DISTRICT OF CHETWYND

DISTRICT OF CHETWYND

SUBDIVISION AND DEVELOPMENT SERVICING BYLAW NO. 981, 2013

March 2013

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DISTRICT OF CHETWYND
SUBDIVISION AND DEVELOPMENT SERVICING BYLAW NO. 981, 2013

A bylaw to regulate and require the provision of services in respect of subdivision and development within the District of Chetwynd.

WHEREAS pursuant to the Local Government Act, a local government may, by bylaw, regulate and require the provision of works and services in respect of the subdivision of land and development.

NOW THEREFORE the Council of the District of Chetwynd, in open meeting assembled, HEREBY ENACTS as follows:

PART 1 REPEAL

1.1 Subdivision Servicing Bylaw No. 448, 1989 and all amendments thereto, are hereby repealed.

PART 2 CITATION

2.1 This Bylaw may be cited for all purposes as "Subdivision and Development Servicing Bylaw No. 981, 2013".

PART 3 ADMINISTRATION

Application

3.1 This bylaw applies to all land within the boundaries of the District of Chetwynd.

3.2 Schedules A-L, attached hereto, form part of this bylaw.

Minimum Parcel Highway Frontage

3.3 Council hereby delegates to the *Approving Officer* the power to exempt a parcel from the statutory or bylaw minimum frontage provided for in Section 944 of the Local Government Act.

Standards of Measure

3.4 Any equivalent imperial units of measure shown, in parentheses, after metric units in any schedule to this bylaw are for information purposes only and do not form part of this bylaw.

Severance

3.5 If any section, subsection, sentence, clause or phrase of this bylaw is for any reason held to be invalid by the decision of any court of competent jurisdiction, the invalid portion shall be severed and the decision that it is invalid shall not affect the validity of the remainder of this bylaw.

Master Municipal Construction Document (MMCD)

3.6 All *Works and Services* shall be completed in accordance with the current Master Municipal Construction Document (MMCD), Volume II, along with this bylaw.

Where there are conflicts between this bylaw and the MMCD, this bylaw shall take precedence.

Approved Products

3.7 Accepted materials are those listed in the District of Chetwynd Approved Products List. Use of materials not listed will require permission from the *Approving Officer*.

PART 4 INTERPRETATION

4.1 Definitions

Approving Officer means the person appointed by *Council* as such under the Land Title Act.

Certificate of Provisional Completion of All Works means a certificate issued by the *Owner's Professional Engineer* stating that:

a) *Works and Services* are ready to be used for their intended purpose;
b) The total cost of addressing incomplete, defective and deficient works and services, as estimated by the *Professional Engineer* and verified by the *District,* is not more than 5% of the total cost of the *Works And Services*; and
c) Fire protection has been approved to the satisfaction of the Fire Chief.

A description of the *Works and Services* that remain to be completed must be included as part of this certificate.

Certificate of Provisional Completion of Deep Utilities means a certificate issued by the *Owner's Professional Engineer* stating that deep utilities *Works and Services* including water, sanitary sewer, and storm sewer mains, are ready to be used for their intended purpose.

Chief Administrative Officer means the District of Chetwynd's Chief Administrative Officer.

Community Drainage System means a system of works designed and constructed to control the collection, conveyance and disposal of stormwater.

Community Sewer System means a sanitary sewage collection system which is owned, operated and maintained by the *District.*

Community Water System means a water supply system which is owned, operated and maintained by the *District.*

Council means the Municipal Council of the District of Chetwynd.

Development means any construction to which the Building Bylaw applies.

District means the District of Chetwynd.

Highway includes a street, road, lane, walkway, pathway, trail, bridge, viaduct and any other way of any width open to the use of the public, and a statutory right-of-way granted to the *District* for the provision of public access or the provision of utility services.

Letter of Final Acceptance means a letter issued by the *District* in respect of *Works and Services* required by this bylaw verifying that all requirements of this bylaw have been met by the owner.

Owner has the same meaning as in the Land Title Act and includes a person authorized by an *Owner* to make a *Subdivision* application in respect of the *Owner's* land.

Parcel has the same meaning as in the Land Title Act and includes a bare land strata lot.

Performance Security means cash or an automatically renewable irrevocable and unconditional letter of credit acceptable to the *Approving Officer*, given to the *District* when the *Owner* would like to obtain *Subdivision* approval or a building permit prior to the installation of on-site and off-site *Works and Services*.

Professional Engineer means a person who is registered or duly licensed as a professional engineer in British Columbia under the provisions of the Engineers and Geoscientists Act.

Subdivision means:

a) The division of land into two or more *Parcels* whether by plan, apt descriptive words, or otherwise;
b) The consolidation of *Parcels* into one *Parcel* by plan;
c) Reconfiguration of *Parcel* boundaries without creation of additional lots; or
d) The creation of a highway or portion of a highway by plan.

Warranty Security means cash or an automatically renewable irrevocable and unconditional letter of credit acceptable to the *Approving Officer*, given to the *District* following the *Provisional Completion of All Works.*

Works and Services means services, facilities or utilities which are required or regulated by bylaw and may include, but are not limited to, highways, curbs, gutters, sidewalks, boulevards, boulevard crossings, transit bays, street lighting, underground wiring, overhead wiring, water distribution systems, fire hydrant systems, sewage collection systems, sewage disposal systems, drainage collection systems, drainage disposal systems, and natural gas, power, telephone, and cable services.

Works and Services Agreement means a written agreement in a form prescribed by the *District* that describes the terms and conditions agreed upon between the *District* and the *Owner* relative to the provision of *Works and Services* associated with a *Subdivision* or *Development*.

PART 5 CONNECTION TO COMMUNITY SYSTEMS

Community Water System

5.1 All water distribution systems and fire hydrant systems in those areas identified in Schedule A shall be connected, in accordance with the standards established under this bylaw, to the *District's Community Water System*.

5.2 If an *Owner* proposes to connect to the *District's Community Water System*, existing water sources must be abandoned in such a way as to prevent cross-connection as per the applicable *District* bylaws.

Community Sewer System

5.3 All sanitary sewage collection systems in those areas identified in Schedule A shall be connected, in accordance with the standards established under this bylaw, to the *District's Community Sewer System.*

Community Drainage System

5.4 All drainage collection systems in those areas identified in Schedule A shall be connected, in accordance with the standards established under this bylaw, to the *District's Community Drainage System.*

PART 6 SERVICING REQUIREMENTS FOR SUBDIVISIONS AND DEVELOPMENTS

Servicing Requirements

6.1 Prior to *Subdivision* approval or the issuance of a building permit, the *Owner* of a *Parcel* being subdivided or developed must provide:

a) *Works and Services* on *Highways* within the *Subdivision* and on *Highways* immediately adjacent to the *Subdivision* up to the centre line of the *Highway*, as prescribed in Schedule A of this bylaw; and

b) excess or extended services as described in Section 939 of the Local Government Act.

6.2 Under the Local Government Act, the *Council* delegates to the *Approving Officer* the authority to:

a) determine what requirements for *Works and Services* are directly attributable to a *Parcel* being subdivided or developed in any particular case;

b) determine what excess or extended services are required in connection with a *Subdivision* or *Development*;

c) determine whether the cost of such excess or extended services is excessive such that the *Owner* must pay the costs;

d) identify the benefiting properties in relation to excess or extended services; and

e) determine what proportion of the costs associated with the excess or extended services is associated with each benefiting property.

6.3 All *Works and Services* shall be provided to the standards prescribed in this bylaw.

6.4 Notwithstanding Section 6.1, the *Owner* may obtain *Subdivision* approval or the building permit prior to the provision of *Works and Services* if the *Owner* provides security in accordance with Part 7 and enters into a *Works and Services Agreement* with the *District of Chetwynd* to construct and install the required works and services by a specified date or forfeit to the *District* the amounts provided as security. Approval from the Ministry of Transportation and Infrastructure is required to post security for Ministry of Transportation and Infrastructure *Highways*.

6.5 For the purpose of charges payable for latecomer connections or use under Section 939 of the Local Government Act, interest shall be calculated annually at a rate established by the *District.*

Exemptions

6.6 The requirements set forth in this bylaw shall not apply to a *Subdivision* or strata *Development* as outlined in Section 938 of the Local Government Act and under the Strata Property Act.

6.7 The requirements under Section 6.1 shall not apply if:

a) The *Subdivision* creates only parkland or natural areas, a *Parcel* for the installation of utilities and related structures and equipment; and
b) A covenant restricting the use of the *Parcel* to one of those uses has been registered on title under Section 219 of the Land Title Act in favour of the *District*.

PART 7 FEES AND SECURITY

Application Fees

7.1 a) An *Owner* applying for *subdivision* approval or a building permit shall submit with the application the following fees:

.1 Application for *Subdivisions* under the *Land Title Act*

A fee of five hundred ($500) dollars for the first *parcel* proposed to be created by *subdivision* and fifty ($50) dollars for each additional *parcel* is payable to the *District*.

.2 Application for *Subdivisions* under the *Condominium Act*

A fee of five hundred ($500) dollars for the first parcel proposed to be created by *subdivision* and fifty ($50) dollars for each additional bareland strata lot is payable to the *District*.

.3 Application for Building Permit

A fee of one hundred ($100) dollars is payable where the provisions of this bylaw are applicable prior to the issuance of a building permit.

Inspection Fees

7.1 a) An *Owner*, prior to making application for final approval of a *Subdivision* or a building permit shall submit with the application the following fees:

.1 Charges for inspection of *Works and Services* in the amount equal to five percent (5%) of the *Owner's Engineer 's* cost estimate for constructing *Works and Services* required by the new S*ubdivision* or development, or actual *District* cost, whichever is greater. The Goods and Services Tax (GST) of five percent (5%) shall be additional to the inspection charges. The *Owner `s Engineer `s* estimate shall include the GST (5%).

Performance Security

7.2 Final approval of a *Subdivision* or issuance of a building permit shall not be granted prior to the provision of *Works and Services* required by this bylaw unless the *Owner* provides to the *District Performance Security* in an amount equal to one hundred and twenty five percent (125%) of the *Professional Engineer's* estimate of the cost of the *Works and Services*, including contingencies, required for the proposed *Subdivision* or *Development*, as approved by the *Approving Officer*, to meet the requirements of this bylaw.

7.3 The *District* may, at the *Owner's* expense, confirm the cost estimate of the *Works and Services* by consulting with a *Professional Engineer* chosen by the *District*. The *Approving Officer* may choose which estimate to use.

7.4 If the required *Works and Services* have not been completely installed in accordance with the approved design drawings within the time specified in the *Works and Services Agreement*, the *District* may draw on the *Performance Security* in order to complete the required works and services. If the cost of installation exceeds the amount of the *Performance Security*, the balance shall be a debt due from the *Owner* to the *District*, recoverable in any court of competent jurisdiction or by any other means available to the *District*.

7.5 The *Owner* shall be solely responsible for the actual cost of the *Works and Services* regardless of the adequacy of the *Performance Security* deposited with the *District*.

7.6 Nothing in this bylaw obliges the *District* to complete *Works and Services* on the default of an *Owner*.

Provisional Completion of Deep Utilities

7.7 Provisional Completion of Deep Utilities shall occur upon receipt and approval by the District of the following from the *Owner*:

.2 A statutory declaration confirming that all *Works and Services* completed to date have been paid for in full; and

.3 A *Certificate of Provisional Completion of Deep Utilities*, issued by the *Owner's Professional Engineer*, together with the supporting documentation upon which it is based, including relevant:

- Quality assurance test results; and
- Inspection reports.

7.8 The *District* shall return 70% of the deep utility portion of the *Performance Security* upon Provisional Completion of Deep Utilities in accordance with this bylaw and the applicable *Works and Services Agreement*. If the *Owner* has provided a letter of credit or certified cheque as security, the letter of credit or certified cheque shall not be returned unless the *Owner* provides a replacement letter of credit or certified cheque for the amount of the remaining *Performance Security.* The *District* may hold the amount retained or replacement letter of credit or certified cheque to secure the *Owner's* obligations under this Section.

Provisional Completion of All Works

7.9 Provisional Completion of All Works shall occur upon receipt and approval by the District of the following from the *Owner*:

a) A statutory declaration confirming that all *Works and Services* completed to date have been paid for in full;

b) A *Certificate of Provisional Completion of All Works*, issued by the *Owner's Professional Engineer*, together with the supporting documentation upon which it is based, including relevant:

- Quality assurance test results; and
- Inspection reports;

c) Record drawings of all works and services, prepared by the *Owner's Professional Engineer*;

d) A list of defects and deficiencies in the work, as identified during an inspection of the *Works and Services* with the *District,* together with a cost estimate sealed by the *Owner's Professional Engineer* of the cost required to rectify these defects and deficiencies. If record drawings are not provided at this point, they shall be considered as a deficiency to be rectified; and

e) Receipt of a schedule of quantities and prices of completed work to date, prepared by the *Owner's Professional Engineer*; and

f) *Warranty Security*, as prescribed in Section 7.11.

7.10 The *District* shall return any remaining *Performance Security* upon Provisional Completion of All Works in accordance with this bylaw and the applicable *Works and Services Agreement*, less ten percent (10%) of the original *Performance Security* posted plus two times the value of deficiencies. If the *Owner* has provided a letter of credit or certified cheque as security, the letter of credit or certified cheque shall not be returned unless the *Owner* provides a replacement letter of credit or certified cheque in the amount of ten percent (10%) of the original *Performance Security* plus two times the value of deficiencies. The *District* will hold the amount retained or replacement letter of credit or certified cheque to secure the *Owner's* obligations under this Section.

Warranty Security

7.11 The *Owner* shall provide to the *District Warranty Security* in an amount equal to ten percent (10%) of the actual cost of the *Works and Services* required by this bylaw plus two times the estimated value of defects and deficiencies remaining to be rectified.

7.12 The *District* may, at the *Owner's* expense, confirm the cost of the *Works and Services* by consulting with a *Professional Engineer*.

7.13 The warranty period shall be a one year period commencing on the date of Provisional Completion of All Works.

7.14 At least two weeks prior to the end of the warranty period, the *Owner* and the *District* shall jointly inspect the works to identify any new defects in the work that have become apparent during the warranty period.

7.15 The *Owner* shall warranty the works and repair or replace any defective works and correct any deficiencies during the warranty period. Should the *Owner* fail to warranty, repair or replace the works, the *District* may effect repairs or replacement using the *Warranty Security* provided for in this bylaw, after having provided the *Owner* at least ten days' notice except in the case of defects in the works creating a safety or health hazard in which case the *District* need provide no greater notice than is prudent in the circumstances.

7.16 The *Owner* shall be responsible for the actual cost of repairing or replacing any defective works and correcting any deficiencies in the works and services regardless of the adequacy of the *Warranty Security* deposited with the *District*. If the cost of repairing or replacing any defective works and correcting any deficiencies exceeds the amount of the *Warranty Security*, the balance shall be a debt due from the *Owner* to the *District*, recoverable in any court of competent jurisdiction or by any other means available to the *District*.

Final Acceptance

7.17 Final Acceptance shall occur when all conditions of the bylaw have been met.

7.18 All *Works and Services* required to be constructed or provided pursuant to the provisions of this bylaw shall remain the sole responsibility of the *Owner* until a *Letter of Final Acceptance* has been issued by the *District*.

7.19 The *District* shall issue a *Letter of Final Acceptance* only upon:

a) Completion of the warranty period; and
b) Correction of all defects and deficiencies in the required *Works and Services*.

7.20 The *District* shall return any unused portions of the *Warranty Security* to the *Owner* upon Final Acceptance.

Insurance

7.21 The *Owner* shall carry adequate insurance, as identified by the *District* through the *Works and Services Agreement*.

PART 8 GENERAL PROVISIONS

Professional Engineer

8.1 The *Owner*, at its expense, shall retain a qualified *Professional Engineer* to design, inspect, test and certify all *Works and Services*.

Cost of Services

8.2 All *Works and Services* required by this bylaw shall be designed, reviewed, constructed and inspected at the expense of the *Owner*.

Engineering Drawings

8.3 Where *Works and Services* are to be constructed, engineering drawings and other required reports and documentation certified by a *Professional Engineer* shall be submitted to the *District* for approval. The engineering drawings shall contain at least the information set out in the Schedules and be accompanied by the following:

a) A letter from the *Owner* confirming the relationship between the *Owner* and the *Owner's Professional Engineer*; and

b) A letter from the *Owner's Professional Engineer* confirming their engagement with the owner and that they will be providing professional services to the owner to ensure that the *Works and Services* are designed and constructed in accordance with the approved plans and this bylaw.

8.4 No construction, alterations, or extensions shall commence until the *Owner* has been advised in writing that the engineering drawings have been approved by the *District* and applicable agencies.

8.5 Where a water supply system is required by this bylaw, the *District* shall not approve the detailed design until the *Owner's Professional Engineer* has submitted design drawings to the regional health authority and provided to the *District* a copy of the approved construction permit.

Project Supervision and Certification

8.6 The *Owner* of lands being subdivided shall engage a *Professional Engineer* or a certified inspector to carry out all necessary field reviews and inspections during the construction of *Works and Services* required as a condition of *Subdivision* approval or issuance of a building permit.

8.7 Within thirty (30) days of the *Works and Services* being operational, the *Owner's Professional Engineer* shall submit a report to the *District* in a format acceptable to the *District* and prior to the commencement of the warranty period. The report shall briefly describe the work and any material changes during construction and certify that the *Works and Services* have been constructed in compliance with this bylaw and the approved plans, drawings and supporting documents. The report shall contain copies of all inspection reports and test results upon which the certification is based.

Record Drawings, Operations and Maintenance Manuals and Safety Procedures

8.8 A minimum of one set of sealed hard copy record drawings prepared by the *Owner's Professional Engineer* and one digital copy of the record drawings in an AutoCAD format specified by the *District*, one set of operations and maintenance manuals, and one set of safety procedures documentation shall be provided to the *District* at the commencement of the warranty period. The record drawings shall include the information shown on the detailed design drawings in accordance with Section 8.3.

Rights-of-Way and Easements

8.9 Prior to or concurrently with final approval of a *Subdivision* plan or building permit, all required rights-of-way and easements shall be registered against or appurtenant to the title of the land being subdivided or their registration shall be the subject of an undertaking by the *Owner's* solicitor to the *District* or its solicitor.

8.10 No *Parcel* may be served by *Works and Services* that are not located on that *Parcel* or within a *Highway* unless the *Works and Services* are located within a registered easement or statutory right-of-way that:

a) Authorizes the construction, operation, maintenance, replacement and repair of the *Works and Services*;
b) Has a width as required according to the schedules in this bylaw, unless otherwise specified by the *Approving Officer*;
c) Prohibits the placement within the easement or right-of-way area of all structures or improvements that would interfere with or impair the operation or maintenance of the *Works and Services*;
d) Creates rights in respect of a specific easement area shown on a reference or explanatory plan;
e) In the case of an easement, that is registered concurrently with a covenant under Section 219 of the Land Title Act in favour of the *District* prohibiting the uses of the *Parcel* that are dependent on the *Works and Services* unless the easement is in place, or has been replaced by a statutory right-of-way in favour of the *District*; and
f) In the case of a statutory right-of-way, is in favour of the person or entity responsible for operating and maintaining the *Works and Services*.

Third Party Review

8.11 Where the review of any document, report or analysis related to servicing that the *Owner* has submitted to the *District* is required, at the sole discretion of the *Approving Officer*, the *District* may engage a third party *Professional Engineer* chosen by the *District* to review the document, report or analysis. The *Owner* may be responsible for the full costs of any required third party review. *Subdivision* approval may not be granted until these costs are paid by the *Owner*.

PART 9 ENFORCEMENT

Authorization to Enter

9.1 The *Approving Officer, District* bylaw enforcement officers, the *Chief Administrative Officer* and other officers and employees of the *District* designated by those officers to administer or enforce this bylaw are authorized to enter, at all reasonable times, upon any property in order to inspect and determine whether the regulations, prohibitions and requirements of this bylaw are being met.

Violation

9.2 Every person who violates any of the provisions of this bylaw shall be deemed to be guilty upon summary conviction of an offence under this bylaw.

9.3 No person shall:

a) fail to comply with a *District of Chetwynd* directive, direction or notice given under this bylaw; or

b) prevent or obstruct or attempt to prevent or obstruct the entry of an officer authorized by Section 9.1.

Offence

9.4 Each day's continuance of an offence under Sections 9.2 and 9.3 constitutes a new and distinct offence.

Penalties

9.5 Any person who violates any of the provisions of this bylaw shall, on summary conviction, be liable to a penalty not exceeding $10,000 plus the cost of prosecution.

PART 10 EFFECTIVE DATE

10.1 This bylaw shall come into full force and effect upon its adoption.

Read a First time this	18th	day of	March,	2013.
Read a Second time this	2nd	day of	April,	2013.
Read a Third time this	2nd	day of	April,	2013.
Rescinded Third Reading this	15th	day of	April,	2013
Read a Third time as amended this	15th	day of	April,	2013
Reconsidered and Adopted by Council this	29th	day of	April,	2013.

_____ _____

MAYOR DIRECTOR OF CORPORATE ADMINISTRATION

SCHEDULES

March 2013

SCHEDULE A

WORKS AND SERVICES REQUIREMENTS

March 2013

SCHEDULE A - WORKS AND SERVICES REQUIREMENTS

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1.0 WORKS AND SERVICES REQUIREMENTS

1.1 Establishment of Service Levels

The minimum level of *Works and Services* to be constructed by an *Owner* prior to approval of *Subdivision* or *Development* is set out in **Table A1**. While **Table A1** sets out the minimum level of *Works and Services* required, the *Approving Officer* retains the right to require a higher level of *Works and Services* or standard due to the conditions affecting a specific *Subdivision* or *Development*. If a *Parcel's* zoning is not included in **Table A1** the *Approving Officer* will determine the required level of service for the *Subdivision* or *Development*.

Table A1 – Level of Service

Service	Level of Service	
	Urban Subdivision *Parcels* zoned Residential or Commercial	**Industrial Subdivision** *Parcels* zoned Industrial
Roads	Urban Roads	Rural Roads
Sewer	Community Sewer System	Community Sewer System
Water	Community Water System	Community Water System
Drainage	Community Drainage System	Ditch
Wiring	Underground	Overhead
Lighting	Thru Subdivision	Thru Subdivision
Landscaping	Public	N/A

For the purposes of **Table A1**:

- **Urban Subdivision** means a *Subdivision* or *Development* where the *Parcels* are zoned Residential or Commercial as indicated in the *District*'s Zoning Bylaw.
- **Industrial Subdivision** means a *Subdivision* or *Development* where the *Parcels* are zoned Industrial as indicated in the *District*'s Zoning Bylaw.
- **Urban Roads** means roads that meet the requirements for urban roads as set out in Schedule E – Roads.
- **Rural Roads** means roads that meet the requirements for rural roads as set out in Schedule E – Roads.

- **Ditch** means a drainage collection and disposal system of open ditches and culverts.
- **Underground** means a system of underground electrical and communications wiring.
- **Overhead** means a system of overhead electrical and communications wiring.
- **Thru Subdivision** means street lighting that is provided throughout the *Subdivision* (rather than only at intersections).
- **Public** means landscaping required on public lands as set out in Schedule G – Landscaping.

1.2 Accessibility

The *Owner's Professional Engineer* shall consider the accessibility of people with disabilities when designing all roads, sidewalks, pathways, curb let downs and driveway crossings.

SCHEDULE B

WATER DISTRIBUTION

SCHEDULE B – WATER DISTRIBUTION

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1.0 WATER DISTRIBUTION

1.1 Water Distribution

Water distribution systems shall be designed in accordance with the requirements of this bylaw, and shall be constructed in accordance with the appropriate American Water Works Association (AWWA) standards. Drawings completed by a *Professional Engineer* showing all works to be constructed shall be submitted to the *Approving Officer* for approval prior to construction. No construction will be allowed prior to obtaining approval from the *Approving Officer*.

The *Owner* shall submit an approved Water Works Construction Permit from the Northern Health Authority (Public Health Authority) to the *Approving Officer* prior to construction.

1.2 Per Capita Demand

To determine the required water demand for residential areas, use the following per capita demands and population densities:

- (ADD) Average Annual Daily Demand (A): 600 litres per capita per day (L/c/d)
- (MDD) Maximum Day Demand (D): 1,200 litres per capita per day (L/c/d)
- (PHD) Peak Hour Demand (H): 1,800 litres per capita per day (L/c/d)

Population densities:

- Single Family = 3 persons/unit
- Multi Family = 2 persons/unit

1.3 Non-Residential Demand

Commercial, industrial and institutional demands should be determined using specific data related to the specific zoning designation of the property. In the absence of such data, use the residential per capita demands as listed in Section 1.2 – Per Capita Demand and the equivalent population values listed in **Table B1** with the following factors:

Average Daily Demand (A): Values listed in **Table B1**
Max Daily Demand (D): D = 2.0 x A
Peak Hour Demand (H): H = 1.5 x D

Table B1: Population/Hectares per Land Use

Land Use	Equivalent Population/Hectare (gross)
Commercial:	90 people/ha
Institutional:	50 people/ha
Industrial:	90 people/ha

For identified commercial and institutional facilities, (A), the average annual daily water demands shall be as per **Table B2**.

Table B2: Average Annual Daily Water Demands

Facility	Unit	Typical Average Annual Daily Water Demand L/(person or unit)/d
Assembly hall	Seat	8
Automobile dealer/renter	Hectare	30,000
Automobile service station	Set of pumps	2,000
Car wash	Vehicle served	5,000
Bed and breakfast	Patron	150
Bowling alley	Lane	800
Camp: Children's, central toilet & bath	Person	180
Day, no meals	Person	50
Campground	Site	600
Curling club	Lane	8,500
Golf course	Hectare	1,500
Greenhouse	Hectare	27,000
Hospital	Bed	1,000
Hotel	Patron	300
Ice arena	Rink	85,000
Motel	Patron	500
Office	Employee	50
Picnic park, with flush toilets	Visitor	30
Restaurant: Conventional	Seat	150
24 hour	Seat	200
Tavern	Seat	80
School: Day, with cafeteria or lunchroom	Student	60
Day, with cafeteria & showers	Student	70
Boarding	Student	400
Self-service laundry	Machine	2,000

1.4 Fire Flows

Fire flows shall be determined in accordance with the requirements of the current edition of "Water Supply for Public Fire Protection – A Guide to Recommended Practice", published by Fire Underwriters Survey.

Fire flows are subject to minimum requirements as summarized in **Table B3.**

Table B3: Minimum Fire Flow Requirements

Developments (without sprinklers)	Minimum Fire Flow
Single Family Residential	60 L/s
Apartments, Townhouses, Duplex, Mobile Home Park	90 L/s
Commercial	150 L/s
Institutional	150 L/s
Industrial	225 L/s

1.5 Design Flows

Total design flows (Q_{design}) are to be the greater of the following:

Q_{design} = D+F — Maximum Day Demand for the population or equivalent population ***plus*** the Fire Flow, or

Q_{design} = H — Peak Hour Demand for the population or equivalent population

1.6 Water Pressure

Table B4: Water Pressure

Maximum allowable pressure	850 kPa (123.3 psi)
Minimum pressure at Peak Hour Demand (H)	300 kPa (43.5 psi)
Minimum pressure in system during design Maximum Day and Fire Flow Demand (D+F)	150 kPa (21.8 psi)

Determination of pressure limits should include consideration of property elevations relative to street level.

1.7 Hydraulic Design

For hydraulic design, the following parameters are established:

- Use a proven network analysis computer model based on the Hazen-Williams formula:

$$Q = \frac{CD^{2.63}S^{0.54}}{278780}$$

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 = 130 for all pipes

- The maximum allowable design velocity under fire flow conditions should be 4.0 m/s. At Peak Hour Demand the maximum flow velocity should be 2.0 m/s.

1.8 Minimum Pipe Diameter

Table B5: Minimum Pipe Diameter

Distribution mains: • Residential • Commercial, Industrial	 150 mm 200 mm
Fire hydrant connections:	150 mm
Residential service connections:	19 mm
Commercial service connections:	50 mm
Service with fire sprinklers:	50 mm*

*May be reduced if *Professional Engineer* through modeling confirms acceptability of a smaller service.

1.9 Dead Ends

Watermains shall be looped wherever possible. Where dead ends are unavoidable, and where permitted by the *Approving Officer*, blow-offs or blow-downs shall be provided. Blow-off and blow-down sizes are:

- 50 mm diameter for 150 mm diameter watermains
- 100 mm diameter for 200 mm diameter and larger watermains

Where proven practical, a hydrant may serve a secondary role as a blow-off.

1.10 Minimum Depth of Cover

Depth of cover shall be determined as the distance from finished ground surface to top of pipe. Watermains and services must be of sufficient depth to:

- Prevent freezing
- Clear other underground utilities
- Provide mechanical protection from external loads
- Clear other underground utilities

The minimum depth of cover is 3.0 metres.

The *Owner* shall provide special consideration for frost and mechanical protection in cases where minimum depths cannot be attained, for example at bridge crossings and in chambers.

The *District* may accept watermains with less than 3.0 meters cover providing that the *Owner's Professional Engineer* has designed insulation adequate to prevent watermain freezing.

1.11 Grade

Grades shall be straight lines between defined deflection points. Elevations shall be recorded.

Where possible, the minimum grade of watermains shall be 0.1%. Grading shall be designed to minimize the number of high points.

When the slope equals or exceeds 10%, the *Owner* shall provide anchorage, joint restraints, trench dams and trench drainage. The *Approving Officer* may require a geotechnical engineering report where appropriate.

1.12 Corrosion Protection

Each metal fitting shall be provided with corrosion protection as shown in the Supplementary Detail Drawings. Metal fittings shall be epoxy coated and attached with a 7.7 kg magnesium anode. Anodes shall be embedded into trench wall, at pipe depth,

with a minimum of 50 mm of native soil completely surrounding the anode. Anodes shall be attached to fittings by fusing methods.

If epoxy coating is chipped, use touch up epoxy paint to repair the damage. Denso tape shall not be used on bolts, fittings, or hydrant barrel unless gaps are smoothed out with mastic to prevent any air or water from sitting in gaps.

1.13 Valves

In general, valves should be located as follows:

- In intersections either in a cluster at the pipe intersection or at projected property lines to avoid conflicts with curbs and sidewalks:
  - 3 valves at “X” intersection
  - 2 valves at “T” intersection
- Not more than 200 m apart
- Not more than 1 hydrant isolated
- Not more than 20 service connections isolated

Gate valves are required on all mains up to 300 mm diameter. Mechanically assisted groundhog butterfly valves may be installed in mains 350 mm and larger. On mains 600 mm and larger, valves may be one size smaller than the mains (with suitable reducers).

1.14 Hydrants

Fire hydrants shall be located, in general, at street intersections and as follows:

- Not more than 180 m apart in single family residential zones and not or more than 90 m apart in higher density residential, industrial, commercial, and institutional zones
- In accordance with “Water Supply for Public Fire Protection – A Guide to Recommended Practice” published by Fire Underwriters Survey
- 1.5 m back from property line
- Minimum 1.0 m clear of any other utility structure
- At property lines in mid-block locations

Hydrant specifications shall be in accordance to the approved product list.

1.15 Air Valves

Combination air valves shall be installed at the summits of all mains 200 mm diameter and larger, except as follows:

- Where the difference in elevation between the summit and valley is less than 600 mm
- Where it can be shown that air pockets will be carried by typical flows
- Where active service connections are suitably located to dissipate entrapped air

Typical air valve sizes, subject to design analysis, are summarized in **Table B6**.

Table B6: Air Valve Sizing

Watermain Size	Valve Size
200 mm to 300 mm	25 mm
350 mm to 600 mm	50 mm
Larger than 600 mm	Special design

Air valves shall be vented to an appropriate above-grade location to eliminate any potential for cross connection in a flooded or contaminated chamber.

1.16 Thrust Restraint

Concrete thrust blocking and/or adequate joint restraining devices shall be provided at bends, tees, wyes, reducers, plugs, caps, valves, hydrants and blow-offs.

The restraint system shall take into account potential future excavations in the vicinity of the watermain. Design calculations shall be based on fitting type, water and test pressure and soil conditions.

1.17 Chambers

Chambers or manholes containing valves, blow-offs, meters, or other appurtenances shall allow adequate room for maintenance, including headroom and side room. Access openings shall be suitable for removing valves and equipment. The chamber shall be

provided with a drain to storm sewer or ditch, complete with backflow prevention, to prevent flooding of the chamber. Rock pits may be considered, subject to suitable soil and groundwater conditions. A pumping system may be required for drainage.

Adequate venting shall be provided. The *Approving Officer* may require provision of forced ventilation, lighting, heating and dehumidification. Access and ventilation details shall comply with WCB requirements.

Insulation to prevent freezing shall be provided where necessary.

1.18 Service Connections

Service connections size shall be calculated on the basis of the designated land use including sprinkler systems and/or on-site hydrants, where applicable. The minimum sizes are listed in **Table B5.**

Each property shall have an independent service located at the centre of each lot; duplexes shall have two services.

Each service shall have a shut-off located within 300mm of the property line within the *District* right-of way.

Each property shall be serviced through a pressure reducing valve.

1.19 Utility Separation

Requirements for separation of sanitary/storm sewers from water mains are as follows, unless otherwise indicated by the local public health authority:

- Horizontal Separation: At least 3 m horizontal separation shall be maintained between a water main and a sanitary/storm sewer.

  In special circumstances, specifically in rock or where the soils are determined to be impermeable, lesser separation than 3 m may be permitted provided that:

  - Approval has been granted by the Provincial Health Authority; or
  - Any potential conflicts are constructed in accordance to Provincial/Local Health Authority Guidelines.

- Vertical Separation: Where a sanitary/storm sewer crosses a water main, the sewer shall be below the water main with a minimum clearance of 0.45 m. Where clearance is less than 0.45 m or the watermain crosses below the sanitary/storm sewer, protective measures approved by the local public health authority must be applied.

Large diameter services must be separated 3 m horizontally from sewer services in separate trenches. Small diameter services may be installed in a common trench.

1.20 Alignment

Except as noted in Section 1.21 – Right-Of-Way (R.O.W.), watermains shall have straight alignments with uniform offsets between intersections.

Mains shall be located such that each property served has at least one side facing the watermain.

Joint deflections and bending of mains are not permitted. Any required vertical or horizontal alignment changes shall be made using appropriate bends or at fitting joints.

1.21 Rights-Of-Way (R.O.W.)

Right-of-way locations should be selected to avoid environmentally sensitive areas such as watercourses, wetlands and wildlife migration corridors, and forested areas.

In all cases, the R.O.W. width shall be sufficient to permit an open excavation with side slopes in accordance with the WorkSafe BC regulations, without impacting on, or endangering, adjacent structures. The minimum R.O.W. width is 6.0 m.

Where required, water feeder mains should have the R.O.W. wide enough for future twinning. The width of the R.O.W. should be the required separation between pipe centerlines plus three (3) times the depth to the crown of the deeper watermain.

Where a utility is located within a R.O.W., and valves, valve chambers, manholes, or other appurtenances which require maintenance are located within the R.O.W., road access shall be provided from a public road. The maintenance access must be sufficiently wide and structurally adequate to support the maintenance vehicles for which the access is intended. Maximum allowable grade of the maintenance access is 12%.

1.22 Connection to Existing Watermains

Connection to an existing watermain shall be undertaken by the *Owner* at the *Owner's* expense under the supervision of *District* staff. The *Owner* shall provide no less than 48 hours notice to *District* staff of the intent to connect to an existing watermain.

At no time shall anybody or anyone other than *District* staff operate existing valves.

1.23 Reservoirs

Preliminary Design Requirement: Reservoir design shall include a preliminary design report which is to be accepted by the *Approving Officer* before detailed design begins. Preliminary design shall cover the following issues:

- Selection of materials (concrete or steel)
- Design standards
- Volume
- Shape
- Number of cells
- Geotechnical report on foundation conditions
- Aesthetics Water Quality and reservoir piping

Capacity: Reservoirs shall be designed to suit the particular circumstances. Reservoir capacity shall be calculated by the following formula:

Total Storage Volume = A + B + C

Where: A = Fire Storage (from Fire Underwriters Survey guide)
B = Equalization Storage (25% of Maximum Day Demand)
C = Emergency Storage (25% of A + B)

Subject to the results of a detailed engineering analysis, and approval of the *Approving Officer*, the requirement for emergency storage (C) may be reduced or eliminated based on consideration of the following:

- Dependability of water source
- Reliability of supply system

- Presence of more than one supply source
- Whether the reservoir is part of a large system
- Presence of other reservoir(s) in system
- Availability of standby power

Structural Design Codes: Structures shall be designed in accordance with the latest edition of the BC Building Code and as applicable the following specialty codes:

- American Concrete Institute (ACI) 350/350R: Code Requirements for Environmental Engineering Concrete Structures, and Commentary
- Portland Cement Association (PCA): Circular Concrete Tanks Without Prestressing
- ACI 350/350R: Seismic Design of Liquid Containing Concrete Structures, and Commentary
- American Waterworks Association (AWWA) D110: AWWA Standard for Wire and Standard-Wound Circular Prestressed-Concrete Water Tanks
- AWWA D115: AWWA Standard for Circular Prestressed Concrete Water Tanks with Circumferential Tendons
- AWWA D100: AWWA Standard for Welded Steel Tanks for Water Storage
- AWWA D103: AWWA Standard for Factory-Coated Bolted Steel Tanks for Water Storage

Design Features:

- Seismic Loading: Design for the following:
  - Watertight structure and fully operational mechanical equipment, following a 475-year return period earthquake
  - Repairable damage and no uncontrolled release of water following a 2500-year return period earthquake
- Two cells, each containing one-half of total required volume and capable of being drained and filled independently. A single cell reservoir may be considered under the following circumstances:
  - Total volume less than 4500 m^3
  - Alternative storage available (another reservoir in system)

  - Alternative supply source available
  - Alternative storage or supply source scheduled to be available within five years
- Overflow drain sized to handle the maximum design inflow
- Separate inlet and outlet pipes, located and oriented to provide circulation within the reservoir
- Independent drain outlet at the bottom, with consideration given to discharge route, capacity and any environmental concerns
- Roof access hatch sized and located for safe and convenient access for personnel, parts, temporary ventilation facilities and cleaning equipment into each cell
- Hatches to include watertight aluminum, complete with hinges and related hardware, drains, locks and intrusion alarms
- Ventilation pipes or openings sized to handle appropriate intake and exhaust air volumes for filling and draining the reservoir. Include security considerations, bird and insect screens, and snow clearance
- Reservoir floor to slope to drain sump in concrete structures and in steel structures where possible. Drain as low as possible in steel reservoirs
- Drain sump in concrete reservoirs to be minimum 1,000mm x 1,000mm x 400mm; invert of drain pipe to be flush with sump floor; grating to be installed over sump
- Stairways or stainless steel or aluminum interior wall ladder from roof access to floor. All ladders and stairs must meet WCB regulations, including attachment points for fall arrest equipment
- Fall prevention railings
- All pipework within the reservoir to be PVC, stainless steel, fiberglass, steel or ductile iron coated to AWWA standards
- All metal parts within the reservoir including bolts, nuts, screws, anchors, ladders, etc. to be stainless steel
- Pressure transducer or ultrasonic level controls for each cell
- Sample lines for at least one sample per 1,000 m^3 volume within each cell
- Washdown connection in each cell, complete with backflow preventer and 65mm diameter pipe
- Convenient vehicle maintenance access conforming to minimum road grades as indicated in Schedule E - Roads

- Fencing, lighting, locks, ladder guards, alarms and other security facilities to minimize vandalism and prevent water contamination
- Site finishing to suit location and surrounding land uses

Valve Chamber: Reservoir piping is to incorporate a valve chamber with the following design features:

- Chamber to include all valves associated with the reservoir operation
- Design in accordance with seismic codes noted in Schedule B Section 1.23 – Reservoirs
- Entrance at grade large enough to permit the safe removal of largest equipment
- Space for safe and convenient operating and maintenance access to all valves, piping, equipment and instruction
    - Interior and exterior of all steel piping to be coated to AWWA standards, or, alternatively, use stainless steel. Steel pipe in contact with potable water to use products that are NSF 61 certified
- Floor drains and drainage system
- Located above 200-year flood level or 1.0 m above highest recorded flood elevation

Additional features, which may be required subject to system operations details, include the following:

- Sampling ports for inlet, outlet and reservoir water
- Flow measurement and recording
- Heat, light and ventilation
- PLC-controlled inlet valve and level monitoring and control system
- Connection to SCADA system
- Uninterruptible power supply (UPS) for control system
- Chlorine residual analyzer for reservoir inlet and outlet if required by Northern Health Authority or *Approving Officer*
- Provision for re-chlorination facilities

1.24 Pump Stations

Preliminary Design: Pump station design shall include a preliminary design report which is to be accepted by the *Approving Officer* before detailed design proceeds. The preliminary design shall follow a 'systems-based' approach which addresses the performance of the pump station and the supply and distribution network together. Preliminary designs shall include the following issues:

- Location
- Capacity
- Hydraulics (Pressure, NPSH, pump RPM, efficiencies)
- Water hammer analysis and mitigative measures
- Number and type of pumps
- Preliminary piping layout
- Type and appearance of structure
- Foundation conditions
- Maintenance requirements and access
- Energy requirements
- Sustainable energy supply:
  - Energy efficiency
  - Standby power
- HVAC
- Aesthetics
- Noise
- Controls and monitoring, including process and instrumentation drawing and control narrative
- Life cycle costs
- Operations

Capacity: Pumping capacity shall be designed to suit the particular circumstances. In general, capacity should meet maximum day demand with the largest pump out of service and balancing storage on-line. If balancing storage is not on-line, pumping capacity should meet peak hour demand with the largest pump out of service. Stand-by

power should be provided to allow the greater of maximum day demand plus fire flow or peak hour demand (D+F, or H) during a power outage.

Design Features:

- Structure, piping and mechanical systems shall be designed in accordance with the BC Building Code
- Located above 200-year flood level or 1.0m above highest recorded flood elevation
- Reinforced concrete, blockwork or brick construction designed to incorporate aesthetic considerations and adequate insulation
- Access doorways sized for safe and convenient removal and replacement of the largest piece of equipment. Lifting hooks or rails with hoisting equipment should be included as required
- Adequate HVAC and lighting
- Standby power, unless fire storage and balancing and/or emergency storage is available without pumping
- Electrical motors to be suitable for use with a Variable Frequency Drive (VFD)
- Air relief discharge and pilot lines to be piped to floor drains
- Housekeeping pads for Motor Control Centre (MCC)
- Hydraulically operated or motorized pump control valves with isolation valves, unless pumps have variable speed drives which control transient pressures
- Totalizers
- Spring return “silent” check valves
- High pressure and surge relief valves or VFDs with isolation valves, if warranted by system characteristics and transient analysis
- Suction and discharge pressure gauges, with isolation valves, for each pump
- Discharge pressure transducer for connection to SCADA
- Mechanical pump seals
- Water quality sampling ports
- Interior and exterior of all steel piping to be coated to AWWA standards, or, alternatively, use stainless steel. Steel pipe in contact with potable water to use products that are NSF 61 certified

- Pump system to be PLC-controlled and connected to SCADA system. PLC to conform to current *District* standard
- 120 V power outlet for small tools
- Hour meters and ammeters for each pump
- Power factor correction, if required by power company
- Noise attenuation to suit the location and local authority standards
- Equipment to be CSA approved and have minimum one-year guarantee on parts and labour. All equipment must be tested prior to acceptance
- Four copies of a comprehensive Operating and Maintenance Manual. Manual shall be hard-backed bound documents with the name of the facility embossed on the cover. Manuals shall contain a table of contents with each section identified by a plasticized, labeled divider

1.25 Pressure Reducing Valve (PRV) Stations

Prior to commencing detailed design of a PRV, the *Professional Engineer* shall submit a preliminary design report that addresses the design considerations of this bylaw. Approval of the preliminary design report shall be obtained prior to the *Professional Engineer* commencing detailed design.

Design Features:

- Above ground building - minimum size: 3 m x 4 m x 2 m (inside dimensions)
- Minimum 30 amp, 120 VAC service
- Forced air ventilation, heat, and light
- External kiosk and antenna
- Sump drain to drainage system
- Structure and piping in accordance with Chambers (Schedule B Section 1.17), Reservoirs (Schedule B Section 1.23), and Pump Stations (Schedule B Section 1.24)
- External bypass with closed valve
- Parallel pressure reducing valves sized for peak hour and maximum day plus fire flows
- Isolating valves

- Air release valves
- Off-street parking
- Upstream and downstream pressure gauges
- Water quality sampling ports
- Landscaping plan
- Interior and exterior of all steel piping to be coated to AWWA standards, or alternatively use stainless steel. Steel pipe in contact with potable water to use products that are NSF 61 certified. Forced air ventilation plus heat and light, shall be provided subject to local authority review
- Four copies of a comprehensive Operating and Maintenance Manual shall be provided to the *District*. Manual shall be hardbacked bound documents with the name of the facility embossed on the cover. Manuals shall contain a table of contents with each section identified by a plasticized, labeled divider
- PLC Controlled and connected to SCADA system

1.26 Testing and Disinfection

Testing and disinfection shall be done as per MMCD requirements and in accordance with applicable AWWA standards.

SCHEDULE C

SANITARY SEWER

SCHEDULE C – SANITARY SEWER

List of Tables:

1.0 SANITARY SEWER

1.1 Sanitary Sewer

Sanitary sewer systems shall be designed in accordance with the requirements of this bylaw.

All standards not specifically described in this Schedule shall be in accordance with good practice and the appropriate standards or as directed by the *Approving Officer*. Detailed design drawings showing all works to be constructed shall be submitted for approval prior to construction.

1.2 Per Capita Flow

Sanitary sewer system design shall be based on an average daily dry weather flow (ADWF) of 300 litres per day per capita (L/d/c). Population densities shall be as follows:

- Single Family = 3 persons/unit
- Multi Family = 2 persons/unit

1.3 Non-Residential Flows

Average dry weather flows (ADWF) for non-residential areas shall be based on specific data related to the development or zoning. In the absence of such data, use the above residential per capita flow and the equivalent population factors as summarized in **Table C1**.

Table C1: Land Use Densities per Population

Land Use	Equivalent Population/Hectare (gross)
Commercial	120 people/ha
Institutional	200 people/ha
Industrial	200 people/ha

Special consideration shall be given to the design of the sanitary sewers for heavy users of water or generators of sanitary sewage.

For identified commercial and institutional facilities, the ADWF shall be as per **Table C2**.

Table C2: Commercial and Industrial ADWF

FACILITY	UNIT	TYPICAL ADWF L/(person or unit)/d
Assembly hall	Seat	8
Automobile dealer/renter	Hectare	30,000
Automobile service station	Set of pumps	2,000
Car wash	Vehicle served	5,000
Bed and breakfast	Patron	150
Bowling alley	Lane	800
Camp: Children's, central toilet and bath	Person	180
Day, no meals	Person	50
Campground	Site	600
Curling club	Lane	8,500
Hospital	Bed	1,000
Hotel	Patron	300
Motel	Patron	500
Office	Employee	50
Picnic park, with flush toilets	Visitor	30
Restaurant: Conventional	Seat	150
24 hour	Seat	200
Tavern	Seat	80
School: Day, with cafeteria or lunchroom	Student	60
Day, with cafeteria and showers	Student	70
Boarding	Student	400
Self-service laundry	Machine	2000
Shopping centre	m^2	0.10
Swimming pool, with toilet and shower	Patron	50
Theatre	Seat	15

1.4 Peaking Factor

The peaking factor is the ratio of Peak Dry Weather Flow (PDWF) to the Average Dry Weather Flow (ADWF). The peaking factor shall be calculated using the design residential population and non-residential equivalent population, with the following formula:

$$PF = \frac{3.2}{(P)^{0.105}}$$

Where: PF = peaking factor

P = residential population plus non-residential equivalent population in thousands

1.5 Infiltration/Inflow

Design flows shall include an Infiltration and Inflow (I/I) allowance at 0.17 L/s/ha

1.6 Design Flow

Design flow, Q (= Peak Wet Weather Flow (PWWF)) = population and equivalent x per capita flow x peaking factor + infiltration/inflow allowance.

Q = PWWF = (P) x (ADWF) x (PF) + I/I

1.7 Pipe Flow Formulas

- Gravity Sewers

  Use Manning's formula:

  $$Q = \frac{AR^{0.667} S^{0.5}}{n}$$

  Where: Q = Design flow in m^3/s

  A = Cross sectional area in m^2
  R = Hydraulic radius (area/wetted perimeter) in m
  S = Slope of hydraulic grade line in m/m
  n = Roughness coefficient
  → concrete = 0.013
  → PVC = 0.011

- Sewage Force Mains

  Use Hazen-Williams formula:

  $$Q = \frac{CD^{2.63}S^{0.54}}{278780}$$

  Where: Q = Rate of flow in L/s
  D = Internal pipe dia. in mm
  S = Slope of hydraulic grade line in m/m
  C = Friction coefficient
  → PVC or HDPE = 130

1.8 Flow Velocities

- Gravity Mains: The minimum full pipe velocity shall be 0.6 m/s. There is no maximum velocity. However, consideration shall be given to scour problems and the dynamic loading on manholes where flow exceeds 3.0 m/s. Anchoring shall be incorporated where the grade(s) of the sewer are 15% or greater.
- Force Mains: At the lowest pump delivery rate anticipated to occur at least once per day, a minimum cleansing velocity of 1.0 m/s shall be maintained. Maximum velocity should not exceed 3.5 m/s.

1.9 Minimum Grades

- Gravity Mains: The grade of any sewer is governed by the minimum required full pipe velocity of 0.6 m/s.
- Forcemains: Forcemains shall be graded at a minimum of 0.5%. Grading shall be designed to minimize high points. Provide air release valves at high points

1.10 Minimum Pipe Diameter

- Gravity Mains:
  - For residential lands – 200 mm
  - For commercial and industrial – 250 mm

  Terminal pipe section, upstream of the last intersection of mains, and where no further extension is planned, shall be:
  - For residential lands – 150 mm at a minimum 1.0% grade
  - For commercial and industrial – 200 mm at a minimum 0.60% grade
- Forcemains:
  - 100 mm
- Service Connection:
  - Single family residential – 100 mm
  - Duplex residential – One 100 mm service per side
  - Multi-family/commercial/institutional – Minimum 150 mm

1.11 Alignment

Except as noted in Schedule C Section 1.12 – Curved Sewers, horizontal and vertical alignments shall be straight lines between manholes.

1.12 Curved Sewers

Where permitted by the *Approving Officer*, horizontal curves may be formed using pipe joint deflections as follows:

- Minimum radius = 60 m
- Constant radius throughout curve
- Minimum design velocity = 0.9 m/s
- Curvature limited to half of maximum curvature specified by pipe manufacturer
- Deflection to be at pipe joints only, no bending of the sewermain will be allowed
- Radius and curvature not less than 60 m
- Curve locations to be recorded at ¼ points and midpoint
- Constant offset from property line or road centerline

1.13 Manholes

- Locations:

  Manholes are required at:

  - Every change in grade
  - Every change in direction, except as permitted for curved sewers
  - Every change in pipe size
  - Downstream end of curved sewers
  - Every pipe intersection except for 100 mm and 150 mm service connections and junctions with trunk sewers 900 mm and larger
  - 120 m maximum spacing for all pipe sizes
  - Every future pipe intersection
  - Every terminal end (upstream end of every sewer main)
  - Temporary clean-outs may be provided at terminal section of a main provided that:

- Future extension of the main is proposed or anticipated
- The length of sewer to the downstream manhole does not exceed 45.0 m
- The depth of the pipe does not exceed 2.0 m at the terminal point
- Clean-outs are not to be considered a permanent structure

- Sanitary manhole rim elevations outside of paved roadways shall be designed to be:
  - Above the adjacent storm manhole rim elevation and
  - Above the surrounding ground so that infiltration from ponding will not occur

- Hydraulic Details:
  - Crown elevations of inlet sewers shall not be lower than the crown elevation of the outlet sewer
  - Minimum drop in invert elevations across manholes:
    - Straight run: 5 mm drop
    - Deflections up to 45°: 20 mm drop
    - Deflections 45° to 90°: 30 mm drop
  - The maximum deflection angle in a junction shall be 90°
  - Drop manhole and ramp structures shall be avoided where possible by steepening inlet sewers. Where necessary, provide drop structures as follows:

Invert Difference	Structure
Up to 0.45 m	Inside Ramp
0.45 m to 0.90 m	Inside Drop
Greater than 0.90 m	Inside Drop

  - Force main discharges shall be directed into the receiving manhole outlet pipe. Manhole benching shall be extended a minimum 200 mm above the force main crown. If a manhole drop cannot be avoided, an inside drop structure is required.

1.14 Depth and Cover

Depth shall be defined as the distance from the finished ground surface to the top of pipe. Sewers shall be of sufficient depth to:

- Permit gravity sewer service to the basements of properties adjacent to the roadway or sewer right-of-way
- Prevent freezing
- Meet the minimum depth requirements of 2.4 m
- Clear other underground utilities
- Prevent damage from surface loading
- Allow for future extension of the sanitary sewer system to service upstream tributary lands at ultimate development, as approved by the *Approving Officer*

Minimum cover on sewer connections at property lines shall be 2.4 m. Insulation of sewer mains and services may be required at the discretion of the *Approving Officer*.

Maximum cover depth: 4.5 m, except under special circumstances and with permission of *Approving Officer*.

1.15 Right-Of-Way (R.O.W.)

Right-of-way locations shall be selected to avoid environmentally sensitive areas such as watercourses, wetlands and wildlife migration corridors and forested areas. Rear yard sewers are discouraged and will only be allowed with appropriate easements, access and the permission of the *Approving Officer.*

Where location of a municipal utility in a statutory right-of-way is permitted by the *Approving Officer*, the minimum right-of-way width is 6.0 m.

In all cases, the width of rights-of-way shall be sufficient to permit an open excavation with side slopes in accordance with the WorkSafe BC regulations, without impacting on, or endangering, adjacent structures.

Where a utility is located within a right-of-way, and valves, valve chambers, manholes, or other appurtenances which require maintenance are located within the right-of-way, access from a public road shall be provided. The maintenance access shall be sufficiently wide and structurally adequate to support the maintenance vehicles for which the access is intended. Maximum allowable grade of the maintenance access is 12%.

1.16 Utility Separation

Requirements for separation of sanitary sewers from water mains are as follows, unless otherwise indicated by the local public health authority.

- Horizontal Separation: At least 3 m horizontal separation shall be maintained between a water main and a sanitary sewer.

  In special circumstances, specifically in rock or where the soils are determined to be impermeable, lesser separation than 3 m may be permitted provided that:

  - Approval has been granted by the Provincial Health Authority, or
  - Any potential conflicts are constructed in accordance to Provincial/Local Health Authority Guidelines.

- Vertical Separation: Where a sanitary sewer crosses a water main, the sewer shall be below the water main with a minimum clearance of 0.45 m. Where clearance is less than 0.45 m or the sewer main crosses above the water, protective measures approved by the local public health authority must be applied.

- Sewers in Common Trench:

  Sanitary and storm sewers may be installed in a common trench, provided that the design has taken into account:

  - Interference with service connections
  - Stability of the benched portion of the trench
  - Conflicts with manholes and appurtenances

  The horizontal clearance between sewer pipes shall be no less than 1.0 m and the horizontal clearance between manholes shall be no less than 0.3 m.

1.17 Service Connections

Unless otherwise permitted by the *Approving Officer*, connections are to serve all plumbing by gravity. Building elevations should be established accordingly. Pumped connections may be permitted if requested prior to sewer design and if appropriate covenants are provided.

Service connections shall be provided to each lot fronting the main. Service connections shall be installed perpendicular to the main, and in no case shall a service connection be

placed so that it extends in front of any property other than the one being serviced unless approved by the *Approving Officer*.

Each property is permitted only one service connection. In special circumstances, where servicing of all buildings on existing industrial or commercial properties is not feasible, two services may be allowed if permitted by the *Approving Officer*. Every legal lot and each unit of a residential duplex shall be provided with a separate service connection.

Connections to new mains shall be made using standard wye fittings. Connections to existing mains shall use wye saddles or, where permitted by the *Approving Officer*, inserta-tees may be used. All services shall enter the main at a point just below the springline.

The minimum grade from the main to the property line shall be 2.0% for 100 mm services or 1% on 150 mm services.

Service connections may be permitted into manholes provided that:

- The connection is not in an adverse direction to the flow in the sewer main
- The connection enters the manhole so the service crown is no lower than the sewer main crown

Manholes are required on service connections larger than 150 mm diameter.

For residential developments connections shall be located at the centre of each lot and as noted on the Supplementary Detail Drawings.

The maximum length of any service connection is 30 m. Services exceeding 30 m in length will be considered mains.

1.18 Sewer Lift Stations

The use of lift stations shall be avoided where possible. Any proposed use of lift stations shall receive prior approval from the *Approving Officer*. Prior to commencing detailed design of a lift station, the *Professional Engineer* shall submit a pre-design report that addresses the design considerations of this bylaw. Approval of the pre-design report shall be obtained prior to the *Professional Engineer* commencing detailed design.

- Preliminary Design Requirements:
  - System Layout: Select location(s) to minimize long-term total number of lift stations
  - Location: Within right-of-way adjacent to road
  - Capacity: Dependent upon the development and catchment area. Designs must consider short, intermediate and long-term future flows
  - Configuration: Submersible duplex pump system unless otherwise approved in advance

Other basic criteria include:

- Construction dewatering requirements
- Access for construction and maintenance
- Aesthetics, noise, odour control and landscaping
- Waterhammer and/or column separation prevention measures
- Security against vandalism and theft
- Flood elevations and station uplift design
- Proximity of receiving sewers, water mains, and power supply
- Minimizing energy requirements
- Type of controls:
  - PLC compatible with the *District's* Control System
  - Ultrasonic and backup float controls
  - SCADA connection or capability
- Standby power

- Sub-surface investigations must be undertaken prior to site approval
- Convenience of operation and maintenance including service vehicle access
- Safety for operators and public
- Capital costs and operation and maintenance costs
- Vehicle loads adjacent to and/or on station structure
- Davit and lifting arms for pumps and fall arrests. Station to be complete with an Uninterruptible Power Supply (UPS) to serve alarms and controls

- Design Features:

  Lift stations shall be designed with a minimum of two pumps, capable of handling the maximum flow condition with any one pump off line.

  Where the design flow exceeds the capacity of a single, commonly available pump, use three or more pumps with capacities such that there is always one pump available for standby.

  Pump requirements:

  - Capable of passing solids up to 75 mm in size.
  - Explosion proof
  - Suitable for use with a variable speed drive
  - Easily removed for maintenance
  - Able to operate alternately and independently of each other
  - Able to meet maximum flow condition with one pump in failure mode
  - Sized so that each motor does not cycle more than six times in one hour under worst case operating conditions or less as recommended by the pump manufacturer
  - Motor over temperature and leak detection system

  Ball type check valves or swing check with outside lever and weight required on each pump discharge.

  Gate valves required outside pump station on influent line and a plug valve for each pump discharge line. The valves must be outside the station and be complete with square operating nut, riser, rock guard and Nelson-type box.

Provision(s) must be made for standby pumping from an external source. An adaptor flange ("Kamlock") complete with a quick coupling and lockable cap will be required. Minimum wet well size: 1.8 m diameter.

Wet well bottom to be benched to direct solids to pump suction. Wet wells to be designed in accordance with the latest edition of the Hydraulic Institute Standards.

Pump station lids to be waterproof and provided with locks;

- Covers may be either aluminum or fiberglass
- Minimum 900 mm x 900 mm in size
- Fasteners to be 316 stainless steel
- Lids to be 200 mm to 300 mm above ground level
- The hatch shall be located out of the roadway away from vehicular access
- The hatch shall be protected from vehicular traffic with bollards

Station access shall be by aluminum ladder and include the following provisions:

- Ladder to be located to avoid interference with removal and installation of pumps
- Ladder to be provided with extension and lock at least 600 mm above station lid
- Fiberglass grating platform to be provided above high water level for wet well access
- Access, ladder and platform to meet Worksafe BC standards

Access shall be located 0.6 m above 200-year flood level or 1.0 m above highest recorded flood elevation. The following design provisions shall be incorporated:

- Metal stations shall not be allowed.
- Steel and fiberglass surfaces to receive minimum two coats of two-component white epoxy enamel. Concrete stations to be designed to prevent sulphide attack.
- Auxiliary equipment and control panels to be housed in weatherproof kiosk adjacent to station. Kiosk to be located not less than 2.0 m and no more than 4.0 m from station lid.
- Kiosk to contain separate compartment for lift station ventilation fan.
- Wet well ventilation shall be designed to address odour control, and confined space entry to Worksafe BC Standard and NFPA Standard 820.

- Wiring in station and fan compartment to be explosion-proof, Class 1, Division 2. Electrical design and installation subject to approval by Provincial Safety Inspector.
- Power and control cables to be continuous from within the lift station to within the kiosk.
- Levels to be controlled by ultrasonic level transmitter, plus emergency high and low level floats.
- Unless otherwise permitted by the Approving Officer, controls to be PLC based and connected to SCADA system. Confirm the *District's* SCADA requirements prior to detailed design.
- Station to be complete with an Uninterruptible Power Supply (UPS) to serve alarms and controls.
- Control panel to include hour meter and ammeter for each pump.
- 110V outlet for hand tools.
- Station to include magnetic flow meter with local display and connections to SCADA.
- Pump control panel to incorporate operator interface with indicator lamps, as indicated in **Table C3**.

Table C3: Pump Control Panel

Condition	Colour	Reset
Pump on, each pump	Green	Manual
Pump fail, each pump	Red	Manual
Pump motor overload, each pump	Red	Manual
Motor winding high temperature, each pump	Red	Manual
Moisture sensor, each pump	Red	Manual
Power failure	Red	Manual
High wet well level	Red	Manual
Condition	**Colour**	**Reset**
High intermediate wet well level	Red	Manual
Low wet well level	Red	Manual

- All indicator lamps must be "push to test" type. Pump control panel to incorporate operator interface (Panelmate or equivalent), and the panel must be complete with a lamp text button.
- Control kiosk to be designed to contain control and SCADA equipment on front panel and power equipment on rear panel. Concrete base to be minimum 75mm above finished grade.
- Lift stations to include automatic generator sets for standby power in case of power failure. Generator set enclosures to be weatherproof and to include noise control. For small lift stations, emergency storage may be considered in place of standby power. Emergency storage is to be based on 8 hours of average day flows plus infiltration.
- Noise levels for facilities must not exceed 65 dB at property line or 20m away whichever is closer.
- A 50 mm water connection with standpipe and cross-connection protection must be provided on-site for cleaning purposes.
- Area around station and related equipment or building is to be graded and fenced. Size of area to be determined by maintenance requirements and minimum 1.2 m clearance to structures with doors opened. Layout of structures and gates is to provide for clearances for pump removal by hoist truck.
- Design in accordance with appropriate seismic standards.

- Equipment to be CSA approved and have minimum one-year guarantee on parts and labour. All equipment must be tested prior to acceptance.
- Provide four copies of a comprehensive Operating and Maintenance Manual, in hardback bound format with name of facility embossed on cover. Manuals shall contain a table of contents with each section identified by a plasticized, labeled divider.

1.19 Corrosion and Odour Criteria

- Dissolved sulphide maximum limit at any point in the system is to be 0.5 mg/l
- Odour Criteria:
  - At 10 m from any gravity main, force main, manhole and lift station or other sewer facility (summer conditions, winds between 2-10 km/h), 1.0 odour units
  - Where sewer facilities are close to houses, parks or walkways, 0.0 odour units
- Analysis for odour and sulphides may be required

1.20 Testing

Testing of installed pipes shall depend on the height of existing ground water and shall consist of low pressure air testing and video inspection as outlined in the MMCD.

SCHEDULE D

STORMWATER

SCHEDULE D - STORMWATER

List of Tables:

1.0 STORMWATER MANAGEMENT

1.1 General

These standards are not intended to be a substitute for sound engineering knowledge and experience. Drainage designs shall be prepared under the direction of a *Professional Engineer* with the appropriate experience and knowledge.

These standards are intended to cover only minimum requirements. Drainage designs shall conform to all pertinent *District* bylaws, regulations, guidelines and policies as well as federal and provincial statutes and guidelines.

1.2 Stormwater Management

Stormwater management involves the planning and design necessary to avoid and/or mitigate the negative hydrological impacts of land development or land use changes on adjacent and downstream lands and watercourses. Adverse hydrological impacts include such issues as increased runoff (peak stormwater flows and volume), erosion, sedimentation, flooding, property damage and injury or loss of life, reduced surface infiltration, reduced minimum groundwater levels and stream flows, water quality deterioration and degradation of aquatic and wildlife habitats. Mitigation measures include but are not limited to the following:

- Appropriate sizing and routing of pipes and channels
- Major flow path routing
- Detention storage
- Removal of sediment and other pollutants
- Landscaping
- Source control
- Erosion protection
- Groundwater infiltration
- Subsurface disposal
- Lot grading

1.3 Integrated Stormwater Management Plan

An Integrated Stormwater Management Plan (ISMP) is required for any *Subdivision* or *Development* larger than 0.4 ha (1 acre) and must be submitted for the full extents of the *Subdivision* or *Development* and not by phase. The ISMP shall include the following:

- Catchment plan for the subject site which includes all upstream lands that drain into or through the site
- Description of the existing and proposed land uses
- Details indicating how the ISMP integrates with the *District's* drainage planning
- Major contours at 1.0 m and minor contours at 0.2 m elevation intervals (existing and proposed)
- Alignment and limits of existing watercourses and wetlands located in existing and proposed, or within 30 m of, the subject site, complete with environmental classifications and/or fish presence information
- Layout of existing and proposed drainage systems
- Proposed point and method of stormwater discharge from the site (e.g., pipe connection to the *District's Community Drainage System*, open discharge to ditch or natural watercourse)
- Existing and proposed major surface flow paths
- Proposed site grading plan in accordance with Schedule H – Site Grading
- Proposed source quality treatment systems, where required
- Locations and sizes of proposed conveyance and other management facilities for both minor and major systems
- Proposed building elevations and their relationship to the 1:100 year major flow path hydraulic grade line
- Construction erosion and sediment control plan
- Pre and post-development flows, with the impact mitigation measures
- Downstream capacity for the system to which the subject site is proposed to discharge
- Pre-development flows for all areas draining to or through the subject site

Subdivision or *Developments* less than 0.4 ha (1 acre) are required to submit a lot grading plan to ensure proper routing of surface flow. Building locations and elevations shall be checked relative to major surface flow paths.

1.4 Minor and Major Systems

Each drainage system consists of the components that relate to either major or minor stormwater systems.

The minor system comprises of the following:

- Minor conveyance system comprising the gutters, inlets, storm sewers, driveway culverts, low flow channels and watercourses
- Storage Facilities
- Water Quality Treatment Systems

The major system comprises of the following:

- Surface flow paths, roadways, storage facility overflows, and watercourses
- Culverts, bridges, and other crossing structures

1.5 Runoff Analysis

Storm drainage systems shall be designed to accommodate the post-development flows using the Rational Method or an approved hydrologic/hydraulic computer model. The final hydraulic report shall be signed and sealed by a *Professional Engineer.*

For *Subdivision* or *Developments* where the total tributary area is 25 hectares or less, the Rational Method may be used to compute the peak runoffs. An approved hydrologic/hydraulic computer model shall be used for analyzing larger catchments and for the design of all storage facilities.

Regardless of the analytical method being used, the tributary area used for the design of the storm drainage system shall be consistent with the actual contours of the land.

It is the *Professional Engineer's* responsibility to confirm the extent of the drainage area with the *Approving Officer* prior to final design.

1.6 Design Frequencies

In general, the design of stormwater management system components is required to accommodate a number of variable stormwater runoff rates and volumes generated by storms of certain recurrence intervals. **Table D1** summarizes the return frequencies to be used for the design of the drainage and stormwater management system components.

Table D1: Drainage and Stormwater Return Frequencies

Drainage System Component	Hydraulic Variables	Hydrologic Design Basis
Minor conveyance system comprising the storm sewers, driveway culverts, low flow channels and watercourses.	Peak flow rate, flow depth, duration of storm events and base flow rates.	1:5 year design storm with winter condition antecedent moisture condition.
Storage facility	Runoff volume, depth, freeboard, peak inflow rate, control discharge rate, time to empty, base flow rates.	Storage capacity to reduce the post-development flow rates to below their respective pre-development levels of the 1:10 year event. This may be increased to 1:100 year if inadequate downstream major flow paths exist.
Major system comprising the surface flow paths, roadways, storage facility overflows and watercourses	Peak flow rate, flow depth, duration, storage outflow and overflow rates, runoff volumes, and velocity.	1:100 year design storm with winter condition antecedent moisture condition. Sufficient freeboard above the maximum hydraulic grade line must be provided to protect buildings.
Culverts, bridges, and other crossing structures	Peak flow rates, depth and freeboard, backwater effect, fish passage.	1:100 year design storm and/or with safe overflow to protect *District* infrastructure and private property. 1:200 year for natural streams with catchments exceeding 10 sq. km or for structures crossing arterial or collector roads.
Water Quality Treatment Systems	Peak flow, base flow	Oil and grit separators required for treatment of flows up to the 5 year post-development peak rate for parking lots and industrial properties.

1.7 Rational Method

The Rational Method calculates the peak flow using the formula:

$$Q = RAIN$$

Where: R = Runoff Coefficient
A = Drainage area in ha.
I = Rainfall intensity in mm/hr.
N = 0.00278
Q = Flow in m^3/s

1.7.1 Runoff Coefficients

Zone designations selected for design purposes shall be based on the highest and best use of the properties in the design catchment area based on the most current version of the *District's* Zoning Bylaw. Future land designations, as defined in the *District's* Official Community Plan (OCP), shall be used if such land use designations will result in a higher runoff coefficient.

Table D2: Runoff Coefficients

Type of Area	Coefficient	
	1:5 year	1:100 year
Woodlot	0.10	0.20
Agricultural (cultivated)	0.10	0.15
Rural Residential	0.35	0.40
Single Family Residential	0.50	0.55
Low Density Multi-Family Residential	0.60	0.65
Apartment	0.70	0.75
Commercial	0.80	0.85
Industrial	0.80	0.85
Institutional	0.75	0.80
Roofs or Pavement	0.95	1.00
Parks/Cemeteries	0.15	0.20
Natural Grass	0.10	0.15

1.7.2 Time of Concentration

The time of concentration is the time required for runoff to flow from the most remote part of the catchment area under consideration to the design node. For both urban and rural areas, the time of concentration consists of the following formula:

$$T_c = T_i + T_t$$

Where: T_c = time of concentration (minutes)
T_i = inlet or overland flow time (minutes)
T_t = travel time in sewers, ditches, channels or watercourses (minutes)

- Inlet or Overland Flow Time (T_i):
  - Inlet times for various land use conditions are given to ensure uniformity in runoff computations

Table D3: Inlet Times

Lot Type	Inlet time (minutes)	
	5 year	100 year
Single Family	15	10
Multi Family	10	5
Commercial/Industrial/Institutional	10	5

  - The inlet time in rural areas shall be calculated using the Airport Method:

$$Ti = \frac{3.26(1.1 - C)\, L^{0.5}}{S^{0.33}}$$

Where: T_i = inlet (minutes), minimum time = 15 minutes
C = runoff coefficient
L = travel distance (m), maximum length = 300 m
S = slope of travel path (%)

- Travel Time (T_t)
  - The travel time in sewers, ditches, channels or watercourses shall be estimated using the following formula:

$$T_t = \frac{C_t \, Ln}{12 \, s^{0.5}}$$

C_t	=	Concentration coefficient depending on the type of flow
	=	0.5 for natural watercourses or ditches
	=	1.4 for overland flow
	=	0.5 for storm sewer flow
L	=	Length of watercourse, conduit or overland flow in metres, along the drainage path from the furthest point in the basin to the outlet.
n	=	Channel friction factor
	=	0.050 for natural channels
	=	0.030 for excavated ditches
	=	0.016 for overland flow on smooth paving
	=	0.400 for overland flow on natural areas
	=	0.013 for concrete pipe
	=	0.011 for PVC pipe
s	=	Basin slope in meter/meter

The above equation provides an approximate travel time which shall be corrected with the actual time of flow calculated from the hydraulic properties of the selected pipe/channel. A composite value for T_t shall be calculated in cases where the type of flow along the longest path varies or the slope changes.

1.7.3 Rainfall Intensity

The Intensity-Duration-Frequency (IDF) curve established for Chetwynd is based on rainfall records collected from the weather station at the Chetwynd Airport. See the Supplementary Detail Drawing S17 for the IDF Curve.

Intensities corresponding to the 0.5, 1, 2, 6, 12, & 24 hour storms shall be calculated to determine the design peak flow rate.

1.7.4 Mean Annual Rainfall (MAR)

Statistically, the Mean Annual Rainfall (MAR) is defined to be the 24 hour rainfall volume with a return period of 2.33 years. For practical purposes, the 2 year 24 hour rainfall volume is used as the MAR and is calculated to be 34.2 mm.

1.7.5 Presentation of Rational Calculations

The *Professional Engineer* shall be required to tabulate the Rational Method calculations for submission along with the appropriate plans and other relevant information.

1.8 Computer Modelling Method

1.8.1 Selection of Modelling Program

For basins larger than 25 hectares, hydrologic programs shall be used for runoff analyses. Hydrologic/hydraulic programs shall also be used for the design of all stormwater detention facilities. Software programs must be run with an EPA SWMM engine.

1.8.2 Catchment Data

Data preparation for planning areas or proposed *Subdivisions* or *Developments* shall be based on the best available information as per the *District's* Official Community Plan (OCP), Zoning Bylaw, adjacent *Subdivision* or *Development* proposals and other pertinent land use information.

The *Professional Engineer* shall determine both pre-development and post-development flows with appropriate parameters chosen to be reflective of the type of soils, ground cover and typical antecedent moisture condition (AMC) prevalent during the winter season.

Where information is not specifically available through applicable documents, future impervious fractions for common land uses, as shown in **Table D4** shall be used for analysis. These are intended as a guide only. In existing developed areas or where more detailed information is available, the *Professional Engineer* shall verify that the values shown are representative of the true conditions.

Table D4: Common Impervious Fractions

Common Land Use	Total Impervious Fraction
Woodlot	0.05
Agricultural	0.10
Sub-Urban Residential	0.35
Single Family Residential	0.45
Low Density Multi-Family Residential	0.65
Apartment	0.75
Commercial	0.90
Industrial	0.90
Institutional	0.80

1.8.3 Storm Events

In order to determine the critical storm event for designing drainage works, analysis shall be conducted using design storms with the appropriate return period and the durations included in **Table D5**. Developing design flows for both existing and proposed conditions are required.

Table D5: Critical Storm Events

Infrastructure Component	Storm Return Period	Storm Durations to Model
Minor conveyance system	1:5 year	0.5, 1, 2, 6, 12, & 24 hour storms to determine design peak flow rate
Major conveyance system	1:100 year	0.5, 1, 2, 6, 12, & 24 hour storms to determine design peak flow rate
Detention Storage Facilities	1:10 year 1:100 year (if necessary)	0.5, 1, 2, 6, 12, & 24 hour storms to determine maximum storage volume and peak overflow rate.

The storm duration which generates the highest peak runoff rate is not necessarily the event which results in the largest storage volume requirement for peak flow attenuation. The *Professional Engineer* shall review all design storm events and select the critical design values for each component of the drainage system.

1.8.4 Presentation of Modeling Results

To document the design rationale used to develop the hydrologic model and to standardize the presentation of model results, the design reports shall include an appropriate section which shall indicate the following:

- Type and version of computer model used
- Summary of all parameters and specific simulation assumptions used
- Design storms with clear documentation and plotted
- A summary of peak flows for each system component
- Inflow and outflow hydrographs for storage facilities
- A plan showing sub-catchment areas, watershed boundary (including upstream catchments) and the drainage system
- A plan identifying the specific land uses modeled for each development condition analyzed
- For detention ponds, stage-area and storage-discharge curves and the layout (including sizing) of pond control devices
- The functional layout and sizing of any flow control/diversion structure and the tabular/graphical plots of inflow and outflow hydrographs
- Tables summarizing the above described performance related parameters

1.9 Minor System Design

1.9.1 Level of Service

The minor drainage system consists of pipes and appurtenances sized to convey peak runoff by gravity (non-surcharged) flow conditions for storms having the return period specified in Schedule D – **Table D1**.

1.9.2 Pipe and Channel Capacity

Apply the Manning Formula under free flow (non-surcharged) condition. The Manning Formula is:

$$Q = \frac{A\,R^{0.667}\,S^{0.5}}{n}$$

Where: Q = flow capacity (m/s)
A = cross sectional area (m²)
R = hydraulic radius (m)
S = slope of hydraulic grade line (m/m)
n = roughness coefficient

Pipes shall be designed to carry the required quantity when flowing ¾ full.

1.9.3 Flow Velocities

Minimum design velocity for pipes flowing full: 0.6 m/s.

Where steep grades result in pipe velocities exceeding 6 m/s, consider measures to prevent pipe erosion and movement. Anchoring shall be incorporated where the grade(s) of the sewer are 15% or greater.

Provide riprap bank protection and, if necessary, energy dissipation facilities in accordance to Section 1.16.4 – Channel Erosion Protection.

1.9.4 Minimum Pipe Diameter

Storm Sewers	250 mm
Culverts:	
• Crossing Roads	600 mm
• Crossing Driveways	450 mm
Catchbasin Leads	200 mm for single catchbasin
	250 mm for double catchbasin

Downstream pipe sizes are not to be reduced unless the proposed downstream pipe is 600mm diameter or larger and increased grade provides adequate capacity. Detailed hydraulic analysis is required. The maximum reduction is two pipe sizes.

1.9.5 Alignment

Horizontal and vertical alignments as straight lines between manholes are preferred.

Horizontal and vertical curves may be formed using pipe joint deflections as follows:

- Minimum radius = 60 m
- Constant radius throughout curve
- Minimum design velocity = 0.9 m/s
- Curve locations to be recorded at ¼ points and midpoint
- Radius and curvature not less than 60 m
- Deflection to be at pipe joints only, no bending of the watermain will be allowed
- Curvature limited to half of maximum curvature specified by pipe manufacturer
- Constant offset from property line or road centerline

1.9.6 Manholes

Either precast or cast in place manholes are acceptable. Manholes are required at:

- Every change in grade
- Every change in direction, except as permitted for curved sewers
- Every change in pipe size
- Upstream and downstream end of curved sewers
- Every pipe intersection
- 120 m maximum spacing for all main sizes
- Every future pipe intersection
- Upstream end of every sewer main

Hydraulic Details:

- Crown elevations of inlet sewers shall not be lower than crown elevation of outlet sewer
- Minimum drop in invert elevations across manholes:
    - Straight run: 5 mm drop
    - Deflections up to 45 degrees: 20 mm drop
    - Deflections 45 to 90 degrees: 30 mm drop
- Drop manhole and ramp structures shall generally be avoided by steepening inlet sewers. Where necessary, provide drop structures as follows:

Invert Difference	Structure
Up to 0.45m	Inside Ramp
0.45m to 0.90m	Outside Drop: 1 m outside
Greater than 0.90m	Outside Drop: 1 m outside

- Hydraulic losses shall be calculated for manholes with significant changes in alignment (>45°). For high velocity flows (>3m/s) or large pipes (>600 mm Ø), detailed analysis is required. For low velocities and smaller pipes, use the following formula:

$$H_L = k \frac{V^2}{2g}$$

Where: H_L = head loss (m)
V = outlet flow velocity (m/s)
g = gravitational acceleration (9.81m/s^2)
k = head loss coefficient (1.0 for channeled 90° bends and tees, to 1.5 without channelized benching)

1.9.7 Depth and Cover

Depth shall be defined as the distance from the finished ground surface to the top of the pipe.

Unless otherwise permitted by the *Approving Officer,* sewers shall be of sufficient depth to:

- Meet the minimum depth of cover requirements of 2.5 m
- Clear other underground utilities
- Prevent damage from surface loading
- Allow for future extension of the minor system to service upstream tributary lands at ultimate development

1.9.8 Right-of-Way (R.O.W.)

Right-of-way locations shall be selected to avoid environmentally sensitive areas such as watercourses, wetlands and wildlife migration corridors and forested areas. Rear yard sewers are discouraged.

Where location of a municipal utility is in a statutory right-of-way the minimum right-of-way width is 6.0 m. In all cases, the width of rights-of-way shall be sufficient to permit

an open excavation with side slopes in accordance with the Worksafe BC regulations, without impacting on or endangering adjacent structures. Where required, trunk and interceptor sewers should have rights-of-way wide enough for future widening and/or twinning.

Where a utility is located within a right-of-way, and valves, valve chambers, manholes, or other appurtenances which require maintenance are located within the right-of-way, provide road access from a public road. The maintenance access must be sufficiently wide and structurally adequate to support the maintenance vehicles for which the access is intended. Maximum allowable grade of the maintenance access is 12%.

1.9.9 Utility Separation

Requirements for separation of storm sewers from water mains are as follows, unless otherwise indicated by the local public health authority.

- Horizontal Separation: At least 3 m horizontal separation shall be maintained between a water main and a storm sewer.

  In special circumstances, specifically in rock or where the soils are determined to be impermeable, lesser separation than 3 m may be permitted provided that:

  - Approval has been granted by the Provincial Health Authority, or
  - Any potential conflicts are constructed in accordance to Provincial/Local Health Authority Guidelines.

- Vertical Separation: Where a storm sewer crosses a water main, the sewer shall be below the water main with a minimum clearance of 0.45 m. Where clearance is less than 0.45 m or the sewer main crosses above the water, protective measures approved by the local public health authority must be applied.

- Sewers in Common Trench: Storm and sanitary sewers may be installed in a common trench, provided that the design has taken into account:

  - Interference with service connections
  - Stability of the benched portion of the trench
  - Conflicts with manholes and appurtenances

The horizontal clearance between sewer pipes shall be no less than 1.0 m and the horizontal clearance between manholes shall be no less than 0.3 m.

1.9.10 Service Connections, Roof Drainage and Building Perimeter Foundation Drainage

Direct storm connections from building roof drains or foundation drains are not permitted. Roof drainage for all buildings shall be discharged to the ground and dispersed via splash pads at the downspouts, provided that the site is graded away from the building, or to an approved sub-surface soak-away system. Building perimeter foundation drains shall drain by gravity to the surface if grades permit or into a sump pump that discharges water onto the surface.

Roof leaders and foundations drains shall not discharge at the top of bank of a natural watercourse or other open channel.

Under no circumstances shall a roof leader or building perimeter foundation drain be connected to a sanitary sewer.

On site surface runoff collection systems, through the use of catchbasins or other inlet devices, are permitted to connect to the storm system.

1.9.11 Catchbasin Spacing

Catchbasins are required at regular intervals along roadways, at intersections and at low points.

Catchbasin spacing is to provide sufficient inlet capacity to collect the entire minor flow or major flow, if required, into the pipe system.

The capacity of a single catchbasin (in sump conditions) can be calculated using the orifice formula:

$$Q = kCA\sqrt{2gh}$$

Where: Q = inlet capacity (m^3/s)

k = clogging factor (0.6)
C = orifice coefficient
A = open area (m^2)
g = gravitational acceleration ($9.81 m/s^2$)
h = depth of ponding (m)

Space catchbasins to drain maximum paved areas of:

- 500 m² on roads with grades up to 4%
- 400 m² on roads with grades greater than 4%

Other spacing requirements include:

- Prevent overflows to driveways, boulevards, sidewalks and private property
- Avoid interference with crosswalks
- Catchbasin leads to discharge into manholes wherever possible. Connections to mains require a wye fitting for new construction or approved saddle for connection to existing mains.
- Maximum lead length: 30 m

Minimum grade of catchbasin leads: 2.0%.

Lawn basins are required on boulevards and private properties where necessary to prevent ponding or flooding of sidewalks, boulevards, driveways, buildings and yards. Double catchbasins shall be provided at all vertical points of intersections on road sag curves.

1.9.12 Pipe Joints

Use watertight joints except where storm sewers are part of a subsurface disposal system.

1.9.13 Tie In Procedures

Connection to the *District's* existing storm infrastructure must be undertaken by the *Owner* at the *Owner's* expense.

1.9.14 Culverts

Driveway culverts that form part of the minor system shall have capacity for the runoff from the 1:5 year storm. The *Professional Engineer* shall determine whether the culvert will operate under the inlet or outlet control at design conditions.

The minimum depth of cover for a culvert shall be 0.3 m, subject to the correct pipe loading criteria.

1.10 Major System Design

1.10.1 Surface Flow Routing

All surface flows shall have specially designed routes that are preserved and protected by easements or right-of-ways and are accessible for maintenance. Design criteria include:

- In accordance to Schedule D Section 1.6 – Design Frequencies
- One lane, or a 3.5 m width at the crown of each arterial road, is to be free from flooding
- Where a road is used as a major flow path, the road grades are to be designed to accommodate and control the flow at intersections and driveways
- Overflow routes are required at all sags and low points in roads and other surface flow routes
- Major flood routes are required at down-slope cul-de-sacs
- Maximum flow depths on roadways are subject to the design velocities as per **Table D6.**

Table D6: Permissible Depths for Submerged Objects

Water Velocity (m/s)	Permissible Depth (m)
0.5	0.80
1.0	0.32
2.0	0.21
3.0	0.09

1.10.2 Surface Flow Capacity

Flow capacity of road surfaces and swales shall be calculated using the Manning formula, which is presented in Schedule D Section 1.9.2 – Pipe and Channel Capacity. Typical values of the Manning Roughness Coefficient “n” are:

- 0.018 for paved roadways
- 0.030 for grassed boulevards and swales
- 0.040 to 0.10 for irregular or treed channels

1.10.3 Site Grading

The establishment of a site grading plan is one of the principal means for establishing a critical component of the major drainage system. A detailed site grading plan is required to be developed in accordance with Schedule H – Site Grading. All lots are to be graded to include provision of protection against surface flooding and property damage for the 1:100 year return frequency design storm. Through control of surface elevations, designs should be such that maximum flow or ponding surface elevations are 300 mm below the lowest anticipated finished ground elevations at buildings.

1.10.4 Piped System

The minor drainage system may be enlarged or supplemented to accommodate major flows. Design considerations include:

- Provision of adequate inlets to accommodate major flows
- The requirement for surface overflow routes at potential surface ponding locations
- Design in accordance with minor drainage system guidelines
- Adequate capacity of the existing downstream storm sewer
- Culverts located in watercourses or culverts crossing roads shall be designed for the 1:100 year event

1.10.5 Inlet and Outlet Structures

Provide inlet and outlet structures for all road culverts. Pipes larger than 1,200 mm in diameter, and non-circular culverts require specially designed inlet and outlet structures.

Outlets may require rip rap protection and/or energy dissipating structures for erosion control. The *Professional Engineer* shall apply Best Management Practices to reduce erosion at all inlet/outlet structures.

Ditch inlets to storm sewers shall include sedimentation basins, safety grillage and hinged trash racks and for all pipes that are 450 mm and larger.

1.10.6 Ditches

Ditches shall only be provided if in accordance with the applicable road classification and design standards.

Ditches adjacent to roads shall conform to the following criteria:

• Maximum depth	1.0 m
• Minimum bottom width	0.5 m
• Maximum side slope	2.0(H):1(V) Confirmed by *Owner*'s Geotechnical *Professional Engineer*
• Minimum grade	0.5%
• Maximum velocity (Unlined ditch)	Determined such that ditch materials do not become erodible

The minimum right-of-way width for a ditch through private property shall be 5 m or the width of the ditch plus 3 m, whichever is greater. The ditch shall be offset in the right-of-way to permit a 3 m wide access for maintenance vehicles. Additional right-of-way may be required to facilitate ditch construction and access. The top of the ditch shall be a minimum 0.5 m from any property line.

1.11 Runoff Controls

1.11.1 Stormwater Storage Facilities

Stormwater detention shall be provided in accordance with the criteria herein:

- Capacity Requirements:

  The storage capacity requirement shall be determined by evaluating the performance under a number of storm events as listed in **Table D1**. Sufficient live storage capacity shall be provided as follows:

  - The storage facility shall be sized to such that post-development flows are equal to pre-development flows.
  - Storm events exceeding the 1:10 year level are generally considered an overflow condition and part of the major system. The facility shall be designed to permit the controlled overflow release of flows up to the peak 1:100 year level to an approved major flow path. If a sufficient major flow path does not exist, or if the proposed release rate will increase the risk of downstream impacts to an unacceptable level, then storage may be required to ensure that the post-development 1:100 year flows do not exceed the 1:100 year pre-development levels or other erosion control measures may be required

The performance of the storage facility shall be evaluated under the selection of storm events listed in **Table D5**. The facility shall be sized and designed for the criteria which results in the largest storage volume. Storage facilities shall be designed and evaluated using an approved modelling program as discussed in Schedule D Section 1.7 – Rational Method. This criteria is applicable to all service areas 0.4 hectares or greater.

- Small Lot Criteria:

  For service areas smaller than 0.4 hectares, the requirement for a detailed analysis of the storage facility is not required.

  1:100 year flows and volumes are to be determined by the *Professional Engineer* as required to suit downstream conditions

- Control Structures:

  The release rate from detention facilities shall be regulated using a control structure.

  The outlet control for storage facilities shall be designed using standard orifice or weir equations.

  Storage facility shall include provisions for discharge rates greater than the design release rate. Designs must also provide means for rapid drawdown, such as an emergency drain.

  Design of inlet/outlet structures shall consider flow energy dissipation and erosion control. Safety railings are required over all inlet/outlet openings larger than 450 mm in diameter. Locks for access hatches are required to prevent unauthorized entrance to the structure.

- Emergency Overflow:

  Whether the facility is sized to control the 1:100 year event or not, an emergency overflow with the capacity for the peak 1:100 year flow rate shall be provided for all storage facilities. The overflow surface shall be finished with erosion resistant material such as concrete, asphalt, paving stone, or an approved equivalent. The design of the spillway and/or overflow shall consider the possibility of blockages in the outlet structure. The overflow shall provide safe discharge to an accepted major flow path. If the stormwater storage facility is an underground storage facility, overflow piping shall be installed and shall have the capacity to safely convey the 100 year event.

- Operation and Maintenance Requirements:

A minimum 4 m wide all-weather vehicle access shall be constructed from a public road right-of-way to the control structure and other works requiring maintenance. The maximum grade on the access shall be 12%. A maintenance access of the same type shall also be provided to a sediment sump or forebay at the inlet end of an open pond.

For facilities servicing multiple lots, and where the *District* agrees to assume responsibility for operation and maintenance of the facility, six copies of the operation and maintenance manual shall be provided when the facility is completed and prior to the *District* assuming ownership. The manual shall include:

- Record drawings of the constructed facility
- Brief description of the facility operation including design flows, design depths, and schematic diagrams of the inlet and outlet structures, connections, controls, valves, bypasses, overflows, etc
- List of manufacturer's operation, service and repair instructions and parts lists (where applicable)
- Stage-storage-discharge relationship of all controls
- General maintenance requirements and emergency procedures

- Public Safety and Signage:

  All above ground storage facilities shall be designed to maximize public safety. Interior side slopes shall be 4:1 within the limits of the live storage volume. Side slopes above the live storage zone may be a maximum of 3:1. The design of storage facilities shall include adequate provisions for installation of standard signage to warn of anticipated water level fluctuations, with demarcation of the expected maximum water levels for design conditions.

- Performance Monitoring:

  Prior to final approval of all stormwater detention facilities, the *Owner* shall prepare and submit to the *District* a written monitoring program to be conducted by the *Owner* for a period of 12 months following construction. Monitoring results are to be submitted to the *District* on a monthly basis for review. Adjustments to the control device shall be required as necessary prior to the expiry of the 1-year warranty period.

1.11.2 Erosion and Sediment Control for Construction

An erosion and sediment control plan shall be provided by the *Owner's Engineer* prior to construction. The purpose of this plan is to prevent the release of silt, raw concrete, concrete leachate and other deleterious substances into any ditch, storm sewer, watercourse or ravine. Construction materials, excavation wastes, overburden soils, or other deleterious substances shall be disposed of or placed in such a manner as to prevent their entry into any watercourse, ravine, *Community Drainage System*, or restrictive covenant area.

All siltation control devices shall be situated to allow for ready access for cleaning and maintenance. Siltation control structures shall be maintained throughout the course of construction and to the end of the maintenance period (final acceptance). Changes in the design of the structure shall be required if the proposed structure is found to perform inadequately.

At minimum, the control plan shall provide the following:

- Section I: Narrative:
  - Project description: A brief description of the nature and purpose of the land-disturbing activity and the amount of grading involved
  - Existing site conditions: A description of the existing topography, vegetation, and drainage
  - Adjacent areas: A description of neighbouring areas, such as streams, lakes, residential areas, and roads that might be affected by the land disturbance
  - Soils: A brief description of the soils on the site including erodibility and particle size distribution (texture)
  - Critical areas: A description of areas within the developed site that have potential for serious erosion or sediment problems
  - Erosion and sediment control measures: A description of the methods that will be used to control erosion and sediment on the site including, temporary erosion control and temporary sediment control measures
  - Permanent stabilization: A brief description of how the site will be stabilized after construction is completed
  - Maintenance: A schedule of regular inspections and repairs of erosion and sediment control structures, and the person responsible for maintenance

- Section II: Details:
  - Detailed drawings: Enlarged dimensioned drawings of key facilities such as sediment basin risers, energy dissipaters, waterway cross-sections, and sediment barriers
  - Seeding and mulching specifications: Seeding dates, seeding, fertilizing, and mulching rates, and application procedures
  - Maintenance program: Inspection schedules, spare materials needed, stockpile locations, and instructions for sediment removal and disposal and for repair of damaged structures
- Section III: Calculations:
  - Calculations and assumptions: Data for design storm used to size pipes and channels and sediment basins and traps (e.g., 5-year, 6-hour storm = 75 mm; intensity peak = 60 mm/hr), design particle size for sediment trap efficiencies, basin discharge rates, size and strength characteristics for filter fabric, wire mesh, fence posts, etc. and other calculations necessary to support drainage, erosion, and sediment control systems
  - Attachments: The erosion control plan shall be accompanied by a grading plan

1.12 Environmental Protection

1.12.1 Water Quality Protection

Oil and grit separators must be installed for all storm connections from industrial parcels and in all parking lots. The separators shall be sized to treat peak runoff flows from a 5-year rain event.

1.12.2 Slope Stabilization

The implementation of stormwater management measures, combined with controls on land development adjacent to watercourses, is intended to minimize the impact on the receiving watercourses.

- Setbacks:

  Disturbance too close to a slope bank can destabilize the bank material and contribute to bank failures. In addition to the environmental restrictions to working within the streamside protection area of a natural watercourse, no disruption to the native ground is permitted within a setback zone established by a 4:1 slope

measured from the bottom of the slope. Detailed site investigations by a qualified Geotechnical *Professional Engineer* are required prior to the approval of any *Subdivision* or *Development* of disturbance within this setback zone.

- Retention of Bank Vegetation:

  Existing vegetation along stream channel banks and within the established riparian setback shall be retained, and the disposal of debris within this setback is prohibited. The working limits for the protection of the riparian setback must be clearly identified and flagged or fenced for the duration of construction.

- Storm Outfalls:

  The number of storm outfalls into natural watercourses shall be minimized. All storm drains from private properties must connect to a *Community Drainage System*. Individual drains to natural watercourses are not permitted.

1.12.3 Channel Erosion Protection

Bank protection shall be constructed along existing and new open watercourses to provide adequate erosion protection in the form of bank armouring, soil stabilization, flow deflection and other methods applicable for the specific site conditions

It is noted that any proposed works within the streamside protection area of an existing watercourse falls under the jurisdiction of the Provincial or Federal governments, and as such, shall be subject to their approval.

SCHEDULE E

ROADS

March 2013

SCHEDULE E - ROADS

List of Tables

1.0 ROADS

1.1 General

The *Approving Officer* will consider the sufficiency and suitability of the proposed road system, the arrangement, width, grade and location of all roads in relation to existing and planned roads, to topographic features, to public convenience and safety, and to the proposed uses of the land to be served by such roads.

The arrangement of roads in a *Subdivision* or *Development* shall either:

- provide for the continuation or appropriate projection of existing roads in surrounding areas; or
- where topographic or other conditions make continuation or projection of existing roads impractical, provide an adequate and suitable roadway system having regard to the uses of the land to be served.

The dimensions, locations and standard of all roads in a proposed *Subdivision* or *Development* shall conform substantially to the Official Community Plan.

The design parameters of all roads within the *District* shall be in accordance with the Transportation Association of Canada's (TAC) most current edition of "Geometric Guide for Canadian Roads."

Local residential roads shall be aligned so that their use by through traffic will be discouraged.

1.2 Road Classification

The existing roadway classifications within the *District* are described as follows:

- **Arterial Roadway** – An arterial road has the primary function of carrying through traffic from one area to another with as little interference as possible from adjacent land uses. An arterial road may provide direct access to properties as a secondary function when alternate access is not available; however, this secondary function is discouraged

- **Collector Roadway –** A collector road has the primary function of distributing traffic between arterial, other collector and local roads within an area. A collector road may also provide direct access to properties
- **Local Roadway** – A local road has the primary function of providing direct access to properties. Local roads normally connect to other local roads or to collector roads

Some roadway classifications have been further divided into urban and rural classifications within this bylaw. Other road network components include:

- **Walkways and Pathways** – Walkways and pathways are paths which follow routes independent from motor vehicle roadways, sidewalks and bike lanes.

1.3 Road Cross-Section Details

The standard roadway cross-sections shall be as shown in the Supplementary Detail Drawings and detailed in **Table E1**.

The standard road cross-sections detailed in **Table E1** and the Supplementary Detail Drawings shall apply to all roadways within the *District*. Where ambient conditions, (standards in existing and substantially "built-up" areas, steep topography, etc.) are not amenable to accommodate the required roadway standards a variance to these standards may be considered by the *Approving Officer*.

Table E1: Roadway Cross-section Details

Facility Classification	Right-of-Way (metres)	Road Width (metres)	Lane Width (metres)	Parking	Shoulder	Curb Type	Sidewalks (metres)	Bicycle Facilities
WALKWAYS AND PATHWAYS								
Asphalt Walkway	5.0	2.4	N/A	N/A	N/A	N/A	N/A	N/A
LOCAL ROADWAYS								
Urban	20.0	10.0	2 - 5	Allowed	N/A	Barrier	1.5 one side	Shared Asphalt
Cul-de-Sac (Urban)	20.0 Radius	14.5 Radius	N/A	Allowed	N/A	Barrier	1.5 one side	Shared Asphalt
COLLECTOR ROADWAYS								
Urban	20.0	11.0	2 – 5.5	Allowed	N/A	Barrier Curb	1.5 one side	Shared Asphalt
Industrial	25.0	11.0	2 – 5.5	N/A	1.3 Gravel	N/A	N/A	N/A
ARTERIAL ROADWAYS								
Arterial	25.0	12.2	3.6	N/A	2.5 Paved	N/A	N/A	N/A

Where roadway cuts or fill sections extend beyond the right-of-way widths noted in **Table E1**, the right-of way shall be widened accordingly.

All rock cuts, escarpments or retaining structures greater than 1m high shall be equipped with protective railings or fencing.

1.4 Road Design Criteria

All road classifications and designations for vertical and horizontal alignment elements shall be designed utilizing the designated design speeds contained in **Table E2**, and in compliance with the most current edition of the *Transportation Association of Canada - Geometric Design Guide for Canadian Roads.* Road design criteria to be referenced from this document include superelevation, centreline radius, maximum grade, vertical curvature and sight distance.

Table E2: Road Design Criteria

Facility Classification	Design Speed (km/h)	Maximum Grade	
		Desirable (%)	Absolute (%)
Asphalt Walkway	N/A	10	15
Local Roadway	50	6	12
Collector Roadway	70	6	8
Arterial Roadway	70	5	8

1.5 Vertical Alignment

The following shall be considered when establishing the vertical alignment of a roadway:

- The vertical alignment of roads must be set so the grades of the driveway to adjacent properties will conform to the Supplementary Detail Drawings.
- The draining grade around the outside curb of a cul-de-sac shall not be less than 0.5% and not greater than 5.0%. Longitudinal gradients of cul-de-sac bulbs shall not exceed 5.0%
- When a cul-de-sac is at the bottom of a hill, the longitudinal gradient of the first 50 m of roadway uphill from the cul-de-sac bulb shall not exceed 5.0%. The maximum longitudinal gradient for the rest of the hill shall not exceed 8.0%
- When a cul-de-sac is at the top of a hill, the longitudinal gradient for the roadway downhill from the cul-de-sac shall not exceed 12.0%

- All changes in gradient over 1.0% on arterial and collector roads and over 2.0% on all other road classifications shall be connected by vertical curves
- Standard cross slopes (normal crown) shall be 2% on all road classifications. Design road elevations shall give due consideration to flood proofing requirements of adjacent properties. Full road crossfall (reverse crown) may be considered in special circumstances, as a means of more closely matching property grade on either side of the roadway
- The length of a transition from a normal cross-sectioned road to a section of road where there is super-elevation or crossfall must, in no case, be less than 70 m for a 50 km/h designed road. In selecting the length of the transition, care and consideration shall be given to draining all of the pavement. Typically, if no horizontal spiral curve is used, 60% of the super-elevation is introduced prior to the beginning of the curve, and the balance is developed in the curve
- Gutter elevations on curb returns and cul-de-sacs shall be shown on the drawings at the beginning, one-quarter points and end of curb returns and at 7.5 m intervals around cul-de-sacs

1.6 Horizontal Alignment

The following shall be considered when establishing the horizontal alignment of a roadway:

- The horizontal centreline alignment of the road shall be in accordance to the Supplementary Detail Drawings.
- Typical locations of works and utilities in Roads are shown on the Supplementary Detail Drawings.
- Centreline chainage stations shall be fully referenced and dimensioned from property lines.
- Horizontal curves shall be fully described showing internal angle, radius, tangent length and arc.
- If reversed curves are required in a roadway alignment they shall be separated by means of tangents of sufficient length
- Where angular deflections occur in a roadway alignment, the angle shall be replaced by a curve of suitable radius

1.7 Cul-de-Sacs

Cul-de-sac bulbs shall be used to terminate “no exit” roads. The following shall apply:

- A maximum cul-de-sac length of 250 m is allowed, unless a secondary emergency vehicle access is provided at least halfway to the end of the cul-de-sac, in which case the length specification is not prescribed.
- Cul-de-sac roads, designed to be permanent, shall be provided at the closed end with an area designed to permit safe and adequate space for the turning of motor vehicles. The end treatment shall be a cul-de-sac bulb.

1.8 Intersections

90º intersections are preferred by the *District*. The *Owner's Professional Engineer* shall make all reasonable effort to design to 90º intersections where possible.

Intersections that cannot conform to a 90º angle may be designed and located within the range of angles between 70º and 110º at the discretion of the *Approving Officer*.

The minimum spacing between intersections shall be designed as per TAC standards.

Local Street Intersecting Arterials - Intersecting local streets shall have a minimum width of 11 m for a distance of 20 m from the end of the curb return of the major street. Thereafter the road shall taper at 30:1 to the design width of the local street.

In the design of all street intersections, including those with lanes and walkways, the *Professional Engineer* shall give consideration to providing adequate decision sight and stopping distances for conflicting traffic streams involving pedestrians, bicycles and/or vehicles.

Line of sight at stop signs shall consider all landscaping and utility installations.

Vertical Curvature at Intersections - Providing the minor intersecting street is subjected to a "Stop” condition, the following K values, indicated in **Table E3** may be used for the minor street.

Table E3: K Values

Classification	Crest		Sag	
	Minimum	Preferred	Minimum	Preferred
Collector	4	6	4	6
Local	2	4	2	4

1.9 Sidewalks, Walkways, Multi-Use Pathways, Bicycle Facilities and Wheelchair Ramps

Concrete sidewalks shall be provided on roads in or adjacent to *Subdivisions* or *Developments* in accordance with **Table E1** and the Supplementary Detail Drawings.

The maximum grade for sidewalks shall not exceed the maximum road grades.

Asphalt walkways shall be provided for access through *Subdivisions* or *Developments* to schools, playgrounds, shopping centres, transit, and other community facilities.

Fencing shall be provided for walkways located between lots.

The maximum grade for walkways shall not exceed 15%. Where walkways would otherwise exceed 15%, concrete stairs shall be installed. Prior to the authorization of concrete stairs, alternate walk routes shall be submitted for *District* review and approval. Only where other acceptable walk routes are not available will the installation of stairs be considered.

Walkways shall be designed as per the Supplementary Detail Drawings.

Wheelchair ramps shall be provided at all intersection curb returns as an integral part of the sidewalk or to link walkways and crosswalks. Design at the midpoint of the curb return.

Bicycle facilities shall be designed in accordance with the *Transportation Association of Canada Geometric Design Guide*.

1.10 Curb Returns

The minimum radius of curb return at intersections shall meet the requirements listed in **Table E4**. Curb returns located on roads within industrial and commercial areas may require a larger radius to facilitate truck and/or bus traffic.

Table E4: Curb Returns

Roadway Classification	Curb Return Radii
Arterial	11 m
Collector	11 m
Local	9 m

When a new road with curbs intersects an existing road without curbs, full curb returns shall be constructed.

1.11 Curb and Gutter

Curb and gutters shall be provided as specified in **Table E1** and the Supplementary Detail Drawings.

Minimum gutter grade shall be 0.5% for all street classifications.

1.12 Driveways/Crossovers

Each property shall only have one driveway access per road frontage, unless there is a demonstrated need and approval is obtained from the *Approving Officer*. Where a lot abuts a lane or road of different classification, the driveway shall be located to access the lane or road of the lower classification.

Driveway letdowns shall be provided for each lot. At the discretion of the *Approving Officer*, access to large parking areas shall be by curb returns rather than a driveway letdown. The *Approving Officer* may require deceleration and acceleration lanes for access off major roads for safety reasons and to minimize disruption to traffic flows.

Driveway access grades shall be designed to permit the appropriate vehicular access for the zone, without “bottoming-out” or “hanging-up”. From edge of pavement to property line, the driveway grade shall match the boulevard slope to encourage drainage towards the road. For the first 10 m on private property, the maximum allowable driveway grade is 15% if accessing a local or collector road. This maximum grade is limited to 10% if accessing an arterial road.

Driveways shall be located a minimum of 1 m from hydrants, poles, street lights, street signs, and property lines.

Residential driveway access onto an arterial road is not permitted unless alternate access is impractical. Wherever physically possible, alternate local road access shall be dedicated to preclude residential driveways accessing directly onto major roads.

Driveway accesses serving corner lots shall be in accordance to **Table E5**.

Table E5: Corner Clearance*

Road Classification	Signalized Intersection (m)	Unsignalized Intersection (m)
Arterial	70	35
Collector	55	25
Local	10	10

**Clearance is measured from the intersection of the property lines at the corner.*

All driveway accesses shall be in accordance to **Table E6** and the Supplementary Detail Drawings.

Table E6: Driveway Widths

Zone	Driveway widths
Single family residential	4m – 6m
Multi-family residential	4m – 9m
Commercial/Industrial*	6m – 18m

** see stormwater schedule for minimum culvert sizing*

1.13 Regulatory and Information Signs

Road name signs and traffic signs for new or improved roads shall be provided by the *Owner* to match the *District's* standard signage and naming convention.

1.14 Appurtenances

All proposed traffic islands, retaining walls, guard-rails, and permanent barricades shall be designed in keeping with good engineering practices.

Traffic control devices shall be designed and installed in accordance with applicable and current *District* requirements.

For all utility poles and anchors which require re-locating prior to road construction, the utility shall confirm the feasibility of their re-location prior to design completion.

The top of escarpments, rock cuts and retaining walls constructed on or adjacent to proposed roadways shall be equipped with railings.

Clearance at Bridges: All roadways to have minimum vertical clearance in accordance to **Table E7**.

Horizontal clearance in metres from edge of travel lane:

Table E7: Vertical Clearances

Classification	Density	Overpass Lane Edge to Rail or Parapet		Underpass Lane Edge to Abutment or Wall	
		Sidewalk*	No Walk	Sidewalk*	No Walk
Collector	low	2.25	1.0	2.5	1.50
	med & high	2.50	1.0	2.5	1.75
Local	low	2.25	1.0	2.5	1.25
	med & high	2.25	1.0	2.5	1.25

**Sidewalk – minimum 1.5m wide and minimum 150mm above roadway grade.*

Minimum vertical clearance from finished road grade to bottom of underpass is 4.90 m.

1.15 Pavement Structure

- General Requirements:

  Pavement structures shall be designed by a qualified *Professional Engineer* in accordance with a commonly accepted design method (AASHTO, Asphalt Institute, etc.). The pavement shall be designed to provide a 20-year design life.

  The parameters used for design shall be based on site specific information which shall include, but is not limited to the following:

  - Existing pavement surface conditions
  - Subsoil conditions
  - Groundwater & drainage conditions
  - Climate
  - Traffic Volumes

- Field and Laboratory Investigations:

  A subsurface exploration program must be completed to a depth of at least 3.0 m below existing and proposed finished roadway surface grades. At least one exploratory borehole and/or test pit shall be made at intervals of no more than 150 m along the proposed horizontal alignment. Insitu testing shall be completed, representative soil samples collected, and laboratory testing carried out as necessary to determine the engineering properties and characteristics of the subgrade materials. The minimum laboratory testing requirements include natural moisture content determinations and grain-size analyses and/or Atterberg limit determinations as appropriate to characterize the site subsoils for design purposes.

  Groundwater levels that may influence the roadway performance shall be determined at the time of the investigation and seasonal fluctuations should be estimated.

- Design Parameters:

  On the basis of the gathered information, a soaked California Bearing Ratio (CBR) value shall be determined or estimated for use in design of the pavement structure. A Resilient Modulus may be approximated from the CBR value using the relationship:

  MR (Mpa) = 10.3*CBR

  The plasticity of the subgrade soils determined in the laboratory shall be reported (swelling/shrinking potential).

  The frost susceptibility of the soils shall be considered in the design.

- Minimum Pavement Design:

  In the absence of traffic volume data, the roads shall be classified, as indicated in **Table E8**, with the associated Equivalent Single Axle Loads (ESAL) for the purposes of pavement structure design:

Table E8: Equivalent Single Axle Loads

Road Classification	Design Traffic (ESAL)
Arterial	1.0×10^6
Collector	2.8×10^5
Industrial	1.0×10^6
Local	2.0×10^5

In the event that the CBR value soaked CBR value is less than 3, the subgrade shall be enhanced to provide a CBR value of 3 to be used for the pavement structure design calculations.

Irrespective of calculated requirements, the following are minimum values for pavement structure component thicknesses for all roadways where:

- the subgrade CBR value is greater than or equal to 6; and
- the subgrade soils are not frost susceptible within 1500 mm of the finished paved surface or groundwater is at least 1.5 m below the proposed subgrade surface.

Table E9: Minimum Pavement Structures

Road Classification	Subbase [1] 75 mm (minus) (mm)	Base [2] 19 mm (minus) (mm)	Hot Mix Asphalt Surface Course [3] (mm)
Arterial	400	150	100 (2 lifts)
Collector	400	150	100 (2 lifts)
Industrial	400	150	100 (2 lifts)
Local	300	150	75
Lanes	300	75	75
Asphalt Walkways	150	75	50

(1) MMCD Crushed Granular Sub-base

(2) MMCD Granular Base

(3) MMCD Upper Course #1

The granular subbase shall be placed and compacted to 98% Standard Proctor Maximum Dry Density. The granular base shall be placed and compacted to 100% Standard Proctor Maximum Dry Density. Non woven geotextile and geogrid shall be

placed on the prepared subgrade. Subgrade drainage shall be provided using perforated drain piping wrapped in a geotextile sock.

Pavement structure designs shall be submitted to the *Approving Officer* in an acceptable report format.

- Construction Recommendations:

  Recommendations related to roadway construction shall be provided by the *Owner*s *Professional Engineer*. The recommendations should address:

  - Subgrade preparation and enhancement
  - Long-term drainage
  - Road structure materials requirements
  - Construction methods and procedures

- Reporting:

  The *Professional Engineer* shall provide a report that includes all pertinent information related to the design and construction of the roadway.

SCHEDULE F

STREET LIGHTING

March 2013

SCHEDULE F – STREET LIGHTING

List of Tables

1.0 STREET LIGHTING

1.1 General

Design of street lighting systems shall be prepared by a qualified *Professional Engineer,* fully knowledgeable with the current Transportation Association of Canada (TAC) "Guide for the Design of Roadway Lighting".

Obtrusive light, light trespass, light pollution and environmental zones are key project design issues that will be considered by the *District*. The *Professional Engineer* will utilize luminaires and design techniques that will mitigate these issues. All light fixtures shall have full cutoff optics.

1.2 Luminance Levels

Roadways and sidewalks will be illuminated to produce accurate and comfortable nighttime visibility and safety. Pedestrian walkways and bikeways may require illumination if requested by the *Approving Officer*. The recommended minimum average maintained horizontal luminance levels; uniformity ratios and veiling luminance ratios used by the *District* are listed in the current TAC "Guide for the Design of Roadway Lighting". Illuminance method can be used for pedestrian walkways and bikeways and where a specific circumstance warrants its use such as curved roadways.

Prior to starting a project, the *Professional Engineer* will verify the road classification (i.e.; arterial, collector, local etc) and the pedestrian activity classification with the *Approving Officer.* Definitions of these terms may be found in the current TAC "Guide for the Design of Roadway Lighting".

The road classifications, luminance levels, ratios, road and pedestrian activity areas proposed will be listed in a table format on the design drawings. The *Professional Engineer* will calculate all luminance levels and ratios as noted under Section 1.5 - Lighting Calculations. For calculations where the roadway surface is asphalt, R3, Road Surface Classification will be used.

1.3 Light Pole Spacing

Spacing and location of poles will be governed by road width, road configuration, intersecting property lines, luminaire photometrics, mounting heights and recommended

lumination levels. Maintain clearances to overhead and underground utilities in accordance with MMCD specifications and standards. The Canadian Electrical Code, Work Safe BC and the BC Electrical Safety Act will also govern pole spacing and height.

Poles will be generally arranged in a one sided, staggered or opposite spacing based on the road classifications listed in **Table F1** in this Section. In circumstances where overhead lines are in conflict with street light poles, one sided spacing may be considered if the required illumination levels and ratios can be achieved. Alternative pole spacing to those listed in **Table F1** must be acceptable to the *Approving Officer.* Where possible, poles will be located close to property lines and will avoid being placed in front of residential windows.

Street light poles will be offset as shown on the *District's* Supplementary Detail Drawings. Alternative offsets require the acceptance of the *Approving Officer*. On existing roadways where the standard offsets cannot be maintained due to underground utility conflicts, the *Professional Engineer* will make recommendations for alternate locations to the *Approving Officer* and obtain acceptance prior to proceeding.

Where possible, luminaires will be installed on all signal poles to maximize intersection illumination. The pole spacing at intersections will therefore be governed by the signal pole locations. Additional street light poles may be required to meet the required lighting levels.

Table F1: Streetlight Pole Locations

Road Type	Pole Location / Spacing
Arterial	Opposite or Staggered
Collector	Spaced on One Side of Roads
Local	Spaced on One Side of Roads
Walkways & Pathways	Entrance & Exit Points

1.4 Luminaires, Poles, Wattages and Light Source

Luminaire type, pole type and wattages are as listed in **Table F2**. When expanding an existing street lighting system, the wattage and mounting height should match those previously installed if the road classification and pedestrian conflict area are identical; unless otherwise accepted by the *Approving Officer.* New luminaires shall have full cut-off optics.

Luminaire wattage, distribution type and voltage will be noted on the engineering drawings. The preferred operating voltage for the street lighting system is 120/240V. Alternative voltages will require acceptance by the *Approving Officer*.

All luminaires will be flat glass, IESNA full cutoff type. Alternative cutoff classifications must be acceptable to the *Approving Officer*. The *Professional Engineer* will select the most effective IESNA luminaire distribution type (i.e. Type 2, Type 3 etc.) to suit the roadway geometrics. Cobra head luminaires will be used for all roadway lighting applications. Cobra head roadway luminaires will be B.C. Ministry of Transportation recognized products. Exact luminaire used in lighting calculations shall be shown on design drawings.

The light source for luminaires will generally be high pressure sodium (HPS). Light sources may differ in designated decorative street lighting areas, however any deviation from HPS must be accepted by the *Approving Officer.*

For development projects requiring pedestrian walkway/bikeway lighting, the cost for the supply and installation of luminaires, mounting arms and lamps will be borne by the *Owner*. The *Professional Engineer* will consult with the *Approving Officer* for specific fixture type, colour and model number information.

Table F2: Luminaire Lighting and Wattage (For HPS Lamps)

Road Classification	Pole Height & Type			
	11.0 m Davit Pole - Cobra Head Luminaire	9.0 m Davit Pole - Cobra Head Luminaire	7.5 m Davit Pole - Cobra Head Luminaire	6.0 m Pedestrian Pole and Luminaire
Arterial Roads	250W/200W	250W/200W/150W	*	
Collector Road		150W	*	
Local Roads			100W	
Walkways & Pathways				100W/70W

(*) Denotes for use to avoid conflicts with overhead lines. In all cases the use of shorter davit poles must be accepted by the *Approving Officer*.

For rural standard roads, coordinate with the local hydroelectric company to arrange for streetlighting on utility poles.

1.5 Lighting Calculations

Lighting calculations will be carried out as follows:

- Lighting calculations are based on the luminance methods described in the current TAC "Guide for the Design of Roadway Lighting". Lighting calculations will be completed using suitable computer lighting design software designed to carry out the required calculations by inputting the luminaire manufacturers IESNA formatted photometrics. The IESNA photometric files for the *District* accepted luminaires are available in electronic format through the specific luminaire manufacturer(s) web sites or local supplier..
- Computer lighting calculations for walkways and bikeways (where required) will be undertaken as described in the current TAC "Guide for the Design of Roadway Lighting".
- Lighting calculations will be based on maintained levels using initial rated lamp lumens and the total light loss factor (TLLF) of 0.72. Refer to **Table F3** for the factors included in the TLLF. The TLLF will be considered as the total maintenance factor.
- The *Approving Officer* reserves the right to obtain a printed copy of the computer lighting calculations from the *Professional Engineer*.

Table F3: Total Light Loss Factor

Lamp Lumen Depreciation (LLD) (1)	Lamp Dirt Depreciation (LDD)(1)	Lamp Component Depreciation (LCD)(2)	Equipment Factor (EF)(3)	Total Light Loss Factor (TLLF)(4)
0.82	0.94	0.98	0.95	0.72

Notes:
(1) Based on a 5 year maintenance schedule
(2) Degradation of the reflector and refractor
(3) Effect of ambient temperature on the lamp including the ballast and lamp factors
(4) TLLF = LLD x LLD x LCD x EF

1.6 Traffic Signals

Traffic signal designs are highly specialized and, if traffic signals are required for a *Subdivision* or *Development*, will therefore be prepared by a *Professional Engineer* qualified in this area of expertise. Traffic signals will be designed in general accordance with Sections 402.6 of the Ministry of Transportation Electrical and Traffic Engineering Manual. Contrary to this manual the *District* uses NEMA phase designations as opposed to the Ministry movement designations. Traffic signal designs will also conform to the British Columbia Motor Vehicle Act and the Manual of Uniform Traffic Control Devices for Canada. Traffic engineering and timing/coordination plans will be provided by the *Owner* and prepared by a qualified traffic Consulting Engineer with PTOE certification.

1.7 Conduit

Conduit design for street lighting and traffic signals will conform to the following criteria:

- Conduits will generally be parallel or perpendicular to the roadway, and routed to run in a direct line between adjacent poles or junction boxes. The exception would be where existing or proposed trees conflict with the conduit run.
- There will be a maximum four (4) 90° bends in a conduit run. Where this cannot be avoided junction boxes will be used as noted under Section 1.9 - Junction Boxes.
- Street lighting conduits will be minimum 30mm diameter rigid polyvinyl chloride (RPVC). Signal conduits will be minimum 50mm RPVC and minimum 25mm RPVC for loop stub-outs.
- Where conduits cross an existing road, they will be installed by a suitable trenchless technology to avoid cutting pavement and interrupting traffic. Prior to specifying trenchless technology, confirm that the site specific soil conditions are suitable. Open cutting of existing roadways is only permitted at the discretion of the *Approving Officer.*

1.8 Junction Boxes

The design of junction boxes for street lighting, traffic signals and fibre optic ducting will conform to the following criteria:

- Large round plastic junction boxes (2 sections deep) with galvanized steel lids will generally be used: where the maximum number of 90° bends in a conduit run is exceeded, where branch conduit runs are required, in conduit runs over 100 metres in length, and at service panels.
- Concrete junction boxes with galvanized steel lids can be used for installations in sidewalks or hard landscape areas.

- Large concrete junction boxes with galvanized steel lids will be used for traffic signal installations only in the quadrant where the traffic controller is to be installed.

1.9 Conductors

The design of conductors for street lighting and traffic signals will conform to the following criteria:

- For the purpose of standardization and to accommodate future expansion, street lighting feeder conductors will be No. 6 RW90. The use of alternate conductor sizes will require the acceptance of the *Approving Officer*.
- For traffic signal installations, multi-conductor cable will be used. The cable will run continuously from the traffic controller to each pole with no splices.
- All conductors shall be stranded copper.

1.10 Service Equipment

Street lighting and traffic signal service equipment will be designed with the following items being taken into consideration:

- The *Professional Engineer* will confirm service locations with the local hydroelectric utility company.
- Street lighting systems are controlled with a lighting contactor and photocell. The photocell will be located on the luminaire nearest the service panel.
- Service panels for street lighting systems will have a 40 Amp – 2 Pole breaker, contactor and photocell bypass switch and will be mounted in a service base as shown on the MMCD Standard Detail Drawings. Smaller size service panels must be accepted by the District and must be detailed on the drawings in the form of a “Wiring Diagram” or “One Line” Diagram.
- Where possible, traffic signal and street lighting systems will be fed from the same service panel. The combination street lighting and traffic signal service panel will have a 100 Amp -2 Pole main breaker, sub-breakers, contactor and photocell by-pass switch. The service panel will be mounted in a service base or on the side of a street light pole or post located near the traffic controller. No other signal equipment will be mounted on the same pole as the service panel. Refer to the MMCD Standard Detail Drawings.

- All services will be 120/240V single phase, 3 wire. Alternative service voltage must be accepted by the *Approving Officer*.

1.11 Concrete Bases

The design of concrete bases for street lighting and traffic signal pole installations will take the following items into consideration:

- When selecting pole base locations, search out proposed or existing utility locations and identify sensitive tree root zones to avoid conflicts. The pole base will be positioned outside the drip line of trees proposed for retention. The *Professional Engineer* will coordinate the design with a Landscape Architect where applicable.
- The *Professional Engineer* will select a concrete base to suit the required pole from those shown in the MMCD Standard Detail Drawings. Where a customized base is required to accommodate unusual soil conditions, or to avoid underground utilities and sensitive tree root zones, the customized base design will be prepared by a qualified *Professional Engineer*, licensed to practice structural engineering in the province of British Columbia. The design must also be acceptable to the *Approving Officer*.
- Avoid running more than two conduits into a street light pole base. Where this situation cannot be avoided, a junction box will be used.

SCHEDULE G

LANDSCAPING

March 2013

SCHEDULE G - LANDSCAPING

1.0 LANDSCAPING

1.1 Objectives

These design standards are intended to enhance the safety, aesthetics and sustainability of public lands and to ensure efficiency and effectiveness of maintenance and operations of these lands.

1.2 Related Standards

This standard shall be referenced to and integrated with, at minimum, the following:

- BC Landscape Standard, Current Edition
- National Guide to Sustainable Municipal Infrastructure (Canada)
- Irrigation Association – Turf and Landscape Irrigation Best Management Practices

1.3 Application of Standard

These standards apply to the following areas:

- Boulevards
- Public walkways and access routes
- Stormwater management facilities
- Parks

1.4 Landscape Consultant

The *Owner* shall retain a Landscape Consultant to be directly supervised by a Landscape Architect or a Registered Irrigation Designer. All landscape drawings and specifications shall be sealed by a professional Landscape Architect.

1.5 Landscape Plan

The Landscape Designer shall consider, at minimum, the following criteria:

- The functional relationship of the landscape design to existing and proposed land uses, utilities, flood patterns, drainage facilities, roads, driveways and pedestrian facilities
- Accessibility as it relates to pedestrians, cyclists and people with limited physical or visual abilities
- Horticultural use of plant material, including plant suitability, survival rate, growth habit, size, disease resistance and water demand
- Appearance of the proposed plant material and site landscape, including appropriateness, aesthetics, visual screening and sight lines
- Protection of existing trees
- Protection of the natural environment and restoration or enhancement of natural habitat
- Site drainage, water levels, ponding and overland flow
- Minimization of the opportunity for crime and undesirable behaviour
- Weed control
- Erosion control
- Fire hazard reduction
- The estimated costs and efficiency of maintenance practices that will be required for the public land
- Restoration of disturbed areas

1.6 Landscape Requirements

In boulevards within public road right of ways, the area from the back of curb or back of sidewalk to the front property line shall be graded as per the site grading plan. Minimum landscaping by the *Owner* shall consist of 100 mm of topsoil to property line.

One tree per lot shall be installed in residential and commercial areas. Trees shall be installed as per the Supplementary Detail Drawing G13 and meet the list of approved species. The landscape plan shall identify the proposed location for each tree to avoid conflict with any utilities, appurtenances, or driveways.

For public access routes, walkways and parks, minimum landscaping by the *Owner* shall consist of 100 mm of topsoil and seed.

1.7 Stormwater Management Facilities

Landscape requirements for wet ponds shall consist of the following:

- Between the normal water level and the top of bank the side slopes shall be naturalized with low maintenance riparian plantings in 100 mm minimum depth growing medium
- Above the top of bank the ground surface shall be turf on 50 mm depth smooth growing medium, with a maximum slope of 4 (horizontal) to 1 (vertical), except as required for vehicle access and pedestrian surfaces
- Shrubs and trees shall be selected, planted and maintained to provide screening, habitat, shade and aesthetics as required

For dry ponds:

- The bottom of dry ponds and infiltration basins shall be turf on 50 mm depth smooth growing medium
- Side slopes with a 4 (horizontal) to 1 (vertical) or shallower slope shall have a turf surface on 50 mm minimum depth smooth growing medium. Side slopes steeper than 4 (horizontal) to 1 (vertical) slope shall be naturalized with low maintenance riparian plantings in 100 mm minimum depth growing medium.
- Above the design high water level the ground surface shall be turf on 50 mm depth smooth growing medium, with a maximum slope of 4 (horizontal) to 1 (vertical), except as required for vehicle access and pedestrian surfaces
- Shrubs and trees shall be selected, planted and maintained to provide screening, habitat, shade and aesthetics as required

1.8 Erosion Control

Land proposed as public land where there is evidence of active or historic erosion that may have maintenance or liability implications for the *District* will not be accepted by the *District* as public land.

The *Owner* shall be responsible for undertaking erosion control and restoration works on proposed public land as necessary for the long-term prevention and control of erosion.

The *Owner* shall develop an erosion and sediment control plan for construction in accordance to Schedule D – Stormwater.

1.9 Fire Management

At the discretion of the *Approving Officer*, the *Owner* may be required to prepare and submit a Fuel Management Plan covering some or all of the proposed Public Land.

The Fuel Management Plan shall be prepared by a Registered Professional Forester (RPF) and shall follow industry standards such as the FireSmart Guidelines endorsed by the BC Ministry of Forests. The Fuel Management Plan shall include but not be limited to the following aspects:

- Map(s) showing existing and proposed vegetation, structures, trails, access points, and firebreaks on public land and vegetated land adjacent to the site, including an assessment of the fuel hazard in these areas.
- Priority zones, as per the FireSmart Guidelines, around all existing or planned structures. Fuel modification prescriptions for these priority zones shall be developed based upon proximity to structures and target stand conditions.
- Establishment of strategic firebreaks adjacent to structures and hazardous fuel types, which may also serve as recreational trails. Breaks shall be a minimum of 1.5 m wide with a 100 mm minimum gravel base.
- Deciduous trees shall be retained where possible.
- Access points shall be provided from the roadway between lots to provide access to Public Land containing natural vegetation as required for land maintenance and fire hazard management.
- Access points shall enable access for emergency and maintenance vehicles. Hydrants shall be located in the road dedication adjacent to the access point.

SCHEDULE H

SITE GRADING

March 2013

SCHEDULE H – SITE GRADING

1.0 SITE GRADING

1.1 General

The *Owner* shall execute site grading work in accordance with the regulations, standards and specifications set out in this Schedule. Site grading shall ensure proper drainage of individual properties and establish an effective surface drainage system for the whole *Subdivision* or *Development* area as part of the major drainage system. Supplemental to the requirements for drainage systems outlined in Schedule D of this bylaw, the *Owner* shall design site grading and drainage works to:

- Accommodate drainage from adjacent areas (including off-site areas) through the site
- Accommodate drainage generated on-site
- Avoid drainage from one lot to another
- Mitigate groundwater problems
- Mitigate soil erosion potential
- Produce buildable lots that provide:
  - access from fronting roadways
  - drainage from each lot and into drainage infrastructure
  - structural competence of undisturbed and embanked soils to support building loads

1.2 Site Grading Plans

Prior to commencement of construction, site grading plans prepared by the *Owner's Professional Engineer* shall be submitted to the *Approving Officer* for approval. These site grading plans are to include the following information:

- Clearing and grubbing boundaries
- Fill and excavation areas (by shading) including structural fill areas and any required retaining walls
- Locations of required siltation abatement and control measures
- Predevelopment topography - Showing existing contours within the subdivision and extending into the adjacent lands, at a maximum 0.5 m interval as well as arrows showing natural flow paths.

- Post development topography – Showing proposed contours within the subdivision and extending into adjacent lands, at a maximum 0.5 m interval as well as arrows showing natural flow paths
- Representation of the major conveyance system - The nature and detail of the major conveyance system is to be shown, including all major drainage flow directions, ponding areas and the extent and maximum depth of ponding anticipated for a 1 in 100 year return frequency rainfall event. The overall major drainage flow route is to be clearly defined and designated with prominent arrows. Include the direction of surface flows on all surfaces and elevations of overflow points from local depressions, details of channel cross sections etc.
- Surface slopes of roadways and other surfaces with arrows indicating the direction of flow.
- Proposed or existing elevations along the boundaries of the subdivision and design elevations at all lot corners and changes of surface slope along property boundaries.
- Lot drainage pattern - The direction of surface drainage for each lot is to be identified, to indicate whether split drainage or through drainage is contemplated. Proposed surface drainage for abutting future development lands is to be shown to the extent that it will impact on the subject lands.
- Lot grading details - Typical detail diagrams of the various types of lot grading arrangements, which will normally conform to the figures provided in the Supplementary Detail Drawings G11 & G12, are to be used, identifying for each lot which typical detail applies.
- Swale details including locations, easement requirements, slopes, cross sections and construction details for the swales.
- Easements and restrictive covenants - Requirements and locations for all easements and restrictive covenants related to drainage provisions and development restrictions associated with the drainage of the property.

1.3 Geotechnical Evaluation

The *Owner* shall engage the services of a qualified Geotechnical *Professional Engineer* to investigate surface soil and sub-surface conditions with respect to site grading within the proposed subdivisions. The Geotechnical *Professional Engineer* shall prepare a report outlining his findings and shall provide clear, definitive recommendations on the geometry and placement of fill sections, compaction requirements for structural and non-structural fills, cut and fill slope geometry handling of topsoil and any other geotechnical issues

affecting site grading construction within the proposed subdivision or development. A copy of the geotechnical evaluation shall be submitted to the *Approving Officer* at the time the engineering drawings are submitted for approval.

1.4 Design Criteria - Lot Grading

Refer to Supplementary Detail Drawings G11 & G12 for typical lot grading details. Wherever possible, lots shall be graded from rear to front, towards roadways. Split drainage will be permitted only where site topography prohibits drainage to roadways. In this situation, portions of lots may be graded to a drainage swale that is then graded to convey drainage to a public right of way. See Section 1.5 for detailed swale design criteria. Other lot drainage configuration may be considered by the *Approving Officer*.

Property line elevations shall be established such that lots have maximum overall slopes of 15% and minimum overall slopes of 2%.

Areas around buildings (or proposed building sites) shall be graded away from the (proposed) foundations to prevent flooding. Finished building elevations must be established such that the ground will slope away from the building at a minimum of 10% for a distance of 2.0 m (or to the property line), on all sides, with the slope directing drainage away from the building. The lot grading must then provide for minimum slopes in the order of 1.5% to 2.0% from all points within the property to the property boundaries, from which the drainage may escape.

Finished ground elevations adjacent to (proposed) foundations shall be located a minimum of 300 mm above the maximum flow or ponding surface elevations for the 1:100 year major storm event.

The *Owner* must ensure that builders are informed of any potential problems or restrictions respecting building design and lot grading. The site grading plan and covenants will be used as the principle means by which this information is communicated.

1.5 Design Criteria – Swales

A swale is a shallow sloped linear depression for conveyance of surface runoff. Drainage swales shall be located in an easement and protected by registration of a covenant on the lot title.

For grassed swales serving lots on one side only:

- Location: Rear of upstream lot in a 3.0 m easement
- Cross Section: V-shape, 150 mm minimum depth and 4H:1V maximum side slope
- Longitudinal slope: 1.5% minimum

For grassed swales serving lots on both sides:

- Location: Common rear property line as centre of a 6.0 m easement.
- Cross-section: Trapezoidal with 1.0 m bottom, 150 mm minimum depth and 4H:1V maximum slope.
- Longitudinal slope: 1.5% minimum

Concrete swales or alternate configurations may be considered where minimum slope requirements for grassed swales cannot be achieved or when swales are located within existing developments or at locations where infill development is proposed.

Additional swale design criteria include:

- Swales shall have capacity to contain the 1:100 year storm major flow within the easement
- Where swales intersect walkways, provide a catchbasin upstream of walkways to intercept the 1:5 year storm flow.
- The number of lots draining to swale shall be dependent on the swale capacities and the catchbasin's 1:5 year storm flow inlet capacity.
- Avoid bends greater that 45 degrees in swale alignments where possible.
- Swales that convey flows from more than two lots must not be routed along the side yard of a single family or duplex residential lot.
- Future swale extensions shall be identified and evaluated to ensure that anticipated constraints and capacities are addressed.

Calculations for the swale's minor and major flow capacities shall be submitted with the *Professional Engineer's* drawings.

1.6 Siltation Abatement and Erosion Control

Siltation abatement and erosion control works shall be designed and implemented during construction in accordance with the requirements specified in Schedule D – Stormwater.

1.7 Site Preparation

All areas of the site where excavations or embankments are to be constructed shall be cleared of trees, structures and debris; grubbed; and stripped of organic topsoil.

Marketable timber shall be salvaged; waste wood, roots, structures and debris shall be disposed of at an approved location off-site.

1.8 Compaction

Unless specified otherwise by the Geotechnical *Professional Engineer* all non structural embankments shall be compacted to a minimum 95% Standard Proctor maximum dry density. Compaction requirements for structural embankments are to be specified by the *Owner's* Geotechnical *Professional Engineer*.

1.9 Detailed Site Surveys

Detailed site surveys are required throughout the site and of relevant areas beyond the site to ensure grading meets requirements. The *Owner* must rough grade all lots to within 300 mm of the proposed grading plan elevations along the perimeter of lots. Swales required for major system conveyance shall be constructed and preferably shall be sodded, or at the least, shall be topsoiled and seeded by the *Owner*.

An as-built plan showing lot and swale elevations surveyed after rough grading must be submitted as a prerequisite to the issuance of the *Certificate of Provisional Completion of All Works*.

SCHEDULE I

QUALITY CONTROL

SCHEDULE I – QUALITY CONTROL

1.0 QUALITY CONTROL AND ASSURANCE

This Schedule sets out the *District's* minimum standards for quality in design, quality in construction and quality in record-keeping for the *Works and Services* to be designed and constructed in accordance with this bylaw.

1.1 Engineering Requirements

- The *Owner* shall demonstrate to the satisfaction of the *Approving Officer* that the *Owner* has retained or shall retain the services of a *Professional Engineer* to undertake the design, inspection, testing and record-keeping for the *Works and Services.*
- The *Owner* shall complete and provide the *Approving Officer* with the following information in an Owner/Professional Engineering confirmation letter to demonstrate that the *Professional Engineer* is qualified to undertake the *Works and Services* and more particularly, has successfully undertaken projects similar in scope, nature and value to the *Works and Services*:
  - The name and address of the *Professional Engineer* and a summary of the projects that the *Professional Engineer* has undertaken that are similar in scope, nature and value to the *Works and Services*.
  - The names of the individuals assigned to various aspects of the project by the *Professional Engineer* together with a summary of the projects that the individual *Professional Engineers* have undertaken that are similar in scope, nature and value to the *Works and Services*.
  - The names and the curriculum vitae for the person(s) that the *Professional Engineer* proposes/has retained to undertake the inspections and testing on its behalf during the construction of the *Works and Services* together with a summary of the projects that the person(s) has completed that are similar in scope, nature and value to the *Works and Services*.
  - The names and addresses of all sub-consultants that the *Professional Engineer* has/proposes to retain and a summary of the projects that the sub-consultants have completed that are similar in scope, nature and value to the *Works and Services*.
  - The *Owner* shall ensure the *Professional Engineer* designs all *Works and Services* in accordance with this bylaw.

- The *Owner* shall also confirm that the *Professional Engineer* will provide the Design, Construction and Record-keeping Quality Control and Assurance Plans described herein. A copy of the agreement shall be filed with the *Approving Officer*.

1.2 Construction Requirements

- The *Owner* shall demonstrate to the satisfaction of the *Approving Officer* that the *Owner* has or shall retain the services of one or more qualified contractors to undertake the construction of the *Works and Services*. The *Owner* shall provide the *District* with the name and address of its contractor(s) together with a summary of the projects that the contractor(s) has undertaken that are similar in scope, nature and value to the *Works and Services* prior to awarding the contract(s) to the contractor.

  In the case where the contractor has not performed similar *Works and Services* in the *District*, the *Approving Officer* may require that the *Owner* provide a list of projects and references from other municipalities that demonstrates that the contractor(s) is qualified to undertake the *Works and Services.*

- The *Owner* shall ensure that its contractor(s) constructs the *Works and Services* in accordance with the design, drawings, plans and specifications approved for construction by the *Approving Officer*.

1.3 Quality Control and Assurance Plans

Requirements regarding the Design Quality Control and Assurance Plan is as follows:

- The *Owner* shall submit or cause the *Professional Engineer* to submit a Design Quality Control and Assurance Plan to the *District* for approval coincident with submission of the first design drawings.
- The *Owner's* proposed Design Quality Control and Assurance Plan shall detail the procedures that will be used to ensure and verify that the design for the *Works and Services*, including all plans, drawings and specifications, shall be completed in accordance with the minimum design standards set out in this bylaw.
- In the case of design items related to pump stations, structures, structural fills, geotechnical or hydro-geotechnical items or any item not described in other Schedules, the Design Quality Control and Assurance Plan shall show such specialist and/or sub-consultants with suitable experience in these works.

Construction Quality Control and Assurance Plan is as follows:

- The *Owner* shall submit or cause the *Professional Engineer* to submit a Construction Quality Control and Assurance Plan to the *Approving Officer* coincident with submission of the first design drawings to the *District*.
- The *Owner's* proposed Construction Quality Control and Assurance Plan must detail the procedures that will be used to ensure and verify that the *Works and Services* shall be constructed in accordance with the *Professional Engineer's* design, plans, drawings and specifications. The Construction Quality Control and Assurance Plan must include:
  - A proposed construction schedule showing milestone dates and the dates of *Provisional Completion* of the *Works and Services*.
  - The nature and frequency (periodic or full-time resident) of the proposed site inspections during construction to ensure that all *Works and Services* constructed satisfy the intent of the design and conform to the drawings, plans and specifications.
  - The nature and frequency of the proposed field and laboratory testing requirements for the *Works and Services* including what materials and equipment are to be tested, what types of tests will be performed and when these tests are to take place.
  - Such information as the *Approving Officer* may stipulate from time to time.

Record-keeping Quality Control and Assurance Plan is as follows:

- The *Owner* shall submit or cause its *Professional Engineer* to submit a Record-keeping Quality Control and Assurance Plan to the *Approving Officer* coincident with submission of the first Design Drawings.
- The *Owner's* proposed Record-keeping Quality Control and Assurance Plan shall detail the procedures that will be used to ensure and verify that proper records will be kept and maintained throughout the design, construction and warranty phases of the *Works and Services*. The Record-keeping Quality and Assurance Control Plan shall ensure that the following records are kept as a minimum:
  - Quality manual and standards.

- Details of any field design or construction changes to the drawings, plans and specifications to which changes are approved in writing by the *District*.
- Deficiency identification forms (Items of the work that are either not supplied or constructed in accordance with the design (drawings, plans and specifications) or that require remedial or corrective action).
- Deficiency disposition/verification Forms (List of the foregoing items of the work that have been corrected).
- Inspection and test records.
- Field measurement records of completed *Works and Services* that have been used by the *Professional Engineer* to accurately prepare reproducible record drawings that are filed with the *District*.

- Notwithstanding the generality of the foregoing, the *Owner* shall ensure that its *Professional Engineer* provides the *District* with the following at the times and in the manner set out below:
  - Certification prior to paving that it has inspected those items of the *Works and Services* that are below areas to be paved such as roads, walkways, driveways and parking lots, have been inspected and that same comply with the design (drawings, plans and specifications). Such certification shall be accompanied by all test and inspection reports and by video tapes and reports on pipe lines.
  - Certification prior to acceptance by the *District* that surface works including paving, drainage, curbs and gutters, sidewalks, street lights, etc. have been constructed in accordance with the design (drawings, plans and specifications).

SCHEDULE J

STANDARDS FOR SUBMISSION BY DEVELOPER

March 2013

SCHEDULE J – STANDARDS FOR SUBMISSION BY DEVELOPER

List of Tables

1.0 GENERAL

1.1 Introduction

This Schedule outlines the minimum standards and requirements for design and record drawing submissions for *Works and Services.*

Where a *District* or MMCD detail drawing exists, it shall be sufficient to refer to the appropriate drawing by reference number and date of issue. Where a detail drawing does not exist, or is unsuitable for a particular case, detail drawings shall be prepared to accurately portray the various elements of the installation.

Where no standard is defined in this Schedule for the preparation of a drawing to portray a particular service, structure, or other item, instructions and requirements may be obtained by discussion with *District* staff.

1.2 General Requirements

Drawings shall clearly show existing and proposed locations of all utilities using offsets from property lines or boundaries of rights-of-way.

All drawings shall be signed and sealed by a *Professional Engineer* registered in the Province of British Columbia.

Elevations shall be relative to geodetic datum. Horizontal coordinates shall be referenced to UTM coordinate system NAD83. Vertical datum is CGVD 1928 – BC.

1.3 Abbreviations

UTM	Universal Transverse Mercator
NAD83	1983 North American Datum
BOC	Back of Curb
EC	End of Curve
BC	Beginning of Curve
PI	Point of Intersection

2.0 DRAFTING STANDARDS

2.1 Sheet Layout

Drawing sheet layout(s) shall conform to and include the following:

- Sheet size to be ANSI D 22 x 34 in (558.8 x 863.6 mm).
- A north arrow shall be placed close to the top right side of each plan view on the sheet.
- A title block that describes the contents of the drawing (eg. Key plan, road, etc.) and clearly indicates the location of the works by road name(s) and/or legal description.
- Drawing scale, date, revision history block, and a detailed legend shall also be included on each sheet layout.

2.2 Dimensions and Units

The following conventions must be used:

- Dimensions and units must be shown in metric. No imperial units are permitted.
- All distances, elevations, and coordinates shall be given in metres to accuracy of 3 decimal places.
- Grades shall be given as a percentage to accuracy of 2 decimal places.
- Areas shall be in square meters rounded to the nearest square meter.
- All pipe sizes shall be given in millimeters as per ASTM specifications using:

  1 inch = 25 mm
- Existing imperial dimensions, except for pipe sizes, are to be soft converted using the factors:

  1 inch = 25.4 millimetres
  1 foot = 0.3048 metres.

2.3 Lettering

- Lettering is to be an open style of Vertical Gothic (eg. Leroy or AutoCAD – ‘romans’).
- All lettering to maintain a 1:10 ratio between plotted text height and plotted pen thickness.
- The minimum plotted text height shall be 1.5 mm.

- The maximum plotted text height shall be 5.0 mm.
- The standard lettering height is 2.0 mm.

2.4 Scales

The following scales shall be normally used:

• Location and Key Plans	-	1:1000; 1:2500; 1:5000; 1:10000
• Composite Plans	-	1:500; 1:1000; 1:2500
• Plan/Profile Drawings	-	Horizontal 1:500 or 1:250 Vertical 1:50 or 1:25
• Cross Sections	-	Horizontal 1:100 Vertical 1:50
• Details	-	1:100; 1:20; 1:10

3.0 DRAWING STANDARDS - DIGITAL

3.1 CAD Creation Guidelines

3.1.1 Software Guidelines

- All drawings must be in standard AutoCAD Version 2004 or later with no extensions. All drawing objects must be standard AutoCAD entities. In order for this to occur, set the AutoCAD system variable PROXYGRAPHICS to 1.
- The use of third party software for AutoCAD will be at the discretion of the contractor/consultant. As these packages typically generate proprietary layers, linetypes and blocks, the contractors/consultant must ensure these items conform to the specifications as outlined in this document.
- All linetypes, fonts, font styles, dimensioning styles, symbols, blocks and layers not deemed as project critical must be purged. Please note that these items may be needed for future project work.
- Drawings are to be submitted in .DWG and .PDF format. Alternatives to .PDF format may be considered such as Autodesk's Drawing Web Format (.DWF)
- All AutoCAD drawing entities must be on modelspace for the final drawings with title block only in paperspace.

3.1.2 Layers and Symbology

A base drawing containing all the standard blocks and layering will be provided by the as part of these specifications.

3.1.3 Colour and Pen Assignments

A .ctb file with colour and layer specifications will be provided by the *District*.

3.1.4 Fonts and Text Sizes

Only standard text fonts supplied with AutoCAD will be used.

3.1.5 Base Drawings

The layer "BMBASE" must be used as the staging layer for inserting and referencing external drawings. The XREF drawings will be inserted as symbols (blocks) at the coordinates (0,0) with a scale factor of 1.

3.1.6 File Storage and Transfer

All files transferred back to the *District* must be in the standard AutoCAD DWG format. Any AutoCAD blocks and XREF's must also be included.

3.2 Layer Naming Convention

The following is the standard for layering name conventions to be used on all drawings being submitted:

3.2.1 Naming Convention:

- X-<TYPE>-DESC
- X = Prefix
- TYPE = Types (see Table K1)
- DESC = Description of the layer or layer name (see Section 3.4)
- Example: E-SAN-MH = Existing Sanitary Manhole

3.2.2 Prefixes:

The following are to be used as the prefix 'X' in the naming convention:

- E - Existing
- D - Detail
- P - Proposed
- F - Future
- T - Titleblock

3.2.3 Types:

The following Table K1 shows the 'TYPE' to be used in the naming convention.

Table J1: Layer Naming Conventions

LAYER CATEGORY	CATEGORY DESCRIPTION
ELEC	Electrical Diagrams (Not Shallow Utilities)
GRADE	Grading
LAND	Landscaping
LGL	Legal/Cadastral
MECH	Mechanical Diagrams
PLAN	Planning
ROAD	Roads
SAN	Sanitary
STM	Storm
SWM	Stormwater Management
STRUC	Structures and Surface Features
SURV	Survey
TOPO	Topography
UTIL	Shallow Utilities
WAT	Water
NOTE: When 'T' or 'D' is the prefix, go directly to 'DESC' (i.e. T-border)	

3.2.4 Suffixes:

Suffixes may be used to describe in more detail the layer or to further separate objects of a similar type. For example, instead of placing all sanitary sewer mains on a layer called 'E-SAN-MAIN', you could place them on layers 'E-SAN-MAIN-150-DR35' and 'E-SAN-MAIN-200-DR35'.

3.3 SPECIAL LAYERS

The following list of layers are pre-set layers contained in the *District's* Standard Drawing Template file (CHETWYND BASE.dwt). **Table K2** describes a few special layers that do not follow the layer convention set out in Section 3.2

Table J2: Special Layers

LAYER NAME	PEN #	LINE TYPE	TYPE OF DATA
_MVIEW	7	Continuous	Viewports
_IMAGE	7	Continuous	Images (i.e. Aerial, etc.)
_TEMP	7	Continuous	Temporary Lines, Notes, Etc
_XREF	7	Continuous	General Cross References
_XREF-DES	7	Continuous	Design Dwg Cross Reference
_XREF-LAN	7	Continuous	Landscape Dwg Cross Reference
_XREF-LGL	7	Continuous	Legal Dwg Cross Reference
_XREF-UTL	7	Continuous	Utility Dwg Cross Reference

3.4 STANDARD LAYERS

The following layers are defined in the *District's* Standard Drawing Template file (CHETWYND BASE.dwt). Each of these layers will use the prefixes defined in Section 3.2.

Table J3: Details

LAYER NAME	PEN #	LINE TYPE	TYPE OF DATA
LINE-LGT	26	Continuous	Linework Lgt Penweight
LINE-MED	24	Continuous	Linework Med Penweight
LINE-HVY	20	Continuous	Linework Hvy Penweight
PAT	27	Continuous	Hatch Patterns
TEXT-LGT	26	Continuous	Text Lgt Penweight
TEXT-MED	24	Continuous	Text Med Penweight
TEXT-HVY	20	Continuous	Text Hvy Penweight

Table J4: Grading

LAYER NAME	E	P	F	LINE TYPE	TYPE OF DATA
GRADE-ARROW	65	64	252	Continuous	Grading Arrows
GRADE-ELEV	63	62	252	Continuous	Spot Elevations
GRADE-PAT	253	252	254	Continuous	Hatch Patterns
GRADE-TEXT	65	64	252	Continuous	Grading Text

Table J5: Landscaping

LAYER NAME	E	P	F	LINE TYPE	TYPE OF DATA
LAND-BOLLARD	73	72	252	Continuous	Bollards
LAND-BORDER	73	72	252	Continuous	Borders
LAND-CONC	73	72	252	Continuous	Concrete Features
LAND-FIXTURES	73	72	252	Continuous	Fixtures/Furniture
LAND-HEDGE	73	72	252	Continuous	Hedges
LAND-PATH	73	72	252	Continuous	Pathways
LAND-PLANTER	73	72	252	Continuous	Planters
LAND-RETWALL	73	72	252	Continuous	Retaining Walls
LAND-SHRUB	71	70	252	Continuous	Shrubs
LAND-TREE	71	70	252	Continuous	Trees
LAND-TREELINE	73	72	252	Continuous	Edge Of Treeline
LAND-TEXT	75	74	252	Continuous	Landscaping Text

Table J6: Legal/Cadastral

LAYER NAME	E	P	F	LINE TYPE	TYPE OF DATA
LGL-ADRS-TEXT	145	144	252	Continuous	Address Text
LGL-BLOCK-TEXT	145	144	252	Continuous	Block Text
LGL-BLOCK	141	140	252	Continuous	Block Linework
LGL-DIM-TEXT	145	144	252	Continuous	Dimension Text
LGL-EASE	141	140	252	Hidden	Easement Linework
LGL-EASE-TEXT	145	144	252	Continuous	Easement Text
LGL-LOT	141	140	252	Continuous	Lot Linework
LGL-LOT-TEXT	145	144	252	Continuous	Lot Text
LGL-PLAN-TEXT	145	144	252	Continuous	Plan Of Subd. Text
LGL-SEC-TEXT	145	144	252	Continuous	Section/Range/Tp.
LGL-STRNAME	141	140	252	Continuous	Street Names
LGL-RW-ROADS	141	140	252	Continuous	Road Right Of Way
LGL-RW-ROADS-TEXT	145	144	252	Continuous	Road Row Text
LGL-RW-UTIL	141	140	252	Dashed	Utility Right Of Way
LGL-RW-UTIL-TEXT	145	144	252	Continuous	Utility Row Text

Table J7: Planning

LAYER NAME	E	P	F	LINE TYPE	TYPE OF DATA
PLAN-AREA	41	40	254	Continuous	Areas Of Measurement
PLAN-BDY	48	10	254	Dashdot	Boundaries
PLAN-PAT	49	47	254	Continuous	Hatch Patterns
PLAN-LU	43	42	254	Continuous	Land Use
PLAN-MET	43	42	254	Continuous	Planimetrics
PLAN-SAN	11	10	254	Continuous	Sanitary
PLAN-STM	91	90	254	Continuous	Storm
PLAN-WAT	151	150	254	Continuous	Water
PLAN-TEXT	45	44	254	Continuous	Text
PLAN-ZON	43	42	254	Continuous	Zoning

Table J8: Roads

LAYER NAME	E	P	F	LINE TYPE	TYPE OF DATA
ROAD-CL	25	24	252	Center	Road Centreline
ROAD-CURB-ASP	23	22	252	Continuous	Asphalt Curb
ROAD-CURB-BACK	21	20	252	Continuous	Back Of Curb
ROAD-CURB-CONC	23	22	252	Continuous	Concrete Curb
ROAD-CURB-FACE	21	20	252	Continuous	Face Of Curb
ROAD-CURB-LIP	23	22	252	Continuous	Lip Of Curb
ROAD-CURB-TEXT	25	24	252	Continuous	Curb Text
ROAD-DRIVE-ASP	23	22	252	Continuous	Asphalt Driveway
ROAD-DRIVE-CONC	23	22	252	Continuous	Concrete Driveway
ROAD-DRIVE-GRAVEL	23	22	252	Continuous	Gravel Driveway
ROAD-DRIVE-PSTONE	23	22	252	Continuous	Paving Stone Driveway
ROAD-DRIVE-TEXT	25	24	252	Continuous	Driveway Text
ROAD-EOG	23	22	252	Continuous	Edge Of Gravel
ROAD-EOP	23	22	252	Continuous	Edge Of Pavement
ROAD-MARK	25	24	252	Continuous	Pavement Markings
ROAD-SHLD	23	22	252	Dashed	Edge Of Shoulder
ROAD-SIGN	23	22	252	Continuous	Road Sign
ROAD-TEXT	25	24	252	Continuous	Text
ROAD-WALK	23	22	252	Continuous	Misc. Sidewalk
ROAD-WALK-ASP	23	22	252	Continuous	Asphalt Sidewalk
ROAD-WALK-CONC	23	22	252	Continuous	Concrete Sidewalk
ROAD-WALK-TEXT	25	24	252	Continuous	Sidewalk Text

Table J9: Sanitary Sewer

LAYER NAME	E	P	F	LINE TYPE	TYPE OF DATA
SAN-MAIN	11	10	252	San	Gravity Lines
SAN-CASING	13	12	252	Continuous	Casing Pipe
SAN-FM	11	10	252	Fm	Forcemains
SAN-LS	13	12	252	Continuous	Lift Stations
SAN-MH	13	12	252	Continuous	Manholes
SAN-SEPTIC	13	12	252	Continuous	Septic Lines/Fields/Tanks
SAN-SERV	11	10	252	Continuous	Service Hookups
SAN-SERV-IC	13	12	252	Continuous	Cleanout/Insp. Chamber
SAN-STRUC	13	12	252	Continuous	Structures
SAN-TEXT	15	14	252	Continuous	Text

Table J10: Storm Sewer

LAYER NAME	E	P	F	LINE TYPE	TYPE OF DATA
STM-MAIN	91	90	252	Stm	Gravity Lines
STM-CASING	93	92	252	Continuous	Casing Pipe
STM-CB	93	92	252	Continuous	Catch Basins
STM-CBLEAD	95	94	252	Continuous	Catch Basin Lead
STM-CBMH	93	92	252	Continuous	Catch Basin / Manholes
STM-CULVERT	93	92	252	Continuous	Culverts
STM-DITCH	93	92	252	Arrow	Ditch
STM-DITCH-TEXT	95	94	252	Continuous	Ditch Text
STM-MH	93	92	252	Continuous	Manholes
STM-SERV	91	90	252	Continuous	Service Hookups
STM-STRUC	93	92	252	Continuous	Structures
STM-SWALE	93	92	252	Swale	Swales
STM-SWALE-TEXT	95	94	252	Continuous	Swale Text
STM-TEXT	95	94	252	Continuous	Text

Table J11: Stormwater Management

LAYER NAME	E	P	F	LINE TYPE	TYPE OF DATA
SWM-BDY	253	251	254	Continuous	Swm Boundary
SWM-PAT	253	251	254	Continuous	Swm Hatch/Pattern
SWM-POND	95	94	252	Continuous	Swm Ponding
SWM-POND-TEXT	95	94	252	Continuous	Swm Pond Text
SWM-TEXT	95	94	254	Continuous	Swm Text

Table J12: Structures and Surface Features

LAYER NAME	E	P	F	LINE TYPE	TYPE OF DATA
STRUC-BLDG	223	222	252	Continuous	Buildings
STRUC-BLDG-TEXT	225	224	252	Continuous	Building Text
STRUC-BRIDGE	223	222	252	Continuous	Bridges
STRUC-FNC	223	222	252	Fence	Generic Fenceline
STRUC-FNC-CLINK	223	222	252	Fence	Chainlink Fenceline
STRUC-FNC-POST	223	222	252	Fence	Post & Cable Fenceline
STRUC-FNC-TEXT	223	222	252	Continuous	Fence Text
STRUC-FNC-WOOD	223	222	252	Fence	Wood Fenceline
STRUC-RETWALL	223	222	252	Continuous	Retaining Walls
STRUC-TEXT	225	224	252	Continuous	Structures Text

Table J13: Survey

LAYER NAME	E	P	LINE TYPE	TYPE OF DATA
SURV-CONTROL	45	44	Continuous	Control/ASCM's
SURV-FIP	45	44	Continuous	Found Iron Pins
SURV-GEOTECH	45	44	Continuous	Mon. Well, Test Pit, BH, PZ
SURV-TRAV	45	44	Phantom	Traverse Lines

Table J14: Topography

LAYER NAME	E	P	F	LINE TYPE	TYPE OF DATA
TOPO-CONT-MAJ	67	64	252	Continuous	Major Contours
TOPO-CONT-MIN	69	66	252	Continuous	Minor Contours
TOPO-CONT-TEXT	65	66	252	Continuous	Contour Text
TOPO-SPOTELEV	63	62	252	Continuous	Spot Elevation
TOPO-TOE	63	62	252	Continuous	Toe Of Slope
TOPO-TOP	63	62	252	Continuous	Top Of Slope
TOPO-TEXT	65	64	252	Continuous	Slope Text
TOPO-TREELINE	63	62	252	Continuous	Treeline
TOPO-WATER-CL	63	62	252	Continuous	Single Line Wat Feature
TOPO-WATER-EDGE	63	62	252	Continuous	Double Line Wat Feature

Table J15: Shallow Utilities

LAYER NAME	E	P	F	LINE TYPE	TYPE OF DATA
UTIL-CABLE	191	190	252	Cable	Tv Cable
UTIL-CABLE-TEXT	195	194	252	Continuous	Tv Cable Text
UTIL-ELEC	191	190	252	Hydro Elec	Line, Box, Mh, Trans.
UTIL-ELEC-LIGHT	193	192	252	Continuous	Light Std
UTIL-ELEC-PP	193	192	252	Continuous	Power Pole
UTIL-ELEC-SERV	191	190	252	Elec	Electricity Service
UTIL-ELEC-TEXT	195	194	252	Continuous	Electricity Text
UTIL-GAS	191	190	252	Gas	Gas
UTIL-GAS-SERV	191	190	252	Gas	Gas Service
UTIL-GAS-TEXT	195	194	252	Continuous	Gas Text
UTIL-TEL	191	190	252	Tel	Telephone Line
UTIL-TEL-MH	193	192	252	Continuous	Telephone Manhole
UTIL-TEL-SERV	191	190	252	Tel	Telephone Service
UTIL-TEL-TEXT	195	194	252	Continuous	Telephone Text
UTIL-CON1	191	190	252	Con1	1 Use Conduit
UTIL-CON2	191	190	252	Con2	2 Joint Use Conduit
UTIL-CON3	191	190	252	Con3	3 Joint Use Conduit
UTIL-CON-TEXT	195	194	252	Continuous	Conduit Text

Table J16: Water

LAYER NAME	E	P	F	LINE TYPE	TYPE OF DATA
WAT-MAIN	151	150	252	Wat	Watermains
WAT-CASING	155	154	252	Continuous	Casing Pipe
WAT-CHAMB	153	152	252	Continuous	Chambers
WAT-SERV-CS	153	152	252	Continuous	Curb Stops
WAT-FTG	153	152	252	Continuous	Fittings
WAT-HYD	153	152	252	Continuous	Hydrants
WAT-IRRIG	151	150	252	Wat	Irrigation
WAT-SERV	151	150	252	Wat	Water Service
WAT-STRUC	153	152	252	Continuous	Lift Sta, Reservoirs
WAT-TEXT	155	154	252	Continuous	Water Text
WAT-VALVE	153	152	252	Continuous	Valves

Table J17: Titleblock

LAYER NAME	PEN #	LINE TYPE	TYPE OF DATA
T-BDR	180	Continuous	Border Linework
T-BLK-TEXT-LGT	184	Continuous	Titleblock Info Text
T-BLK-TEXT-MED	182	Continuous	Titleblock Info Text
T-BLK-TEXT-HVY	180	Continuous	Titleblock Info Text
T-GRID-MAJ	185	Continuous	Major Grid Line
T-GRID-MIN	187	Continuous	Minor Grid Line
T-GRID-TEXT	180	Continuous	Grid Text
T-LEGEND	184	Continuous	Legend
T-NORTH	184	Continuous	North Arrow
T-STAMP-DISCLAIMER	184	Continuous	Disclaimer Stamp
T-STAMP-FORISSUE	184	Continuous	For Issue Stamp
T-STAMP-PERMIT	184	Continuous	Permit To Practice Stamp
T-STAMP-PLOT	184	Continuous	Plot/Date Stamp

3.5 STANDARD OBJECT PROPERTIES

All objects colour and linetype properties should be set to “bylayer”. This ensures the greatest amount of control over the entire drawing and enables changes to be made quickly and easily.

3.5.1 Point Groups

- Naming Convention: <TYPE>-<SOURCE>-<DATE>
- Type = See **Table J18**
- Source = Data source, surveyor, etc…
- Date = Current date in the format yyyy-mm-dd

Table J18: Point Group Types

Name	Description
SURV	Field Surveys
UTIL	Record Utility Information (not for surface use)
CTRL	Survey Control Points
INTP	Interpolated Points

3.6 SYMBOLS

Submitted drawings shall include symbols provided in the *District's* Standard Drawing Template file. Symbols must be inserted using the specified insertion point, which is to be centre point of the symbol unless otherwise indicated. Where possible, symbols are to be inserted at the end or mid points of line segments.

4.0 REQUIRED DRAWINGS

4.1 Cover Sheet (Title Page)

The cover sheet shall show the following information:

- Name of *Development* or *Subdivision*
- Name and address of *Owner* and *Professional Engineer*.
- Site location plan of *Development* or *Subdivision*.
- Legal description of subject properties.
- File numbers of approving authorities. (i.e. *District* and/or Ministry).
- Complete drawing index of all sheets belonging to the set.
- Other pertinent information

4.2 Key Plan(s)

Key Plans shall show the following information:

- Lot numbers, plan numbers, and road names of the subject *Development* or *Subdivision* and adjoining properties.
- Cross reference of the drawings by outlining the area contained in each drawing and referencing that drawing by drawing number.
- General construction notes.
- Other pertinent information.

4.3 Building Envelope Plan (if applicable)

Building Envelope Plan shall show the following information:

- Overall plan of current phase
- Lot numbers
- Roads, curbs, gutters and sidewalks
- Rights of way and easements
- Offset lines from all property boundaries indicating required building setbacks
- 10 metre by 10 metre square on each parcel indicating the required minimum building envelope
- Notes that indicate the required setbacks from all property boundaries pursuant to the Zoning Bylaw
- Other pertinent information

4.4 Composite Plan(s) (as required)

Composite Plans shall show the following information:

- All existing and proposed utilities, roads, walkways, and sidewalks.
- All rights of way and easements including widths.
- Control monuments with identification number.
- All legal information, including bearings, dimensions, lot numbers, block numbers, legal plan numbers, and street names. All lots must be numbered.
- Show legal lot line dimensions.

- All roadway dimensions including width of right of way, BOC to BOC and BOC to edge of right of way.
- Area of each parcel.
- Other pertinent information.

4.5 Plan / Profile Drawings

Plan/Profile drawings shall show the following information:

4.5.1 General

The following criteria shall apply to all drawings:

- Both plan and profile stationing must be tied to a property line or road boundary.
- The profile shall be shown at true centerline length and projected below the plan in as close a horizontal relationship as possible.
- The top half of a plan/profile sheet shall show the plan view and shall show the legal layout with legal descriptions of all properties, the location of all sidewalks, catch basins, underground utilities such as sewer, water, telephone, television power, manholes, valves, hydrants, and all survey monuments, etc.
- Drawings shall also show existing dwellings, fences, trees, hedges, unusual ground features, existing roads and driveways including the type such as asphalt, concrete or gravel.
- Plan/profile drawings for various services may be combined on one plan providing the plans are clear and readable. Plan/profile drawings may combine the following services:
  - Roads & Storm Drains
  - Sanitary Sewers & Water
  - Roads, Storm Drains, Sanitary Sewers and Water may be included on one drawing depending on the complexity of the design and at the discretion of the *Approving Officer*.

4.5.2 Road Plan/Profile Drawings (may be combined with Storm Drains)

Road plan views shall show the following information:

- Drawings shall show width of road, width of shoulders, and the offset of curb from property line.
- Chainages of the B.C. and E.C. of horizontal curves shall be shown together with the delta angle, centerline radius, tangent length, and centerline arc length. Curb radii are not required if the centerline radius and road width are shown, except on curb returns at intersections and at the end of cul-de-sacs.

Road profile views shall show the following information:

- The design gutter and/or centerline grade (%).
- Vertical curve chainage and elevations of B.C., E.C. and P.I.:
  - the external value, e;
  - the length of vertical curve;
  - the chainage and elevation of the low spot of sag curves; and
  - K value of vertical curvature (crest on sag).
- Existing ground elevation along the centerline of the proposed roadway and/or the edge of existing asphalt.

4.5.3 Water Plan/Profile Drawings (may be combined with Sanitary Sewer)

Water plan views shall show the following information:

- Offset of pipelines from property lines.
- Length and size of pipe.
- Offset of connections from property lines.
- The locations of hydrants, valves, services, end-of-main, or other appurtenances referenced to the nearest property line.
- Information on any curves or pipe deflections.
- Easements (existing and/or required).

Water profile views shall show the following information:

- Surface profiles (existing and design, if applicable) over proposed main.
- Length, size, grade, type, and material of pipe.

- Profiles of invert and crown of pipes.
- Location, type and invert elevation of all crossing utilities.

4.5.4 Storm Drains and Sanitary Sewer Plan/Profile Drawings

Storm and Sanitary plan views shall show the following information:

- The structural details of all manholes and chambers, etc. not covered by standard drawings.
- Offset of pipelines from property lines.
- The size of pipe.
- Offset of connections from property lines.
- The locations of manholes, clean-outs and services relating to property lines.
- Information on any curves or pipe deflections.
- Easements (existing and/or required).
- Future curb and gutter lines (if applicable).
- Manhole identification numbers.
- Inverts of service connections at property line (if applicable).
- For storm drainage, features such as ditches, culverts, streams, channels, etc.

Storm and sanitary profile views shall show the following information:

- Surface profiles (existing and design, if applicable) over proposed main.
- Length, size, grade, type, and material of pipe.
- Profiles of invert and crown of pipes.
- Location, type and invert elevation of all crossing utilities.
- Invert elevations of manholes.
- Alignment station of manholes.
- Manhole identification number.
- Rim elevations of proposed or adjusted manholes.

4.6 Grading Plan(s)

In addition to any other requirements presented, grading plans shall show the following information:

4.6.1 General

- Clearing and grubbing boundaries
- Fill and excavation areas (by shading) including structural fill areas
- Locations of required siltation abatement and control measures
- Pre-development contour lines at a maximum 0.5 m interval. The topographic information shall extend a minimum 30.0 m outside the development site
- Proposed contours, slopes, grades, and spot elevations including surface slopes of roadways and other surfaces with arrows indicating the direction of flow.
- Proposed or existing elevations along the boundaries of the subdivision and design elevations at all lot corners and changes of surface slope along property boundaries.
- The minor (5 year return) storm sewer system with the flows calculated per section and the accumulated flows from all upstream sections. Provision must be made for upstream development potential where applicable;
- The major (100-year return) system. The nature and detail of the major conveyance system is to be shown, including all major drainage flow directions, ponding areas and the extent and maximum depth of ponding anticipated for a 1 in 100 year return frequency rainfall event along with the maximum hydraulic grade line. The overall major drainage flow route is to be clearly defined and designated with prominent arrows. Include the direction of surface flows on all surfaces and elevations of overflow points from local depressions and details of channel cross sections.
- Swale details including locations, right of way requirements, slopes, cross sections and construction details for the swales.
- Right of ways and restrictive covenants - Requirements and locations for all right of ways and restrictive covenants related to drainage provisions and development restrictions associated with the drainage of the property.

4.6.2 Lot Grading

- All existing corner lot elevations
- All proposed corner lot elevations
- Lot drainage pattern - The direction of surface drainage for each lot is to be identified, to indicate whether split drainage or through drainage is contemplated. Proposed

surface drainage for abutting future development lands is to be shown to the extent that it will impact on the subject lands.

- Lot grading details - Typical detail diagrams of the various types of lot grading arrangements, which will normally conform to the figures provided in the Supplementary Detail Drawings, are to be used, identifying for each lot which typical detail applies.
- The proposed building envelope with the minimum finished ground elevation noted for each lot.

4.7 Landscape Plan(s)

Landscape plans shall show the following information:

- Extent of proposed landscape works and services
- Existing and proposed property information, including lot lines, easements, right of ways, legal descriptions, addresses and dimensions
- Existing and proposed contours, slopes, grades and spot elevations for landscaped areas (if not already shown on grading plan)
- Existing and proposed buildings, structures, roads, curbs, sidewalks, walls, fences, signs, site features and other appurtenances
- Existing vegetation proposed to be removed, relocated or retained
- Areas of proposed preservation, naturalization, restoration, lawn and landscaping, including soil types, depths and amendments
- Proposed plant species name (botanical and common), size and planting condition
- Existing and proposed irrigation systems (if required)
- Construction details and specifications or other pertinent information as required.

4.8 Integrated Stormwater Management Plan (ISMP)

In addition to any other requirements presented, Integrated Stormwater Management Plans shall generally show the following information:

- Site and surrounding area (400 m minimum outside development) showing roads and major features. A small location plan of the watershed is also to be included.

- Major contours at 1.0 m and minor contours at 0.2 m elevation intervals (existing and proposed)
- Existing and proposed major surface flow paths.
- Detention pond details, if applicable.
- Area, in hectares, of development and the total area of drainage basin.
- Directional arrows of flow within the site and on surrounding areas.
- Sub-catchment boundaries, coefficients and areas.
- Pipe system including size, grade, and minor and major flows (a table may be utilized).
- The subject development is to be highlighted.
- Other pertinent information (see Schedule D)

4.9 Erosion and Sediment Control Plan(s)

In addition to any other requirements presented in this bylaw, Erosion and Sediment Control Plans shall generally show the following information:

- Existing contours of the site at an interval sufficient to determine drainage patterns.
- Final contours if the existing contours are to be significantly changed.
- Final drainage patterns/boundaries.
- Existing vegetation such as significant trees, shrubs, grass, and unique vegetation.
- Limits of clearing and grading.
- Erosion and sediment control measures (temporary and permanent) including locations, names and details, in accordance with "Land Development Guidelines for the Protection of Aquatic Habitat".
- Storm Drainage systems including drain inlets, outlets, pipes, and other permanent drainage facilities (swales, waterways, etc.).

4.10 Street Lighting Plan(s)

A plan view of the street lighting shall be provided. General notes on the plan shall reference municipal standards, specifications and appropriate design criteria.

4.11 Street Sign, Paint Marking, and Traffic Control Device Plans

A drawing identifying signs, markings, and required control devices shall be provided. Detailed drawings may be required for traffic control devices. These plans can be added to road plan drawings if the plan is clear and readable.

4.12 Traffic Management Plan(s)

Detail routes for construction traffic and traffic controls for traffic on existing roads affected by construction may be required if requested by the *Approving Officer*.

4.13 Road Cross Section Plan(s)

Shall be scaled at 1:100 horizontal and 1:50 vertical and shall note the existing ground elevation, the proposed elevations of the road centreline, the curb and gutter (or road edge) and property lines. Cross-sections are required at critical locations as required by the *Approving Officer*.

4.14 Construction Details

Show all proposals for construction which are not covered or specifically detailed in the *District*'s standards. Where there is a *District* or MMCD standard, it is expected to refer to the detail drawing number.

4.15 Electrical, Gas, and Communication Utilities

The *Owner's Professional Engineer* shall obtain and submit engineering drawings from each utility drawing showing detailed design and construction requirements for any necessary *Works and Services*. The *Professional Engineer* shall assemble all drawings and superimpose them onto an overall subdivision compilation drawing(s) to ensure that there are no conflicts between any of the municipal services and the shallow utilities both underground and above ground.

5.0 DRAWING SUBMISSIONS

5.1 Design Submissions

Half-size (11x17) drawings will be considered for design submissions with prior approval from *Approving Officer*.

3 paper copies of all design drawings are required for design submissions.

5.2 Record Drawings

Record Drawings shall be submitted prior to issuance of a *Certificate of Provisional Completion of All Works*. *Record Drawings* must be delivered in both paper and electronic format(s) to the *District*. Record Drawings shall include all drawings in approved design submission or as requested by *Approving Officer*.

The *Owner* shall submit to the *District* a complete set of electronic drawings of the subdivision or development in DWG format compatible with the current version of AutoCAD, as currently used by the District of Chetwynd, in addition to a digital hard copy in Adobe PDF format in accordance with this Schedule.

5.3 Electronic Drawings

5.3.1 General Requirements

The *Owner* shall submit to the *District* a complete set of electronic drawings of the *Subdivision* or *Development* in AutoCAD .dwg format.

The electronic drawing shall be prepared in accordance with Section 3. All external files associated with the electronic drawing (e.g. special fonts, line types, and/or images) shall be supplied with the electronic drawing submission. No drawing shall be submitted that contains any external references (xrefs). All externally referenced drawings shall be bound prior to submittal.

5.4 Digital Hard Copies

A digital hard copy is any digital file that is reproducible without the ability to modify the drawings contents or appearance.

5.4.1 General Requirements

Adobe's Portable Document Format (*.pdf) is the preferred file type. However alternatives may be considered such as Autodesk's Drawing Web Format (*.dwf)

Drawing sets submitted as a digital hard copy shall be electronically sealed by the *Professional Engineer*.

5.4.2 Device/Document Settings for Plotting Adobe Portable Document Format

Ensure all text is legible and the shading and hatching ordered so as not to block or hide other line work and/or text.

The following settings shall be used when plotting the drawings to Adobe PDF:

- paper size to be ANSI D 22" x 34"
- layout to be "landscape"
- graphic print quality to be no less than "600 dpi"

SCHEDULE K

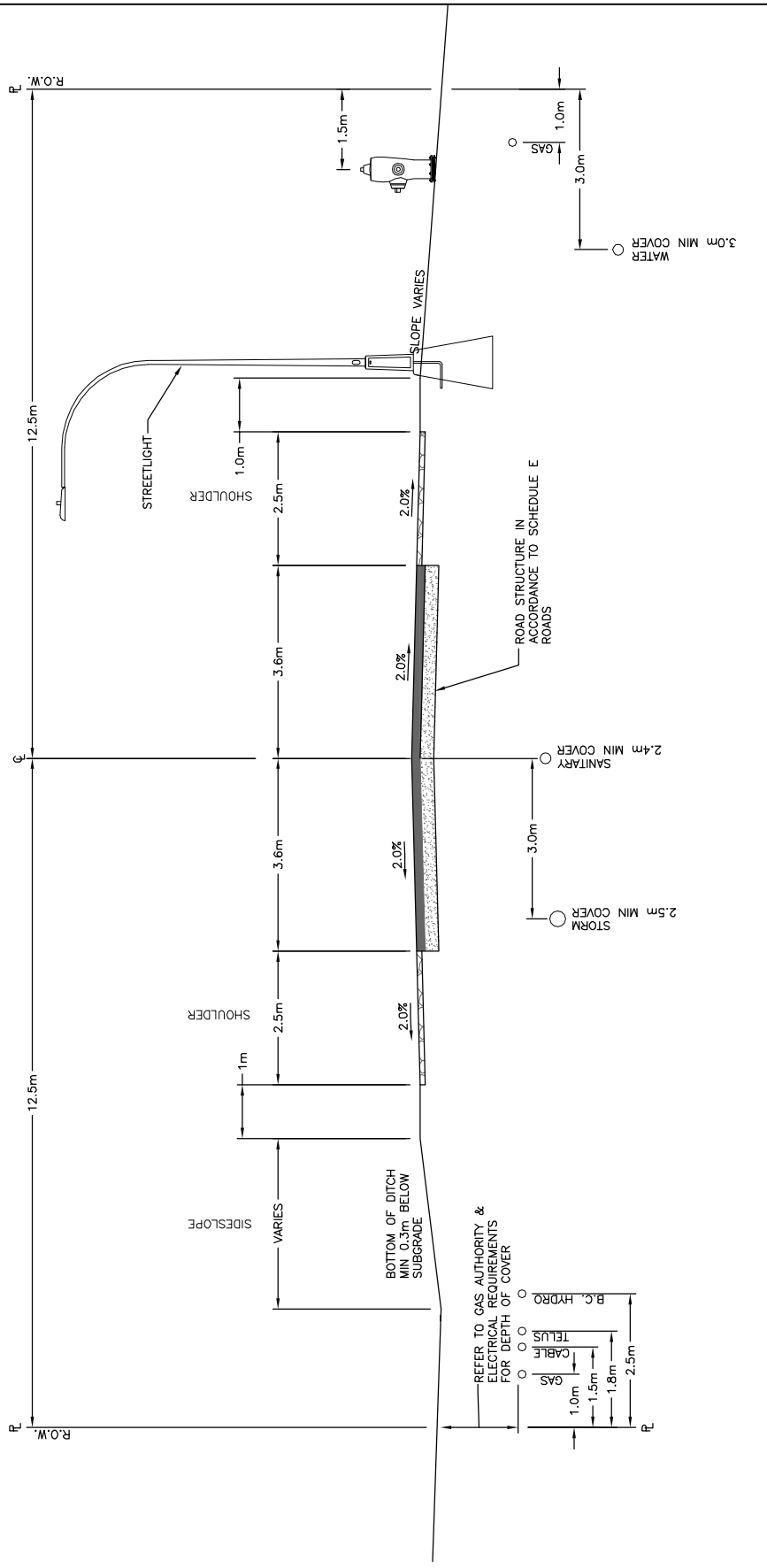
SUPPLEMENTARY DETAIL DRAWINGS

March 2013

SCHEDULE K - SUPPLEMENTARY DETAIL DRAWINGS

Naming of Supplementary Detail Drawings follows MMCD Standard Detail Drawings naming convention. Supplementary drawings that replace an existing MMCD Standard Detail Drawing are denoted with an "S" in front of the MMCD Standard Detail Drawing number.

Drawing Number	Drawing Title
A	**Roads**
A1	Arterial Road – Typical Section
A2	Collector – Typical Section
A3	Local Road – Typical Section
A4	Local Road (Cul-De-Sac) – Typical Section
A5	Industrial Collector Road – Typical Section
A6	Asphalt Walkway – Typical Section
A7	Approved Driveway Configuration Examples for Duplex Lots
G	**General**
SG4	Typical Utility Trench Section and Pipe Bedding Detail
SG8	Pipe Anchor Blocks
G9	Water and Sewer Crossings
G10	Corrosion Protection in Native Soil at Steel or Iron Fittings
G11	Landscaping and Approved Tree Species
G12	Lot Grading Typical Detail – Split Drainage
S	**Storm and Sanitary**
S16	Large Diameter Water and Sewer Services
S17	Rainfall Intensity-Duration-Frequency Curve
W	**Water**
SW4	Typical Hydrant Assembly
SW6/SW7	Standard Air Valve Assembly
SW8	Buried Standpipe Detail
W12	Pressure Main Thrust Blocks



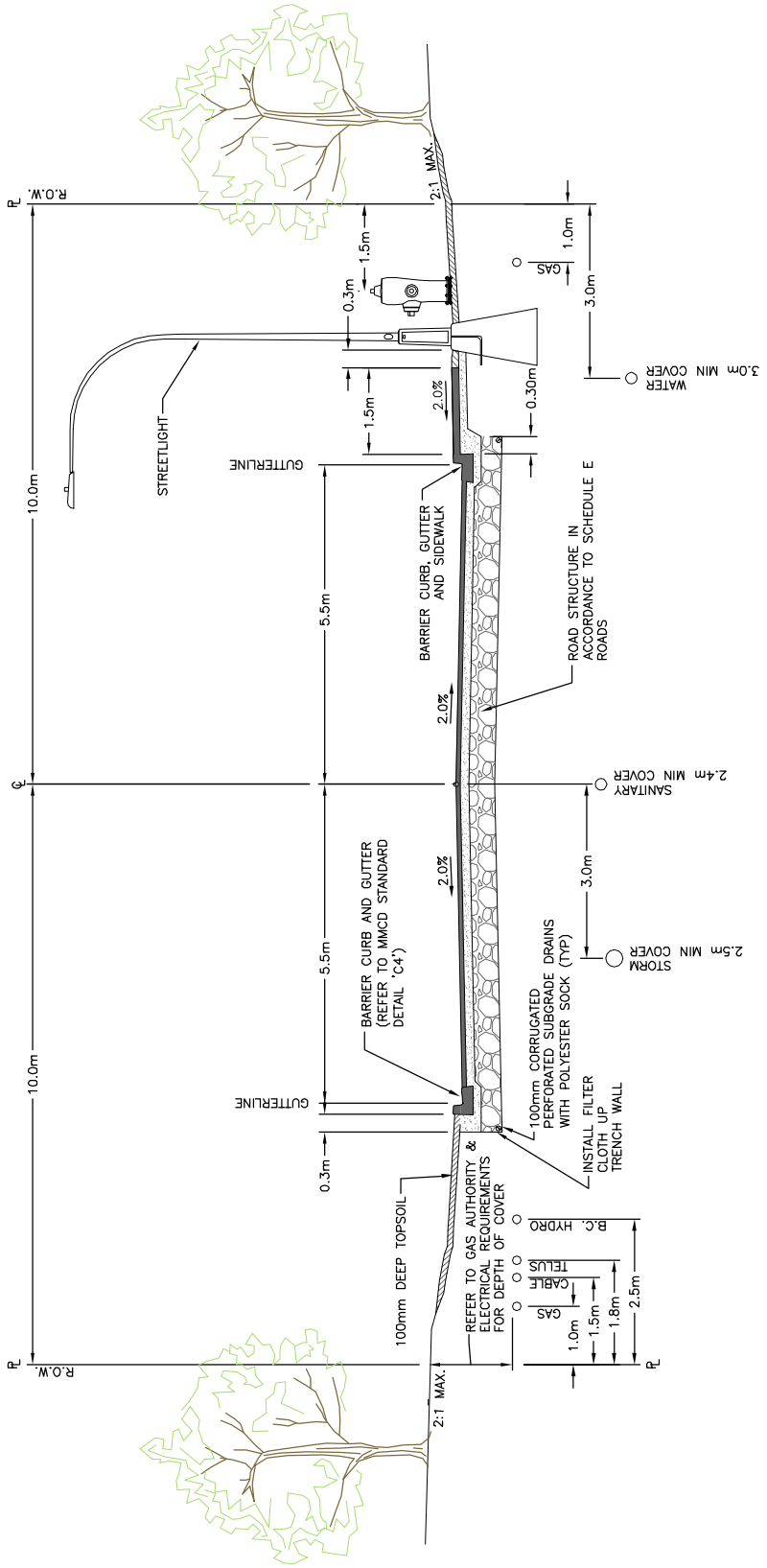
U:\Projects_FSJ\1320\0070\01\D-Drafting-Design-Analysis\CADD\dwgs\CURRENT\A-Road Cross Sections.dwg, A1, 2013/01/23 08:29 am JHofmann

DISTRICT OF CHETWYND
BRITISH COLUMBIA, CANADA

REV.	BY	DESCRIPTION	DATE

ARTERIAL ROAD TYPICAL SECTION

APPROVED BY:	–	DATE DRAWN: 2012/12/21	SCALE:	1:125	DRAWING No.:	A1



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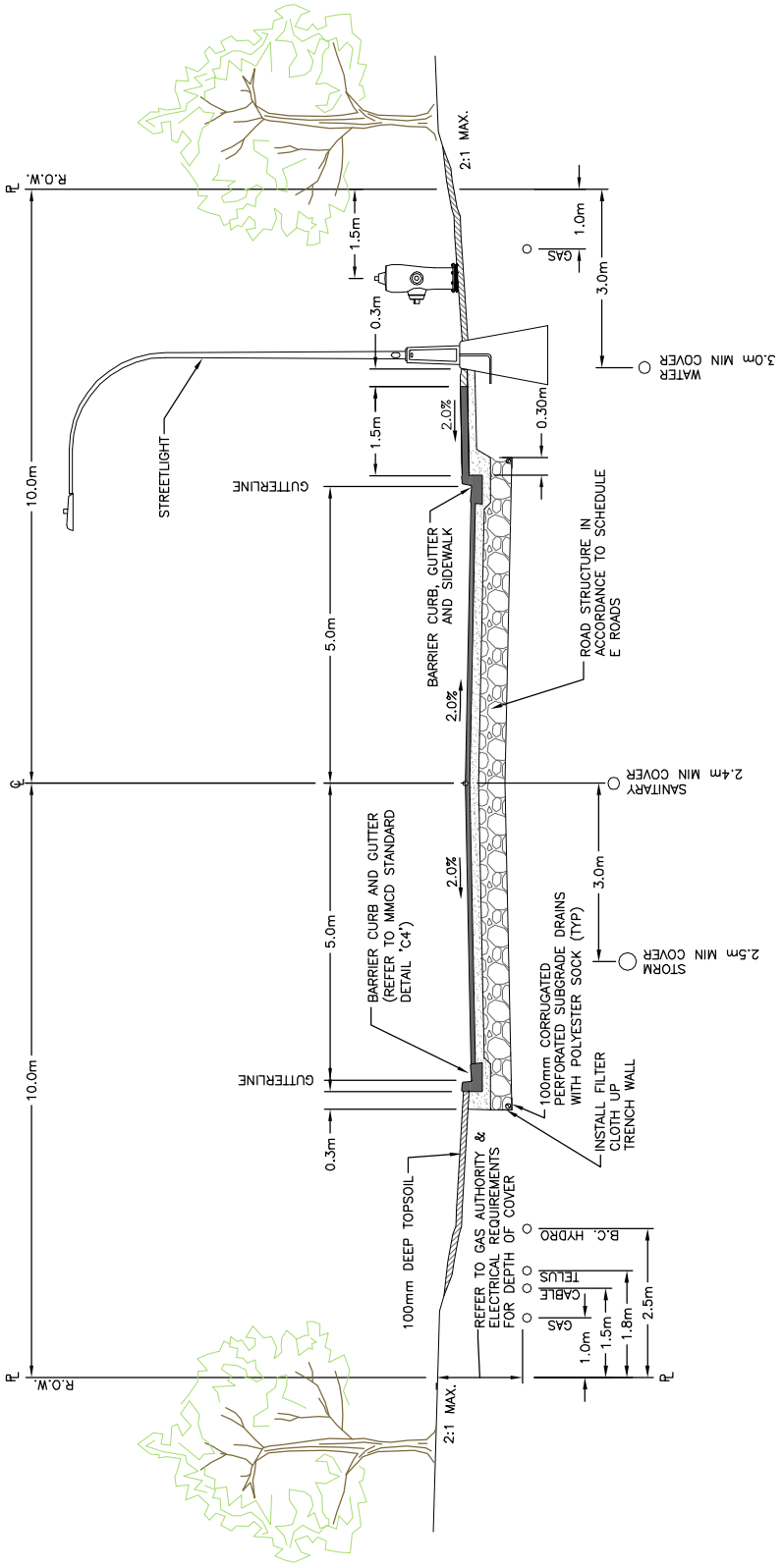
DISTRICT OF CHETWYND
BRITISH COLUMBIA, CANADA

REV.	BY	DESCRIPTION	DATE

COLLECTOR TYPICAL SECTION

APPROVED BY:	–	DATE DRAWN: 2012/12/21	SCALE: 1:125	DRAWING No.: A2



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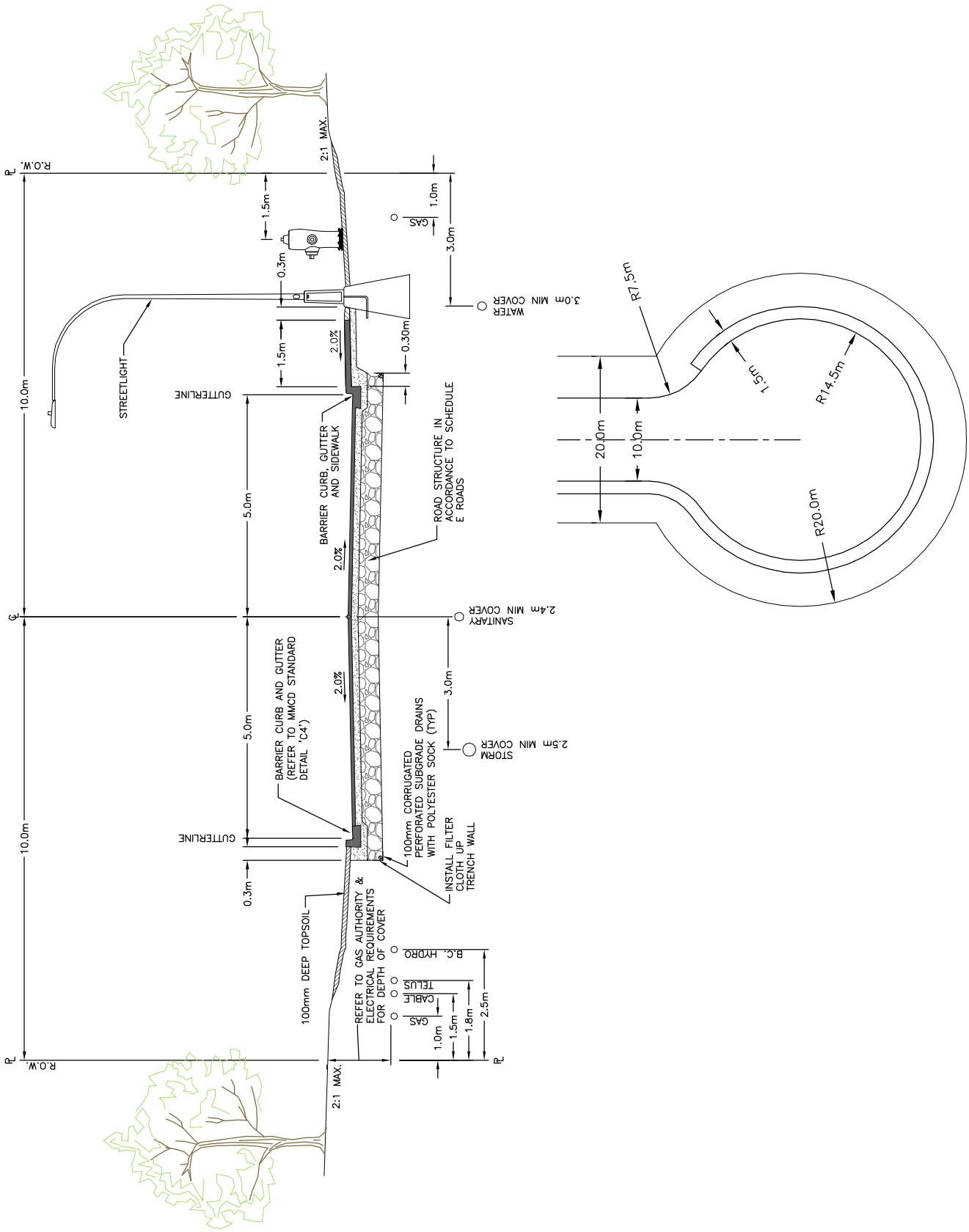
DISTRICT OF CHETWYND
BRITISH COLUMBIA, CANADA

REV.	BY	DESCRIPTION	DATE

LOCAL ROAD TYPICAL SECTION

APPROVED BY:	–	DATE DRAWN: 2012/12/21	SCALE:	1:125	DRAWING No.:	A3



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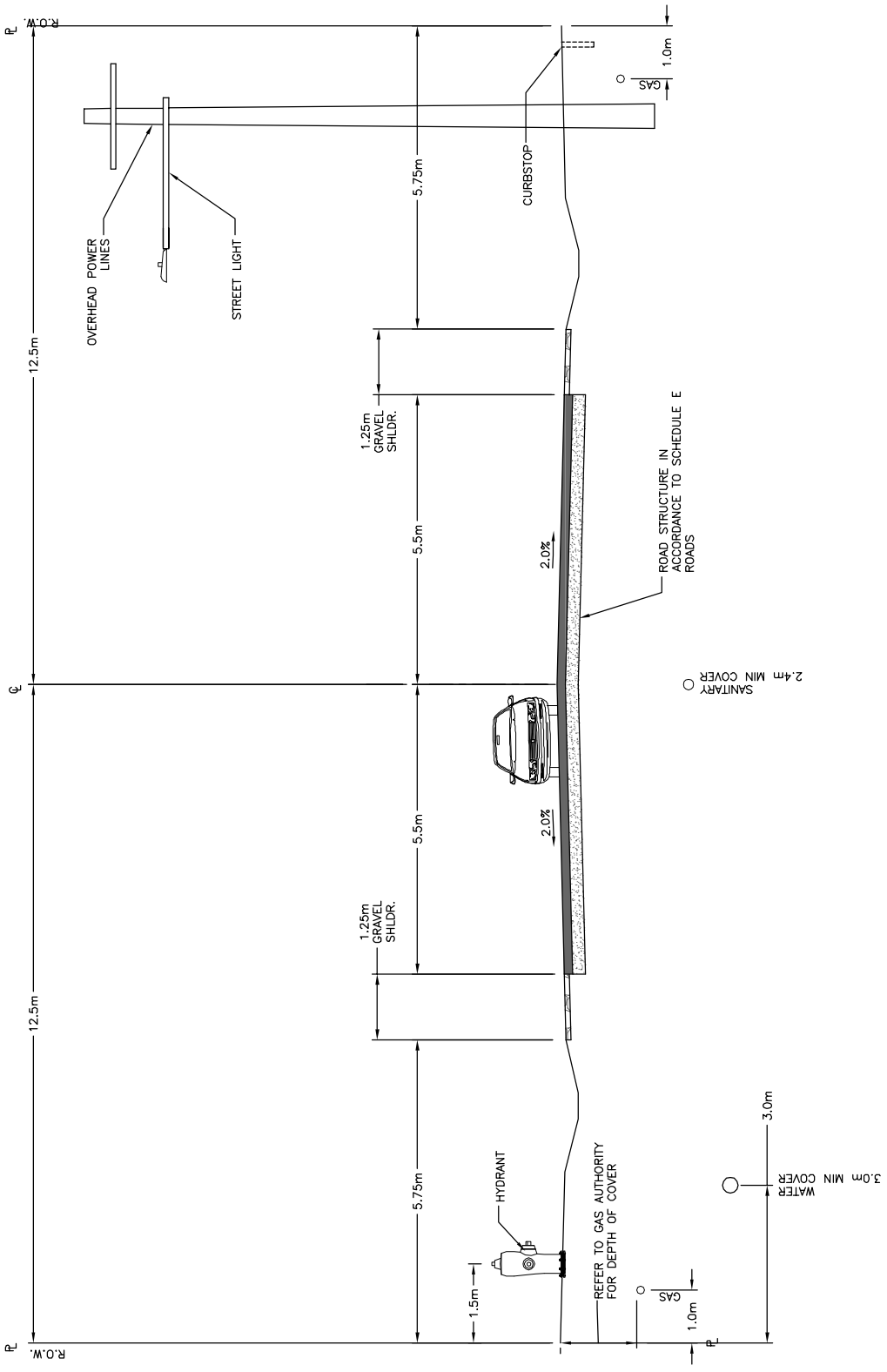
DISTRICT OF CHETWYND
BRITISH COLUMBIA, CANADA

REV.	BY	DESCRIPTION	DATE

LOCAL ROAD (CUL-DE-SAC) TYPICAL SECTION

APPROVED BY:	–	DATE DRAWN: 2012/12/21	SCALE:	1:125	DRAWING No.:	A4



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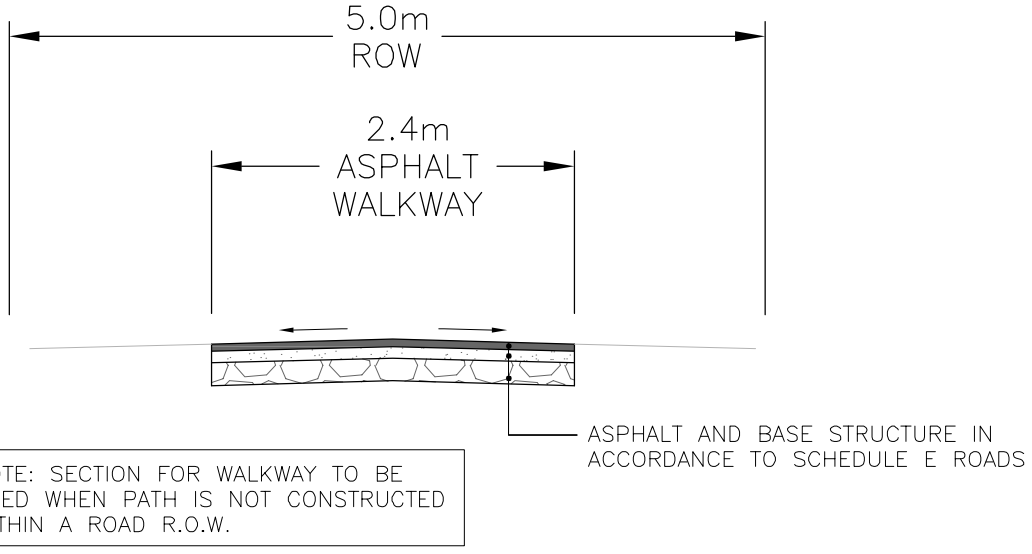
DISTRICT OF CHETWYND
BRITISH COLUMBIA, CANADA

REV.	BY	DESCRIPTION	DATE

INDUSTRIAL COLLECTOR ROAD TYPICAL SECTION

APPROVED BY:	–	DATE DRAWN: 2012/12/21	SCALE:	1:125	DRAWING No.:	A5



NOTE: SECTION FOR WALKWAY TO BE USED WHEN PATH IS NOT CONSTRUCTED WITHIN A ROAD R.O.W.

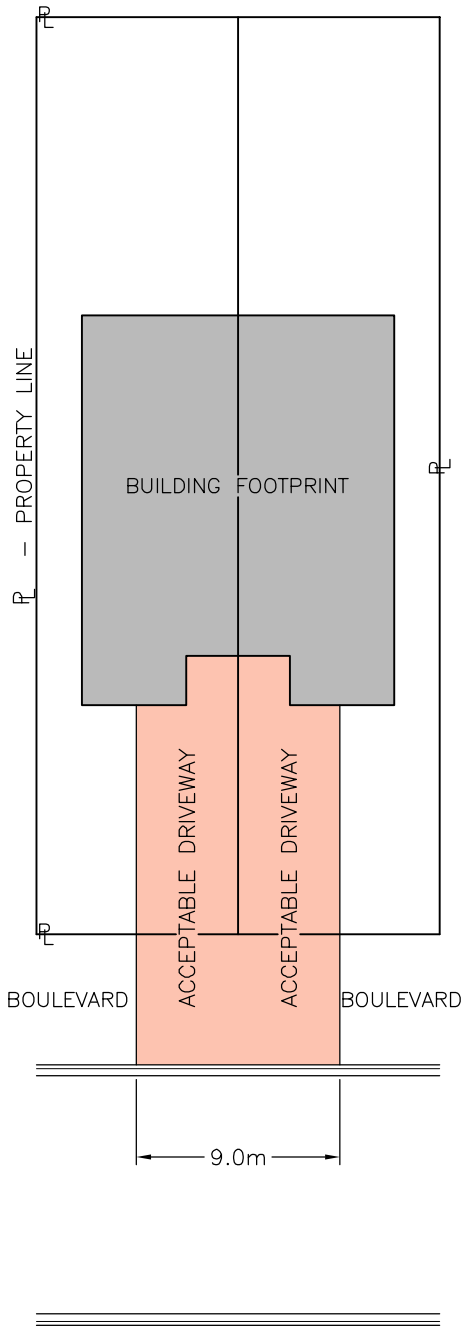
DISTRICT OF CHETWYND
BRITISH COLUMBIA, CANADA

REV.	BY	DESCRIPTION	DATE

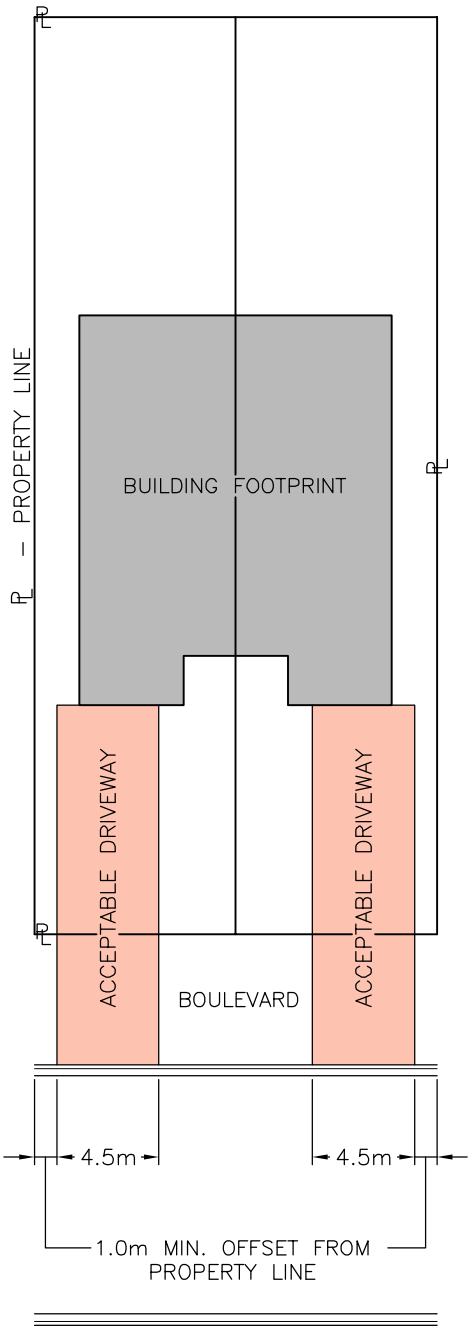
ASPHALT WALKWAY TYPICAL SECTION

APPROVED BY:	–	DATE DRAWN: 2012/12/21	SCALE:	1:50	DRAWING No.:	A6

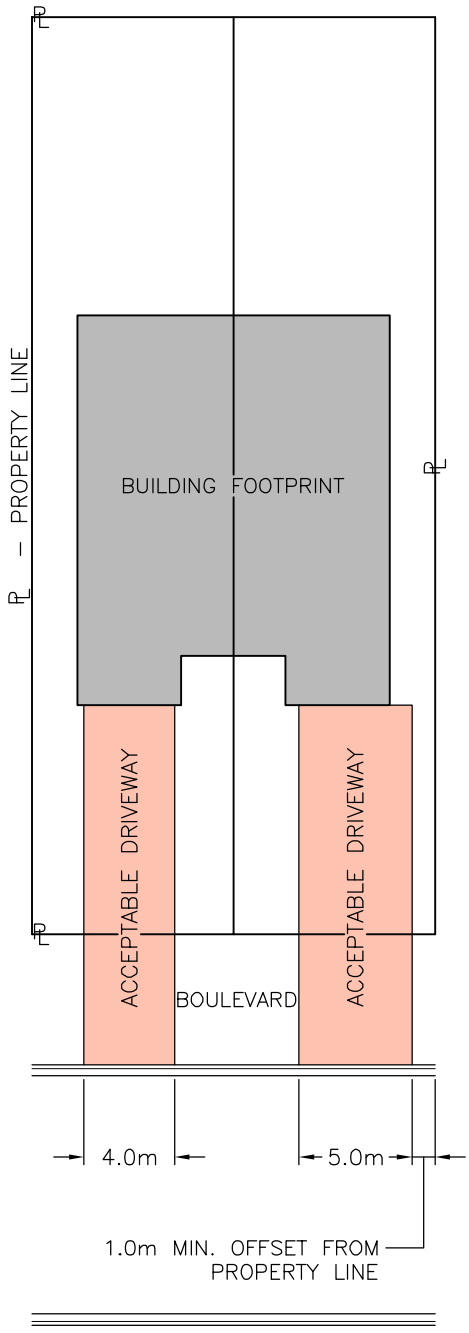
EXAMPLE 1



EXAMPLE 2



EXAMPLE 3



NOTE: TOTAL WIDTH OF DRIVEWAYS FOR DUPLEX LOTS SHALL NOT EXCEED 9m.

THIS SPECIFICATION MUST BE READ IN CONJUNCTION WITH THE LATEST VERSION OF THE MMCD AND THE SCHEDULES IN THE SUBDIVISION SERVICING BYLAW. WHERE THERE ARE CONTRADICTIONS, THIS DRAWING SHALL PREVAIL.

DISTRICT OF CHETWYND
BRITISH COLUMBIA, CANADA

REV.	BY	DESCRIPTION	DATE

APPROVED DRIVEWAY CONFIGURATION EXAMPLES FOR DUPLEX LOTS

APPROVED BY:	—	DATE DRAWN:	12/12/12	SCALE:	N.T.S.	DRAWING No.:	A7

ALL TRENCH BACKFILL AND COMPACTION TO BE 95% SPMDD.

UNIMPROVED AREA TO BE RESTORED WITH 100mm DEPTH OF TOPSOIL

LANDSCAPED AREA TO BE RESTORED TO PREVIOUSLY EXISTING CONDITION.

RESTORE WITH MIN. 300mm OF GRANULAR BASE COMPACTED TO 100% SPMDD

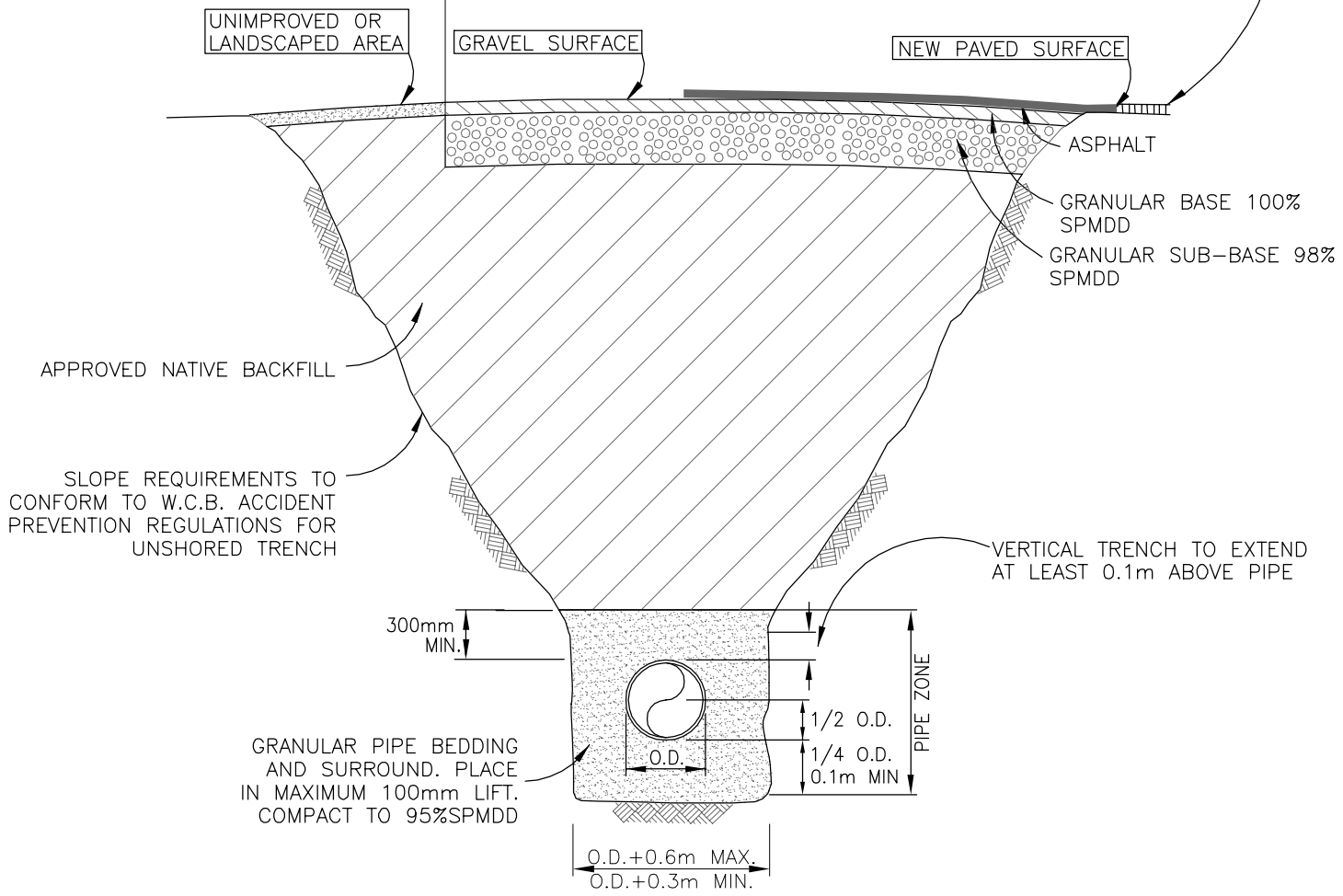
ALL TRENCH BACKFILL AND COMPACTION TO BE 98% SPMDD

RESTORE AND CONSTRUCT TO SPECIFIED DEPTHS AS PER ROAD CLASSIFICATION.

IF EXISTING STRUCTURE IS THICKER OR THINNER, TAPER TO PROPOSED STRUCTURE GRADUALLY TO ENSURE SUBGRADE DRAINAGE.

ALL BACKFILL AND COMPACTION TO BE 98% SPMDD

THE EDGES OF EXISTING PAVEMENT SHALL BE COATED WITH AN APPROVED BITUMINOUS BONDING AGENT PRIOR TO THE PLACING OF ASPHALT.



TYPICAL UTILITY TRENCH & PIPE BEDDING DETAIL

NOTES:
1. MMCD TYPE 1 BEDDING TO BE USED UNLESS OTHERWISE SPECIFIED.
2. TRENCHING TO COMPLY WITH ALL REQUIREMENTS OF WORKSAFE BC.

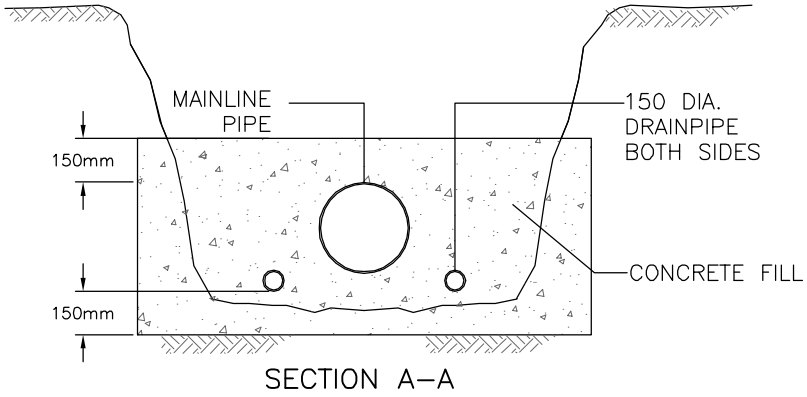
THIS SPECIFICATION MUST BE READ IN CONJUNCTION WITH THE LATEST VERSION OF THE MMCD AND THE SCHEDULES IN THE SUBDIVISION SERVICING BYLAW. WHERE THERE ARE CONTRADICTIONS, THIS DRAWING SHALL PREVAIL.

DISTRICT OF CHETWYND
BRITISH COLUMBIA, CANADA

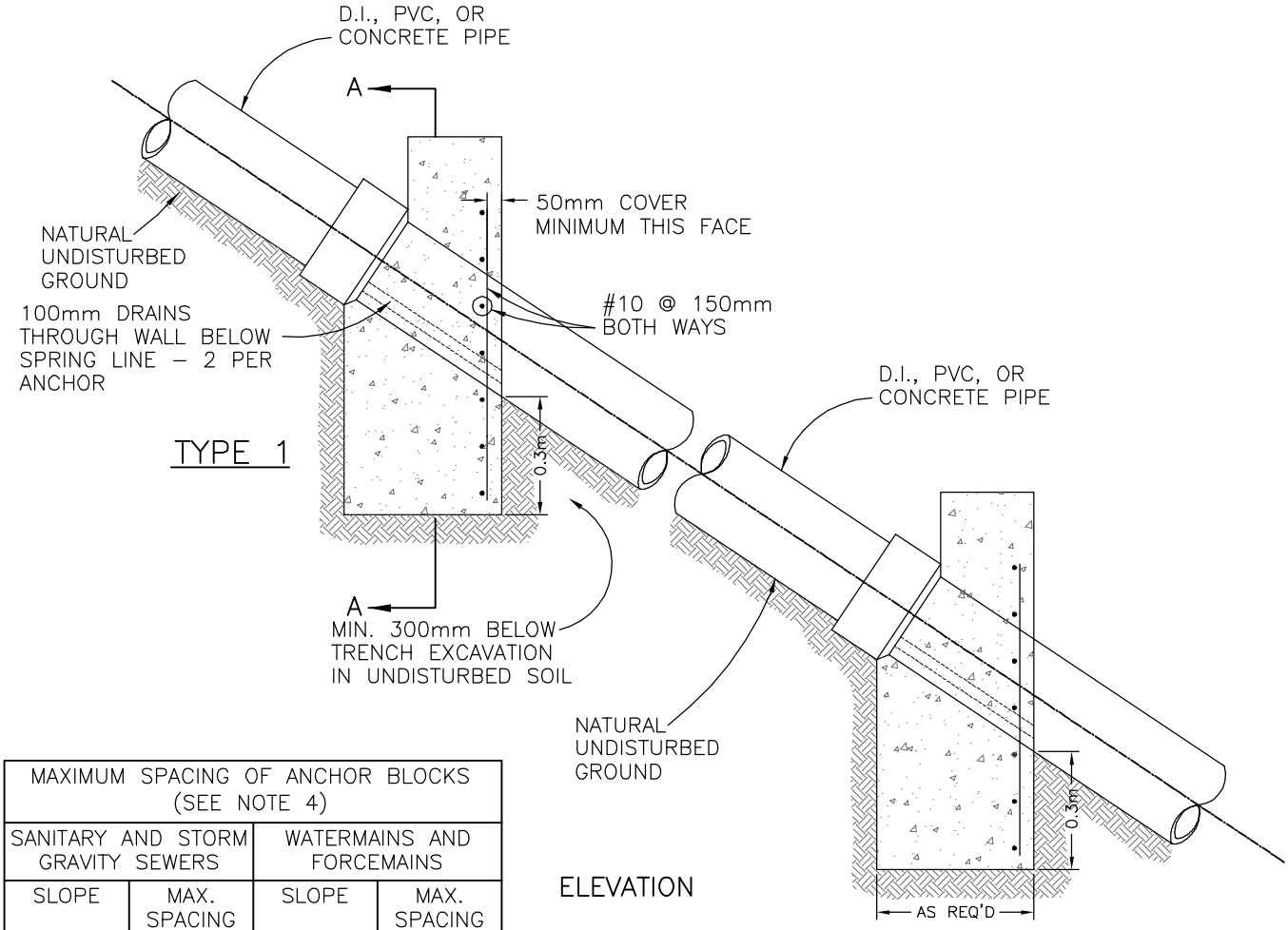
REV.	BY	DESCRIPTION	DATE

TYPICAL UTILITY TRENCH SECTION AND PIPE BEDDING DETAIL

APPROVED BY:	—	DATE DRAWN:	12/12/12	SCALE:	N.T.S.	DRAWING No.:	SG4



SECTION A–A



ELEVATION

MAXIMUM SPACING OF ANCHOR BLOCKS (SEE NOTE 4)			
SANITARY AND STORM GRAVITY SEWERS		WATERMAINS AND FORCEMAINS	
SLOPE	MAX. SPACING	SLOPE	MAX. SPACING
15%–20%	25m	10% OR GREATER	10m
20%–35%	20m		
35%–50%	15m		
50%–OVER	10m		

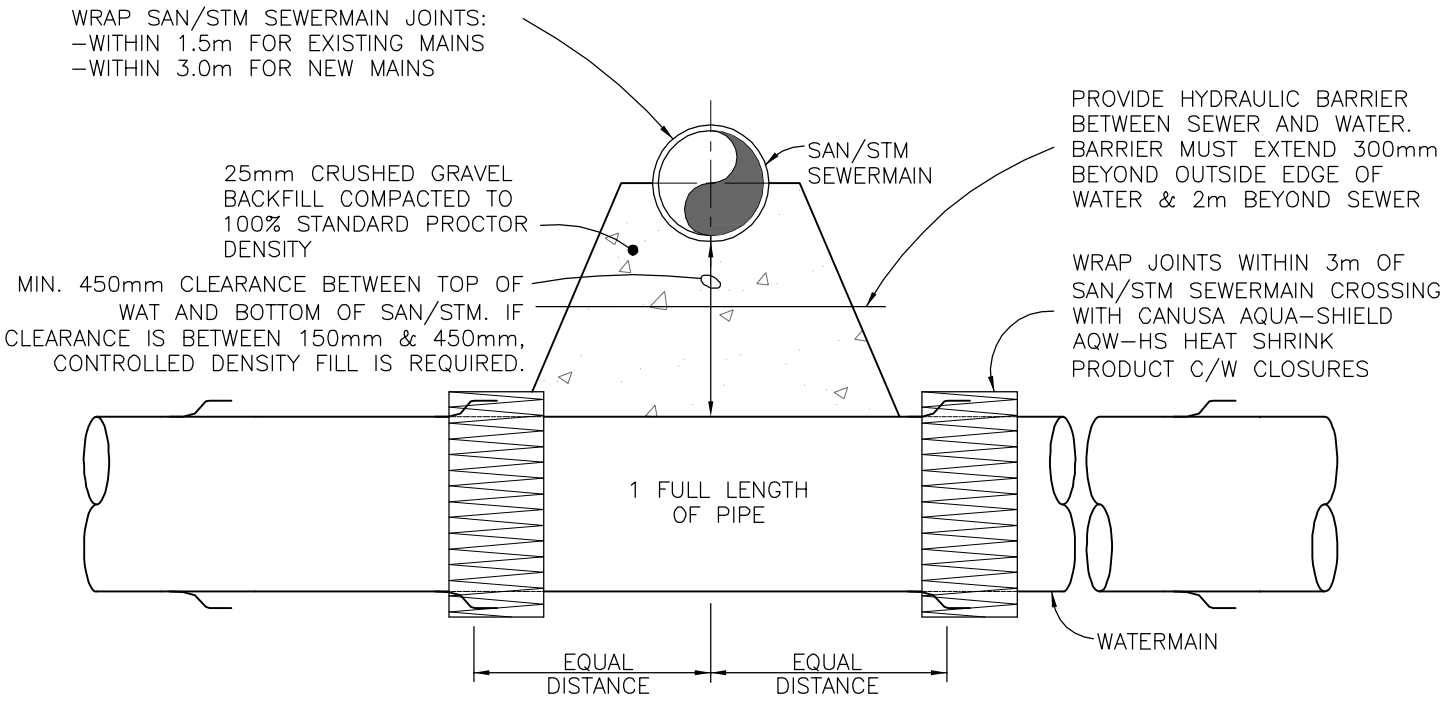
THIS SPECIFICATION MUST BE READ IN CONJUNCTION WITH THE LATEST VERSION OF THE MMCD AND THE SCHEDULES IN THE SUBDIVISION SERVICING BYLAW. WHERE THERE ARE CONTRADICTIONS, THIS DRAWING SHALL PREVAIL.

DISTRICT OF CHETWYND
BRITISH COLUMBIA, CANADA

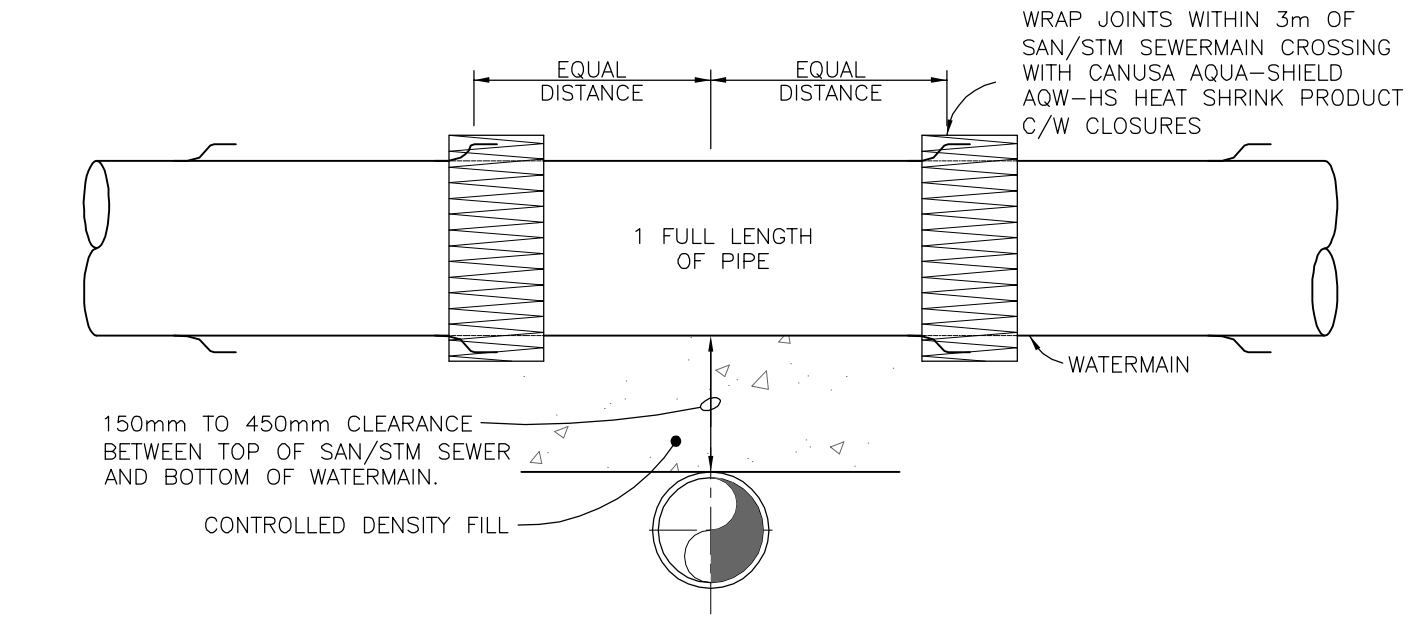
REV.	BY	DESCRIPTION	DATE

PIPE ANCHOR BLOCKS

APPROVED BY:	–	DATE DRAWN:	12/12/12	SCALE:	N.T.S.	DRAWING No.:	SG8



WATER CROSSING UNDER SAN/STM SEWER



WATER CROSSING OVER SAN/STM SEWER (150mm TO 450mm CLEARANCE)

NOTE: WHERE WATER CROSSES OVER SAN/STM WITH GREATER THAN 450mm CLEARANCE NO SPECIAL PROTECTION IS REQUIRED

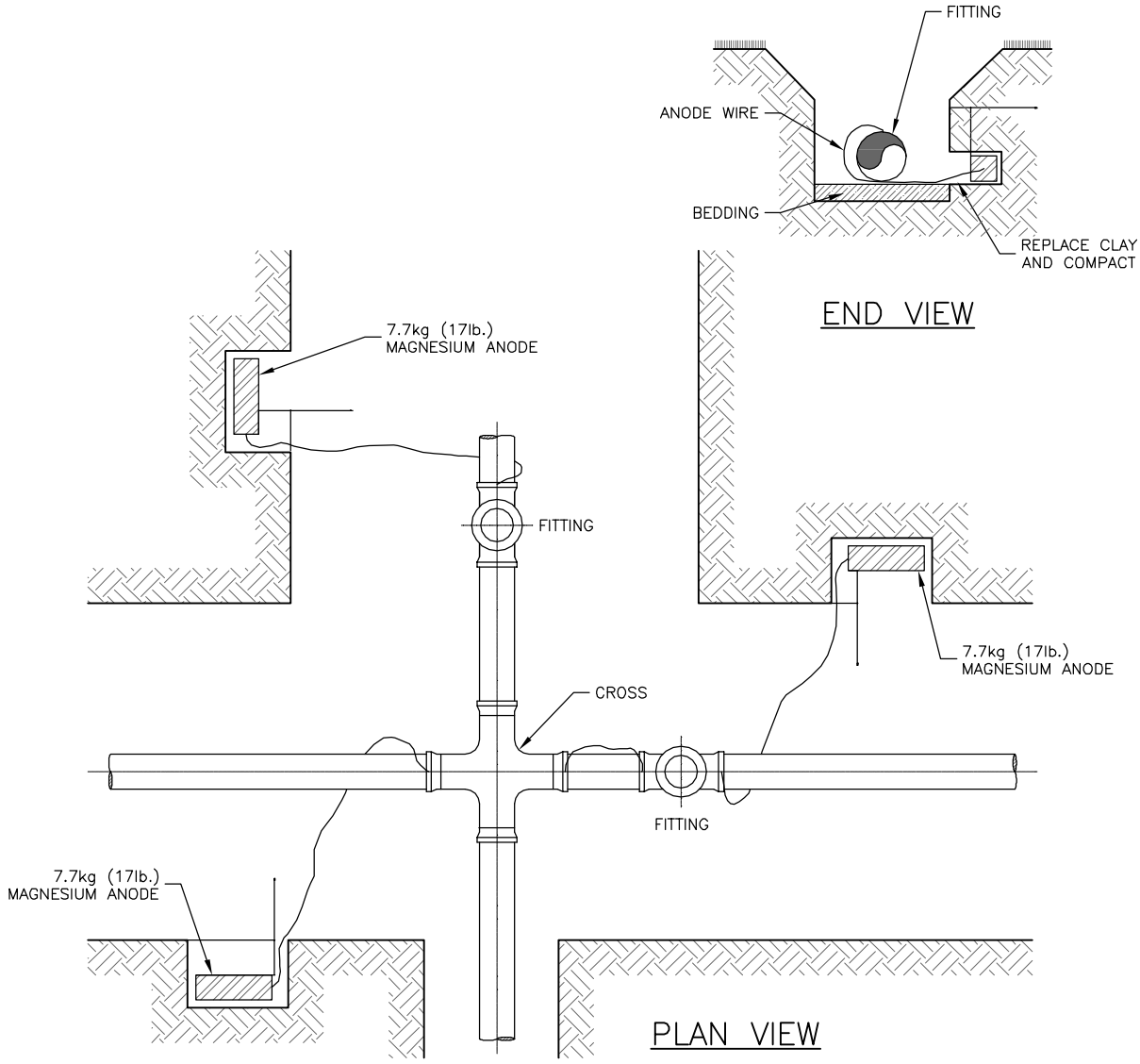
THIS SPECIFICATION MUST BE READ IN CONJUNCTION WITH THE LATEST VERSION OF THE MMCD AND THE SCHEDULES IN THE SUBDIVISION SERVICING BYLAW. WHERE THERE ARE CONTRADICTIONS, THIS DRAWING SHALL PREVAIL.

DISTRICT OF CHETWYND
BRITISH COLUMBIA, CANADA

REV.	BY	DESCRIPTION	DATE

WATER & SEWER CROSSINGS

APPROVED BY:	–	DATE DRAWN:	12/12/12	SCALE:	N.T.S.	DRAWING No.:	G9



INSTALLATION PROCEDURES:

1.) INSTALL ANODE AT APPROX. PIPE DEPTH IN NATIVE SOIL.
2.) ANODES TO BE EMBEDDED INTO TRENCH WALL TO PROVIDE FOR A MINIMUM OF 50mm OF NATIVE CLAY COMPLETELY SURROUNDING THE ANODE.
3.) ANODES TO BE AT LEAST 300mm CLEAR OF THRUST BLOCK.
4.) ALL METALLIC FITTINGS TO BE EPOXY COATED ACCORDING TO THE APPROVED PRODUCTS LIST. IF EPOXY COATING IS CHIPPED, USE TOUCH UP EPOXY PAINT.
5.) INSTALL ONE 7.7kg (17lb.) MAGNESIUM ANODE PER FITTING ACCORDING TO THE APPROVED PRODUCTS LIST.
6.) ATTACH ANODE TO FITTING BY FUSING METHODS (CADWELD OR THERMITE WELD)
7.) IF FITTINGS ARE IN CLOSE PROXIMITY, CONDUCTIVELY CONNECT FITTING WITH A #10 AWG WIRE THERMITE WELDED TO FITTINGS.
8.) WHERE BOLTS ARE USED TO CONNECT FLANGES OR FITTINGS, SCRATCH EPOXY COATING TO ENSURE CONTINUITY BETWEEN FITTINGS AND BOLTS.

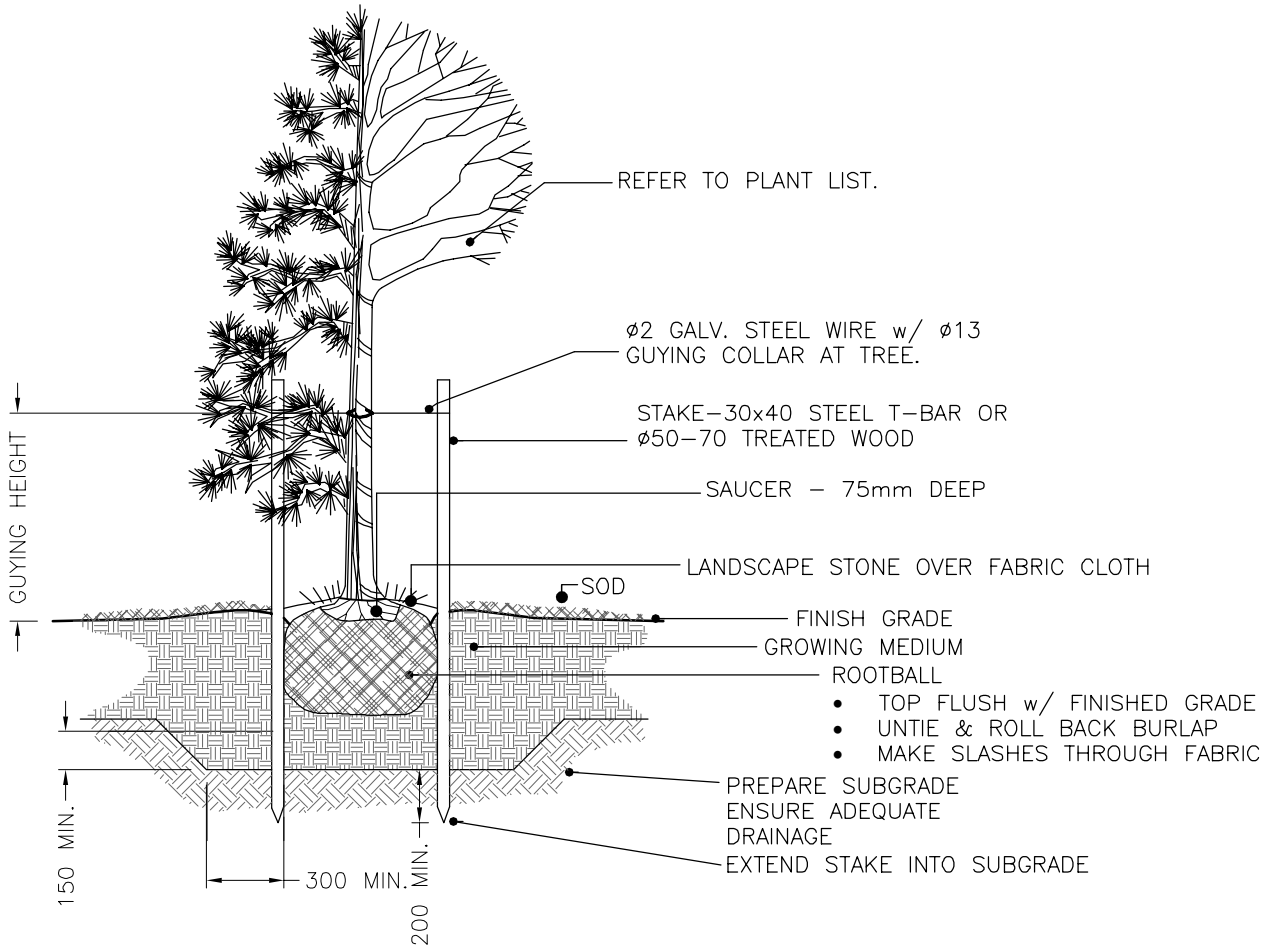
THIS SPECIFICATION MUST BE READ IN CONJUNCTION WITH THE LATEST VERSION OF THE MMCD AND THE SCHEDULES IN THE SUBDIVISION SERVICING BYLAW. WHERE THERE ARE CONTRADICTIONS, THIS DRAWING SHALL PREVAIL.

DISTRICT OF CHETWYND
BRITISH COLUMBIA, CANADA

REV.	BY	DESCRIPTION	DATE

CORROSION PROTECTION IN NATIVE SOIL AT STEEL OR IRON FITTINGS

APPROVED BY:	–	DATE DRAWN:	13/01/21	SCALE:	N.T.S.	DRAWING No.:	G–10



NOTES:

1. INSTALL GUY WIRES AT 50% OR 75% OF TREE HEIGHT. DO NOT REMOVE OR CONSTRAIN ANY BRANCHES.

2. MIN. SIZE 50mm CALIPRE

3. APPROVED SPECIES:

BETULA PAPYRIFERA
CARAGANA ARBORESCENS ' SUTHERLAND'
FRAXINUS 'NORTHERN GEM'
FRAXINUS 'NORTHERN TREASURE'
FRAXINUS PENNSYLVANICA 'PATMORE'
MALUS BACCATA
MALUS 'DOLGO'
MALUS 'BIG RIVER'
MALUS 'MAKAMIK'
MALUS 'PINK SPIRE'
MALUS 'ROYALTY'
MALUS 'RUDOLPH'
MALUS 'THUNDERCHILD'
PRUNUS PADUS COMMUTATA
SALIX PENTANDRA
SORBUS AMERICANA
SORBUS AUCUPARIA 'ROSSICA'
SORBUS DECORA
TILLIA X FLAVESCENS 'DROPMORE'
ULMUS AMERICANA 'BRANDON'
LARIX SIBERICA
PICEA GLAUCA
PICEA PUNGENS
PINUS BANKSIANA
PINUS CEMBRA
PINUS CONTORTA VAR. LATIFOLIA
PINUS SYLVESTRIS

4. SPACING: TREE SPECIFIC

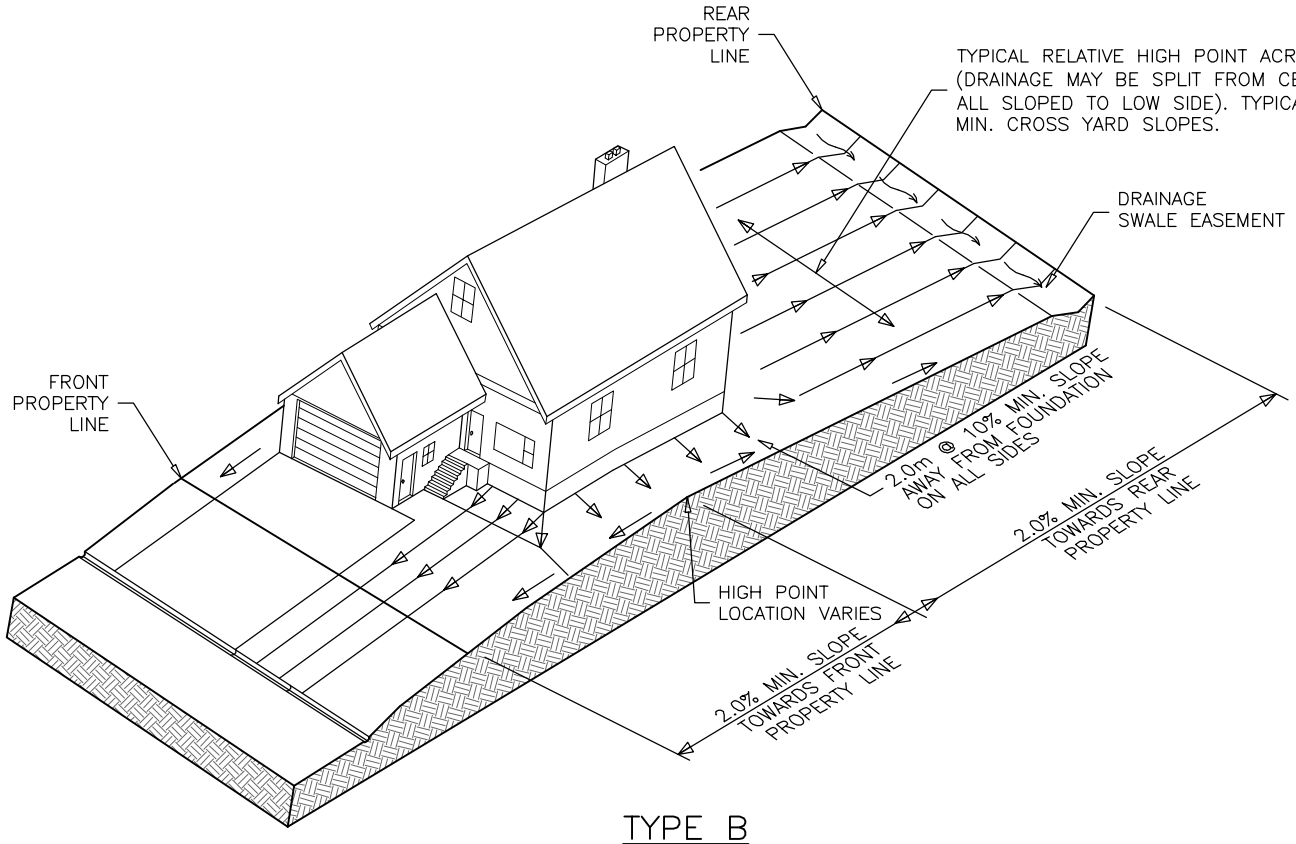
THIS SPECIFICATION MUST BE READ IN CONJUNCTION WITH THE LATEST VERSION OF THE MMCD AND THE SCHEDULES IN THE SUBDIVISION SERVICING BYLAW. WHERE THERE ARE CONTRADICTIONS, THIS DRAWING SHALL PREVAIL.

DISTRICT OF CHETWYND
BRITISH COLUMBIA, CANADA

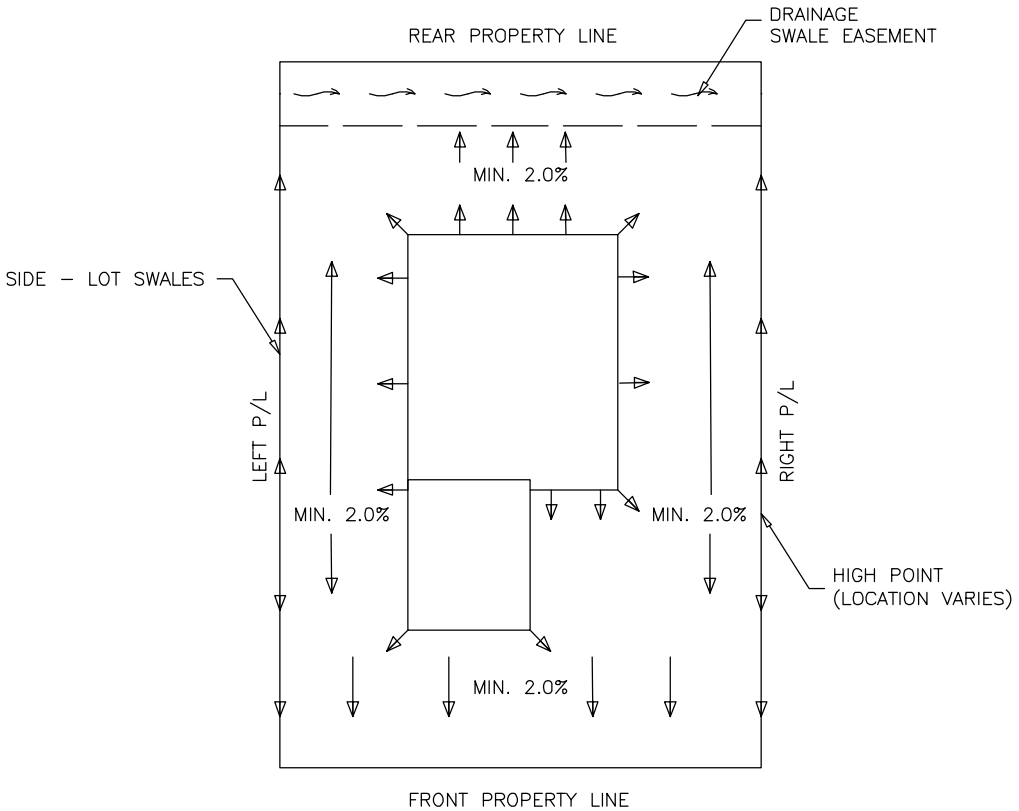
REV.	BY	DESCRIPTION	DATE

LANDSCAPING AND APPROVED TREE SPECIES

APPROVED BY:	–	DATE DRAWN:	13/01/19	SCALE:	N.T.S.	DRAWING No.:	G11



TYPE B
SPLIT DRAINAGE



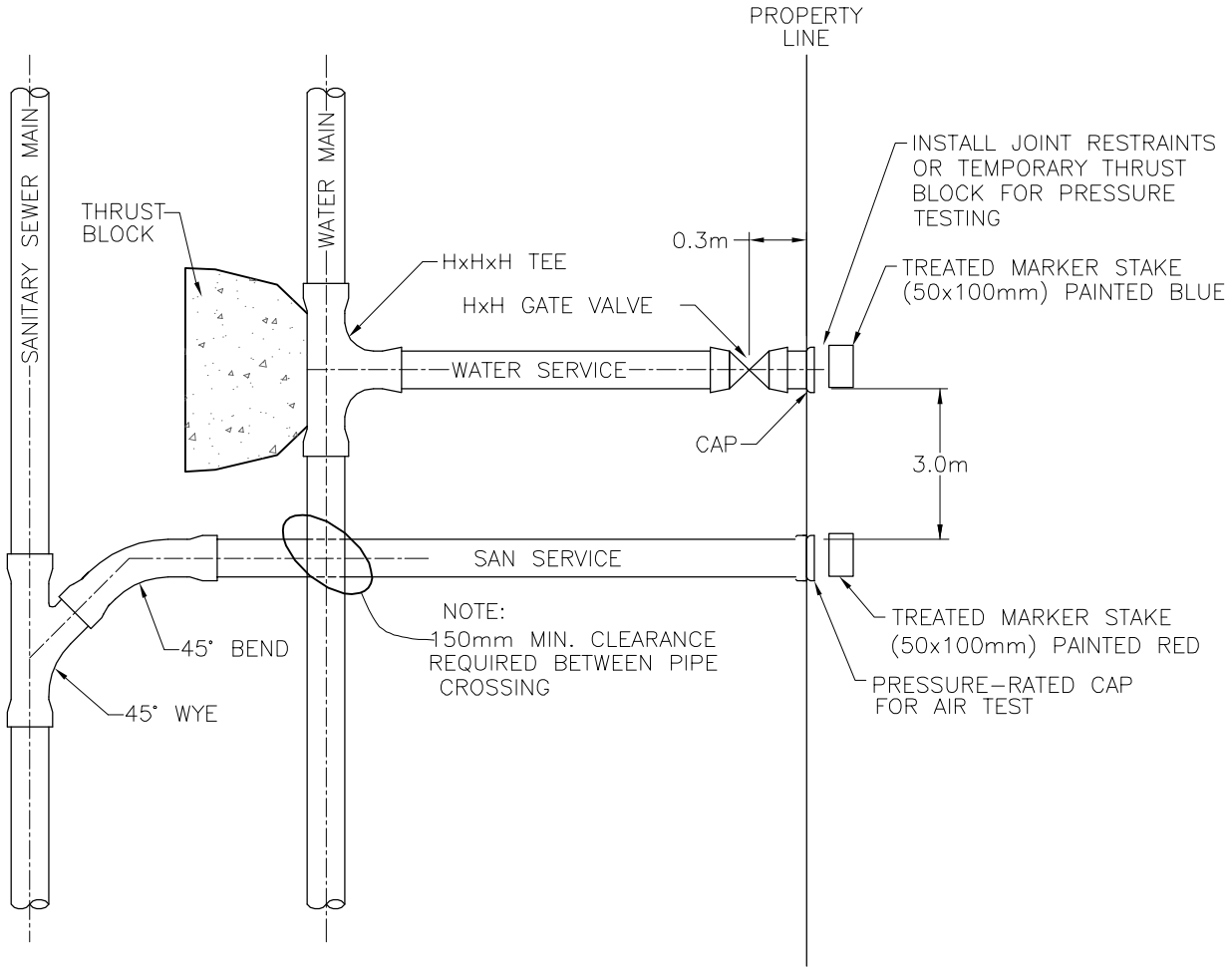
THIS SPECIFICATION MUST BE READ IN CONJUNCTION WITH THE LATEST VERSION OF THE MMCD AND THE SCHEDULES IN THE SUBDIVISION SERVICING BYLAW. WHERE THERE ARE CONTRADICTIONS, THIS DRAWING SHALL PREVAIL.

DISTRICT OF CHETWYND
BRITISH COLUMBIA, CANADA

REV.	BY	DESCRIPTION	DATE

LOT GRADING TYPICAL DETAIL SPLIT DRAINAGE

APPROVED BY:	–	DATE DRAWN:	12/12/12	SCALE:	N.T.S.	DRAWING No.:	G12



NOTES:

- ALL CAST IRON FITTINGS TO BE EPOXY COATED
- ALL PIPE JOINTS WITHIN 3m OF ANOTHER UTILITY CROSSING, TO BE WRAPPED WITH CANUSA – CPS AQUA SHIELD HEAT SHRINKABLE WRAP
- THIS DRAWING IS APPLICABLE WHEN WATER SERVICES ARE GREATER THAN 50mm DIAMETER OR SEWER SERVICES ARE GREATER THAN 100mm DIAMETER
- ALL SERVICES TO BE INSTALLED AT THE CENTER OF THE LOT

THIS SPECIFICATION MUST BE READ IN CONJUNCTION WITH THE LATEST VERSION OF THE MMCD AND THE SCHEDULES IN THE SUBDIVISION SERVICING BYLAW. WHERE THERE ARE CONTRADICTIONS, THIS DRAWING SHALL PREVAIL.

DISTRICT OF CHETWYND
BRITISH COLUMBIA, CANADA

REV.	BY	DESCRIPTION	DATE

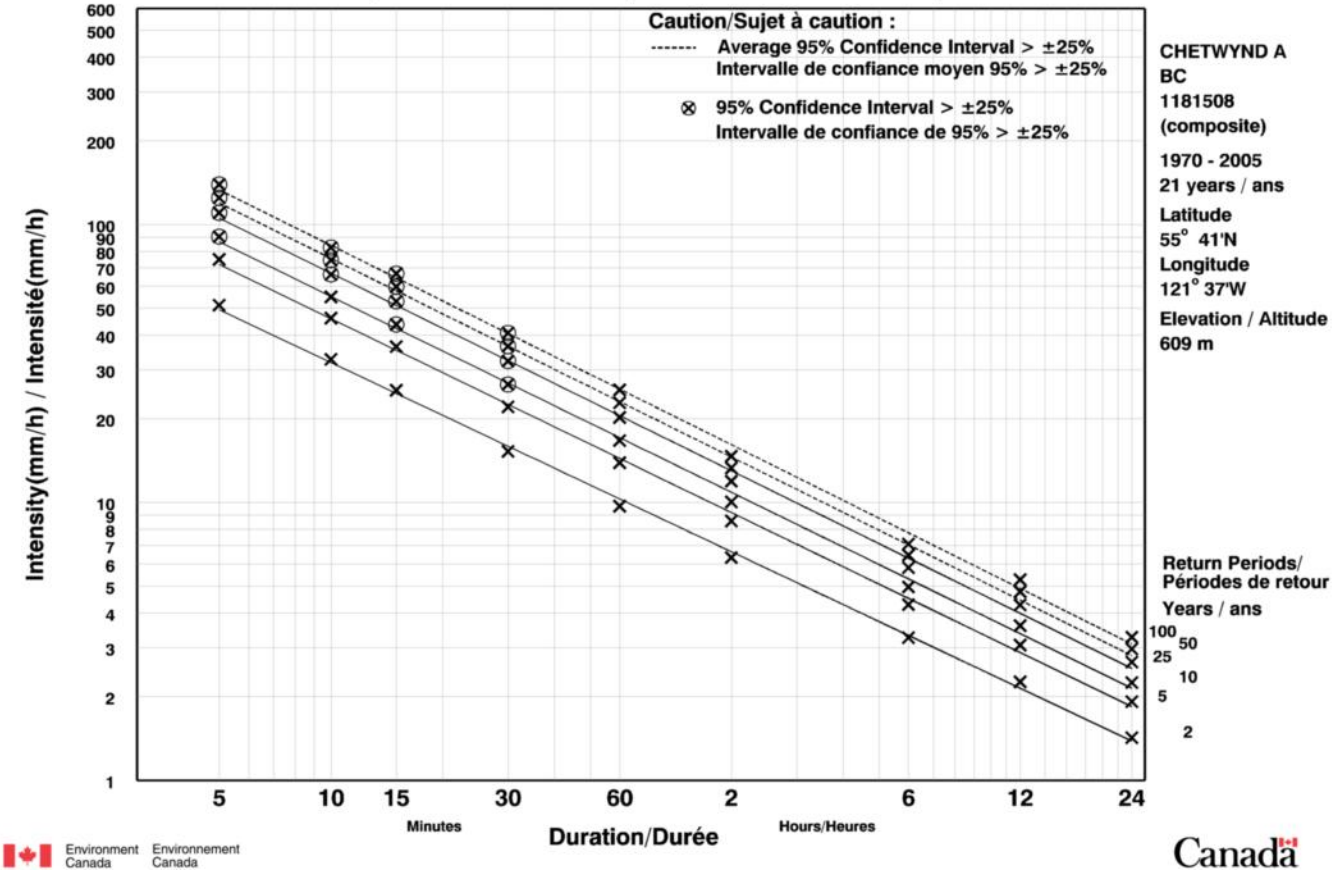
LARGE DIAMETER WATER & SEWER SERVICES

APPROVED BY:	–	DATE DRAWN:	12/12/12	SCALE:	N.T.S.	DRAWING No.:	S16

Short Duration Rainfall Intensity-Duration-Frequency Data

2011/05/17

Données sur l'intensité, la durée et la fréquence des chutes de pluie de courte durée



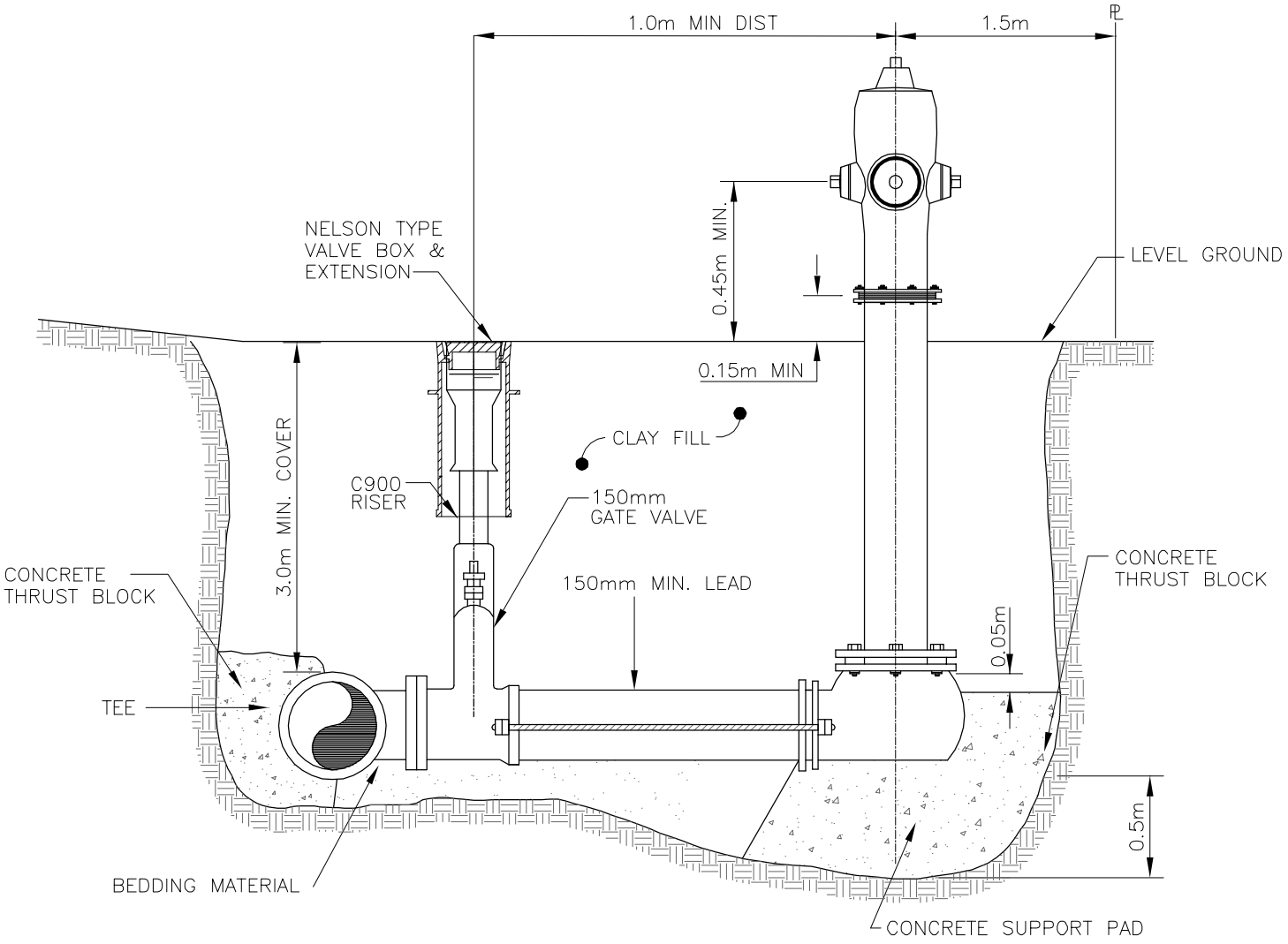
THIS SPECIFICATION MUST BE READ IN CONJUNCTION WITH THE LATEST VERSION OF THE MMCD AND THE SCHEDULES IN THE SUBDIVISION SERVICING BYLAW. WHERE THERE ARE CONTRADICTIONS, THIS DRAWING SHALL PREVAIL.

DISTRICT OF CHETWYND
BRITISH COLUMBIA, CANADA

REV.	BY	DESCRIPTION	DATE

RAINFALL INTENSITY–DURATION–FREQUENCY (IDF) CURVE

APPROVED BY:	–	DATE DRAWN:	12/12/12	SCALE:	N.T.S.	DRAWING No.:	S17



NOTES:

1. HYDRANTS SHALL BE COMPRESSION TYPE AND EACH SHALL CONTAIN
   A) PUMPER PORT – 146.1mm OD, FOUR (4) THREADS PER 25.4mm
   B) HOSE OUTLETS – 76.2mm OD. – 8 THREADS PER 25.4mm (BC STANDARD THREAD)
2. PUMPER OUTLET MUST FACE CURB
3. HYDRANT BOOT SIZED FOR 150mm PIPE
4. HYDRANT BODY COLOUR – YELLOW
5. HYDRANT DRAIN MUST BE PLUGGED WITH THREADED BOLT
6. ALL CAST IRON FITTINGS TO BE EPOXY COATED
7. HYDRANT BOOT TO BE EPOXY COATED
8. ALL CAST IRON FITTINGS TO BE OUTFITTED WITH 7.7kg (17lb.) MAGNESIUM ANODE. HYDRANT BARREL AND BOOT TO EACH HAVE THEIR OWN ANODE.

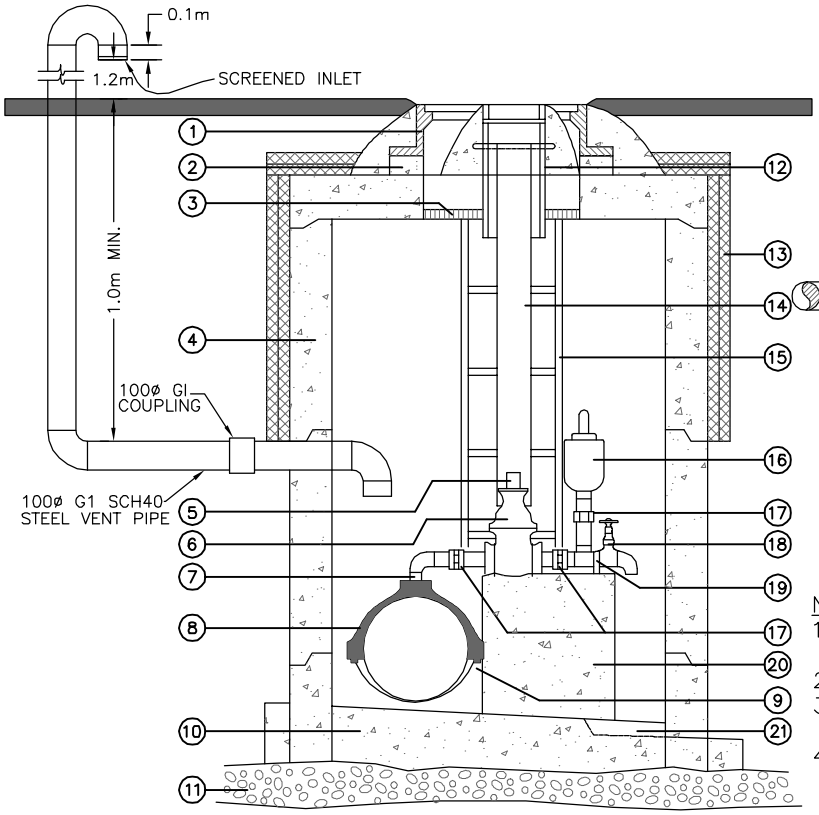
THIS SPECIFICATION MUST BE READ IN CONJUNCTION WITH THE LATEST VERSION OF THE MMCD AND THE SCHEDULES IN THE SUBDIVISION SERVICING BYLAW. WHERE THERE ARE CONTRADICTIONS, THIS DRAWING SHALL PREVAIL.

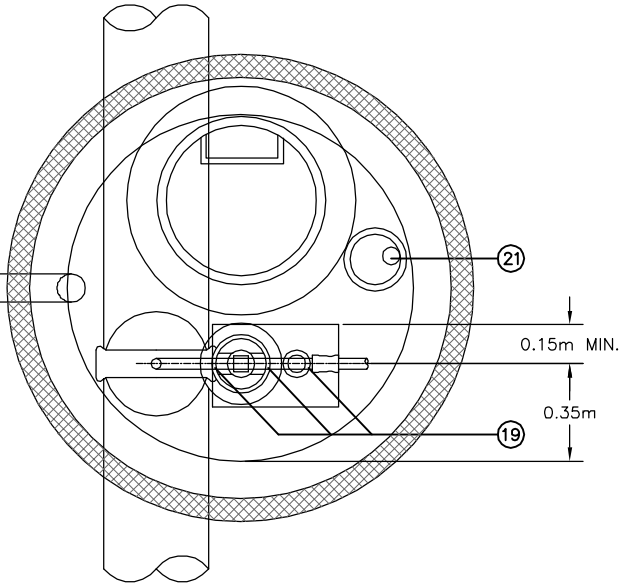
DISTRICT OF CHETWYND
BRITISH COLUMBIA, CANADA

REV.	BY	DESCRIPTION	DATE

FIRE HYDRANT ASSEMBLY

APPROVED BY:	–	DATE DRAWN:	12/12/12	SCALE:	N.T.S.	DRAWING No.:	SW4





NOTES:

1. MANHOLE BARRELS TO BE 75mm CLEAR OF WATERMAIN
2. ALL FITTINGS TO BE BRASS
3. ALL JOINTS TO BE MORTARED WATER TIGHT INSIDE & OUT
4. INSTALLATIONS OCCURRING OUTSIDE SURFACE PADS MEASURING 1500mm x 1500mm x 150mm

SCHEDULE OF QUANTITIES

ITEM	DESCRIPTION
1	MANHOLE FRAME & COVER (DOBNEY FOUNDRY C-18), MORTAR INSIDE & OUT.
2	PRECAST CONCRETE RISER RINGS IN 50mm, 100mm, & 150mm HEIGHTS. USE A MINIMUM OF 1 & A MAXIMUM OF 3 RINGS WITH MAXIMUM TOTAL HEIGHT OF 250mm.
3	HALF MOON TREATED PLYWOOD COVERS WITH HANDLES, & 50mm RIGID INSULATION ON LOWER SIDE.
4	PRECAST CONCRETE SECTIONS, 1500mm DIAMETER. LID REINFORCED TO H-20 LOADING.
5	50mm SQUARE OPERATING NUT.
6	CAST IRON RESILIENT SEAT GATE VALVE WITH 50mm OPERATING NUT.
7	CORP. STOP
8	ROBAR 2706 SERIES SERVICE SADDLE, DOUBLE STAINLESS STEEL STRAPS.
9	50mm MINIMUM CLEARANCE
10	CONCRETE BASE POURED IN PLACE, MINIMUM 27.5Mpa, MINIMUM 150mm THICKNESS. SURFACE TO SLOPE AT 2% TOWARDS SUMP.
11	150mm LAYER OF 38mm MINUS GRAVEL COMPACTED TO 100% SPMDD
12	'MR' TYPE WATER VALVE BOX, MORTAR INSIDE AND OUT.
13	50mm RIGID FOAM INSULATION (SM). EXTENDED MINIMUM 1.2m BELOW SURFACE
14	150mm PVC C900 DR18 WATER PIPE. RISER TO VALVE BOX CORED INTO LID
15	ALUMINUM LADDER RUNGS
16	COMBINATION AIR & VACUUM RELEASE VALVE c/w VENT CAP
17	UNION.
18	150PSI RATED 19mm HOSE BIB.
19	STAINLESS STEEL OR GALVANIZED STRAPPING ANCHORED TO SUPPORT BLOCK WITH HILTI BOLTS.
20	CONCRETE SUPPORT BLOCK TO BE CAST IN PLACE WITH BASE.
21	DRAIN TO STORM OR ROCK PIT.

AIR VALVE SIZE	CORPORATION STOP SIZE
25	25
50	50
100	100

THIS SPECIFICATION MUST BE READ IN CONJUNCTION WITH THE LATEST VERSION OF THE MMCD AND THE SCHEDULES IN THE SUBDIVISION SERVICING BYLAW. WHERE THERE ARE CONTRADICTIONS, THIS DRAWING SHALL PREVAIL.

DISTRICT OF CHETWYND
BRITISH COLUMBIA, CANADA

REV.	BY	DESCRIPTION	DATE

STANDARD AIR VALVE ASSEMBLY

APPROVED BY: —
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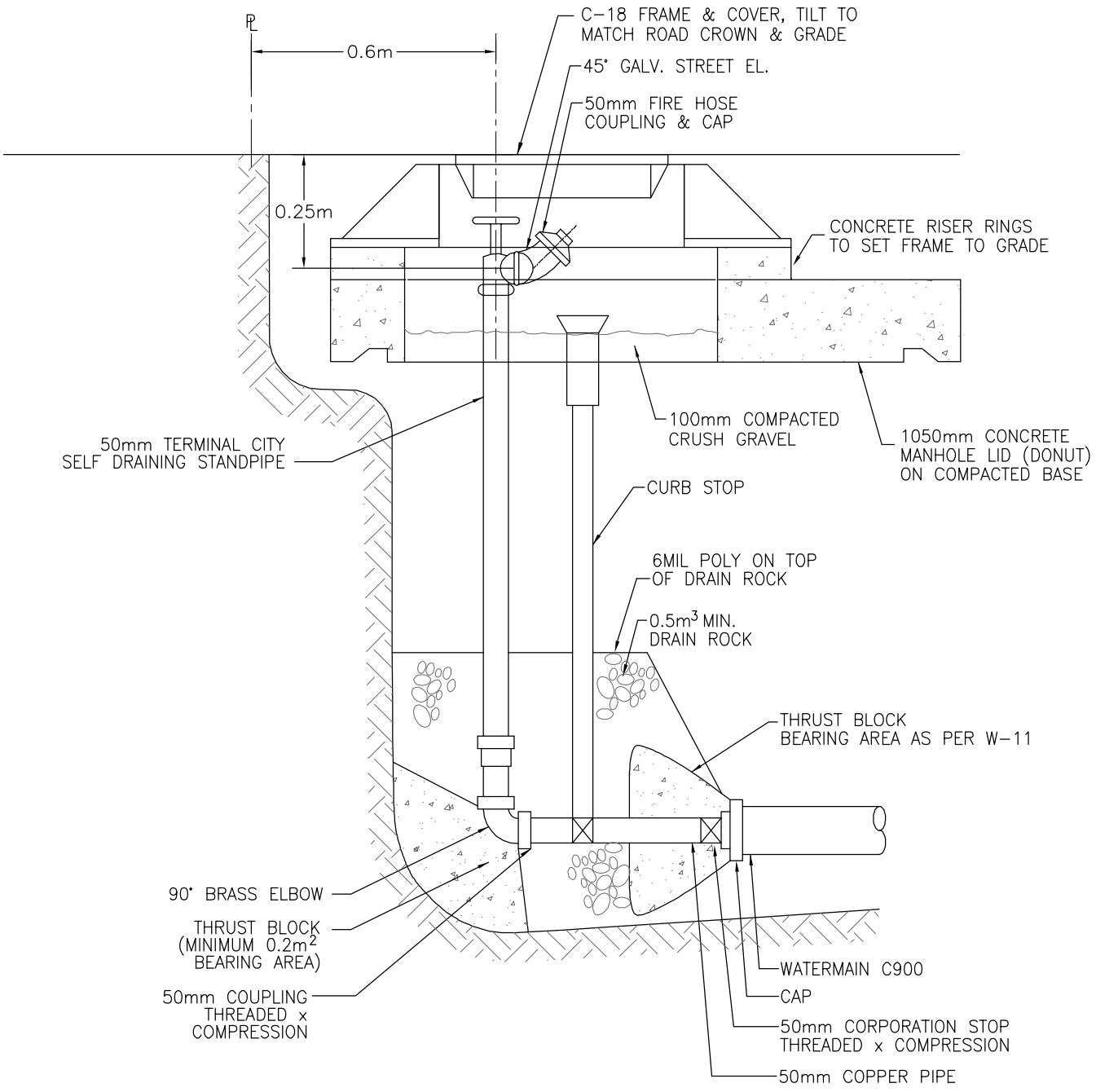
SCALE: N.T.S.
DRAWING No.: SW6/SW7



THIS SPECIFICATION MUST BE READ IN CONJUNCTION WITH THE LATEST VERSION OF THE MMCD AND THE SCHEDULES IN THE SUBDIVISION SERVICING BYLAW. WHERE THERE ARE CONTRADICTIONS, THIS DRAWING SHALL PREVAIL.

DISTRICT OF CHETWYND
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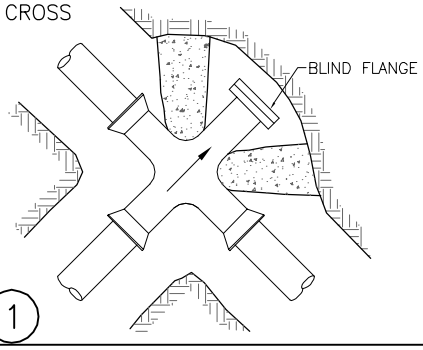
REV.	BY	DESCRIPTION	DATE

BURIED STANDPIPE DETAIL

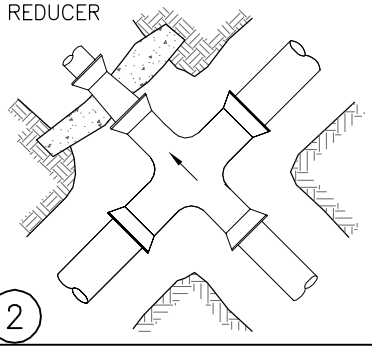
APPROVED BY:	—	DATE DRAWN:	12/12/12	SCALE:	N.T.S.	DRAWING No.:	SW8

CROSS



1

REDUCER



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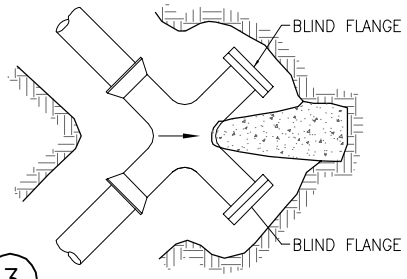
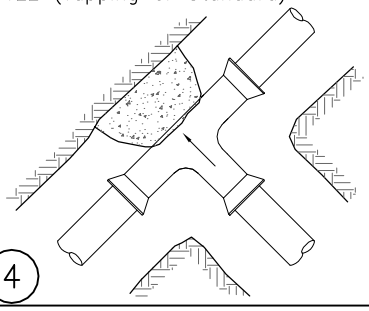
CROSS



3

TEE (Tapping or Standard)



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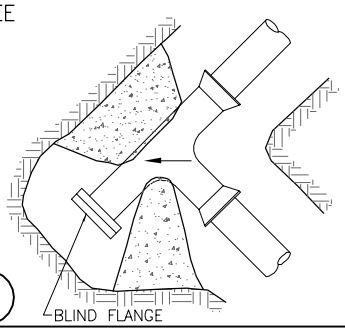
TEE



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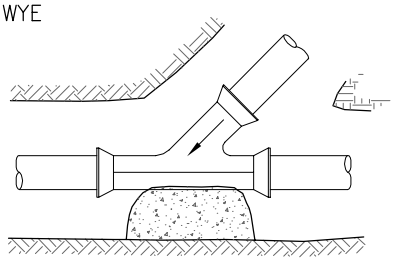
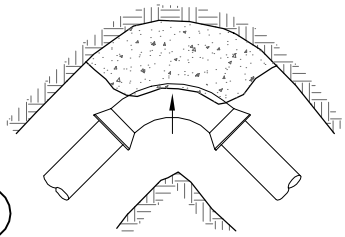
WYE



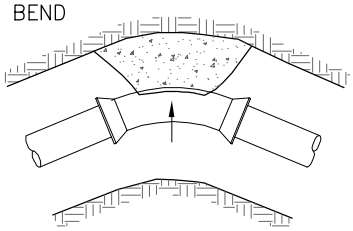
6

90° BEND



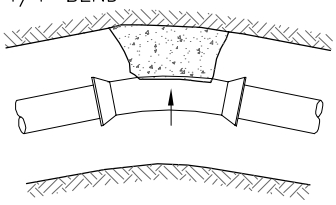
7

45° BEND



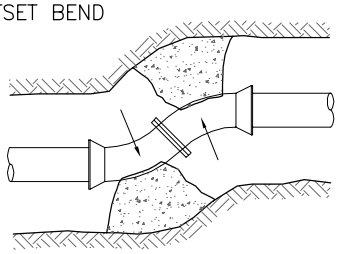
8

22–1/2° BEND AND
11–1/4° BEND



9

OFFSET BEND



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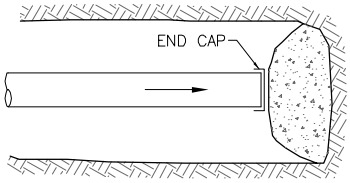
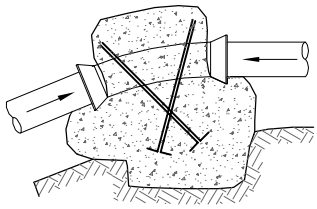


11

VERTICAL BEND



VERTICAL REACTION BLOCK SHALL BE DESIGNED BY A STRUCTURAL ENGINEER.

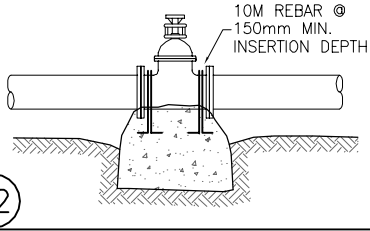
13

BEARING AREA OF BLOCKS

CONCRETE AREAS IN M^2

TYPE	PIPE SIZE	150	200	250	300
	1, 4, 11, 12	0.4	0.7	1.1	1.6
	3, 5, 7	0.5	1.0	1.5	2.2
	2	0	0.3	0.5	0.75
	6, 8	0.4	0.5	0.8	1.2
	9	0.4	0.4	0.4	0.6
	10	0.8	1.0	1.6	2.4

ANCHOR BLOCK FOR VALVE



12

NOTES:
- CONCRETE MUST BE TYPE 50
- THRUST BLOCKS FOR MAINS LARGER THAN 300mmø SHALL BE DESIGNED BY A PROFESSIONAL ENGINEER AND SHOWN ON THE ENGINEERED DRAWINGS
- OWNER'S PROFESSIONAL ENGINEER TO CONFIRM SIZE AND CONFIGURATION OF THRUST BLOCKS OR OTHER MEANS OF RESTRAINTS TO SUIT ACTUAL CONDITIONS

DESIGN ASSUMPTIONS
- HYDRAULIC HEAD=1.38 MPa.
- SOIL BEARING VALUE = 0.096 MPa. (MED SOFT CLAY)

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REV.	BY	DESCRIPTION	DATE

PRESSURE MAIN THRUST BLOCKS

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