanical room housing the Backflow Prevention Assembly and associated appurtenances for Premises Isolation shall be located on the Owner's property.

(a) For residential services, check valves (Dual Check Valve – DuC) installed integrally with a water meter/meter setter shall be maintained and serviced by the residential owner.

5.72 ACCEPTABLE BACKFLOW PREVENTERS

.1 For the purpose of Premise Isolation, three CSA categories of Backflow Prevention Assemblies are acceptable.

(a) CSA B64.4:

(i) This includes the Reduced Pressure Principle (RP Backflow Prevention Assembly. For specialized service such as for fire supply, a Reduced Pressure Principle Detector (RPD) or RPF may be required.

(b) CSA B64.5:

(i) This includes the Double Check Valve Assembly (DCVA). For specialized service such as for fire supply, a Double Check Detector Assembly (DCDA) or DCVAF may be required.

(c) CSA B64.6:

(i) This includes the Dual Check Valve (DuC). For specialized service such as for fire supply, a DuCF may be required.

5.73 HAZARD CATEGORY

.1 There are three classifications of connection hazard. Classification shall be to CSA B64.10 as follows:

(a) **Minor** – nuisance to the water supply that results in a reduction in only the aesthetic quality of the water. This would include water that might have been heated or cooled and connections that cannot create a danger to health.

(b) **Moderate** – any minor hazard connection that has a low probability of being a severe hazard. This includes, but is not limited to, connections involving water where the aesthetic qualities of the water have been reduced and, under certain conditions can create a danger to health.

(c) **Severe** – any type of cross connection or potential cross connection involving water that has additives or substances that, under any concentration, can create a danger to health.

5.74 DEVICES REQUIRED FOR PREMISES ISOLATION

.1 Premises Isolation shall be provided by installation of a Backflow Prevention Assembly on the service line connection between the property/parcel and City of Nanaimo Water Distribution System. The Backflow Prevention Assembly installed, as service line protection, ensures water of questionable quality cannot leave a property and enter the City of Nanaimo Water Distribution System.

.2 Premises Isolation for a property shall be required in all cases even if the plumbing system on the property complies with the British Columbia Plumbing Code.

.3 Backflow protection shall provide Premises Isolation at one of the three hazard categories', as follows:

(a) Dual Check Valve (DuC) Backflow Prevention Assembly for properties with minor hazard classification. Also includes DuCF.
(b) Double Check Valve (DCVA) Backflow Prevention Assembly for properties with moderate hazard classification. Also includes DCVAF and DCDA.
(c) Reduced Pressure Principle (RP) Backflow Prevention Assembly for properties with a severe hazard classification. Also includes RPF and RPD.

.4 For fire protection, Backflow Prevention Assemblies shall be DuCF, DCVAF and RPF. Each Backflow Prevention Assembly shall be UL/ULC listed and FM approved.

5.75 PROPERTIES, HAZARD CLASSIFICATION AND PREMISES ISOLATION REQUIRED

.1 All properties require Premises Isolation with an approved Backflow Prevention Assembly on the service line(s) leading to and supplying a property. Subject to review by the Cross Connection Control Coordinator for appropriate hazard classification and required Backflow Prevention Assembly, Premises Isolation shall be required for the following properties.

(a) **Minor Hazard Classification -** Dual Check Valve (DuC) Backflow Prevention Assembly required.

(i) Duplex Housing with shared service
(ii) Residential Premises
(iii) Townhouse (shared services)

(b) **Minor/Moderate Hazard Classification -** Double Check Valve (DCVA) Backflow Prevention Assembly required.

(i) Church

(c) **Moderate Hazard Classification -** Double Check Valve (DCVA) Backflow Prevention Assembly required.

(i) Airport
(ii) Apartment Building
(iii) Arena
(iv) Auto Dealership
(v) Campsite
(vi) Grocer
(vii) Hair Salon
(viii) Dental Office
(ix) Hotel
(x) Fuel Dispensing Facility
(xi) Kennel
(xii) College
(xiii) Medical Clinic (non-surgical)

(xiv) Laundry (commercial, coin-operated)
(xv) Manufacturing Plant (not specified)
(xvi) Mobile Home Park
(xvii) Multi-Service Interconnected Facility
(xviii) Multi-Tenant Single-Service Facility
(xix) Nursing Home
(xx) Office Building
(xxi) Motel
(xxii) Penitentiary
(xxiii) Restaurant
(xxiv) School (elementary, junior high and senior high)
(xxv) Shopping Mall
(xxvi) Swimming Pool Facility
(xxvii) Water Park

(d) **Moderate/Severe** – Reduced Pressure Principle (RP) Backflow Prevention Assembly required.

(i) Animal Feed Lot
(ii) Animal Stock Yard
(iii) Commercial Premises
(iv) Farm
(v) Fire Station
(vi) Industrial and Institutional Premises
(vii) Golf Course
(viii) Funeral Home
(ix) Marina (pleasure boat)
(x) University
(xi) Veterinary Clinic
(xii) Waste Disposal Plant

(e) **Severe Hazard Classification** – Reduced Pressure Principle (RP) Backflow Prevention Assembly required.

(i) Aquaculture Farm
(ii) Aquarium (public)
(iii) Asphalt Plant
(iv) Auto Body Shop
(v) Automotive Repair Shop
(vi) Beverage Processing Plant (includes distillery and brewery)
(vii) Blood Clinic Severe
(viii) Campsite with RV Hook-Ups or Dump-Stations
(ix) Carwash
(x) Chemical Plant
(xi) Concrete Plant
(xii) Dental Surgery Facility
(xiii) Dock and Marine Facility
(xiv) Dry Cleaning Plant

(xv) Dye Plant
(xvi) Exhibition Ground
(xvii) Film Processing Facility
(xviii) Fish Farms or Hatchery
(xix) Food Processing Plant
(xx) Funeral Home
(xxi) Garbage Transfer Facility
(xxii) Hospital
(xxiii) Laboratory
(xxiv) Laundry (commercial)
(xxv) Meat Packing Plant
(xxvi) Medical Clinic (surgical)
(xxvii) Milk Processing Plant
(xxviii) Mining Facility
(xxix) Mortuary or Morgue
(xxx) Motorcycle Repair Facility
(xxxi) Oil Refinery
(xxxii) Paint Manufacturing Plant
(xxxiii) Petroleum Processing or Storage Facility
(xxxiv) Pharmaceutical Manufacturing Facility
(xxxv) Photo Processing Facility
(xxxvi) Plants Using Radioactive Material
(xxxvii) Plastic Manufacturing Plant
(xxxviii) Plating Shop and Plant
(xxxix) Poultry Farm
(xl) Power Generating Facility
(xli) Premises where access is prohibited or restricted
(xlii) Printing Plant
(xliii) Pulp and or Paper Plant
(xliv) Radiator Shop
(xlv) Recycling Facility
(xlvi) Refinery, Petroleum Processing
(xlvii) Rendering Facility
(xlviii) Research Building
(xlix) Sewage Dump Station
(l) Sewage Treatment Plant
(li) Steam Plant
(lii) Steel Manufacturing Plant
(liii) Trackside Facility for Trains
(liv) Wastewater Facility
(lv) Wastewater Pump Station
(lvi) Wastewater Treatment Plant
(lvii) Water Filling Station
(lviii) Water Treatment Plant
(lix) Water Treatment Pump Station
(lx) Zoo

(f) Irrespective of the previous list of properties, the Cross Connection Control Coordinator shall complete a survey of the property/parcel for hazard classification and shall specify the appropriate Backflow Prevention Assembly required for Premise Isolation.

5.76 TESTING, MAINTENANCE AND REPORTING

.1 Testable Backflow Prevention Assemblies:

(a) The following Backflow Prevention Assemblies are testable.

(i) DCVA, DCDA and DCVAF backflow prevention assemblies; and
(ii) RP, RPD and RPF backflow prevention assemblies.

.2 Tester Certification and Testing Requirements:

(a) British Columbia Water and Waste Association (BCWWA) certified backflow assembly testers shall test backflow prevention assemblies within the City of Nanaimo Water Distribution System. The tester is responsible for the accurate documentation, correct assessment of each assembly tested, device tagging and test form submission to the Cross Connection Control Coordinator.
(b) Testers shall have an active BCWWA backflow assembly tester certificate and are required to test Backflow Prevention Assemblies in accordance with CSA B64.10.1.

.3 Frequency of Field Testing and Maintenance:

(a) To ensure satisfactory operation, a Backflow Prevention Assembly shall be field tested in accordance with the applicable requirements specified for each Backflow Prevention Assembly in accordance with CSA B64.10.1 at the following times:

(i) Upon installation;
(ii) After a backflow incident;
(iii) After alteration of the supply pipe upstream of a Backflow Prevention Assembly;
(iv) When cleaned, repaired, or overhauled;
(v) When relocated;
(vi) Annually; and
(vii) As required by the Cross Connection Control Coordinator.

.4 Reporting:

(a) Test results shall be reported on the forms provided by the Cross Connection Control Coordinator appropriate for the type of Backflow Prevention Assembly and procedure. The tester shall complete the:

(i) Backflow Prevention Assembly test and inspection report and submit the completed form back to the Cross Connection Control Coordinator, and

(ii) Backflow Prevention Assembly test tag and affix the tag to the device.

(b) The form and tag shall be fully completed and accurate.
(c) Fire departments and fire alarm companies shall be notified when a fire protection service is to be shut down for field testing.
(d) The main Backflow Prevention Assembly and, if equipped, an equivalent bypass Backflow Prevention Assembly shall be tested at the same time.
(e) A detector type Backflow Prevention Assembly shall have the main line and bypass Backflow Prevention Assemblies tested at the same time.

5.77 INSTALLATION STANDARDS FOR BACKFLOW PREVENTION ASSEMBLIES FOR PREMISES ISOLATION

.1 Location of Backflow Prevention Assemblies:

(a) The location of Backflow Prevention Assemblies providing Premises Isolation shall be immediately after the water meter within the property line of a property or within a building (mechanical room) before any branching off. To facilitate inspection, field testing and maintenance, Backflow Prevention Assemblies shall be installed in accessible locations to facilitate maintenance and testing, but preferably not a confined space. A Backflow Prevention Assembly may be installed in an insulated above ground enclosure that complies with ASSE 1060 requirements. Class 1 freeze protection and complete with manufacturer installed heater for wet/damp locations.

(i) For dedicated fire service lines with no meter connection, Premises Isolation shall be immediately within the property line of a property or within a building (mechanical room) before any branching off. Backflow Prevention Assembly shall be detector type.

(b) Air gaps, backflow preventers, or vacuum breakers with vents to atmosphere shall not be installed in a corrosive or polluted environment.
(c) DuC Backflow Prevention Assemblies for residential service are normally part of the water meter/setter installation and shall be contained in the same pit as the water meter.
(d) DCVA Backflow Prevention Assemblies may be installed in a dry, below grade chamber, if equipped with a drain to daylight or sump pump. All test cocks on the device shall be capped and watertight.
(e) RP Backflow Prevention Assemblies shall not be installed in a below grade pit, vault or chamber.
(f) Relief ports shall not be directly connected to a drain. Adequate drainage, as recommended by the manufacturer, shall be provided for discharge from relief ports.

(i) A connection to the relief port of a RP Backflow Prevention Assembly shall be made using the manufacturer's drain connection fitting. The pipe from the outlet of the drain connection fitting shall:

1. Be at least equal in size to that of the drain connection fitting;
2. Be rigid;
3. Slope downward from the Backflow Prevention Assembly; and
4. Terminate with an indirect connection (air break) above a floor drain, sump, or other safe location.

.2 Mounting Clearance and Orientation:

(a) Backflow Prevention Assemblies shall be installed at a convenient height for testing, maintenance and proper operation. Mounting clearances shall be as per the City of Nanaimo Specifications and Standard Detail Drawings, manufacturer's recommended clearances or the following clearances, whichever are greater.

(i) Height above floor or platforms as measured to the center of a device:

1. Minimum vertical clearance from floor or platform: 750 mm.
2. For a RP minimum vertical clearance from bottom of relief valve to floor shall be 300 mm.
3. Maximum vertical clearance from floor or platform: 1500 mm.

(ii) Minimum workspace clearance to the nearest wall or obstruction:

1. Above the device: 300 mm.
2. In front of the device: 750 mm.
3. Behind the device: 20 mm.

(b) Backflow Prevention Assemblies shall be installed in the orientation in which they have been tested and approved, showing compliance with the applicable Standard of the CSA B64 Series.

.3 Bypass:

(a) Bypass around a Backflow Prevention Assembly shall be prohibited unless the bypass is fitted with equivalent piping and an equivalent Backflow Prevention Assembly.

.4 Shut-off Valves and Test Cocks:

(a) Each testable Backflow Prevention Assembly shall be complete with approved shut-off valves and test cocks with resilient seats providing a drip-tight shut-off.
(b) All valves shall be indicating.

.5 In-line Strainers:

(a) In-line strainers shall be installed before the water meter with Backflow Prevention Assemblies installed after the water meter, fire protection systems are an exception.

(i) A fire protection system shall not have a strainer installed anywhere upstream of the Backflow Prevention Assembly.

5.78 FIRE PROTECTON SYSTEMS

.1 Premise Isolation with listed devices shall be required for all service connections to fire protection systems. The municipal water supply shall be protected against backflow caused by back siphonage or back pressure.

.2 Devices installed in fire protection systems, as required by the Fire Code, should be maintained and tested in accordance with the requirements of the Fire Code Standards.

.3 Classes of Fire Protection Systems:

(a) **Class 1 System** – a fire protection system that has direct connections only from public watermains, has no pumps, tanks, or reservoirs, and has all sprinkler drains discharging to atmosphere, dry wells, or other safe outlets.
(b) **Class 2 System** – a fire protection system that is the same as a Class 1 system, but also includes a booster pump in the connection from the municipal water supply system.
(c) **Class 3 System** – a fire protection system that has direct connections from the municipal potable water supply system, elevated storage tanks (either open or closed), fire pumps talking suction from above-ground covered reservoirs or tanks, and pressure tanks. In Class 3 systems, storage facilities are only filled from, or connected to, the municipal potable water supply system, and the water in the tanks is maintained in a potable condition. Class 3 systems resemble Class 1 systems in all other respects.
(d) **Class 4 System** – a fire protection system that has direct connections from the municipal potable water supply system (similar to Class 1 and Class 2 systems) and an auxiliary water supply dedicated to fire department use and available to the premises, such as an auxiliary supply located within 500 m of the pumper connection.
(e) **Class 5 System** – a fire protection system that has direct connections from the municipal potable water supply system and that is also interconnected with an auxiliary water supply.
(f) **Class 6 System** – a fire protection system that is a combined industrial and fire protection system and is supplied from the municipal potable water supply system only, with or without gravity storage or pump suction tanks.
(g) **Residential "partial flow through" System** – a fire protection system in which flow (during non-functioning periods of the fire system) only occurs through the main header to a water closet located at the farthest point of the system.

.4 Acceptable Premises Isolation:

(a) Class 1 System with materials acceptable for use in potable water systems and no antifreeze or additives – DCVAF or RPF.
(b) Class 2 System with materials acceptable for use in potable water systems and no antifreeze or additives – DCAF or RPF.

(c) Class 1 and Class 2 Systems with materials not acceptable for use in a potable water system or antifreeze or additives – RPF.
(d) Class 3, Class 4, Class 5 and Class 6 Systems – RPF.
(e) Residential "partial flow through" system with materials acceptable for use in potable water systems and no antifreeze or additives – DuCF, DCVAF, RPF.

.5 Fire Protection Service:

(a) A detector type Backflow Prevention Assembly shall be required when no water meter is installed up-stream of the detector type Backflow Prevention Assembly.

.6 Retrofitting Older Fire Protection Systems:

(a) A comprehensive evaluation by a qualified, competent person (such as a professional engineer) shall be undertaken. This qualified person shall ensure adequate flow and pressure through the device(s) to meet fire protection needs, and to address the thermal expansion issues associated with installing Backflow Prevention Assemblies.

5.79 DISTRIBUTION SYSTEM PROTECTION

.1 Any outlet used on a permanent or temporary basis to dispense potable water from the City of Nanaimo Water Distribution System to water hauling equipment shall be protected against backflow caused by back siphonage or back pressure with an RP Backflow Prevention Assembly.

.2 For Permanent Connections:

(a) Reservoirs and storage tanks: A screened air-gap separation is recommended on overflow pipes.
(b) Air release, vacuum, combination valves: A screened air-gap separation is recommended on air-discharge outlet pipes. The valve air opening must be properly vented above the ground and provided with an insect screen on the vent. Ideally the valves should be installed above ground and protected from freezing.
(c) Fire hydrants and other appurtenances with underground drain ports: Eliminate all underground drain connections, wherever possible. For dry barrel fire hydrants, no recommended protection is presently available.

.3 For Temporary Connections:

(a) Supply of water for filling or disinfecting new mains, etc.: A RP Backflow Prevention Assembly shall be required.
(b) Supply of water for construction sites, filling tanks, etc.: A RP Backflow Prevention Assembly shall be required.

(c) Supply of water for sewer flushing:

(i) The use of water directly from hydrants/standpipes is prohibited for sewer flushing. All sewer flushing water shall be provided from tanker trucks.

5.80 USE OF FIRE HYDRANTS AND STANDPIPES

.1 No hydrant or standpipe may be operated or used for the purpose of accessing water without a Hydrant or Temporary Use Permit issued by the Cross Connection Control Coordinator.

(a) A water meter complete with a RP Backflow Prevention Assembly in a secured portable container shall be provided by the City of Nanaimo.

5.81 IRRIGATION SYSTEMS

.1 Annual testing and documentation shall be required and is the responsibility of the Owner of the irrigation system.

.2 All irrigation systems (including residential systems) installed shall be subject to:

(a) Periodic review by the Cross Connection Control Coordinator.
(b) CSA B64.10/B64.10.1
(c) AWWA Canadian Cross Connection Control Manual, and
(d) The National Plumbing Code of Canada.

.3 Any outlet used to dispense potable water from the City of Nanaimo Water Distribution System to supply an in-ground irrigation system shall be protected against backflow caused by back siphoning with the following:

(a) For systems without injection of chemicals:

(i) A DCVA Backflow Prevention Assembly installed upstream of the irrigation system shut-off or other control valves.

1. For 19 mm to 50 mm dia. Irrigation Mains a DCVA Backflow Prevention Assembly shall typically be installed in a below grade box in accordance with Section 14.0 Standard Drawing No. I-1. All test cocks on the device shall be capped and watertight.
2. A DCVA Backflow Prevention Assembly may also be installed in an insulated above ground enclosure that complies with ASSE 1060 requirements, Class 2 frost protection.

(b) For any system with injection of chemicals:

(i) A RP Backflow Prevention Assembly shall be installed upstream of the irrigation system shut-off valves.

1. A RP Backflow Prevention Assembly shall be installed in an insulated above ground enclosure that complies with ASSE 1060 requirements, Class 2 frost protection.