

5.0 WATER DISTRIBUTION

5.1 GENERAL

The Master Water Plan, Official Community Plan, and any other related planning documents shall be consulted to ensure long-term water plans and objectives are addressed by each design.

The location of pressure zone boundaries, PRV stations, and pumping stations will be pre-determined by the General Manager.

Water systems design shall conform to all applicable provincial and federal requirements.

5.2 DEMANDS

Every water distribution system must be designed to convey adequate supply for consumption and fire protection demands at a desirable pressure.

Consumption demand shall be that of all land uses including Residential, Industrial and Commercial demand during the summer season, including demand for irrigation or sprinkling.

5.2.1 Consumption Demand

Design populations used in calculating water demand shall be computed in accordance with the City's land use density and population predictions, or the planned development in the area to be served, whichever is greater.

Residential

1. Population Densities

The following are to be used, unless approved by the General Manager:

- 3.3 persons/unit (min): Single-family (detached)
- 2.9 persons/unit (min): Multi-family (other)
- 2.1 persons/unit (min): Multi-family (apartment)

All design population assumptions must be reviewed with and approved by the General Manager.

2. Demands

- Peak Hour Demand (H) = 1,500 Lpcpd (Litres per capita per day)
- Maximum Day Demand (D) = 1,000 Lpcpd
- Average Day Demand (A) = 500 Lpcpd

Industrial & Commercial

In the absence of any data on existing or proposed uses, the following design demands for commercial and industrial areas shall be used:

1. The peak hour industrial rate to be used in localized design, including that of a separate industrial zone is 180,000 litres per hectare per day (Lphpd). Any residential demands in such areas are to be allowed for at the maximum day rate (D).
- or -
2. The industrial water use coincident with the early evening peak requirements on the whole system (H) to be used in the design of main feeders and to be allowed for in the overall network analysis for peak system conditions is 90,000 Lphpd.

These flow requirements are provided for guidance only. For major subdivision development, it is suggested that the Engineering Division be consulted regarding take-off location(s). Any proposed flow requirements must be approved by the General Manager.

5.2.2 Fire Flow Demand

The requirements of this section are based on the publication “Water Supply for Public Fire Protection – A Guide to Recommended Practice” published by the Fire Underwriters Survey. The fire flows presented are minimum levels of protection. The Consultant must determine whether the fire flow required for the proposed development will exceed these minimum required flows.

All fire flows are to be available to the furthest distance within the site from the service location and/or at the point of highest elevation.

The minimum required fire flows for different land uses is provided in Table 5.1.

Table 5.1 Fire Flows

Zone	Required Fire Flow (lps)
Single & Two Family Homes with minimum 3.0 m separation	120
Single, Two Family and Townhouses	230
Condo/Apartment (Combustible Construction)	275
Condo/Apartment/High Rise (Non-Combustible Construction)	180
Commercial	200
Industrial/Institutional	250

Where each existing and future building on a lot is or will be constructed with an automatic fire sprinkler system for the entire building, the minimum fire flow provided to that lot may be reduced to the minimum flow calculated in accordance with the Fire Underwriters Survey once the consultant has confirmed the building design at the building permit stage and submitted signed & sealed fire flow calculations.

All proposed fire flows are to be approved by the General Manager.

5.3 HYDRAULICS

5.3.1 Design Flow

The total design flow is the greater of:

$$Q_{\text{design}} = D + F \quad \text{maximum day demand for the population, plus the fire flow}$$

-or-

$$Q_{\text{design}} = H \quad \text{peak hour demand for the population}$$

5.3.2 Water Pressure

The water supply distribution system shall be designed to maintain an operating pressure of between 700 kPa and 280 kPa during all except fire events. With the combination of maximum daily demand and the specified fire flow, the minimum residual water pressure shall be 140 kPa at the required fire hydrants and at all other nodes in the system.

Every effort should be made to provide loops in the distribution system.

5.3.3 Analysis

The Consultant shall complete a hydraulic analysis of the proposed distribution system showing flows and pressures during peak hour and maximum day plus fire flow scenarios.

The pipe and node data, including the domestic flows, and fire flows, shall be provided to the City.

The City will supply the Consultant with a reservoir location and the maximum design pressure on which to base calculations.

For local distribution systems, sources may be assumed to be the nearest water mains that are 300 mm diameter or larger. Available heads and flows will be confirmed by the Engineering Division through overall water network analysis or verification by hydrant flow test data at the discretion of the General Manager.

5.3.4 Hydraulic Design

The analysis of the proposed distribution system shall be carried out using the Hazen-Williams formula:

$$Q = (C D^{2.63} S^{0.54})/278,780$$

Where: Q = Rate of flow in l/s

D = Internal pipe diameter in mm

S = Slope of hydraulic grade line in m/m

C = Roughness coefficient

Appropriate pipe coefficients for existing and proposed pipe shall be approved by the General Manager.

5.4 VELOCITY AND HEADLOSS

In all water distribution system analysis the Consultant shall consider the impacts of surge pressures. For mains 400 mm and larger, the Consultant shall keep velocities below 3 m/s.

5.5 MINIMUM PIPE SIZES

The minimum pipe size for watermains is 150 mm diameter.

Watermains, which are 250 mm diameter, are not permitted unless otherwise approved by the General Manager.

5.6 MINIMUM GRADE

Invert grades of water mains shall be such as to assure proper clearance between top of valves and valve box covers

5.7 DEFLECTION

Deflection at pipe joints is permitted unless otherwise approved in writing by the General Manager.

5.8 LOCATION

Mains shall be referenced to the street or right-of-way and uniformly located within it.

The location of the watermain shall be in accordance with the City's standard utility location as shown on the "Typical Cross Section" drawings in Section 7.0.

If, for any reason, the location shown is impractical, the offset may be changed with the approval of the General Manager, but it shall in any case be located clear of curb and gutter. Wherever possible, water mains shall be kept parallel to the property line, and the distance from the property line is to be shown on the drawing.

Where the water main being installed has future extension possibility a running line shall be chosen to accommodate it. The main shall have a terminal valve and cap and also a tee, valve, and offset to tie into the existing main.

5.9 SEPARATION

The elevations of all existing underground utilities crossing the proposed watermain shall be confirmed in the field and shall be shown on the plan and profile.

The minimum requirements for separation of sanitary or storm sewer (including ditches) from watermain are as follows, unless otherwise indicated by Provincial Health Regulations.

The following separations are from edge to edge unless otherwise specified.

5.9.1 Horizontal Separation

- Private Utilities: 1.0 m
- Roadway lighting base & conduit and communications conduit: 0.3 m
- Sanitary or Storm: 3.0 m

Where the separation from sanitary or storm sewer as indicated is unavoidable, the following measures are to be taken:

1. The minimum separation shall be 1.2 m
2. The watermain shall be at least 0.5 m above the crown of the sanitary or storm sewer
3. All watermain joints are to be wrapped with heat shrink plastic or packed with compound and wrapped with petroleum tape in accordance with the latest version of the ANSI/AWWA Standards C214, C209, C217

5.9.2 Vertical Separation

- Private Utilities: 0.3 m
- Roadway lighting conduit and traffic communications conduit: 0.3 m
- Sanitary or Storm: 0.5 m above the sewer and the crossing is made midway on a full length of watermain pipe

Where the separation from sanitary or storm sewer as indicated is unavoidable, the following measures are to be taken:

1. If the watermain is above the sanitary or storm sewer, the minimum separation shall be 0.3 m. The joints are to be wrapped with heat shrink plastic or packed with compound and wrapped with petroleum tape in accordance with the latest version of the ANSI/AWWA Standards C214, C209, C217
2. If the watermain is beneath the sanitary or storm sewer, the minimum separation shall be 0.3 m. The crossing shall be made midway on a full length of watermain pipe and the joints are to be wrapped (above standard).

5.10 MINIMUM DEPTH OF COVER

Watermains shall be installed at a reasonable depth to:

- Clear other underground utilities
- Prevent freezing
- Provide mechanical protection from external loads
- Minimum cover shall be 1.0 m unless otherwise approved by the General Manager

5.11 CROSSINGS

Wherever the main crosses railway or highway rights-of-way, the pipe shall be installed in an encasement pipe to the approval of the relevant authority.

When a water main crosses a Railway a steel water main shall be used for that portion of the main, extending for the full width of the right-of-way and gate valves installed at both property lines.

5.12 THRUST RESTRAINT

Thrust restraint must be provided for all valves, tees, bends, and caps. The Consultant must design mechanical joint restraint systems with due regard for pipeline pressure transients and expected test pressures. A joint restraint table for the horizontal and vertical restraint lengths must be shown on the design drawings. Along the City's designated Emergency Water Supply Loop all pipe joints must be fully restrained.

Thrust blocks shall not be use in the City of Richmond. Consideration for the use of thrust blocks will be given upon written application to the General Manager of Engineering and Public Works. If thrust blocks are permitted, thrust block design calculations and soil bearing pressures must be shown on the design drawings.

5.13 VALVES

5.13.1 Isolation Valves

Valves should be located as follows:

- Not more than 300 m apart in single family residential and agricultural areas
- Not more than 150 m apart in all other areas
- Single family residential areas: such that no more than 40 residential units and 3 fire hydrants will be affected during isolation of a section of the watermain
- At all branches and intersections, unless otherwise approved by the General Manager:
 - 4 valves at “X” intersections
 - 3 valves at “T” intersections
- Where a new main is connected to an existing main, valves on both the new and the existing mains shall be installed where necessary

All valves are to be resilient seated gate valves unless otherwise approved by the General Manager.

Gate valves shall be the same diameter as the main up to 300 mm diameter. For mains larger than 300 mm in diameter, valves shall be no more than one diameter size smaller.

Geared operators, with risers and extension rods and a valved bypass shall be provided on gate valves 400 mm and larger.

5.13.2 Air Valves

Automatic air relief valves shall be installed at all summits in the main in accordance with good engineering practice.

5.14 HYDRANTS

5.14.1 Locations

Fire hydrants shall be located as follows:

- Not more than 120 m apart in single family residential areas
- Not more than 75 m apart in commercial, industrial and multifamily areas
- Not more than 150 m apart in agricultural

Hydrant locations must be approved by the Richmond Fire Department. It is the Consultant's responsibility to confirm proposed location of the hydrant with the Richmond Fire Department.

5.14.2 Other Requirements

- The Consultant must ensure sufficient hydrants and access paths are provided to deliver the required fire flows
- Hydrants shall be positioned so as to be completely accessible, and in such a manner that the possibility of damage from vehicles or injury to pedestrians will be minimized
- A gate valve shall be provided at the main on all hydrant connections
- Hydrants shall be offset 0.5 m from the adjacent property line, unless otherwise approved
- Hydrants shall be provided with thrust restraint to the approval of the General Manager
- Minimum 1.0 m clear of any other utility structure
- Hydrants shall be located, where possible, near lot lines
- Hydrants shall be clear of driveways and Road P.C.s

5.15 FLUSHOUTS/BLOW-OFFS

Blow-off installation must be incorporated in all dead-end mains.

5.16 SERVICE CONNECTIONS

5.16.1 Location

- Service connections in new subdivisions are to be installed, where possible, at 3.0 m from the lot line furthest from the driveway; in the case of cul-de-sacs, 0.5 m from the lot line
- Services should be kept clear of sewer connections and driveways, and should be installed at 90 degrees to the property line complete with water meter
- Where service location will conflict with fire hydrants or other obstructions, the locations may be specifically offset. Service connections shall not be connected to 400 mm or larger mains unless specifically permitted by the General Manager.

5.16.2 Size

No sizes between 50 mm and 100 mm shall be permitted.

- 25, 40 and 50 mm diameter
 - The 25 mm size shall be regarded as standard
- 100 mm diameter or larger
 - Generally be used to serve commercial and industrial sites
 - Shall be designed individually for the particular requirements in each case
 - Shall be joint restrained from tee at main to property line
 - 2 valves, one a the main and one near the property line
- Service connections to parks, where required, shall be 50 mm in diameter

5.16.3 Cover

- For service connection size of 25 mm diameter refer to drawings W2a-SD in the Supplementary Specifications and Detail Drawings
- For service connection size of 40 and 50 mm diameter refer to drawings W2b-SD in the Supplementary Specifications and Detail Drawings
- For service connection size of 100 mm diameter or larger refer to Section 5.10.

5.16.4 Connection to Main

Services shall be connected to the main by an approved service saddle, installed in the main as part of the service. The saddle shall be tapped with AWWA threads to accept the corporation stop.

5.16.5 Water Meters

Water flow meters are required for all water connections. The location, size and the remote reading device of the flow meter shall be as specified by the Building Approvals Department.

5.16.6 Backflow Prevention

As required by the Building Approvals Department to BC Building Code requirements and City Bylaws.

5.17 DEAD ENDS

5.17.1 Street Ends

At the end of a street which may be extended in the future, the water main shall, whenever possible, extend at least 1.5 m beyond the end of the paving.

Watermains shall be terminated with a gate valve, followed by a 6 m length of pipe, thrust restraint and blow-off assembly.

5.17.2 Cul-de-sacs

Water mains ended at a cul-de-sac shall be terminated by 100 mm capped end complete with blow-off.

5.18 PRV AND PUMP STATIONS

Guidelines and specific requirements for pressure reducing stations and pumping stations shall be obtained from the General Manager prior to undertaking design.

The location of such stations shall be determined by the General Manager.

5.19 CORROSION PROTECTION

A geotechnical soils analysis shall be completed by a Professional Engineer on the alignment of any proposed metallic pipeline, in areas where ferrous fittings are proposed, and in areas of corrosive soils identified by the General Manager.

For areas identified as corrosive, measures shall be taken in the design and construction to prevent the corrosion of the pipeline and appurtenances. The General Manager must approve corrosion protection measures.

5.20 CONNECTION TO EXISTING MAINS

All tie-ins to existing watermains shall be done by the City.