The Corporation of the
Village of Ashcroft

VILLAGE OF ASHCROFT

SUBDIVISION AND DEVELOPMENT SERVICING BYLAW #839, 2020

December 2020

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Village of Ashcroft

SUBDIVISION AND DEVELOPMENT SERVICING BYLAW NO. 839, 2020

A bylaw to regulate and require the provision of services in respect of Subdivision and Development within the Village of Ashcroft.

WHEREAS the Village of Ashcroft wishes to repeal and replace Subdivision Control Bylaw No. 480, 1989;

AND 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 may delegate to the Approving Officer appointed under the Land Title Act its authority to exempt a parcel of land from the minimum highway frontage specified in the Local Government Act;

NOW THEREFORE the Council of the Village of Ashcroft, in open meeting assembled, HEREBY ENACTS as follows:

1. Village of Ashcroft Subdivision Control Bylaw No. 480, 1989, and amendments thereto are hereby repealed.

2. This Bylaw shall be cited as the “Village of Ashcroft Subdivision and Development Servicing Bylaw No. 839, 2020”.

PART 1 ADMINISTRATION

Application

1.1 This Bylaw applies to all Parcels within the boundaries of the Village of Ashcroft.

1.2 Schedules A-K, attached hereto, form part of this Bylaw.

Note that does not form part of this bylaw: Appendices 1, 2, 3 and 4 are provided for information purposes only.

Standards of Measure

1.3 Metric units are used for all measurements in this Bylaw. Imperial units of measure shown in parentheses are for information purposes only and do not form part of this bylaw.

Severance

1.4 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 must be severed and the remainder of this Bylaw shall remain in effect.

Master Municipal Construction Document (MMCD)

1.5 All *Works and Services* must be completed in accordance with the portions of the Master Municipal Construction Document (MMCD), Volume II, version currently adopted by the *Village*, along with all supplementary specifications and supplementary detail drawings located in Appendix 1 and Appendix 2.

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

Approved Products

1.7 Materials used for *Works and Services* must be those listed in the *Village's* Approved Products List, as amended from time to time, unless otherwise approved by the *Chief Administrative Officer* or their designate.

PART 2 INTERPRETATION

2.1 Definitions

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

Certificate of Total Completion means a certificate issued by the *Owner's Professional Engineer* stating that all *Works and Services* have been completed, including any deficiencies listed on the *Certificate of Provisional Completion.*

Certificate of Provisional Completion 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 *Owner's Professional Engineer* and verified by the *Village*, is not more than 2% of the total cost of the *Works and Services*; and

c) Fire protection built to the standards set out in this Bylaw, has been approved by the Fire Chief.

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

Note that does not form part of this Bylaw: Fire protection includes adequate water supply (and the availability of hydrants, where appropriate) as well as access for fire trucks.

Chief Administrative Officer means the *Village* of Ashcroft's *Chief Administrative Officer*.

Community Drainage System means a system of works owned, operated, and maintained by the Ministry of Transportation and Infrastructure or the *Village* designed and constructed to control the collection, conveyance, and disposal of stormwater.

Community Sewer System means a sanitary sewage collection system which is operated by or on behalf of the *Village*.

Community Water System means a water supply system operated by the Village; or a water supply system operated by a water utility holding a Certificate of Public Convenience and Necessity under the Water Act in respect of which no compliance orders under the Drinking Water Protection Act are outstanding as of the date of Subdivision application. A Community Water System has the same meaning as a Domestic Water System.

Council means the Municipal *Council* of the *Village* of Ashcroft.

Development means any construction to which the *Village's* Building Regulations Bylaw applies.

Domestic Water System has the same meaning as in the Drinking Water Protection Act, but excludes a system dependent on potable water delivered by means of a tank truck, vehicle water tank, or other similar prescribed means of transporting drinking water, whether or not there are any related works or facilities.

Excess or Extended Services has the same meaning as under the Local Government Act.

Frontage means that length of lot boundary which immediately adjoins a street or road.

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 *Village* for the provision of public access or the provision of utility services.

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

Maintenance Security means an automatically renewable irrevocable and unconditional letter of credit in a form acceptable to the *Chief Administrative Officer*, a bond or a certified cheque, provided to the *Village* following the completion of all *Works and Services*.

Owner has the same meaning as in the Land Title Act.

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

Performance Security means an automatically renewable irrevocable and unconditional letter of credit in a form acceptable to the *Chief Administrative Officer*, a bond or a certified cheque, provided to the *Village* 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* under the provisions of the Engineers and Geoscientists Act.

Right-of-Way means a registered portion of the property with the *Village of Ashcroft* in which no construction work excluding road work is allowed, in order to provide public or private access to adjacent properties.

Subdivision means and includes a *Subdivision* as defined in the Land Title Act and a *Subdivision* under the Strata Property Act.

Village means the *Village* of Ashcroft.

Works and Services means *Works and Services* that may be required under this Bylaw, including but not limited to highways, 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, natural gas lines, telecommunication lines, cable lines, and drainage disposal systems.

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

PART 3 MINIMUM PARCEL HIGHWAY FRONTAGE

3.1 Council hereby delegates to the *Approving Officer* the power to exempt a parcel from the statutory or bylaw minimum frontage set out in the Local Government Act.

PART 4 CONNECTION TO COMMUNITY SYSTEMS

Community Water System

4.1 All water distribution systems and fire hydrant systems in those areas identified in Schedule A must be connected to the *Village's Community Water System.*

4.2 All connections to the *Village's Community Water System* must be made in accordance with the standards established under this Bylaw.

4.3 Prior to connecting water distribution systems to the *Community Water System*, existing water sources providing water to *Parcels* that will be serviced by the *Community Water System* must be abandoned in such a way as to prevent any connection or cross-connection with the *Community Water System*, in accordance with Cross Connection Control Bylaw No. 742, 2005.

Community Sewer System

4.4 All sanitary sewage collection systems in those areas identified in Schedule A must be connected to the *Village's Community Sewer System*.

4.5 All connections to the *Village's Community Sewer System* must be made in accordance with the standards established under this Bylaw.

Community Drainage System

4.6 All drainage collection systems in those areas identified in Schedule A must be connected to the *Village's Community Drainage System.*

4.7 All connections to the *Village's Community Drainage System* must be made in accordance with the standards established under this Bylaw.

PART 5 SERVICING REQUIREMENTS FOR SUBDIVISIONS AND DEVELOPMENT

Servicing Requirements

5.1 The *Owner* of every *Parcel* being subdivided must, as a condition of approval of the *Subdivision* by the *Approving Officer*, provide *Works and Services* within the *Subdivision* in accordance with the standards established in this Bylaw.

5.2 *Council* hereby delegates to the *Chief Administrative Officer* or their designate, the power to require that, prior to *Subdivision* approval by the *Approving Officer,* or the issuance of a building permit by the *Village*, the *Owner* of a *Parcel* being subdivided or developed provide *Works and Services*, in accordance with the standards established in this Bylaw, on that portion of every *Highway* immediately adjacent to the *Parcel* being subdivided or developed up to the centre line of the *Highway*.

5.3 Council hereby delegates to the *Chief Administrative Officer* or their designate, the power to require that the *Owner* of a *Parcel* being developed, as a condition of the issuance by the *Village* of a building permit, provide *Works and Services* in accordance with the standards established under this Bylaw.

5.4 All *Works and Services* required to be provided under this Bylaw must be provided in accordance with the standards prescribed in Schedules A, B, C, D, E, F, G, H, I, J, and K of this Bylaw.

5.5 Every *Owner* of a *Parcel* being subdivided or developed must provide all *Works and Services* that are required to be provided under this Bylaw or by the *Chief Administrative Officer* or their designate pursuant to the powers delegated to the *Chief Administrative Officer* or their designate, at the *Owner's* expense and the *Owner* must construct and install such *Works and Services* to the standards established under this Bylaw before the *Approving Officer* approves of the *Subdivision* or the *Village*, or its designate, issues the building permit for the *Development.*

5.6 For the purposes of Section 5.5, the construction and installation of *Works and Services* are not considered completed until a *Certificate of Provisional Completion* for all of the *Works and Services* required to be constructed and installed with respect to the *Subdivision* or *Development* is provided and accepted*.*

5.7 Notwithstanding Section 5.6, *Subdivision* approval may be given or the building permit may be issued if the *Owner* of the *Parcel* being subdivided or developed:

a) Deposits to the *Village, Performance Security* in accordance with Section 6.3; and

b) Enters into an agreement with the *Village* to construct and install the required *Works and Services* by a specified date or forfeit to the *Village* the amounts secured under paragraph (a).

Note that does not form part of this Bylaw:
The *Owner* can only obtain *Subdivision* approval prior to the provision of *Works and Services* once all buried utilities have been installed and roads are constructed to top of granular sub-base.

5.8 Council hereby delegates to the *Chief Administrative Officer* the power to enter into agreements under Section 5.7(b) on behalf of the *Village* and on such terms and conditions that the *Chief Administrative Officer* considers desirable.

5.9 Prior to *Subdivision* approval or issuance of a building permit, the *Owner* must provide *Excess or Extended Services* as described in the Local Government Act.

5.10 *Council* hereby delegates to the *Chief Administrative Officer* or their designate the power under the Local Government Act to:

a) Determine what *Excess or Extended Services* are required in connection with a *Subdivision* or Development;

b) Determine whether the cost of such *Excess or Extended Services* is excessive such that the *Owner* must pay the costs;

c) Identify the benefiting properties in relation to *Excess or Extended Services*;

d) Determine what proportion of the costs associated with the *Excess or Extended Services* is associated with each benefiting property; and

e) Enter into an agreement with the *Owner* of the *Parcel* being subdivided or developed to establish the period during which charges may be collected in accordance with the Local Government Act, which period must not exceed 15 years from the date the services are completed.

5.11 For the purpose of charges payable for latecomer connections or use under the Local Government Act, interest shall be calculated annually at a rate established by the BC Municipal Finance Authority.

Exemptions

5.12 The requirements under Section 5.1 shall not apply to a *Subdivision* under the Strata Property Act.

5.13 The requirements under Section 5.1 shall not apply if:

a) The *Subdivision* or *Development* creates only:

   a. parkland or natural areas;

b. a parcel for the installation of utilities and related structures and equipment; or

c. a parcel to be used only for the parking of motor vehicles; and

b) A covenant restricting the use of the parcel to one of those uses has been registered on title under the Land Title Act in favour of the *Village*.

PART 6 FEES AND SECURITY

Application and Inspection Fees

6.1 Prior to *Approving Officer* approval of the *Subdivision* or issuance of a building permit by the *Village,* every *Owner* of a *Parcel* being subdivided or developed shall pay to the *Village* the following:

a) the *Subdivision* or building permit fees as set out by the *Village;*

b) inspections fees for the costs of the inspection of *Works and Services* in an amount equal to the *Village's* estimate of the actual cost of inspections; and,

c) any additional taxes, including Goods and Services Tax, that are chargeable on the fees set out in this section.

Performance Security

6.2 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 *Village Performance Security* in an amount equal to one hundred and twenty five percent (125%) of the *Owner's Professional Engineer's* estimate of the cost of the *Works and Services*, including contingencies, required for the proposed *Subdivision* or *Development*.

6.3 The *Village* may, at the *Owner's* expense, confirm the cost estimate of the *Works and Services* by consulting with a *Professional Engineer* of its choosing.

6.4 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 *Village* may:

a) complete the required *Works and Services* ; and,

b) draw on the *Performance Security* in order to pay the costs of completing the *Works and Services*.

6.5 If the cost to the *Village* of completing the *Works and Services* exceeds the amount of the *Performance Security*, the balance is a debt due from the *Owner* to the *Village*, recoverable in any court of competent jurisdiction or by any other means available to the *Village*.

6.6 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 *Village*.

6.7 Nothing in this Bylaw obliges the *Village* to complete *Works and Services* on the default of an *Owner*.

Provisional Completion

6.8 Provisional Completion may be given or the building permit may be issued if the *Village* has received 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*, issued by the *Owner's Professional Engineer*, together with the supporting documentation upon which it is based, including relevant:

- Quality assurance test results signed and sealed by a *Professional Engineer*; and
- Inspection reports;

c) Record drawings of all work completed to date, prepared by the *Owner's Professional Engineer* and approved by the *Chief Administrative Officer* or their designate. A failure by the *Owner* to provide all record drawings as required by this subsection is a deficiency to be included in the list of defects and deficiencies required by subsection 6.8 (e);

d) Results of a field inspection of all *Works and Services* with the *Village*;

e) A list of defects and deficiencies in the work, as identified during an inspection of the *Works and Services* by the *Village*, together with a cost estimate sealed by the *Owner's Professional Engineer* of the cost required to rectify the defects and deficiencies.; and

f) A schedule of quantities and prices of completed work to-date, prepared by the *Owner's Professional Engineer*.

6.9 The *Village* shall return any remaining *Performance Security* upon Provisional Completion in accordance with this Bylaw and the applicable *Works and Services Agreement,* less ten percent (10%) of the original performance security posted. 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.* The *Village* may hold the amount retained, the replacement letter of credit, or the certified cheque to secure the *Owner's* obligations under this Section.

Note that does not form part of this Bylaw:
For example, if the *Owner's Professional Engineer's* estimate of the cost of the *Works and Services* is $1 million, the *Owner* will have provided $1.25 million as the original performance security. If the *Village* has to draw on the performance security, in the amount of $0.25 million, to complete the required *Works and Services* in accordance with the approved design drawings then $0.875 million (the remaining performance security, less 10% of the original performance security) will be returned to the *Owner* upon Provisional Completion.

Total Completion

6.10 Completion shall occur upon receipt of the following from the *Owner*:

a) A *Certificate of Total Completion*, issued by the *Owner's Professional Engineer*;

b) Receipt of record drawings of completed work prepared by the *Owner's Professional Engineer* and approved by the *Chief Administrative Officer* or their designate; and,

c) *Maintenance Security*, in the form prescribed in Section 6.12.

6.11 The *Village* shall return the remainder of the *Performance Security* upon Total Completion in accordance with this Bylaw and the applicable *Works and Services* Agreement.

Maintenance Security

6.12 The *Owner* must provide to the *Village Maintenance Security*, in an amount equal to fifteen percent (15%) 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.

6.13 The *Village* may, at the *Owner's* expense, confirm the actual costs incurred by the *Owner* to design, construct, and inspect the *Works and Services* by consulting with a *Professional Engineer* of its choosing.

6.14 The maintenance period shall be a two-year period commencing on the date established by the *Village* under Section 6.15.

6.15 The *Village* shall:

a) Establish the date of commencement of the maintenance period, which shall be no earlier than the date of completion; and

b) Advise the *Owner* of the date of commencement of the maintenance period and of any defects or deficiencies in the *Works and Services* of which the *Village* is aware, to be addressed by the *Owner* during the maintenance period.

6.16 The *Owner* must repair or replace any defective works and correct any deficiencies during the maintenance period. Should the *Owner* fail to maintain, repair, or replace the works, the *Village* may effect such maintenance, repairs, or replacement using the *Maintenance 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 and Services* creating a safety or health hazard in which case the *Village* need provide no greater notice than is prudent in the circumstances.

6.17 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 *Maintenance Security* deposited with the *Village*. If the *Village* pursuant to Section 6.15 has incurred costs of maintaining, repairing, or replacing any defective works and correcting deficiencies in excess of the amount of the *Maintenance Security*, the excess cost is a debt due from the *Owner* to the *Village*, recoverable in any court of competent jurisdiction or by any other means available to the *Village*.

Final Acceptance

6.18 *Final Acceptance* shall occur when all conditions set out in this Bylaw have been met.

6.19 All *Works and Services* required to be constructed or provided pursuant to the provisions of this Bylaw must remain the sole responsibility of the *Owner* until a *Letter of Final Acceptance* has been issued by the *Village*.

6.20 The *Village* shall issue a *Letter of Final Acceptance* only upon:

a) Completion of the maintenance period;

b) Correction of all deficiencies in the *Works and Services*;

c) Receipt of record drawings of the completed *Works and Services* prepared by the *Owner's Professional Engineer* and approved by the *Chief Administrative Officer* or their designate; and

d) Receipt of a schedule of quantities, aligned with the record drawings of the completed *Works and Services*, prepared by the *Owner's Professional Engineer*.

6.21 The *Village* must return any unused portions of the *Maintenance Security* to the *Owner* upon *Final Acceptance*.

Note that does not form part of this Bylaw:
Sixty (60) days before expiration of the maintenance period, the *Village* may, at its discretion, inspect the *Works and Services* and notify the *Owner* of any deficiencies that must be rectified.

Insurance

6.22 The *Owner* must, at its own expense, carry insurance in the amount required of the *Owner* for the *Works and Services* as set out in the *Works and Services Agreement*.

Third Party Review

6.23 The *Village* may engage a third party chosen by the *Village* to review any document, report, or analysis related to servicing that the *Owner* has submitted to the *Village* and to assist with inspection of *Works and Services* prior to Provisional Completion, Total Completion and/or Final Acceptance or at any other time during the construction period. The *Owner* will be responsible for the full cost of any required third-party review.

PART 7 GENERAL PROVISIONS

Professional Engineer

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

Cost of Services

7.2 All *Works and Services* required by this Bylaw must be designed, reviewed, constructed, and inspected at the expense of the *Owner*.

Engineering Drawings

7.3 Where *Works and Services* are to be constructed, engineering drawings and other required reports and documentation certified by a *Professional Engineer* must be submitted to the *Village* for approval. The engineering drawings must contain at least the information set out in Schedule K 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.

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

7.5 Where a water supply system is required by this Bylaw, the *Village* 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 *Village* a copy of the approved construction permit.

Project Supervision and Certification

7.6 The *Owner* of every *Parcel* being subdivided must, at the *Owner's* expense, engage a *Professional Engineer* 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.

7.7 Prior to the commencement of the maintenance period, and within thirty (30) days of the *Works and Services* being operational, the *Owner's Professional Engineer* must submit a certified report to the *Village* in a format acceptable to the *Village*. The certified report must 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 must contain copies of all inspection reports and test results upon which the certification is based.

Record Drawings, Operations and Maintenance Manuals and Safety Procedures

7.8 A minimum of one set of sealed and certified hard copy record drawings by the *Owner's Professional Engineer,* one sealed .pdf copy of the certified record drawings, one digital copy of the record drawings in an AutoCAD format specified by the *Village*, one set of operations and maintenance manuals, and one set of safety procedures documentation must be provided to the *Village* at commencement of the maintenance period. The record drawings must include the information shown on the detailed design drawings in accordance with Section 7.3.

Rights-of-Way and Easements

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

7.10 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 Schedules B-J, unless otherwise specified by the *Chief Administrative Officer* or their designate;

Note that does not form part of this Bylaw:
The actual width of the easement or right-of-way will be dependent on the soil conditions of the site and should be determined by the *Chief Administrative Officer* or their designate on a case by case basis. There may be instances where a larger minimum width is necessary to ensure safe trenches can be constructed with sufficient room to temporarily store the fill.

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 *Village* 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 *Village*; 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*.

Note that does not form part of this Bylaw:
As per fees set out by the *Village* for *Subdivision* and *Development*, *Owners* will be responsible for all cost associated with administering and reviewing their application and engineering drawings.

PART 8 ENFORCEMENT

Authorization to Enter

8.1 The *Approving Officer, Village* bylaw enforcement officers, the *Chief Administrative Officer,* and other officers or employees of the *Village* 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.

8.2 No person shall obstruct or interfere with any person enforcing this Bylaw or entering a property pursuant to Section 8.1.

Offence

8.3 Every person who contravenes a provision of this Bylaw is guilty of an offence and is liable, upon summary conviction, to a fine not exceeding $10,000.

8.4 Each day that an offence against this Bylaw continues shall be deemed a separate and distinct offence.

This Bylaw comes into full force and effect upon its adoption.

Read a first time this 26th day of October, 2020.

Read a second time this 26th day of October, 2020.

Read a third time this ___ day of _____, 2020.

Adopted this ___ day of _____, 2020.

_____ _____

MAYOR CLERK

SCHEDULES

SCHEDULE A

WORKS AND SERVICES REQUIREMENTS

SCHEDULE A - WORKS AND SERVICES REQUIREMENTS

List of Tables

Table A1 – Level of Service

List of Standard Drawings

Figure 1 – Village of Ashcroft Development Areas

1.0 WORKS AND SERVICES REQUIREMENTS

1.1 Establishment of Service Levels

The minimum level of service 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 service required, the *Approving Officer* retains the right to require a higher level of service or standard due to the conditions affecting a specific *Subdivision*.

Table A1 – Level of Service

Service	Level of Service	
	Urban Subdivision	**Rural Subdivision**
	Parcels within the Townsite	Parcels outside of the Townsite
Roads	Urban Roads***/****	Rural Roads
Sewer	Community Sewer System	Community Sewer Systems, Other*
Water	Community Water System	Domestic Water System, Other**
Drainage	Community Drainage System	Ditch*****
Wiring	Overhead	Overhead
Lighting	Thru Subdivision	Thru Subdivision
Landscaping	Public	N/A

* Other refers to a community or private wastewater disposal system at the discretion of the *Approving Officer*.

** *Other refers to connection to a community water system at the discretion of the Approving Officer.*

*** *Urban Infill areas noted in Figure 1 refers to development infill areas that shall match the exiting Urban Road cross-sections listed in Schedule E - Roads.*

**** *Optional Urban Road cross-sections noted in Figure 1 refers to areas within the Townsite boundary's where alternate local Urban Road cross-section noted in Schedule E - Roads may be allowed at the discretion of the Approving Officer*.

***** *Ditches only permitted where included in Level of Service Typical Cross Sections*

1.2 Town Site Standards

- The Town Site shall be defined as all areas designated on **Figure 1**
- Road width shall be designated based on specific urban cross-sections located in Schedule A – Works and Services, and as identified in Schedule E – Roads

- Road Cross-sections are shown on Drawings A1 through A4 located in Appendix 2
- Curbing shall be concrete to MMCD Barrier or Rollover standards or as shown on road cross sections in Schedule A - Works and Services and where identified in Schedule E – Roads
- Sidewalk width, location and materials shall be as indicated on specific road cross sections in Schedule A - Works and Services and as identified in Schedule E – Roads
- Street trees shall be planted in accordance with Schedule G - Landscape

1.3 Accessibility

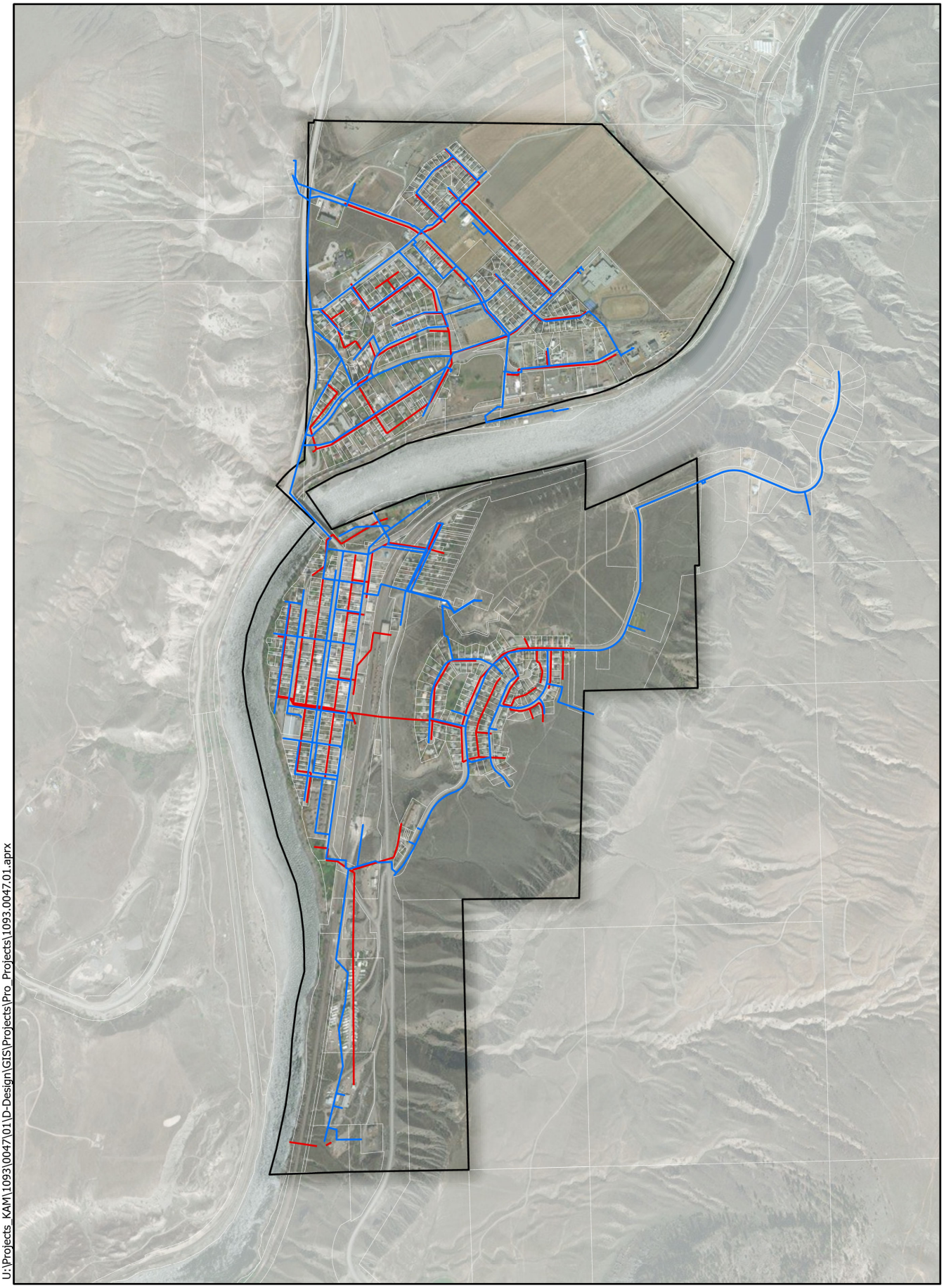
The *Owner's Professional Engineer* shall consider the accessibility of people with disabilities when designing all roads, sidewalks, pathways, curb let downs and driveway crossings.

The Corporation of the Village of Ashcroft

VILLAGE OF ASHCROFT
SUBDIVISION AND DEVELOPMENT SERVICING BYLAW

DATE: JUNE 2020

URBAN systems



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Legend

- Watermain
- Sanitary Gravity Main
- Townsite

VILLAGE OF ASHCROFT TOWNSITE AREA

FIGURE

1

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SCHEDULE B

WATER DISTRIBUTION

SCHEDULE B – WATER DISTRIBUTION

List of Tables

1.0 WATER DISTRIBUTION

1.1 Definitions

Community Water System means a *water supply system* operated by the *Village*; or a *water supply system* operated by a water utility holding a Certificate of Public Convenience and Necessity under the Water Act in respect of which no compliance orders under the Drinking Water Protection Act are outstanding as of the date of Subdivision application. A Community Water System has the same meaning as a Domestic Water System.

Domestic Water System has the same meaning as in the Drinking Water Protection Act, but excludes a tank truck, vehicle water tank or other similar prescribed means of transporting drinking water, whether or not there are any related works or facilities.

Ground Water has the same meaning as in the Water Sustainability Act.

MDD means maximum day demand.

Potable Water means water that meets the current health based criteria listed as maximum acceptable concentrations in the Guidelines for Canadian Drinking Water Quality and, in the case of microbiological parameters, the standards set out in Schedule B to the Drinking Water Protection Regulation if those standards are higher than the standards specified in the Guidelines for Canadian Drinking Water Quality.

Qualified Professional means a person who is registered or duly licensed as a professional engineer or a professional geoscientist under the provisions of the Engineers and Geoscientists Act.

Qualified Pump Installer means a person who is registered as a *qualified pump installer* under the Ground Water Protection Regulation.

Qualified Well Driller means a person who is registered as a *qualified well driller* under the Ground Water Protection Regulation.

Unrecorded Water has the same meaning as in the Water Sustainability Act.

Water Supplier has the same meaning as in the Drinking Water Protection Act.

Water Supply System has the same meaning as in the Drinking Water Protection Act.

Well has the same meaning as in the Water Sustainability Act.

1.2 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 *AWWA Standards*. *Professional Engineered* drawings 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 Interior Health Authority (Public Health Authority) to the *Approving Officer* prior to construction.

1.3 Per Capita Demand

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

- (ADD) Average annual daily demand (A): 1,800 litres per capita per day (L/c/d)
- (*MDD*) Maximum day demand (D): 5,000 litres per capita per day
- (PHD) Peak hour demand (H): 6,000 litres per capita per day

**These flows are based on the actual water usage observed by the Village over the period of 2009 to 2016. PHD is an assumed peak flow 20% higher than MDD.*

1.4 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 1.3 – 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=1.5xD

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

1.5 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, Mobile Home Park	90 L/s
Commercial	150 L/s
Institutional	150 L/s
Industrial	225 L/s

1.6 Design Flows

Water system design flows shall be based on the ultimate population and fully developed non-residential land as anticipated in the Official Community Plan (OCP).

Equivalent populations for non-residential flows can be estimated using the established non-residential demands and the Maximum Day per capita demand.

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

1.7 Water Pressure

Table B4: Water Pressure

Maximum allowable pressure	850 kPa
Minimum pressure at Peak Hour Demand (H)	265 kPa
Minimum pressure in system during design	
Maximum Day and Fire Flow Demand (D+F) residual	150 kPa

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

Pressure in pipes must not exceed manufacturers pressure rating or as outlined in Table B4: Water Pressure, whichever is lower.

1.8 Hydraulic Design

For any computer generated analysis, the *Owner* shall seek clarification prior to analysis from the *Village* regarding approved software programs.

For hydraulic design, the following parameters are established:

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

$$Q = \frac{CD^{2.63}S^{0.54}}{278{,}780}$$

Where: Q = Rate of flow in L/s
D = Internal pipe diameter in mm
S = Slope of hydraulic grade line in m/m
C = Roughness coefficient
= 130 for all pipes

- The maximum allowable design velocity under fire flow conditions should be 3.5 m/s

1.9 Minimum Pipe Diameter

Table B5: Minimum Pipe Diameter

*Distribution mains:	200 mm
Fire hydrant connections:	150 mm
Service connections:	25 mm
Service with fire sprinklers:	50 mm*

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

Where permitted by the *Approving Officer*, distribution main minimum diameter may be reduced to 150mm provided that the main terminates in a short residential cul-de-sac, and has a length less than 80 m.

1.10 Dead Ends

Watermains shall be looped wherever possible. Where dead ends are unavoidable, and where permitted by the *Approving Officer*, hydrants shall be provided as a blow-off.

Hydrant shall be maximum 30m from a drain (i.e. storm drain, ditch or catch basin), stormwater manhole or sanitary manhole.

1.11 Minimum Depth of Cover

Depth of cover shall be determined on 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

Minimum Depth of Cover over any watermain shall be 2.0m.

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.

Watermains buried less than 1.8 metres are required to be insulated with a minimum of 50mm high density Styrofoam HI placed a minimum of 600mm each side of pipe center, and 150mm above the watermain. *Owner's Professional Engineer* to confirm design for thickness of insultation required.

1.12 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.

1.13 Corrosion Protection

Where there is a potential for encountering corrosive soils, a geotechnical corrosion analysis on the alignment of any proposed metallic watermain or metallic fittings or appurtenances shall be conducted to determine the corrosiveness of the native soils. If the soils are determined to be corrosive, measures such as Cathodic protection shall be included to prevent the corrosion of the watermain and appurtenances. Cathodic protection (sacrificial anodes) shall have a 25-year life expectancy.

1.14 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:
  - 4 valves at “X” intersection
  - 3 valves at “T” intersection
- Not more than 200m apart
- Not more than 1 hydrant isolated
- Not more than 20 service connections isolated

Gate valves are required on all mains up to 300mm diameter. Mechanically assisted groundhog butterfly valves may be installed in mains 350mm and larger. On mains 400mm and larger, valves may be one size smaller than the mains (with suitable reducers). All butterfly valves larger than 400mm shall require a 50mm bypass.

1.15 Hydrants

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

- Not more than 150m apart nor more than 90m from a building
- In accordance with “Water Supply for Public Fire Protection – A Guide to Recommended Practice” published by Fire Underwriters Survey
- Installed opposite property pins at a 600mm offset or as shown on the standard drawings
- Minimum 1.0m clear of any other utility structure
- At property lines in mid-block locations
- Minimum of 450mm above ground per Standard Detail Drawing
- Type: Canada Valve Century Fire Hydrant, Red
- Connection: one 100mm port and two 63.5mm ports

Owner will provide documentation of hydraulic calculations for approval by the *Approving Officer* to confirm fire flows through hydrant are possible.

1.16 Air Valves

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

- Where the difference in elevation between the summit and valley is less than 600mm
- 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
- Where a hydrant is located at a highpoint

Typical air valve sizes, subject to design analysis, are summarized in **Table B7**.

Table B6: Air Valve Sizing

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

Air valves may not be installed in chambers that are considered to be a confined space. Install air valves in a sealed cylindrical chamber that allows for the air valve disconnection and maintenance from ground level. Provide isolation valve on air valve inlet that allows isolation of the air valve from ground level for disconnection and maintenance. Vent the valve chamber to above-grade location to eliminate any potential for cross connection in a flooded or contaminated chamber. Valve box to include drain that discharges to rock pit complete with curb stop isolation valve operable from ground level. Air valve box shall not be located within the roadway lane of travel. Provide lateral piping from the watermain to the air valve, with cover adequate for frost protection and grade facilitating the air valve as the high point. Protect the air valve chamber with cast iron valve box suitably rated for and installed to provide protection for AASHTO H20 loading.

1.17 Blow Offs

50mm blow-offs shall be installed at the end of all mains where future development is planned but a hydrant is not yet needed, except where a hydrant is located within 10m of the termination point.

1.18 Thrust Restraint

Cast in place concrete thrust blocking and/or adequate joint restraining devices shall be provided at bends, tees, wyes, reducers, plugs, caps, valves, hydrants and blow-offs. Joint restraints shall only be allowed when designed by the *Owner's Professional Engineer*.

The *Professional Engineer* shall take into consideration the existing conditions for thrust restraints in their design for new watermain piping and fittings and for any tie into existing

watermain piping and fittings. All thrust restraint systems shall not disturb existing thrust blocks and/or thrust restraint systems.

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.

1.19 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 WorkSafe BC requirements.

Insulation to prevent freezing shall be provided where necessary.

All chambers including but not limited to, lift stations, pump stations and PRV stations shall be located above ground upon review of by *Approving Officer*.

Double block and bleed configuration shall be at the project site, upon review of the *Approving Officer*.

1.20 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 size is 25mm.

Each service shall have a shut-off located within 300mm of the property line within the *Village right-of way*. Each connection of 100mm diameter or larger requires an approved backflow device suitable for the intended use at the property side of the shut-off. The location shall be reviewed by the *Approving Officer.*

Owner shall provide documentation regarding the location and installation of the backflow device. Annual maintenance records shall be provided to the *Village*.

1.21 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 3m 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 3.0m 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 0.5m and the joints of the water main, over a length extending 3m either side of the sewer main, are to be wrapped with heat shrink plastic in accordance with the latest version of the *AWWA Standards* C217, and C214 or C209.

  Where it is not possible to obtain the vertical separation indicated above, and subject to local public health authority approval, the following details shall be used:

  - The water pipe joints shall be wrapped as indicated above; and
  - The sewer shall be constructed of pressure pipe such as high density polyethylene with fused joints (HDPE) or PVC and pressure tested to assure it is watertight.

1.22 Alignment

Except as noted in Section 1.23 – Right-Of-Ways (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.

1.23 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.

Table B7 summarizes the minimum *right-of-way* widths.

Where the location of a *Village* utility in a statutory *right-of-way* is permitted by the *Approving Officer*.

Table B7: Minimum Right-of-Way Widths

Service Type	R.O.W Width
Single service	Three times the depth from surface to the crown of the pipe [6 m minimum width]
Service Type	**R.O.W Width**
Two services within the same trench	Three times the depth from surface to the crown of the deeper pipe [7 m minimum width]
Two or more services adjacent to one another but in separate trenches	Cumulative widths for single services PLUS required clearance between the services [8 m minimum width]

Note: When the service is within a road allowance, and the distance from the property line to the centre of the service is less than one half of the width indicated above for a single service, the difference should be provided as right-of-way on the adjacent property.

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, water feeder mains should have *rights-of-way* wide enough for future widening and/or twinning. The width of the *right-of-way* should be the required separation between pipe centerlines plus three (3) times the depth to the crown of the deeper watermain. The *Owner* shall be responsible for the registration of the R.O.W..

The *Professional Engineer* shall provide cross sections indicating the minimum safe distances to adjacent building footings based on a safe angle of repose from the limits of the excavation.

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*, 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 10%.

1.24 Curved Watermains

Where permitted by the *Approving Officer*, horizontal curves may be formed by arcing the pipe barrel as follows:

- Deflection to be at pipe joints only, no bending of the watermain will be allowed

- Constant radius throughout curve
- Curvature shall not exceed one half the limit specified by the manufacturer, whichever is less.
- Curve locations to be recorded at ¼ points and mid-point
- Constant offset from property line or road centerline

1.25 Connection to Existing Watermains

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

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

1.26 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:

- Located above ground, non-confined space
- Chamber to include all valves associated with the reservoir operation
- Design in accordance with seismic codes noted in Schedule B Section 1.26 – 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 Interior Health Authority or *Approving Officer*
- Provision for re-chlorination facilities

1.27 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:

- Above ground, non-confined space per WCB requirements
- 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 *Village* of Ashcroft 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 *C.S.A.* 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

1.28 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.

Preliminary Design Parameters:

- Design flows:
  - Peak hour
  - Maximum day plus fire flow
  - Continuous, emergency or fire flow operation
  - Location
- Chamber details:
  - Structure and access
  - Controls and monitoring
  - HVAC
  - Lighting

Design Features:

- Above ground building, non-confined space
- Sump drain to drainage system
- Site accessibility
- Power efficiency
- Structure and piping in accordance with Chambers (Schedule B Section 1.19), Reservoirs (Schedule B Section 1.26), and Pump Stations (Schedule B Section 1.27)
- 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

- 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 *Village*. 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

1.29 Testing

PVC Pipe and associated fittings shall be tested as follows:

- The pipe shall be filled with water and all air expelled. Hydrant lead valves shall be open
- The testing section should be filled at least 24 hours prior to testing
- By pumping water into the testing section, the pressure shall be increased to 0.7 MPa or 1.5 time the design pressure, whichever is greater. This pressure shall be maintained for at least two hours
- The quantity of water required to maintain the test pressure shall not exceed the allowable leakage determined by the following formula

$$L = \frac{N * D * P^{0.5}}{131{,}000}$$

Where L = allowable leakage (Litres per hour)

N = number joints in test section

D = nominal pipe diameter (mm)

P = average test pressure in kPa

- All other pipes to be pressure tested in accordance with applicable *AWWA Standards* under the supervision of *Village* staff.

1.30 Disinfection

The distribution system shall be disinfected by chlorination after the system has been flushed of dirt and other foreign materials. Chlorination procedures shall conform to AWWA C651 under supervision of *Village* staff.

On completion of chlorination, the entire piping system shall be thoroughly flushed again, filled with water, and left in a condition ready for use. Disinfection water shall not be discharged into fish bearing streams.

1.31 Bacteriological Testing

Upon completion of the disinfection procedure noted in 1.30 – Disinfection, the Owner shall contact the Village to witness the collection two water samples. Bacteriological tests shall be as per the current ANSI/AWWA C651 Standard for Disinfecting Water Mains. A quote from this standard is provided for information only:

"5.1.1 Standard conditions. After final flushing and before the new water main is connected to the distribution system, two consecutive sets of acceptable samples, taken 24 hr apart, shall be collected from the new main (Section 5, AWWA C651)."

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 or as directed by the *Approving Officer* shall be in accordance with good practice and the appropriate standards.

For any computer-generated analysis, the *Owner* shall seek clarification prior to analysis from the *Village* regarding approved software programs.

1.2 Per Capita Flow

Sanitary sewer system design shall be based on an average daily dry weather flow (ADWF) of 360 litres per day per capita (L/d/c).

For residential areas, the land use densities in **Table C1** shall apply.

Table C1: Land Use Densities

	People/Gross Ha.	People/Unit
Single Family	24-30	3
Multi-family Low	65	2.5
Multi-family Medium	(3 storey) 120	2.5
Multi-family High	(4-12 storey) 320-960	2
Mobile Home	40	2

1.3 Non-Residential Flows

Average daily 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 C2**.

Table C2: 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 C3**.

Table C3: 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:

$PF = 6.75 * P^{-0.11}$ Where: PF = peaking factor

P = population and equivalent

1.5 Infiltration/Inflow

Design flows shall include an infiltration allowance to cover groundwater infiltration and system inflows as follows:

- Pipes not in water table: 5,000 l/ha/d
- Pipes in water table: 8,000 l/ha/d

1.6 Design Flow

Design flow Q (=PWWF) = population and equivalent * per capita flow * peaking factor + infiltration/inflow allowance.

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 (0.013 for all pipes)

- 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/sec. 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/sec. 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/sec 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/sec
- 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:
  - Residential – 100 mm
  - Multi-family/commercial/institutional – min 150 mm

A manhole shall be located at the upstream end of all terminal pipe sections, with considerations for future developments per review by the *Approving Officer*.

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:

- Constant radius throughout curve
- Minimum design velocity = 0.9m/s
- Curvature shall not exceed 3 degrees, or one half the limit specified by the manufacturer, whichever is less.
- Deflection to be at pipe joints only, no bending of the sewer main will be allowed
- 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 100mm and 150mm service connections and junctions with trunk sewers 900mm and larger
  - 125m maximum spacing for pipes 375mm diameter and smaller
  - 155m maximum for pipes 450mm diameter to 750mm diameter
  - Every future pipe intersection
  - 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 45.0m
    - The depth of the pipe does not exceed 2.0m 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/or
    - 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: 20mm drop
    - Deflections up to 45 degrees: 20mm drop
    - Deflections 45 to 90 degrees: 30mm drop
  - 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 0.45m	Inside Ramp
0.45m to 0.90m	Outside Drop
Greater than 0.90m	Outside Drop*

** Inside drop may be used if specifically permitted by the Approving Officer.*

  - The maximum deflection angle in a junction shall be 90°
  - Force main discharges shall be directed into the receiving manhole outflow pipe. Manhole benching walls shall be extended a minimum 200mm above the force main crown. If a manhole drop cannot be avoided, an inside drop pipe is required. Tie in of force mains into an existing manhole shall be reviewed by *Approving Officer*.

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 1.5m for gravity and 1.8m for forcemain
- 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 1.5m. Insulation of sewer mains and services may be determined at the discretion of the *Approving Officer*.

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

1.15 Rights-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* widths for instance are summarized in **Table C4**.

Table C4: Minimum Right of Way Widths

Service Type	R.O.W Width
Single service	Three times the depth from surface to the crown of the pipe [6m minimum width]
Two services within the same trench	Three times the depth from surface to the crown of the deeper pipe [7m minimum width]
Two or more services adjacent to one another but in separate trenches	Cumulative widths for single services PLUS required clearance between the services [8 m minimum width]

Note: When the service is within a road allowance, and the distance from the property line to the centre of the service is less than one half of the width indicated above for a single service, the difference should be provided as right-of-way on the adjacent property.

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.

The width of the *right-of-way* shall be the required separation between pipe centerlines plus three times the depth to the crown of the deeper sewer.

The *Professional Engineer* shall provide cross sections indicating the minimum safe distances to adjacent building footings based on a safe angle of repose from the limits of the excavation.

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 10%.

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 3m 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 3.0m 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 0.5m and the joints of the water main, over a length extending 3m either side of the sewer main, are to be wrapped with heat shrink in accordance with the latest version of the *AWWA Standards* C217, and C214 or C209.

  Where it is not possible to obtain the vertical separation indicated above, and subject to local public health authority approval, the following details shall be used:

  - The water pipe joints shall be wrapped as indicated above, and
  - The sewer shall be constructed of pressure pipe such as high density polyethylene with fused joints (HDPE) or PVC and pressure tested to assure it is watertight.

- 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
  - Conflict with manholes and appurtenances

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

1.17 Service Connections

Every legal lot and each unit of a residential duplex shall be provided with a separate service connection.

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 not be extended at an angle that exceeds 45° from 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*.

Connections to new mains shall be made using standard wye fittings. Connections to existing mains shall use wye saddles. 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 100mm services or 1% on 150 mm services.

The minimum depth of a service at the property line must be 1.5 provided that gravity service to the Minimum Building Elevation (MBE) is available.

Where rear yard sewers are necessary, due to steep topography, the minimum cover must be 1.5m provided that gravity service, to the Minimum Building Elevation, is available.

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

Inspection chambers are required for all service connections, except when the sewer main is in a *right-of-way* and the service is less than 2.5m long and ties into a manhole.

Control manholes will be required for all commercial, industrial and light industrial connections at the discretion of the *Approving Officer.*

Service connections shall be installed at the lower (downstream) portion of the lot for larger lots or *parcels* of land. For residential *development*, connections shall be as noted on the Standard Drawings.

The maximum length of any service connection is 30m, unless otherwise permitted by the *Approving Officer*.

Service Types: Sanitary sewer connections only. No RV sanitary dump, storm leads, roof leaders or other connection types shall be permitted. Under no circumstances shall a building perimeter foundation drain be connected to a sanitary sewer.

1.18 Pump Stations

The use of pump stations shall be avoided where possible. Any proposed use of pump stations shall receive prior approval from the *Approving Officer*. Prior to commencing detailed design of a pump 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 pump 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
  - Access: Identify features that provide operators access for operation and maintenance procedures without entering confined spaces

Other basic criteria include:

- All chambers including but not limited to, lift station, pump stations and PRV stations will be located above ground upon review by the *Approving Officer.*
- Construction dewatering requirements
- Access for construction and maintenance
- Aesthetics, noise, odour control and landscaping
- Water hammer 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 *Village of Ashcroft*
  - Ultrasonic and backup float controls
  - SCADA connection or capability
- Standby power and backup 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:

  Pump 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, access hatch directly above pump, with adequate clearance on all sides,
  - Lifting davit suitable for pump weight and located for access through hatch
  - 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
  - All pump station valves shall be located in a separate vault.
  - Double block and bleed configuration per WorkSafeBC

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 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
- A minimum of two access hatches shall be provided

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
- Fibreglass grating platform to be provided above high water level for wet well access
- Access, ladder and platform to meet Worksafe BC standards
- Double block and bleed configuration to meet Worksafe BC standards

Access shall be located 0.6m above 200-year flood level or 1.0m 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 2.0m and no more than 4.0m from station lid.
- Kiosk to contain separate compartment for pump station ventilation fan.

- Wet well ventilation shall be designed to address odour control, and confined space entry to WCB 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 pump station to within the kiosk.
- Backup power
- Levels to be controlled by ultrasonic level transmitter, plus emergency high and low level floats.
- 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 C5**.

Table C5: 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.

- Pump 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 pump 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 50mm 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 1.2m 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

Odour Criteria:

- Dissolved sulphide maximum limit at any point in the system is to be 0.5 mg/l
- Odour Criteria:
  - At 10m 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

Corrosion Criteria:

- Where there is a potential for encountering corrosive soils, a geotechnical corrosion analysis on the alignment of any proposed metallic sanitary sewer main or metallic fittings or appurtenances shall be conducted to determine the corrosiveness of the native soils. If the soils are determined to be corrosive, measures such as Cathodic protection shall be included to prevent the corrosion of the watermain and appurtenances. Cathodic protection (sacrificial anodes) shall have a 25-year life expectancy.

1.20 Testing

Testing of installed pipes shall depend on the height of existing ground water and shall consist of all tests required by MMCD and the *Village of Ashcroft* supplementary MMCD Specification.

- Testing of gravity Mains: gravity main testing procedure shall consist of flushing the pipes, CCTV video inspection and then a low pressure air test per MMCD specifications.

- Testing of Force Mains: Force mains shall be tested as described in Schedule B Section 1.29 - Testing

SCHEDULE D

STORMWATER

SCHEDULE D - STORMWATER

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1.0 STORMWATER MANAGEMENT

1.1 General

The Village of Ashcroft has not yet developed Master Watershed Plans, Master Drainage Plans, or Integrated Stormwater Management Plans (the "Master Plan"), but plans to undertake these studies and develop these documents. The Professional Engineer shall contact the Village prior to undertaking any analysis or design work to determine if a Master Plan exists for the area of interest. All development related servicing proposals must satisfy the servicing framework in the appropriate Master Plan if it exists. If not, the Village is to provide direction.

Stormwater quality and quantity control measures must be a consideration in all stormwater designs to protect downstream areas and receiving water bodies.

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 *Village* bylaws, regulations, guidelines and policies as well as federal and provincial statutes and guidelines, where relevant. These include but are not limited to the following:

- Local Government Act
- Fisheries Act
- Water Sustainability Act
- Navigable Waters Protection Act
- Wildlife Act
- Riparian Area Regulation
- Migratory Birds Convention Act
- Dike Maintenance Act
- Land Development Guidelines for the Protection of Aquatic Habitat (Canada/BC)
- Stormwater Planning – A Guidebook for British Columbia (BC/Canada)
- Urban Runoff Quality Control Guidelines for British Columbia (BC)
- National Guide to Sustainable Municipal Infrastructure (Canada)
- Beyond the Guidebook: Context for Rainwater Management and Green Infrastructure in British Columbia (BC)
- A Changing Climate in British Columbia – Evolving Responsibilities for APEGBC and APEGBC Registrants.

1.2 Servicing Objectives

The Village's objectives related to stormwater management are as follows:

- A piped or ditched minor system with conveyance capacity designed for the 1:5 year return period storm to minimize inconvenience of frequent surface runoff.
- A piped or overland major system with conveyance capacity designed for the 1:100 year return period storm to provide safe conveyance of flows to minimize damage to infrastructure and property.
- Where possible, implementation of systems that result in impervious areas being connected to the storm system indirectly rather than directly (e.g. draining through pervious areas) to allow for retention and/or detention of small storms.
- Best Management Practices (BMPs) designed to reduce the negative impacts on water quality applied to the paved surfaces of all multi-family residential, industrial, commercial, public and institutional uses, or other areas that provide communal vehicle parking, or where there is a specific risk from other point or non-point source pollution.
- Protection from erosion and sedimentation recognizing the importance of environmental concerns.
- All new development shall be planned, designed, and constructed to avoid negative downstream impacts.

1.3 Climate Change

The *Professional Engineer* shall assess implications of climate change on any proposed drainage infrastructure. The design engineer must adhere to the professional responsibilities outlined in EGBC position paper, A Changing Climate in British Columbia – Evolving Responsibilities for APEGBC and APEGBC Registrants.

1.4 Stormwater Management Plan

A Stormwater Management Plan is required for any *development* larger than 0.4 ha (1 Acre). The stormwater management plan 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.
- Reference to the applicable Master Watershed Plan, Master Drainage Plan, or Integrated Stormwater Management Plan (the "Master Plan") including details indicating how the proposed site relates to the Master Plan and its recommendations. *Owner* shall engage with the *Village* to receive the current Master Plan, if complete.

- Contour plan with 1.0m elevation interval (existing and proposed). Five metre contours may be considered for areas of steep terrain outside the developing lands to depict general drainage patterns. All contours must be labeled and easily discernable.
- Proposed lot grading plan including identification of cut and fill areas, building envelopes within the proposed lots, directional arrows showing proposed drainage flow routes on each lot, and lot numbering as per the final registered plan.
- Alignment and limits of existing watercourses and wetlands located in existing and proposed, or within 30m of, the subject site, complete with environmental classifications and/or fish presence information, if available.
- Layout of existing and proposed drainage systems.
- Proposed point and method of stormwater discharge from the site (e.g., pipe connection to *Village* drainage system, open discharge to ditch or natural watercourse).
- Existing and proposed major surface flow paths.
- Proposed control features to meet the water quantity and quality targets identified in the applicable Master Plan, if appropriate.
- Locations, sizes, design flows/volumes, capacities, and hydraulic grade line (HGL) elevations of all proposed works for both minor and major systems.
- Proposed service connection locations and their associated minimum building elevations (MBE).
- Hydrologic calculations summarized in table form.
- Construction erosion and sediment control plan.
- Groundwater management where groundwater emergence can reasonably be expected.
- Pre and post-*development* flows, both entering and leaving the subject lands.
- Capacity assessment of downstream works, or reference to the applicable Master Plan demonstrating adequate capacity, including consideration for prevention of erosion and flooding.

1.5 Runoff Analysis

Storm drainage systems shall be designed using the Rational Method or the hydrograph method through the use of an approved hydrologic/hydraulic computer program. All calculations pertinent to the design of the drainage system shall be signed and sealed by the *Professional Engineer* and submitted to the *Approving Officer*.

For *developments* where the total tributary area is 20 hectares or less, the Rational Method may be used to compute the peak runoffs. An approved hydrologic/hydraulic computer

program shall be used for analyzing larger catchments and for the design of all storage facilities.

The extent of the tributary drainage areas of the storm drainage system under design shall be in accordance with the natural and/or proposed contours of the land. The *Owner* must engage with the *Village* to receive the most current documents outlining area servicing plans established for the catchment in which the subject property is located. The developer must demonstrate that there will be no downstream impacts from their *development*.

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

In all cases the Professional Engineer (in determining the critical design conditions) is to consider the impact of snowmelt on the drainage systems.

1.6 Site and Lot Grading

Developments shall incorporate site and lot grading techniques in accordance with the following criteria:

- Each lot shall be graded to drain to a *Village* drainage system or a natural drainage path independent of adjacent lots. Minimum lot grades to be 2%. Lot grading is to be uniform and consistent.
- Areas around buildings (or proposed building sites) shall be graded away from the (proposed) foundations to prevent flooding.
- Lots lower than adjacent roadways shall be avoided where possible. Otherwise an approved stormwater management technique shall be incorporated to direct the runoff to an existing or proposed drainage system. Proper flood proofing and accommodation of the major flow path is required at the low points of roadways.
- Existing or proposed buildings shall be sited above the hydraulic grade line of the Major System. The minimum building elevations, as defined in Schedule D Section 1.9 – Minimum Building Elevations (MBE) shall be noted on the drawings.
- Lot grading shall not channelize flow for discharge into natural watercourses.
- Avoid drainage across adjacent lots where practical. Side and rear-yard swales shall be employed as necessary.

1.7 Minimum Building Elevations (MBE)

The MBE applies to the elevation of the lowest floor slab or underside of the floor joists where the lowest floor is constructed over a crawlspace, whichever is lower in elevation in

a building. Crawlspace is defined as the space between a floor and the underlying ground having a maximum height of 1.2m to the underside of the joists and not used for the storage of goods or equipment damageable by floodwater.

The MBE is to be at least 0.60 m above the storm sewer service connection invert and 0.30 m above the major drainage system hydraulic gradeline (HGL), whichever governs. 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 150mm below the lowest anticipated finished ground elevations at buildings.

If site grading in accordance with this section is not possible, roof drainage may be discharged into the municipal drainage system, at the discretion of the *Approving Officer*, where the size of the proposed or existing storm sewer has been designed for, or can be shown to accommodate the anticipated flows.

For sites near a watercourse for which a floodplain elevation has been established, the MBE is to be a minimum of the 200-year flood level (inclusive of 0.60 m freeboard). Where a flood elevation has not been established, setbacks should be as per the Provincial guidelines as follows:

Vertical Setback

- 1.5 metres above the natural boundary of any watercourse, lake, marsh, or pond.

Horizontal Setback

- 30 metres from the natural boundary of significant watercourses (greater than 10 metres in width);
- 15 metres from the natural boundary of any other watercourse;
- 7.5 metres from the natural boundary of a lake, marsh, or pond;
- 7.5 metres from any standard dike right-of-way or structure providing flood protection or seepage control.

Where more than one setback is applicable, the greater distance shall be applied.

1.8 Roof Drainage and Building Perimeter Foundation Drainage

Roof drainage for residential buildings shall be discharged to the ground and dispersed via splash pads at the downspouts to landscaped areas, provided that the site is graded away from the building, or to an approved sub-surface soak-away system. Sub-surface soak-away systems shall be designed by a *Professional Engineer*. Where discharge to landscaped areas or sub-surface soak-away systems is not possible, a subsurface

retention system shall be constructed to reduce peak flows to minor piped or ditched system. Roof drainage for commercial buildings may be connected to the municipal drainage system at the discretion of the *Approving Officer*.

If site grading in accordance with Schedule D Section 1.9 - Minimum Building Elevations (MBE) is not possible, roof drainage may be discharged into the municipal drainage system, at the discretion of the *Approving Officer*, where the size of the proposed or existing storm sewer has been designed for, or can be shown to accommodate the anticipated flows.

Roof leaders and foundation drains shall not discharge at the top of bank of a natural watercourse or other open channel. Under no circumstance shall roof leaders discharge to the sanitary sewer system.

Building perimeter foundation drains shall be discharged into soak away pits or to a low point in the lot if no downstream impacts will be experienced. If the *Owners Professional Engineer* determines that soak away pits or discharge to a low point on the property is not possible with the specific property, the perimeter drains shall be directed to individual sump pumps to discharge at the surface. The *Owner* may choose to upgrade the storm drainage system to include residential services. In cases where building foundation drains are connected to the storm drainage system at the discretion of the Approving Officer, backflow prevention devices shall be installed.

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

1.9 Rational Method

The Rational Method calculates the peak flow using the formula:

$$Q = RAIN$$

Where: R = Runoff Coefficient

A = Drainage area in hectares (ha).

I = Rainfall intensity in mm per hr.

N = 0.00278

Q = Flow in cubic metres per second (m^3/s)

1.9.1 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 *Village's* Zoning Bylaw. Future land designations, as defined in the

Village's Official Community Plan (OCP), shall be used if such land use designations will result in a higher runoff coefficient.

Table D1: Runoff Coefficients

Type of Area	Coefficient	
	1:5 year	1:100 year
Woodlands	0.10	0.30
Agricultural (cultivated)	0.30	0.40
Rural Residential	0.35	0.40
Single Family Residential	0.50	0.55
Low Density Multi-Family Residential	0.60	0.65
High Density Multi-Family Residential	0.70	0.75
Commercial	0.80	0.85
Industrial	0.80	0.85
Institutional	0.75	0.80
Parks/Cemeteries	0.20	0.30

Notes:

- The above table assumes conventional site drainage of directing all surface drainage overland into streets and catch basins.
- In case of mixed land use, a composite runoff coefficient is to be determined
- The Professional Engineer is to verify the above values meet site specific conditions and if higher values are required.
- Higher values may be applicable in those areas which experience rainfall during winter when the ground is frozen. These values may reach 0.80 to 0.95.

1.9.2 Rainfall Intensity

The intensity for the Rational Method should be determined using the appropriate rainfall Intensity, Duration, and Frequency (IDF) curve with the duration equal to the Time of Concentration (Tc) calculated as indicated below. Unless otherwise indicated in the appropriate Master Plan document, and in the absence of an IDF curve for Ashcroft, the Professional Engineer shall determine the most appropriate IDF curve to use. Climate change considerations are outlined in Section 1.2.1 Climate Change.

1.9.3 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:

$$Tc = Ti + Tt$$

Where: Tc = time of concentration (minutes)
Ti = inlet or overland flow time (minutes)
Tt = travel time in sewers, ditches, channels or watercourses (minutes)

In developments where substantial undeveloped areas remain, the contributing drainage area flows and corresponding tme of concentration should be checked by trial and error to determine the maximum peak outflow rate.V

- Inlet or Overland Flow Time (Ti):
- Typical inlet times for various urban *development* conditions (assuming that BMP's are not applied) are as follows:

Table D2: Inlet Times

Lot Type	Inlet time (minutes)	
	Max	Min
Single Family	15	10
Multi-Family	10	5
Commercial/Industrial/Institutional	10	5

- The inlet time in relatively flat rural areas can be calculated using the Airport Method:

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

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

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

$$Tt = \frac{L\ n}{60R^{0.337}\ s^{0.5}}$$

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 = Manning roughness coefficientr
= 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
= 0.013 for PVC pipe

R = Hydraulic radius (area/wetted perimeter) in m

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 Tt shall be calculated in cases where the type of flow along the longest path varies or the slope changes.

Other formulae are available for calculation of Ti and Tt obtain approval from Village.

1.9.4 Presentation of Rational Method Calculations

The *Professional Engineer* shall tabulate and submit the Rational Method calculations along with the appropriate plans and other relevant information.

1.10 Hydrograph Method

1.10.1 Selection of Modelling Program

Computer modelling programs based on hydrograph methods are required for catchment areas greater than 20 hectares. The Village supports PCSWMM and EPA SWMM models and the *Professional Engineer* shall seek clarification prior to analysis.

1.10.2 Design Storms

A design storm is a theoretical precipitation pattern used to represent the distribution of rainfall intensity over time. The *Professional Engineer* shall determine the most appropriate design storm to be used in the stormwater modelling analysis for the site and gain approval from the Village. The *Professional Engineer* shall produce hyetographs for the stormwater model based on the design storm they have selected and had approved.

Theoretical design storms are suitable for most hydrological studies. However, the simulation of large watersheds or complex drainage systems may require analysis of extended duration storms or continuous rainfall data. It is incumbent on the *Professional Engineer* to obtain the appropriate rainfall data for the analysis.

1.10.3 Catchment Data

Data preparation for planning areas or proposed *development* shall be based on the best available information as per the Official Community Plan (OCP), Zoning Bylaw, *subdivision* proposals and other pertinent land use information.

In most cases, the *Professional Engineer* shall determine both pre-*development* and post-*development* flows using the default methods of selected software, except when that is the Soils Conservation Service (SCS) curve number (CN) approach. The SCS CN method shall not be used. If sufficient information is known about the infiltration characteristics of the soils, either the Horton's or Green Ampt methods may be applied. Whichever method is selected, the parameters shall 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 relevant documents, future impervious fractions for common land uses, as shown in **Table D3,** shall be used for analysis. These are intended as a guide only. In areas of existing *development* or where more detailed information is available, the *Professional Engineer* shall verify that the values shown are representative of the true conditions.

Table D3: Common Impervious Fractions

Common Land Use	Total Impervious Fraction
Woodlands	0.05
Agricultural (cultivated)	0.30
Rural Residential	0.20
Single Family Residential	0.40
Low Density Multi-Family Residential	0.65
High Density Multi-Family Residential	0.78
Commercial	0.90
Industrial	0.90
Institutional	0.80

1.10.4 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 a range of durations. Developing design flows for both existing and proposed *development* conditions may be required.

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. The specific requirements will be confirmed by the *Approving Officer*.

1.10.5 Presentation of Modeling Results

To document the design rationale used to develop the hydrologic and hydraulic 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 as noted in section 12.1.1
- Summary of all parameters and specific simulation assumptions used
- Design storms used, to be clearly documented and plotted
- A summary of peak flows for each system component
- Inflow and outflow hydrographs for storage facilities
- Predicted hydraulic grade lines throughout drainage system under conditions governing the design

- Volumetric runoff coefficient and unit peak flow (peak flow divided by area) summarized for each catchment

The report documentation shall include:

- A digital file submission with the model input and output files
- 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

1.11 Minor System Design

1.11.1 Level of Service

The minor drainage system consists of pipes, ditches and appurtenances sized to convey peak runoff by gravity (non-surcharged) flow conditions for the 1:5 year storm.

See Figure 1 – Storm Sewer Design – Rational Method located at the end of Schedule D.

1.11.2 Pipe and Channel Capacity

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

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

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

A = cross sectional area (m^2)

R = hydraulic radius (m)

S = slope of hydraulic grade line (m/m)

n = roughness coefficient

Indicate hydraulic grade line for both the 5-year and 100-year return period on the design drawings, along with the peak design flow rate and pipe capacity for each.

1.11.3 Flow Velocities

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

Where steep grades result in pipe velocities exceeding 6 m/s, consider measures to prevent pipe erosion and movement.

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

1.11.4 Minimum Grades

Minimum grades of storm sewers are required to obtain the minimum velocity of 0.6 m/s except for catchbasin leads and service connections, for which minimum grades are as indicated elsewhere.

1.11.5 Minimum Pipe Diameter

Storm Sewers	250mm
Culverts:	
• Crossing Roads	600mm
• Crossing Driveways	450mm
Catchbasin Leads	200mm for single catchbasin 250mm for double catchbasin
Service Connections (where approved by *Approving Officer*):	
• Commercial	150mm

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

1.11.6 Alignment

Except as noted in Schedule D Section 1.11.7 – Curved Sewers horizontal and vertical alignments are to be straight lines between manholes.

1.11.7 Curved Sewers

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

- Constant radius throughout curve
- Minimum design velocity = 0.9m/s
- Curvature shall not exceed 3 degrees, or one half of the limit specified by manufacturer, whichever is less
- Deflection to be at pipe joints only, no bending of the pipe will be allowed
- Curve locations to be recorded at ¼ points and midpoint
- Constant offset from property line or road centerline
- Subject to approval by Approving Officer, sewers larger than 600 mm diameter may include deflections formed by mitred bends to a maximum mitre of 45 degrees.

1.11.8 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 100mm and 150mm service connections and junctions with trunk sewers 900mm and larger
- 150m maximum spacing for mains smaller than 900mmØ
- 250m maximum spacing for pipes 900mmØ and larger
- Every future pipe intersection
- Upstream end of every storm sewer main
- Every catchbasin lead connection

Manhole rim elevations outside of paved roadways shall be designed to be above the surrounding ground so that inflow from ponding will not occur.

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: 10mm drop
    - Deflections up to 45 degrees: 20mm drop
    - Deflections 45 to 90 degrees: 30mm 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
Greater than 0.90m	Outside Drop

- Hydraulic losses shall be calculated for manholes with significant change of grade or alignment. For high velocity flows (>3m/s) or large pipes (>600mmØ), 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 = flow velocity entering junction (m/s)

g = gravitational acceleration (9.81 m/s^2)

k = head loss coefficient (1.0 for channeled 90° bends and tees, to 1.5 without channelized benching)

1.11.9 Depth and Cover

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

Sewers shall be of sufficient depth to:

- Prevent freezing
- Meet the minimum depth of cover requirements of 1.2m for gravity
- 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, as defined by the Approving Officer

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

1.11.10 Rights-of-Way (R.O.W.)

Wherever possible, storm mains and service connections should be located within public road right of ways. Where this can't be accomplished, the following considerations are required:

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 shall only be permitted with the approval of the Approving Officer.

Right-of-way widths for service connections shall be sized to allow for approximately three times the depth from surface to the crown of the pipe (6m minimum width) where permitted by the Approving Officer.

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 or endangering adjacent structures.

Where required, trunk and interceptor sewers should have rights-of-way wide enough for future widening and/or twinning. The width of the right-of-way should be the required separation between pipe centerlines plus three (3) times the depth of the crown of the deeper sewer.

Where required, overland flood routes should be protected and preserved by restrictive covenants or rights-of-way.

The Professional Engineer shall provide cross sections indicating the minimum safe distances to adjacent building footings based on a safe angle of repose from the limits of the excavation.

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 10%.

1.11.11 Utility Separation

- Horizontal Separation

At least 3m 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 3.0 m may be permitted provided that:

- Approval has been granted by the Provincial Health Authority; or
- Any potential watermain/storm main conflicts are constructed in accordance with 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 0.5 m and the joints of the water main, over a length extending 3 m either side of the sewer main, are to be wrapped with heat shrink plastic in accordance with the latest version of the AWWA Standards C217, and C214 or C209.

Where it is not possible to obtain the vertical separation indicated above, and subject to local Public Health Authority approval, the following details shall be used:

- The water pipe joints shall be wrapped as indicated earlier; and

- The sewer shall be constructed of pressure pipe such as high density polyethylene (HDPE) with fused joints or PVC and pressure tested to assure it is watertight.

- 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, and

- Conflict 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.

1.11.12 Commercial/Institutional Service Connections

Every legal lot shall be provided with a separate service connection.

Unless otherwise permitted by the *Approving Officer*, connections are to serve the perimeter (foundation) drains of all buildings by gravity. In cases where the minimum building elevation is lower than 0.6m above the 100-year hydraulic grade line (HGL); the private property owner may request, or the *Approving Officer* may direct the *Owner* to install a private sump pump and check valve or backwater valve to facilitate the removal of any potential flood waters. All pumping infrastructure shall be located on private property and remain the sole responsibility of the property owner. A covenant shall be registered on the property for such systems.

Service connections shall be provided to each lot fronting the main. Service connections shall not be extended at an angle that exceeds 45° from 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*.

Where rear yard storm sewers are necessary, due to steep topography, the minimum cover shall be 1.5m provided that gravity service to the Minimum Building Elevation is available.

Minimum grade from property line to storm sewer main:

- 150 mm diameter pipe: 1%
- Larger sizes: grade based on minimum velocity of 0.75 m/s

1.11.13 Catch Basin 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 (0.8)

A = open area (0.68m^2 for Dobney B-23 grate)

g = gravitational acceleration (9.81m/s^2)

h = depth of ponding (m)

Space catchbasins to drain maximum paved areas of:

- 500m^2 on roads with grades up to 4%
- 400m^2 on roads with grades greater than 4%

Other spacing requirements include:

- Prevent overflows to driveways, boulevards, sidewalks and private property
- Avoid interference with crosswalks
- Avoid low points in curb returns at intersections
- Catchbasin leads to discharge into manholes
- Catchbasins shall not be installed in series

- Maximum lead length – 30m

Minimum grade of catchbasin leads: 2.0%. The *Approving Officer* may consider catchbasin leads with grades less than 2% to a minimum of 0.5%.

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.

1.11.14 Pipe Joints

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

1.11.15 Groundwater Collection

In low areas where groundwater concentration may cause surface ponding, reduced soil stability, or submergence of other utilities, provide screened and filtered manhole inlets or perforated sections of storm sewer pipe to allow groundwater to flow into the pipes and be conveyed away from the site.

1.11.16 Ditch Inlets

Ditch inlets to storm sewers shall include safety grillage for large pipes (>600mm), debris screens and sedimentation basins.

1.12 Major System Design

1.12.1 Level of Service

The major drainage system is to convey flows in excess of the capacity of the minor system. It generally consists of surface flow paths such as swales and roadways, plus roadway culverts and watercourses sized to convey peak runoff by gravity flow conditions for the 1:100 year storm. In some cases, the major flow path may need to be conveyed sub-surface within the storm sewer network.

1.12.2 Surface Flow Routing

All surface flows shall have specially designed routes that are preserved and protected by *right-of-way's* and are accessible for maintenance. Design criteria include:

- Maximum flow depth on roadways: 150mm
- One lane, or a 3.5m 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, and shall remain clear of obstructions before, during and after construction.

1.12.3 Surface Flow Capacity

Flow capacity of road surfaces and swales shall be calculated using the Manning formula, which is presented in Schedule D Section 1.13.2 – Pipe and Channel Capacity. Typical values of the Manning Roughness Coefficient "n" are:

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

1.12.4 Piped System

Where permitted by the *Approving Officer*, the minor drainage system may be enlarged or supplemented to accommodate major flows. System details shall be indicated in the Stormwater Management Plan. 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

1.12.5 Culverts

Culverts located in watercourses or culverts crossing roads shall be designed for the 1:100 year event. Culverts and channels under bridges for highways and major arterials, particularly in a defined floodplain, are to be designed to pass the 1:200 year event. The fishery value of the watercourse will establish the design requirements for the crossing. Particular designs will apply if fish passage is needed. Approvals are required under the BC Water Sustainability Act and the Federal Fisheries Act, and may be required under the federal Navigable Waters Protection Act.

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 0.3m, subject to the correct pipe loading criteria.

The maximum length of a driveway culvert is 6.0m, unless otherwise permitted by the *Approving Officer*.

1.12.6 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 determine *Best Management Practices* to reduce erosion at all *inlet/outlet structures*.

Hinged trash racks shall be provided at the inlets of all pipes that are 450mm and larger. Grills may also be required at the inlets on smaller diameter storm sewers, at the discretion of the *Approving Officer*.

1.12.7 Ditches

Ditches shall only be provided in accordance with the applicable road classification and design standards. They may also be considered by the *Approving Officer* for special interim uses.

Ditches adjacent to roads shall conform to the following criteria:

- Maximum depth 1.0m
- Minimum bottom width 0.5m
- Maximum side slope 2.0(H):1.0(V) Confirmed by *Owner*'s *Professional Engineer*
- Minimum grade 0.5%
- Maximum velocity (Unlined ditch) See **Table D4**

Where soil conditions are suitable or where erosion protection is provided, higher velocities may be permitted. If grades are excessive, erosion control structures or ditch enclosures may be required.

The minimum *right-of-way* width for a ditch through private property shall be 5m or the width of the ditch plus 3m, whichever is greater. The ditch shall be offset in the *right-of-way* to permit a 3m 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 0.5m from any property line.

Table D4: Maximum Recommended Velocities in Earth and Grass Lined Channels

Earth – Soil Type	Permissible Velocities* m/s
Fine Sand (noncolloidal)	0.5
Sandy Loam (noncolloidal)	0.5
Silt Loam (noncolloidal)	0.6
Ordinary Firm Loam	0.9
Fine Gravel	1.2
Stiff Clay (very Colloidal)	1.4
Graded Loam to Cobbles (noncolloidal)	1.4
Graded, Silt to Cobbles (colloidal)	1.7
Alluvial Silts (noncolloidal)	0.9
Alluvial Sites (colloidal)	1.4
Coarse Gravel (noncolloidal)	1.8
Cobbles and Shingles	1.7
Shales and Hard Pans	1.8
Grass Lined – Slope 0.5% - 5%	1.5
Grass Lined – Slope 5% - 10%	1.2

Erosion Resistant Soils	1.2
Erosion Resistant Soils	0.9
Erosion Resistant Soils	0.7
Highly Erodible Soils	0.9
Highly Erodible Soils	0.7
Highly Erodible Soils	0.5

* Note: Permissible velocities noted here should be considered as guidelines only. The *Owner's Professional Engineer* shall review all discharge velocities and their potential effects on all downstream channels.

1.13 Runoff Controls

Runoff controls are required to meet the objectives indicated in previous sections. Runoff controls may include:

- Detention storage
- Low impact development features
- Infiltration

Location and maintenance options for control facilities include:

- On-site, i.e. on single-family, multi-family or non-residential development sites. Registered covenants are required to ensure appropriate maintenance by the property owners.
- Off-site, i.e. on public lands, commonly right-of-ways or parks. Maintenance is to be carried out by the local authority.

1.13.1 Stormwater Storage Facilities

Peak flow attenuation shall be provided where post-*development* stormwater runoff rates exceed the existing or pre-*development* runoff rates, and the following conditions exist:

- The proposed *development* site contributes directly or indirectly to a natural watercourse or open channel that has a risk of increased erosion, due to increased flow conditions.
- The need for a storage facility has been identified in historical documents governing drainage for that catchment.

- The existing stormwater infrastructure downstream of the site does not have adequate capacity to accept additional flow and still meet the criteria herein. In this case, the *Approving Officer* will consider the potential for upgrading of the downstream deficiencies, at the *Owner's* cost, as an alternative to storage.

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

- The storage capacity requirement shall be determined by evaluating the performance under a number of storm events and durations to identify the critical event. 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 1.11 – Rational Method and 1.12 - Computer Modelling Method. This criteria is applicable to all service areas 0.4 hectares or greater.

- 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.

- Storage facilities shall be designed with safe overflow paths.

- Small Lot Criteria: For service areas smaller than 0.4 hectares, the *Approving Officer* may waive the requirement for a detailed analysis of the storage facility, provided that the *Owner's Professional Engineer* can demonstrate that the existing downstream stormwater system has the capacity to convey the proposed post *development* peak flow rates and volumes.

- Storage Options:

  Detention storage facilities for commercial, industrial, institutional and multi-family developments shall be considered private systems and are to be located on private property with a registered protective covenant. Costs and long-term operation and maintenance are the responsibility of

the property owner. Private systems shall not service more than a single lot.

At the discretion of the *Approving Officer*, the *Village* may agree to assume responsibility for the long-term operation and maintenance of facilities that service multiple properties. In that case, the proposed facility and all connecting services shall be contained within municipal *right-of-ways*. In addition, the facility must be accessible by vehicle from a municipal *right-of-way*.

Proposed stormwater detention options shall be reviewed on a site-specific basis. The *Professional Engineer* shall consider storage methods listed in this section, and other methods of merit which the *Professional Engineer* may determine appropriate. The number and location of facilities shall consider the ultimate land use and servicing plan for the watershed. The proposed concept for all storage facilities shall be approved by the *Approving Officer* prior to detailed design. Typical control facilities include:

- Dry detention ponds, rain gardens, and swales
- Underground storage vaults
- Parking lot surface detention
- Infiltration Systems

The *Professional Engineer* shall consider the site and downstream conditions to determine the most suitable type of storage facility. All proposals shall address safety, long-term performance and maintenance issues.

- Geotechnical Considerations:

  On steep slopes, where stormwater detention or infiltration is proposed, where discharge to a natural watercourse or open channel is proposed, or as required by the *Approving Officer*, a geotechnical investigation shall be completed in order to address issues such as groundwater table, soil permeability, composition and stability. Such investigations shall be undertaken prior to the preparation of the final design of the facilities.

- 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. Rapid draw down of the facility may be necessary for emergency purposes or to restore the available storage to accommodate subsequent storm events.

Provisions to accommodate higher discharges shall involve over-sizing the fixed openings and sewers connected to control structures. Adjustable mechanism such as slide gates or removable orifice plates may be used to regulate the design release rates. The extent of the over-sizing will depend on the capacity of the downstream drainage system.

Design of *inlet/outlet structures* shall consider flow energy dissipation and erosion control. Safety railings are required over all inlet/outlet openings larger than 450mm 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 4m 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 10%. 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 *Village* agrees to assume responsibility for operation and maintenance of the facility, the operation and maintenance manual shall be provided when the facility is completed and prior to the *Village* 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 minimize risk to 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. If the permanent storage depth in a wet detention pond exceeds 1.0m, a safety barrier shall be provided in addition to signage. This barrier should be aesthetically pleasing and may be in the form of a chain and post fence, continuous planting of dense shrubs, etc.

- Performance Monitoring:

  Prior to final approval of all stormwater detention facilities, the *Owner* shall prepare and submit to the *Village* 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 *Village* on a monthly basis for review. Adjustments to the control device shall be required as necessary prior to the expiry of the 1-year maintenance period.

1.13.2 Biofiltration Swales

The term *biofiltration* swale refers to a depressed flow conveyance / detention area that is surfaced with a relatively deep layer of highly permeable topsoil and vegetation (turf or ornamental landscaping) that absorbs and filters stormwater prior to discharge off-site.

Minimum depth of *biofiltration* swales shall be 150mm. Maximum depths shall be 300 mm. Deeper swales may be considered provided side slopes do not exceed 3:1. Turf lined swales shall be constructed with a minimum 200mm of top soil beneath the turf. Ornamentally landscaped swales to be lined with a minimum of 450mm of top soil, with consideration for ornamental rock placed in the invert to resist soil erosion.

Perforated underdrains may be added for enhanced groundwater recharge in areas where underlying native soils do not provide reasonable infiltration capacity. See Schedule D Section 1.16.2 - Water Quality Protection and Schedule D Section 1.16.5 - Groundwater Recharge.

1.13.3 Groundwater Recharge

The drainage characteristics of the surface soils in the *Village* are variable from one location to another. These conditions may provide the opportunity to implement infiltration measures to reduce stormwater runoff. All *development* proposals are encouraged to implement on-site mitigative measures for the purposes of groundwater recharge. For all *development*s, the *Professional Engineer* shall submit a report prepared by a qualified hydrogeologist which clearly identifies the specific opportunities and constraints for implementing shallow groundwater recharge systems on-site. At a minimum, this report shall present the following items:

- Description of site condition, size and location
- Description of proposed *development* and resulting design flows
- Description of native soils and water table conditions on-site to a depth of 5 meters
- Estimated infiltration rates for each strata of material within the 5 meter depth (complete with a description of seasonal variability)
- Recommendations for recharge methods suitable for the proposed *development*

Based on the opportunities identified in the above noted investigation, groundwater recharge systems may be approved, at the discretion of the *Approving Officer*, either in lieu of *stormwater detention facilities*, or to reduce stormwater detention requirements.

Requirements to incorporate recharge systems in the design will be reviewed by the *Approving Officer* on a site specific basis. However, the *Professional Engineer* is required to demonstrate that infiltration potentials are being maximized, to the greatest extent possible:

- Pre-Treatment:

  Particularly in multi-family, commercial, institutional and industrial *development*s, all groundwater recharge systems shall include pre-treatment measures to remove sediments, suspended solids and greases prior to entering the infiltration zone. *Biofiltration* is the preferred approach.

- Overflow System:

  Recharge systems shall be designed with sufficient volume to maximize the opportunity for infiltration. However systems contained within a municipal *right-of-way*, or where the infiltration rate of the native sub-soils are questionable, require an overflow connected to the municipal drainage system which is sufficiently sized for the 1:10 year peak discharge from the site.

- Recharge Systems:

  Methods of groundwater recharge (infiltration) systems may be approved by the *Approving Officer* on a site specific basis. The proposed system shall satisfy long-term performance and maintenance issues in order to be approved. Typical systems supported by the *Village* include the following:

  - Drywells
  - Rock pits
  - Perforated drains
  - Bioswales

Premanufactured modular infiltrator chambers (design as per manufacturers recommendations)

1.13.4 Erosion and Sediment Control for Construction

An erosion and sediment control plan shall be provided. 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, storm sewer 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 party 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 = 3.1 in.; intensity peak = 2.6 in./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

1.14 Environmental Protection

1.14.1 Creek Setback Protection

An environmental review shall be completed in accordance to all applicable Provincial and Federal legislations.

1.14.2 Water Quality Protection

Best Management Practices for the treatment of stormwater runoff to remove pollutants shall be applied to the paved surfaces of all multi-family residential, industrial, commercial, public and institutional uses, or other areas that provide communal vehicle parking, or where there is a specific risk from other point or non-point source pollution.

Best Management Practices (*BMP*'s) shall be implemented to protect water quality where indicated above, or where required by the *Approving Officer*. **Table D5** summarizes potential *BMP*'s and appropriate application. These shall be considered and implemented where practical. Implementation of any or all *BMP*'s will be at the discretion of the *Approving Officer*. This list is not exhaustive and there may be alternatives which the *Professional Engineer* may wish to propose for review by the *Approving Officer*. BMPs for water quality control should be designed for the 2 year post-*development* peak flow rate.

Table D5: Potential Best Management Practices and Applications

Best Management Practice	Land Uses
Coalescing plate oil/water separator or equivalent (mandatory for noted applications)	Gas stations, automotive service facilities, auto recycling facility.
Mechanical oil/grit separators (engineered treatment unit)	Parking lots <1,000 m^2, light industrial and commercial sites
Biofiltration swales and rain gardens	All uses
Sump manholes and catchbasins with trash hoods	All uses
Covered containment area	All commercial, industrial or agricultural chemical handling and storage areas.
Infiltration and groundwater recharge systems	All uses
Constructed wetland / stormwater detention	All uses

The noted *Best Management Practices* are intended for water quality control and do not necessarily perform a function of runoff (peak or volume) control.

1.14.3 Slope Stabilization

The implementation of stormwater management measures, combined with controls on *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 on 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 *Professional Engineer* is required prior to the approval of any *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 design shall consider the erection of temporary fencing and flagging during construction which clearly identifies the working limits for the protection of the riparian setback, and permanent fencing as required after completion 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 municipal system as outlined in Section 1.10 – Roof Drainage and Building Perimeter Foundation Drainage. Individual drains to natural watercourses are not permitted unless specific approval has been granted by provincial and federal agencies as well as the *Approving Officer*.

1.14.4 Channel Erosion Protection

Where required and permitted by the *Approving Officer* and/or Federal and Provincial Agencies, bank protection shall be considered 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. Some of the optional methods are summarized below. However, it is the *Professional Engineer's* responsibility to assess the requirements for a suitable method of bank protection.

- Grass lined and natural channels: Most suitable for longitudinal gradients of 2% or less.
- Rip-rap protection: The selection of rip-rap protection shall consider the flow velocities and scour of the underlying materials. The use of granular material or geotextiles shall provide a suitable barrier to prevent the migration of finer materials caused by either the flow in the main channel or by flows from the channel banks due to seepage.
- Bio-engineering: Bio-engineering methods of bank protection shall be promoted wherever possible for the protection and stabilization of watercourses. Bio-engineering solutions involve the use of live plants and vegetation to provide bank lining and cohesion of bank materials to resist scour. The plant materials used will require anchoring to ensure long-term stability. Bio-engineering solutions shall be compiled by the *Professional Engineer* with demonstrated expertise in this area.

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.

Figure 1: Storm Sewer Design – Rational Method

Storm Sewer Design – Rational Method																
Project Location:								**Date:**								
Reference No.:								**Calculated By:**								
Storm Return Period:								**Sheet:** _____ of _____								
Tributary Area								**Storm Sewer Design**								
Location	**From MH**	**To MH**	**R**	**A(ha.)**	**Sum A(ha.)**	**Sum RA**	**Rainfall Intensity (mm/hr)**	**Storm Q (m^3/s)**	**L(m)**	**S(%)**	**Diam. (mm)**	**n**	**Velocity(m/s)**	**Q cap (m^3/s)**	**Tc (min)**	**Location of HGL**

SCHEDULE E

ROADS

SCHEDULE E - ROADS

List of Tables

1.0 ROADS

1.1 Definitions

Insitu Testing means being tested in its original state or in the location and condition of the item or product in the field.

1.2 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* 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 design parameters of all roads within the *Village* of Ashcroft shall be in accordance with the following documents:

- Transportation Association of Canada's (TAC) most current edition of "Geometric Guide for Canadian Roads."
- TAC – Pavement Design and Management Guide;
- TAC – Manual of Uniform Traffic Control Devices for Canada (MUTCD);
- TAC – Canadian Guide to Neighbourhood Traffic Calming;
- Village of Ashcroft by-laws;
- Local Government Act (BC);
- Community Charter (BC);
- Motor Vehicle Act (BC);
- BC Transit Infrastructure Design Guidelines;
- U.S. Department of Transportation – Roundabouts: An Information Guide;
- TAC – Canadian In-service Road Safety Reviews;
- TAC – Canadian Road Safety Audit Guide; and

- British Columbia MOTI (Ministry of Transportation and Infrastructure) – Manual of Standard Signs and Pavement Markings.

Where required standards cannot be reasonably achieved, then the *Approving Officer* may allow lesser design parameters.

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

The retrofit of an existing road or intersection should include a review of the collision history to determine how collision risk can be minimized.

1.3 Road Classification

The existing roadway classifications within the *Village* 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 property as a secondary function when alternate access is not available though this 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

Collector and local 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
- **Laneways** – Laneways are paths that provide secondary access to properties. No laneways shall be permitted unless approved by the Approving Officer.

The roadway classifications are summarized in **Table E1**.

Table E1: Roadway Classification

Roadway Classification	**Right-of-Way Width** (metres)
WALKWAYS AND PATHWAYS	
Concrete/Asphalt Walkway	2.4
Multi-Use Pathway	5.0
LOCAL ROADWAYS	
Urban	20.0
Rural	20.0
Cul-de-sac	20.0
Service Commercial	20.0
Heavy Industrial	20.0
COLLECTOR ROADWAYS	
Urban	20.0
Rural	20.0
Arterial Roadways	
Arterial	30.0

Notes:

- be considered in the design process and added to the *right-of-way* width were All *right-of-way* widths do not include an allocation for bicycle facilities. These should necessary.
- In cold climates, where a portion of the urban local roadways is sometimes used for snow storage, *right-of-way* and pavement widths of 20m and 10m respectively are recommended.
- No laneways shall be permitted unless approved by the *Approving Officer*.

1.4 Road Cross-Section Details

The standard roadway cross-sections shall be as shown in Schedule A – Works and Services Requirements and detailed in **Table E2**.

The standard road cross-sections detailed in **Table E2** and Schedule A – Works and Service Requirements List of Standard Drawings shall apply to all roadways within the *Village* of Ashcroft. 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 E2: Roadway Cross-Section Details

Facility Classification	Right-of-Way (metres)	Road Width (metres)	Lane Width (metres)	Parking	Shoulder	Curb Type	Sidewalks	Bicycle Facilities
WALKWAYS AND PATHWAYS								
Concrete /Asphalt Walkway	2.4	2.0	N/A	N/A	N/A	N/A	N/A	N/A
Multi-Use Pathway	5.0	4.0	N/A	N/A	0.5 m gravel	N/A	N/A	Shared Asphalt
LOCAL ROADWAYS								
Urban	20.0	10.0	2 - 5	Allowed	N/A	Rollover	1.5 m one side	Shared Asphalt
Rural	20.0	10.0	2 - 5	N/A	1.0	N.A	N/A	Shared Asphalt
Cul-de-sac (Urban)	20.0	9.0	2 - 4.5	Yes	N/A	Rollover	1.5 m one side	Shared Asphalt
Service Commercial	20.0	10.0	2 - 5	N/A	1.0	N/A	1.5 m One side	N/A
Heavy Industrial	20.0	10.0	2 - 5	N/A	N/A	Barrier Curb	N/A	N/A
COLLECTOR ROADWAYS								
Urban	20.0	12.0	2 – 6	N/A	N/A	Barrier Curb	2.5 m Both Sides	Wide scales
Rural	20.0	11.0	2 – 5.5	N/A	N/A	N/A	N/A	N/A
ARTERIAL ROADWAYS								
Arterial	30.0	14.0	2 – 3.6	N/A	2.4	N/A	N/A	N/A

Where roadway cuts or fill sections extend beyond the *right-of-way* widths noted in **Table E2**, 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.

1.5 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 E3**, 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 E3: Road Design Criteria

Facility Classification	Design Speed (km/h)	Maximum Grade	
		Desirable (%)	Absolute (%)
Concrete/Asphalt Walkway	N/A	10	15
Multi-Use Pathway	30	10	15
Local Roadway	50	6	10
Collector Roadway	70	6	8
Arterial Roadway	70	5	8

1.6 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 Standard Drawings A1 – A12. Where it is impractical to meet these criteria, the *Approving Officer* may approve the use of private access roads
- 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 50m 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 2.0% on all road classifications unless specified otherwise by the *Approving Officer*. 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 70m 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 7.5m intervals around cul-de-sacs

1.7 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 Standard Drawings A1 – A12, or permitted otherwise by the *Approving Officer*
- Typical locations of works and utilities in Roads are shown on the Standard 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, the *Approving Officer* may require that they be separated by means of tangents of sufficient length
- Where angular deflections occur in a roadway alignment, the *Approving Officer* may require that the angle be replaced by a curve of suitable radius

1.8 Cul-de-sacs

Cul-de-sac bulbs shall be used to terminate “no exit” roads as detailed in the List of Standard Drawings. The following shall apply:

- A maximum cul-de-sac length of 250m measured from the edge of the intersecting through road to the centre of the cul-de-sac bulb 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.
- Guidelines for emergency access roads at long cul-de-sacs include the following:
  - Maximum grade: 10%, can be exceeded at the discretion of the *Approving Officer*.
  - Minimum *right-of-way* and pavement width: 6.0m
  - Gates to prevent access by non-emergency vehicles;
  - Gravel structure equivalent to local road complete with pavement if used for walkway
  - Shared use as pedestrian walkway and bikeway at the discretion of the Approving Officer
  - 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.

1.9 Intersections

90º intersections are preferred by the *Village* of Ashcroft. The *Owner's Professional Engineer* shall make all reasonable effort to design to 90º intersection 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 on local and collector streets shall be 60 m. The minimum spacing on arterial roadways shall be 200 m.

Local Street Intersecting Arterials - Intersecting local streets shall have a maximum width of 11 m for a distance of 20m 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, the cross fall of the minor street should be varied to suit the profile of the major street. The maximum rate for changing cross fall at intersections is as follows:

- Arterial: 3% in 30m
- Collector: 4% in 30m
- Local: 6% in 15 m

1.10 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 E2** and the Standard Drawings.

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

Concrete walkways shall be provided for access through the *subdivision* to schools, playgrounds, shopping centres, transit, beaches and other community facilities, asphalt walkways may be considered at the discretion of the *Approving Officer.*

Fencing shall be provided for walkways located between lots.

The maximum grade for walkways shall not exceed 10%. Where walkways would otherwise exceed 10%, concrete stairs shall be installed. Prior to the authorization of concrete stairs, alternate walk routes shall be submitted for *Village* review and approval. Only where other acceptable walk routes are not available, will the installation of stairs be considered.

Wheelchair ramps shall be provided at all intersection curb returns as an integral part of the sidewalk or to link walkways, crosswalks and multi-use pathways. Design at the midpoint of the curb return. Reference Standard Drawings.

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

1.11 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, and will be as specified by the *Approving Officer*.

When a new road with curbs intersects an existing road without curbs, only half the curb returns shall be constructed unless the road design for the uncurbed road is available and will allow construction of the full curb returns. Full curb returns shall be constructed at the intersection of two curbed roads.

1.12 Curb and Gutter

Curb and gutters shall be provided as specified in **Table E2** and the Standard Drawings.

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

Minimum curb return radius shall be in accordance to **Table E4**.

Table E4: Minimum Curb Returns

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

1.13 Driveways/Crossovers

Each property shall only have one driveway access per road *frontage*, unless 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.

Details for driveway letdowns are provided in the Standard Drawings. 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 10m 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 1m from hydrants, poles, street lights or street signs.

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 edge of pavement or the gutter flow-line.*

All driveway accesses shall be in accordance to **Table E6**.

Table E6: Driveway Widths

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

* *See drainage schedule for minimum culvert sizing*

1.14 Regulatory and Information Signs

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

1.15 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 *Village* requirements.

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

Clearance to aerial utilities subject to requirements and approvals from all regulatory bodies as required.

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

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 m	1.0 m	2.5 m	1.50 m
	med & high	2.50 m	1.0 m	2.5 m	1.75 m
Local	low	2.25 m	1.0 m	2.5 m	1.25 m
	med & high	2.25 m	1.0 m	2.5 m	1.25 m

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

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

1.16 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 within 850mm of the finished paved surface 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 Axel Loads

Road Classification	Design Traffic (ESAL)
Arterial	2.8×10^5
Collector	2.8×10^5
Industrial	5.6×10^4
Residential	2.8×10^4

  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.

  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

SCHEDULE F – STREET LIGHTING

List of Tables

1.0 STREET LIGHTING

1.1 General

All new developments require street lighting. New developments that are to be serviced with buried electrical shall consider the requirements noted in this schedule. New developments that have existing BC Hydro poles along the roadway may be illuminated using BC Hydro lease lights in the event that spatial limitations exist and stand-alone davit poles cannot be installed. Design of street lighting systems shall be prepared by a *Professional Engineer* registered in the Province of British Columbia. A copy of the lighting calculations shall be submitted to the *Approving Officer*.
All new luminaires and replacement luminaires shall be LED lighting. Roadway classification and pedestrian activity levels shall be verified with the Village representative prior to proceeding with the design.

References:
TAC Guideline – Transportation Association of Canada Guide for the Design of Roadway Lighting
ANSI/IESNA RP-8-18 American National Standard Practice for Design and Maintenance of Roadway and Parking Facility Lighting

1.2 Minimum Levels of Illumination

Designer is to use luminance criteria for roadway lighting. The luminance levels and uniformity ratios provided below are intended as the lowest recommended values for the types of roads shown.

Designer is to use illuminance criteria for cul-de-sacs and sidewalks. Criteria is provided in appropriate sections of the reference standards.

Table F1 summarizes the minimum illumination level(s) for roadways in average cd/m^2.

Table F1: Minimum Levels of Illumination for Roadways

Road Area and Pedestrian Activity		Average Luminance cd/m²	Average-to-Minimum Uniformity Ratio	Maximum-to-Minimum Uniformity Ratio	Maximum-to-Average Veiling Luminance Ratio
Road Type	Pedestrian Activity				
Freeway	--	≥ 0.6	≤ 3.5	≤ 6.0	≤ 0.3
Partial Lighting of Interchange On-Ramps/Off-Ramps	--	≥ 0.6	≤ 3.5	≤ 6.0	≤ 0.3
Expressway–Highway	High	≥ 1.0	≤ 3.0	≤ 5.0	≤ 0.3
	Medium	≥ 0.8	≤ 3.0	≤ 5.0	≤ 0.3
	Low	≥ 0.6	≤ 3.5	≤ 6.0	≤ 0.3
Arterial	High	≥ 1.2	≤ 3.0	≤ 5.0	≤ 0.3
	Medium	≥ 0.9	≤ 3.0	≤ 5.0	≤ 0.3
	Low	≥ 0.6	≤ 3.5	≤ 6.0	≤ 0.3
Collector	High	≥ 0.8	≤ 3.0	≤ 5.0	≤ 0.4
	Medium	≥ 0.6	≤ 3.5	≤ 6.0	≤ 0.4
	Low	≥ 0.4	≤ 4.0	≤ 8.0	≤ 0.4
Local/Alleyway	High	≥ 0.6	≤ 6.0	≤ 10.0	≤ 0.4
	Medium	≥ 0.5	≤ 6.0	≤ 10.0	≤ 0.4
	Low	≥ 0.3	≤ 6.0	≤ 10.0	≤ 0.4

1.3 Streetlight Pole Locations

Table F2 summarized streetlight pole locations.

Table F2: Streetlight Pole Locations

Road Type	Pole Location / Spacing	Pole Type	Lamp Standard Height
Local	Spaced on One Side of Roads	Davit *	9.1m
Walkways & Pathways	Entrance & Exit Points	Post	4.0m

* Ornamental streetlights to be approved by Approving Officer

1.4 Underground Ducts

Underground wiring for streetlighting shall be designed and installed in accordance with the requirements of the Canadian Electrical Code and BC Hydro design requirements for service entrances. Any municipal codes or bylaws and requirements of other authorities having jurisdiction shall be followed.

The standard offset for the location of the underground streetlighting ducts in road *rights-of-way* shall conform to the applicable Standard Drawing.

The minimum depth for the underground ducts shall be installed as per the Canadian Electrical Code.

It is the *Owner*'*s* responsibility to ensure that the supply service to the streetlighting system receives approval from BC Hydro. The *Owner* shall also ensure the street lighting system is energized prior to issuance of a *Certificate of Total Completion*.

1.5 Lamp Standards & Luminaires

Davit poles shall be used on all municipal roadways. Downtown areas and private developments (strata's) may use decorative post-top luminaires. Post-top luminaires may be supplied with receptacles that are to be used for Christmas lights or other decorative means.
Luminaires are to be LED, 4000K color temperature unless otherwise requested and approved, 120VAC, Type 2 distribution unless required otherwise due to the classification or the roadway, and provided with house shields in all residential areas. Luminaires shall be CSA approved

For calculations, a light loss factor of 0.8 is to be used. Luminaires shall have a readily available IES file that is provided by the supplier and used for the calculations.

All lighting circuits shall be provided with a test switch. Each lamp shall be provided with a 7-pin photocell. In the event that a single photocell is provided, a contactor shall be provided on each circuit to switch on/off all the connected luminaires and all other luminaires shall be provided with a 7-pin shorting cap.

Bases are to be manufactured to MMCD standards and include the type stamp in a visible location on the base. The number of conduits entering/leaving the base shall be a minimum of two (2) and additional conduits are acceptable and shall be indicated on the drawings.

Streetlight bases are to be installed 0.5m from the back of sidewalk or curb to the center of the streetlight base.

LED products shall meet the following specifications:

- IESNA LM-79-08 IESNA Recognized Method for the Electrical and Photometric Measurements of Solid-State Lighting Products (from an independent laboratory)
- IESNA LM-80-08 IESNA Recognize Method for Measuring Lumen Maintenance of LED Light Sources

1.6 Product Standards of Acceptance

Davit Poles: Nova Pole or Valmont Industries. Poles to be designed to MMCD standards with a 2.5m davit arm and painted black.

Post-top Poles: Nova Pole or Valmont Industries. Alternative suppliers will be considered. Selected poles to be approved by the Village prior to ordering.

Davit Luminaires: Lumec Signify Roadfocus RFM. Preference is to standardize using 108W or 72W luminaires. Other wattages are acceptable if the calculations require so. House shields are to be used in all residential areas. Only 4000K color temperature shall be used.

Post-top Luminaires: Lumec Signify Metroscape. Only 4000K color temperature shall be used. 3000K color temperature will be considered if a formal request is made.

Photocell: Intermatic LED4536SC

Bases: Bases to be meet MMCD standards at minimum for the type and weight of pole being used. Type C or C1 bases for davit poles. Type B bases for post-top poles.

Services Bases: Service bases and panels to meet MMCD standards. Valid Manufacturing or equivalent.

All shop drawings are to be provided to the municipality for review prior to ordering. Lighting calculations are to be provided on the drawings along with the lighting layout and bill of materials for review by the municipality.

SCHEDULE G

LANDSCAPING

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 – Landscape Irrigation Best Management Practices

1.3 Application of Standard

These standards apply to the following types of Public Lands:

- Boulevards
- Recreation Corridors
- Public Access Routes
- Stormwater Management Facilities
- Erosion Control
- Amenity areas (i.e. seating areas, playgrounds, games courts, picnic areas)

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*. Irrigation drawings and specifications shall be prepared by a *Certified Irrigation Designer*.

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
- Placement of proposed 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 behavior
- 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 Boulevards

Boulevards within public road *rights-of-way* having an urban cross-section:

- Grass surfaces are permitted
- Surfaces located between the back of curb or back of sidewalk shall be landscaped in commercial areas only
- Street trees may only be installed in Public Access Routes only if permitted by the *Approving Officer*

- Landscaping materials should be hardy and should provide visual interest throughout the seasons.

1.7 Public Access Routes and Recreational Corridors

Lighting of all public access routes and recreational corridors shall be provided as required by the *Approving Officer*.

1.8 Stormwater Management Facilities

- Wet Ponds
  - Between the normal water level and the top of bank the side slopes shall be naturalized with low maintenance riparian plantings in 100mm minimum depth growing medium
  - Above the top of bank the ground surface shall be turf on 50mm 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
  - Irrigation system per Schedule G Section 1.11 - Irrigation
  - Meet all criteria listed in Schedule D – Stormwater
- Dry Ponds
  - The bottom of dry ponds and infiltration basins shall be turf on 50mm depth smooth growing medium or, if approved or required by the *Approving Officer*, a hard-surfaced recreational surface
  - Side slopes with a 4 (horizontal) to 1 (vertical) or shallower slope shall have a turf surface on 50mm minimum depth smooth growing medium. Side slopes steeper than 4 (horizontal) to 1 (vertical) slope shall be naturalized with low maintenance riparian plantings in 100mm minimum depth growing medium
  - Above the design high water level the ground surface shall be turf on 50mm 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
  - Irrigation system per Schedule G Section 1.11 - Irrigation
  - Meet all criteria listed in Schedule D – Stormwater

1.9 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 *Village* will not be accepted by the *Village* 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.

At the discretion of the *Approving Officer*, the *Owner* may be required to prepare and submit an erosion control plan covering some or all of the proposed Public Land.

The *Owner* is responsible for preventing and controlling erosion, and for restoring sites impacted by erosion, for the term of the Maintenance Period.

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

1.10 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, hard surfaces, utility service lines (whether overhead or underground) and firebreaks on Public Lands 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 1.5m wide with a 100mm 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 emergency and maintenance vehicles. Hydrants shall be located in the road dedication adjacent to the access point

1.11 Irrigation

An irrigation system shall be designed, installed, operated and maintained to provide sufficient application of water to maintain the plants and grass of the landscape *works and services* in a healthy and growing condition for the irrigation of Public Land to be maintained by the *Owner*(s). If an irrigation system is not required at the time of construction, but will be required in the future, sufficient design, servicing and construction shall be performed to enable the irrigation system to be readily installed, connected and operated in future.

Where Public Land is to be maintained by the *Village*, an irrigation system shall be designed, operated and maintained until the end of the Maintenance Period. One (1) metered water service and one (1) metered electrical service (120 volts, 60 amps) shall be provided for each park, open space, drainage facility, boulevard, median, roundabout, traffic circle and cul-de-sac island at a location acceptable to the *Approving Officer*. The service shall include the establishment of water and electrical service accounts, testing and certification of the backflow prevention device, a plumbing permit, an electrical permit, and all materials, labour, fees and utility costs necessary to provide the service until the end of the Maintenance Period.

1.12 Fencing

A standard fence is to be constructed in accordance to the Zoning Bylaw and is subject to approval of the *Approving Officer*.

1.13 Seeding

Upon completion of earthworks, all excavation and embankment slopes shall be covered with a minimum 100 mm thickness of organic topsoil with clean sand mix and seeded as follows:

- Schedule all operations to ensure optimum environmental protection and seeding operations. Schedule seeding to follow as soon as practical after growing medium placement and finish grading to provide vegetative cover as soon as possible.
- Schedule seeding after frost has left ground and before October.

- Do not perform work under adverse field conditions such as winds greater than 10 km per hour, frozen soil, hot and arid conditions, excessively wet or dry soil or soil covered with snow, ice or standing water.
- No seeding shall be carried out in areas or over surfaces that are not properly prepared. The *Owner* is to examine the site before starting work to verify all surfaces are properly prepared.
- All seed, mulch, fertilizers and related materials, where required, are to be stored in dry, weatherproof storage place and to be protected from damage by heat, moisture, rodents or other causes until time of seeding. Labels or other identification are not to be removed or defaced.
- A slow release fertilizer formulation based on analysis of soil to be seeded shall be applied in conjunction with the seed.
- Mulch shall be specially prepared wood cellulose and/or textile fabric of a type commonly used and approved for hydraulic seeding.
- Blend seed application into adjacent grass and forest to form uniform surfaces.
- Maintain seeded areas as necessary to establish a complete coverage of grass in a healthy and growing condition until final acceptance.
- Seeded areas will be accepted when seeded areas are uniformly established and areas are free of rutted, eroded, bare or dead spots and free of weeds.

2.0 PRODUCTS

2.1 Seed

Grass seed to meet requirements of Canada Seed Act for Canada No. 1 seed.

Seed mixes shall be supplied by a recognized supplier of certified seed.

Seed to be packed and delivered in original containers clearly showing:

- Name of supplier
- Analysis of seed mixture
- Percentage of pure seed
- Year of production
- Net weight
- Date and location of bagging

Installed seed mixes and application rates are to take into account site specific variables such as altitude, micro-climate, soil type, and soil organic content, as well as water availability, seed availability, seed germination rates, and time of seeding.

All seed species, installed on sites where no additional water supplementation is to be applied other than natural rainfall, shall be drought tolerant varieties.

A seed mix shall be specified from the following seed species for a typical installation in populated areas i.e., *subdivisions*, roadside cover slopes, and empty lots:

- **TYPE A Seed Mix**: Apply for all areas that are intended to be maintained; or partially maintained; or that may receive periodic maintenance (mown) over the long term. These areas may include irrigation (either full or partial) to, and following establishment; or be entirely un-irrigated from time of establishment onward.
  - Seed Rate = 100kg/ha
  - Species Percentage by **Weight**

Creeping Red Fescue	18.00%
Annual Ryegrass	19.00%
Perennial Ryegrass	28.50%
Tall Fescue	22.50%
Timothy	2.00%
Orchardgrass	4.50%
Kentucky Bluegrass	2.50%
Dahurian Wildrye Grass	3.00%

- **TYPE B Seed Mix** : Apply for all areas that WILL NOT be, either maintained (mown) or irrigated, over the long term.
  - Seed Rate = 60kg/ha
  - Species Percentage by **Weight**

Bluebunch wheatgrass	38%
Rough Fescue	10%
Rocky mountain fescue	16%
Sandberg bluegrass	22%
Junegrass	3%

- Annual Ryegrass 24%

No less than five (5) species of grass seed shall be used in each custom blend to the above species percentage by weight.

Percentages and application rate for custom mixes shall be specified by the supplier and shall be not less than 80 kg/ha. Seeding should be done in two applications at right angles to each other.

Nitrogen fixing legumes such as clover may be used in limited quantity in seed mixes where a quick short term (less than 3 years) cover crop is required to control erosion or to establish native dryland grasses. Inclusion of legumes in seed mixes is to be approved prior to application.

SCHEDULE H

RETAINING WALLS

SCHEDULE H – RETAINING WALLS

1.0 RETAINING WALL SYSTEMS AND ALTERATIONS

1.1 Conditions Requiring Retention

Retention of land shall be required in the following conditions:

- Where it is deemed necessary, by the *Approving Officer* or a Geotechnical engineer to:
  - Provide stability to existing or altered slopes or to control potential erosion
  - Protect *Works and Services* or provide access to *Works and Services*
  - To retain other land or structures
  - Control surface drainage by altering the contours of the land
- Where the slopes either existing or altered are steeper than their natural geological angle of repose, or steeper than 2 horizontal to 1 vertical whether terraced or otherwise. Allowable slope steepness to be confirmed by the *Owner's* geotechnical engineer.

1.2 Design and Inspection

The design and inspection of any retention system or structure above 1.2m shall be prepared and carried out by the *Professional Engineer* who shall be responsible to acquire geotechnical consultation and advice where conditions present the need for it, as designated by the BC Building Code.

Evaluation of the aesthetic appearance will be completed by the *Approving Officer* prior to construction. The following types of structures may be permitted pending aesthetic approval from the *Approving Officer* as permanent structures:

- Lock blocks (concrete blocks approximately 750mm x 750mm x 1,500mm) unless:
  - No more than 2 courses of blocks are exposed with the top surface being flat without locking stubs
  - Ends of the system include sloping transition blocks where topography is sloping
  - Exposed faces and surfaces, including the top surfaces of such system, are faced or surfaced with either exposed aggregate or other decorative finish
  - Footings in accordance to *Professional Engineer'*s requirements
  - Geogrid reinforced in accordance to *Professional Engineer'*s requirements

- Gabion (wire baskets filled with rocks) except for in-stream or waterfront erosion protection, not more than 2 baskets high. Rock material and construction method to be approved by the Approving Officer. Design shall be aesthetically pleasing
- Cast in place concrete retaining walls:
  - Where required, retaining walls shall be designed by a Professional Engineer.
- Stacked Rock Walls:
  - In accordance with Schedule H Section 1.2 – Design and Inspection first paragraph
- Guardrails or Fences:
  - Guardrails or fences shall be required at the top of retention structure where the difference in elevation between adjacent levels exceeds 1m
  - Landscaping alternatives may be used providing it is of a dense thorny type to discourage access to the top of the retention structure area and providing the difference in elevation between adjacent levels does not exceed 1.5m

1.3 Submissions for Retention Structures

Engineering submissions are required for all retention structures which are more than 1.2m high and/or terraced at a slope steeper than 2 horizontal to 1 vertical. Allowable slope steepness to be confirmed by the *Owner's* geotechnical engineer.

Submissions shall be accompanied by the following documentation signed and sealed by the *Professional Engineer*:

- Scaled structural, geotechnical and drainage details
- Scaled site plan showing the location of the retention structures in relation to any property lines. *Rights-of-way* or easements, tanks, other structures, underground *works and services* or natural features and confirmed by a Professional BC Land Surveyor if deemed necessary
- Letters of Assurance of Design and Field Review

1.4 Completion of Retention Works

The *Owner* shall take all necessary measures, temporary and permanent to provide any necessary protection.

All required retention works are required to be completed prior to:

- Provisional Completion of a *subdivision*

SCHEDULE I

SITE GRADING

SCHEDULE I – SITE GRADING

1.0 SITE GRADING GENERAL

The *Owner* shall execute site grading work in accordance with the regulations, standards and specifications set out in this Schedule. Through areas of steep topography the *Owner* shall undertake site grading work as requested by the *Approving Officer* in order to provide developable building sites, reasonable lot access, and accommodate or enhance drainage.

1.1 Conceptual Review Submission Requirements

The *Owner* shall provide a conceptual grading plan at least one (1) month prior to the submission of the *subdivision* design to enable the *Village* to provide comments regarding the overall grading scheme.

1.2 Approval of Engineering Drawings Required Prior to Construction

Prior to commencement of construction, engineering drawings for site grading work shall be submitted to the *Approving Officer* for approval. These drawings shall explicitly show:

- Clearing and grubbing boundaries
- Fill and excavation areas (by shading)
- Structural fill areas
- Lot grading elevations and sections
- Drainage works
- Siltation abatement and control
- Profiles along excavation and embankment control lines
- Where applicable, temporary emergency access points

No construction of the work shall commence until the *Owner* has received written approval from the *Approving Officer*.

1.3 Geotechnical Evaluation

In addition to the geotechnical overview undertaken during the initial phases of the project, the *Owner* shall engage the services of a qualified *Professional Engineer* to investigate surface soil and sub-surface conditions with respect to site grading within the proposed *subdivision*s. The *Professional Engineer* shall prepare a report outlining their 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, pavement structures for roads and any other geotechnical issues affecting site grading construction within the proposed *subdivision*. A copy of the geotechnical evaluation shall be submitted for approval to the *Approving Officer* with the site grading or engineering drawings.

1.4 Drainage

Supplemental to the requirements for drainage systems outlined in Schedule D - Stormwater of this bylaw, the *Owner* shall design site grading and drainage works to:

- Accommodate drainage throughout the site
- Accommodate drainage generated on-site
- Mitigate drainage at all building locations
- Drainage for back and side yard of property should be directed to street and not be conveyed over adjacent properties.
- Mitigate sub-surface drainage/groundwater problems
- Mitigate soil erosion potential
- Mitigate siltation of adjacent or receiving *Village* storm and sanitary mains or ditches and receiving streams and watercourses

The *Professional Engineer* shall prepare and seal the appropriate drawings to explicitly show the works required to accommodate site drainage.

1.5 Detailed Site Survey

Detailed site surveys are required throughout the site and of relevant areas beyond the site to ensure grading in accordance with the requirements of this Bylaw with respect to assuring the competence of non-structural and structural fills and to accommodate site drainage during and after construction of the *subdivision* or *development*.

1.6 Design Criteria - General

The intent of site grading plans is to ensure that the following parameters are accommodated:

- Overall site drainage to provide:
  - Conveyance of off-site runoff onto and through the site
  - Conveyance of on-site runoff into existing watercourses or new drainage infrastructure
  - Abatement of drainage from one lot to another
  - Abatement of sub-surface groundwater problems
  - In accordance with Schedule D – Stormwater
- Build-able lots are created 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
- Provide drawings that are easy to interpret by approving authorities, contractors, and builders to construct the work

1.7 Design Criteria - 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 loaded, hauled and disposed of at an approved location off-site, or ground/chipped onsite.

Dust control measures shall be put in place during construction.

1.8 Design Criteria - Excavation and Embankment Slopes

Unless specified otherwise by the *Professional Engineer* or Worksafe B.C., maximum (steepest) excavation and embankment slopes shall be 2.0m horizontal to 1.0m vertical.

1.9 Design Criteria - Compaction

Unless specified otherwise by the *Professional Engineer* all embankment shall be compacted as follows:

- Non-Structural Embankments – *Owner's Professional Engineer* shall confirm Minimum Standard Maximum Proctor Dry Densities
- Structural Embankments – *Owner's Professional Engineer* shall confirm Minimum Standard Maximum Proctor Dry Densities

1.10 Design Criteria - Lot Grading

Wherever possible, lots shall be graded towards roadways, and in no case shall lots be permitted to drain onto an adjacent lot. Through areas where site topography prohibits drainage to roadways, lots may be graded to lot lines with drainage swales graded out to the roadways. Drainage swales shall be protected by registration of a covenant and a statutory *right-of-way* on the lot title.

Where lot grading is undertaken maximum lot grades shall be 15% graded to 20 m back from the front property line with minimum lot grades of 2%.

1.11 Design Criteria - Lot Access

Maximum 10% access grades measured from the curb to property line elevation shall be provided to each lot.

1.12 Design Criteria - Landscaping and Seeding

Upon completion of earthworks, all excavation and embankment slopes seeded in accordance with Schedule G – Landscape.

1.13 Design Criteria - Siltation Abatement and Erosion Control

Shall be in accordance to Schedule D – Stormwater.

SCHEDULE J

QUALITY CONTROL

SCHEDULE J – QUALITY CONTROL

1.0 QUALITY CONTROL AND ASSURANCE

This Schedule sets out the *Village'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.

Minimum design standards are set out in Schedules A to K.

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 the *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 resumé (curriculum vitae) for the person(s) that the *Professional Engineer* proposes/has retained to undertake the inspections and testing on their 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 W*orks 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 *Village* 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 prior to awarding the contract(s) to the Contractor

  In the case where the Contractor has not performed similar *Works and Services* in the *Village* of Ashcroft, 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

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 *Village* 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 Schedule A - K, 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 drawing to the *Village*
- 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 Substantial and Total Performance 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 with 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
  - Other 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 *Village*
  - Deficiency Identification Forms (Items of the Works 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 Works 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 as-built drawings that are filed with the *Village*

- Notwithstanding the generality of the foregoing, the *Owner* shall ensure that its *Professional Engineer* provides the *Village* with the following at the times and in the manner set out below:
  - Certification, prior to paving, that items of the *Works and Services* that are below areas to be paved (such as roads, walkways, driveways and parking lots) have been inspected by the *Professional Engineer* and 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 *Village* 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)
- Copies of inspection reports & record drawings shall be submitted to the Village (in PDF format for inspection reports and both PDF and AutoCAD formats for record drawings).

SCHEDULE K

STANDARDS FOR SUBMISSION BY DEVELOPER

SCHEDULE K – 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 engineering work(s).

Where a *Village* standard drawing exists, it shall be sufficient to refer to the appropriate drawing by reference number and date of issue. Where a standard 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 *Village* 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 UTM NAD 83 Zone 10.

1.3 Abbreviations

UTM	Universal Transverse Mercator
NAD 83	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 22x34in (558.8x863.6mm)
- A north arrow shall be placed close to the top right side of each plan view on the sheet
- A title block which describes the contents of the drawing (e.g. Key plan, road, etc.) and shall clearly indicate 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 meters 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 = 25mm
- Existing imperial dimensions, except for pipe sizes, are to be soft converted using the factors:

  1 inch = 25.4 millimeters

  1 foot = 0.3048 meters

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 1.5mm
- The maximum plotted text height shall be 5.0mm

- The standard lettering height is 2.0mm

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 1:250 or 1:500 Vertical 1:25 or 1:50
- Cross Sections - Horizontal 1:100 Vertical 1:50
- Details - 1:10; 1;20; 1:100; 1:500

3.0 DRAWING STANDARDS (DIGITAL)

3.1 General Requirements

The *Owner* shall submit a complete set of electronic drawings of the *subdivision* or *development* in AutoCAD DWG format upon completion of the proposed works.

All drawing objects colour and linetype properties shall be set to 'bylayer'.

All drawings must be purged of all unnecessary information prior to submission to the *Village*.

3.2 Drawing Conventions

3.2.1 Layer names and Colour

The *Village* uses the following convention for naming AutoCAD layers:

<*category*>-<*object*>-<*type*>

Where the available '*categories'* are defined in **Table K1**; and '*objects'* could be lines, mains, manholes, valves, walls, fences, and text; and '*type'* describes the type of object.

For example, concrete could be used to describe a 'type' of sidewalk as in ROAD-WALK-CONCRETE or ROAD-WALK-TEXT would describe text associated with the sidewalk.

Table K1: Layer Names and Colour

Layer Category	Category Description	Colour Pen #
COM	Communications (e.g. Tel or Cable)	230-239
ELEC	Electrical	190-199
GAS	Gas	190-199
LAND	Landscape Information	70-79
LGL	Legal Information	140-149
ROAD	Roads	20-29
SAN	Sanitary Sewer	10-19
STM	Storm Drainage	90-99
STRUC	Structures and Hard Surface Features	220-229
SURV	Survey Information (e.g. Control points)	40-49
TOPO	Topography (e.g. Contours)	60-69
WAT	Water	150-159

Some common layer examples are:

- SAN-MAIN-200mm
- ROAD-EDGE-ASPHALT
- SURV-POINT-CONTROL

If required layer names may be prefixed as in **Table K2** to signify either existing, proposed, or future works.

Table K2: Layer Names - Prefix

Prefix	Description	Range
E-	Existing Features	Colours 11-249 odd
P-	Proposed Works	Colours 10-248 even
F-	Future works	250-255

3.2.2 Special Layers

Exceptions to the layer naming convention described above are described in **Table K3**.

Table K3: Layer Names - Exceptions

Layer Category	Category Description	Colour Pen #
_MVIEW	Viewports	0
_IMAGE	Externally Referenced Images	0
_TITLE	Title Block Data (text and line work)	180-189

3.2.3 Lineweight Conventions

Colours 1-9 are generally used for Title blocks and miscellaneous text and notes.

1	0.20	black	6	0.30	black
2	0.30	black	7	0.20	black
3	0.35	black	8	0.15	black
4	0.60	black	9	0.10	black
5	0.20	black			

Colours 250-255 are generally used for FUTURE works and hatch patterns.

250	0.10	grey	252	0.20	grey
251	0.15	grey	253 - 255	0.25	grey

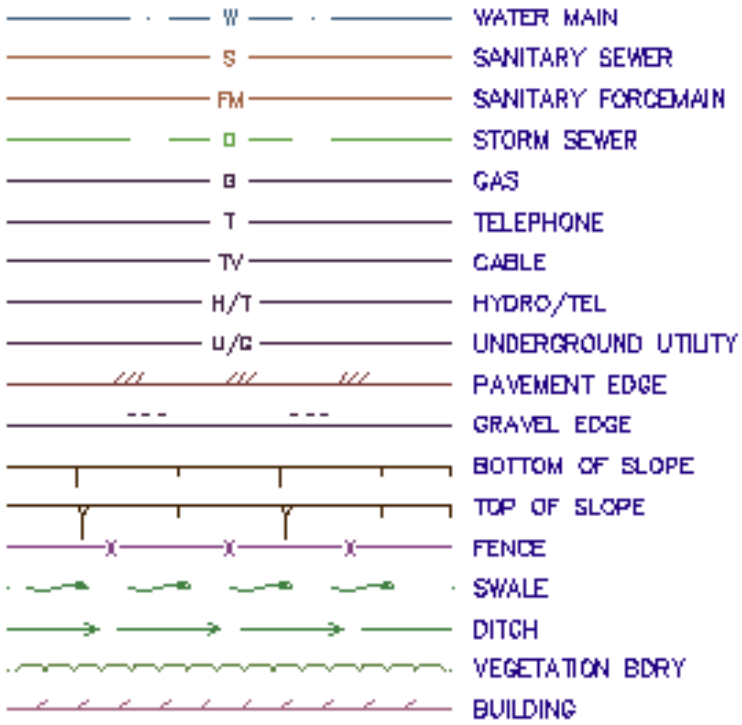
Colours 10-248 (even) are generally used for proposed works, as follows:

10, 20, 150...	0.60	black	16, 26, 156...	0.30	black
12, 22, 152...	0.40	black	18, 28, 158...	0.20	black
14, 24, 154...	0.35	black			

Colours 11-249 (odd) are generally used for existing works, as follows:

11, 21, 151...	0.20	black	17, 27, 157...	0.10	screen 60
13, 23, 153...	0.15	black	19, 29, 159...	0.10	screen 30
15, 25, 155...	0.10	black			

3.2.4 Linetypes



4.0 REQUIRED DRAWINGS

4.1 Cover Sheet (Title Page)

The cover sheet shall show the following information:

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

Note: The standards defined in Schedule K Section 2.1 – Sheet Layout, 3rd and 4th bullet and Schedule K Section 2.3. Lettering do NOT apply to the cover sheet.

4.2 Key Plan(s)

Key Plans shall show the following information:

- Lot numbers, plan numbers, and road names of the subject *development* 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 meter by 10 meter 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 ***profiles*** 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
  - 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 manholes, 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 ***profiles*** 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. Where the sanitary sewers and storm drains or other utilities are to be installed in a common trench, a typical cross-section showing vertical and horizontal distances between pipes and classes of pipe and bedding shall be shown
- 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 ***profiles*** 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 in this Schedule, grading plans shall show the following information:

4.6.1 General

- Pre-development contour lines. The topographic information shall extend a minimum 30.0m outside the *development* site
- Proposed contours, slopes, grades, and spot elevations
- 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 *Professional Engineer* shall note wherever the major system is not in the pipe or the roadway, showing the routing and flows for the 100-year return storm
- All swales proposed to affect the submitted Stormwater Management Plan
- The *development* proposal shall meet existing land and utility elevations along the *development* boundary unless specifically approved by the *Approving Officer*
- A legend noting all items proposed in the Stormwater Management Plan. Applicable "General Notes" should also be included

4.6.2 Lot Grading

- All existing corner lot elevations (uncircled)
- All proposed corner lot elevations (circled)
- The proposed building envelope with the Minimum Building Elevation noted
- The slope of the lot (directional arrow), noting a minimum 2% grade on the lots

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, 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
- Construction details and specifications or other pertinent information as required

4.8 Stormwater Management Plan (SMP)

In addition to any other requirements presented in this Schedule, Stormwater Management Plans shall show the following information:

- Site and surrounding area (400m minimum outside *development*) showing roads and major features. A small location plan of the watershed is also to be included
- Contours of existing ground (1.0m intervals where slope <20%, 2.0m >20%) for the site and surrounding area mentioned above
- Major flood routing (1:100 year) show as arrows and indicate if in pipe or on surface show an "open" arrow for surface routes and the same arrow "shaded" for routes in pipes
- 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

4.9 Erosion and Sediment Control Plan(s)

As noted in Schedule D Section 1.15.3 – Erosion and Sediment Control for Construction:

- 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 as outlined in Schedule F – Street Lighting.

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

A drawing identifying signs, markings, and required control devices. 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 only 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 *Village* Standards and Specifications. Where there is a *Village* standard, it is expected to refer to the Drawing Number. It is not necessary to include or provide work(s) for which there is a *Standard Drawing*.

4.15 Electrical, Gas, and Communication Utilities

Per appropriate authority (*Owners Professional Engineer* shall obtain and submit utility drawings when requested by *Approving Officer*).

5.0 DRAWING SUBMISSIONS

5.1 Design Submissions

Half-size (11X17) drawings will be considered for design submissions with prior approval from *Approving Officer*.

6 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 Total Completion*. Record Drawings must be delivered in both paper and electronic format(s) to the *Village*. Record Drawings shall include all drawings in approved design submission or as requested by *Approving Officer*.

The *Owner* shall submit to the *Village* 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 *Village* of Ashcroft, in addition to a digital hard copy in Adobe PDF format in accordance with Sections 1.1 and 1.2 of this Schedule.

5.3 Electronic Drawings

5.3.1 General Requirements

The *Owner* shall submit to the *Village* a complete set of electronic drawings of the *subdivision* or *development* in AutoCAD DXF or DWG format.

The electronic drawing shall be prepared in accordance with Section 2.0 and the conventions prescribed in Section 3.0.

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

Portable Document Format (*.pdf) is the preferred file type. However, alternatives may be considered. Alternative formats might be Autodesk's Drawing Web Format (*.dwf) or scanned tif or jpg images.

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"

APPENDICES

APPENDIX 1

SUPPLEMENTARY GENERAL CONDITIONS AND SPECIFICATIONS

Supplementary General Conditions

Table of Contents

SGC 1.21 Contract Administrator

1.21.1 **"Contract Administrator"** means the person, firm or corporation appointed by the *Owner* and identified by the *Owner* in writing to the *Contractor*. The *Contract Administrator* may be the *Owner's* Engineer, the Approving Officer, other employee or officer, or may be an outside consultant.

Supplementary Specifications

Table of Contents

The following Supplementary Specifications included in this section are modifications or additions to the Specifications in the Master Municipal Construction Document Volume II (Platinum Edition):

SS 01 00 00 General Clarifications

Add Measurement and Payment clause as follows:

1.1 Measurement and Payment

The MMCD specifications and supplemental specifications for the purpose for this Bylaw are referred to for construction specifications only. All measurement and payment clauses do not apply with respect to this Bylaw.

SS 01 42 00 Reference Specifications

1.1 Nomenclature

Delete reference 1.1.26 :‡

.26 NAAPI North American Association of Pipeline Inspectors

1.2 Referenced Specifications

Delete Referenced Specifications 1.2.15.1, .2, .5, .10 and .11‡

Add Referenced Specification:‡

1.2.18.36 CSA A3000 Cementitious Materials Compendium

SS 01 55 00 Traffic Control, Vehicle Access and Parking

1.4 Traffic Control

Delete section 1.4.10.3 and replace with the following: ‡

.3 When workmen or equipment are employed on travelled way over brow of hills, around sharp curves or at other locations where oncoming traffic would not otherwise have adequate warning.

SS 03 30 20 Concrete Walks, Curbs and Gutters

2.1 Materials

Delete section 2.1.5.1 and replace with the following: ‡

.1 Hand-formed and hand-placed concrete:

Slump:	80 mm.
Air entrainment:	5 to 8%.
Maximum aggregate size:	20 mm.
Minimum cement content:	335 kg/m^3.
Minimum 28 day compressive strength:	32 MPa.

SS 03 30 53 Cast-In-Place Concrete

2.1 Materials

Delete section 2.1.1 and replace with the following: ‡

.1 Portland cement: to CSA A3000

Delete section 2.1.2 and replace with the following: ‡

.2 Supplementary cementing materials: to CSA A3000

Add section 2.1.10 as follows:

.10 Type 50 (High Sulphate Resistant) concrete to be used for the manufacture of all concrete products incorporated into this project.

SS 03 40 01 Precast Concrete

2.1 Materials

Add section 2.1.2 as follows:

.2 Type 50 (High Sulphate Resistant) concrete to be used for the manufacture of all concrete products incorporated into this project.

SS 31 05 17 Aggregates and Granular Materials

2.7 Granular Pipe Bedding and Surround Material

Delete section 2.7.1 and replace with the following: ‡

		Percent Passing								
Sieve Designation		**Type 1***			**Type 2***			**Type 3***		
50.0	mm			100			100	100	-	100
38.0	mm			100			100	90	-	100
25.0	mm			100			100	20	-	60
19.0	mm	90	-	100	90	-	100	0	-	15
12.5	mm	65	-	85	70	-	100			
9.5	mm	50	-	75				0	-	5
4.75	mm	25	-	50	40	-	70			
2.36	mm	10	-	35	25	-	52			
1.18	mm	6	-	26	15	-	38			
0.600	mm	3	-	17	6	-	27			
0.300	mm				3	-	20			
0.075	mm	0	-	5	0	-	8			

***Type 1:** *standard gradation*
***Type 2:** *to be used only in dry trench conditions and with Contract Administrator's approval*
***Type 3:** *minimum 40% Porosity*

Recycled concrete free from contaminated and other extraneous material, confirming to the Type 1 gradations, may be used as pipe bedding and surround material.

2.11 Recycled Aggregate Material

Delete section 2.11.1 and replace with the following: ‡

.1 Aggregates containing recycled material may be utilized if approved by the Contract Administrator. In addition to meeting all other conditions of this specification, recycled material should not reduce the quality of construction achievable with quarried materials. Recycled material shall consist only of aggregates, crushed portland cement concrete, or asphalt that is free of impurities.

Add section 2.11.2 as follows: ‡

.2 Recycled Concrete and Asphalt (RCA): To be well graded mixture of aggregates, crushed portland cement concrete, or asphalt, substantially free from lumps and impurities. This material shall be manufactured to conform to the following gradation

Sieve Designation	Percent Passing
25 mm	100
19 mm	80 - 100
9.5 mm	50 - 85
4.75 mm	35 - 70
2.36 mm	25 - 50
1.18 mm	15 - 35
0.300 mm	5 - 20
0.075 mm	0 - 6

.1 California Bearing Ratio of the supplied materials shall be a minimum of 20% and shall be tested at every 5,000 tonnes.

Add section 2.11.3 as follows: ‡

.3 Virgin Materials: All aggregates and granular materials shall consist of entirely virgin materials, except recycled aggregate materials.

2.13 Recycled Asphalt Pavement (RAP)

Add sections 2.13.1, 2.13.2 and 2.13.3 as follows: ‡

.1 Recycled Asphalt Pavement (RAP) shall consist of asphalt concrete free from organic matter, contaminated and other extraneous material.

.2 Source of RAP shall be from asphalt removal, surplus generated during plant start-up, transition between mixes, plant clean out, or excess mix produced that could not be placed.

.3 RAP gradation shall not exceed the maximum aggregate size for the specific asphalt mix.

3.1 Handling

Add section 3.1.3 as follows: ‡

.3 Handling and storage of RAP shall be in accordance with National Asphalt Pavement Association (NAPA) – Quality Improvement Series 129 Best Practices for RAP and RAS Management.

SS 31 22 01 Site Grading

Clause 3.3.1 ‡

Delete Table 1 and replace with the following:

TABLE 2: TOLERANCES FOR SUBGRADES WHERE GROWING MEDIUM (TOPSOIL) TO BE PLACED OVER SUBGRADE

Conditions	Intended Growing Medium Depth	Tolerance
Within 3 m from fixed elevations (e.g., paving edges, curbs, etc.)	0 – 150 mm	± 25 mm
	151 – 300 mm	± 25 mm
	301 – 600 mm	± 50 mm
Other areas	0 – 150 mm	± 25 mm
	151 – 300 mm	± 50 mm
	301 – 600 mm	± 50 mm

SS 31 23 01 Excavating Trenching and Backfilling

3.5 Backfill and Compaction

Delete section 3.5.4 and replace with the following:

.4 Compaction: place backfill and compact to following Standard Proctor Maximum Dry densities (SPMDD) in compliance with ASTM D698. (All following references to density imply compliance with ASTM D698).

.1 Boulevards and easements to minimum 98%, or as specified by the owner's professional engineer.

.2 Roads, driveways, shoulders, re-shaped ditches and sidewalks to minimum 98% or as specified by the owner's professional engineer.

.3 Use caution in pipe zone to ensure no damage to pipe.

3.6 Surface Restoration

Delete section 3.6.2.2 and replace with the following:

.2 Restore unimproved and grassed surfaces with approved topsoil and hydraulic seeding as required by the Contract Administrator.

SS 31 23 23 Controlled Density Fill

2.1 Materials

Delete section 2.1.1 and replace with the following:

.1 Portland Cement: to CSA A3000.

Delete section 2.1.2 and replace with the following:

.2 Fly ash: to CSA A3000.

SS 31 24 13 Roadway Excavation, Embankment and Compaction

2.2 Specified Materials

Add section 2.2.1.5 as follows: ‡

.5 Recycled concrete and asphalt (RCA)

3.3 Inspection of Native Surface

Delete section 3.3.1 and replace with the following:

.1 Prior to placing embankment fill, proof roll graded native surface using fully loaded single or dual axle dump truck. Contract Administrator may authorize use of other acceptable proof rolling equipment. Remove soft or other unstable material. Replace with approved embankment fill and compact replacement fill to minimum 98% Standard Proctor Maximum Dry Density in compliance with ASTM D698. (All following references to density imply compliance with ASTM D698).

3.5 Compaction

Delete section 3.5.2 and replace with the following:

.2 Compact to a density of not less than 98% Standard Proctor Maximum Dry Density.

SS 31 37 10 Riprap

2.1 Riprap

Delete Table in 2.1.1.1.1 and replace with the following: ‡

Percent Heavier Than	Percent Lighter Than	Equivalent		
		Mass (kg)	Weight (N)	Diameter (mm)
0	100			As specified
50	50			In
100	0			Contract Documents

SS 32 11 16.1 Granular Subbase

2.1 Specified Materials

Add 2.1.1.8 as follows: ‡

.8 Recycled concrete and asphalt (RCA)

3.3 Compaction

Delete section 3.3.2 and replace with the following:

.2 Compact to a density of not less than 98% Standard Proctor Maximum Dry Density.

SS 32 11 23 Granular Base

3.1 Inspection of Underlying Subbase

Delete section 3.1.1 and replace with the following:

.1 Ensure underlying subbase surface true to the cross section and grade, and of the specified material compacted to 98% Standard Proctor Maximum Dry Density, in compliance with ASTM D698. Do not place granular base until finished subbase surface is inspected and approved by the Contract Administrator.

3.3 Compaction

Delete section 3.3.2 and replace with the following:

.2 Compact to a density of not less than 100% Standard Proctor Maximum Dry Density.

SS 32 12 16 Hot Mix and Warm Mix AC Paving

1.0 General

Delete section 1.0.1 and replace with the following: ‡

.1 Section 32 12 16 refers to those portions of the work that are unique to the supply and placement of hot-mix asphalt (HMA) and warm-mix asphalt (WMA) concrete paving. This section must be referred to and interpreted simultaneously with all other sections pertinent to the works described herein.

Add section 1.0.2 as follows: ‡

.2 WMA represents technologies which allow a reduction in the temperature at which asphalt mixtures are produced and placed. WMA technologies include those in which an additive is mixed with the asphalt cement or added to the mixture during production, and to plant foaming processes.

2.2 Mix Design

Delete sections 2.2.1 and 2.2.2 and replace with the following: ‡

.1 Submit job formula to Contract Administrator for review and approval. The mix design shall identify HMA or WMA. In addition to the regular information provided in the mix design the mix design for Warm Mix Asphalt shall include the following:

.1 WMA technology and/or WMA additives information.

.2 WMA technology manufacture's established recommendations for usage.

.3 WMA technology manufacturer's established target rate for water and additives, the acceptable variation for production, and documentation showing the impact of excessive production variation.

.4 Temperature range for mixing.

.5 Temperature range for compacting.

.6 Asphalt binder performance grade test data over the range of WMA additive percentages proposed for use.

.2 Mix may contain up to 15% recycled asphalt cement replacement without changing binder grade. Design of mix to include RAP from proposed source blended with virgin aggregate.

Add sections 2.2.3.3.5 and 2.2.3.3.6 as follows: ‡

.5 Percentage of RAP used shall be stated in the mix design report.

.6 Minimum Tensile Strength Ratio (TSR): 80 for mix design with RAP content.

Add section 2.2.4 as follows: ‡

.4 Modification of asphalt cement either using additives or by foaming shall be in accordance with the approved mix design of the WMA.

3.1 Plant and Mixing Requirements

Add section 3.1.1.9.4 as follows: ‡

.4 Use minimum 0.3% of anti-stripping agent, if Tensile Strength Ration (TSR) is less than 80%.

Delete section 3.1.4 and replace with the following: ‡

.4 Mixing tolerances including variations resulting from adding RAP:

.1 Permissible variation in aggregate gradation from job mix (percent of total mass):

.1	4.75mm sieve and larger	5.5
.2	2.36mm sieve	4.5
.3	0.600mm sieve	3.5
.4	0.150mm sieve	2.5

.5 0.075mm sieve 1.5

.2 Permissible variation of asphalt cement from job mix, 0.3%

.3 Permissible variation of mix temperature at discharge from plant, 5°C.

3.4 Transportation of Mix

Delete section 3.4.5 and replace with the following: ‡

.5 Deliver loads continuously in covered vehicles and immediately spread and compact. Deliver and place mixes at temperature within specified range under the approved mix design.

SS 32 12 17 Superpave Hot-Mix Asphalt Concrete Paving ‡

1.0 General

Delete section 1.0.1 and replace with the following:

.1 Section 32 12 17 refers to those portions of the work that are unique to the supply and placement of Superpave hot-mix asphalt (HMA) and Superpave warm-mix asphalt (WMA) concrete paving. This section must referenced to, and interpreted simultaneously with, all other sections pertinent to the works described herein. Requirements applicable to Superpave HMA in sub-sections 2.0 Products and 3.0 Execution also apply to Superpave WMA.

Add section 1.0.6 as follows:

.6 WMA represents technologies which allow a reduction in the temperature at which asphalt mixtures are produced and placed. WMA technologies include those in which an additive is mixed with the asphalt cement or added to the mixture during production, and to plant foaming processes.

1.4 Submission of HMA Mix Design(s)

Delete section 1.4.1.2 and replace with the following:

.2 Information on the design aggregate structure including the source(s) of aggregate, type of aggregates, RAP, required quality characteristics and gradation;

2.2 Mix Design

Delete section 2.2.2 and replace with the following:

.2 Submit Superpave HMA mix design(s), to Contract Administrator for review and approval, in accordance with 1.4 of this section. The mix design shall identify HMA or WMA with the respective mixing and compaction temperatures.

Add sections 2.2.3, 2.2.4, and 2.2.5 as follows:

.3 Where RAP will be incorporated in the mix, the mix design, shall include RAP content as per Section 1.2 References.

.4 Use minimum 0.3% of anti-stripping agent, if Tensile Strength Ratio (TSR) is less than 80%.

.5 Modification of asphalt cement for WMA either by using additives or by foaming shall be in accordance with the approved mix design of the WMA technology.

3.4 Transportation of Mix

Delete section 3.4.5 and replace with the following:

.5 Deliver loads continuously in covered vehicles and immediately spread and compact. Deliver and place mixes at temperature within specific range under the approved mix design.

3.6 Compaction

Delete section 3.6.1 and replace with the following:

.1 Roll asphalt continuously to average density of 93% of the Superpave Maximum Theoretical Density (MTD) with no individual test less than 91% of MTD.

SS 32 13 13 Portland Cement Concrete Paving

2.1 Materials

Delete section 2.1.4 and replace with the following:

.4 Concrete mixes and materials: to section 03 30 53 – Cast-in-place Concrete meeting CSA A32.1 Exposure Class C2.

SS 32 13 16.1 Roller Compacted Concrete Paving

2.1 Materials

Delete section 2.1.3 and replace with the following:

.3 Portland Cement: to CSA A3000.

Delete section 2.1.4 and replace with the following:

.4 Fly Ash: to CSA A3000

SS 32 17 23 Painted Pavement Markings

2.1 Materials

Delete reference title for section 2.1.6 and replace with the following title: ‡

.6 Pavement Markings:

Delete section 2.1.6.7‡

Add section 2.1.7 as follows: ‡

.7 Thermoplastic material:

.1 Material composition shall be at the discretion of the manufacturer subject to the approval of the Contract Administrator. Each formulation shall be identified by a code number

.2 No retained water when tested by ASTM D-570

.3 Specific gravity of the supplied product shall be within 3% of that specified for the selected formulation.

.4 Material shall not deteriorate upon contact with de-icing chemicals, gasoline, diesel fuel or grease dropped by traffic.

.5 Material shall not break down, deteriorate, scorch or discolour, if held within the application temperature range specified by the manufacturer for a period of four hours and it must be able to be reheated from room temperature to the application temperature four (4) times without showing any of these detrimental effects.

.6 When applied at the temperature recommended by the manufacturer and at a film thickness of 2 to 4mm, the material shall set solid and show no tracking under traffic after elapsed times as follows:

.1 Two (2) minutes at an air temperature of 10°C, relative humidity less than 75%, and road surface temperature from 10° C.

.2 Five (5) minutes at an air temperature of 32° C, relative humidity less than 75%, and road surface temperature from 35°C.

.3 The drying time under conditions intermediate between the two air temperatures shall be interpolated using a straight line model.

.7 The quantity, type, and gradation of the component reflecting glass spheres premixed in the thermoplastic material shall be at the discretion of the manufacturer, but shall provide retro-reflection levels specified below.

3.3 Application

Delete section 3.3.3.3 and replace with the following: ‡

.3 Thermoplastic material shall be heated in the melter to a temperature of 382 ^{0}F

SS 32 31 13 Chain Link Fences and Gates

Add sections 3.3, 3.4 and 3.5 as follows: ‡

.3 Installation of Gates

.1 Install gates in locations as shown on Contract Drawings.

.2 Level contours between gate posts and set gate bottom approximately 40 mm above ground surface.

.3 Determine position of centre gate rest for double gate. Cast gate rest in concrete as directed. Dome concrete above ground level to shed water.

.4 Install gate stops where specified.

.4 Touch up

.1 Clean damaged surfaces with wire brush removing loose and cracked coatings. Apply two coats of organic zinc-rich paint to damaged areas. Pre-treat damaged surfaces according to manufacturer's instructions for zinc-rich paint.

.5 Cleaning

.1 Clean and trim areas disturbed by operations. Dispose of surplus material as specified in Contract Document.

SS 32 92 19 Hydraulic Seeding

3.3 Equipment

Delete section 3.3.1 and replace with the following: ‡

.1 All hydraulic seeding/mulching equipment adjustment to reflect Rates of Application determined for the project.

3.5 Application for Hydraulic Seeding

Delete section 3.5.4 and replace with the following: ‡

.4 If required, add legume seed to grass mixture at time of seeding. Inoculate legume seed with standard product humus culture before mixing with grass seed. Protect inoculated seed from exposure to sunlight for periods of over one-half hour. Use seed within eight hours from inoculation; otherwise, seed to be reinoculated.

SS 32 92 20 Seeding

3.3 Application for Mechanical Dry Seeding

Delete section 3.3.5 and replace with the following: ‡

.5 Apply mulch with seed; or apply mulch immediately after seeding. Do not seed areas which cannot be mulched the same day.

SS 33 01 30.1 CCTV Inspection of Pipelines

1.3 Submission of Certification

Delete section 1.3.1 and replace with the following: ‡

.1 Submit copy of the CCTV operator’s current NASSCO certification certificate to the Contract Administrator at least one week prior to the start of the CCTV inspection operations.

3.7 Photographs and/or Digital Images

Delete section 3.7.2.5 and replace with the following: ‡

.5 CSA condition defect code.

3.12 Coding Accuracy

Delete section 3.12.4 and replace with the following: ‡

.4 An operator failing to meet the accuracy requirements on two occasions will not be permitted to code on the remainder of the project until they have successfully passed the NASSCO Level of Qualification for CSA Operators.

SS 33 11 01 Waterworks

2.2 Mainline Pipe, Joints and Fittings

Delete section 2.2.2.2 and replace with the following:‡

.2 Joints: It is mandatory that the push-on integrally thickened bell and spigot type conform to ASTM D3139 Clause 6.2 with single elastomeric gasket to ASTM F477.

Delete section 2.2.2.2 and replace with the following:

.2 Joints: Push-on bell and spigot type conforming to ASTM D3139 with single elastomeric gasket to ASTM F477.

Delete section 2.2.4.13 and replace with the following: ‡

.13 Joint Restraint Devices: General Requirements:

.1 Ductile iron castings to ASTM A536.

.2 Anti-corrosion coating of ductile iron castings to AWWA C219, AWWA C210, C213 or C550.

.3 Bolts and nuts high strength low alloy steel to AWWA C111 or as specified in Contract Documents, stainless steel to ASTM F593 or F738 for bolts and ASTM F594 or F836 for heavy hex nuts. Rolled threads, fit and dimensions to AWWA C111.

.4 Tie rods to 2.2.4.10 of this Section.

.5 Restrainers for ductile iron pipe shall be mechanical joint fittings or push-on joint fittings with tie rod.

.6 Restrainers for PVC pipe shall be mechanical joint fittings or push-on joint fittings with tie rod lugs.

.7 Restrained harnesses or integral restraint systems manufactured as part of the pipe joint.

.8 All joint restraint systems for PVC pipe to be approved by the specific PVC pipe manufacturer, and that they do not derate the pipe manufacturer's recommended working pressures.

.9 Restrainers for PVCO pipe shall be mechanical joint fittings or push-on joint fittings with tie rod lugs.

.10 All joint restraint systems for PVCO pipe to be approved by the specific PVCO pipe manufacturer, and that they do not derate the pipe manufacturer's recommended working pressures.

Add section 2.2.7 as follows: ‡

.7 Oriented Polyvinyl Chloride (PVCO) Pressure Pipe:

.1 Pipe:

.1 Pipe to be manufactured to specifications for pipe size ranges as follows:

.1 Pipes 100 to 600mm dia. - AWWA C909

.2 Pipes to be certified by Canadian Standards Association for pipe size ranges 100 mm to 600 mm dia. - CSA B137.3.1

.2 Cast iron pipe equivalent outside diameter.

.3 To be compatible with specified mechanical joint and push-on joint fittings and valves without use of special adapters.

.2 Joints: Push-on integrally thickened bell and spigot type to AWWA C909 Clause 4.3.3.2 (a) with single elastomeric gasket to ASTM F477.

2.4 Valve and Large Meter Chambers

Delete section 2.4.7 and replace with the following:

.7 Mortar: aggregate to CAN/CSA-A82.56, masonry cement to CSA A3000

3.12 Hydrants

Delete Clause 3.12.6 and replace with the following:

.6 For hydrants not in service, place a burlap sack or canvas bag over the hydrant and secure in place. Remove when water main is accepted by the Contract Administrator.

3.17 General Procedure Flushing, Testing, and Disinfection

Delete section 3.17.2 and replace with the following:

.2 Perform all tests in presence of Contract Administrator and Owner between 08:00 and 17:00 h, Monday to Friday unless otherwise authorized. Notify Contract Administrator 72 h in advance of proposed test.

3.19 Testing Procedures

Delete 3.19.2 and replace with the following:

.2 Before pipe is filled with water, pipe bedding, concreting of all valves and fittings and backfilling to be completed as required in this specification. Fill each section of pipe and allow to remain full of water for a period of at least 24 hours prior to

commencement of any pressure tests. Submit pipeline to a test of 1.5 x working pressure applied at highest elevation in each section, with a minimum of 1034 kPa applied at lowest point of test section. Ensure that test pressure does not exceed pipe or thrust restraint design pressures. Minimum duration of test period to be 2 hours. Maximum test pressures should not exceed those specified in CSA B137.3 – Table 9.

Add new section 3.19.7 as follows:

.7 Fire Hydrants to be included in all watermain testing.

3.20 Disinfection, General

Add new section 3.20.3 as follows:

.3 All water mains to be flushed, disinfected, and bacteriological tested in accordance with AWWA C651. Bacteriological testing to include total coliforms, fecal coliforms, and heterotrophic plate count (HPC). Bacteriological samples to be collected by the Owner. Bacteriological samples can only be collected Monday to Thursday.

SS 33 30 01 Sanitary Sewers

2.1 Concrete Pipe

Delete section 2.1.3.4 and replace with the following: ‡

.4 Lift insert opening not required to be grouted provided it does not extend beyond the depth of the engineered design.

SS 33 34 01 Sewage Forcemains

3.15 Pressure Testing Procedure

Delete section 3.15.2 and replace with the following: ‡

.2 Before pipe is filled with water, pipe bedding, concreting of all valves and fittings and backfilling to be completed as required in this specification. Each section of pipe to be filled and allowed to remain full of water for a period of at least 24 hours prior to commencement of any pressure tests. Pipeline to be submitted to a test of 1.5 x working pressure applied at highest elevation in each section. At no time shall test pressure exceed pipe or thrust restraint design pressures. Maximum allowable leakage rate at test pressure to not exceed 1.25 litres per millimetre diameter of pipe per kilometre per 24 hour period. Minimum duration of test period to be 2 hours.

SS 33 44 01 Manholes & Catchbasins

1.4 Material Certification

Delete section 1.4.1 and replace with the following: ‡

.1 Products manufactured to ASTM Standards shall be marked with the applicable specification number. Compliance test results shall be provided at the request of the Contract Administrator.

2.1 Materials

Add section 2.1.7.3 as follows: ‡

.3 Any frame and cover assembly creating a point load on the concrete riser rings will not be permitted.

.12 Catchbasin lids manufactured to ASTM C478M.

Delete section 2.1.13 and replace with the following:

Delete section 2.1.15.2 and replace with the following:

.2 Cement: to CSA A3000

Delete section 2.1.17 ‡

3.1 Excavation and Backfill

Add section 3.1.2 as follows: ‡

.2 For manholes, when base gravels are complete, excavate for grade rings and manhole frame assembly. Do not disturb the compacted road base beyond the excavation requirement.

3.3 Manhole Installation

Delete section 3.3.12.2 and replace with the following: ‡

.2 Allowable products are precast concrete risers, and cast-in-place form system. Individual riser height shall be 50 mm, 75 mm, or 100 mm.

Delete section 3.3.12.5 and replace with the following: ‡

.5 Proper layer of grout between the spacers, covering the entire surface of the rings, should be utilized.

Add section 3.3.17 as follows: ‡

.17 Ensure frames conform to design contour of pavement or existing surface. Use of shim and mortar will only be permitted outside of road pavement. One of the following means shall be used to set final grade for frame and cover within road pavement:

.1 Tapered pre-cast concrete, HDPE, or metal adjustment riser rings when use with conventional manhole frame and cover under Standard Detail Drawing S1; or

.2 Integrated height adjustable manhole frame and cover assembly. Any assembly creating a point load on the riser rings will not be permitted.

.3 After grade rings and manhole frame assembly has been installed and adjusted the remaining excavation must be filled to the top of road base or bottom lift of asphalt surface with 30mpa 10mm aggregate concrete or 19mm base gravel compacted to specification. Ensure specified asphalt thickness can be achieved.

Reference **Section 33 49 23‡** **Storm Drainage Water Retention Structures**

Add Standard Specification 33 49 23

1.0 GENERAL

.1 Section 33 49 23 refers to those portions of the work that are unique to the supply and installation of underground storm water infiltration / detention systems. Related appurtenances are included in other sections. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

.2 All details of storm sewer facilities not specifically covered in this section to comply with CSA, ASTM and CGSB standards and/or manuals of practice as specified in Contract Documents.

1.1 Related Work

.1	Temporary Facilities Section	01 53 01
.2	Aggregates and Granular Materials Section	31 05 17
.3	Excavating, Trenching and Backfilling Section	31 23 01
.4	CCTV Inspection of Pipelines Section	33 01 30.1
.5	Cleaning of Sewers Section	33 01 30.2
.6	Pipe Culverts Section	33 42 13
.7	Manholes and Catchbasins Section	33 44 01

1.2 References

.1 The abbreviated standard specifications for testing, materials, fabrication and supply, referred to herein, are fully described in Section 01 42 00 –Reference Specifications – Site Infrastructure.

1.3 Samples

.1 Samples may be required.

1.4 Material Certification

.1 Aggregate surrounding infiltration systems shall have a minimum void ratio of 40%

.2 At least 14 days prior to commencing work, submit to Contract Administrator the material manufacturer's recent test data and certification that materials to be incorporated into works are representative and meet requirements of this Section. Include manufacturer's drawings where pertinent

.3 Project specific shop drawings of the system components hall be sealed by a Professional Engineer registered in the Province of British Columbia. Shop drawing shall show general layout of the system and its structural design parameters such as assumed allowable bearing capacity and loadings.

1.5 Scheduling of Work

.1 Schedule work to minimize interruptions to existing services.

.2 Submit schedule of expected interruptions to Contract Administrator for approval and adhere to approved schedule.

1.6 Measurement and Payment

.1 Payment for underground storm water infiltration / detention system will be made separately for various sections of the system consistent with pipe materials and models, depths and backfill requirements shown on Contract Drawings and described under individual payment items in Schedule of Quantities and Prices.

Measurement for the system will be made based on specified design storage volume installed or as specified in Contract Document.

.2 Payment for underground storm water infiltration / detention system includes saw cutting pavement, excavation, disposal of surplus excavated material, supply and installation of the system, fittings and related materials, bedding, surrounding aggregates, system access including connection to the distribution header, geotextile and if required impermeable liner, imported or native backfill as shown on Contract Drawings, cleaning, all surface restoration as specified under Excavating, Trenching and Backfilling Section 31 23 01 – Sub-section 3.6, except permanent pavement restoration, and all other work and materials necessary to complete installation as shown on Contract Drawings and specified under this Section.

.3 Payment for Inspection and Testing of underground storm water infiltration / detention systems shall be lump sum.

.4 Payment for flushing of underground storm water infiltration / detention systems shall be lump sum.

2.0 PRODUCTS

.1 Pipe culverts used for infiltration and detention purposes shall be referred to Section 33 42 13 – Pipe Culverts.

.2 All products shall withstand H-20 loading.

2.1 Concrete Box Culvert

.1 Concrete Box Culvert: to ASTM C1433-08

.2 End caps/walls: to ASTM C1433-08

.3 Box culverts to be manufactured in accordance to depth of fill tables specified in ASTM C1443-08 to suit site conditions.

.4 Box culvert lay lengths: Up to 2.44m, or as specified on Contract Drawings.

.5 Geotextile fabric to be used at joints.

.6 All concrete box culvert system shall incorporate at least one manhole access point to allow for inspection and maintenance.

.7 Manholes access tees and/or flow control structures including bases and lids: manufactured to CSA A257.4 and/or ASTM C478.

2.2 Polypropylene Arched Chamber, Corrugated Wall

.1 Raw materials and processes used in the manufacture of storm water chambers shall meet the requirements of ASTM F 2418 and CSA B184.

2.3 Polyethylene Arched Chamber, Corrugated Wall

.1 Raw materials and processes used in the manufacture of storm water chambers shall meet the requirements of CSA B184.

2.4 Corrugated Steel Pipe System, Corrugated Wall

.1 Corrugated steel pipe to Section 33 42 13. Pipe material to be Galvanized Steel, Aluminized Type 2 Steel or Polymer Laminated Steel to CSA G401.

.2 Couplers shall be Hugger Band type couplers complete with o-ring gaskets to Section 33 40 01.

.3 Integral CSP manholes shall be detailed as per shop drawings. Pre-cast concrete manhole tops shall be designed such that the top bears on the surrounding backfill so that all live load is transmitted to the backfill zone adjacent to the CSP manhole riser.

.4 Steel plate bulkheads shall be fabricated from steel plate with continuously welded reinforcing steel members. Bulkheads shall be factory coated with 2 coats of zinc-rich paint as per CSA G401. Bulkheads shall be attached to the CSP pipe barrel with a continuous fillet weld.

2.5 Polymeric Cubic Structure

.1 Cubic structure materials to be polypropylene copolymer (CPP) to ASTM D4101 and supporting columns to be poly vinyl chloride (PVC) to ASTM D1784.

.2 Module interactions: adjacent modules must be capable of transferring the applied side and vertical loads to adjacent modules through an assembly of modules.

2.6 Geotextile and Liner

.1 Geotextile fabric used for separating bedding and surrounding aggregate from native soils and backfill shall be AASHTO M288 Class 2 non-woven geotextile.

.2 Impermeable liner used in detention system for separating bedding and surrounding aggregate from native soils and backfill shall be minimum 30 mil thick PVC or LLDPE liner.

2.7 Granular Chamber Bedding and Surround Material

.1 As shown on Contract Drawings.

.2 Refer to Section 31 05 17 - Aggregates and Granular Materials for material specifications.

.3 Approved Bedding and Surround Materials: 19mm or 40mm clear crushed gravels with a minimum porosity of 40% after installation.

2.8 Backfill Material

.1 As shown on Contract Drawings.

.2 Refer to Section 31 05 17 - Aggregates and Granular Materials for material specifications.

3.0 EXECUTION

3.1 General

.1 System bedding details, including granular surround and material specifications to be as shown on Contract Drawings, including Standard Detail Drawing G4.

.2 The component supplier's representative shall be available to provide project start-up assistance and provide technical support. Should site conditions deviate from the sealed shop drawings during construction, the Contract Administrator shall be notified.

3.2 Preparation

.1 Carefully inspect materials for defects before installing. Remove defective materials from site. Clean system components of debris and water before installation.

3.3 Excavation

.1 Excavate in accordance with Section 31 23 01 - Excavating, Trenching and Backfilling.

.2 System alignment and depth as shown on Contract Drawings.

3.4 Granular Bedding

.1 Fill over-excavation below design elevation of bottom of specified bedding with approved bedding and surround materials placed and compacted to 95% Modified Proctor Density. Drain rock may be used for backfill of over-excavation only with Contract Administrator's approval.

.2 Shape bed true to grade to provide continuous, uniform bearing surface for the system.

.3 Geotextile fabric shall be laid in accordance to the approved shop drawings

.4 For detention systems using an impermeable liner, a subsequent manufacturer approved impermeable liner and geotextile fabric shall be placed on top of the initial fabric layer and secured per the manufacturer's recommendations.

.5 Place granular bedding material in 150mm lifts across width of the excavation and compact to 95% Modified Proctor Density in compliance with ASTM D1557.

3.5 System Installation

.1 Handle system components in accordance with manufacturer's recommendations.

.2 Lay and join system components in accordance to the manufacturer's instructions and specifications except as noted otherwise herein. Pipe culvert systems shall be installed in general compliance with Section 33 42 13 - Pipe Culverts.

.3 Lay system components on prepared bed, true to line and grade. Ensure section is in contact with shaped bed throughout its full length.

.4 Keep jointing materials and installed sections free of dirt, water and other foreign materials. Whenever work is stopped, install removable bulkhead at open end to prevent entry of water and foreign materials.

.5 Cut system component, as recommended by the manufacturer, without damaging unit.

3.6 Surround Materials

.1 After assembling the system and the Contract Administrator has inspected work in place, place surrounding material in uniform layers not exceeding 150 mm compacted thickness simultaneously on both sides. Material can be placed directly over the assembled sections and allowed to build up equally on each side of the system, as long as care is taken to ensure assembled sections remain true to line and grade

.2 Compact each layer from bedding to underside of backfill to minimum 95% Modified Proctor Density.

3.7 Backfill

.1 Place and compact backfill material in accordance with Section 31 23 01 - Excavating, Trenching and Backfilling.

.2 Backfill requirements, including type of material and compaction requirements, as shown on Contract Drawings, including Standard Detail Drawing G4.

3.8 Inspection

.1 Where specified, install inspection chamber at specified location, set plumb and to specified elevation as shown on Standard Detail Drawing S7 or Drawing S10 as applicable. If inspection chamber located in driveway, lane or paved surface install cover or lid as shown on Standard Detail Drawing S9 or Drawing S10 as applicable.

3.9 Flushing

.1 Flush completed system per Section 33 01 30.2 Cleaning of Sewers. Before flushing and testing, ensure infiltration / detention system is completely finished and make arrangements with Contract Administrator for scheduling of testing.

.2 Water may be supplied from Municipal fire hydrants upon application for a Hydrant Use Permit.

.3 Obtain municipal approval prior to discharging flushing water to municipal sewers or drainage ditches.

.4 Comply with General Conditions, Clause 20.4, Environmental Laws, in regard to discharge of flushing water.

.5 Provide Contract Administrator with all required approvals prior to discharging flushing water.

.6 Remove foreign material from assembled system and related appurtenances by flushing with water. System to be flushed at water velocities as high as can be obtained from available water sources. Continue flushing at least until flow from most distant point has reached discharge point and until water discharged is clean and clear.

3.10 Testing

.1 Following installation of a system and prior to substantial completion, the completed installation shall be visibly inspected to ascertain the requirement for cleaning.

.2 Visual inspection shall consist of either physical manual inspection or CCTV camera which shall be submitted to the Contract Administrator for review.

.3 System shall be cleaned, if by Contract Administrator's determination, it is apparent that accumulated solids or siltation exceed acceptable limits which may impede the proper operation of the system design.

.4 Cleaning shall be done in accordance with manufacturer's recommended approved practices, owner's requirement and Contract Administrator's approval.

.5 After cleaning has been completed, a re-inspection may be required to insure effective removal of materials present.

.6 An operating manual, complete with recommended maintenance schedule shall be provided to the Owner and/or Contract Administrator with submission of design proposal.

3.11 Installation Standard

.1 Repair all deficiencies and visible leaks.

.2 Repair procedures and materials subject to approval of Contract Administrator.

.3 Contract Administrator reserves right to require Contractor to replace defective installations at Contractor's sole cost.

.4 Test procedures, including video inspection, to be repeated and repairs made until satisfactory results are obtained.

APPENDIX 2

SUPPLEMENTARY DETAILED DRAWINGS

Supplementary Detailed Drawings

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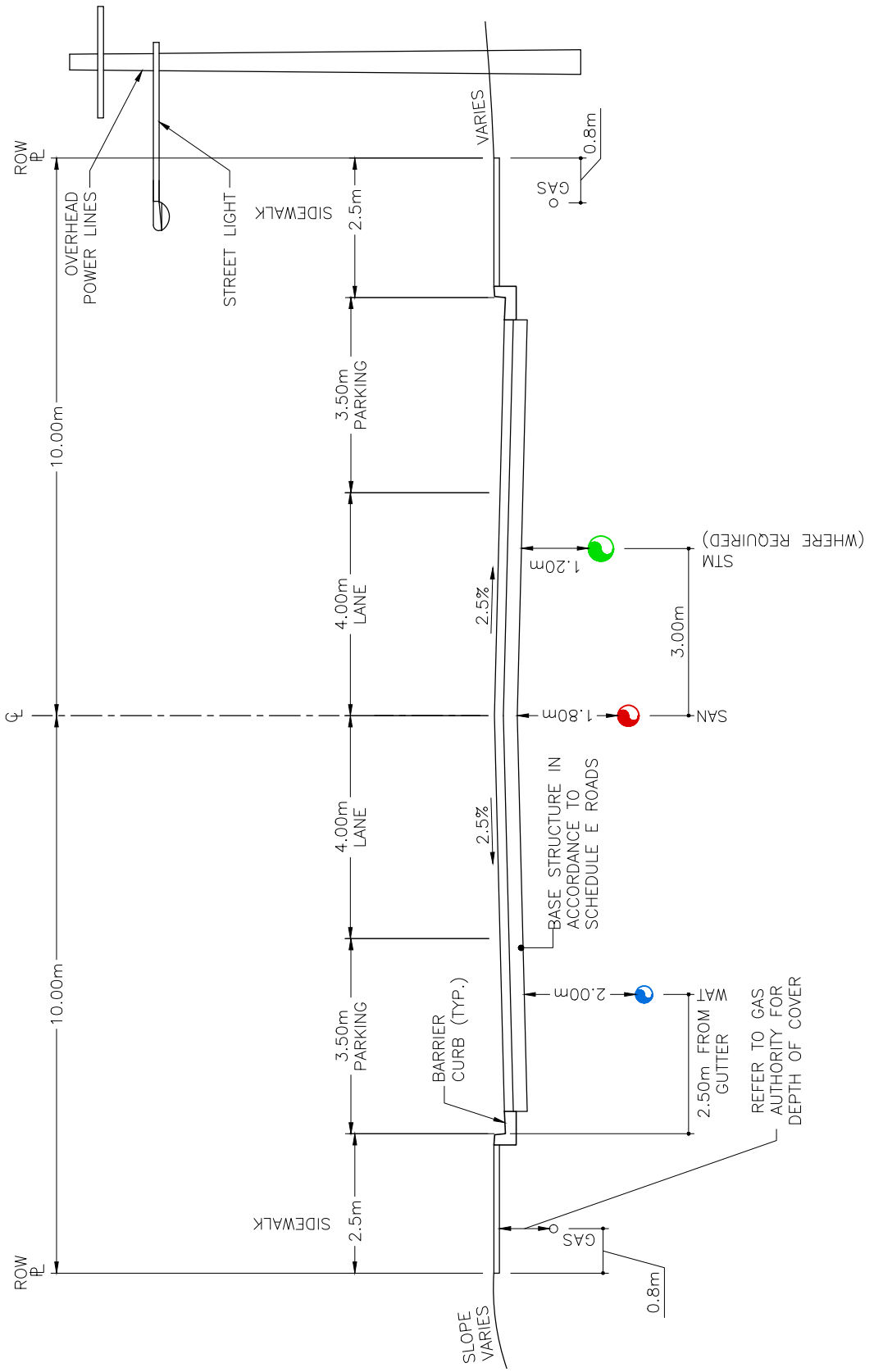

Ashcroft
Wellness Awaits You

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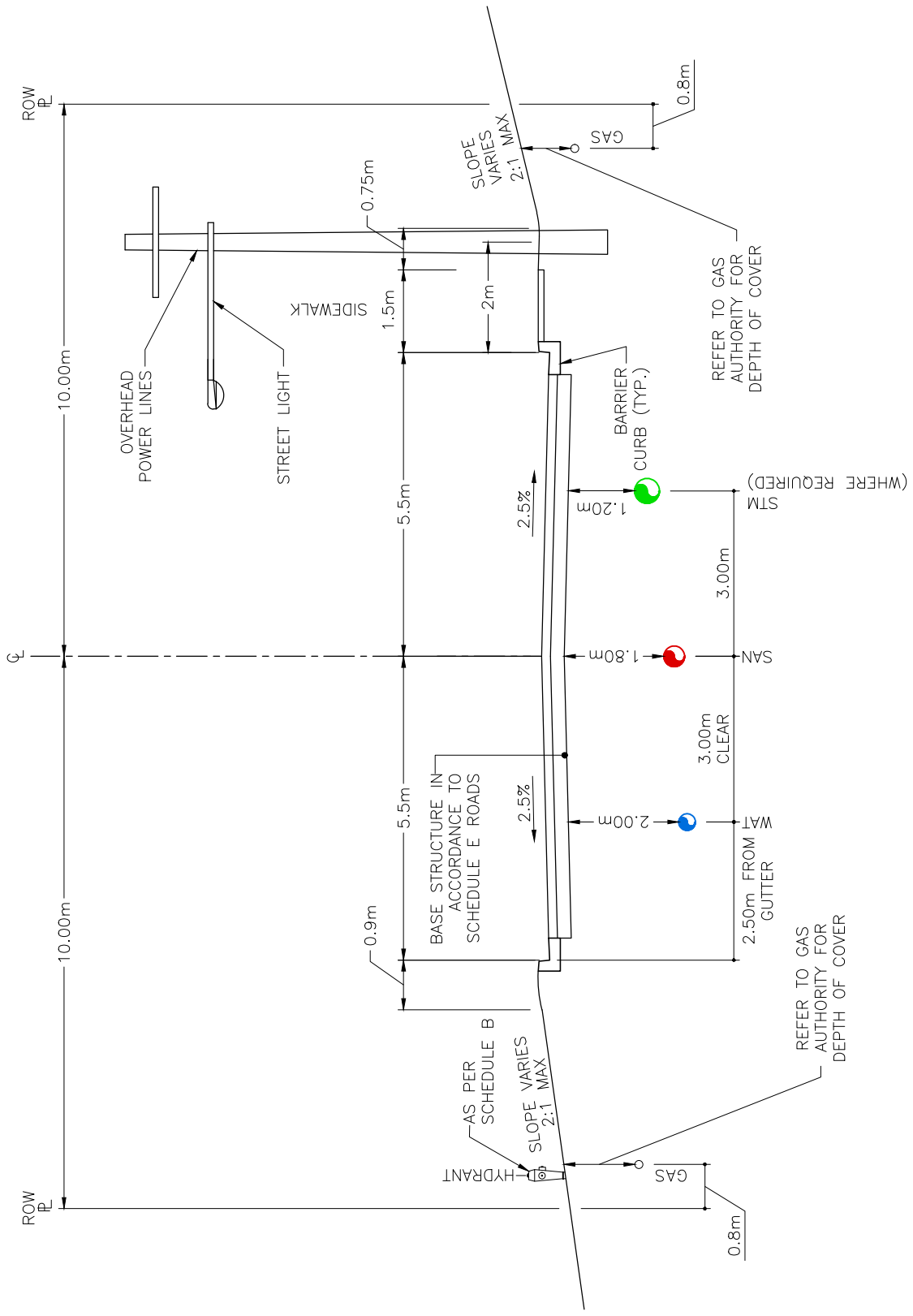
APPROVED BY:	SECTION:	REVISION No.	DWG.No. A1



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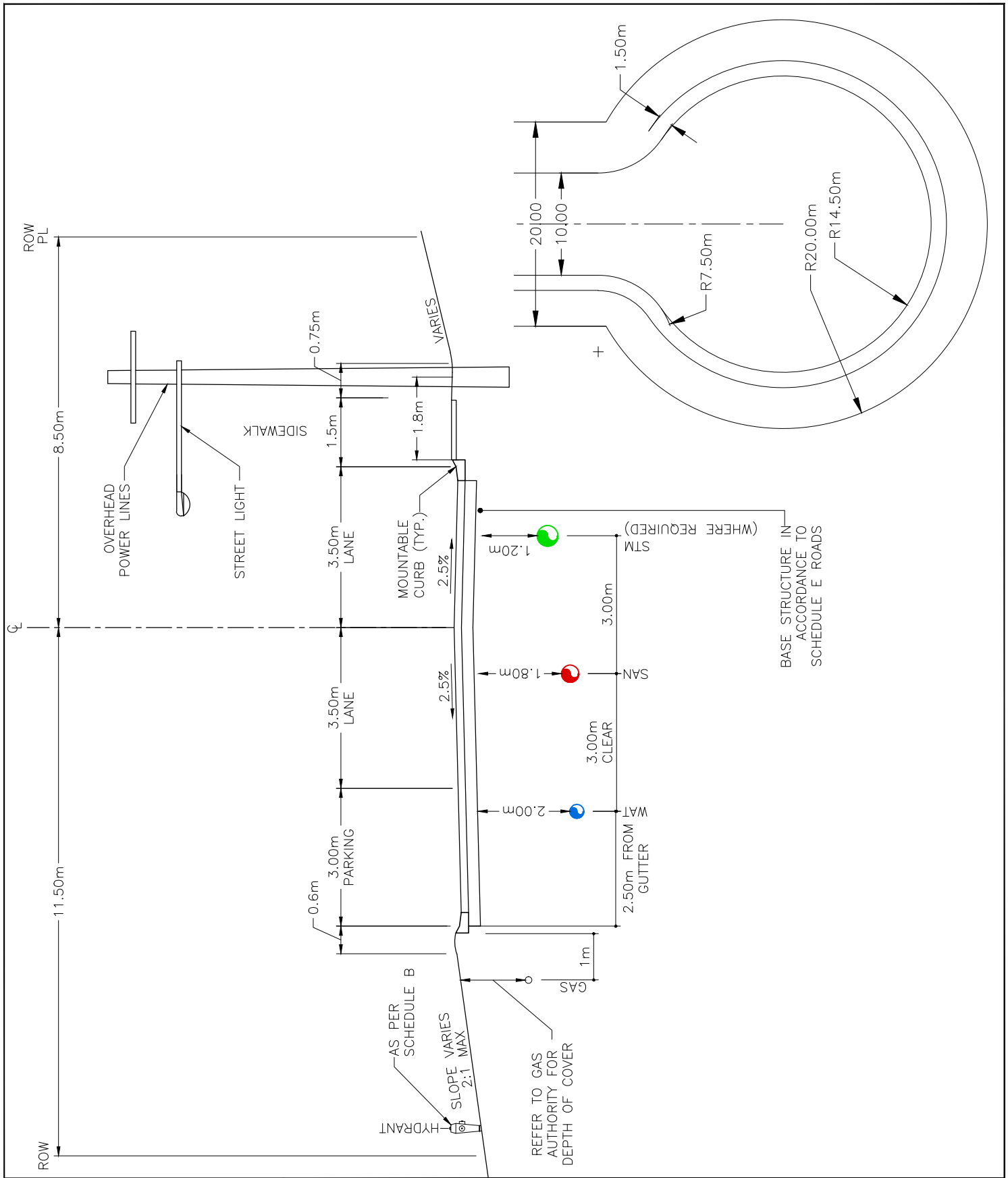

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Ashcroft
Wellness Awaits You

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DATE DRAWN: 2020-06

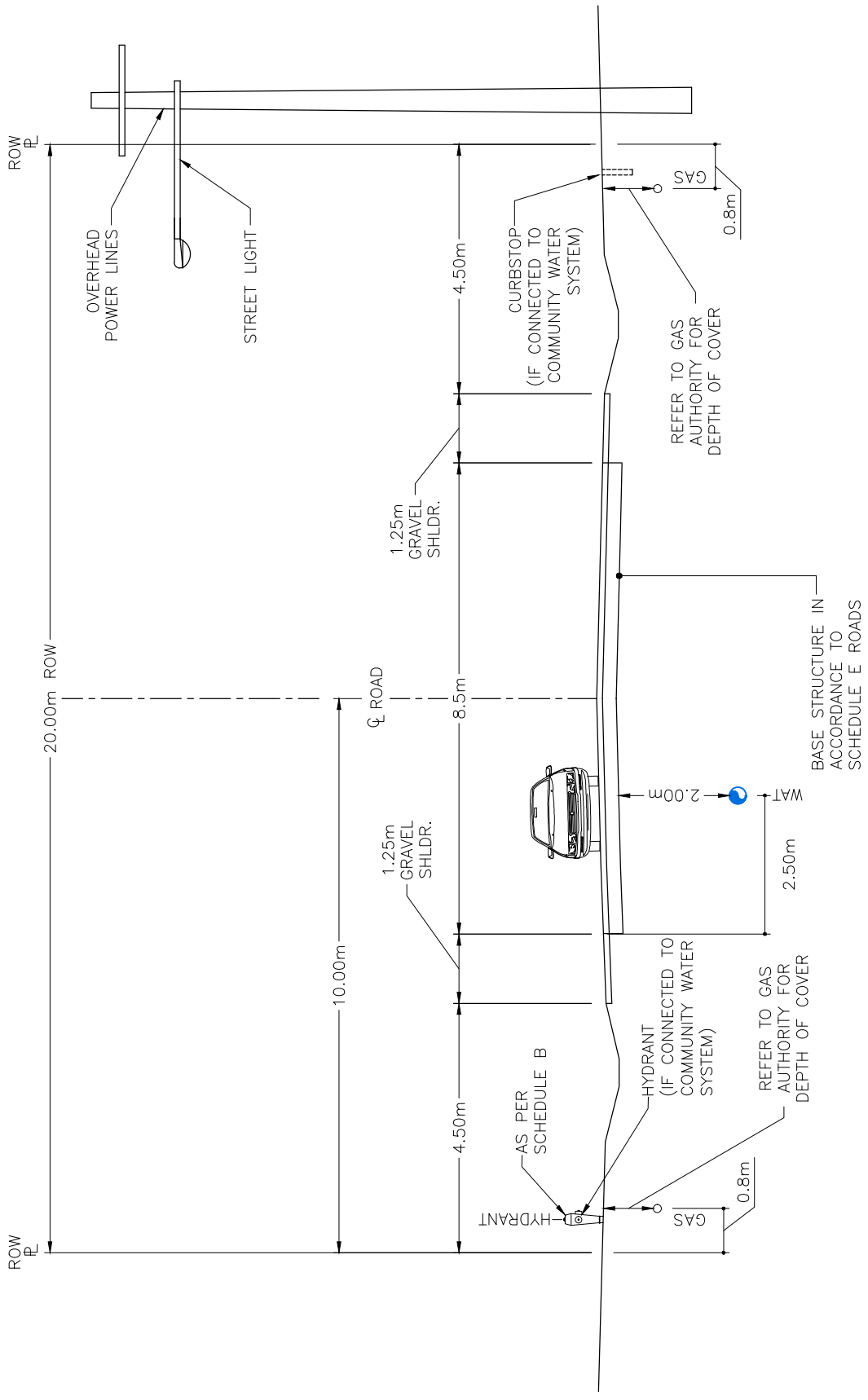
APPROVED BY:

TITLE: LOCAL ROAD (CUL-DE-SAC) TYPICAL SECTION

SECTION:

REVISION No.

DWG.No. A3



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Ashcroft
Wellness Awaits You

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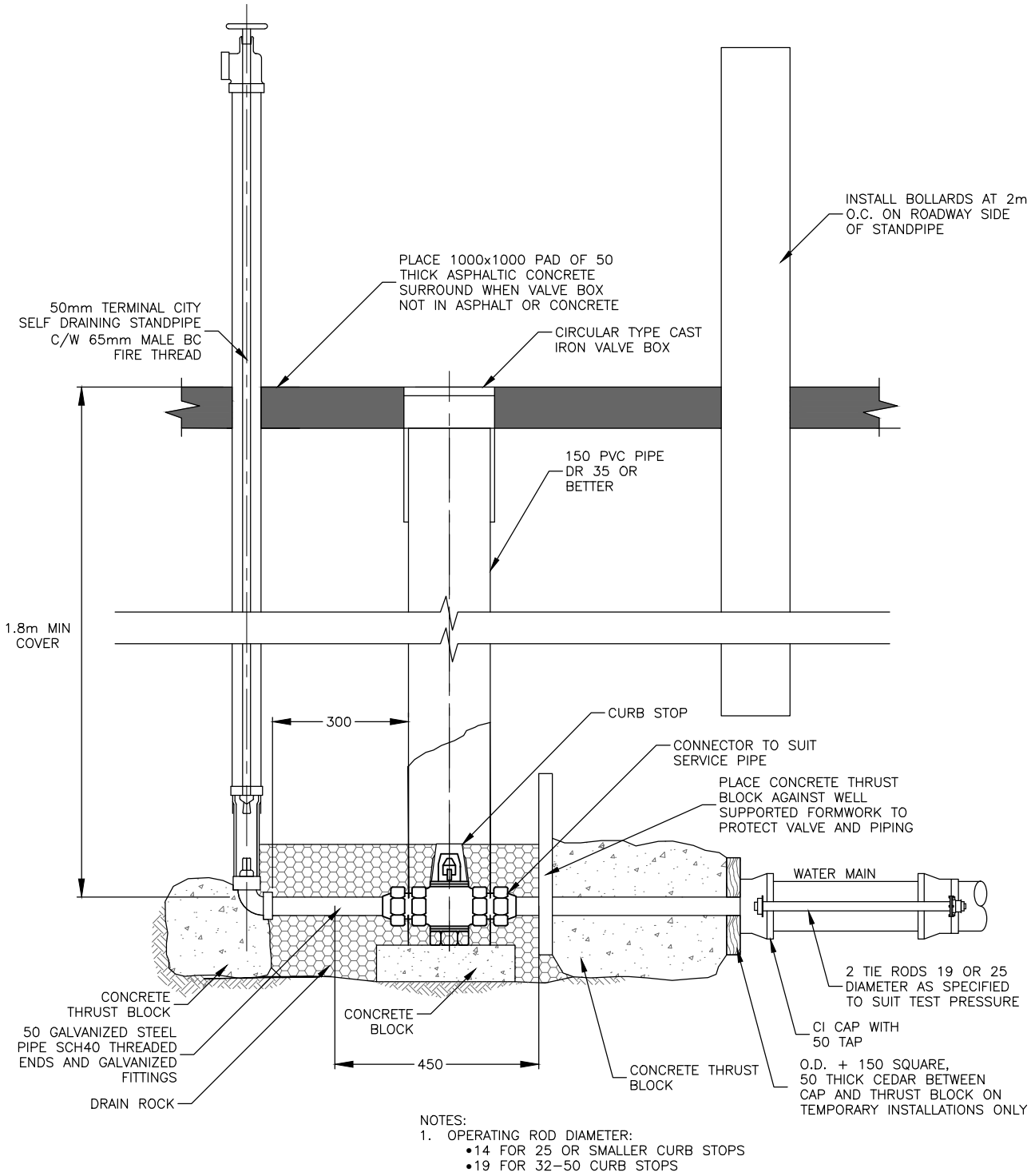

NOTES:
1. OPERATING ROD DIAMETER:
   - 14 FOR 25 OR SMALLER CURB STOPS
   - 19 FOR 32–50 CURB STOPS

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	DATE DRAWN: 2020–06	
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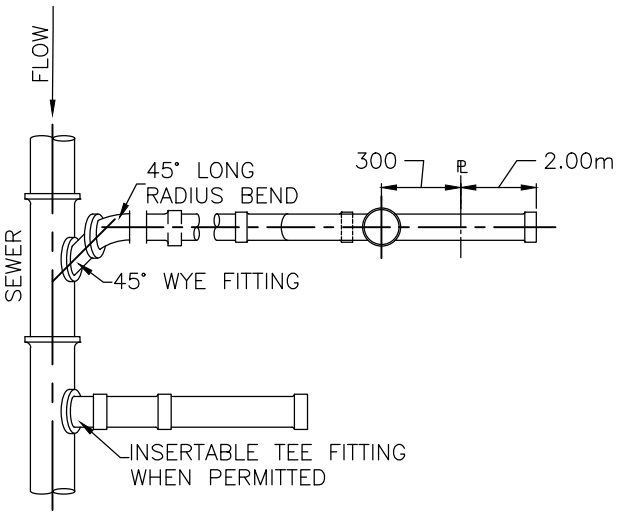

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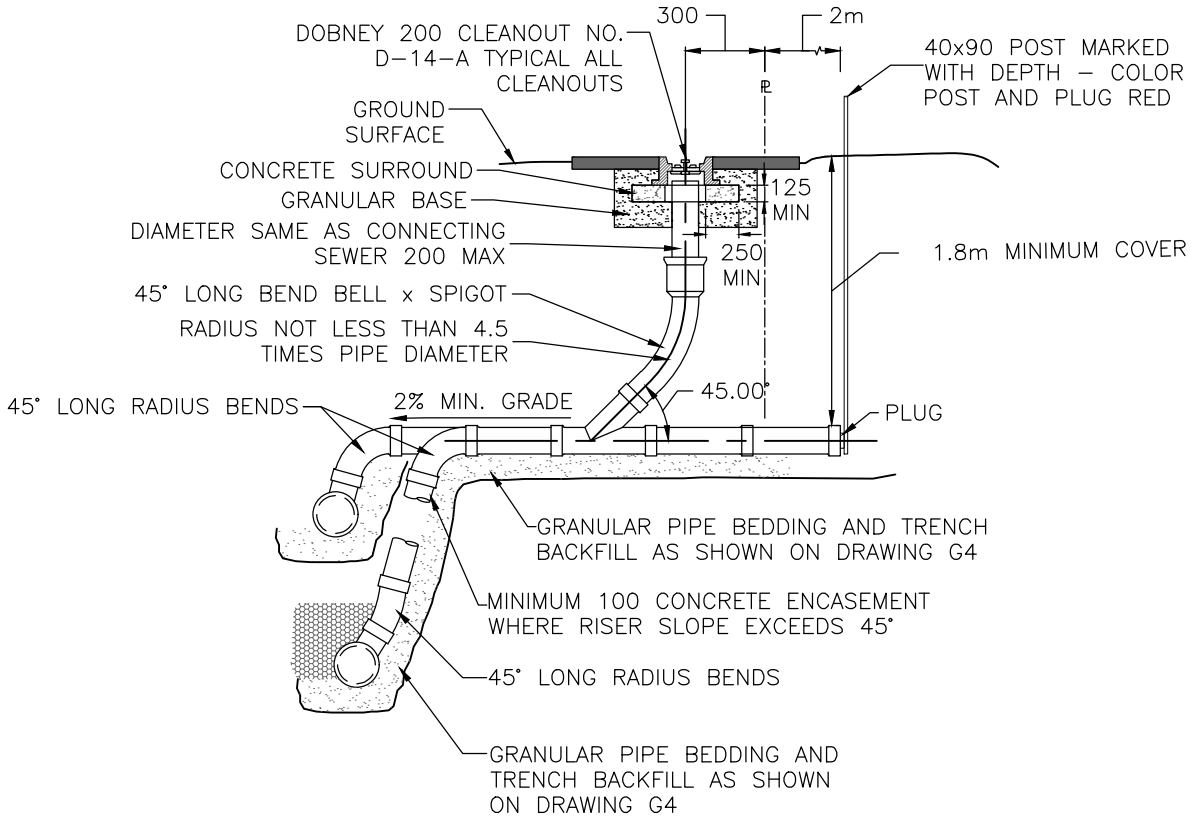

ELEVATION

1. CONNECTIONS TO BE 100 OR AS SPECIFIED ON CONTRACT DRAWINGS
2. RISER TYPE SERVICE TO BE USED ONLY WHEN SERVICE IS MORE THAN 2.4m ABOVE WYE INVERT OR AS DIRECTED BY CONTRACT ADMINISTRATOR
3. LOCATION OF SERVICE AND MARKER AS SHOWN ON CONTRACT DRAWINGS

Ashcroft Wellness Awaits You	SCALE: NOT TO SCALE	TITLE: SANITARY SEWER SERVICE CONNECTION	
	DATE DRAWN: 2020-06		
	APPROVED BY:	SECTION:	REVISION No. / DWG.No. S7A

APPENDIX 3

VILLAGE OF ASHCROFT APPROVED PRODUCTS LIST

MMCD Reference		Item Description	Approved Product	Standard	Comments/Restrictions
1. Waterworks					
1.1 Pipe	1.1.1	Polyvinyl Chloride Pipe	Ipex Napco	CSA B137.3; AWWA C900 DR25, 18 and 14; AWWA C905 DR41, 32.5, 25 and 18 AWWA C900 DR25, 18 and 14 AWWA C905 DR41, 32.5, 25 and 18	C900 Sizes 100 – 300 mm C905 Sizes 350 – 1200 mm
1.2 Fittings	1.2.1	Cast Iron Fittings	Terminal City Canada Pipe	ASTM C110-82 ASTM B16.1-1975 Exterior Coating to ANSI/AWWA C151/A21.5.1 Coal Tar Enamel to AWWA C203 Cement Mortar Lined to ANSI/AWWA C104/A21.4	Corrosion protection in accordance with recommendations from Owners Geotechnical Engineer
	1.2.2	Ductile Iron Fittings	Terminal City Alf's Castings Westview Sales	ASTM C153-84 ASTM C16.1-1975 Exterior Coating to ANSI/AWWA C151/A21.5.1 Hot Coal Tar Enamel to AWWA C203 Cement Mortar Lined to ANSI/AWWA C104/A21.4	Corrosion protection in accordance to recommendations from Owners Geotechnical Engineer
	1.2.3	PVC Extruded Fittings	Ipex Inc. Napco Galaxy Plastic	CSA B137.2 and B137.3 AWWA C907 (100-900 mm)	Long Body 5° Bends Long Radium Bends
1.3 Couplings	1.3.1	Couplings	Robar Smith-Blair Hymax		Corrosion protection in accordance to recommendations from Owners Geotechnical Engineer
	1.3.2	Adapter Flanges	Uni-Flange Terminal City	ANSI B16.1 125lb/ANSI D16.5 150lb	Epoxy coated Type 304 SS Bolts Flanges and all bolts to be wrapped in Denso tape

MMCD Reference		Item Description	Approved Product	Standard	Comments/Restrictions
1.4 Restraining Devices			Uni-Flange Ford	ASTM A536 Grade 65-45-12 ANSI/AWWA C111/A21.11 ANSI/AWWA C153/A21.53	Series 1300 – 1390 for PVC Pipe Series 1300, 1390, 1400 and 1450 for DI Pipe Epoxy coated Type 304 SS Bolts All bolts to be wrapped in Denso tape
1.5 Tapping Sleeves	1.5.1		Robar Terminal City	Stainless Steel or Mild Steel (Epoxy Coated)	Wrap in Denso tape
1.6 Fire Hydrants & 50 mm Standpipes	1.6.1		Terminal City Canada Valve	AWWA C502	Painted Red (Hydrant) Compression Type Confirm depth of bury with design Corrosion protection in accordance to recommendations from Owners Geotechnical Engineer
1.7 Repair Clamps	1.7.1		Robar Industries Ltd. Mueller Canada Pipe Clow Canada Ford	Stainless Steel "Two Piece Type"	Sizes 100 – 600 mm
1.8 Valves	1.8.1	Mainline Gate Valves	Clow Canada Terminal City Mueller	AWWA C505 Electrostatically Applied Fusion Bonded Epoxy Coated	Resilient Seat Sizes 100 – 350 mm Corrosion protection in accordance with recommendations from Owners Geotechnical Engineer
	1.8.2	Butterfly Valves	Keystone Pratt Mueller Rotork	AWWA C504 – Class 150B Electrostatically Applied Fusion Bonded Epoxy Coated	Resilient Seat Sizes 400 – 900 mm Direct Bury Corrosion protection in accordance to recommendations from Owners Geotechnical Engineer

MMCD Reference		Item Description	Approved Product	Standard	Comments/Restrictions
	1.8.3	Valve Boxes	Terminal City Iron Work Westview Sales	Coal Tar Enamel to AWWA C203 Exterior coating to ANSI/AWWA C151/A21.5.1	Terminal City MR Type North American Manufactured
	1.8.4	Check Valves	Apco Mueller Watts		Sizes 100 – 400 mm AWWA C504 Flanges Corrosion protection in accordance to recommendations from Owners Geotechnical Engineer
1.9 Water Service	1.9.1	Water Service Pipe 19 – 50 mm	Ipex Noranda Wolverine	ANSI H23.1 ASTM B88 AD WWT-799 ASTM F1281 CSA 137.1 AWWA C901	Type K Soft Copper
	1.9.2	Taped Coupling	Ipex Robar Robar	AWWA C907 CSA B137.2 AND B137.3	CC Thread
	1.9.3	Water Service Saddles	Canada Pipe	2706 CD2 or SC2	Double Strap Stainless Steel CC Thread Brass Epoxy Coated
	1.9.4	Corporation Stops	Mueller Cambridge/Ford		Sizes 19 – 50 mm CC Thread and Compression
	1.9.5	Curb Stop Residential (Stop & Drain) Irrigation (Stop & Drain)	Mueller Cambridge Ford		Sizes 10 – 50 mm Full Flow, Full Port Comp x Comp
	1.9.6	Service Box	Trojan Mueller	SSB1 A726 and A728	2.75 m Bury 1.5 m Internal Stainless Steel Rod Epoxy Coated Boot 12 pound zinc anode

MMCD Reference		Item Description	Approved Product	Standard	Comments/Restrictions
2. Sewer					
2.1 Storm Pipe	2.1.1	Concrete Pipe	Ocean Construction	ASTM C14, C76 A443, C655	600 mm and Larger Type 50 Cement
	2.1.2	Polyvinyl Chloride Pipe	Ipex. Napco Royal Flex-Loc Pipe Ltd.	CSA B182.2 ASTM D2412 AD NQ3624-060	DR28 100 – 150 mm DR35 150 – 900 mm
	2.1.3	Ultra-Rib	Ipex Napco	CSA B182.4 ASTM F794	300 mm and Larger
	2.1.5	Corrugated High Density Polyethylene Pipe	Big O Boss 2000 Big O Boss 1000 (Culverts Only) AOS/Hancor	ASTM D3350, CSA B182.6 – M92 ASTM D1248, F405, F667	Bell and Spigot with Gaskets Screw on Couplers
	2.1.6	Corrugated Steel Pipe Spir-L-Ok	Armtec Inc. (Culverts Only)	CSA CAN3-G401, M81	2.0 mm Gauge Minimum 400 mm Galvanized Coated Minimum 2.0mm thickness Coating as per Canadian Durability Guideline for CSP - CSPI
2.2 Vaults	2.2.1	Pre-Cast Reinforced Concrete	Grosso Kemp Kon Kast Ocean Langley Concrete Leko		Precast Concrete Minimum 960 Opening H20/CS-600 Loading Type 50 Cement
2.3 Catchbasins	2.3.1	Barrels	Grosso Kemp Kon Kast Ocean Langley Concrete Leko	ASTM C478	Pre-Cast Concrete 750 mm and 900 mm Diameter 1500 Deep H20/CS-600 Loading Type 50 Cement

MMCD Reference		Item Description	Approved Product	Standard	Comments/Restrictions
	2.3.2	Complete Bases and Lids	Grosso Kemp Leko Kon Kast Ocean	ASTM 478	Pre-Cast Concrete 360 maximum 640 mm Opening H20/CS-600 Loading Type 50 Cement
	2.3.3	Lawn Basin	Le-Ron Plastics Inc. Ocean Leko		70A06 with B33 Grate Dobney B22A grate Type 50 Cement
	2.3.4	Frame and Grate	Dobney Foundry Trojan Westview Sales Terminal City		Type 1 B23 Grate and 24 Frame LH or RH Type 2 Style B39B, B18 and B19 Type 3 B24 Adjustable Frame B23 Grate TF-33 Grate to indicate that stormwater drains to fish habitat or stream
2.4 Headwalls	2.4.1	Pre-Cast Concrete HDPE	Grosso Kemp Kon Kast Armtec		Pre-Cast Concrete Type 50 Cement
2.5 Storm and Sanitary Manholes	2.5.1	Barrels-Storm	Grosso Kemp Kon Kast Ocean	ASTM C478	Pre-Cast Concrete Minimum 1050 mm H20/CS-600 Loading Type 50 Cement
		Barrels-Sanitary	Ipex Grosso		PVC 1200 mm diameter
	2.5.2	Concrete Lid-Storm	Grosso Kemp Kon Kast Ocean	ASTM C478	Pre-Cast Concrete Minimum 1050 mm H20/CS-600 Loading Type 50 Cement

MMCD Reference		Item Description	Approved Product	Standard	Comments/Restrictions
	2.5.3	Pre-Cast Bases-Storm	Grosso Kemp Kon Kast Ocean		GU Liners Type 50 Cement
		Pre-Cast Bases-Sanitary	Ipex Grosso		PVC lined Type 50 Cement
	2.5.4	Frame and Cover	Dobney Foundry Westview Sales Terminal City		C18 Frame and Cover C18D Frame and Cover H20/CS-600 Loading TF-39
2.6 Sanitary Sewer Pipe	2.6.1	Concrete Pipe	Ocean	ASTM C14, C76 or C655	750 mm or Larger Bell and Spigot with Gaskets Type 50 Cement
	2.6.2	PVC Pipe	Ipex Rehau Industries Ltd. Royal Flex-Loc	CSA B182.2 ASTM D2412 and NQ3624-060	DR28 100 – 150 mm DR35 150 – 900 mm
	2.6.3	High Density Polyethylene Pipe (HDPE)	Phillips Sclair Drisco	AWWA C906	DR32.5 to DR11
2.7 Sanitary and Storm Sewer Services	2.7.1	PVC Pipe	Ipex Royal Flex-Loc Napco	CSA B182.2 ASTM B2412 AD NQ 3624-060	DR28 100 – 150 mm
	2.7.2	Service Wyes	Ipex/Galaxy Le-Ron Plastics Inc.	CSA B182.2 ASTM D3034, AD F1336	DR28 Bell and Spigot All new mainline construction
	2.7.3	Saddles	Ipex Le-Ron Plastics Inc. Robar Galaxy	CSA B182.2 ASTM D3034 ASTM F1336	Double Strap Wye Only on existing mains

MMCD Reference		Item Description	Approved Product	Standard	Comments/Restrictions
	2.7.4	Inspection Chamber	Galaxy Plastics Le-Ron Plastics Inc.		100 mm and 150 mm 70A4WOP or 70A6WOP Chamber 73A08HSL Locking Collar 71ALID086L Locking Lid Red – Sanitary Green – Storm
2.8 Forcemains	2.8.1	PVC Pipe & Fittings	Ipex Rehau Industries Ltd. Royal Flex-Loc Galaxy Plastics	CSA B137.2 AND B137.3 ASTM D1784 AWWA C907	DR25 and DR18 C900 Sizes 100 – 300 mm C905 Sizes 350 – 1200 mm
	2.8.2	High Density Polyethylene (HDPE) Pipe and Fittings	Philips Drisco Sclair	AWWA C906	DR11 to DR32.5
	2.8.3	Series PVC Pipe & Fittings	Ipex Rehau Industries Ltd. Royal Flex-Loc	CSA B137.2 and B137.3 AWWA C905	Series 100 to Series 160
	2.8.4	Lift Station Pumps	Flygt Gorman Rupp Myers		
	2.8.5	Valves	Clow Terminal City Mueller	AWWA C505	Resilient Seat Sizes 100 – 350 mm
	2.8.6	Services	See 1.9 Water Services		

APPENDIX 4

VILLAGE OF ASHCROFT APPROVED SOFTWARE PROGRAMS

PART 1 APPROVED SOFTWARE PROGRAMS

This document supports the Village of Ashcroft Subdivision and Development Servicing Bylaw No. 839 as the approved list of software programs for analysis and design, listed as follows:

- EPASWMM
- PCSWMM
- WaterCAD

This is not an exhaustive list, as additional software programs may be approved, pending review of the *Approving Officer*.

PART 2 UPDATED DOCUMENTS

The *Owner* shall obtain the most current version of this approved software programs list from the Village prior to any analysis.