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ENGINEERING SPECIFICATIONS AND STANDARD DRAWINGS

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1 GENERAL INFORMATION

1.1 SCOPE

1.1.1 These Engineering Specifications and Standard Drawings shall apply to the design and installation of Waterworks connected to the Juan de Fuca Water Distribution System owned by the Capital Regional District (CRD) and operated by the **Capital Regional District Water Services (CRD Water Services)** as defined in CRD Bylaw 2538. The CRD Water Services Engineering Specifications and Standard Drawings apply to the design and installation of water mains, together with their respective connections and appurtenances and any other associated works such as pump houses, reservoirs, vaults, etc. which are required to be designed and/or installed.

1.2 DOCUMENTS

1.2.1 The following specifications and conditions shall apply to all or any of the respective services:

Section 1	General Information
Section 2	Water Main Connection/Extension Policies and Procedures
Section 3	Drawings
Section 4	Design of Water Mains and Water Services
Section 5	Installation
Section 6	Water Utility Excavation, Backfill, Restoration and Cleanup
Appendix A	Approved Materials
Appendix B	Standards Forms
Appendix C	Standard Drawings

1.2.2 All services shall be designed and installed as detailed in the specifications and according to the procedures set out in this specification.

1.2.3 Where strict compliance with these specifications is impractical or unreasonable, the General Manager, CRD Water Services may permit a minor variance to the specifications provided prior approval is obtained. Once approved a record of these changes shall be sent to CRD Water Services.

1.3 DEFINITIONS

The following definitions shall apply to all CRD Water Services Engineering Specifications and Standard Drawings, as well as, Agreement Documents.

- 1.3.1 **“The Agreement”** means the Waterworks Extension Agreement. Unless otherwise specified, the Agreement shall be governed by the law of British Columbia.
- 1.3.2 **“As-Constructed Drawings” or “As-Built Drawings”** means those Design Drawings, which have been revised to reflect any changes in design that were incorporated into the actual construction of the Work.
- 1.3.3 **“Applicant”** means a person who is the owner, lessee, or tenant of an authorized property and who has requested or applied for water service or for any other matter or thing under ***Bylaw 3490 Water Distribution Local Service Conditions, Fees and Charges Bylaw No.1 or the most recent version of Water Distribution Local Service Conditions, Fees and Charges Bylaw No.1*** from CRD Water Services.
- 1.3.4 **“Approving Authority/Officer”** means a public body or officer with powers to enforce statutes, regulations, codes and by-laws, and to issue consents, approvals, licenses and permits.
- 1.3.5 **“Board”** means the Capital Regional District Board.
- 1.3.6 **“Commission”** means the Juan de Fuca Water Distribution Commission.
- 1.3.7 **“Consulting Engineer”** means the Consulting Engineer, who is acting on behalf of the Applicant, is the person, firm, or corporation identified as such in the Agreement Documents and is registered to practice as a Professional Engineer in the Province of British Columbia.
- 1.3.8 **“Contractor”** means the person, firm or corporation identified as such in the Agreement documents and is referred to as if singular in number and masculine in gender. The term Contractor means the Contractor or his authorized representative as designated by the Applicant or CRD Water Services in writing, which shall undertake the installation of the Waterworks on behalf of either the Applicant or CRD Water Services.
- 1.3.9 **“CRD”** means the Capital Regional District.

- 1.3.10 **“CRD Water Services”** means the CRD Water Department or CRD Water Services Department or its authorized agent or representative.
- 1.3.11 **“Design Drawings”** means those drawings prepared in accordance with the Engineering Specifications and Standard Drawings and/or the “Agreement” documents which are a detailed, illustrative description of the work to be constructed.
- 1.3.12 **“Engineer-Client Agreement”** means the agreement entered into by the Applicant and a Professional Engineer wherein the Applicant engages the services of the Professional Engineer to provide the level of engineering service required by the Agreement Documents for the design and construction supervision of the Waterworks.
- 1.3.13 **“Final Acceptance”** means those Design Drawings, which have been given final acceptance marked “Reviewed” by CRD Water Services with the required signature and date.
- 1.3.14 **“General Manager”** means the person appointed by the Board as General Manager of CRD Water Services, or any agent or employee of CRD Water Services who has been authorized to act on behalf of the General Manager.
- 1.3.15 **“Prepayment of Estimated Costs”** means the deposit to be made by the Applicant to the CRD Water Services in the form of cash, certified cheque and/or Irrevocable Letter of Credit equal to 120 percent of the estimated amount of the cost of installing and paying for the Waterworks required by the Agreement Documents.
- 1.3.16 **“Engineer of Record”** means the Engineer/Consulting Engineer, who is acting on behalf of the Applicant; is the person, firm or corporation identified as such in the Agreement Documents; is licensed by the Association of Professional Engineers and Geoscientists of BC (APEGBC); has sealed the Design Drawings; supervised/inspected the construction; sealed daily inspection reports and As-Constructed drawings.
- 1.3.17 **“Standard Drawings”** means the CRD Water Services Standard Drawings.

- 1.3.18 **“Statutory Declaration”** means a signed statement made by virtue of Statutory Declarations Act before an officer authorized to administer an oath, such as a Justice of the Peace, Commissioner of Oaths, Notary Public or a solicitor with a practicing certificate. A statutory declaration is a solemn declaration made in writing by a party knowing and intending it to have the same effect as though it were a declaration made under the Canada Evidence Act. It has the same effect as a sworn document (as Affidavit).
- 1.3.19 **“VIHA”** means the Vancouver Island Health Authority.
- 1.3.20 **“Waterworks Extension Agreement”** means the executed Agreement between CRD Water Services and the Applicant for Waterworks to expand the Districts water supply system by the Applicant. The Agreement supersedes all prior negotiations, representations or agreements, either written or oral. The Agreement may be amended only as agreed upon between the parties.
- 1.3.21 **“Waterworks and/or the Work”** means the physical plant of CRD Water Services, and all the equipment, apparatus, appliances, property, pipes, reservoirs, pump stations, appurtenances, and facilities, owned and employed by or used in connection with CRD Water Services, in providing the supply of water or any other service to the boundary line of any property.
- 1.3.22 **“Waterworks Inspector”** means the person either employed or engaged by CRD Water Services and is referred to throughout the Waterworks Extension Agreement as if masculine in gender. The term Waterworks Inspector means the CRD Water Services representative or Professional Engineer approved by the General Manager, who shall make such inspections and tests as he considers necessary, of any work being carried out under the Waterworks Extension Agreement and shall co-ordinate work being carried out within the areas served by CRD Water Services.

2 WATERWORKS CONNECTION/EXTENSION POLICIES AND PROCEDURES

2.1 INTRODUCTION

2.1.1 This section contains Waterworks Connection / Extension Policies and Procedures for connection/extension to the CRD Juan de Fuca Water Distribution System.

2.2 GENERAL INFORMATION AND POLICIES

2.2.1 The extension and upgrading of the water distribution system owned and operated by CRD Water Services to serve new customers or new development is the responsibility of the Applicant and includes all costs of engineering design and construction of the Waterworks, all at the Applicant's expense. The Applicant shall enter into a Waterworks Extension Agreement with CRD Water Services.

2.2.2 Topographical surveys, design and preparation of drawings for Waterworks shall be carried out by Consulting Engineer engaged by the Applicant and in accordance with these specifications.

2.2.3 General Provisions

- .1 The estimated costs of Waterworks extensions shall be based upon compliance with these specifications and the requirements of other regulatory authorities having jurisdiction.
- .2 The CRD Water Services may charge the Applicant, whether or not the development is within a serviced or un-serviced area, the full cost (in advance), for extensions and the servicing and/or the cost of replacing or enlarging any existing Work (including water mains, pump stations, reservoirs and control systems) to serve the area with the required water supply and fire flow while maintaining water quality. If there are no water main(s) to the development, the Applicant shall pay for the water mains to supply the development. The size and number of the water mains shall be determined as part of the development of an approved water distribution network, as determined by CRD Water Services.
- .3 The CRD Water Services will only assume ownership and responsibility of the Waterworks that comply with these specifications and are located as follows:
 - a) In publicly gazetted roads;
 - b) In a statutory right-of-way held in favour of CRD, where the right-of-way is required by CRD, or;
 - c) On property owned outright by CRD.

2.2.4 Responsibility for Material Furnished by Applicant/Contractor

- .1 The Applicant/Contractor shall be responsible for all material furnished by him and shall replace at his own expense all such material found defective in manufacture or damaged in handling after delivery by the manufacturer. This shall include the furnishing of all material and labour required for the replacement of installed materials.
- .2 All materials furnished by the Contractor shall be approved by CRD Water Services before being incorporated into the Work. A list of approved construction materials is included in Appendix A.

2.2.5 Responsibility for Material Furnished by CRD Water Services

- .1 The Contractor's responsibility for material furnished by CRD Water Services shall begin at the point of delivery to said Contractor. Material already on the site shall become the Contractor's responsibility on the day work commences.

2.2.6 Responsibility for Safe Storage

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

2.3 RIGHT-OF-WAY OR EASEMENT DOCUMENTS

- 2.3.1 The Applicant shall be responsible for preparation of all right-of-way documents prepared for Waterworks where CRD Water Services will assume responsibility for maintenance and/or ownership, including all associated costs. Where a single right-of-way is required, the minimum acceptable width is 6.0 m. The water main shall be located a minimum of 1.5 metres from the edge of the right-of-way. The right-of-way shall be registered using the language provided in the CRD standard right-of-way documents, provided in Appendix B.
- 2.3.2 A right-of-way shall be located within a single property adjacent and parallel to property boundaries and shall be clear of proposed building sites.
- 2.3.3 A right-of-way shall be provided by the Applicant for the eventual extension of the water main as required by CRD Water Services.

2.4 ENGINEERING SUPERVISION

- 2.4.1 The Engineer of Record shall be responsible for the layout, inspection and approval of all services, which are the responsibility of the Applicant in order to certify the Work was constructed in accordance with the approved Design Drawings and the CRD Water Services Engineering Specifications and Standard Drawings. The inspection may be carried out by an Engineering Technologist or another Engineer under his supervision. A minimum of twenty (20) hours of inspection per week is required. The Applicant shall provide daily reports certified by the Engineer of Record. The inspector shall record the information using the form Daily Inspection Report included in Appendix B.
- 2.4.2 Connection of the Waterworks extension to the existing Waterworks shall not be made until the inspection reports described in 2.4.1 are provided and reviewed by CRD Water Services.
- 2.4.3 The Engineer of Record shall submit copies of his inspection reports to CRD Water Services on a weekly basis. If copies of the inspection reports are not provided, CRD Water Services shall require the Applicant to excavate and expose the water main/appurtenances to determine the geodetic elevation and NAD83 UTM coordinates at 50 m intervals along the water main, at all critical crossings and at all bends, prior to acceptance by CRD Water Services and the Applicant shall bear all costs of such work.
- 2.4.4 In addition, CRD Water Services shall undertake periodic inspections and shall immediately notify, in writing, the Contractor and the Engineer of Record of any unacceptable materials or practices. If remedial action is not taken to the satisfaction of CRD Water Services, the Waterworks shall not be accepted.
- 2.4.5 If the Engineer of Record wishes to make any changes to the approved design either before or during the execution of the work, he shall first submit a copy of the Design Drawings showing proposed revisions to CRD Water Services. If approval is granted for the revision, the original drawing shall be immediately revised, signed off by CRD Water Services and new drawings issued.
- 2.4.6 The attention of the Engineer of Record is directed to the safety regulations of the Workers' Compensation Act of BC. All CRD Water Services employees have been instructed to enter only those excavations that meet the requirements of Workers' Compensation Act of BC. No approval shall be given to installations, which because of unsafe working conditions, cannot be inspected.

2.5 CIRCULATION AND APPROVAL OF DESIGN DRAWINGS

- 2.5.1 The Engineer of Record shall prepare Design Drawings and submit these concurrently to CRD Water Services and VIHA. Where the design involves a pump station or reservoir, submit a hard copy and digital copy in MS Word of a design brief and copy of the contract specifications shall be submitted, one hard copy and one digital copy (either PDF or MS Word).
- 2.5.2 CRD Water Services requires one paper copy and an AutoCAD “DWF” (Drawings Web Format) file containing the complete set of drawings. The DWF file shall be created with a minimum plot resolution of 1200 dpi. Ensure that all relevant layers are turned on when creating the DWF.
- 2.5.3 After review, comments will be returned on the DWF file by email to the Engineer of Record for revisions.
- 2.5.4 When all comments have been addressed the Engineer of Record shall submit two paper copies and an AutoCAD DWF file of the revised Design Drawings, signed and sealed by the Engineer of Record, to both CRD Water Services and VIHA for final approval.
- 2.5.5 The Applicant shall provide a Declaration of Engineer-Client Agreement prior to receiving design approval. The Declaration shall be in the form provided in Appendix B.
- 2.5.6 Prior to acceptance of the Design Drawings, any required right-of-way, whether within or outside the proposed development, shall be obtained and registered by the Applicant, or a *Letter of Undertaking* from the Applicant’s Lawyer stating that the CRD shall receive a right-of-way at registration of the development. See Section 2.3 of this specification for right-of-way preparation procedure.
- 2.5.7 Where authorization, approval and/or permits are required from municipalities, senior governments and other authorities having jurisdiction, it is the Applicant’s responsibility to obtain these. All permits must be in place prior to start of construction.

- 2.5.8 Developments adjacent to, affected by or affecting the following will require plans to be submitted to the appropriate municipal/non-municipal authority including, but not limited to, the following:

AUTHORITY
Capital Regional District (departments other than Water Services)
Municipality having jurisdiction.
Ministry of Transportation.
Fire District having jurisdiction.
Vancouver Island Health Authority (VIHA) - Public Health Engineer.
B.C. Hydro, Telus, Shaw Cable, Terasen Gas, Railways
Department of National Defense
BC Transportation Finance Authority (Galloping Goose)
Ministry of Environment
Ministry of Forests

- 2.5.9 The above approvals are in addition to those of CRD Water Services and are required prior to design approval with the exception of VIHA. VIHA approval is required prior to commencing construction.

2.6 WATER MAIN AND SERVICE INSTALLATION

2.6.1 The following steps shall be completed prior to start of construction of the Waterworks:

PRIOR TO STARTING CONSTRUCTION
Step 1 - Design Drawings shall be approved by CRD Water Services.
Step 2 – Ensure permits and approvals, including VIHA, for all authorities having jurisdiction have been received.
Step 3 - The Applicant or his representative shall make arrangements to inspect the site of the work in the company of a CRD Water Services representative 24 hours prior to the start of construction. If work proceeds without proper inspection, CRD Water Services will require the Work to be exposed for an inspection prior to acceptance.
Step 4 - A copy of the Design Drawing(s) and CRD Water Services' Engineering Specifications and Standard Drawings shall be maintained by the Contractor at the construction site during the installation of all Waterworks and these drawings shall be used to document any changes during construction.
CAUTION: THE APPLICANT SHALL BE AWARE THAT PROCEEDING WITH CONSTRUCTION PRIOR TO RECEIVING THE ABOVE APPROVALS AND PERMITS MAY RESULT IN A MONETARY FINE. IF CONSTRUCTION PROCEEDS WITHOUT THE NECESSARY APPROVALS, THE APPLICANT SHALL BE REQUIRED TO PROVE THE CONSTRUCTION MEETS CRD WATER SERVICES ENGINEERING SPECIFICATIONS AND STANDARD DRAWINGS. New Waterworks shall not be connected to the existing CRD Juan de Fuca Water Distribution System or the CRD supply system until the Waterworks have been inspected, pressure tested, disinfected and accepted in writing by CRD Water Services.

2.7 ACCEPTANCE OF WATERWORKS BY CRD WATER SERVICES

2.7.1 Upon acceptance of the Waterworks by CRD, a Construction Completion Certificate shall be issued. The following required documentation shall be completed and approved by CRD, prior to issuing the Construction Completion Certificate. Forms are provided in Appendix B.

REQUIRED DOCUMENTATION	
1.	As-Constructed Drawings
2.	Hydrant/Valve Forms
3.	Field Inspection Reports
4.	Statement of Actual Construction Costs (see below)
5.	Statutory Declaration (see below)
6.	Warranty Security (see below)

2.7.2 CRD Water Services shall receive and accept As-Constructed Drawings for the work, signed and sealed by the Engineer of Record, including Daily Inspection Reports, and the hydrant/valve forms for the work prior to Acceptance of Waterworks.

2.7.3 The Engineer of Record shall submit for review and approval a letter certifying, in writing, the extent and value of work completed, itemizing the work, and that the completed Work meet the Engineering Specifications of CRD Water Services.

2.7.4 The Applicant shall provide a Statutory Declaration stating that all employees, contractors, subcontractors, and suppliers used in connection with the work have been fully paid and satisfied, that there are no claims outstanding or pending, and there is no lien filed against the work. The Statutory Declaration shall be provided by an independent third party.

2.7.5 The Applicant shall provide a warranty security to be held by CRD Water Services in the form of an **Irrevocable Letter of Credit or cash deposit**, in the amount of 10% of the cost of the work as agreed to by CRD Water Services or two thousand dollars (\$2,000.00), whichever is greater, for the one (1) year period of warranty for all Waterworks.

2.8 WARRANTY OF THE WORK

2.8.1 The Applicant shall be responsible for all costs to repair, alter, reconstruct or replace any or all the Work to remedy any defect, fault or deficiency in or developing in, the completed work from the date of issuance of a Construction Completion Certificate for a period of warranty of one (1) year, whether the work is performed by the Applicant, CRD Water Services or a third party hired by CRD Water Services to complete the work.

2.8.2 In the event that emergency repairs are required, CRD Water Services reserves the right to perform the work without notice to the Applicant. An invoice shall be issued to the Applicant for all costs of such work and shall be payable net 30 days.

2.8.3 Where the repairs do not negatively impact the operation of the plant or distribution system, CRD Water Services shall notify the Applicant in writing, specifying a time for initiating and completing the work. The Applicant shall initiate and complete the work during the warranty period expeditiously. Should the Applicant disregard or fail to commence repairs within the time period given, CRD Water Services may, at its discretion, complete the remedial Work in accordance with the terms of the Agreement.

2.8.4 Release of Warranty Security

- .1 CRD Water Services shall inspect the Work prior to the expiration of the warranty period. Any outstanding deficiencies shall be corrected as noted above prior to release of the warranty security.
- .2 Upon successful completion of the warranty period, the Applicant may apply for release of the warranty security.

2.9 TESTING AND DISINFECTION

- 2.9.1 The Applicant/Contractor shall flush and disinfect all water mains in accordance with AWWA Standards, after a satisfactory pressure test has been carried out. This work shall be completed prior to connecting to the Juan de Fuca Water Distribution System or the CRD supply system. All work shall be completed in accordance with Section 5.5.
- 2.9.2 The Engineer of Record shall, at his discretion, arrange for periodic compaction testing within the trench. A minimum of 1 test for every 100 m of pipe installed. Copies of test results shall be submitted to CRD Water Services.

2.10 PAYMENT TO CRD WATER SERVICES**2.10.1 Work by CRD Water Services**

- .1 Work that is to be carried out by CRD Water Services is subject to prepayment of 120% of the estimated costs. Where the actual cost of the work exceeds the estimated cost, the Applicant shall be responsible to pay any additional cost. Where costs are less than estimated, a refund will be issued. Six weeks should be allowed after payment for preparation of plans, work orders and scheduling of the work.

2.10.2 Work by Applicant

- .1 Where work is to be carried out by the Applicant with materials supplied by CRD Water Services, prepayment for the estimated costs of materials shall be made to CRD Water Services.

3 DRAWINGS

3.1 SCOPE

3.1.1 This section shall govern the preparation of all Design Drawings for the Waterworks within the Juan de Fuca Water Distribution System and the preparation of As-Constructed Drawings.

3.2 GENERAL

3.2.1 Any information received from CRD Water Services with respect to the existing water system shall be used as a guide only. Verification of locations and elevations shall be checked by actual survey or subsurface investigation. CRD Water Services takes no responsibility for the exactness of service information obtained from base plans and drawings. Confirmation of the location of underground utilities shall be the sole responsibility of the Applicant.

3.2.2 All existing statutory rights-of-way or easements and their permitted uses shall be checked through the Land Titles Office and be shown lightly shaded on the Design Drawings. Registration numbers shall be shown.

3.2.3 All proposed rights-of-way for new Waterworks shall be shown as a dashed line. These shall be tied to the iron pin in each lot, together with their width, permitted use, and the note "acquire" or "proposed". Right-of-way documents shall be prepared as detailed in these specifications.

3.2.4 A north arrow, existing and proposed street names shall be shown on the Design Drawing. The north arrow shall be generally oriented towards the top of the sheet.

3.2.5 All services shall generally be shown on one plan using the symbol shown in brackets for the following:

(MC)	Mountable Curb	(G)	Gas
(NMC)	Non-mountable Curb	(U/G)	Underground wiring
(W)	Water	(S/W)	Sidewalk
(S)	Sanitary Sewer	(H)	Hydro Pole
(D)	Drain Sewer	(T)	Telephone Pole
(SFM)	Sanitary Forcemain	(FW)	Fire Fighting Water (non-potable)

* Other services shall be clearly designated on the drawing.

- 3.2.6 Existing water mains, sanitary sewers, drain sewers, and sanitary forcemains, (including all appurtenances), ditches, pavement, curbs, sidewalks, underground wiring, gas, poles, trees, service connections and other underground utilities shall be indicated in plan and profile where applicable.
- 3.2.7 All proposed utilities shall be fully dimensioned as specified herein.

3.3 DRAWING INFORMATION

- 3.3.1 Maximum acceptable drawing size shall be A1 metric size 594 mm x 841 mm.
- 3.3.2 Provide plan and profile on the same sheet meeting the following requirements:
- .1 Plan view shall be in the upper half of the page and profile in the lower half.
 - .2 The use of the plan on one sheet and profile on a second sheet shall not be accepted.
 - .3 Layout dimensions shall be given from an iron pin or lot line or UTM coordinates.
 - .4 Proposed Waterworks construction shall be shown as dashed lines and the existing shown as solid lines.
 - .5 Construction notes shall be confined to a separate "note" column, wherever possible, with numbered references in plan or profile.

3.4 SCALES

- 3.4.1 All drawings and dimensions shall use metric units.

Plan View:	Horizontal 1:500 or 1:250	Vertical 1:100 or 1:50
Cross Sections:	Horizontal 1:100	Vertical 1:100
Structural Details:	1:20 (typically)	

3.5 REQUIREMENTS FOR SUBDIVISION KEY PLAN

- 3.5.1 Provide a key plan on the Design Drawings, which shall include the following information:
- .1 Plan of adjacent streets and existing lots with streets named and legal information of adjacent lots given;

- a) Civic address with the property being subdivided shown shaded;
- b) North arrow;
- c) The location of existing and proposed hydrants;
- d) Contours at 1 or 2 m intervals;
- e) Title "Proposed Subdivision of (give the full legal description)"; and Civic Address;
- f) If the subdivision is to be developed in stages, each proposed stage shall be clearly outlined and order of development indicated.

3.6 REQUIREMENTS FOR WATERWORKS

- 3.6.1 Provide a plan and profile drawing for each section of water main with the following information shown on the profile:
 - .1 The size, type and class of pipe or DR ratio, and class of bedding;
 - .2 For mains 50 mm and larger, profile grades to 2 decimal places;
 - .3 Provide location of fire hydrants and other appurtenances.
- 3.6.2 The following information shall be shown on the plan:
 - .1 The offset of the water main centreline from the property line;
 - .2 Where short pipe lengths are required on curves, refer to Section 4.2.5, Deflection of Pipe.
 - .3 Extent of work required of CRD Water Services in making the connection to the existing Waterworks.
- 3.6.3 Design Drawings for pump stations, meter stations and pressure control stations prepared and submitted for review by CRD Water Services shall include the following information as a minimum:
 - .1 All facilities shall have a civic address provided by the municipality prior to acceptance;
 - .2 Plan view of the station detailing all pipe work, meters, valves, etc., within the station, architectural, mechanical and structural details, details, ventilation, controls, lighting, electrical disconnects, SCADA, drainage, etc. Schematic drawings of pipe work will not be accepted;
 - .3 Section view of the station showing finished ground, station and pipe work elevations related to geodetic datum, drainage, hatches, etc;

- .4 Location plan showing legal (street/intersection) location of station;
- .5 Site plan showing topographic details and all utility information for approximately a thirty (30) metre radius around the station;
- .6 Material list of each item detailing manufacturer, pressure class, size, dimensions (if applicable), ordering information, etc;
- .7 Pump curve (for pump stations) showing the total dynamic head (as geodetic elevation) on the y axis in metres and on the x axis the flow in litres per second;
- .8 For detailed requirements for Pump Stations, refer to the CRD Water Services Pump Station Design Guidelines.

3.7 REQUIREMENTS FOR MECHANICAL ROOM DRAWINGS

3.7.1 Overall Plan View

- .1 Provide overall site plan with location of water service from the connection to water main in the public right-of-way to location of water entry to building.
- .2 Show location of water pipe through building.
- .3 Show remote readout and wiring.

3.7.2 Detailed Mechanical Room to include the following:

- .1 Backflow prevention assemblies.
- .2 Wiring for remote readout.
- .3 Strainers are required for all compound meters and fireline meters 100 mm and larger.
- .4 Bypass with valves and hose bib.

3.8 REQUIREMENTS FOR OTHER UTILITIES

3.8.1 Complete details of all other utilities shall be obtained from the appropriate utility company and shown, including the following:

- .1 Existing utilities;
- .2 Utility offset from property line and/or iron pin;
- .3 Lot service connections and other appurtenances;
- .4 Existing and proposed poles shall be dimensioned from the pole centre to property line and/or pin.

3.9 AS-CONSTRUCTED DRAWINGS

3.9.1 Submit As-Constructed Drawings as follows:

SUBMISSION PROCEDURE		Other Requirements
Step 1	Submit one (1) paper copy of As-Constructed Drawings and a “.dwf” of the drawings.	Sealed by Engineer of Record.
Step 2	Revised according to CRD comments.	
Step 3	Submit two (2) sets of drawings using velum (or other acceptable reproducible), a “.dwf” and a “.dwg file.	Sealed by Engineer of Record.
Step 4	If acceptable to CRD Water Services, one (1) set of drawings shall be stamped reviewed and returned.	Signed by CRD authorized representative.

.1 The digital “.dwg” file shall be complete with plotter configuration file of the original Design Drawing.

.2 When the “.dwf” file is larger than 1 MB, split it into 2 or more “dwf” files.

3.9.2 The As-Constructed Drawings shall clearly show the location of all services and bends as installed using offsets from iron pins. The locations shall be shown either by check-marking any original dimension on the drawing (if they are correct) or by showing the revised dimension beside the original dimension. Show the location of any bends or reducers using geodetic elevation and NAD83 UTM coordinates. In addition, the location of the end of underground pipe shall be shown.

3.9.3 Within two weeks of completion of the Waterworks installed by the Applicant, the Engineer of Record shall deliver As-Constructed drawings to CRD Water Services. These drawings shall include a statement signed, sealed and dated by the Engineer of Record certifying:

"... that the following services were inspected during construction and were installed in accordance with CRD Water Services Engineering Specifications and Standard Drawings and as shown on this drawing."

3.9.4 Within two weeks of completion of the Work installed by the Applicant, provide hydrant and valve information in CRD Water Services standard format (refer to Appendix B).

3.9.5 Provide Operation and Maintenance Manuals using the CRD Water Services format, one hard copy and one MS Word file. Manufacturer information may be scanned and provided in high quality PDF format.

3.9.6 In accordance with Section 2.8, the Warranty Period will not start until As-Constructed Drawings; hydrant/valve forms; Operations and Maintenance manuals for Pressure Control Stations, pump stations and reservoirs; are received and accepted by CRD Water Services.

SUBMISSIONS		Other Requirements
Step 1	Submit one (1) paper copy of As-Constructed Drawings and a “.dwf” of the drawings.	Sealed by Engineer of Record.
Step 2	Revised according to CRD comments.	
Step 3	Submit two (2) sets of drawings using velum (or other acceptable reproducible), a “.dwf” and a “.dwg file.	Sealed by Engineer of Record.
Step 4	If acceptable to CRD Water Services, one (1) set of drawings shall be stamped reviewed and returned.	Signed by CRD authorized representative.

3.10 TOLERANCES

3.10.1 Provide layout dimensions as follows:

- .1 Record all horizontal dimensions to the nearest 0.1 m;
- .2 Record all vertical elevations to the nearest centimetre except that ground elevations and service connection inverts at property line shall be to the nearest 0.01 m;
- .3 Record road horizontal locations to the nearest 0.030 m;
- .4 Record road vertical locations to the nearest 0.015 m.

3.10.2 All other dimensions (i.e. structures, etc.) shall be recorded to the required tolerances and shown on the drawings and appropriate specifications.

3.11 ADDITIONAL REQUIRED INFORMATION

3.11.1 For Waterworks, provide the followings details:

- .1 Domestic water services and reference to lot corner iron pin;
- .2 Location of any bends and reducers, referenced using geodetic elevation and NAD83 UTM coordinates;
- .3 Location of rock cuts and maximum depth of rock excavation;
- .4 Profile of main indicating numerically the invert at 10 m stations;
- .5 Reference locations of fire hydrants to isolation valve;
- .6 Location of all valves referenced to a minimum of 2 fixed points;
- .7 Location for any changes in pipe material referenced using geodetic elevation and NAD83 UTM coordinates.

3.11.2 For roads, curbs and sidewalks, provide the following details:

- .1 Location of end of curb, sidewalk and pavement.

3.11.3 For bridges and other structures, provide the following details:

- .1 Location of structure;
- .2 Elevation of deck.

3.12 STANDARD NOTES

3.12.1 In addition to project specifications, the following standard notes shall appear on all drawing submissions:

- .1 Construction shall not proceed without first obtaining CRD Water Services acceptance of the Design Drawings and a Construction Permit from VIHA.
- .2 Contractor shall be registered with Work Safe BC.
- .3 All Waterworks construction and materials shall be in accordance with CRD Water Services Engineering Specifications and Standard Drawings.
- .4 Water mains shall be Ductile Iron Pressure Class 350 to AWWA C151; or PVC DR18 to AWWA C900 or AWWA C905; HDPE DR11 to AWWA 906; or other material, approved in advance, on a case by case basis by CRD Water Services.
- .5 Provide a minimum 0.9 m cover for water mains.

- .6 Mark water mains below grade using a metallic detectable reinforced underground utility marking tape. The tape shall be minimum 150 mm wide, metallic blue in colour and shall be marked "CAUTION: WATER LINE BURIED BELOW". Install tape on top of the pipe cushion 300 mm above the top of the pipe. Provide "Thortec" marking tape or approved equal.
- .7 Maintain a minimum of 3 m horizontal clear separation and 450 mm clear vertical separation between water mains and all sanitary sewers/services and drain sewers/services except where noted and approved by CRD Water Services. **Sanitary sewer mains shall not cross over water mains.** For a sanitary forcemain, where the above-noted separations cannot be achieved, the forcemain shall be gasketed pressure rated pipe with a minimum DR (Dimension Ratio) of 28; or HDPE minimum DR17.
- .8 Maintain a minimum of 3 m horizontal clear separation and 450 mm clear vertical separation between water services and sewer services, sanitary or storm/drain. In special circumstances, where a sanitary sewer or storm drain service is lower than a water service by more than 450 mm in elevation the horizontal offset may be reduced to no less than 1.0 metres except where noted and approved by CRD Water Services. VIHA approval is required for any reduction in the separation.
- .9 For crossing of existing sewers, where the water main does not have the required 450 mm vertical separation, wrap water main joints with petrolatum tape 3 m either side of the water main. Where a vertical separation of 150 mm cannot be achieved, special mitigative measures shall be approved by CRD Water Services.
- .10 Where new catchbasin (CB) leads do not have a 450 mm vertical separation, wrap CB lead joints with petrolatum tape.
- .11 Maintain a minimum of 1.5 m horizontal centre to centre and 150 mm clear vertical separation between water mains and electrical conduits, gas mains and telephone conduits except where noted and approved by CRD Water Services.
- .12 Maintain a minimum of 1.0 m horizontal centre to centre and 150 mm clear vertical separation between water services and electrical, gas and telephone services except where noted and approved by CRD Water Services.
- .13 Contractor shall conduct a pressure test in accordance with CRD Water Services Engineering Specifications and in the presence of CRD personnel.

- .14 Contractor shall flush and disinfect water mains in accordance with AWWA Standards and as approved by CRD Water Services. Water samples for health tests to be collected and processed by CRD. Provide 24 hours notice to CRD.
- .15 Neutralize chlorine solutions in accordance with Ministry of Environment and Fisheries and Oceans Canada regulations prior to discharge to any drainage course.
- .16 Contractor shall provide 24 hour notice to CRD Water Services prior to proceeding with any Waterworks.
- .17 CRD Water Services shall make all connections to existing water mains at Applicant's expense. Contractor shall provide 48 hours notice to CRD Water Services for work required by CRD Water Services forces.
- .18 Where practical, service lines and meter boxes shall be installed to finished grade, outside of driveways or paved areas.
- .19 Any temporary or permanent connection to the Juan de Fuca Water Distribution System or the CRD supply system shall be performed by CRD Water Services personnel only.

4 DESIGN OF WATER MAINS AND WATER SERVICES

4.1 SCOPE

- 4.1.1 This specification shall govern the design of Waterworks within or connected to the Juan de Fuca Water Distribution System.

4.2 DESIGN CRITERIA

4.2.1 Water Distribution System Pressure Required

- .1 In general, any extension of the water system shall be designed to provide 414 kPa (60 psi) at the water main in the road during peak hour demand. Water mains shall not be extended unless the residual pressure will be greater than 276 kPa (40 psi) at the meter box during peak hourly demands. For exceptional circumstances, where the water pressure is not adequate to provide service to a property, the Applicant may apply to the General Manager for a variance to allow the property owner (at his own expense) to provide a suitable booster pump with appropriate backflow prevention.
- .2 Where an extension would adversely impact the service level to existing customers, the applicant shall be required to upgrade the existing distribution system to mitigate this.

4.2.2 Minimum Fire Flow Required

- .1 Fire flows shall be in accordance with the bylaws of the municipality having jurisdiction over the area in which the Waterworks are to be constructed, and in accordance with Fire Underwriters Survey (FUS) but in no case shall it be less than 4,800 litres per minute (L/m) [1057 imperial gallons per minute (lgpm)] for two hour duration in addition to maximum daily domestic demand, delivered with a residual pressure not less than 140 kPa (20 psi). For commercial, institutional and industrial areas, the minimum fire flow available shall be 5,000 L/m [1,100 lgpm] for 4 hours, delivered with a residual pressure of not less than 140 kPa (20 psi).

4.2.3 Depth of Bury

- .1 All water mains shall be installed to a designed grade to provide a minimum depth of cover of 0.9 m to the top of the pipe.
- .2 Where the depth of bury is greater than 1.2 m, approval shall be required by CRD Water Services.

4.2.4 Location

- .1 Water mains shall be located within a road allowance as approved by the authority having jurisdiction. Design with a minimum distance of 1.5 metres from edge of road allowance or statutory right-of-way.
- .2 Water mains shall not be located under sidewalks or where sidewalks may be constructed in the future.
- .3 The water service shall be located in the road allowance fronting the lot to be serviced. Where a water service is required for irrigation purposes, provide a 19 mm water service, complete with water meter and double check valve backflow preventer, to traffic islands with planting areas. The Applicant shall apply for a water meter, installed by CRD Water Services, and supply and install an approved, testable backflow preventer.
- .4 Where the Applicant requesting service does not have a water main fronting the property, the Applicant shall be responsible for all costs to supply and install the water main along the full frontage of the property to be developed and any extension required to the most convenient existing water main that will provide an adequate supply of water, all of which shall be to the approval of CRD Water Services.
- .5 At all pipe intersections, the pipe shall connect to existing mains.
- .6 Where the final road pattern prevents the looping of the water main network within the roadway, a water main may be required through a minimum 6 m statutory right-of-way registered in favour of the CRD. The water main shall be a minimum of 150 mm diameter. No services shall be connected to the water main within the right-of-way.
- .7 The water main shall extend at least 1.2 m beyond the pavement at the extreme end of a cul-de-sac.
- .8 At all dead ends, provision shall be made for flushing the completed main prior to filling and pressure testing. Provision shall also be made for expelling air during filling by the installation of double acting air valves or main cocks where necessary.

4.2.5 Deflection of Pipe

- .1 For Ductile Iron Pipe, the pipe may be deflected on a curve with a minimum permissible pipe line radius of 60 m using 5.5 m lengths of pipe, but in no case shall be less than the manufacturer's recommendations.

- .2 For PVC pipe, deflection of the joints may be made in accordance with the manufacturer's instructions. Only manufacturers, IPEX and Royal Pipe Systems, allow deflection at the joint (refer to Appendix A). The Engineer of Record shall record the manufacturer of the pipe and the date code, on the As-Constructed Drawings, and certify that deflections were in accordance with the manufacturer's instructions. Small degree (5°) bends may be used to lay PVC pipe on a curve if required.
- .3 No bending of PVC pipe shall be permitted, irrespective of the manufacturer's recommendations.

4.2.6 Minimum Separation from other utilities

- .1 A minimum horizontal clear separation from water mains and water services to other utilities shall be provided as shown in Table 4.2.

Table 4.2 Minimum Horizontal Separation from Other Utilities

Utility	Water Main Minimum Separation (metres)	Water Service Minimum Separation (metres)
Electrical	1.5	1.0
Gas	1.5	1.5
Sewer	3.0	1
Drain Sewer or Drainage Ditch	3.0	1

- .2 Sewers and services shall be installed under water mains and services. Provide 0.45 m minimum clear vertical separation.
- .3 A minimum linear horizontal clearance of 3 m shall be maintained between the water main and a sanitary/drain sewer with the exception that in rock or hardpan, a variance may be requested. Approval from both CRD Water Services and VIHA is required. For this situation, install the water main on a bench with continuous support, maintaining a minimum horizontal separation of 1.0 m and a 0.45 m minimum vertical separation from the invert of the water main to the crown of the sanitary drain sewer. In addition, the sewer pipe shall be a continuous pressure rated pipe, such as, HDPE to AWWA C906 or PVC AWWA C900 or Ductile Iron to AWWA C151.

- .4 Where it is necessary for the water main to cross other underground utilities, the crossing shall be made at an angle 45 degree or greater and the vertical clearance between utilities at the crossing point shall be not less than 0.45 m. Where a vertical separation of 0.45 m is not achievable, mitigating measures as approved by CRD Water Services shall be included.
- .5 Where existing conditions provide less than the minimum clearance, the Applicant shall obtain approval from CRD Water Services for a variance. The following mitigative measures are acceptable:
 - a) Where a water main crosses over a sewer or sewer service connection with less than 0.45 m but greater than 0.15 m clear vertical separation between the water main and the sewer, provide Ductile Iron AWWA C151 Pressure Class 350 pipe for the water main and wrap joints with an approved product, 3 m either side of the crossing.
 - b) Where the existing water main is Asbestos Cement (AC) pipe and the sewer or sewer service connection will cross under with less than 0.45 m, minimum clear vertical separation shall be 0.15 m clear vertical separation. If the excavation of the AC pipe does not impact the integrity of the pipe, the AC pipe may be allowed to remain in place. However, controlled density fill (CFD) must be place from the springline of the other service to the springline of the AC pipe in accordance with Standard Drawing 1.15.
 - c) Where existing conditions do not allow for the minimum vertical separation of 0.15 m, measures to mitigate the problem shall be approved by both CRD Water Services and VIHA on a case by case basis.

4.2.7 Trench Dams Requirements for Water Mains Installed on Slopes

- .1 For slopes of 10 % to 30%, construct trench dams using standard sandbags filled with 5:1 ratio of sand to cement and in accordance with Standard Drawing 4.11.
- .2 For slopes greater than 30%, construct trench dam using 20 MPa concrete and in accordance with Standard Drawing 4.10.

- .3 All trench dams shall have a 100 mm drain pipe from the 50 mm below the top of the upstream side of the dam to daylight in a rock pit or ditch.

SLOPE	TRENCH DAM REQUIREMENTS
10 % to 15%	Every 30 m, as per Standard Drawing 4.11.
15 % to 30%	Every 15 m, as per Standard Drawing 4.11.
Greater than 30%	Every second pipe joint, as per Standard Drawing 4.10.

4.2.8 Pipe Size

- .1 In general, water mains shall be a minimum of 150 mm diameter. Pipe size shall be determined by CRD Water Services. The water distribution system is a pipe network of large feeder mains and smaller distribution mains. Therefore, the size of the main shall be determined by the requirements of the network and not the needs of an individual customer or development. Off-site Waterworks improvements may be required to meet the requirements of Section 4.2.1.2 as determined by CRD Water Services and the Applicant shall be the responsible for all costs of such improvements.
- .2 When determining the size of pipes, the following criteria shall govern:

FLOW CRITERIA	MAXIMUM ALLOWABLE VELOCITY
For domestic flows under peak hour conditions	1.5 m/s
For fire flows	3.0 m/s
Transmission mains, such as, a long main from a pump station to a reservoir	2.0 m/s

- 4.2.9 For a dead-end road or cul-de-sac, with the approval of CRD Water Services, the water main may be reduced to a 100 mm diameter, after the last fire hydrant. Alternatively, after the last fire hydrant, service may be delivered via a 50 mm diameter type “K” copper water main for a maximum of 5 single family dwelling units.

4.3 SERVICES

- 4.3.1 All customers shall be individually metered, in accordance with the current version of the applicable CRD Bylaw.
- 4.3.2 Water services for single family residences shall be a minimum 19 mm diameter. A duplex shall be considered as two single family residences and each shall have its own service. Where two service connections are served by a single service line, the service line shall be one pipe size larger than the largest meter supplied.
- 4.3.3 For commercial, industrial and institutional users, a single service should typically be installed into a mechanical room. Immediately inside the mechanical room, provide a tee off the main service line for the potable water service. On the potable water service, provide a meter with bypass piping, which will allow the meter to be repaired without loss of water supply to the building. Install an approved testable backflow preventer in accordance with CSA B64.10, prior to the water meter. Install an approved backflow preventer on the bypass. After the tee for the potable water service, provide an approved testable backflow preventer in accordance with CSA B64.10 on the main fire line (refer to Standard Drawing 3.13).
- 4.3.4 All irrigation services shall be individually metered followed by an approved testable backflow preventer in accordance with CSA B64.10.

4.4 MATERIALS

- 4.4.1 Approved materials are listed in Appendix A.
- 4.4.2 All pipe and fittings shall conform to the current CSA, AWWA, or ASTM specifications for a working pressure of 1030 kPa (150 psi). Where working pressure exceeds 1030 kPa (150 psi), the pressure class of pipe and fittings shall be increased accordingly.
- 4.4.3 Ductile Iron pipe shall have a push-on joint with gasket, conforming to the latest edition of AWWA Standard C151. Pipe shall have cement mortar lining inside and asphaltic shop applied coating outside. Pipe shall be minimum Pressure Class 350. For pipe greater than 250 mm diameter, the joint shall incorporate thrust restraint capacity of 150% of the working pressure of the pipe.

- 4.4.4 PVC pipe shall conform to the latest edition of AWWA Standard C900 "Poly Vinyl Chloride" (PVC) for pipe diameters 150 mm through 300 mm. The pipe shall have a maximum dimensional ratio (DR) of 18 with Ductile Iron outside diameter and integral bell gasketed joint. The pipe shall be supplied in 6.1 m nominal lengths.
- 4.4.5 For pipe diameters greater than 300 mm, PVC pipe shall conform to the latest edition of AWWA Standard C905 "Poly Vinyl Chloride" (PVC) Pressure Pipe. The pipe shall be minimum Class 150 [Dimensional ratio (DR) of 18] with Ductile Iron outside diameter and integral bell gasketed joint. Generally, the pipe shall be supplied in 6.1 m nominal lengths.
- 4.4.6 Where the installation of High Density Polyethylene (HDPE) pipe is approved, for pipe diameters 100 mm through 1575 mm, HDPE pipe shall conform to the latest edition of AWWA Standard C906 Polyethylene (PE) Pressure Pipe and Fittings. Generally, HDPE shall be DR11, unless otherwise approved. As well, fittings such as tees, bends, reducers and crosses, for HDPE pipe installations shall be HDPE and fused to the pipe.
- 4.4.7 Stainless steel pipe shall conform to the latest edition of AWWA C220 "Stainless Steel Pipe 100 mm and larger. All stainless steel pipe shall be type 316 L. All piping in chambers shall be a minimum of Schedule 10S.
- 4.4.8 All 19 mm, 25 mm and 50 mm water service tubing shall be type "K" soft copper tubing (ASTM B.88-80) or approved alternative.
- 4.4.9 Main stops and service stops shall have compression type end fittings suitable for copper pipe.
- 4.4.10 Single broad strap stainless steel service clamps and bronze bushings to match the pipe and connection sizes shall be provided for each proposed water service connection.
- 4.4.11 A valve box shall be provided with each gate valve and as required for other appurtenances (as per Standard Drawing 1.13).
- 4.4.12 If copper tubing requires a soldered joint, only lead free solder shall be used (95-5 solder).
- 4.4.13 Where alternative pipe materials are being proposed, if deemed necessary by CRD Water Services, a flavour profile analysis shall be required to determine the suitability of lining materials.

4.5 FIRE HYDRANTS

4.5.1 Hydrants shall be located in the boulevard and should preferably be located at or near a street intersection; otherwise they may be located on the projection of the property line dividing two lots. Consult with the local Fire Department and CRD Water Services to confirm proposed hydrant locations.

4.5.2 Hydrants shall be located a minimum of 1.2 m from face of curb and a maximum of 2.5 m.

4.5.3 All hydrants shall be installed with a Mueller Hydrant Defender Security Device or approved equal, where required by CRD Water Services.

4.5.4 Provide hydrant spacing in accordance with the following table:

ZONING	MAXIMUM HYDRANT SPACING
Single family residential areas with more than 3m separation between houses.	150 m
Single family residential areas with less than 3 m separation between houses.	90 m
Townhouses or multi-family	90 m
Institutional, commercial, industrial, apartments or other high density areas.	90 m

4.5.5 Generally, a hydrant shall not be located within 3 m of a utility pole or light standard or within 1 m of underground utility or open ditches. Where the hydrant must be located in the ditch, it shall be installed as per Drawing 4.14.

4.5.6 All hydrants shall be installed in accordance with Standard Drawing 1.3 or 1.14.

4.5.7 Hydrants shall conform to the latest version of AWWA C502, Dry Barrel Fire Hydrants and shall be rated for a minimum working pressure of 1225 kPa (175 psi).

4.5.8 Inlet connections shall be for 150 mm (6") or 200 mm (8") I.D. pipe.

4.5.9 Inlet joints shall conform to the latest version of AWWA C111.

- 4.5.10 All joints shall fit Pressure Class 350 Ductile Iron pipe.
- 4.5.11 For push-on joints, two lugs for 19 mm (3/4") tie rods shall be provided on the horizontal centreline of the inlet connection.
- 4.5.12 Hydrant operating nuts and port cap nuts shall be pentagonal in shape, with a 44 mm (1 3/4 ") diameter circumscribed circle.

4.6 VALVES

- 4.6.1 Generally, a minimum of two valves are required at a tee intersection and a minimum of three valves are required at a cross-intersection. Where deemed necessary by CRD Water Services, additional valves may be required.
- 4.6.2 Line valves shall not be more than 300 m apart. For convenience of operations, line valves may be required adjacent to a hydrant if there are no connecting mains within 120 m.
- 4.6.3 Line valves or hydrant valves shall not be located within 600 mm of a curb line, in a ditch, or above another service.
- 4.6.4 On service connections greater than 25 mm, a valve and box shall be placed on the connection adjacent to the main.
- 4.6.5 Resilient seat gate valves conforming to the latest version of AWWA C509 shall be used for valves up to and including 500 mm in diameter. The valve shall be supplied without a gear box.
- 4.6.6 Valves shall conform to the Approved Materials List, Appendix A.

4.7 FITTINGS

- 4.7.1 Generally, all fittings and appurtenances shall have standard hub ends (Tyton or approved equal) except where valves are attached to the fitting, in which case flanges shall be used.
- 4.7.2 Where required by CRD Water Services, air valves shall be installed at all high points on water mains (refer to Standard Drawings 1.2).
- 4.7.3 A 100 mm flush valve or 50 mm flush valve shall be installed at each dead end, refer respectively to Standard Drawing 1.6 and 1.5.

4.7.4 Approved restrainers shall be used where deemed appropriate and necessary. All fittings for pipe greater than 250 mm diameter shall be restrained.

4.7.5 All fittings shall conform to the Appendix A - Approved Materials.

4.8 THRUST BLOCKS

4.8.1 Thrust blocks shall be constructed in accordance with Standard Drawing 1.8.

4.9 MECHANICAL METER ROOMS

4.9.1 Drawing submissions shall include the following:

- .1 Cover drawing shall have a location plan and plan view of building and water entry.
- .2 Emphasize using a bold line, the water service from entry to building to mechanical meter room.
- .3 Show the plumbing fixture unit count for the building and any irrigation flow requirements for CRD to check the size of the domestic meter.

4.9.2 No connections to the water service line or installation of valves may be made prior to the meter with the exception of the fire service.

4.9.3 Where a meter is used for domestic and fire service and the meter is greater than 50 mm diameter, a compound meter is required.

4.9.4 Provide a strainer for compound meters larger than 50 mm.

4.9.5 Minimum Space Requirements

- .1 Meter shall be a minimum of 750 mm and a maximum of 1500 mm above finished floor.
- .2 Vertical distance from the meter to the nearest permanent obstruction shall be no less than 1200 mm.

4.9.6 Piping Requirements

- .1 No fittings including valves shall be within 5 pipe diameters upstream and 3 pipe diameters downstream of the meter.

4.10 PRESSURE CONTROL STATIONS

- 4.10.1 In general, all Pressure Control Stations (PCS) shall include a pressure reducing valve with a diameter equal to the pipe upstream of the PCS for fire flow demand and a separately piped pressure reducing valve for the average day demand. The sizing of the pressure control valve shall be to CRD Water Services approval.
- 4.10.2 All PCS stations shall be accompanied by a meter chamber complete with a magnetic flow meter installed upstream of the PCS station. Provide electrical power to the meter chamber complete with an approved kiosk to house an electrical disconnect and BC Hydro meter and where required, SCADA equipment. Critical PCS stations, as determined by CRD Water Services, shall require SCADA. The kiosk shall require a decal on the outside, approved by the CRD. Obtain all required permits for the work.
- 4.10.3 All PCS stations must have a civic address from municipality. The Applicant shall obtain the address from the municipality.
- 4.10.4 Provide a plan view and section drawings for the PCS. Design Drawings shall be accompanied by a design brief and shall be approved by CRD Water Services prior to installation.
- 4.10.5 The Engineer of Record for the Waterworks Design Drawings shall certify the design submission.
- 4.10.6 All pressure reducing valves shall have speed controls and valve stem position indicator.
- 4.10.7 Provide a minimum 50 mm flush valve on pressure reducing valves 150 mm diameter or larger.
- 4.10.8 Provide a flow test port and gauge between downstream isolation valve and control valve.
- .1 For a 50 mm pressure reducing valve (minimum 19 mm port) with gauge.
 - .2 For a 150 – 200 mm pressure reducing valve (minimum 50 mm port) with gauge.
 - .3 Any connections for isolating valves or drain ports shall be at either the 3 o'clock or 9 o'clock positions.

4.11 Pumping Stations

- 4.11.1 Refer to CRD Water Services Pump Station Design Guidelines.

4.12 RESERVOIRS

4.12.1 Criteria for Design of Facilities

.1 Residential - Number of People per Unit

LAND USE	DESCRIPTION	AVERAGE OCCUPANCY
Low Density	Any residential development with a gross density of less than of 20 units/hectare	3.2 persons/unit
Medium Density	Any residential development with a gross density of greater than 20 units/hectare and less than 50 units/hectare.	2.8 persons/unit
High Density	Any residential development with a gross density in excess of 50 units/hectare.	1.8 persons/unit

.2 Average Day Demand (for single family residential; total number of units > 100)

Average Day Demand	545 Litres/capita/day
Commercial / Institutional / Institutional	18.7 m ³ /day/ha 1.87 L/day/m ²

.3 Peaking Factors

Maximum Day	2.5 times Average Day Demand
Peak Hour	1.4 times Maximum Day Demand*
* For small isolated areas, higher peak hour demand may be required, as determined by CRD Water Services.	

.4 Fire Storage

Minimum fire storage	5,000 L/min for 4 hours or 1,200 m ³
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.5 Emergency Storage

Emergency Storage	50% of Average Day Demand
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4.12.2 Reservoirs shall be sized to provide capacity comprised of domestic storage plus the greater of the fire and emergency storage. A reservoir shall have a minimum of two (2) cells. For larger reservoirs, 3 or more cells may be required to allow a cell or cells to be taken out of service during the winter due to water quality concerns.

4.12.3 Storage shall be based on the following:

TOTAL STORAGE REQUIRED = A plus the greater of B and C
A = Equalization storage capacity (25% of Maximum Day Demand)
B = Fire Storage (Minimum of 4 hours at 5,000 L/min)
C = Emergency storage (50% of Average Day Demand)

4.12.4 Prior to design submit for approval, a design philosophy, which shall include cleaning of the reservoir.

4.12.5 Design the reservoir using the philosophy of a drain then fill cycle. Water shall drain down to low water level; pumps shall start and pump until the reservoir reaches the top water level. Low water level shall be equal to the fire or emergency storage volume, whichever is greater.

4.12.6 Mixing in the reservoir shall be achieved using a mixing head on the inlet pipe located in the middle of the reservoir. The head shall have 4 nozzles with each nozzle directed toward a corner of the reservoir. The flow from each nozzle shall achieve a minimum velocity of 2.5 m/s and not greater than 3.5 m/s. The nozzles shall be located at two thirds the distance from the floor to the low water level. Nozzles shall be Tideflex or an approved equal.

4.12.7 The top operating water level (TWL) of the reservoir shall be reviewed and approved by CRD Water Services. TWL shall be a minimum 400 mm below the underside of concrete roof (at the lowest point). Overflow level shall be 150 mm above the TWL.

4.12.8 A dedicated transmission water main shall be provided between the relevant pump station and the reservoir, separate from the outlet/distribution water main.

4.12.9 Reservoirs shall have isolation valves located such that any one of a group of reservoir cells can be removed from service for cleaning and maintenance without removing the other cell(s) from service.

4.12.10 Isolation valves shall be installed to permit the reservoir to be completely bypassed or taken offline.

4.12.11 Mechanical

- .1 All piping under and inside the reservoir to 3 m outside the reservoir shall be 316L Stainless Steel, minimum Schedule 10S, with the exception of water sampling piping. Sample pipe shall be type "K" copper pipe. Location of sample lines shall be reviewed and approved by CRD Water Services. Use corrosion resistant brackets/clamps to secure and support copper piping for sampling lines.
- .2 Provide magnetic flow meters on the outlet piping and where required by CRD Water Services, on the inlet piping to the reservoir.
- .3 All valves shall be right hand opening with a 31 mm (1 1/4") square operating nut.
- .4 Provide a 750 mm man-way access to each cell of the reservoir. The man-way shall consist of a steel spool piece or sleeve through the reservoir wall with a hinged flange and attached blind flange on the outside. The hinged flange shall have grease nipples to allow for lubrication. The flange and blind flange shall have a 150 lb. bolt pattern. The spool piece/sleeve, flange and blind flange shall be fusion bonded epoxy coated to AWWA C116/A21.16-98. Provide 316L Stainless Steel bolts for every second hole.
- .5 The man-way shall be located inside the mechanical/electrical building attached to the reservoir.

4.12.12 Metal

- .1 All platforms shall be structural aluminum grating or fibreglass grating.
- .2 All internal ladders shall be constructed of 316L Stainless Steel with serrated rungs.
- .3 Use corrosion resistant brackets/fasteners to secure and support copper piping for sampling lines.
- .4 All external ladders shall be aluminium with secured access.

4.12.13 Structural

- .1 Reservoirs shall be of reinforced concrete construction, faced as necessary to blend with the surroundings. Access shall be provided to any check valve; isolation valve chambers; or other appurtenances. Secured access shall be provided to the top of the reservoir by means of stairway or ladder. A stainless steel ladder with safety cage as applicable shall be provided inside the reservoir.
- .2 Where possible, the reservoir shall be buried and protected by externally by an approved waterproof membrane.
- .3 Reservoir and attached electrical/mechanical building shall be designed for post-disaster use i.e. the structure does not leak and shall be fully usable following a 2475 year return period earthquake.
- .4 Reservoir floors shall have a trowel finish and sloped floor to the floor drain in the middle of the reservoir with a minimum slope of 1%. Ponding of water shall not be accepted.
- .5 Provide a lighted and ventilated electrical/mechanical building enclosure shall be provided for valves, water quality sampling points and instrumentation/SCADA equipment.

4.12.14 Site Requirements

- .1 The Applicant shall apply for and obtain a civic address for the property from the municipality, which shall be displayed on the outside of the building, signage to CRD Water Services approval.
- .2 A survey monument (supplied by CRD Water Services) shall be set by the Applicant in a corner of the reservoir roof, a minimum of 1 m from the edge of the roof. Provide the Geodetic elevation (Geological Survey of Canada (GSC) datum) and horizontal NAD83 UTM coordinates with sub decimetre accuracy.
- .3 Generally, reservoir sites including adequate working space shall be located on land transferred by the Applicant in fee simple lot to the CRD with access to a public road right-of-way. If access to a public road right-of-way is not available and provided the reservoir does not front on a public road right-of-way, access shall be provided by a statutory right-of-way registered in favour of the CRD as per the CRD's standard right-of-way agreement.

- .4 A vehicle access road to the reservoir shall be provided with a minimum drivable surface width of 3.5 m, a maximum allowable grade of 12% and a minimum 6 m turning radius suitable for trucks and boom hoists. Provision shall be made on the site for delivery trucks and cars to turn around. Generally, the access road and turning areas shall be paved. An asphalt paved parking area is required for vehicles during maintenance or repair operations.
- .5 The access road to the reservoir and the reservoir parking shall be paved with a minimum of 50 mm asphalt or as recommended by a Geotechnical Engineer registered in the Province of BC. Sub-base shall be approved by Geotechnical Engineer. Sub-base material shall be a minimum of 300 mm of 75 mm minus crushed road base (as per Standard Drawing 4.5) and base material of 150 mm of 25 mm minus crushed road base (as per Standard Drawing 4.4).
- .6 Where the reservoir is buried, a 3.5 m wide access road shall be provided to allow vehicle access to the top of the reservoir and shall be constructed to the specifications described in subsections .4 and .5 above.

4.12.15 Landscaping, Grading & Drainage

- .1 Aesthetically pleasing landscaping shall be provided, which blends in with the local surroundings and is preferably of low maintenance design and low water consumption to the approval of CRD Water Services and the local municipality. Where grass is deemed acceptable by CRD Water Services, a metered irrigation system with appropriate backflow prevention assembly shall be installed. Design shall be approved by CRD Water Services.
- .2 Site grading shall allow for positive drainage away from the building. The use of berms is recommended in areas sensitive to noise and visual impact.

4.12.16 Security

- .1 Reservoirs shall be fenced with a chain link security fence at least 2.4 m high with 3 strands of barbed wire on top. The fencing shall be designed to allow service vehicles to be off the roadway/sidewalk prior to opening the gate, i.e. off the road. A 4.3 m gate for vehicular access and a separate man gate shall be provided. Local zoning by-laws may dictate type and height of fence. Specifications for fencing material are subject to approval by CRD Water Services.
- .2 All hatches shall be protected against vandalism with a double hatch as per Standard Drawings 3.5 & 3.6.

- .3 All vents shall be protected as per Standard Drawing 4.12.
- .4 Doors shall be reinforced steel, with a steel frame cast into the walls to CRD Water Services approval. Supply doors complete with Mul-T-Lock dead bolt locks to comply with CRD Water Services security system.
- .5 All openings or penetrations of the reservoir walls or roof shall be secured against vandalism, to the approval of CRD Water Services.

4.12.17 Electrical/SCADA

- .1 The Applicant shall provide details of the BC Hydro Account that was set up during construction. The Applicant shall be required to have this account paid in full prior to transfer/acceptance of the reservoir to CRD.
- .2 In general, refer to the CRD Water Services Pump Station Design Guidelines for electrical and SCADA requirements.
- .3 All electrical materials and equipment shall be CSA approved.
- .4 For the operator interface, or HMI, provide a Beijer Electronics EXTER T100 Touch Screen with latest full version of Windows CE to enable the loading of engineering drawings on the screen. Provide unit with a 4GB Lexar Professional memory card. Provide with communication cable from Moscad to Exter RS 232 Cable with additional DB9 connector MDL: CAB-CRD.
- .5 The HMI shall provide the operator with detailed information on the reservoir, such as, alarms and status points, set points for low water level (LWL), top water level (TWL), Overflow Level, flow rates for inflow and outflow, 24 hour totalized inflow/outflow and present conditions in the reservoir.
- .6 Each cell shall be provided with Siemens Milltronics Model 100 Ultrasonic level transmitter. Float switches shall provide backup for the Ultrasonic level transmitters and shall be provided by a cable directly from the pump station.
- .7 Provide connection/communication to CRD Water Services' SCADA system including the instrumentation and controls necessary to transmit/receive the data considered relevant by CRD Water Services. Generally, communications shall be by radio, and, if required, a radio path survey shall be carried out at the Applicant's expense.
- .8 Lighting levels shall be calculated using the lumen method for lighting calculation set forth by the Illuminating Engineering Society (IES) of North America Handbook. Provide a lighting level of 800 Lux.

- .9 All lighting shall be easily accessible for maintenance purposes. Fluorescent lighting shall be provided in all stations and shall be located within 2.5 m of the floor in order to facilitate replacement of the fixture and/or tubes. Fluorescent lights shall be vapour proof (fibreglass type). Locate lighting fixtures clear of overhead hoists and not directly above floor mounted equipment, i.e. pumps, MCC. Fixtures shall be Lithonia Model DM-2-32-AR-120-GEB10RS (or approved equal), CSA approved. If fixture is hung from ceiling use field installable wet location fittings to stem hang fixture on 12.5 mm conduit – specify option WLF.
- .10 HID lighting shall be considered for high-bay areas on larger buildings with supplementary fluorescent units for rapid reaction.
- .11 At least one, outside, vandal-proof weatherproof light fixture shall be provided adjacent to or over the access door to the reservoir entrance. This fixture shall be activated by a motion detector and night sky compliant. Approved product is a Harmony Eye-Lite by Fail-Safe. Minimum lighting at entrance and service areas shall be 50 lux.
- .12 Provide industrial grade waterproof PVC boxes for all switches and receptacles, industrial grade. Provide waterproof cover plates of same material.
- .13 All receptacles shall be GFCI receptacles.
- .14 All indoor equipment located in the electrical/mechanical room shall be installed in splash resistant and dust-tight enclosures.

4.12.18 Water Quality

- .1 Each cell of the reservoir shall be provided with a sampling port as detailed in Standard Drawings 4.8 and 4.9. Where sampling points are located in the electrical/mechanical building, the enclosure shown in Standard Drawing 4.9 is not required. Provide a drip tray connected to the drain for the sampling port.
- .2 Design each cell of the reservoir with a chlorine injection port in accordance with CRD Water Services Standard Drawing 4.1. Vehicle access is required to the chlorine injection port.
- .3 CRD Water Services to determine the location of sampling lines inside the reservoir and the sampling port location.
- .4 Sampling ports, chlorine injection, electrical and control valves shall generally be housed in a building meeting CRD Water Services approval.

5 INSTALLATION

5.1 SCOPE

- 5.1.1 This section shall govern the installation of all Waterworks within the CRD Juan de Fuca Water Distribution System.
- 5.1.2 In general, water services originate at the main and terminate at the meter box and shall include the saddle, corporation stop, copper service line, meter stop with stainless steel plug and meter box, but exclude the meter. All water meters shall be supplied and installed by CRD Water Services at the Applicant's expense.
- 5.1.3 For commercial, industrial and institutional buildings, where the water meter is located in the mechanical room of a building, the water service shall originate at the main and terminate at the property line. The Applicant shall retain ownership of the water service line from the property line to the meter and shall be responsible for all maintenance costs.
- 5.1.4 For a strata property, where the water main is owned by CRD Water Services, the water service shall originate at the water main terminating at the edge of the statutory right-of-way and shall include the saddle, corporation stop, copper service line and meter box. The Applicant shall retain ownership of the water service line from the edge of the statutory right-of-way to his unit and shall be responsible for all maintenance costs.
- 5.1.5 For a strata property, where the water main is not owned by CRD Water Services, the water service is not owned by CRD Water Services. Water meters shall be owned and maintained by CRD Water Services as authorized through the Water Distribution Local Services Bylaw.
- 5.1.6 All installation shall be in accordance with the current AWWA Standards.

5.2 WATER MAINS

- 5.2.1 Ductile iron pipe shall be installed without joint conductance unless specifically required for corrosion protection.
- 5.2.2 All pipe shall be delivered to site with end caps.

- 5.2.3 When the water main is under construction in a trench, water and debris shall be prevented from entering openings in the water main by keeping the excavation sufficiently dewatered and also by capping or plugging such openings with watertight fittings. Pipe and fittings shall be protected from contamination during construction. At the end of each working day, pipes shall be securely capped. Stockpiled pipe shall be covered to prevent contamination.
- 5.2.4 Existing valves shall not be operated except by CRD Water Services personnel.
- 5.2.5 Connections to existing water mains shall be made only by CRD Water Services. For existing 100 mm diameter pipe; 19 mm services shall be tapped a minimum 600 mm apart, (and 600 mm from a collar) and rotated alternately 45 degrees on the circumference of the pipe. Larger services connecting to pipes greater than 100 mm diameter shall be a minimum of 1.25 m apart. Service saddles shall be installed in all cases.
- 5.2.6 All services shall be tapped in the top half of the pipe.
- 5.2.7 Where installation of other services cross under existing AC water mains, a section of the AC pipe shall be replaced with Ductile Iron pipe, in accordance with Section 4.2.6.5. This work shall be done by CRD Water Services at the Applicant's expense.
- 5.2.8 Where the AC water main is greater than 200 mm, contact CRD Water Services and ensure CRD Water Services personnel are present during the excavation. If the excavation of the AC pipe does not impact the integrity of the pipe, the AC pipe may be allowed to remain in place. However, controlled density fill (CFD) must be placed from the springline of the other service to the springline of the AC pipe in accordance with Standard Drawing 1.15.
- 5.2.9 For domestic water services along a public road right-of-way, the meter box shall be installed between 300 mm and 600 mm outside of the front property line and generally, a minimum of 1.0 m from the property corner (refer to Standard Drawing 2.6).
- 5.2.10 The meter box shall not be located within a driveway or area that is to be paved in the future. If this prevents the application of Section 5.2.8, then the meter box shall be located at the edge of the roughed-in driveway or paved area.
- 5.2.11 Notwithstanding the generality of Section 5.2.8 and 5.2.9, the meter box location shall be at the discretion of CRD Water Services.

- 5.2.12 Water services shall be installed from the water main to the property line, using the shortest practical route, and generally, perpendicular to the main. The 19 and 25 mm water service tubing shall be of one continuous piece between the corporation stop and curb stop.
- 5.2.13 The ditch excavation shall be deep enough to allow a minimum of 0.9 m of cover material to be placed over the water service except the curb stop.
- 5.2.14 Where required, water service to traffic islands with planting areas is required, the Applicant shall apply for water service and meter with an approved backflow prevention assembly.
- 5.2.15 Concrete thrust blocks shall be installed as shown in Standard Drawing 1.8. Cast-in-place concrete thrust blocks shall have a minimum 20 MPa compressive strength at 28 days. Alternatively, engineered mechanical restraint may be used.
- 5.2.16 The pipe shall not be backfilled until the installation has been inspected and approved, and the horizontal and vertical alignment recorded by the Engineer of Record.
- 5.2.17 Where a water main is to be extended, one of the following options shall apply for service connections:
- .1 Water main and service connections shall be installed by the Applicant or;
 - .2 Water main and service connections shall be installed by CRD Water Services at the Applicant's expense.
- 5.2.18 All new water mains shall have detectable marking tape installed 300 mm above the water main and in accordance with the tape manufacturer's instructions. Acceptable marking tapes are listed in Appendix A.
- 5.2.19 The pipe shall be laid to alignment and grade shown on the approved Design Drawing within the following tolerances:
- .1 Horizontal tolerance shall not be greater than 50 mm from designed location. The rate of deviation from the required alignment shall not exceed 30 mm in 7.5 m.
 - .2 Vertical tolerances shall not be greater than 25 mm from designed grades.

5.3 BEDDING

- 5.3.1 Bedding for water main and services shall be as detailed on Standard Drawing 1.12.

5.4 PRESSURE AND LEAK TESTING

- 5.4.1 All water service connections shall be installed prior to pressure testing of the water mains.
- 5.4.2 The pipe shall be pressure tested after it has been laid and backfilled or partially backfilled. All newly laid pipe and hydrants shall be subjected to a hydrostatic pressure equal to 150% of the working pressure of the pipe i.e. 1551 kPa (225 psi), at its lowest point, for 2 hour duration. The test pressure shall not vary more than \pm 34.5 kPa (5 psi) for the duration of the test. Pressure tests shall conform to the latest revision of AWWA Standard C600 for Ductile Iron pipe and latest revision of AWWA Standard C605 for PVC pipe. Where other pipe material is approved, testing shall in accordance with applicable AWWA standards.
- 5.4.3 Before applying the specified test pressure, all air shall be expelled from the pipe. If permanent air valves are not located at all high points, the Contractor shall install corporation stops at such points as to allow air to expel as the line is filled. After the air is expelled, the main stops shall be closed and the test pressure applied using a pump connected to the pipe. The test pressure shall be corrected based on the elevation of the lowest point of the section under test and the elevation of the test gauge. The pump, pipe connection including any necessary taps, and all necessary apparatus, shall be furnished by the Contractor.
- 5.4.4 After a preliminary satisfactory test has been achieved, the Contractor shall notify CRD Water Services to witness the final test. The Contractor shall furnish the pump, pipe, connections and all other necessary apparatus and labour to conduct the test.

- 5.4.5 For Ductile Iron, pressure piping will not be accepted until the leakage is less than the maximum allowable leakage determined from the following formula:

$$L_m = \frac{SD\sqrt{P}}{715,317}$$

where L_m = testing allowance (makeup water), in litres per hour

S = length of pipe tested, in metres

D = the nominal diameter of the pipe in millimetres

P = the average test pressure during the leakage test in kilopascals

- 5.4.6 For PVC, pressure piping will not be accepted until the leakage is less than the maximum allowable leakage determined from the following formula:

$$L_m = \frac{ND\sqrt{P}}{130,400}$$

where L_m = testing allowance (makeup water), in litres per hour

N = number of joints in the length of pipeline tested

D = the nominal diameter of the pipe in millimeters

P = the average test pressure during the leakage test in kilopascals

- 5.4.7 For High Density Polyethylene (HDPE) pipe

- .1 Allow water, pipe and soil to thermally stabilize;
- .2 Section of pipe to be tested shall be no longer than 1500 m;
- .3 Test pressure shall be 150% of the rated pressure of the pipe. Normal rated pressure of the pipe is 150 psi, therefore the test pressure is 225 psi;
- .4 The test pressure is monitored at the lowest elevation of the pipe;
- .5 Acceptance criteria: Pressure shall remain steady (within 5 percent of the target value) for one hour. Maximum test time shall be 8 hours.

- 5.4.8 Where concrete thrust blocks have been installed, testing shall not commence until 7 days after the concrete was poured.

- 5.4.9 Testing against closed valves is not permitted.

- 5.4.10 The Contractor shall, at his own expense, locate and repair leaks until the leakage is within the specified limits.

5.5 FLUSHING AND DISINFECTION

- 5.5.1 Upon completion of the backfilling and satisfactory pressure and leak test results, the water mains shall be flushed with a minimum velocity of 1.5 m/s to remove any debris in accordance with AWWA standards and manuals of practice, subject to CRD Water Services approval.
- 5.5.2 Disinfection shall be done by the Contractor in accordance with the latest revision of AWWA C651 and subject to CRD Water Services approval, and shall be repeated until the regulations are achieved.
- 5.5.3 The Contractor shall contact CRD Water Services a minimum of twenty-four (24) hours in advance of disinfecting procedure to schedule a suitable time for a bacteriological sample to be taken for testing by CRD Water Services Water Quality Division.
- 5.5.4 If the samples do not pass the tests noted in 5.5.2 and 5.5.3, the Contractor shall repeat the process of disinfecting and/or flushing. This shall be repeated until a satisfactory test result is obtained by CRD Water Services. The Applicant shall be responsible for all costs to retest the water quality.

6 WATER UTILITY EXCAVATION, BACKFILL, RESTORATION AND CLEANUP

6.1 SCOPE

- 6.1.1 This specification shall govern the excavation, backfilling and clean up within the Juan de Fuca Water Distribution System.
- 6.1.2 All work shall be in accordance with WCB Regulations.

6.2 EXCAVATION

- 6.2.1 Excavate to the required alignment, width, depth and grade in accordance on the CRD Water Services Standard Drawings or the approved Design Drawings.
- 6.2.2 For work on existing roadways, excavated material shall not be stockpiled on the roadway.
- 6.2.3 If the material at the bottom of the excavation is organic or other unsuitable material, it shall be over-excavated to firm ground and backfilled with suitable compacted material, unless otherwise specified by the Professional Engineer.
- 6.2.4 Excavations shall be dewatered where necessary. Provide sedimentation and erosion control as required.
- 6.2.5 All solid rock boulders and large stones shall be removed to provide a minimum clearance of 150 mm around pipe.
- 6.2.6 Where an existing structure or underground installation may be affected by the Work, appropriate mitigating measures shall be implemented.

6.3 BACKFILL

- 6.3.1 All backfill shall be completed in accordance with the Standard Drawing 1.12.
- 6.3.2 Where a pipe or conduit is installed beneath an existing or foreseeable future pavement, sidewalk, driveway or gravel shoulder; backfill shall be 75mm minus crushed road base, compacted to a minimum 95% Modified Proctor density.
- 6.3.3 Suitable native material may be used as backfill where the pipe or conduit is installed in non-travelled areas. Backfill shall be free of stones over 150 mm size, frozen material, organic, or other perishable or objectionable material that would prevent proper consolidation or which might cause subsequent settlement.

- 6.3.4 Controlled density fill (CDF), where required, shall be used in lieu of compacted gravel backfill. CDF shall be manufactured and placed in accordance with CAN/CSA A23.1 & 2. CDF shall be excavatable in the future and have a maximum unconfined compressive strength of 0.5 MPa at 28 days and maximum cement content of 25 kg per m³. A copy of concrete test results shall be provided to CRD. As-constructed drawings shall show location and extent of CDF.

6.4 RESTORATION

- 6.4.1 Upon completion of the work, remove waste materials and debris, trim slopes and correct defects. Dispose of excess materials at an approved disposal site.
- 6.4.2 Reinstatement pavement, sidewalks and lawns to the elevation, which existed before the excavation, or as shown on the drawings to the satisfaction of the governing municipality. Reinstatement shall be to condition as good or better than original.
- 6.4.3 Where seeding is required, use a premium quality grass seed at the rate of 50 grams of seed per square metre.
- 6.4.4 Where replacement of topsoil is required, provide a minimum of 200 mm approved topsoil, mounded on top to allow for settlement and sown with a good quality grass seed. If the installation is under a developed lawn, the soil shall be rolled, fine raked during the appropriate season and sown with a good quality grass seed at a rate of 50 grams seed per square metre.
- 6.4.5 If final paving cannot be completed immediately, gravel filled trenches shall be maintained to within 25 mm of the original surface prior to final paving, or cold mix asphalt applied if required by the municipality.
- 6.4.6 Patching cuts in existing pavement.
- .1 As a minimum, pavement restoration shall meet the local municipality requirements.
 - .2 Cuts shall be hot mix paved within 3 days of backfilling and to the same thickness as the adjacent pavement with a minimum of 50 mm, weather permitting.
 - .3 If weather conditions do not permit hot-mix asphalt, cuts shall be paved within 3 days of backfilling using cold-mix asphalt and replaced as weather permits.

- .4 Where the excavation is on the shoulder or under the traveled portion of the street, the surface material shall be cut in neat straight lines at the edges of the trench by means of an asphalt cutting wheel, milling machine or pneumatic pavement breaker. Where the edges of any area requiring repaving extend outside the straight lines cut, further cuts shall be made so that the final patch will have a neat appearance.
 - .5 Any area of pavement adjacent to the excavation which has become undermined or deformed due to excavation practices or blasting shall be removed and repaved as above.
- 6.4.7 For pavement cuts, which have settled, remove asphalt, excavate and re-compact the trench, then repave.

6.5 COMPACTION TESTING

- 6.5.1 The Engineer of Record shall arrange for periodic compaction testing of the backfill and asphaltic concrete. As a minimum, test the backfill and asphaltic concrete once every 100 m of pipe installed. A copy of test reports shall be included with Daily Inspection Reports.