

SCHEDULE "F"

ENGINEERING STANDARDS AND SPECIFICATIONS

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SECTION NO. 1 – GENERAL INFORMATION

1. INTRODUCTION

(a) This schedule forms Schedule "F" to Bylaw No. 2070-2011 cited as "Development Bylaw, 2011". It identifies the Engineering Requirements, Standards and Specifications which apply to the design, construction, installation and acceptance of Works and Services within the City of Abbotsford.

(b) For additional information, clarification or suggestions for changes and alternatives, please consult with:

General Manager, Engineering and Regional Utilities
City of Abbotsford
32315 South Fraser Way
Abbotsford, BC V2T 1W7

Telephone: 604-864-5514

Fax: 604-853-2219

2. SCOPE AND USE OF THIS SCHEDULE

This schedule shall be applicable to Subdivisions, Developments and City properties or Statutory Right of Way in the City of Abbotsford.

3. CONSTRUCTION SPECIFICATIONS

(a) All construction within the scope of this schedule shall conform to the latest edition of the Master Municipal Construction Documents - Volume 2 (GOLD) and the requirements, standards and specifications prescribed by this Bylaw.

(b) Should any conflict exist or arise between these documents, the City of Abbotsford's Development Bylaw, 2011, Bylaw No. 2070-2011, shall take precedent over the Master Municipal Construction Documents.

4. DEVELOPER PERFORMANCE RESPONSIBILITY

(a) Where Works and Services are to be designed, constructed and installed within the City, the Developer shall be aware of the areas and degrees of performance and responsibility required under this schedule.

(b) The Engineer, or his duly authorized representative, shall be the City's representative during the design, construction, installation and maintenance of the Works and Services.

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(c) Work Performance

The whole of the work, and the manner of performing the same, shall be done in accordance with the requirements, standards and specifications set out in this Bylaw to the satisfaction of the Engineer, whose decision shall be final and binding.

(d) Variation of Works and Services at Developer's Request

(i) Any variation to the Works and Services previously accepted shall be subject to review by the Engineer. All requests for variations to the Works and Services shall be designed and sealed by a Consulting Engineer on behalf of a Developer, and shall be made in writing to the Engineer.

(ii) Any requests for variations shall include a signed and sealed revision to the previously accepted drawing(s). The Engineer's decision as to the acceptability of any revision(s) shall be final and binding.

(e) Unforeseen Conditions

(i) If, at any time after the drawings have been accepted for construction, unforeseen conditions or circumstances become known which make it necessary that changes in the design or extra Works and Services be done in order to complete the project to good engineering practice, the Engineer shall have the right to order such changes or extra Works and Services as he deems necessary to complete the Works and Services in an acceptable manner.

(ii) All costs of such extra Works and Services shall be borne by the Developer.

(f) Verbal Agreements

No verbal instruction, objection, claim or notice by any party to the other shall change or modify any of the terms or obligations contained in any of the requirements, standards or specifications, and none of the requirements, standards or specifications shall be held to be waived or modified by reason of such verbal instruction, objection, claim or notice.

(g) Service of Notices

Any notice, order, direction, request or other communication given by the City, shall be deemed to be well and sufficiently given if the same be left at any office used by the Developer or be delivered to the Developer's Consulting Engineer or Contractor.

SCHEDULE "F" (Cont'd)

(h) Pre-Construction Meeting

Prior to the commencement of any Works and Services to be constructed within the scope of Schedule "F" to "K", a pre-construction meeting shall be held. The Developer, their Consulting Engineer and Contractor, along with City departmental representatives of Engineering, Development Services and Public Works shall meet for the purposes including, but not necessarily limited to:

- (i) the City releasing the accepted Works and Services drawings to the Developer;
- (ii) the City receiving Insurance Policy submissions as required by this Bylaw;
- (iii) providing the City with a WorksafeBC "Notice of Project";
- (iv) reviewing procedures for traffic control, tie-ins to City services, testing and documentation submissions;
- (v) reviewing procedures for requests for reduction of Letters of Credit;
- (vi) establishing conditions for the issuance of a Certificate of Substantial Completion and Certificate of Final Acceptance;
- (vii) establishing lines of communication;
- (viii) reviewing project coordination requirements with other Developers or Contractors engaged by the City;
- (ix) providing the City with a full set of digital construction drawings on Compact Disk (CD); and
- (x) securing written acknowledgement that the Developer or the Developer's Contractor is designated as the "Prime Contractor" in respect of all obligations by virtue of the Workers Compensation Act and Regulations.

5. CONDUCT OF WORK

(a) Responsibility

- (i) The Developer shall be held fully responsible to the City for the acts and omissions of his agents and of all persons directly or indirectly employed by him. The Developer agrees to bind all agents or employees to the requirements, standards and specifications of this schedule.
- (ii) The Developer shall not commence the construction of any Works and Services without written permission from the Engineer.

SCHEDULE "F" (Cont'd)

(b) Materials and Workmanship

The whole of the work shall be done in a substantial and workmanlike manner with materials, articles and workmanship of the best quality and description as required by, and in strict conformity with, this schedule. Unless otherwise specified, all materials shall be new.

(c) Survey Monuments and Legal Postings

(i) All legal posts, stakes and integrated survey monuments within and outside the area of the work, and on adjoining areas of work, shall be preserved, undisturbed and visible. In the event any of the above are disturbed, lost or destroyed, they shall be replaced by the City, at the cost of the Developer, to the satisfaction of the Engineer.

(ii) All surveys within integrated areas of the City shall be tied to the monument system based on the Surveyor General's instructions.

(d) Disposal of Excavated Materials – Soil Removal

(i) No person shall place material from excavation on private property within the Agricultural Land Reserve unless that person has obtained a permit issued by the City as required under the Soil Conservation Act.

(ii) No person shall place material from excavation on properties outside the Agricultural Land Reserve unless that person has obtained a permit issued by the City as required under the City's Soil Removal and Deposit Bylaw.

(e) Work of Others

(i) The City, its officers, employees, agents and Contractors shall be at liberty to enter upon the site of the work with its workmen and materials to do other work, and the Developer shall afford any such workmen all reasonable access and facilities.

(ii) The Developer shall arrange his work and dispose of his materials in such a manner as will not interfere with the work or storage of materials of others upon the site of the work. The Developer shall join his work to that of others, and perform his work in proper sequence in relation to that of others to the acceptance of the Engineer.

SCHEDULE "F" (Cont'd)

- (f) Existing Structures and Utilities
 - (i) Plans or descriptions, verbal or otherwise, of existing piping or structures that are given to the Developer are intended only as an aid in the location of these items. Measurements and locations of the existing piping and structures are compiled from the most reliable information available. This information must be verified by the Developer prior to proceeding with construction.
 - (ii) The City does not check, review or maintain the accuracy of any plans, maps or elevations that are in its possession. The Developer, or his Consulting Engineer, must review any information received from the City, and verify its accuracy by field investigation.
- (g) Drainage
 - (i) The City utilizes natural watercourses as part of the Drainage System. Accordingly, the Developer shall be responsible for complying with all Federal, Provincial and Municipal legislation with respect to protection of fish, fish habitat and watercourses.
 - (ii) The Developer shall keep all portions of the site efficiently drained during construction and until acceptance by the City. The Developer shall be responsible for all damage which may be caused from water backing up, flowing over, through, from or along any part of the work, or elsewhere.
 - (iii) Existing culverts, drains, ditches and water courses affected by the work shall be kept clear of excavated material at all times. When it is necessary to relocate, remove or alter an existing drainage structure, the Developer shall provide suitable alternative measures for handling the drainage.
 - (iv) The Developer shall clean streets, catch basins, manhole sumps, detention tanks, and maintain erosion and sediment controls as often as the Engineer deems necessary, or as deemed necessary by other City permits or legislation enacted for such purposes, until the Works and Services are accepted by the City.
- (h) Work to Fit With Others
 - (i) The Developer shall do all cutting, fitting or patching of his work that may be required to properly fit or receive existing structures and utilities.
 - (ii) The Developer shall not connect his Works and Services to existing Works and Services without the prior written consent of the Engineer.

SCHEDULE "F" (Cont'd)

(i) Damage to Work

(i) The Developer shall bear the risk and all loss or damage which may occur on or to the Works and Services until accepted by the Engineer.

(ii) All repair, restoration or re-execution of the Works and Services shall be carried out to the satisfaction of the Engineer and at no cost to the City.

(j) Use of Completed Portions

The City shall have the right to take possession of any completed, or partially completed, portion of the Works and Services when considered necessary by the Engineer. Such possession shall not be deemed an acceptance of Works and Services. If prior use increases the cost of constructing uncompleted Works and Services, or causes refinishing of completed work beyond normal wear and tear, the Developer shall be entitled to such compensation as the Engineer may determine.

(k) City's Right to Repair, Restore or Re-Execute the Works and Services

(i) Should the Developer, within 14 calendar days of the City's written notice to do so, fail to perform the design, construction and installation of Works and Services, or fail to begin, repair, restore or re-execute the Works and Services, all to the satisfaction of the Engineer, or fail to comply with the Requirements, Standards and Specifications of this schedule, the City shall be hereby empowered to repair, restore or re-execute the Works and Services at the cost of the Developer.

(ii) Despite any other provisions of this Bylaw, the City reserves the right to repair, restore or re-execute the Works and Services on an emergency basis without written notice.

(iii) The work performed by the City shall not relieve the Developer from the performance and fulfillment of any of his obligations and duties under this Bylaw.

(l) Payment of Accounts

(i) The Developer shall pay all accounts for labour, services and materials, incurred by the City as a result of the City performing any repair, restoration, execution or re-execution of the Works and Services, whether during the design, construction and installation of the Works and Services or during any Warranty Period as established herein. Should payment not be made upon invoice, and if the Works and Services performed relate to outstanding Works and Services secured for in the Security Deposit or Warranty Deposit, the City shall deduct the payment from the Security Deposit or Warranty Deposit, provided the remaining Security is adequate for the outstanding Works, plus 200%.

SCHEDULE "F" (Cont'd)

- (ii) If the amount is greater than the Security Deposit or Warranty Deposit, as the case may be, the Developer shall pay the difference when invoiced.

- (m) Arbitration

In the case of any dispute between the City and the Developer during the progress or afterwards of the design, construction or installation of the Works and Services, as to any matter arising there under, either party may at his option give to the other, notice of such dispute and the parties may, with respect to the particular matters then in dispute, agree to submit the same to arbitration in accordance with the laws of the Province of British Columbia; provided, however, that if arbitration has not been agreed upon, either party may elect to have such dispute determined by a Court of competent jurisdiction. Arbitration shall not be a cause for the stoppage of work.

- (n) Employee and Plant Safety, Adequacy
 - (ii) The Developer shall be responsible for the safety of his employees and for the safety, adequacy and sufficiency of his plant, equipment and method of executing the design, construction and installation of Works and Services.

 - (ii) The Developer shall be responsible for notification of the proposed construction and installation of the Works and Services to *Works Safe BC*, and shall conduct the delivery of all Works and Services in compliance with the regulations of *Works Safe BC*. A copy of the notification letter shall be forwarded to the Engineer prior to commencement of construction.

- (o) Public Convenience, Access and Clean-Up
 - (i) In carrying out the work, the Developer shall always consider the convenience and safety of the public.

 - (ii) The Developer shall not obstruct any Roadway or Sidewalk longer than is necessary.

 - (iii) The Developer shall provide for safe access to Sidewalks, driveways, buildings and private property for vehicles and pedestrians at all times.

 - (iv) The Developer shall allow for passing along and crossing of all Roadways and Sidewalks, where practical, during the execution of the construction and installation of the Works and Services.

 - (v) The Developer shall construct and maintain in good order suitable platforms, approaches, structures, bridges, crossings, signage or other Works and Services as required by the Engineer.

SCHEDULE "F" (Cont'd)

- (vi) The Developer shall not deposit material upon a Roadway or other public or private property without the consent of the Engineer or private property Owner.
 - (vii) During all phases of the construction and installation of Works and Services, including the Warranty Period, the Developer shall take precautions to abate nuisance caused by mud, dust or erosion by clean-up, sweeping, sprinkling with water or other means, as necessary to accomplish results acceptable to the Engineer.
 - (viii) The Developer shall obtain written consent from the Engineer prior to any closure of a Roadway, access way or Statutory Right of Way.
- (p) Traffic Control Barriers, Lights
- (i) The Developer shall, at his own expense, provide, erect and maintain all required barriers, fences, warning flashers with amber globes, or other such proper protection including qualified flag persons or watchmen if necessary, to ensure safety to the public as well as those engaged about the premises or with the construction and installation of the Works and Services.
 - (ii) The Developer shall also provide signs or notices in compliance with the Ministry of Transportation's Traffic Control Manual for Works on Roadways and Uniform Traffic Control Devices Manual.
- (q) Disposal of Debris by Open Burning
- Debris from construction and site clearing works or material brought to the site shall not be disposed of by open burning without first obtaining a burning permit from the City pursuant to the City's Fire Service Bylaw.
- (r) Releases at Completion of Works and Services
- (i) The Engineer may require that, upon completion of construction and installation of any portion of the Works and Services on private property, the Developer obtains from each affected property Owner, a formal release, in writing, verifying that the property has been restored by the Developer to the same condition it was in as before such construction or installation.
 - (ii) In the case of a dispute, the Engineer's decision shall be final.

SCHEDULE "F" (Cont'd)

- (s) Warranty Period (except for Landscaping)
 - (i) The Warranty Period for Works and Services designed, constructed and installed under this Bylaw, shall be for a minimum of one (1) year following the date of issuance of the Engineer's Certificate of Substantial Completion and shall expire upon issuance of the Certificate of Final Acceptance.
 - (ii) During the Warranty Period, the Developer shall guarantee the stability and sufficiency of the materials and workmanship of the Works and Services and shall make good, correct and repair all defects, imperfections, damage, settlements and acts of vandalism which may arise or occur in relation to the Works and Services.
 - (iii) The Developer shall ensure that the Roadways, including Sidewalks and Walkways, are kept clean and free of dirt and debris during the Warranty Period.
- (t) Warranty Period for Landscaping
 - (i) Upon completion of Landscaping as required under this Bylaw, the Developer shall notify the Engineer who shall issue a Certificate of Substantial Completion (Landscape) upon satisfactory inspection of the work to determine conformance with the requirements, standards and specifications of this schedule.
 - (ii) The Warranty Period for Landscaping shall be for a minimum of one (1) year from the date of issuance of the Certificate of Substantial Completion (Landscape) as issued by the Engineer.
 - (iii) During the Warranty Period for Landscaping, the Developer shall replace any plant material that dies, is damaged or that fails to grow satisfactorily as determined by the Engineer. All replacements shall be with plant material of the same kind and size as the original Plantings unless otherwise specified by the Engineer.
 - (iv) The Developer shall warrant all replacement plant material for a period equal to the original Warranty Period (one year).
 - (v) Should the Developer fail to make good and repair any defects, imperfections, vandalism acts, settlements or clean-up after being given at least seven (7) calendar days written notice during the Landscaping Warranty Period, the City shall make, or cause to be made, all necessary repairs at the cost of the Developer and shall recover such costs in accordance with Subsection (l).

SCHEDULE "F" (Cont'd)

- (vi) The Engineer reserves the right to extend the Developer's warranty responsibilities for an additional time period, not to exceed one (1) year if at the end of the initial Warranty Period, leaf Development, plant growth or overall vigor is not sufficient to ensure future survival.

6. AGREEMENTS, BONDING, INSURANCE, PERMITS

(a) Servicing Agreement - Contents and Provisions

- (i) Prior to commencement of installation and construction of the Works and Services, the Developer shall execute a Servicing Agreement with the City substantially in the form of agreement contained in Schedule "H" of this Bylaw. The Mayor and Corporate Officer are hereby authorized to execute any Servicing Agreement substantially in the form as set out in Schedule "H".
- (ii) The Servicing Agreement makes provision for, among other matters:
 - A. Security Deposit;
 - B. indemnity clause;
 - C. insurance requirements;
 - D. Warranty Period;
 - E. Warranty Deposit;
 - F. reduction of Letter of Credit; and
 - G. administration fees.

(b) Servicing Agreement Procedure

- (i) When entering into a Servicing Agreement the following procedure shall be followed:
 - A. three copies of the Servicing Agreement shall be obtained from the Economic Development and Planning Services Department. All copies of the Agreement shall be executed by the Developer and returned to the Engineer along with the following:
 - i. Security Deposits in the amount and form specified;
 - ii. a non-refundable administration and inspection fee in the amount calculated in accordance with Subsection (c) and specified in the Servicing Agreement; and

SCHEDULE "F" (Cont'd)

- iii. any other connection fees, cash in lieu of Works and Services, latecomer fees, or similar charges levied by the City and required in the Servicing Agreement.

(c) Administration and Inspection Fee

- (i) The administration and inspection fee shall be based upon the estimated cost of construction and calculated as follows:

Estimated Cost	Fee Value
Up to \$300,000	= 5%
Over \$300,000	= 5% on the first \$300,000 and 3% on remainder

- (ii) Additional administration and inspection fees will be invoiced where the City must act on behalf of the Developer, or agents, to perform any repair, restoration, execution or re-execution of the Works. Invoiced charges are to be based on full cost recovery for all labour, materials, equipment, inspection and supervision, plus a 15% administration fee. Minimum inspection and administration fee to be \$500 each.

(d) Security Deposit

- (i) The Security Deposit deposited by the Developer is to ensure the required design, construction, installation and maintenance of the appropriate legislated Works and Services and Landscaping. The Security Deposit shall be based on:

- A. the estimated cost of construction as provided by the Developer's Consulting Engineer and Landscape Architect and accepted by the Engineer. The estimated cost of construction shall be provided in the Master Municipal Construction Document Form of Tender, estimated quantities and prices format that includes the related Master Municipal Construction Document section, quantities, unit prices and extension. In addition, the Master Municipal Construction Document costs shall be summarized by asset type in the City of Abbotsford Construction Cost Allocation Form;
- B. ten percent (10%) for engineering including environmental, testing and sub-consultant services; and
- C. five percent (5%) of the value of the Works and Services or \$15,000, whichever is greater, for the submission and acceptance by the Engineer of the as-builts drawings.

- (ii) The Security Deposit shall be in the form of cash or an automatically renewing and irrevocable Letter of Credit which shall refer to the municipal project number and the Developer's name or company that is noted on the Servicing Agreement.

SCHEDULE "F" (Cont'd)

(e) Indemnity Clause

- (i) The Developer shall indemnify and hold the City, its officers, employees, elected officials, agents and Contractors harmless from and against all actions and proceedings, costs, damages, expenses, claims and demands whatsoever and by whomsoever, brought by reason of or arising in any way from the design, construction, installation or performance of the required Works and Services.
- (ii) If as a result of any willful or negligent act or omission of the Developer in fulfilling its obligations under this Bylaw, the City becomes obligated to pay any money to any person, the Developer shall reimburse the City for all such monies and reasonable expenses.

(f) Public Liability and Property Damage

- (i) Prior to the commencement of any Works and Services, the Developer shall obtain and maintain a policy or policies of insurance acceptable to the Engineer and in accordance with the requirements of Subsections (f) to (g). In all policies:
 - A. each Contractor engaged in the work and the City shall be named as an additional insured;
 - B. each policy shall contain a provision that the insurance shall apply as though a separate policy has been issued to each named insured; and
 - C. each policy shall provide that no expiry, cancellation or material change in the policy shall become effective until after 30 days notice of such cancellation or change. Notice of change shall be given to the City by registered mail.
- (ii) The Developer shall maintain in good standing the insurance policy or policies until issuance of a Certificate of Final Acceptance by the Engineer.

(g) Insurance Policy Limits

The following are limits to be included:

- (i) Comprehensive Public Liability Insurance and Property Damage Insurance providing coverage of at least \$5,000,000, inclusive against liability for bodily injury or death and/or damage to property on an all risk occurrence basis;

SCHEDULE "F" (Cont'd)

- (ii) Motor Vehicle Insurance for public liability and property damage providing coverage of at least \$5,000,000, inclusive on owned, non-owned or hired vehicles; and
 - (iii) completed operations coverage on an all-risk occurrence basis of at least \$5,000,000, inclusive against liability for bodily injury, death and/or damage to property of others arising out of the existence of any condition in the work when completed or any installation or repair operations during the period of 12 calendar months next ensuing after the issuance of a Certificate of Substantial Completion by the City.
- (h) Insurance Policy Submission
- (i) At the pre-construction meeting, the Developer shall deliver, to the City, a copy of the policy or policies of insurance certificate signed by a licensed insurance agent, certifying as follows:

"I hereby certify that the attached insurance policy provides insurance coverage as required by Servicing Agreement number _____ between the City of Abbotsford and (the Developer), and that the attached Insurance Policy No. _____ is valid for the period of the Servicing Agreement."

(ii) No construction may commence if this provision has not been satisfied.
- (i) Patents and Copyrights
- The Developer shall pay all royalties, patent and license fees, and hold and save the City, its officers, agents, servants and employees, harmless from liability of any nature or kind, including costs and expenses, for, or on account of, any copyrighted or un-copyrighted composition, secret process, patented or un-patented invention, articles or appliances manufactured or used in the execution of the Works and Services, including their use by the City.
- (j) Permits
- Where any work is undertaken on a Highway within the City and outside the area of the required Works and Services or any work is undertaken without the benefit of an executed Servicing Agreement or registered Development Agreement covenant where full or partial road closures are necessary or contemplated, the Developer shall obtain a Highway Excavation Permit from the Engineer.

SCHEDULE "F" (Cont'd)

7. INSPECTION AND SECURITY DEPOSIT REDUCTIONS

(a) Inspections - General

- (i) The Engineer may, but is not obligated to, examine any part of the Works and Services including workshops or other places where material is being prepared or stored. The Developer shall provide access and all information requested. The Contractor shall open for inspection any part of the Works and Services that have been covered up without inspection by the Engineer.
- (ii) The Consulting Engineer shall supply representative samples of materials as requested by the Engineer. The Consulting Engineer shall provide on-site survey, measurements, inspection and testing of the Works and Services. The testing and geotechnical firm(s) shall immediately forward results, reports or recommendations to the Consulting Engineer and the Engineer.
- (iii) Examination by the Engineer shall not constitute inspection, supervision or co-ordination of the Works and Services, and neither are they intended to serve in place of proper engineering inspection and supervision of the Works and Services by the Developer's Consulting Engineer.

(b) N/A

(c) Inspections by the Consulting Engineer

The Consulting Engineer shall be responsible for:

- (i) carrying out on-site engineering inspection of the Works and Services to ensure that they comply with the requirements, standards and specifications of this Bylaw and that the design, construction and installation of the Works and Services are carried out according to sound engineering practices and standards and conform to the intent of the accepted designs;
- (ii) engaging the services of qualified testing and geotechnical firms to provide quality assurance inspections, recommendations and testing of the Works and Services, as required by the Engineer; and
- (iii) ensuring that all other requirements of the City are performed and completed to a satisfactory conclusion.

SCHEDULE "F" (Cont'd)

- (d) Testing or Confirmation of Completed Works and Services
- (i) The City may conduct independent testing of any or all Works and Services. Typically, these tests will be conducted on a random basis and are for the purpose of ensuring that the Works and Services being accepted by the City meet the minimum requirements, standards and specifications of this Bylaw.
 - (ii) In addition to ensuring that the City has proper and accurate records of the Works and Services constructed by the Developer, survey spot checks may be conducted from time-to-time to verify authenticity of the as constructed information.
 - (iii) The costs for this random testing or surveying shall be borne by the City. If the Works and Services do not comply with this Schedule, the Developer shall bear such costs, plus all costs for repairs, replacement, reconstruction and re-certification of any Works and Services disturbed, exposed, removed or affected by the random checks.
- (e) Security Deposit Reductions
- (i) As the Works and Services progress, the Developer may request a reduction in the Security Deposit. The Developer's Consulting Engineer shall prepare and submit to the Engineer a Security Deposit reduction request setting forth an estimate of the quantity, value and percentage of the work completed. A marked up print of the approved construction drawings indicating as-built information related to the completed work must be submitted with each reduction request.
 - (ii) Despite any provision of this Bylaw, the Engineer may, in the Engineer's sole discretion, deny reductions to the Security Deposit where, in the Engineer's opinion, the amount of Security Deposit remaining is required to cover any portion of the remainder of the Work and Services, Landscaping or repair to damage to City property. No Security Deposit reduction request shall be for a period of less than one month. Typically Security Deposit reduction requests shall be submitted by the 25th day of the month for work up to and including the 15th day of the month. Security Deposit reductions are for the convenience of the Developer and, in no case, shall be taken as acceptance of the material plant or workmanship of stipulated Works and Services.
 - (iii) Following issuance of the Certificate of Substantial Completion, the Engineer may reduce the Security Deposit to the Warranty Deposit.

SCHEDULE "F" (Cont'd)

- (f) Certificate of Substantial Completion
- (i) The Consulting Engineer shall notify the Engineer when construction of the Works and Services are substantially complete. The Engineer shall, if necessary, issue a list of deficiencies that must be corrected prior to issuance of a Certificate of Substantial Completion.
 - (ii) A Certificate of Substantial Completion shall be issued by the Engineer when:
 - A. all deficiencies are rectified;
 - B. as built drawings of the required Works and Services have been accepted by the Engineer and digital colour photos of all storm water detention and flow control structures and CCTV inspections of pipe works constructed for infiltration galleries are received and accepted;
 - C. Service and Hydrant Record Cards have been accepted by the Engineer;
 - D. all legal encumbrances have been registered or released accordingly; and
 - E. a Certificate of Inspection and Request for Substantial Completion from the Consulting Engineer has been received stating that all Works and Services have been supplied, designed, constructed and installed in substantial conformance with the accepted design drawings and the requirements, standards and specifications of this Bylaw and all other applicable City Bylaws.
 - (iii) Portions of Works and Service, that the City deems to be of public safety or public interest, that are eligible for Substantial Completion that have not been completed in the time frame as indicated in the Development Agreement, Servicing Agreement or this Bylaw may be reviewed by the City for execution of public safety and interest Works and Services. If the City performs this review, inspection or execution, the Developer will be invoiced as identified in Subsection 6 (c) (ii) of this Schedule.
- (g) Building Permit Issuance
- (i) No Building Permit for any building will be issued without the Developer providing proof acceptable to the Engineer, in writing or on plans, that the building is serviced to the standards and specifications of this Bylaw.

SCHEDULE "F" (Cont'd)

- (ii) No single-family Building Permit will be issued until a Certificate of Substantial Completion for the required Works and Services under the Servicing Agreement has been issued by the Engineer.

- (h) Despite Subsection (g) (ii), a Building Permit for a Show Home may be issued in accordance with the requirements of the City's Show Home Building Permit Policy 400-1-21.

- (i) Service Record Cards
Services Record Cards for each Parcel shall show:
 - (i) Statutory Right of Way and easements as they pertain to the Parcel;
 - (ii) location, inverts and depth of water, storm and sanitary connections;
 - (iii) MBE;
 - (iv) recommended GPE;
 - (v) elevations at back of curb, Parcel corners and finished ground at the rear building envelope line;
 - (vi) all dimensions of front, side and rear property lines of the Parcel;
 - (vii) elevations and offset from property line of Sidewalk, back of curb, street lights, power/telecommunications ducts, service boxes, water meter boxes, gas mains and hydrants;
 - (viii) street trees in relation to the Parcel;
 - (ix) driveway/curb drop to the Parcel;
 - (x) building envelop outline; and
 - (xi) all retaining walls.

SCHEDULE "F" (Cont'd)

- (j) Warranty Deposit
 - (i) Upon issuance of the Certificate of Substantial Completion, the Engineer may release the Security Deposit less a Warranty Deposit of five percent (5%) of the estimated cost of the Works and Services or \$25,000, whichever is the greater, to secure the maintenance or repair to the Works and Services during the Warranty Period referred to in Subsection 5 (s). An updated cost estimate must be included for the final top lift of asphalt or other works deferred to the maintenance period. Any deficiencies that are to be corrected prior to Final Acceptance must be secured in addition to the Warranty Deposit in the amount of 200% of the estimated cost provided by the Developer's Consulting Engineer and accepted by the Engineer.
 - (ii) The Warranty Deposit shall not be applied to the maintenance or repair of BC Hydro, Telecommunications or FortisBC Gas equipment and plant installations but may be applied to the maintenance or repair of excavations and soil settlement areas on City property arising from such installations.
 - (iii) In addition to the Warranty Deposit requirements for the Works and Services related to the issuance of a Building Permit, the Engineer may retain an additional amount of the security in the amount of 5% of the value of the Works and Services, or \$15,000, whichever is greater, to insure the submission of as-built drawings within sixty days of the date of Final Acceptance of the works relating to the Building Permit.
- (k) Inspection of Landscaping
 - (i) The Developer shall, at his sole cost and expense, supply representative samples of materials and plants as requested by the Engineer. No payment, reimbursement or remuneration shall be made to the Developer for the cost of labour, plant, material, work or any delay occasioned by this requirement.
 - (ii) Inspections by the Consulting Landscape Architect are limited to ensuring that the Landscaping is in compliance with the requirements, standards and specifications of this schedule and are in general conformance with the intent of the accepted plans and are in a condition acceptable to the City.
- (l) Certificate of Substantial Completion (Landscape)
 - (i) Upon completion of Landscaping, the Consulting Landscape Architect shall inspect the work and, if necessary, issue to the Contractor a list of deficiencies that shall be corrected. Upon adequate completion of all deficiencies the Consulting Landscape Architect shall submit BCSLA L3 Schedule to the Engineer. Following receipt of appropriate Schedule, a

SCHEDULE "F" (Cont'd)

Certificate of Substantial Completion (Landscape) shall be issued by the Engineer.

- (ii) Upon issuance of the Certificate of Substantial Completion (Landscape), the City may release that portion of the Security Deposit held for Landscaping, less a warranty holdback of 20%. The warranty holdback shall be held for a period of one year from issuance of the Certificate of Substantial Completion (Landscape).

- (m) Certificate of Final Acceptance
 - (i) A Certificate of Final Acceptance will be issued by the Engineer upon expiration of the Warranty Period for required Works and Services provided all deficiencies have been corrected. A Certificate of Final Acceptance (Landscape) will be issued by the Engineer upon expiration of the Landscape Warranty Period provided all deficiencies have been corrected.

 - (ii) Works and Service, that the City deems to be of public safety of public interest, that are eligible for the Final Acceptance that have not been completed in the timeframe as indicated in the Servicing Agreement, or this Bylaw may be reviewed by the City for execution of public safety and interest Works and Services. If the City performs this review, inspection or execution, the Developer will be invoiced as identified in Subsection 6 (c) (ii) of this Schedule.

SCHEDULE "F" (Cont'd)

SECTION NO. 2 – ENGINEERING STANDARDS

1. INTRODUCTION

- (a) The purpose of this section is to outline the minimum standards and requirements the City will accept for the submission of quality design and as-built drawings for Works and Services.
- (b) Whenever Works and Services are required or proposed, the Consulting Engineer shall arrange for a pre-design meeting to review the requirements for the proposed Development to ensure understanding and conformance by the Consulting Engineer of the latest City standards, specifications and policies.
- (c) Incomplete or substandard submissions will be returned to the Consulting Engineer without comment. A subsequent re-submission, which remains incomplete or substandard, may result in a meeting with the Consulting Engineer, Developer and Engineer.
- (d) All submissions for design of Works and Services shall comply with the following:
 - (i) all applicable requirements of this schedule;
 - (ii) all applicable requirements of Schedule "F" to "K"; and
 - (iii) all applicable requirements of City Bylaws.
- (e) The Consulting Engineer shall be responsible for the coordination of civil design works of the Development with the design of the BC Hydro, FortisBC Gas, telecommunication infrastructure and the Street Tree and Landscaping plans for that Development. Conflicts in the horizontal and vertical planes for all service connections and mains shall be resolved between the Consulting Engineer, the appropriate utility and the Landscaping Architect.

2. SURVEY INFORMATION

- (a) All surveys shall be conducted safely with minimal nuisance to traffic or the public at large. The Developer must obtain permission from any Owner before entering private property.
- (b) All elevations shall be from geodetic datum (NAD 83, CSRS). Information regarding the location and elevation of existing Integrated Survey Monuments within the City may be obtained from the Engineering and Regional Utilities department or from the City's website.
- (c) Originating benchmarks and integrated survey monuments shall be noted on all applicable plans.
- (d) Copies of legible field notes shall be made available to the City upon request.

SCHEDULE "F" (Cont'd)

- (e) Centrelines (or offset lines) are to be marked and referenced in the field, and all chainages shall be keyed to the legal posting.
- (f) All existing items such as survey monuments, manholes, catch basins, fire hydrants, utility poles and existing dwellings including addresses, fences, trees, hedges and unusual ground formations shall be noted.
- (g) Where applicable, or as requested by the Engineer, cross-sections are required. The sections shall include locations and elevations of:
 - (i) centreline of pavement;
 - (ii) edge of pavement;
 - (iii) gutter line;
 - (iv) top of curb;
 - (v) back of Sidewalk;
 - (vi) edge of shoulder;
 - (vii) ditch invert;
 - (viii) top of ditch banks including high and low watermark(s);
 - (ix) property line;
 - (x) an existing ground elevation 3 metres inside property line and 5 metres beyond cut or fill slopes; and
 - (xi) toe and top of bank of cut and fill slopes.

3. DRAWING SUBMISSIONS

- (a) All drawings shall be prepared in accordance with the following requirements and all other applicable requirements of this Schedule. A digital version of the standard title block, standard legend and standard construction notes are available for downloading from the City website.
- (b) All drawings shall clearly identify the Works and Services in sufficient detail. Drawings shall be inked and use minimum 80CL size Leroy lettering or digital CAD equivalent.
- (c) All new Works and Services are to be shown in bold lines.

SCHEDULE "F" (Cont'd)

- (d) Specific notes pertaining to the construction of Works and Services are to be shown on the specific service drawing separate from standard notes referred in Subsection (a).
- (e) Baselines and chainages are to be referenced to at least one legal property pin on each sheet.
- (f) Offsets are to be shown to both sides of the Highway or Statutory Right of Way or to one side with the Highway or Statutory Right of Way width noted.
- (g) All drawings, except for the street lighting plan and the Street Tree and Boulevard planting plan(s), shall be signed and sealed by the Consulting Engineer responsible for the design and construction supervision of the Works and Services.
- (h) All Landscaping plans including Street Tree and Boulevard planting plans shall be sealed and signed by the Consulting Landscape Architect.
- (i) Street lighting and traffic signal plans shall be signed and sealed by a professional electrical engineer responsible for the design of the street lighting and Traffic Signal Works and Services.

4. PLAN INFORMATION

Typically, all drawings should be oriented to view northward or westward with chainages increasing from left to right and from bottom to top with North at the top or right side of the drawing. Information on plans shall include:

- (a) the municipal project "SUB" Number and reference file number(s), noted in the lower right-hand corner of all drawings;
- (b) the legal layout of roads and properties;
- (c) the legal descriptions of all properties included in the Development;
- (d) dimensions to the nearest 0.01 metres;
- (e) existing house numbers of Parcels adjacent to the proposed Works and Services; and
- (f) all existing and proposed registered Statutory Right of Way and easements.

5. ENGINEERING DESIGN DRAWINGS

For Residential, Industrial and Subdivision Developments, a complete set of engineering design drawings of proposed Works and Services shall include, in the following sequence:

SCHEDULE "F" (Cont'd)

- (a) cover sheet - noting:
 - (i) the Consulting Engineer's name, address, phone and fax numbers;
 - (ii) Developer's name address, phone and fax numbers, including contact name;
 - (iii) Surveyor's name, address, phone and fax numbers;
 - (iv) the legal description and address of the lands involved;
 - (v) a location plan insert approximately 100 mm square and at 1:4000 scale showing all proposed roads and proposed Subdivision layouts in relation to surrounding lands;
 - (vi) a drawing index (for smaller projects, general notes may be included on the cover sheet, otherwise general notes shall be on a separated sheet or on the appropriate utility sheet); and
 - (vii) benchmark details.
- (b) Key Plan - at a 1:1000 or 1:500 scale - noting:
 - (i) all proposed Works and Services including service connections, appurtenances such as hydrants, valves, manholes, catch basins, street lights, street trees, driveways to each Parcel and post boxes complete with all offsets, locations and dimensions;
 - (ii) if more than one sheet is required, note the westerly or southerly portion first and identify as Key Plan "A" with additional plans noted as "B" and "C", etc.; and
 - (iii) the Development site shall be outlined with a bold line. City infrastructure, including all works within a Statutory Right of Way, must be identified separately from private infrastructure. Clarity of ownership is important.
- (c) Rainwater Management Plan (SWMP) at 1:1000 scale noting:
 - (i) the full catchment area to the nearest adequate downstream connection point for the site to be developed;
 - (ii) the post-Development contour lines at maximum 1 metres intervals. These contour lines should match to the pre-Development contour lines at the Development boundary or as designed by the Consulting Engineer. Existing topographic information shall extend a minimum 30 metres outside the Development boundary;

SCHEDULE "F" (Cont'd)

- (iii) a directional arrow on each Parcel indicating the prevailing post-Development slope of the land;
 - (iv) the proposed minor (10-year return) Drainage System complete with inlet and outlet structures, catch basins and connection(s) to existing, adequate Drainage Systems;
 - (v) the proposed major (100-year return) post-Development flood route(s) and Drainage System, complete with connections to existing, adequate Drainage Systems;
 - (vi) the storm detention facility location, size, volume, area of catchment, release rate and head on orifice;
 - (vii) a legend noting all items shown on the SWMP;
 - (viii) a design table, per ES-D-5 noting information for each segment of proposed main including the catchment area (in hectares), run-off coefficients, time of concentration, rainfall intensity, major and minor flow volume, pipe size, slope and capacity both existing and proposed; and
 - (ix) water courses, creeks, streams, ponds, lakes wetlands including setback boundaries as per guidelines set by Ministry of Environment or Department of Fisheries and Oceans.
- (d) Road Works and Water Mains – may be on the same plan and profile drawings and shall be at a scale of 1:500 horizontal and 1:50 vertical noting:
- (i) existing and proposed elevations and locations of:
 - A. the centre line of proposed and existing Roadways;
 - B. proposed and existing curbs and gutters and Sidewalks;
 - C. all curves at appropriate arc locations; and
 - D. all existing and proposed catch basins including lid elevations;
 - (ii) BC, EC, arc length and "k" value design details of all vertical and horizontal curves;
 - (iii) all water mains and appurtenances including valves, hydrants, bends, tees, tie-in locations, test points, blow offs, air valves etc.;
 - (iv) the full pipe shall be shown on the profile;
 - (v) all water main crossover points with sewers and other utilities, including clearance and protection details;

SCHEDULE "F" (Cont'd)

- (vi) the size, class, type, length and slope of each continuous water main pipe section; and
 - (vii) joint restraint and thrust block design tables.
- (e) Storm and Sanitary Sewers – may be on the same plan/profile drawings and shall be at a scale of 1:500 horizontal and 1:50 vertical noting:
- (i) all sewer mains and appurtenances including cleanouts, inspection chambers, manholes, catch basins, etc.;
 - (ii) symbols on profile denoting the service connection location and elevations at the property line;
 - (iii) the major Drainage System hydraulic grade lines (HGL) on the profile;
 - (iv) the full pipe shall be shown on the profile;
 - (v) rim elevations of all manholes catch basins and cleanouts;
 - (vi) the size, class, type, length and slope of each continuous pipe section;
 - (vii) chainages and invert of each appurtenance shall be shown on profile;
 - (viii) all crossover points with other sewers, water mains and utilities including clearance and protection details;
 - (ix) storm detention system, information calculations and construction details, if not provided on the SWMP;
 - (x) water courses, creeks, streams, ponds, lakes wetlands including setback boundaries as per guidelines set by Ministry of Environment or Department of Fisheries or Oceans; and
 - (xi) at least one property line shall be located by chainage relating to the mains on each sheet.
- (f) Road Cross-Sections - the scale shall be at 1:100 horizontal and 1:50 vertical. Plans shall include:
- (i) cross-sections every 20 metres and shall show proposed construction over existing conditions to 10 metres beyond property line of the Statutory Right of Way for Highway purposes; and
 - (ii) additional sections may be required or requested where large cuts or fills are involved.

SCHEDULE "F" (Cont'd)

- (g) Ornamental Street Lighting Plan - shall be to a scale of 1:500 or 1:250, noting:
 - (i) sign and seal of a professional electrical engineer;
 - (ii) general notes;
 - (iii) mounting height and type of lamp standard including finishing (i.e.: galvanized, galvanized/powder-coated);
 - (iv) make, model, wattage and type of luminaire;
 - (v) photometric calculations in table form;
 - (vi) location of proposed service base and hydro service box;
 - (vii) off-set and chainages of each lamp standard; and
 - (viii) pole elevations. Title and scale information (e.g. ELEVATIONS 1:75) shall be added under each set of elevations.

- (h) Lot Grading Plan
 - (i) The City follows recommendations and guidelines set out in Schedule "K" of this Bylaw. This section outlines limitations and procedures to be followed in setting grades and construction practices to be followed by the Developer, Consulting Engineer, Contractor and Owner; and
 - (ii) plans shall be at a scale of 1:500 or 1:250 noting:
 - A. pre-Development ground contours in dashed lines;
 - B. post-Development ground contours (1 metres intervals) in solid lines;
 - C. elevations at the corners of each proposed Parcel;
 - D. elevations at the proposed rear building line of each proposed Parcel;
 - E. drainage swales. Typically swales are required on the uphill side of all downhill properties;
 - F. CB's and lawn basins complete with rim elevations;

SCHEDULE "F" (Cont'd)

- G. proposed retaining walls including height, length, face surface area, top of wall (TOW), bottom of wall (BOW), elevations, drainage, type of construction, geotechnical details with reports and certifications by qualified geotechnical consultants. Note: the Developer shall construct all retaining walls that are integral to lot grading designs;
- H. all areas of cut and fill in excess of 1.5 metres deep shall be identified and located clearly and accurately; and
- I. all drainage courses, creeks, streams, ponds and wetland areas with setback boundaries identified and located by legal survey and protected by physical structures such as fences walls or permanent barriers.

(i) Construction Details

All construction details that are not covered or specifically detailed in the Construction Specifications and Standard Detail Drawings shall be provided on the drawings pertinent to the utility. Where there is a City standard or detailed drawing, a reference to the standard is acceptable.

(j) Tree Survey Plan

The City's Tree Protection Bylaw, 2010, Bylaw No. 1831-2009, Development Permit or Preliminary Layout Approval Letter will specify requirements for identification and protection of trees.

(k) Pavement Marking and Street and Traffic Advisory Plan – shall be at a scale of 1:500, or 1:250, or 1:1000 noting:

- (i) pavement markings including, arrows, edge of pavement lines, median and traffic movement islands, centre line and Lane markings; and
- (ii) street and traffic signs including, directional arrows, advance warning signs and checkerboards, street name signs and traffic advisory signs.

(l) Landscaping Plan – shall be at a scale of 1:500 or 1:250 noting:

- (i) location, offset, spacing, type etc. of all street trees;
- (ii) locations of service connections and driveway(s) to each Parcel;
- (iii) location of all street furniture such as hydrants, street lights, signs, post boxes and any other appurtenances affecting the placement and integrity of the proposed street trees;
- (iv) an itemized list of the species to be planted; and

SCHEDULE "F" (Cont'd)

- (v) seal and signature of a Consulting Landscape Architect.
- (m) For any other Development, including a Building Permit for an Industrial, Commercial, Multi-family or Institutional Development, the following engineering design drawings shall be provided prior to issuance of a Building Permit:
 - (i) cover sheet per Subsection (a);
 - (ii) site servicing plan per Subsection (b), Key Plan;
 - (iii) Rainwater Management Plan per Subsection (c);
 - (iv) offsite/frontage Road Works and Water Mains per Subsection (d);
 - (v) offsite/frontage Storm and Sanitary Sewers per Subsection (e);
 - (vi) offsite/frontage Ornamental Street Lighting Plan per Subsection (g);
 - (vii) lot grading plan per Subsection (h); and
 - (viii) erosion control plans.
- (n) Other Information

The following additional information shall be noted on pertinent drawings:

- (i) all existing underground utilities complete with size, type of material, inverts, off-sets and notes detailing connection and tie-ins, by whom, how and at whose expense;
- (ii) all existing structures, including houses, sheds, fences, poles, pole anchors, overhead or underground encroachments, wells, septic tanks and septic fields, with notations indicating their fate (i.e., to be demolished, removed, filled, etc.);
- (iii) the Consulting Engineer or Consulting Landscape Architect shall consult with outside utility agencies where applicable to ensure that the design, construction and installation of the franchise utility infrastructure are possible without interference with proposed Works and Services. All revisions to either Works and Services or franchise utility designs shall be coordinated by the Consulting Engineer. Any further dedications, Statutory Right of Way, easements etc. that are required to provide appropriate franchise utility designs are the responsibility of the Developer; and

SCHEDULE "F" (Cont'd)

- (iv) the Consulting Landscape Architect shall confirm location of all existing utilities and the adequacy of existing and proposed Statutory Right of Way, prior to final submission of landscape design drawings.

6. DESIGN SUBMISSION SEQUENCE

- (a) The Consulting Engineer shall arrange a pre-design meeting with the City at which preliminary information and concept plans will be reviewed for initial comment.
- (b) Save and except for the electrical drawings for street lighting and traffic signals, the first drawing submission of the Consulting Engineer(s) shall be in the form of an unrestricted PDF electronic file consisting of the proposed Works and Services including the Pavement Marking and Traffic Advisory plans. Drawings for street lighting and traffic signals shall be submitted in print form that are signed and sealed by the Electrical Engineer.
- (c) Design drawings shall be accompanied by:
 - (i) all applicable calculations for the design of the proposed water mains, storm sewers including detention/retention facilities and sanitary sewers;
 - (ii) two bound copies of a detailed geotechnical report in print form;
 - (iii) three paper sets of franchise utility final design drawings previously reviewed by the Consulting Engineer; and
 - (iv) a PDF electronic file of the Landscaping plans.
- (d) Subsequent design submissions shall consist of:
 - (i) a complete construction Class A cost estimate in the form as stated in Section 1 (6) (d) (i) (A) (this may accompany first submission) sealed by the Consulting Engineer;
 - (ii) an unrestricted PDF electronic file of the Works and Services plus signed and sealed prints of the electrical drawings for street lighting and traffic signal;
 - (iii) all previous submission "red lined" marked sets with all changes highlighted in yellow (any "red lined" marks not revised shall be accompanied by a memorandum outlining the reasons why the change was not made);
 - (iv) any revisions or changes by the Consulting Engineer not part of the earlier submissions shall be identified and described in a memorandum explaining the changes; and
 - (v) all items "red lined" by the City shall be addressed by the Consulting

SCHEDULE "F" (Cont'd)

Engineer. Failure to do so will result in submissions being returned without review.

- (e) The final submission shall consist of:
 - (i) a new cost estimate marked "FINAL SUBMISSION ESTIMATE";
 - (ii) nine (9) complete sets of paper plans of the proposed Works and Services, signed and sealed by the Consulting Engineer, Electrical Engineer and Consulting Landscape Architect as required;
 - (iii) signed "Waterworks Construction Permit" from Fraser Health Authority;
 - (iv) one (1) paper print set of Street Lighting plans for distribution to the City Maintenance Planner;
 - (v) one (1) paper print set of Storm Water Management Plans for distribution to City Manager of Transportation and Drainage;
 - (vi) two (2) paper print sets of Landscaping plans for distribution to Parks, Recreation and Culture Department and City Parks Planner;
 - (vii) one (1) paper print set of Pavement Marking and Street & Traffic Advisory plans for distribution to the Traffic Planner; and
 - (viii) one (1) set of drawing files in DWG or DXF format on Compact Disk (CD).

7. AS-BUILT DRAWING INFORMATION

- (a) The Engineering and Regional Utilities department will provide, upon request, a sufficient number of blank Service Record Cards for the Development. Service Record Cards are considered part of the "as-built drawing" submission, and shall be submitted with the first as-built drawing submission.
- (b) The as-built drawings shall show the Works and Services as they have been constructed in order to provide accurate and detailed information when adding to or maintaining the Works and Services shown on the plans.

The drawings shall be the original AutoCAD design drawings, amended to reflect the actual constructed roadway, underground infrastructure and all other constructed works. "As-built" drawings must contain as much original design as possible and reflect all of the work performed including removed and abandoned infrastructure. The Construction Revisions block, must describe in adequate detail what was removed or changed.

- (c) The following procedure shall be followed in the submission of as-built drawings:

SCHEDULE "F" (Cont'd)

- (i) the Consulting Engineer shall submit an unrestricted PDF electronic file of the Works and Services, showing all works as constructed (except for the road cross-section sheet(s)), one (1) set of photocopied Service Record Cards and one (1) set of photocopied Hydrant Record Cards for review;
- (ii) the as-built submission will be returned to the Consulting Engineer for revisions, if necessary. The Consulting Engineer shall re-submit the PDF electronic file for review and acceptance;
- (iii) as-built drawings shall be presented as follows:
 - A. the key plan showing the as-constructed offsets and locations of all Works and Services including service connections;
 - B. the road works, water main, sanitary sewer and storm sewer plans showing elevations, inverts and off-sets as constructed. Profiles of the utilities shall state pipe materials, bedding and backfill used with chainages referenced to at least one legal posted Parcel line on each sheet;
 - C. the Rainwater Management Plans as constructed;
 - D. the lot grading plans showing as-constructed ground elevations at all Parcel corners, rear building envelop line, back of curb or Sidewalk, and any changes in grade across the Parcel. The MBE, GPE, lawn basins, manholes and swales and any other feature that may affect the construction of a building on the Parcel shall be identified. Uniform grades between Parcel corners will be assumed to a tolerance of ± 150 mm;
 - E. the Street Light plans showing make, model, type of luminaire unit, illumination levels achieved with the as-built light spacing, locations of service bases, photocells and hydro service entrances as constructed;
 - F. any plans and details for PRV stations, pump stations etc., complete with any operating manuals, Letters of Assurance, Schedules B1, B2, and C-B for structural, electrical and geotechnical aspects of the construction etc.;
 - G. a final geotechnical report addressing all recommendations and details of the preliminary report, confirming construction techniques, applications and details including placement and compaction of fill materials in excess of 1.5 metres, stability of cut and fill slopes and embankments equal to or steeper than 2V:1H; and

SCHEDULE "F" (Cont'd)

- H. a geotechnical report including Letters of Assurance, Schedules B1, B2, and C-B for structural confirmation of all retaining walls in excess of 1.2 metres in height; and
- (iv) when the City is satisfied with the as-built drawing submission, the Consulting Engineer shall submit the following:
- A. one (1) set of drawings on 24 lb coated bond paper identified in bold letters with the words "AS-BUILT" in the revision block complete with date;
 - B. a letter with the following certification noted:
 - i. "I certify that these as-built drawings represent the Works and Services that have been supplied, constructed and installed in substantial conformance with the intent of the designs as accepted by the Engineer dated _____."; and
 - ii. the seal and signature on the letter shall be that of the Consulting Engineer who was personally responsible for the design and inspections. The City will return one (1) set to the Consulting Engineer upon acceptance noting acceptance of as-built drawings;
 - C. one (1) complete set of Service Record Cards for each Parcel submitted on yellow card stock material;
 - D. Hydrant Record Cards, submitted in triplicate;
 - E. one (1) set of drawing files in DWG or DXF format and multi-page PDF file on Compact Disk (CD);
 - F. all plan(s), Service Record Card(s) and record drawing(s) on 24 lb coated bond paper will take precedence over digital information; and
 - G. upon acceptance by the City, the Engineer may authorize a Security Deposit reduction to reflect the acceptance of the as-built drawings and the Service Record Cards.

SCHEDULE "F" (Cont'd)

SECTION NO. 3 – WATER DISTRIBUTION – DOMESTIC AND FIRE FIGHTING

1. GENERAL

- (a) The design of water systems in the City shall conform to the requirements of the Provincial *Drinking Water Protection Act* and the *Health Act* and regulations and these Engineering Standards and Specifications.
- (b) Refer to Schedule "I" for procedures regarding de-chlorination and de-chloramination.

2. PRE-DESIGN REQUIREMENTS

- (a) The adequacy of the existing available water supply shall be confirmed with the Engineer prior to design or any extension or connection to existing City Water Distribution Systems. Where Developments are to be served by Clearbrook Waterworks District, the Developer shall satisfy themselves that Clearbrook Waterworks District can adequately provide flow volumes and service pressures for the design domestic and fire fighting requirements of their Development.
- (b) The proposed Water Distribution System shall be designed to provide domestic requirements and fire protection, as specified herein.
- (c) The required flow shall be the sum of the maximum daily demand plus the required fire flow.
- (d) Water mains shall be looped at the direction of the Engineer.

3. DEMAND

Average annual daily demand	570 litres/capita/day
Maximum daily demand	1,364 litres/capita/day
Peak hour demand	2,200 litres/capita/day

- (a) Populations used in calculating water demand shall be computed in accordance with the City's population predictions or with the planned Development in the area to be served, whichever is greater.
- (b) The Consulting Engineer shall confirm projections with the Engineer prior to completing designs.

4. FIRE FLOW REQUIREMENTS

- (a) Fire flow requirements for Residential, Commercial, Industrial and Institutional Developments in the City shall follow published criteria by the Fire Underwriters' Survey (FUS) entitled, "Water Supply for Public Fire Protection - A Guide for Recommended Practice" (latest edition).

SCHEDULE "F" (Cont'd)

- (b) Accessory processing use buildings in Agricultural zones greater than 200 metres square in building area shall have fire flows as per NFPA 1142.
- (c) Minimum acceptable fire flows for specified zones are:

<u>Land Use</u>	<u>Fire Flow</u>
≤ 16 units/ha	4,500 l/min (990 Igpm)
>16 units/ha & ≤ 45 units/ha	7,200 l/min (1590 Igpm)
Industrial, Institutional, Commercial and Residential > 45 units/ha	
-wood frame	10,000 l/min (2200 Igpm)
-non-combustible	7,000 l/min (1540 Igpm)

- (d) If available fire flows are less than the minimum requirements as stated herein, or velocity exceeds 3.0 m/s, the Developer shall improve, upgrade or extend the existing Water Distribution System. Where necessary, the City may require the proposed extended Water Distribution System to be upsized. The Engineer may authorize payment for the cost of upsizing beyond sizes required by these standards and specifications.
- (e) At the discretion of the Engineer, interim fire flows, at a minimum of 75% of the required minimum rate, may be accepted if Works and Services scheduled in any of the first five years of the City's current Ten-Year Capital Works Program will provide the required coverage.

5. WATER PRESSURE

Minimum Peak Demand Pressure at 5 metres above MBE	300 KPa
Maximum Allowable Pressure	830 KPa
Minimum Fire Hydrant Pressure (residual)	150 KPa

6. HYDRAULIC NETWORK CONSIDERATIONS

- (a) The Consulting Engineer shall provide, at the discretion of the Engineer, a hydraulic analysis of the proposed water system showing minimum flows and pressures. It is the policy of the City that all water mains shall be looped at every opportunity.
- (b) Where there is an existing hydraulic network in place, the City may provide information for design calculations at a cost to the Developer.

SCHEDULE "F" (Cont'd)

- (c) Design computations shall be based on Hazen-William's 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: for mains less than or equal to 150 mm diameter use 150, for mains greater than or equal to 200 mm diameter use 100

- (d) The minimum pipe grade shall be 0.1%. Where the maximum grade is greater than 10%, the main shall be constructed with joint restraints plus anchoring designed by a geotechnical Engineer.
- (e) Design velocities within new water mains shall not exceed 3.0 m/sec.

7. WATER MAINS AND APPURTENANCES

- (a) Water Main Pipe Sizes

Water main pipe sizes shall be the greater of the sizes shown in the table below or the size required to meet velocity or fire flow constraints as determined by the Engineer.

<u>Land Use</u>	<u>Water Main Size (Minimum)</u>
≤ 45 units per ha.	200 mm diameter *
> 45 units per ha.	250 mm diameter
Congregate Apt. and Institutional	250 mm diameter
Commercial	250 mm diameter
Industrial	250 mm diameter

*In all Single Family Residential (RS) Zones, water mains may be reduced to 150 mm diameter provided that:

- (i) they are at the terminus of a system that cannot be extended in the future;
- (ii) minimum fire flow and water pressure requirements are met; and
- (iii) the water main services ≤ 18 single-family homes.
- (b) All water mains greater than 400 mm diameter are to be ductile iron or welded steel – regardless of location. All water mains and service connections 100 mm diameter and greater, including hydrant laterals, crossing an arterial or collector standard road are to be ductile iron or welded steel.
- (c) Testing of the soil and surrounding environment shall be conducted for all new or

SCHEDULE "F" (Cont'd)

replacement mains. The results are to be used to predict the deterioration rate of the main and appurtenances shall be of a suitable material and thickness, or supplemented by a corrosion mitigation technique, to ensure at least 50 years of service prior to a leak or failure. Soil analysis shall be conducted by a corrosion engineering firm or personnel in accordance with a standardized evaluation procedure such as ANSI/AWWA Standard C105, appendix A (10 point system) or 25 point system developed by William Spickelmire. Evaluation of the surrounding environment shall include sources of stray current, fluctuating water table, leak records (if available) and soil condition changes along the alignment. A copy of the corrosion analysis report and recommendations shall be provided to the City.

- (d) Water mains designated to provide "lifeline water" in the case of disaster shall be designed as directed by the Engineer.
- (e) Designs showing water mains or service connections being installed under a retaining wall are to be avoided. When extraordinary circumstances exist, the Engineer may give consideration to designs that incorporate steel carrier pipes which allow the main or service connection to be removed and replaced without impacting the long term stability of the retaining walls.
- (f) Valves
 - (i) Valves shall be located as follows:
 - A. at intersections;
 - B. in a cluster at the pipe intersections;
 - C. at hydrant tees (an additional valve is required if the hydrant lead exceeds 15 metres);
 - D. every 200 metres in Residential areas servicing densities ≤ 45 units/ha;
 - E. every 150 metres in Residential areas servicing densities >45 units/ha, and Industrial, Commercial and Institutional areas; and
 - F. every 300 metres in rural areas.
 - (ii) The minimum number of valves at intersections shall be:
 - A. three (3) where mains "Cross"; and
 - B. two (2) where mains "Tee".
 - (iii) Valves shall be the same diameter as the main up to 300 mm diameter. For mains larger than 300 mm in diameter, at the discretion of the

SCHEDULE "F" (Cont'd)

Engineer, valves may be no more than one (1) diameter size smaller.

- (iv) All direct bury mainline valves shall be resilient seat gate valves. Butterfly valves shall not be used unless approved by the Engineer. Gate valves ≥ 400 mm diameter shall be provided with a bypass.
- (v) Valves shall be set on pre-cast concrete blocks.
- (g) Pressure Reducing Valves/Stations

Pressure reducing valves are required where water systems cross pressure zones. Refer to latest standards and specifications for design and installation of PRV stations from the Engineer.
- (h) Air and Vacuum Release Valves
 - (i) Approved air and vacuum release valves shall be installed at all summit points including temporary dead ends and other locations as determined by the Consulting Engineer.
 - (ii) The Consulting Engineer shall size air and vacuum release valves based on manufactures specifications.
- (i) Valve and Meter Chambers
 - (i) Chambers or manholes containing valves, blow-offs, meters or other appurtenances shall be connected directly to the Drainage System complete with appropriate back flow protection. Chambers or manholes may be drained to the surface or to absorption pits, subject to adequate soil conditions and the approval of the Engineer. Mechanical or automated systems for de-chloramination of expelled or leaking water shall be incorporated at the discretion of the Engineer.
 - (ii) Meter chambers shall be located within the road right of way outside the traveled portion of the roads (including driveways) or in a right of way on private property. Whenever possible, the chambers shall be located in landscaped areas not subject to vehicular traffic. Chambers in landscaped areas within 1.5 metres of a driveway shall be considered to be subject to vehicular traffic unless they are protected by bollards or barrier curb.

Chambers installed in landscaped areas not subject to vehicular traffic may have a lightweight fiberglass lid with an aluminum hatch. Where it is necessary to install a chamber in a landscaped area subject to vehicular traffic or parking lot, the chamber lid shall be designed to withstand a "dynamic" H₂O loading. This dynamic loading includes a 30% impact allowance to the H₂O wheel load identified in the American Association of State Highway and Transportation Officials (AASHTO) standard

SCHEDULE "F" (Cont'd)

specification for Highway bridges. For these applications the hatch must be made of steel with lift assists incorporated into the hatch. Maximum force required to open the lid shall not exceed 16 kilograms (35 pounds). Manhole frame and covers shall not be used for chamber lids in any circumstances.

- (iii) Locking mechanisms for the meter chamber lid shall be recessed and of a design approved by the Engineer.
- (j) Blow-offs

Blow-offs shall be provided on all dead-end mains. For mains > 200 mm diameter, the blow-off shall be 100 mm diameter. For mains ≤ 200 mm diameter, the blow-off shall be 50 mm diameter.
- (k) Mechanical Joint Restraints and Thrust Blocks
 - (i) Mechanical joint restraints shall be provided at all fittings requiring thrust restraint. The Consulting Engineer shall show calculations and the number of joint restraints required to resist the thrust at the fittings.
 - (ii) Where approved by the Engineer, the Consulting Engineer's design may utilize concrete thrust blocks, the design shall give due regard to soil bearing pressures, pipeline pressure transients and expected test pressures. Thrust block design calculations and soil bearing pressures must be shown on the design drawings.
 - (iii) Mechanical joint restraints shall be used on water mains designated by the Engineer as "lifeline service mains in case of disaster". The decision as to which mains are to be so designated is at the discretion of the Engineer.

8. HYDRANTS

- (a) The lateral connection type, colour and location of all fire hydrants or other Fire Department connections shall be subject to the approval of the Fire Chief.
- (b) Fire hydrants shall be:
 - (i) located within a Statutory Right of Way for Highway purposes in urban areas at a maximum spacing of 150 metres. and, where possible, within 75 metres of all possible building Parcels;
 - (ii) if within a private Parcel:
 - A. located within a Statutory Right of Way;
 - B. located so that there is a clear radius of a minimum 1.5 metres

SCHEDULE "F" (Cont'd)

around the hydrant at all times measured from center of hydrant;
and

- C. shall comply with the Fire Prevention Bylaw and the Building Bylaw;
- (iii) located in accordance with the appropriate Standard Drawing or as designated by the Engineer;
- (iv) at the EC/BC of curb returns in Highway intersections where possible;
- (v) at least 1.5 metres away from an ornamental lamp standard, utility pole, street tree or driveway;
- (vi) opposite a property line between two Parcels or at the beginning of the radius of truncation for a corner Parcel; and
- (vii) in rural areas: within a Statutory Right of Way for Highway purposes at a maximum spacing of 300 metres, unless otherwise directed by the Engineer.

9. SERVICE CONNECTIONS AND WATER METERS

- (a) The standard single family Residential connection in the City is 19 mm and shall be located at the property line in the centre of the Parcel wherever possible per Standard Drawing ES-G-1. For non-standard single-family, Multi-family and non-Residential applications the Consulting Engineer shall calculate the size of service required and submit a request for the service connection complete with demand calculations. The City Engineer shall review the application to confirm the service size requirement and determine if it can be accommodated by the City's infrastructure.
- (b) All service connections in the City shall be metered at the property line and service connections less than or equal to 50 mm shall include a dual check valve and meter setter.
- (c) For all Multi-family apartment style service connections that are being installed to support a building fire line or sprinkler system and domestic water an Electronic Magnetic ("MAG") water meter shall be required. Domestic service can be provided off the fire line service, which may be connected at any point after the meter.

SCHEDULE "F" (Cont'd)

- (i) Hydrants shall not be connected to metered combined fire and domestic services. A separate main located in a Statutory Right of Way shall be provided for the hydrant(s). The domestic service shall be metered at the property line with a positive displacement meter for sizes up to 50 mm (2") or a "MAG" meter for sizes greater than 50 mm.
- (ii) On site water lines which serve only fire hydrants shall not be metered.
- (d) For Industrial, Commercial and Institutional (ICI) applications domestic and fire services shall be separate.
 - (i) The fire service shall incorporate a double check back flow preventor which includes a flow detector feature ("tattle tale" meter). The preferred location for the backflow preventor shall be at the entry point into the building, preferably in a designated mechanical room. Alternate locations and configurations must be submitted to the Engineer for approval prior to execution of the Servicing Agreement or issuance of Building Permits.
 - (ii) Domestic service connections up to 50 mm (2") shall have a positive displacement meter located in a meter box at property line as per CS-W-1 or CS-W-21. Domestic service connections greater than 50 mm shall have a "MAG" type meter installed in a vault as per CS-W-2.
 - (iii) The Consulting Engineer shall calculate the domestic and fire sprinkler demands for the proposed Development. These calculations, along with a request for the service connection shall be presented to the Engineer for review. The Engineer will determine if the distribution system has the capacity to provide the additional demand.
 - (iv) The meter size will be based on meter manufacturers ratings and flow velocity constraints. Final approval for size of meter and service must be approved by the Engineer.
 - (v) Use of the fire service is to be for fire sprinkler systems only. Any other use is prohibited and subject to fines and penalties contained in the Waterworks Rates and Regulations Bylaw.
- (e) All meters are supplied by the City at the Developer's cost.
- (f) The City shall install meters up to and including 50 mm diameter. All other meters shall be installed by the Developer under direct supervision of the City's Engineering and Regional Utilities department.
- (g) Single family Residential meters shall typically be installed as per standard detail drawings. Meters on connections servicing onsite fire lines or sprinklers as well as domestic services shall be located:
 - (i) within a Highway or on a registered Statutory Right of Way; or

SCHEDULE "F" (Cont'd)

- (ii) at the discretion of the Engineer, onsite in areas that are close to the outside of a building, in hard surfaced or landscaped areas which are not subject to parking or overgrowth.
- (h) Water meter boxes shall be set flush with the proposed finished elevation of the Boulevard or hard surface area.
- (i) Service connections shall be located so they are not in driveways or under traveled areas where ever possible. Should this be unavoidable, meter chambers shall be capable of supporting dynamic H-20 loading. Manhole frames and covers are not acceptable.
- (j) Bareland and townhouse strata units (excluding apartment style condominiums) shall be individually serviced and metered. The meter shall be located outdoors in a meter box in such a way as to protect the service from freezing or damage from vehicular traffic. Meter boxes shall be easily accessible to accommodate meter maintenance and an access covenant must be registered on the property. Apartment style stratas shall be supplied by a single combination domestic and fire line meter.

10. WATER DISTRIBUTION SYSTEM LOCATION/CORRIDORS

- (a) All proposed Water Distribution Systems within a Statutory Right of Way for Highway purposes shall be located as shown on the typical cross-sections or as designated by the Engineer. Where a Water Distribution System crosses private property it shall be protected by a Statutory Right of Way. The width of the Statutory Right of Way shall be dependent on the depth of the main as follows:

<u>Depth of Main</u>	<u>Width of SROW</u>
≤ 2 m	3 m
> 2 m & ≤ 4 m	4 m
> 4 m	6 m

- (b) When a Water Distribution System is within a Statutory Right of Way on private property, a restrictive covenant may also be required at the discretion of the Engineer to restrict the depth and location of any proposed footings, buildings, overhangs etc. in the vicinity of the water main.
- (c) When a Water Distribution System is located within a Statutory Right of Way, the Developer will be required to provide access for maintenance vehicles. The maintenance access shall be constructed to withstand H20 loading.
- (d) A new Water Distribution System by a Developer shall not be connected to a City System until:

SCHEDULE "F" (Cont'd)

- (i) pressure testing and bacteriological testing have been completed, passed and accepted by the Engineer; and
- (ii) if on private property, a Statutory Right of Way and document has been registered in the Land Title Office.

11. COVER

- (a) Minimum cover over the crown of ductile iron (D.I.) water mains shall be 1 meter and minimum 600 mm over appurtenances. For all other types of mains, the minimum cover shall be 1.2 metres.
- (b) At high points in the water system, adequate cover must be maintained to facilitate installation of an air release valve complete with chamber as per City drawings CS-W-7 and CS-W-17.

12. SEPARATION FROM OTHER UTILITIES

- (a) Water Distribution Systems constructed in proximity to other utilities shall conform to the criteria of the Provincial *Drinking Water Protection Act* and Regulations.
- (b) When crossing Asbestos Cement (AC) pipe, a minimum 3 metres length of the AC pipe (1.5 metres each side of the crossing point) shall be removed and an equal length of ductile iron (DI) or PVC pipe shall be inserted. Such work must be carried out by or under the direct supervision of City forces.
- (c) Horizontal Separation

At least three (3) metres horizontal separation shall be maintained between a water main and either a sanitary or storm sewer.

In special circumstances, specifically in rock or where the soils are demonstrated by a geotechnical engineer to the satisfaction of the Engineer to be impermeable, lesser separation than 3 metres may be permitted provided that:

- (i) the sewer main and water main are installed in separate trenches and the water main invert is at least 0.5 metres above the crown of the sanitary sewer or storm sewer and the joints are wrapped with heat shrink plastic or packed with compound and wrapped with petrolatum tape in accordance with the latest version of AWWA Standards C217, C214 or C209; or

SCHEDULE "F" (Cont'd)

- (ii) the pipes are installed in the same trench with the water main located at one side on a bench of undisturbed soil at least 0.5 metres above the crown of the sanitary or the storm sewer and the joints of the water main are wrapped with heat shrink plastic or packed with compound and wrapped with petrolatum tape in accordance with the latest version of AWWA Standards C217, C214 or C209.

(d) Vertical Separation

Where a sanitary sewer or storm sewer crosses a water main, the sewer should be below the water main with a minimum clearance of 0.5 metres and the joints of the water main, over a length extending 3 metres either side of the sewer main are to be wrapped with heat shrink plastic or packed with compound and wrapped with petrolatum tape in accordance with the latest version of AWWA Standards C217, C214 or C209.

Where it is not possible to obtain the vertical separation above, and subject to the satisfaction of the Engineer, the following details may be used:

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

13. PRIVATE WATER SYSTEMS

- (a) Where no City water system exists, the Developer shall provide potable water from a proven ground water source as per the Provincial *Drinking Water Protection Act* and Regulations and these Engineering Standards. Private water systems will only be considered for fee simple and bare land strata single family lots.
- (b) The water quality shall meet or exceed the latest edition of "Guidelines for Canadian Drinking Water Quality", as published by *Health Canada*. A certified laboratory that is under the direction of the Standards Council of Canada or the Canadian Association of Environmental and Analytical Laboratories shall complete testing and supply all testing results to the Engineer and Consulting Engineer.
- (c) For each single-family dwelling created or proposed there must be a dedicated well capable of providing 2500 litres per day and a peak flow of 9 litres per minute for a 4 hour period.
- (d) Each lot or proposed lot must have its own self contained well. Community or shared wells will not be permitted. The Owner of each lot will be responsible for all operational, maintenance and replacement costs of the associated well.

SCHEDULE "F" (Cont'd)

- (e) All water well drilling, construction and well abandonment shall conform to "Guidelines for Minimum Standards in Water Construction" as published by the B.C. Ministry of Environment, Lands and Parks and the B.C. Water Well Drilling Association. The well driller must be certified as a water well driller in British Columbia.
- (f) A Consulting Engineer or certified hydrologist shall submit well test information and certification that the well meets or exceeds the above standards. See Form F6 for certification requirements.
- (g) If there are two wells or less in the proposed Development a certification by a Consulting Engineer based on a Water Well Contractor's Report or Well Testing Contractor's Report will be sufficient. Where well yield is considered marginal, +/- 10% by the Consulting Engineer or where more than two (2) wells are involved, a hydro-geological evaluation of the proposed water source is required.
- (h) Well Testing Procedure

Completed wells shall be tested by pumping continuously at a constant rate for a minimum period of four hours. The tested rate must be at or greater than the required 9 lpm. See appropriate forms and appendices for recording of information and data. While the test is running, the following measurements shall be made:

- (i) water levels in the well at specific time intervals;
- (ii) pumping rate must be constant;
- (iii) times that all readings were made;
- (iv) notes on colour, smell and taste of the water pumped; and
- (v) notes on weather conditions during and up to 48 hours prior to the time of testing.

SCHEDULE "F" (Cont'd)

SECTION NO. 4 – DRAINAGE SYSTEMS

1. GENERAL

- (a) The drainage design criteria standardize the procedures for designing rainwater collection, management and conveyance facilities in the City. All Drainage Systems shall be designed with consideration for water quality and quantity, public safety, regulatory requirements, maintenance, economic benefits and the natural environment.
- (b) The Drainage System criteria are focused on peak reduction strategies (i.e. storm water detention). Alternate strategies that incorporate volume reduction and improved water quality are encouraged, especially strategies that result in the elimination of underground tanks in single family Developments. Alternate strategies may require submission of continuous simulation modeling of the proposed system.
- (c) Drainage Systems shall consist of two (2) components: the Minor System and the Major System designed into a coordinated system using storm water management principles.
- (d) Designers shall consult with the Engineering and Regional Utilities department to determine what existing information may be of assistance to them.
- (e) Treatment of runoff to improve water quality is required for all non-covered paved parking, storage or workspace areas in Multi-family, Industrial, Commercial and Institutional Developments.
- (f) Erosion and sediment control is required for all Developments or Works and Services discharging runoff into Drainage Systems and natural watercourses.
- (g) A minimum 300 mm thick layer of absorbent soil – a growing medium that balances water storage capacity, saturated hydraulic conductivity and nutrient and organic components – is required for all lawn and soft-landscape areas for all Developments within the Urban Development Boundary.

2. RAINWATER MANAGEMENT PRINCIPLES

- (a) Rainwater Management includes the planning, analysis of storm runoff from rainfall events on a site, neighbourhood and watershed level. The design of the Drainage System shall incorporate techniques such as absorbent soils, rain gardens, bio-swales, storm detention, lot grading, subsurface disposal, erosion control and other acceptable methods to mitigate the runoff impacts due to Development.
- (b) A comprehensive Rainwater Management Plan is required for all Developments of greater than 0.5 ha in size except rural or Agricultural Developments unless otherwise directed by the Engineer.

SCHEDULE "F" (Cont'd)

- (c) The Rainwater Management Plan shall include all major elements of the Drainage System, including sub-catchment plans, storage and flow control facilities, lot grading (including pre and post-Development ground elevations), major flood path routing and all other appropriate information pertinent to the design.

3. MINOR SYSTEM

- (a) The Minor System shall be designed to prevent flooding and property damage and minimize public inconvenience caused by rainfall events with a return period of 1 in 10 years. The runoff from a 1 in 10 year rainfall event is referred to as the "Minor Flow".
- (b) The Minor System consists of underground conduits, culverts, open channels, water courses and storage facilities designed to carry or detain runoff of frequent storm events.
- (c) Storage facilities include detention/retention ponds, underground detention tanks, linear detention ditches, exfiltration trenches for roof water and other methods which reduce the rate of runoff into the downstream Drainage System.

4. MAJOR SYSTEM

- (a) The Major System shall be designed to protect the public and prevent significant property damage due to flooding caused by the rainfall events with a return period of up to 1 in 100 years.
- (b) The runoff from a 1 in 100 year rainfall event is referred to as the "Major Flow". The Major System shall have the capacity to carry post-Development flows not carried by the Minor System or detained in a flow control facility.
- (c) The Major System comprises surface flood paths, swales, channels, watercourses, Roadways, Walkways, pathways, flow control facilities or other City owned facilities at the discretion of the Engineer, designed to accommodate the Major Flow.
- (d) Overland flow paths on Roadways, in swales and watercourses shall be designed to ensure that the maximum hydraulic grade line is below the lowest existing or proposed MBE of adjacent buildings.
- (e) Surcharging at an inlet under major flow is acceptable provided that the headwater profile does not rise above the MBE of adjacent properties. The maximum elevation of standing water above existing finished ground surfaces, parking lots, street surfaces etc. caused by any surcharging shall not be greater than 300 mm. Adequate erosion protection shall be required where surcharging is evident.

SCHEDULE "F" (Cont'd)

- (f) Where surface flood paths cannot be established, pipes and culverts of the existing or proposed Minor System may be enlarged to accommodate the major flow or the major flow can be reduced by detaining it in a storage facility. Emergency overflow routes may be required by the Engineer.

5. DRAINAGE SYSTEMS

- (a) All proposed Drainage Systems shall drain to existing, adequate Drainage Systems.
- (b) The presence of existing Drainage Systems does not imply that there is adequate capacity to receive the minor or major flow from proposed Development, nor does it imply that the existing system is adequate.
- (c) As required by the Engineer, the Developer shall analyze all downstream piped Drainage Systems to determine if they are adequate for the projected increase in runoff created by any Development.
- (d) Existing Drainage Systems which are undersized or inadequate to accept additional drainage flow shall be upgraded to accommodate the proposed flows at the Developer's expense, or the detention system shall be enlarged to detain the major flow.
- (e) All Drainage Systems shall be located within a Statutory Right of Way for Highway purposes or registered Statutory Right of Way. When a proposed Drainage System is proposed to be connected to an existing, adequate Drainage System that is not protected as above, efforts by the Developer may be required to acquire necessary Statutory Right of Way at the discretion of the Engineer. The cost for securing this protection shall be borne by the Developer.

6. DESIGN METHODS

- (a) Hydrology
 - (i) Storm Drainage Systems shall be designed to accommodate post-Development flows using the Rational Method or a Runoff Hydrograph Method at the discretion of the Engineer. No reduction in pipe sizing for flow reductions due to the presence of upstream detention facilities is permitted unless otherwise authorized by the Engineer.

SCHEDULE "F" (Cont'd)

(ii) The Rational Method: $Q=R\text{AIN}$

Where:

- Q = Flow in (m³/s)
- R = Runoff Coefficient
- A = Drainage area in hectares (ha)
- I = Rainfall intensity in mm/hr
- N = 0.00278

Q: is the resulting flow from the catchment or sub-catchment area

R: For designs not incorporating alternate rainwater management strategies, the Runoff Coefficient for the Minor System shall be not less than:

- 0.6 for single family land use
- 0.7 for Multi-family land use
- 0.9 for Commercial land use
- 0.9 for Industrial land use
- 0.95 for Roadways and rooftops

A: The catchment areas shall be determined using the natural contours of the land. The Consulting Engineer shall confirm the extent of catchment areas with the Engineer. City data on existing contour mapping and aerial photographs may not be accurate enough for design purposes and the Consulting Engineer shall confirm true and accurate surface elevations and contours for his design.

I: Rainfall Intensity can be derived from drawing ES-D-1.

N: 0.00278 - a fixed constant

(b) Time of Concentration

(i) The time of concentration is the time required for water to flow from the most remote part of the catchment area or Development area to the drainage element under design computed by the following formula:

(Note: actual velocities in storm sewers shall be used to calculate T_c values.)

SCHEDULE "F" (Cont'd)

$$T_c = T_i + T_t$$

Where:

T_c = time of concentration (minutes)

T_i = inlet or overland flow time (minutes)

T_t = travel time in sewers, ditches, channels or watercourses (minutes)

- (ii) A composite value for T_c is calculated where the type of flow along the longest flow path varies or the slope changes.

- (iii) Overland Sheet Flow in Undeveloped Basins

The maximum sheet flow path length in any undeveloped basin shall be 300 metres. The overland sheet flow time shall not exceed 15 minutes.

- (iv) Inlet Time for Developed Areas

A. For low density Residential Development, assume an inlet time of 10 minutes;

B. For all other uses and undeveloped areas, inlet times shall be calculated as follows:

$$T_t = \frac{C_t L n}{12 s^{0.5}}$$

Where:

T_t = travel time (minutes)

C_t = flow travel coefficient (0.5)

L = length of flow path (m)

n = roughness coefficient:
0.050 natural channels

0.030 excavated ditches

0.013 concrete lined channels

0.013 concrete pipe

0.011 PVC pipe

S = slope in m/m

- (c) Presentations of Rational Method Calculations

The designer shall tabulate all Rational Method calculations for submission along with appropriate plans and other relevant information as directed by the Engineer.

SCHEDULE "F" (Cont'd)

(d) Runoff Hydrograph Method

- (i) For basins larger than 10 hectares, hydrologic programs may be used for runoff analyses. Standard runoff simulations shall be modeled using programs acceptable to the Engineer.
- (ii) The model used shall be based on the post-Development conditions using the most current planning information. Conservative parameters shall be selected if calibration data is not available. For assessment of existing systems, the drainage model may be based on the existing conditions if no future land use changes are anticipated. The total developed tributary area should not deviate from the total natural drainage area.
- (iii) It is incumbent upon the Consulting Engineer to obtain the appropriate rainfall data for the analysis and receive approval from the Engineer of the system and process to use.
- (iv) Presentation of Modeling Results

The Consulting Engineer shall submit a drainage report including the following:

- A. name and version of modeling program;
- B. calibration results;
- C. design storms and design parameters;
- D. schematic diagram of the model;
- E. drainage map showing the catchment and sub-catchment boundaries, slopes, land uses, soil conditions, etc.; and
- F. input and output printouts and computer files.

7. PIPE DESIGN

(a) Hydraulics

- (i) Hydraulics shall be calculated using Manning's Formula:

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

SCHEDULE "F" (Cont'd)

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 = coefficient of roughness
 0.013 for all smooth pipes
 0.020 for existing CMP pipes.

- (ii) Downsizing of storm sewers on steeper grades is not permitted for mains 600 mm diameter or less. Downsizing of a maximum of two nominal pipe sizes for mains larger than 600 mm diameter may be considered at the discretion of the Engineer.
- (iii) Velocity
 - A. Minimum = 0.6 m/sec flowing half full
 - B. Maximum = there is no maximum velocity. However if the design velocity exceeds three (3) m/s and super-critical flow occurs, provisions for structural stability of the main and durability of the pipe shall be addressed by the Consulting Engineer.
 - C. Despite the above, where the slope of the proposed main exceeds 15%, scouring protection and anchor blocking shall be incorporated. A geotechnical Engineer may be required to provide design details, monitor construction and provide construction reports at the discretion of the Engineer.
- (b) Strength – "Class"

All concrete pipes shall be reinforced. Where cover on any main exceeds 2.5 metres, the Consulting Engineer shall submit calculations proving the class of pipe specified is adequate for the expected loading.
- (c) Pipe Joints

All storm sewer systems shall be designed for closed joint construction unless otherwise approved by the Engineer.

8. STORM SEWER MAINS AND APPURTENANCES

- (a) Minimum Pipe Sizes
 - (i) Mains shall not be < 250 mm in diameter.

SCHEDULE "F" (Cont'd)

- (ii) Mains with Catch Basin (CB) connections shall not be < 300 mm in diameter.
 - (iii) Single CB leads shall not be <200 mm in diameter.
 - (iv) Double CB leads shall not be < 250 mm in diameter.
- (b) Depth
- (i) The depth at crown of proposed Drainage Systems should be enough to provide gravity service connections for all Parcels abutting the main. The elevation at the upstream terminus of any main shall be sufficient to service all upstream tributary lands beyond the Development and within the approved design catchment area.
 - (ii) All pipes shall have at least 1.2 metres cover. Where pipes in traveled areas must be designed with less than 1.5 metres cover, the designer shall include specific details of pipe material, backfill and bedding.
 - (iii) Designs showing storm sewer mains or service connections being installed under a retaining wall are to be avoided. When extraordinary circumstances exist, the Engineer may give consideration to designs that incorporate steel carrier pipes which allow the main or service connection to be removed and replaced without impacting the long term stability of the retaining wall.
- (c) Manholes
- (i) Manholes are required:
 - A. every 120 metres for pipes \leq to 900 mm in diameter;
 - B. every 200 metres for pipes > 900 mm in diameter;
 - C. at all changes in grade or alignment;
 - D. at the upstream terminus of all mains; and
 - E. at all intersecting sewers.
 - (ii) In manholes, the crown of the inlet pipe shall be at or above the crown of the outlet pipe.
 - (iii) Manholes shall include a minimum 600 mm sump where ditches discharge to storm sewers.
 - (iv) The drop through all manholes shall be 30 mm unless otherwise approved by the Engineer.

SCHEDULE "F" (Cont'd)

- (v) All manholes with sumps shall be accessible for maintenance.
- (vi) Manholes shall be minimum 1200 diameter.
- (d) Cleanouts
 - Cleanouts shall be minimum 200 mm diameter and may be provided on terminal sections of mains when:
 - (i) extension of the main is proposed in the future;
 - (ii) the distance to the nearest downstream manhole < 45.0 metres; or
 - (iii) the depth of the sewer at the terminal point < 2.0 metres.
- (e) Catch basins
 - (i) Locations:
 - A. at regular intervals along Roadways;
 - B. at intersections and curb returns wherever practical. Storm water should be drained into CB's on the upstream side of curb returns and wheel chair letdowns;
 - C. at any trapped low points where double side inlet CB's are required; and
 - D. at end of curb points unless a hard-surface flow path to a ditch is provided.
 - (ii) Design:
 - A. CB's shall collect up to a maximum of 800 m² of pavement runoff per CB where gutter grades are less than or equal to 3% and up to a maximum of 500 m² of pavement runoff where gutter grades exceed 3%; and
 - B. the Consulting Engineer shall specify the appropriate type of catch basin to be used in swales and shallow ditches to the satisfaction of the Engineer.
- (f) Service Connections
 - (i) See Standard Drawing ES-G-1 and ES-G-2 for typical location. An Inspection Chamber (IC) is required for all connections to City mains. ICs shall be installed at the property line or Statutory Right of Way line (see Standard Drawings No. ES-G-1, ES-G-2 and ES-G-3).

SCHEDULE "F" (Cont'd)

- (ii) Diameter:
 - A. minimum 150 mm for single family Residential; and
 - B. minimum 200 mm for all other applications.
 - (iii) Minimum slope from main to property line shall be 2%;
 - (iv) All Parcels abutting a proposed Drainage System shall be provided a service connection except where existing service from another Drainage System is adequate and acceptable to the Engineer.
 - (v) The Drainage System and all service connections shall be at a depth to permit gravity flow from existing or proposed building(s) to the main.
 - (vi) Connections for all single family Residential Parcels shall be provided at 150 mm above the major system hydraulic grade line or 150 mm above the center line of adjacent Roadways that are designed to convey major system flow at the discretion of the Engineer.
 - (vii) One service connection per Parcel is permitted unless otherwise permitted by the Engineer.
 - (viii) When infilling an existing ditch, all existing service connections from existing properties to the ditch or where any type of drainage is provided by the existing ditch, provision shall be made to maintain or replace the service.
- (g) Inlet/Outlet Structures
- (i) All storm mains ≥ 300 mm diameter, require properly designed reinforced concrete inlet and outlet structures per Standard Drawings. Storm mains < 300 mm diameter require headwall per Standard Drawings.
 - (ii) All mains discharging to open ditches, creeks or watercourses require riprap protection for a minimum of 3 metres downstream of the apron of the outlet structure or headwall. Additional riprap may be required at the discretion of the Engineer.
 - (iii) Where the velocity of flow in the main is ≥ 1 m/sec, an outlet structure is required, complete with energy dissipating baffles.
 - (iv) Structures exceeding 1 metre in height and 2 metres in width shall include a railing.

SCHEDULE "F" (Cont'd)

- (h) Culverts
 - (i) Minimum diameter = 300 mm.
 - (ii) The minimum diameter shall be greater than or equal to the depth of headwater at the inlet, unless otherwise approved the Engineer.
 - (iii) Culverts located in natural watercourses or all culverts crossing Roadways shall be designed to convey the flow resulting from a minimum 1:200 year rainfall event. The Consulting Engineer shall provide calculations and recommendations if the culvert will be operating under inlet or outlet control conditions.
 - (iv) Reinforced concrete culverts and corrugated High Density Polyethylene (HDPE) are preferred for general uses. Other materials may be considered at the discretion of the Engineer.
 - (v) The minimum depth of cover is 0.3 metres subject to adequate pipe loading design parameters.
 - (vi) Inlet and outlet structures are required on all culverts designed to convey the major flow. Energy dissipation and scouring protection or erosion control shall be included in the design of any culvert installation.
 - (vii) Driveway culverts may be considered to be part of the minor system at the discretion of the Engineer and shall have the capacity for the 1 in 10 year rainfall event.
- (i) Ditches
 - (i) Open ditches for drainage are not acceptable for permanent servicing of land within the Urban Development Boundary of the City unless otherwise approved by the Engineer. Ditches shall be used for drainage in rural areas.
 - (ii) Ditches adjacent to Roadways shall conform to the following:
 - A. maximum depth shall be 1.5 metres;
 - B. minimum bottom width shall be 0.5 metres;
 - C. maximum side slopes 1.5H:1V;
 - D. minimum grade shall be 0.5%; and

SCHEDULE "F" (Cont'd)

- E. flow velocities in excess of 0.6 m/s shall include design details to prevent scouring, erosion and under-cutting:
- i. where poor and erosive soil conditions exist or where erosion protection is impossible to be provided, ditch enclosure may be required at the discretion of the Engineer; and
 - ii. the minimum Statutory Right of Way width for an existing or proposed ditch crossing private property shall be 6 metres wider than the top width of the ditch. The ditch shall be offset in the Statutory Right of Way to permit access for maintenance vehicles. The top of a ditch adjacent to a property line shall be a minimum 0.5 metres away from that property line.

(j) French Drains

French drains shall be provided where the presence of ground water may affect the stability of the existing or proposed road structure. French drains are required where indicated by investigation and soils report(s) prepared by a qualified geotechnical Engineer and at the discretion of the Engineer.

(k) Swales

Swales may be used:

- (i) in conjunction with lot grading to provide rear, front and side yard drainage as required or directed by the Engineer;
- (ii) to convey overland Major Flows at the discretion of the Engineer; and
- (iii) on a rural Highway for road drainage at the discretion of the Engineer.

(l) Lot Grading Swales

- (i) Lot grading swales shall be:
 - A. minimum depth = 150 mm;
 - B. minimum width = 1.5 metres;
 - C. minimum slope = 1.0%;
 - D. maximum velocity = 1 m/s; and

SCHEDULE "F" (Cont'd)

- E. lined with turf on minimum 150 mm topsoil or clear crushed rock up to the high water mark, erosion blanket or approved alternative where velocities exceed 0.6 m/s at the discretion of the Engineer.
 - (i) Lot grading swales shall be used to protect adjacent downstream properties from overland sheet flow from uphill lands.
 - (ii) Where a lot grading swale conveys drainage across a property line at a point discharge location, a registered easement is required.
 - (iii) The maximum length of a lot grading swale from the upstream end to the Drainage System discharge point, shall be 45 metres or the width of 3 fee simple Parcels unless otherwise approved the Engineer.

- (m) Major Flow Path Swales

Major flow path swales shall be

 - (i) designed for the capacity of the expected flows;
 - (ii) designed with scour protection and energy dissipation;
 - (iii) secured and protected by a Statutory Right of Way; and
 - (iv) designed with suitable access for continuous maintenance and inspection by the City.

- (n) Roadside Drainage Swales
 - (i) Roadside drainage swales shall be connected to an adequate Drainage System with an appropriate connection per standards and specifications and shall be used where the road drainage is minimal and can be contained safely and practically in a swale rather than a ditch.
 - (ii) Roadside drainage swales shall be:
 - A. maximum 2.0 metres wide;
 - B. maximum 0.3 metres deep;
 - C. designed with the roadside edge of the swale at least 2 metres from the edge of pavement;
 - D. designed with a maximum velocity of 1 m/s; and

SCHEDULE "F" (Cont'd)

E. lined with sod on minimum 150 mm topsoil or erosion blanket or approved alternative.

(o) Minimum Basement Elevation (MBE)

The MBE of all Parcels shall be 150 mm above the hydraulic grade line of the Major Flow or centreline of abutting Roadway if designed to convey the Major Flow on the surface. MBE's shall not be adjusted or revised without approval of the Engineer.

(p) Curvilinear Sewers

At the discretion of the Engineer, curvilinear sewers may be permitted where:

- (i) the main is on a constant simple curve;
- (ii) the minimum radius is 750 times the diameter of the pipe;
- (iii) there is no deflection at joints or fittings;
- (iv) all joints are located by survey for record drawing information; and
- (v) minimum velocities and minimum grades are maintained.

(q) Location/Corridors

- (i) Mains located within the Statutory Right of Way for Highway purposes shall substantially conform to the standard typical cross-sections.
- (ii) Where a Drainage System is designed to convey drainage for more than 2 Parcels across private property, it shall be secured within a Statutory Right of Way as per Section 5. The depth of a main or the width of a swale or ditch shall determine the width of the Statutory Right of Way as follows:

Depth of Main (ground to invert)	Width of SROW with 1 pipe	Width of SROW with 2 pipes
≤ 3 m	3 m	4.5 m
> 3 m & ≤ 4 m	4 m	5.5 m
> 4 m	6 m	8.0 m

- (iii) Storm mains in Statutory Right of Way may require access for maintenance at the discretion of the Engineer. The access way shall be a minimum 3 metres wide and designed for 9.1 tonne loading.

(r) Storm Water Pumping - Underground Parkades

- (i) All internal underground parking structure drainage is to be directed to the

SCHEDULE "F" (Cont'd)

sanitary sewer whether it is by gravity or by a pumped system.

- (ii) Pumping systems for external drainage of footings of underground parkades may be permitted, at the discretion of the Engineer, if the following are provided:
 - A. a hydrogeological assessment of the impacts of pumping if the system is pumping groundwater;
 - B. back up power sources;
 - C. high water level alarms;
 - D. the pumped water is directed to the on-site stormwater detention facility; and
 - E. the underground parkade drainage is isolated from the Major flow.
- (iii) A restrictive covenant shall be registered against the property with an underground parkade drainage pumping system. The covenant shall indemnify and hold the City harmless from any damage, loss or act resulting from the failure of the pumping system for any reason. In addition, the covenant shall describe maintenance procedures.
- (s) Rock Pits/Dry Wells

Rock pits/drain wells shall be used for single-family infill lot Development or replacement or reconstruction of existing homes unless otherwise recommended by a geotechnical Engineer. The rock pit/drain well shall be designed by a geotechnical Engineer and sized to store and infiltrate a 1:10 year rainfall event.
- (t) Natural Watercourses
 - (i) Natural watercourses may be integral components of the Drainage System. The Consulting Engineer shall refer to the "Land Development Guidelines for the Protection of Aquatic Habitat" issued by the Ministry of Environment Lands and Parks and Department of Fisheries and Oceans, when proposing Developments near natural watercourses.
 - (ii) Works in set-back areas and discharge to creeks, streams and watercourse is subject to federal and provincial authority approvals. The Developer shall retain the services of a qualified environmental professional to complete as required studies and obtain any necessary permits and approvals prior to constructions.
- (u) Erosion and Sediment Control and Protection of Aquifer and Habitat
 - (i) Any Development of lands shall be undertaken and completed in such a

SCHEDULE "F" (Cont'd)

way that prevents erosion either by wind or rainfall or sediment or other deleterious substances from entering the aquifer or City Drainage Systems and watercourses.

- (ii) Expertise from other sources such as erosion and sediment control specialists, environmental consultant(s) or Engineers may be necessary, at the discretion of the Engineer, to ensure adequate design, especially in sensitive areas.

- (v) Absorbent Soils
 - (i) Absorbent soils shall conform to the Master Municipal Construction Document specification for growing medium, (MMCD 2000, Section 02921, Clause 2.10) with an organic matter content of between 8% and 15% dry weight, for low traffic lawn areas.
 - (ii) Native soil may be used, provided it meets the standards for absorbent soils or can be amended to meet all the requirements for use as a growing medium.
 - (iii) Expertise from other sources such as Consulting Landscape Architects may be necessary, at the discretion of the Engineer, to ensure the growing medium meets the requirements for absorbent soils.

SCHEDULE "F" (Cont'd)

SECTION NO. 5 - STORM WATER DETENTION/INFILTRATION1. GENERAL

The goal of the City in managing storm water is to provide sustainable hydrologic systems that mimic natural systems, protect groundwater resources and minimize downstream flooding and erosion. The City supports and encourages volume reduction strategies and requires reduction of peak runoff rates through the use of storm detention facilities.

- (a) Post Development storm water runoff from all Developments is required to be controlled to prevent or mitigate flooding or environmental impacts to the satisfaction of the Engineer. These controls may be in the form of:
 - (i) Detention storage in surface ponds or underground pipes, chambers or tanks; and
 - (ii) Infiltration systems designed to augment or reduce detention storage.
- (b) The City encourages innovative approaches to achieving control of post Development runoff. Groundwater recharge in the form of rain gardens, vegetated swales and infiltration galleries provide positive environment benefits. Prior to proceeding with designs, Consulting Engineers and Developers may consult with the Engineer to explore innovative approaches they may wish to utilize on their projects. The Engineer may require hydrological, geotechnical or other reports to consider suitability of these approaches. The Engineer may require innovative approaches in certain catchment or sub-catchment areas in support of other objectives.

2. STORAGE FACILITY REQUIREMENTS

- (a) Storage facilities shall be sized to detain the volume of run-off from incoming peak flows generated by a 1 in 10 year rainfall event from the contributing developed area and discharge it at the allowable release rate. Where the Modified Rational Method is used to calculate storage, a safety factor of 1.5 shall be applied to the calculated storage volume.
- (b) The allowable release rate is 5 litres per second per hectare (l/s/ha) of the net developed area or as otherwise directed by the Engineer.
- (c) Storage facilities require a flow restrictor to limit the outflow to the allowable release rate at the design head, an emergency release designed to empty the facility in two (2) hours, and an overflow directed to the major flow path.
- (d) Where existing Drainage System or overland flow routes are inadequate to convey the runoff from a 1 in 100 year rainfall event, the Consulting Engineer shall design the storage facility to detain the 100 year rainfall event.

SCHEDULE "F" (Cont'd)

- (e) Storage facilities for Developments discharging to Clayburn Creek upstream of Wright Street shall be designed to detain the 1:100 year rainfall event.

3. STORAGE FACILITY TYPES

- (a) Surface Dry Type – Grassed/landscaped open pond(s) designed with a maximum ponding depth of 2.5 metres for a 1:10 year rainfall event and 3.0 metres depth for a 1:100 year rainfall event.
- (b) Surface Wet Type – Grassed/landscaped open ponds designed to permanently retain water even during extended periods of no rainfall with a minimum pond depth of 1 metres at the deepest point, a maximum pond depth of 3.5 metres for a 1:10 year rainfall event, or 4 metres for a 1:100 year rainfall event. The Consulting Engineer shall confirm approval and specific design requirements of this type including planting, weed and stagnation controls prior to design and construction.
- (c) Surface Parking lot – May be used as detention or to augment detention in Commercial or Industrial Developments at the discretion of the Engineer. Maximum ponding depths shall be equal to or less than 75 mm in Commercial areas and 150 mm in Industrial areas.
- (d) Underground storage – To be on private property unless otherwise approved by the Engineer. It shall be designed to permit regular cleaning and maintenance, or designed to minimize the need for cleaning through the use of runoff screening and filtering devices. Systems are to be designed for a life expectancy of 75 years. Proposals to use proprietary systems will be considered provided the component materials are resistant to chemicals found in urban runoff.
 - (i) Underground concrete tanks require WorksafeBC confined entry design guidelines and regulations to be incorporated in the tank design. A Building Permit is required for construction.
- (e) Linear detention ditches – Permitted in Industrial Developments only and shall be designed with fencing and maximum water depth of 2.5 metres. These shall be accessible for maintenance as required.

4. MAINTENANCE

- (a) The Developer is responsible for inspection and maintenance of any storage facility or system up to the end of the Warranty Period. The consultant shall submit a maintenance plan specifying how the system will be inspected and cleaned during and at the end of the Warranty Period in a manner that prevents sediment and other deleterious substances from entering the downstream Drainage System.

SCHEDULE "F" (Cont'd)

- (b) The following describes how maintenance responsibilities for detention facilities following the end of the Warranty Period:

Type	Servicing	Maintained By
Surface facilities in Statutory Right of Way	Fee simple Single Family Residential Developments	City
Underground facilities in Statutory Right of Way	Fee simple single family Residential Developments	City
Community facilities in Statutory Right of Way or on City property	Servicing a number of Developments or larger catchment area	City
All types	Commercial, Industrial Institutional strata and Multi-family Developments	Owner

- (c) Only one detention facility is permitted per Development if future maintenance is City responsibility, unless otherwise approved by the Engineer.
- (d) The Statutory Right of Way for underground facilities shall be sized to allow for future replacement without adversely affecting adjacent structures, Roadways or utilities.

5. OFF LINE VS. ON LINE DETENTION

- (a) Off line detention (where the incoming flow is directed into the control manhole and not directly into the detention facility) shall be provided as this reduces cleaning and maintenance activities.
- (b) Where on line detention is the only alternative, the designer shall provide the following:
- (i) a low flow channel through the detention system utilizing a half section of pipe in the bottom of the detention facility equal in diameter to the largest incoming pipe with adequate capacity to carry flows less than 5 l/s/ha. Gradients on the low flow channel shall be a minimum of 0.5 %; and
 - (ii) a sump which shall be accessible to truck mounted vacuum equipment. Maximum length of suction hose available from a truck mounted vacuum to the bottom of the sump is typically 20 metres.

6. LOCATION

- (a) The location of all detention facilities and systems shall be approved by the Engineer prior to design.

SCHEDULE "F" (Cont'd)

- (b) Detention facilities or systems are not permitted on Statutory Right of Ways for Highway purposes, on Agricultural Land Reserve designated lands or in steamside protection or enhancement areas unless otherwise approved by regulatory agencies and the City.

7. OTHER DESIGN CONSIDERATIONS

- (a) Where berms or dykes are used, the design shall be reviewed and approved by a geotechnical Engineer.
- (b) Where native granular material in the floor of the basin percolates at a rate ≤ 25 mm per minute a system of perforated under drains is required. A geotechnical report may be required to establish the need for such drains.
- (c) An emergency overflow spillway with capacity to convey the Major Flow is required for all storage facilities. The spillway surface shall be finished with erosion resistant materials such as concrete, turf stone or other approved equal. The maximum slope of the spillway shall be 4V:1H. The design of the spillway or overflow shall consider the possibility of blockages in the outlet structure and the consequences of extreme storm events.
- (d) An overflow is permitted at the control structure or from the detention facility directly to the Drainage System if it has the capacity for the Major Flows.
- (e) Fencing may be required around permanent wet detention ponds as directed by the Engineer. All linear detention ditches in Industrial areas shall be fenced. Fencing shall consist of 1.5 metres high chain link fencing.
- (f) A surface dry type facility shall be covered with a minimum 150 mm topsoil, seeded or planted with a vegetative cover that requires little or no maintenance, provides protection from erosion and is unaffected by frequent flooding. Maximum interior side slopes of 4H:1V and to drain completely during periods of no rainfall.
- (g) Wet type detention ponds shall have interior side slopes no steeper than 7H:1V in the active storage zone and 4H:1V above and below this zone. The slopes shall be covered with a minimum 150 mm topsoil and seeded or planted with a vegetative cover that requires little or no maintenance. Interior side slopes in the active storage zone may be increased to 1:1 provided the active storage depth does not exceed 2 metres and the slope is covered with rip-rap (200mm to 300mm diameter). Wet ponds may be fenced as directed by the Engineer but shall also include ability to access for maintenance and cleaning as necessary. Other features required in wet detention ponds include:
 - (i) planting to reduce water temperature and improve water quality;
 - (ii) length to width ratio of 2:1;

SCHEDULE "F" (Cont'd)

- (iii) other security measures may be required at the discretion of the Engineer; and
- (iv) minimum freeboard of 0.3 metres.
- (h) Signs which read "Warning - This Area is Subject to Flooding During Heavy Rainfall" shall be strategically placed on any surface detention pond.
- (i) The flow control structure shall be in accordance with Standard Drawing CS-D-2 or CS-D-3.
- (j) Detention facilities shall be located a minimum of 0.5 metres above the maximum seasonal water table. The Engineer may request groundwater monitoring studies to confirm this.
- (k) Detention tanks may be located within a parkade structure, provided that:
 - (i) The tank shall be designed for the 1:10 year rainfall event and the major storm overland flow route shall direct overflows to the major storm system;
 - (ii) A waterproof tank wall shall be required in order to ensure that seepage from the tank will not access the parkade structure or undermine the foundation or floor slabs of the parkade structure. Certification of the design and installation of the waterproofing system will be required from a Consulting Engineer and shall be submitted prior to occupancy;
 - (iii) Access to the control manhole will be from the surface, outside the building and in a location where unrestricted access is available for maintenance personnel and equipment at all times;
 - (iv) A Statutory Right of Way in favour of the City is required over the detention tank and shall provide unobstructed access to the detention tank for inspection and maintenance purposes. The City may request regular inspections of the tank; and
 - (v) A covenant is to be registered against the title to the land to indemnify and hold harmless the City against any claims due to leakage from the detention tank into the building or failure of the pumping system or backup of the City storm system which may have resulted in leakage into the building.

SCHEDULE "F" (Cont'd)

8. INFILTRATION SYSTEMS

- (a) Infiltration Systems in Commercial, Institutional and Multi-family Developments are intended for runoff from roof areas only. Rooftops draining to an infiltration facility may not be used for storage of materials which might contaminate or pollute the run-off. Runoff from other areas may be permitted to infiltrate provided groundwater protection measures and strategies are provided to the satisfaction of the Engineer.
- (b) Infiltration systems for Commercial, Institutional, Industrial and Multi-family Developments are to be closed systems with no connection to the Drainage System.
- (c) Design Considerations
 - (i) An infiltration system must be at least 1.2 metres above bedrock, clay or other impervious soils.
 - (ii) An infiltration system must be at least 1.2 metres above the maximum seasonal water table.
 - (iii) Minimum distances from an infiltration system to proposed or existing foundation walls shall be 5 metres and to property lines shall be 1.5 metres.
 - (iv) The design of an infiltration system shall be based on the saturated infiltration rate of the soil at the design depth of the trench. Rates may be determined using standard percolation tests but they shall be performed and monitored by qualified geotechnical testing personnel and in the presence of a City Works Inspector. A safety factor of 3 shall be applied to the results.
 - (v) Only the base area of the linear trench shall be considered as permeable.
 - (vi) The maximum allowable storage time is twenty-four hours.
 - (vii) A "Drainage Analysis Sheet", ES-D-3 and ES-D-4 shall be submitted to the Engineer. The City may provide calculations based on the information supplied.
 - (viii) Rainwater storage medium shall be resistant to chemicals found in urban runoff.

SCHEDULE "F" (Cont'd)

9. LINEAR DETENTION DITCH

- (a) Linear detention ditches are acceptable on private lands zoned for Industrial use. They must be fully accessible for maintenance at all times and be protected from public trespass by appropriate fencing. The Engineer may require impermeable liners or water quality treatment measures for runoff directed to them.
- (b) Design Considerations:
 - (i) the maximum ponding depth is 2.5 metres;
 - (ii) the minimum freeboard is 0.3 metres;
 - (iii) the maximum side slopes shall be 1.5H:1V;
 - (iv) the bottom width shall be no less than 0.5 metres and no more than 2.0 metres; and
 - (v) the minimum base slope is 0.5%.

10. VOLUME REDUCTION STRATEGIES

- (a) Volume reduction strategies such as rain gardens, vegetated swales, absorbent soils, and other innovative strategies are supported and encouraged by the City.
- (b) The design of volume reduction measures located on the road allowance or other public property shall consider and address maintenance requirements, protection of drinking water aquifers, geotechnical stability, seepage impacts, and sustainability.

SCHEDULE "F" (Cont'd)

SECTION NO. 6 – SEWAGE COLLECTION AND DISPOSAL1. GENERAL

The design of Sanitary Sewer Systems in the City shall conform to Ministry of Environment, Waste Management Branch, Guidelines for Assessing Sewage Collection Facilities, latest edition, and these Engineering Standards.

2. PRE-DESIGN REQUIREMENTS

- (a) The adequacy of the existing downstream Sanitary Sewer System shall be confirmed with the Engineer, prior to design of the proposed system.
- (b) The Consulting Engineer shall confirm with the Engineer the peaking factor and ultimate density of the population expected in the catchment area.

3. DESIGN FLOW

- (a) Design Flow = average daily flow x peak factor + Infiltration
- (b) Variables are derived from the following:

Average daily flow	=	350 litres/day/capita (l/d/c)
Peaking factor	=	Babbitt Curve shown on ES-S-2
Infiltration allowance	=	11,200 litres/day/hectare

- (c) The peaking factor is applied to the sanitary sewage contribution only.
- (d) The following table is a guideline for applying minimum density by land use to determine flow:

<i>For Residential</i>	<i>Persons/Unit</i>
Low Density (≤ 16 units per hectare)	3.3
Medium Density (≥ 17 and ≤ 45 units per hectare)	2.5
High Density (> 45 units per hectare)	1.8
<i>For Non-Residential</i>	<i>Persons/Hectare</i>
Commercial	65
Industrial	50
Institutional	54*

*For hospitals, use 900 litres/bed/day. For nursing homes use 450 litres/bed/day. Do not apply a peaking factor for Institutional calculations.

SCHEDULE "F" (Cont'd)

4. PIPE DESIGN

(a) Hydraulics

Refer to Hydraulic Element chart (ES-S-1).

(b) Gravity Sewers

(i) Use Manning's formula:

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

Where

- Q = design flow in m³/s
 A = cross-sectional area in m²
 R = hydraulic radius (area/wetted perimeter) in m
 S = slope of hydraulic grade line in m/m
 n = roughness coefficient = 0.013

(ii) Terminal sections of mains serving 10 homes or less shall have a minimum grade of 1.0%.

(c) Force Main Sewers

Use Hazen-William's 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 = friction coefficient = 120

(d) Velocities

- (i) Gravity Sewer = 0.6 m/sec (minimum)
 (ii) Force Main = 0.9 m/sec (minimum) = 3.5 m/sec (maximum)
 (iii) Gravity sewers with velocities > than 4.5 m/sec shall be anchored.

SCHEDULE "F" (Cont'd)

- (e) Depth of Mains
 - (i) The depth at crown shall be designed to allow service connections for all existing or proposed Parcels abutting the main. All mains shall have a minimum 1.2 metres cover.
 - (ii) The Engineer may approve construction of mains with less than 1.2 metres cover, provided that specific details of pipe material, backfill, and bedding design are submitted for review and acceptance prior to construction.
 - (iii) Mains shall be designed to service all upstream lands in the appropriate sewer catchment area as directed by the Engineer.

5. SANITARY SEWER MAINS AND APPURTENANCES

- (a) Pipe
 - (i) Minimum pipe sizes shall be:
 - (ii) Mains: 200 mm; and
 - (iii) Terminal Mains: 150 mm (serving 10 homes or less or equivalent flow).
- (b) Manholes

Locations:

 - (i) at all changes in grade, direction and pipe size;
 - (ii) at all intersecting sewers;
 - (iii) at all terminal sections;
 - (iv) at the downstream end of curvilinear sewers;
 - (v) every 120 metres; and
 - (vi) shall be installed so that the lid is not in the wheel path of typical traffic flow or under potential fence lines.
- (c) Rim Elevations
 - (i) Manhole rim elevations in off-road areas shall be set 50 mm above adjacent storm manhole rim elevation and 150 mm above adjacent ground to prevent infiltration from surface ponding.

SCHEDULE "F" (Cont'd)

- (ii) Manhole rim elevations within the Roadway or asphalt shall be set at the elevation of the first lift of asphalt and adjusted to be flush with final lift of asphalt when required, to conform to the slope and contour of the Roadway.
- (d) Types
 - (i) Outside drop structures shall be used wherever possible to minimize the depth of the main.
 - (ii) Drop structures, the minimum difference in grade between the inlet and outlet shall be 0.6 metres.
 - (iii) Inside drop structures shall not be used for new construction.
 - (iv) Where the invert-to-invert change in grade through a manhole is >200 and ≤ 450 mm, a ramp shall be constructed in the manhole.
 - (v) Ramps in manholes for mains ≥ 200 mm will be considered only when the manholes are ≥ 1200 mm in diameter.
 - (vi) Manholes shall be minimum 1200 mm in diameter or sized to fit the main.
 - (vii) Designs showing sanitary sewer mains or service connections being installed under a retaining wall are to be avoided. When extraordinary circumstances exist, the Engineer may give consideration to designs that incorporate steel carrier pipes which allow the main or service line to be removed and replaced without impacting the long term stability of the retaining wall.

6. HYDRAULIC CONSIDERATIONS

- (a) The crown of the inlet pipe shall be at or above the crown of the outlet pipe.
- (b) Minimum drop in elevation through manholes:

At:	Drop:
Deflections up to 22 ½°	Use upstream design grade
Deflections up to 45°	15 mm
Deflections up to 90°	30 mm

Note: There shall be no horizontal change of direction > 90° (degrees) through any manhole.

SCHEDULE "F" (Cont'd)

7. CLEAN-OUTS

Clean-outs shall be 200 mm diameter and may be provided on terminal sections when:

- (a) extension of the main is proposed or anticipated; and
- (b) the distance to the nearest downstream manhole is < 45 metres, and the depth of the sewer at the terminal point is \leq 2.0 metres.

8. SERVICE CONNECTIONS

- (a) All legal properties and each unit of a Residential duplex abutting a sanitary sewer main and within the Sewer Boundary shall be provided with a connection.
- (b) Unless otherwise approved by the Engineer, connections are to serve all plumbing by gravity. Building elevations should be established accordingly.
- (c) Minimum diameter shall be 100 mm.
- (d) Minimum slopes from spring line of main to property line or Statutory Right of Way line shall be 2%.
- (e) An inspection chamber (IC) is required for all connections to City mains. IC's shall be installed at the property line or Statutory Right of Way line (see Standard Drawing No.ES-G-1, ES-G-2 and CS-S-2).
- (f) The typical location of service connections shall be at the downstream side of the Parcel.
- (g) The minimum cover from finished surface at the property or Statutory Right of Way line to top of connection shall be 1 metres. The maximum cover from finished surface design grade at PL or Statutory Right of Way line to top of connection shall be 2.5 metres.
- (h) The invert elevation at the property line shall be above any design surcharge level in the Sewage System adjacent to the lands or Parcel.
- (i) All service connections shall enter the main at or above the spring-line.
- (j) Only one connection per property is permitted unless otherwise approved by the Engineer.
- (k) Connections to new mains shall be made using wye fittings only. Service connections greater than 150 mm diameter shall be made at a manhole.
- (l) A standard manhole is required at or near the property line for all Commercial and Industrial zoned properties, suitable for sampling purposes.

SCHEDULE "F" (Cont'd)

9. CURVILINEAR SEWERS

At the discretion of the Engineer, curvilinear sewers may be permitted where:

- (a) the main is on a constant simple curve;
- (b) the minimum radius is 750 times the diameter of the pipe;
- (c) there is no deflection at joints or fittings;
- (d) all joints are located by survey for as-built purposes; and
- (e) minimum velocities and minimum grades are maintained.

10. SEWER LOCATION/CORRIDORS

- (a) Mains within the Statutory Right of Way for Highway purposes shall be located as per the standard typical cross-sections.
- (b) Where sanitary sewer mains cross private property, they shall be within a registered Statutory Right of Way. The depth of the main shall determine the width of the Statutory Right of Way as follows:

Depth of Main (ground to invert)	Width of SROW with 1 pipe	Width of SROW with 2 pipes
≤ 2.5 m	3 m	4.5 m
> 2.5 m & ≤ 4 m	4 m	5.5 m
> 4 m	6 m	8.0 m

- (c) Sanitary sewer mains in Statutory Right of Way shall require access for maintenance. The access-way shall be a minimum 3.0 metres wide and designed for 9.1 tonne loading.

11. SANITARY PUMP STATIONS

The use of sanitary pump stations is discouraged. Where the only alternative is the use of pump stations, the Consulting Engineer shall receive prior approval from the Engineer. The design and construction shall conform to "Standard for Design of Sanitary Pump Stations", attached as Schedule "G".

12. OTHER SEWERAGE SYSTEMS

- (a) Excluding community sewer systems owned, operated and maintained by the City of Abbotsford, no other community sewer collection, treatment and disposal system shall be approved, other than for fee, simple and bare land strata single family lots.

Where no community Sewer System exists or can be extended due to grade, soil

SCHEDULE "F" (Cont'd)

conditions, existing building interference or conformance to an adequate, pre-design alignment, the Developer shall provide an approved alternate sewerage system for each Parcel. The approved alternate system shall be engineered by a Consulting Engineer or certified professional per standards and specifications of the *Health Act* and filed with Ministry per *Health Act* requirements. Proof of filing shall be submitted to the City prior to Final Approval of a Development by the Approving Officer or issuance of a Building Permit.

- (b) Prior to Final Approval of a Building Permit or prior to Final Acceptance from the Engineer, which ever is required per standards of this Bylaw or the Building Bylaw, proof of final filing with Ministry of Health per requirements of the *Health Act*, shall be submitted by the Consulting Engineer or certified professional.

SCHEDULE "F" (Cont'd)

SECTION NO. 7 – HIGHWAYS1. GENERAL REQUIREMENTS

Roadway design shall conform to these Engineering Standards or as otherwise accepted by the Engineer. Principles of design shall also conform to standards and practices developed by the Transportation Association of Canada (TAC) and described in their manual "Geometric Design Standards for Canadian Roads".

2. HIGHWAY CLASSIFICATIONS

- (a) The appropriate Highway classification shall be consistent with the Official Community Plan (OCP).
- (b) The Developer and/or his Consulting Engineer shall confirm with the Engineer the appropriate Highway classification within or adjacent to the proposed Development in order to establish appropriate road allowance widths and Roadway design.
- (c) Where a Highway passes through more than one zone, the zone having the most impact on the Roadway shall dictate the appropriate classification to be used.
- (d) Dedications by the Developer shall be dependent on the ultimate design of the Roadway within each Highway classification and the ability to provide Works and Service, as defined by the Engineer and this Bylaw.
- (e) Standard off-sets for utilities and other services are shown on the Typical Standard Cross-Sections. When existing utilities do not match the typical cross-section off-sets, or will not permit the use of a typical cross-section, the Consulting Engineer shall confirm an alternate design with the Engineer at a pre-design meeting and prior to submission of design drawings. The Developer may be required to provide further dedication or provide Statutory Right of Way in order to accommodate ultimate designs that include Landscaping and franchise utilities.

3. DESIGN ELEMENTS

- (a) Once an appropriate Highway classification has been established, the Developer and his Consulting Engineer shall confirm the Roadway design, either by using the applicable standard cross-sections, or by preparing and submitting a specific design for review.
- (b) See Table 7.1, 7.2 and 7.3 to determine an appropriate design cross section for all roads associated with the Development. Dedication and Statutory Right of Way requirements for all Highways within and adjacent to a Development shall be approved by the Engineer prior to design.

SCHEDULE "F" (Cont'd)

TABLE 7.1

Typical Urban Highway Design Features

Feature	Width (m)	<u>Major Arterial with left turn Lane</u>		<u>Major Arterial with median</u>		<u>Urban Regional Road (Fraser Hwy)</u>		<u>Urban Arterial with left turn Lane</u>		<u>Urban Arterial with median</u>		<u>Urban Arterial undivided</u>	
		(m)	#	Width (m)	#	Width (m)	#	Width (m)	#	Width (m)	#	Width (m)	#
<u>Curb face to Curb face</u>													
Left turn Lane	3.3	1	3.3			1	3.3	1	3.3				
Raised median	1.2	1	1.2			1	1.2	1	1.2				
Planted Median	3.3			1	3.3					1	3.3		
Inside Lanes	3.35	4	13.4	4	13.4	2.25 ^a	7.5	2	6.7	2	6.7	2	6.7
Outside Lanes ^b	4.3	2	8.6	2	8.6	2.65 ^a	11.4	2	8.6	2	8.6	2	8.6
Parking Lanes	2.4												
Gutter widths	0.3	2	0.6	2	0.6	2	0.6	2	0.6	2	0.6	2	0.6
Subtotal			27.1		25.9		24.0		20.4		19.2		15.9
<u>Curb face to Property Line</u>													
Barrier curbs	0.15	2	0.3	2	0.3	2	0.3	2	0.3	2	0.3	2	0.3
Driveover curbs	0.10												
Tree strips	1.5	2	3.0	2	3.0	2	3.0	2	3.0	2	3.0	2	3.0
Basic Sidewalks	1.5	2	3.0	2	3.0	2	3.0	2	3.0	2	3.0	2	3.0
Enhanced Sidewalks ^c	2.5												
Boulevard			0.1		0		0.3		0.3		0.3		0.3
Subtotal			6.4		6.3		6.6		6.6		6.6		6.6
Total Right of Way Width			33.5		32.2		30.6		27.0		25.8		22.5

^a Number of Lanes adjusted to provide additional width for higher speeds or extra truck activity

^b Outside Lanes to be increased to 4.7 metres on the following to provide marked bicycle Lanes (additional 0.8 metres of land dedication is also required):

- Clearbrook Road -Peardonville to Downes
- Gladwin Road -Peardonville to Downes
- McCallum Road -King to South Fraser Way

^c Enhanced Sidewalks for Commercial and Institutional land use zones require additional land or Statutory Right of Way on private property.

SCHEDULE "F" (Cont'd)

TABLE 7.2

Typical Urban Highway Design Features

Feature	Width (m)	<u>Urban Collector with left turn</u>		<u>Urban Collector undivided</u>		<u>Industrial Local^C_D</u>		<u>Multi-family (MF) Local</u>		<u>Single-family (SF) Local</u>		<u>SF single loaded Local</u>	
		(m)	#	Width (m)	#	Width (m)	#	Width (m)	#	Width (m)	#	Width (m)	#
<u>Curb face to Curb face</u>													
Left turn Lane	3.3	1	3.3										
Raised median	1.2	1	1.2										
Planted Median	3.3												
Inside Lanes	3.35	2	6.7	2	6.7		6.6		4.6		3.6		4.0
Outside Lanes ^A	4.3	2	8.6	2	8.6		4.8						
Parking Lanes	2.4							2.0	4.8	2	4.8	1	2.4
Gutter widths	0.3	2	0.6	2	0.6	2	0.6	2	0.6	2	0.6	2	0.6
Subtotal			20.4		15.9		12.0		10.0		9.0		7.0
<u>Curb face to Property Line</u>													
Barrier curbs	0.15	2	0.3	2	0.3	2	0.3	2	0.3			1	0.15
Driveover curbs	0.15									2	0.3	1	0.15
Tree strips	1.5	2	3.0	2	3.0	2	3.0	2	3.0	2	3.0	1	1.5
Basic Sidewalks	1.5	2	3.0	2	3.0	1	1.5	2	3.0	1	1.5	1	1.5
Enhanced Sidewalks ^B	2.5												
Boulevard			0.3		0.3		3.2		3.7		3.2		3.2
Subtotal			3.3		6.6		8.0		10.0	1	8.0		6.5
Total Right of Way Width			27		22.5		20.0		20.0		17.0		13.5

^A Outside Lanes to be increased to 4.7 metres on the following to provide marked bicycle Lanes (additional 0.8 metres of land dedication is also required):

- Clearbrook Road -Peardonville to Downes
- Gladwin Road -Peardonville to Downes
- McCallum Road -King to South Fraser Way

^B Enhanced Sidewalks for Commercial and Institutional land use zones require additional land or Statutory Right of Way on private property.

^C For Industrial Local Roads within the City-in-the-Country Plan Lands, see Drawings ES-R-13, ES-R-14 and ES-R-15.

^D For Peardonville Road, between Simpson Road and Marshall Road, the curb face to curb face width shall be 12.0 metres. The boulevard width, as shown on Drawings ES-R-13, ES-R-14 and ES-R-15, shall be modified to suit.

SCHEDULE “F” (Cont’d)

TABLE 7.3

Rural Highway Design Features

<u>Feature</u>	<u>Rural Regional Road</u> (Fraser hwy)			<u>Rural Collector</u> 4 Lane		<u>Rural Collector</u> 2 Lane with left turn Lane		<u>Rural Local</u> 2 Lane	
	(m)	#	Width (m)	#	Width (m)	#	Width (m)	#	Width (m)
Left turn Lane	3.3	1	3.3			1	3.3		
Raised Median	1.2	1	1.2						
Inside Lanes	3.5	2	7.0	2	7.0				
Outside Lanes	3.75	2	7.5	2	7.5	2	7.5	2	7.5
Paved shoulder	2.0	2.5 ^a	5.0	2	4.0				
Gravel shoulder	1.5					2	3.0	2	3.0
Shoulder rounding	0.25	2	0.5	2	0.5	2	0.5	2	0.5
Drainage	2.25	2	4.5	2	4.5	2	4.5	2	4.5
Boulevards			1.5		1.5		1.2		4.5
Total			30.5		25.0		20.0		20.0

^a number of Lanes adjusted to provide additional width for higher speeds or extra truck activity

(c) Dedication and Statutory Right of Way

- (i) The Developer shall dedicate and provide sufficient road allowance to accommodate all Works and Services required to service the proposed Development.
- (ii) Highway cross sections shall be designed to accommodate all relevant features including appropriate pavement width for the classification of the road, Sidewalks, fire hydrants, ornamental street lights, traffic signals, overhead or underground power and telecommunications plant including service boxes, junction boxes and kiosks, gas mains, water meter boxes, inspection chambers, street trees and street/traffic signs, postal kiosks and bus-stop shelters. The location of utility and Roadway elements are shown in Drawing ES-R- 7. Extended Statutory Right of Way may be required if all relevant features do not fit within the designated Statutory Right of Way noted in Tables 7.1, 7.2 and 7.3.

SCHEDULE "F" (Cont'd)

(d) Design Standards

TABLE 7.4
Design Standards

Classification	Min. design speed (km/h)	Max. Super-elev (%)	Grade (%)		K-Value				Minimum Sight Distance (m)	
					Crest Curves		Sag Curves			
			Min	Max ^{2,3}	Min	Desire	Min	Desire	Stopping	Decision
Arterial Road	70	6 ¹	0.5	8	20	25	15	25	110	200-270
Collector Road	50	6 ¹	0.5	10	7	10	7	12	65	140-190
Local Road	50	3	0.5	12	7	10	6	10	65	140-190
Lane	30	0	1.0	12	4	5	4	7	45	110-160
Alternate Access	30		1.0	15						
Walkway			1.0	15						

¹ Maximum super-elevation reduced to 4% where there are intersecting roads or private accesses.

² Maximum grades approaching intersections are 2% less than indicated. Reduction applies for length equal to stopping sight distance.

³ Reduced maximum grades are recommended for hillside Developments where frost or icy conditions may present.

(i) Unless otherwise approved by the Engineer, the standard design speed to be used for the design of Roadways in the City is the 85th percentile speed of the traffic, which typically can be assumed to be as shown in Table 7.4.

(ii) Prior to planning and design, the Consulting Engineer shall verify with the Engineer the design speed to be used.

(e) Gradients

(i) Maximum and minimum gradients for Roadways shall be as shown in Table 7.4.

(ii) The Engineer may approve a gradient of 12% on Local and Collector Roads. The Consulting Engineer may be required to supply to the Engineer all information pertinent to his request including traffic studies, sight line and stopping distance calculations, proposed design restrictions, etc.

(f) Cross Slopes and Super-Elevation

(i) Cross slopes for all Roadways shall not be less than 2% nor more than 4%. The crown of the road shall be at the centreline of the Statutory Right of Way unless otherwise approved by the Engineer. Super-elevation for any Highway shall be approved by the Engineer prior to design.

SCHEDULE "F" (Cont'd)

(g) Horizontal Curves

- (i) Horizontal curves shall be governed by the design speed of the road. Radii shall be derived from the equation:

$$R = \frac{V^2}{127 (e+f)}$$

Where:

- R = radius of curve in metres
- V = vehicle speed in kilometres per hour
- e = Roadway superelevation in metres per metre
- f = side friction factor

Values for f:

70 km/h	=	0.17
60 km/h	=	0.18
50 km/h	=	0.21
40 km/h	=	0.25
30 km/h	=	0.31

- (ii) The following examples are derived from this equation, and shall be typical unless otherwise approved by the Engineer:

<u>Classification</u>	<u>Design Speed (km/h)</u>	<u>Min. Radius (m)</u>
Local Roads	50 km/h with 2% Cross-fall	103
	50 km/h with 2% Super elevation	85
Collector Roads	60 km/h with 2% Cross-fall	177
	60 km/h with 2% Super elevation	142
	60 km/h with 4% Super elevation	129

(h) Vertical Curves

- (i) Vertical curves shall be governed by the design speed of the road. Typically, the numerical value for the length of a vertical curve should not be less than the numerical value of the design speed in km/h.
- (ii) Vertical curves are required for all changes in grade greater than 1.5%.
- (iii) Crest Curves
- A. See Table 7.4.

SCHEDULE "F" (Cont'd)

B. When a Local Road meets another Local Road at a stop condition and no through road condition is contemplated, then a 20 km/h design speed is permitted. The Engineer, prior to Final Approval, shall review stopping distances and "k" values.

(iv) Sag Curves

A. See Table 7.4.

B. When a Local Road meets another Local Road at a stop condition and no through road is contemplated, 20 km/h design speed is permitted. The Engineer, prior to Final Approval, shall review stopping distances and "k" values.

(i) Curb Returns

The Consulting Engineer shall take special care in the design of curb returns on hillside Development. The maximum gradient around curb returns from one street to another shall not exceed 12%, or 1.5 times the grade of the major street, whichever is less.

(j) Pavement Tapers

(i) Pavement tapers are used to connect the end of new road construction to the existing Roadway.

(ii) Unless otherwise specified by the Engineer, tapers shall be:

Highway Classification	Direction of Taper	Taper (length : width)
Local Roads	Widening in direction of Travel	10:1
	Narrowing in direction of Travel	20:1
Collector Roads*	Widening in direction of Travel	10:1
	Narrowing in direction of Travel	30:1
Arterial Roads*	Widening in direction of Travel	30:1
	Narrowing in direction of Travel	30:1

* for 50 Km/h

4. INTERSECTIONS

(a) Dedications

(i) For intersection design and required Statutory Right of Way dimensions for traffic channelization, refer to ES-R-3.

SCHEDULE "F" (Cont'd)

(ii) Curb Returns

- A. All curb returns radii shall be governed by the narrower pavement width of the intersecting street or as specified by the Engineer and shall typically conform to the following:

Pavement Width	Radius
9 m	8 m
10 m	8 m
12 m	10 m
≥ 15 m	11 m
At rural road intersections	12 m

- B. For intersections at angles other than 90°, traffic movement shall suit the appropriate design vehicle turning radius, as determined by the Consulting Engineer and confirmed by the Engineer.

(iii) Centreline Crossing Maximum Meeting Grades

<u>Predominant Roadway</u>	<u>At Intersection With</u>					
	<u>Arterial Roads</u>		<u>Collector Roads</u>		<u>Local Roads</u>	
	<u>Max. Grade</u>	<u>Distance</u>	<u>Max. Grade</u>	<u>Distance</u>	<u>Max. Grade</u>	<u>Distance</u>
Arterial Roads	Site specific		Site specific		n/a	n/a
Collector Roads	5%	60 m	6%	30 m	*	*
Local Roads	n/a	n/a	6%	30 m	*	*

* as per Engineer requirements

Note: Distances are measured along the predominant Roadway from the end of the approach vertical curve (EVC) to the beginning of the departure vertical curve (BVC).

<u>Non-predominant Highway Classification</u>	<u>At Intersection With</u>					
	<u>Arterial Roads</u>		<u>Collector Roads</u>		<u>Local Roads</u>	
	<u>Max. Grade</u>	<u>Distance</u>	<u>Max. Grade</u>	<u>Distance</u>	<u>Max. Grade</u>	<u>Distance</u>
Collector Roads	2%	30 m	2%	25 m	n/a	n/a
Local Roads	2%	25 m	2%	20 m	2%	10 m

SCHEDULE "F" (Cont'd)

Note: Distances are measured along the non-dominant road from the ultimate near curb line of the major road to the beginning of the vertical curve (BVC).

- (b) Spacing and Location
 - (i) Intersecting roads shall meet as close to 90° as possible.
 - (ii) Crossing sight distances shall be as outlined by TAC.
 - (iii) The location of intersections near curves and hills shall be governed by guidelines established by TAC, including sight and stopping distance references.
 - (iv) Where T-intersections occur on Collector or Arterial Roads, the minimum spacing between them shall be 80 metres as measured between the centrelines of the intersecting streets.
 - (v) Where T-intersections occur on Local Roads, the minimum spacing between them shall be 64 metres as measured from the nearest property lines of the intersecting streets.

5. HIGHWAY LENGTHS

Cul-de-sacs

- (a) The maximum centre-line length of permanent dead-end Highways shall be:

Type of Land Use	Maximum Centreline Length
Residential	275 m
Industrial, Commercial	110 m
Institutional	110 m
Agricultural (rural)	400 m
P-loop *	400 m

*Note: The entrance leg of a P-loop shall not exceed 110 metres.

- (b) The centreline length shall be measured from the centreline of the intersecting Roadway to the 'throat' of the cul-de-sac bulb or the end of the turnaround.
- (c) Topographic or traffic generation considerations may warrant variations to the maximum length at the discretion of the Engineer.

SCHEDULE "F" (Cont'd)

- (d) Future Through Road/Temporary Dead-End
 - A. The maximum centreline length of a cul-de-sac in a Residential Development may be extended to 400 metres provided that the road is intended to be extended in the future as part of an advanced street plan and provided that alternate access for emergency vehicle use is dedicated and constructed.
 - B. Temporary dead-end roads shall use radial or hammerhead type turnarounds as per standard detail drawings. The turnaround shall be within the dedicated road Statutory Right of Way or on a registered Statutory Right of Way, as required.

6. ALTERNATE ACCESS

- (a) Alternate access is constructed for the use of emergency vehicles or for other vehicles under emergency conditions only. It shall not be open to traffic other than pedestrians unless conditions warrant its use under emergency situations. Where alternate access, whether temporary or permanent, is required, it shall:
 - (i) be a minimum 6 metres wide and conform to the appropriate Standard Drawing;
 - (ii) be designed for 9.1 tonne axle loading (20,020 lbs);
 - (iii) be within a registered Statutory Right of Way or dedicated road Statutory Right of Way; and
 - (iv) be gated per Standard Detail Drawing CS-R-7.
- (b) Where alternate access is permanent; it shall be as above and also:
 - (i) be fenced complete with appropriate barricades; and
 - (ii) have a street light at the entrance and exit to the intersecting streets.

SCHEDULE "F" (Cont'd)

7. STRUCTURAL CONSIDERATIONS

(a) Cuts and Fills

- (i) Cut and fill slopes shall be a minimum of 2% and a maximum of 10% within 2 metres of the proposed curbs and back of Sidewalk.
- (ii) Cut and fill slopes greater than 2%, to a maximum slope of 2H:1V as approved by a geotechnical Engineer, may begin at 2 metres from back of proposed curbs or Sidewalks and shall project to meet existing slopes.
- (iii) At the discretion of the Engineer, cut and fill slopes outside the dedicated road allowance shall be protected by registered Statutory Right of Way.
- (iv) Where rock cuts are anticipated the slope of the rock face shall be as designated by a geotechnical Engineer. The surface shall be treated as required by the geotechnical Engineer. At the base of all rock cuts or slopes stabilized with rock, a suitable 'rock fall' zone shall be provided to protect pedestrian and vehicle traffic from incidental rock or debris falls. The width of the 'rock fall' zone shall be as indicated by a geotechnical Engineer.

(b) Retaining Walls

- (i) The use of treated wood timber or railway ties is prohibited. Lock blocks may be used at the discretion of the Engineer (as headwalls for culverts in ravines for example).
- (ii) The use of retaining walls to contain road cuts and fills is permitted subject to:
 - A. the approval of the Engineer;
 - B. any wall(s) and associated tieback/geogrid works on private property being within a registered Statutory Right of Way;
 - C. submission of geotechnical reports detailing soil analysis to support designs and type of construction, base, backfill and drainage;
 - D. aesthetic treatment of retaining walls that are open to public view shall be provided and as approved by the Engineer;
 - E. a Building Permit being issued prior to construction (requirements of the Building Department and *BC Building Code*, shall be met, including railings and fencing as necessary), and

SCHEDULE "F" (Cont'd)

- F. the provision of temporary and permanent, secure safety fencing along the top of retaining walls.
- (c) Road Base and Pavement Design
- (i) Roadway structural design shall be designed for an expected life of 25 years under the expected traffic conditions for the specified Highway classification. The Consulting Engineer shall specify road base and depth of asphalt to be used for all Roadway designs in the City.
- (ii) A geotechnical report shall be submitted with any Roadway design, confirming the structural adequacy of any existing Roadway and/or new Roadway being constructed by the Developer.
- A. Regardless of the method used for design:
- i. the minimum granular base course thickness = 75 mm;
- ii. the minimum asphaltic concrete thickness = 76 mm (laid in two separate lifts); and
- iii. the minimum sub-base course thickness = 450 mm (350 mm for Residential Local Roads and 200 mm for Lanes).
- (iii) Test holes and soil analyses shall be undertaken by a qualified soils testing company. All reports shall be signed and sealed by the geotechnical Engineer.
- (iv) Benkelman Beam maximum seasonally adjusted design deflections (mean plus two standard deviations) are as follows:

Classification	Road Base	Asphalt
Arterial Roads	1.5 mm	1.0 mm
Collector Roads	2.0 mm	1.3 mm
Local Roads	2.6 mm	1.5 mm
Lane	3.1 mm	1.5 mm
Industrial Roads	2.0 mm	1.3 mm

8. EXISTING ROADWAY UPGRADING

Existing Roadway re-construction designs, including asphalt overlays, shall be based on recommendations of a geotechnical Engineer. A report shall be submitted including the results of Benkelman Beam tests and evaluation of test holes to establish design parameters.

SCHEDULE "F" (Cont'd)

9. PAVING

(a) Paving Materials

- (i) The standard paving material in the City is hot-mixed, machine laid, asphaltic concrete, and it shall conform to the appropriate Standards and Specifications.
- (ii) Gravel, surface-treated, or flush-coat treatments are not acceptable for new Roadway construction.

(b) Paving Procedure

- (i) All paving shall be done in 2 lifts. Thickness shall be as designated by the accepted design.
- (ii) The first lift shall be laid on an approved base.
- (iii) The final lift of pavement shall be placed at the end of the Warranty Period or earlier at the discretion of the Engineer.
- (iv) As a guideline, the final paving shall be completed when 80% of the lots are built out.
- (v) In any case, the final paving shall be placed within three (3) years of Substantial Completion of the Subdivision.

10. SIDEWALKS, CURBS AND GUTTERS

(a) Curbs and Gutters

- (i) All urban Roadways shall be constructed with concrete curb and gutter on both sides unless otherwise specified by the Engineer.
- (ii) Barrier curbs and gutters shall be used Fronting all Industrial, Commercial, Institutional and Multi-family Developments or uses.
- (iii) Rollover curb and gutter shall be used on all urban local Residential roads except when adjacent to schools, parks or Multi-family Developments or uses, in which case, barrier curbs and gutters are required.
- (iv) Despite the above roads designated as major surface flood routes and steep grades require the use of barrier curbs and gutters at the discretion of the Engineer.
- (v) Transition between barrier curbs and rollover curbs shall take place over a minimum distance of 3 metres.

SCHEDULE "F" (Cont'd)

- (vi) Road support structure shall be constructed a minimum 300 mm beyond the edge of any surface design feature.
- (vii) All curbs shall be constructed to Master Municipal Construction Document C4 standard.
- (b) Wheelchair Ramps
 - (i) Wheelchair ramps are required at all intersections and as directed by the Engineer. The wheelchair ramps shall conform to the appropriate Standard Drawing.
 - (ii) A catch basin shall be located to intercept road drainage at the upstream side of wheelchair ramps.
- (c) Sidewalks

- (i) Sidewalks shall be constructed as per the applicable Highway classification and typical standard cross-section, or as otherwise directed by the Engineer. Typically:

Zoning	Width
Single Family Residential	1.5 m
Multi-Family Residential	1.5 m
Commercial	1.5 m or 2.5 m as directed by the Engineer
Industrial	1.5 m
Institutional	1.5 m or 2.5 m in front of schools

- (ii) Sidewalks are typically constructed on the north and east side of the Roadway.
 - A. On urban Roadways with Sidewalk and street lighting designed for one side only, the street lighting shall be on the same side as the Sidewalk.
 - B. Cul-de-sacs and dead ended Roadways serving eight or more homes shall have a Sidewalk constructed up to the throat of the cul-de-sac or the beginning of the turnaround.
 - C. Where a Walkway or permanent alternate access is proposed from a cul-de-sac, the Sidewalk shall be extended to connect with them and a street light is required at the connection point.
 - D. The grade of the Sidewalk adjacent to Roadways shall be consistent with the grade of the Roadway. Where drop off behind a Sidewalk exceeds 0.6 metres a handrail is required.

SCHEDULE "F" (Cont'd)

- E. Sidewalks adjacent to rollover curb and gutter shall be a minimum 140 mm thick. Sidewalks adjacent to barrier curb and gutter shall be 115 mm thick except at driveway crossings where the thickness shall be increased to 150 mm.
- F. Base and sub-base preparation shall extend a minimum of 600 mm beyond the width of the Sidewalk or Walkway.

11. DRIVEWAYS

- (a) Single family Residential driveway access to an urban Arterial Road is not permitted.
- (b) The maximum grade of any driveway from the edge of pavement, back of curb or back of Sidewalk to the property line shall not exceed 2%.
- (c) Driveway grades in excess of 15% may be approved at the discretion of the Engineer and shall be designed by an Engineer to ensure that vehicles will not "bottom-out" or "hang-up" on curbs and Sidewalks.
- (d) Where a corner Parcel adjoins roads of different classifications, access is only permitted to the lower classification Roadway.
- (e) Only one driveway access is permitted to a single family lot unless otherwise approved by the Engineer.
- (f) No driveway shall be constructed within 1.5 metres of a street light or fire hydrant or street tree.
- (g) Engineers shall consider sight line constraints at horizontal and vertical curves when setting driveway locations. Driveways on the inside of horizontal curves and near the crest of vertical curves should be avoided.
- (h) Driveway widths shall be as determined by the Zoning Bylaw, but typically shall be:

Zone or Land Use	Driveway Widths
Single Family Residential	Maximum 6.0 metres, minimum 2.7 metres
Multi-Family Residential	Maximum 9 metres
Commercial, Institutional	<u>Single D/W</u> :- Maximum 9 metres unless otherwise approved the Engineer.
Industrial, Agricultural	<u>Single D/W</u> :- Maximum 12 metres unless otherwise approved the Engineer. <u>More than one D/W</u> :- Maximum 9 metres unless otherwise approved by the Engineer.

SCHEDULE "F" (Cont'd)

- (i) All driveway access shall be by curb/Sidewalk letdown only except for single family Residential.
- (j) Acceleration and deceleration Lanes may be required for access or egress to Collector or Arterial Roads. Further dedication may be required to accommodate the extra width of the Roadway.

12. BOULEVARDS AND PLANTING STRIPS

- (a) All Boulevards and Planting Strips shall be finished with 300 mm topsoil and seeding or sod at the discretion of the Engineer. Seed mix shall be as specified by the Engineer.
- (b) The Developer shall be responsible for maintaining the Boulevards and Planting Strips until the end of the Warranty Period.
- (c) Landscaping may be required in certain areas and on certain classification of Highways at the discretion of the Engineer.

13. MEDIANS

- (a) Medians shall be landscaped according to an approved plan prepared by a Consulting Landscape Architect. Maintenance of the Landscaping shall be expected for one (1) year from Substantial Completion or the duration of the Warranty Period as set by the Engineer.
- (b) Landscaped medians shall include irrigation systems.
- (c) All medians shall be constructed with barrier curb and gutter or extruded curb at the discretion of the Engineer complete with a 450 mm wide by 75 mm thick concrete splash strip on a prepared granular base.
- (d) All medians shall be constructed with signage and lighting at the discretion of the Engineer. Flashing warning beacons shall be used at locations where illumination levels are inadequate, at the approach end of a median island where a median transition is required to accommodate the median island, or where accident history warrants the installation of the flashing beacon (as per the MUTCD recommendations).

14. SIGNAGE

Pavement markings, street signage, traffic advisory signs etc. shall be installed by the City at cost to the Developer. A Pavement Marking, Street and Traffic Advisory Plan is required as part of the design submission by the Consulting Engineer.

SCHEDULE "F" (Cont'd)

15. WALKWAYS

- (a) Walkways with an overall grade of 8% or less shall have a uniform gradient. Walkways with a gradient between 8% and 12% shall be designed and constructed with stepped ramps per Standard Detail Drawing CS-R-10. Where the gradient exceeds 12%, a stairway shall be constructed in accordance with the Standard Detail Drawing No. CS-R-11.
- (b) The maximum length of any ramp shall be 15 metres including a flat landing area at both ends. Ramps may 'switchback' but a flat landing area shall be constructed at the 'switchback' step. Where stepped ramps are constructed in combination with stairs, the ramps shall alternate from one side of the stair to the other. Each transition landing area shall be flat. The Developer shall ensure sufficient Statutory Right of Way is provided for adequate construction to these standards.
- (c) Walkways shall have ornamental street lighting at:
 - (i) the entrance and exit;
 - (ii) all changes in direction greater than 30° along its length;
 - (iii) every 50 metres; and
 - (iv) the designer shall consider the issue of maintenance access to luminaires.
- (d) Walkways shall be adequately drained and in urban areas shall be concrete with chain link fencing on both sides and bicycle baffles at both ends per standard detail drawings.

16. HANDRAILS

- (a) Handrails shall be constructed in accordance with the Standard Detail Drawings where grades are in excess of 12%, where steps are constructed, or where grade separation between the back or edge of Walkways and Sidewalks exceeds slopes of 2.5V:1H.
- (b) Handrails may be required on storm sewer inlet/outlet structures, along Walkways and Sidewalks where steep or excessive side slopes are encountered, or in any location as deemed necessary by the Engineer where in his opinion the safety of the public or maintenance worker is a concern.

17. COMMUNITY MAILBOXES

- (a) The Engineer shall approve the location of all community mailboxes.

SCHEDULE "F" (Cont'd)

- (b) Community mailboxes shall typically be located along the designated side yard property line of corner Parcels and behind the Sidewalk as far from any intersection as possible.
- (c) Community mailboxes shall not to be located on Arterial or Collector Roads. At intersections controlled by a traffic light, community mailboxes within the Statutory Right of Way for Highway purposes shall be at least 30 metres from the BC/EC of the corner truncation property line. At the intersection of Local Roads, they shall be at least 12.5 metres from the BC/EC of the corner truncation property line.
- (d) Community mailboxes shall be at least 30 metres from crosswalks and major driveways (e.g., schools, Commercial Developments, etc.).
- (e) Community mailboxes shall have a minimum clearance of 5 metres to fire hydrants and 2 metres to exposed municipal, power, telecommunications or gas utility fixtures.

18. BUS STOPS

Where Development occurs adjacent to a bus route, provisions shall be made for bus stops, as either extra road allowance or registered Statutory Right of Way. The minimum dimension for a bus stop area shall be 1.5 metres wide and 4.0 metres long. Typical improvements of designated bus stop locations shall include:

- (a) concrete Sidewalk to the curb to provide an all weather access to each door of the bus;
- (b) sufficient road allowance to provide enough space for a bus shelter (1.5 metres x 4.0 metres), garbage can (1.0 metres in diameter) and, depending on pedestrian volume; at least one (1) advertising bench (2.5 metres x 0.7 metres). Base preparation for any bus stop furniture shall be treated as an extension of the Sidewalk;
- (c) any bus stop furniture or structure(s) shall be clear of the designated Sidewalk to provide handicapped access along any Sidewalk or Walkway;
- (d) appropriate street lighting to illuminate the bus stop; and
- (e) sign post inserts shall be installed in the Sidewalk for bus stop signs.

19. TRAFFIC ACCESS AND IMPACT STUDIES

In order to review a Development application, the Engineer may require a Traffic Access and Impact Study for any of the following conditions when:

SCHEDULE "F" (Cont'd)

- (a) the proposed Development will generate 100 or more two-way (i.e. inbound plus outbound) trips during the adjacent street's peak hour or the proposed Development's peak hour;
- (b) a change in use of an existing Parcel results in changes in the type of access operation, peak hour access volumes or the type of traffic;
- (c) the proposed Development is adjacent to a Roadway or intersection with localized safety or capacity deficiencies as identified by the Engineer; and
- (d) any other local traffic problems exist which may affect the ability of the existing or proposed Highway to accommodate the proposed Development.

20. MOUNTAINOUS TERRAIN DESIGN ALTERNATIVES

- (a) Where the average slope of the land in an area exceeds 15%, the design of Roadways in the Development may employ the following criteria at the discretion of the Engineer. The Consulting Engineer shall verify with the Engineer the use of these criteria prior to commencement of planning and design of a Development:
 - (i) Design Speeds;

Highway Classification	Design Speed (kph)	Posted Speed (kph)
Collector Roads	50	40
Local Roads (Residential)	40	30

- (ii) and the Engineer may approve a maximum gradient of 12% on Collector Roads.

SCHEDULE "F" (Cont'd)

(b) Intersections

- (i) At intersections a flat continuous grade through the intersection is required. The through grade of the major Roadway shall be predominant. The maximum grade and minimum length of the flat section through the intersection shall be as noted below:

<u>Predominant Roadway</u>	<u>At Intersection With</u>			
	Collector Roads		Local Roads	
	Max. Grade	Distance	Max. Grade	Distance
Arterial Roads	6%	60 m	n/a	n/a
Collector Roads	8%	60 m	8%	30 m
Local Roads	n/a		8%	30 m

Note: Distances are measured along the predominant Roadway from the end of the approach vertical curve (EVC) to the beginning of the departure vertical curve (BVC).

<u>Non-predominant Roadway</u>	<u>At Intersection with:</u>					
	Arterial Roads		Collector Roads		Local Roads	
	Max. Grade	Distance	Max. Grade	Distance	Max. Grade	Distance
Collector Roads	4%	15 m	4%	15 m	n/a	n/a
Local Roads	4%	15 m	4%	10 m	4%	10 m

Note: Distances are measured along the non-predominant Roadway from the ultimate near curb line of the predominant Roadway to the beginning of the vertical curve (BVC).

SCHEDULE "F" (Cont'd)

SECTION NO. 8 - STREET LIGHTING AND TRAFFIC SIGNALS

1. GENERAL

- (a) Street lighting design shall comply with ANSI/IESNA RP-8 2000, Master Municipal Construction Document Specifications and these standards.
- (b) Detail drawings and specifications for ornamental street lighting systems shall be prepared by a qualified professional electrical engineer experienced in Roadway lighting design and registered with the Association of Professional Engineers and Geoscientists of British Columbia.

2. MINIMUM STANDARD REQUIREMENTS

Based on the "Illuminance Method":

Highway Classification	Application	Minimum Avg. Lux	Minimum Wattage	Pole Height	Pattern	Maximum Uniformity Ratio	Intersection Minimum Lux
ARTERIAL	Residential Industrial	15	150	9.1 or 11	staggered/ opposing	3:1	22
	Commercial Institutional	18	150	9.1 or 11	staggered/ opposing	3:1	27
COLLECTOR	Residential	8	150	9.1	staggered	3:1	12
	Industrial	10	150	9.1	staggered	3:1	15
	Commercial Institutional	13	150	9.1	staggered	3:1	20
LOCAL	Residential	4	100	7.62	one side	6:1	11
		4	70	6	one side	6:1	11
	Commercial Institutional	10	150	9.1	one side	3:1	15
	Industrial	10	150	9.1	as required by Engineer	3.1	15
RURAL		8	150	Lease lights on power poles			8

Note: Other design methods may be considered by the City of Abbotsford. The Consulting Engineer shall obtain approval before proceeding with alternate design methods.

The illumination levels at all intersections shall be determined by the higher Highway classification and application.

SCHEDULE "F" (Cont'd)

3. STREET LIGHT POLE LOCATIONS

- (a) Poles shall be located within 1.0 metres of property corners, and shall not conflict with proposed driveway and/or underground services. Minimum offset from driveways shall be 1.5 metres. Refer to Standard Drawings for the typical locations.
- (b) Where Sidewalk but no planting strip/Boulevard is present, poles shall be located behind the Sidewalk.

4. UNDERGROUND DUCTS

- (a) Underground wiring for street lighting shall be designed in accordance with Master Municipal Construction Document Standard Details, B.C. Hydro Specifications and shall conform to the rules and regulations of the *Canadian Electrical Code (Part 1)*, the Provincial Electrical Inspection amendments and any City codes or Bylaws and other authorities having jurisdiction.
- (b) The standard offset for the location of the underground street lighting ducts within Statutory Right of Way for Highway purposes shall conform to the typical cross-sections.
- (c) The minimum depth for the underground ducts shall be 0.9 metres.
- (d) It is the Consulting Electrical Engineer's responsibility to ensure that the service entrance for street lighting systems is approved by B.C. Hydro prior to construction.

5. CLEARANCES TO HYDRO LINES

The requirements of B.C. Hydro, *Canadian Electrical Code*, B.C. Electrical Inspectors Branch, and the WorksafeBC, shall be followed with respect to clearances between street light poles, luminaires, high voltage and other conductors.

6. NUMBER OF LUMINAIRES PER SERVICE

- (a) The consulting electrical engineer shall set the number of luminaires on any hydro service. Where a new system can be extended in the future, the design shall account for this in sizing wire and circuits accordingly.
- (b) Where an existing system is to be extended, the consulting electrical engineer shall ensure that existing service entrance, circuits and power draw on the existing service meets minimum standards and regulations of the *Canadian Electrical Code*.

SCHEDULE "F" (Cont'd)

7. TRANSITION LIGHTING

On Roadways connecting Residential areas to Commercial areas, the spacing of luminaires shall change gradually to suit the change in levels of illumination. In the case where luminaire output or type changes, the spacing in the transition zone may not have to change significantly. In any case, the spacing changes in the transition area shall not be abrupt or irregular.

8. OTHER DESIGN FEATURES (Note: Also refer to Schedule "F", Section No. 2, 5(g))

- (a) All luminaires shall have full cut off optics. Cobra head luminaires shall have flat glass lenses with detachable ballast module as in "Powerdoor" by GE or approved alternate.
- (b) The design drawings shall show:
 - (i) distribution type;
 - (ii) maximum spacing of luminaires;
 - (iii) minimum average lux achieved for the luminaire selected, i.e.: design requirement and level achieved by design;
 - (iv) luminaire manufacturer, type and model number;
 - (v) the uniformity ratio, i.e.: design requirement and uniformity achieved by design;
 - (vi) type of pole (davit/post-top/decorative), make/model/colour, pole height, offset from property lines and curbs (minimum offset from centre of pole to back of curb shall be 0.85 m);
 - (vii) Roadway classifications;
 - (viii) pole elevations;
 - (ix) all poles shall have minimum 1.0 metres radius clear working area; and
 - (x) all lamps shall be mogul base, non-cycling type.

9. TRAFFIC SIGNAL DESIGN

- (a) Traffic signal systems are to be designed in general conformance with:
 - (i) BC Motor Vehicle Act and Regulations;
 - (ii) Canadian Electrical Code, latest edition;
 - (iii) City of Abbotsford Supplementary Specifications;

SCHEDULE "F" (Cont'd)

- (iv) BC Ministry of Transportation Electrical and Traffic Engineering Manual;
 - (v) Canadian Manual of Uniform Traffic Control Devices (MUTCD); and
 - (vi) Master Municipal Construction Document (MMCD) Specifications and Design Guidelines.
- (b) Detail drawings and specifications for traffic signal systems shall be prepared by a qualified pre-approved professional electrical engineer experienced in traffic signal design and registered with the Association of Professional Engineers and Geoscientists of British Columbia.
- (c) Before proceeding with traffic signal system designs or designs that may impact existing traffic signal systems, designers shall contact the Engineer to confirm the scope of work and ensure the requirements of the project are fully understood. This is particularly important for Developer derived work where the City is not directly responsible for engaging the design firm.

SCHEDULE "F" (Cont'd)

SECTION NO. 9 - LANDSCAPING

1. GENERAL

Landscape design shall comply with the British Columbia Landscape Standard as published by the British Columbia Society of Landscape Architects and by the British Columbia Landscape and Nursery Association, 7th Edition, and as amended from time-to-time. A Registered Consulting Landscape Architect shall prepare drawings and Planting specifications for street trees, yard trees, Boulevards, medians and any other landscape screening at the discretion of the Engineer, in consultation with the General Manager of Parks, Recreation and Culture, or their designate.

2. PLANTING REQUIREMENTS

(a) Highways

A minimum 6.0 cm caliper "street" tree shall be required on any Highway at the discretion of the Engineer. The species, spacing and location, shall be at the discretion of the Engineer, in consultation with the General Manager of Parks, Recreation and Culture, or their designate. The Developer shall pay \$546 for each proposed street tree shown on the landscape drawings that are accepted by the City. These funds will be used by the City to purchase, install and maintain the street trees. For clarity, the payment of this fee does not include the supply and installation of tree grates, Structural Soil, planting medium, drainage or irrigation systems.

(b) Boulevards

Boulevards shall be landscaped where the Boulevard is physically separated from the adjacent Development by a solid landscape screen, topographic feature, watercourse or fence.

(c) Medians

Medians shall be landscaped at the discretion of the Engineer, in consultation with the General Manager of Parks, Recreation and Culture, or their designate.

SCHEDULE "F" (Cont'd)

(d) Single Family Residential Parcels

A "yard" tree shall be provided for each newly created single-family Residential Parcel in a Development.

Yard trees shall be a minimum height of 2.0 metres for conifers, and a trunk diameter of 4.0 cm measured at 1.2 metres above the root crown for the deciduous species.

(e) Through Lots

Landscaping shall be provided along the rear lot line for each newly created Residential through lot in a Development. Landscaping shall be on private property and shall consist of plant material, maintenance-free fencing, or a combination of both at the discretion of the Engineer, in consultation with the Approving Officer.

3. PLANT SPACING AND LOCATION

(a) Spacing of street trees shall be determined based on species type as set out in the following table, and shall also observe the clearances set out in Section 4:

Tree Type	Spacing on Centre (o/c)
Large	12.0 m – 15.0 m
Medium	9.0 m – 12.0 m
Small	6.0 m – 9.0 m
Columnar Trees	6.0 m – 9.0 m

(b) Boulevard median and landscape Plantings shall be designed to fill in within three (3) years of installation. A maximum spacing at installation shall be 900 mm o/c for #2 pot shrubs and 450 mm o/c for 10 cm pot evergreen ground covers.

(c) Street tree planting shall not be required within the cul-de-sac bulb area.

SCHEDULE "F" (Cont'd)

4. MINIMUM TREE PLANTING CLEARANCES

Listed below is the minimum distance trees should be planted from street feature or furniture:

Street Feature/Furniture	Minimum Separation to Tree
Lamp Standards	5.0 m
Steel/wooden poles, posts & bollards	3.0 m
Hydrants	3.0 m
Catch Basins	3.0 m
Manholes, Valve Boxes, Service Boxes	3.0 m
Water, Drainage & Sewer Service and Connection locations	2.0 m
Driveways	1.5 m
Intersection Corners	in line with 8 m sight triangle as per CS-TP-14

5. SPECIES SELECTION

- (a) The selection of tree species to be used in a Subdivision or Development shall be made from the "Recommended Tree Species" list shown in Schedule "I". These trees are recommended because they are known to generally perform well in our climatic conditions. All trees have both advantages and limitations and no single tree is suitable for all situations. Recommended species included on the list have been selected for their adaptability, resistance to pests, lack of chronic diseases and proven performance in our region. Selected trees are generally available in local nurseries; however, some varieties may require a full search of the Pacific Northwest region to obtain a reliable source of large quantities of any given species. If other trees are found to meet these criteria, they may be added to the lists.
- (b) The introduction of new tree species (not currently on the list) to the City of Abbotsford inventory is encouraged. Unproven and newly introduced tree species should be tested in limited quantities for several years, prior to making a long term, large scale commitment to the cultivar. Within the varied genus of tree types, numerous cultivars are available that have been developed specific to the conditions of the Pacific Northwest. Time, experimentation and ongoing monitoring will allow for the preferred species list to be refined to adjust to the specific conditions found within the City of Abbotsford. The Planting of new trees types in limited quantity in City parks or other open public property will help in the evaluation of tree compatibility under local conditions.

SCHEDULE "F" (Cont'd)

- (c) The list of recommended tree species has been divided into four (4) categories according to their mature size:

1	Small Trees:	mature height of less than 10 metres
2	Medium Trees:	mature height of 10 metres – 15 metres
3	Large Trees:	mature height greater than 15 metres
4	Columnar Trees:	narrow habit, mature width of less than 8 metres

- (d) The schedules of recommended tree species provide limited information on each tree species selection. Further information is available from a variety of sources. Relevant tree attributes and limitations should be reviewed prior to selection.
- (e) Tree shapes and growth habit change as trees age. The size ratings indicated in the appended recommended tree schedules reflect an estimate of the size and form of a healthy 40-year-old tree grown under average City conditions.
- (f) Landscaping design shall blend with existing Plantings. Tree species shall differ from one street to the next.
- (g) New Boulevards greater than 200 metres in length shall have more than one tree species. Changes should typically occur at intersections.

6. PLANTING STOCK ORIGIN

All plant material shall be nursery-grown stock. Collected material is not acceptable.

7. ROOT SYSTEM

Plants shall be ball and burlap (B&B), Machine Dug into Wire Basket (MDWB) or container grown stock. Bare root (BR) trees are not acceptable. B&B and MDWB stock shall be dug and sacked at least one year prior to Planting. Container grown stock shall have a sufficiently well established root system to hold the soil together when removed from the container. In all cases, the root system shall be strong, fibrous and free of disease, insects, defects or injuries and shall be sufficiently developed to guarantee successful transplantation.

8. CONDITION

All plant material shall be of good health and vigour with no visible signs of disease, insect pests, damage or other objectionable disfigurements.

9. SUB-GRADE

Prior to placing growing medium in Boulevard and median planting areas, the sub-grade shall be established at a minimum:

- (a) 150 mm below finished grade for all designated seeded or sod areas and 300 mm for all designated ground cover planting areas;

SCHEDULE "F" (Cont'd)

- (b) 450 mm below finished grade for all designated shrub-planting areas;
- (c) 600 mm below finished grade for all designated non-hard surfaced street tree areas between the back of curb and Sidewalk;
- (d) 750 mm below finished grade for all designated hard surfaced street tree areas between the back of curb and Sidewalk; and
- (e) refer to the typical cross-sections for other details. Grade transitions shall be smooth and even, and shall be such that ponding cannot occur on the sub-grade surface. Debris, roots, branches, stones, building material, contaminated subsoil, visible weeds and anything else that may interfere with the proper growth and Development of the planted Boulevard, shall be removed from the sub-grade prior to installing the growing medium.

10. DRAINAGE

Drainage Systems connected to the municipal storm sewer system shall be provided under hard surfaced street tree planting areas.

11. IRRIGATION

Drip irrigation and controllers meeting City standards shall be provided where street trees are planted in hard surfaced street tree planting areas. All irrigation systems shall be metered.

12. LANDSCAPE LIGHTING

At the discretion of the Engineer, conduit from the nearest City electrical outlet to each tree pit shall be provided for all trees planted in hard surfaced street tree planting areas. Lighting systems acceptable to the Engineer may be required.

13. GROWING MEDIUM AND STRUCTURAL SOIL

- (a) Growing medium properties shall meet the needs of groomed and moderate areas. Growing medium shall be installed at the following minimum depths prior to shrub planting in non-hard surfaced areas (measured from top of sod thatch):
 - (i) sod only areas 150 mm;
 - (ii) ground cover areas 300 mm;
 - (iii) shrub areas 450 mm; and
 - (iv) street tree areas 600 mm.

SCHEDULE "F" (Cont'd)

- (b) Structural Soil shall be installed at the following minimum volumes and depths prior to installation of hard surfaces:
 - (i) where street trees are required in hard surfaced areas, shall be 600 mm deep over a minimum of 14 m² per tree (not including growing medium and root ball in the Planting pit); and
 - (ii) where street trees are required in non-hard surfaced areas, Structural Soil is required under the Sidewalks immediately adjacent to the trees and shall be 600 mm deep over a minimum 3.3 m² area.

14. PLANTING PROCEDURES - BOULEVARDS AND MEDIANS

- (a) All Plantings for Boulevards and median areas shall be delivered to the site and protected from sun and drying winds. Plants that cannot be planted immediately upon delivery shall be kept well watered. New plants shall not remain unplanted for longer than three (3) days after delivery.
- (b) Plants shall be planted so that after settlement they will be at the original growing medium depth. Allow for settling of the growing medium after planting so that the total depth of the root ball remains in the topsoil.
- (c) Plants shall be set plumb in the planting beds or planting pits, except where the plant's character requires variation from this.
- (d) Growing medium shall be placed in layers around the roots or ball, preferably by hand. Each layer shall be carefully tamped to avoid injuring the roots or ball, or disturbing the position of the plant.
- (e) Upon completion of the Plantings the soil shall be raked to remove any debris brought to the surface by planting operations. After raking the planting area shall be covered with a minimum 50 mm depth of bark mulch placed in an even layer over the entire soil surface.
- (f) Once planting and mulching is completed, the site shall be cleaned of all excess soil, rock and debris.

15. MAINTENANCE OF PLANTINGS

- (a) The Contractor is responsible for all necessary maintenance of Plantings for one year from the date of issuance of the Certificate of Substantial Completion (Landscape). This shall include any procedure necessary to maintain all plants in a healthy growing condition such as watering, weeding, staking, pruning and treatment for disease and pests.
- (b) All planting beds shall have weeds removed at least once per month during the growing season by hand pulling or hoeing.

SCHEDULE "F" (Cont'd)

- (c) Plantings are to be watered as often as required to ensure that no stress occurs to the plants during hot weather.

16. SUBSTANTIAL COMPLETION AND ACCEPTANCE

Warranty Periods for Plantings will relate to a substantial conformance with Landscaping designs, drawings and construction details as accepted by the Engineer. Acceptance of Plantings shall be awarded at the discretion of the Engineer following sufficient time to ensure establishment of growth and maturability.

SCHEDULE "F" (Cont'd)

SECTION NO. 10 – ENGINEERING STANDARD DESIGN DRAWINGS

1. GENERAL

- (a) The following Engineering Standard Design Drawings are attached to, and form part of, the Engineering Standards. They shall typically be included on or be referred to on design drawings submitted for construction.
- (b) All references to these Engineering Standard Design Drawings shall, in each instance, be understood to refer to the latest dated revision as issued by the City of Abbotsford Engineering Department.

General (G)

Typical Location of City Service Connections	ES-G-1
Typical Sewer Servicing.....	ES-G-2
Typical Storm Servicing	ES-G-3
Common Trench Installation	ES-G-4

Drainage (D)

Rainfall Intensity Duration Curves.....	ES-D-1
Drainage Analysis Sheet - Detention	ES-D-2
Drainage Analysis Sheet - Detention/Infiltration	ES-D-3
Drainage Analysis Sheet – Infiltration Trench Calculations	ES-D-4
Storm Sewer Design Table	ES-D-5

Sewer (S)

Hydraulic Element Chart.....	ES-S-1
Peaking Factor for Sanitary Sewer Design (Babbitt Curve).....	ES-S-2

SCHEDULE "F" (Cont'd)

Roadway (R)

Typical Urban Cul-de-sac	ES-R-1
Typical Urban Cul-de-sac-Offset Type	ES-R-2
Typical Major Intersection Configuration and Transitions	ES-R-3
Typical Intersection – Curb Radii & Truncations	ES-R-4
Urban Residential Access Lane (Centre drainage)	ES-R-5
Urban Residential Access Lane (One way cross-fall).....	ES-R-6
Urban Highway Design Features	ES-R-7
Typical Rural Culvert Arrangements	ES-R-8
Rural Residential	ES-R-9
Typical Temporary Hammerhead Turnaround – Residential	ES-R-10
Typical Rural Cul-de-Sac.....	ES-R-11
Typical Rural Cul-de-Sac- Offset type – 20 m Statutory Right of Way	ES-R-12
City-in-the-Country Plan lands CICIP Industrial Road Cross Section (applicable to infiltration rate greater than 50 mm/hr)	ES-R-13
City-in-the-Country Plan lands CICIP Industrial Road Cross section Constant Cross-Slope, Swale on one Side (applicable to infiltration rate greater than 50 mm/hr)	ES-R-14
City-in-the-Country Plan lands CICIP Industrial Road Cross Section (applicable to infiltration rate less than 50 mm/hr)	ES-R-15

SCHEDULE "F" (Cont'd)

SECTION NO. 11 – FORMS

1. The following forms are attached to, and form part of, these Engineering Standards and Specifications. They may typically be required, referred to and included with pre-design information and design drawing submissions.
2. All references to these forms shall, in each instance, be understood to refer to the latest dated revision as issued by the City of Abbotsford's Engineering and Regional Utilities department.

Certificate of Inspection and Request for Substantial Completion	Form F-1
Certificate of Substantial Completion (Landscape)	Form F-2
Certificate of Final Acceptance (Landscape)	Form F-3
Certificate of Substantial Completion	Form F-4
Certificate of Final Acceptance	Form F-5
Private Well Certification	Form F-6
Well Pump – Field Test Sheet	Form F-7
Certificate of Bacteriological Test	Form F-8
Certificate of Water Main Commissioning	Form F-9

SCHEDULE "F" (Cont'd)

Form F-1 CERTIFICATE OF INSPECTION AND REQUEST FOR SUBSTANTIAL COMPLETION

In accordance with Subsection 7 (ii) (e) of Schedule "F", I hereby certify that all engineering and construction services, required under Bylaw No. 2070-2011, cited as 'Development Bylaw, 2011', for the Development of:

LEGAL DESCRIPTION: _____

PROJECT NO: _____ SUB NO: _____

which Works and Services were designed by:

NAME OF FIRM: _____

Address: _____

and accepted for construction on Drawings numbered:

Drawing No.	Date	Drawing No.	Date
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

have been inspected by or under the direction of:

I further certify that the as-built drawings hereby submitted represent the Works and Services as installed for the aforementioned Subdivision or Development.

I further acknowledge that the following documentation has been provided to the City of Abbotsford Works Inspector:

Geotechnical Consultant:

1. summary letter of testing and all supporting data signed and sealed by the geotechnical engineer to confirm that all works met the City specifications and standards;
2. road sub grade inspection acceptance memo;
3. curb base and sub base materials density test;
4. road base and sub base materials density test;
5. curb Benkelman beam test results;
6. road Benkelman beam test results;

SCHEDULE "F" (Cont'd)

7. utility trench density test results;
8. Sidewalk base and sub base compaction test results and proof roll acceptance memo;
9. pavement Marshall tests results and core data;
10. curb concrete test results;
11. Sidewalk concrete test results;
12. rock retaining walls and slopes construction memo;
13. all other remaining walls are certified; and
14. building lot compaction test results (as appropriate).

Electrical Consultant:

Electrical Engineering Consultant has supplied a summary letter stating that all traffic signal and street light works have been inspected and meet City specifications and standards.

Civil Consultant:

Certification that is signed and sealed stating that the following works meet City specifications and standards:

1. submitted as built mylars, prints and electronic file in CD format;
2. water main pressure tests;
3. water main bacteriological sampling test results;
4. sewer main inspection video in DVD format and written inspection report;
5. sanitary sewer leakage test results;
6. Service Records Cards;
7. Hydrant Records Cards;
8. all legal pins have been replaced and monument replacement by the City have been paid for;
9. all Statutory Right of Ways have been registered; and
10. all construction deficiencies have been rectified to the satisfaction of the City Works Inspector.

Environmental Consultant:

SCHEDULE "F" (Cont'd)

Environmental Consultant has supplied a summary letter stating that all erosion and sediment control measures are in place and Development site is authorized.

A request for Substantial Completion is hereby submitted:



Engineer's Seal

Printed Name of the
Consulting Engineer
Responsible for Design

SCHEDULE "F" (Cont'd)

Form F-2 CERTIFICATE OF SUBSTANTIAL COMPLETION (LANDSCAPE)

FILE NO./SUB NO.: _____
PROJECT: _____
LOCATION: _____
DEVELOPER: _____
ADDRESS: _____

LANDSCAPE ARCHITECT: _____
ADDRESS: _____

This Landscape Certificate of Substantial Completion is issued pursuant to Section No. 1, 7(l) of Schedule "F" of the City of Abbotsford's Development Bylaw, 2011, Bylaw No. 2070-2011.

The WARRANTY PERIOD for the works shall **begin** on: _____

The WARRANTY PERIOD for the works shall **expire** on: _____

The Certificate of Final Acceptance (Landscape) will be issued:

- (i) following the expiration of the Warranty Period;
- (ii) when all deficiencies have been cleared; and
- (iii) when the Engineer is satisfied that all conditions of the Subdivision have been fulfilled.

The Landscape Certificate of Substantial Completion does not constitute acceptance of any of the Works and Services supplied, constructed, or installed by the Contractor.

Deficiency List attached: Yes
 No

Engineer

Date

cc: Developer/Consulting Landscape Architect
Administrative Manager
Manager of Arboriculture, Trails and Projects

SCHEDULE "F" (Cont'd)

Form F-3 CERTIFICATE OF FINAL ACCEPTANCE (LANDSCAPE)

FILE NO./SUB NO.: _____

PROJECT: _____

LOCATION: _____

DEVELOPER: _____

ADDRESS: _____

LANDSCAPE ARCHITECT: _____

ADDRESS: _____

This Certificate of Final Acceptance (Landscape) is issued pursuant to Section No. 1, 7(m) of Schedule "F" of the City of Abbotsford's Development Bylaw, 2011, Bylaw No. 2070-2011.

The WARRANTY PERIOD for the works **began** on: _____

The WARRANTY PERIOD for the works **expired** on: _____

The Certificate of Final Acceptance (Landscape) constitutes the acceptance of the landscape Works and Services supplied, constructed, or installed by the Contractor and that all landscape conditions of the Subdivision have been fulfilled.

TAKE NOTICE THAT the Warranty Period for the above works is satisfactorily complete and that the Engineer has accepted these works as of:

Date

Engineer

- cc: Developer/Consulting Landscape Architect
- Administrative Manager, Corporate Services
- Administrative Manager, Development Services
- Manager of Arboriculture, Trails and Projects

SCHEDULE "F" (Cont'd)

FILE NO./SUB NO.: _____
 PROJECT: _____
 LOCATION: _____
 DEVELOPER: _____
 ADDRESS: _____

 CONSULTING ENGINEER: _____
 ADDRESS: _____

This Certificate of Final Acceptance is issued pursuant to Subsection 7 (m) of Schedule "F" of the City of Abbotsford's Development Bylaw, 2011, Bylaw No. 2070-2011.

The WARRANTY PERIOD for the works **began** on: _____

The WARRANTY PERIOD for the works **expired** on: _____

The Certificate of Final Acceptance constitutes the acceptance of the Works and Services supplied, constructed or installed by the Contractor and that all conditions of the Servicing Agreement have been fulfilled.

TAKE NOTICE THAT the Warranty Period for the above works is satisfactorily complete and that the Engineer has accepted these works as of:

J. S. Gordon, P. Eng. Date
 General Manager, Engineering and Regional Utilities

Development Technologist _____

- | | |
|---|---|
| cc: Consulting Engineer
Finance (Administrative Manager)
Works Inspector
Public Works (Reception)
Mapping and Surveying | Dev Services Clerks (for scanning)
Park Planning and Design (Development Technologist II)
Engineering (Asset Manager)
Email to: financeam@abbotsford.ca |
|---|---|

Form F-6 PRIVATE WELL CERTIFICATION

Pursuant to Schedule "F" of the Development Bylaw, 2011, Bylaw No. 2070-2011, which requires that each Parcel to be created and/or each existing Parcel forming part of the proposed

SCHEDULE "F" (Cont'd)

Development shall be serviced with potable water in accordance with the requirements of the Bylaw for the Development of:

LEGAL DESCRIPTION: _____

PROJECT NO.: _____

I certify that a quantity of not less than 2,500 litres per day has been proven for each existing or proposed Parcel in the Development.

I certify that each well within the Development has been tested and is capable of continuously providing water at a rate of 9 litres per minute for a four-hour period.

I certify that water quality tests have been conducted and that the "Canadian Drinking Water Standards, (latest edition)" can be met for each existing or proposed Parcel in the Development.

Certified by:

Signature and Name of Consulting Engineer

Company Name

Address

Date



Engineer's Seal

SCHEDULE "F" (Cont'd)

Form F-8 BACTERIOLOGICAL TEST CERTIFICATE

Project: _____

Location: _____

City Drawing Number : _____

Test section(s): Sta. _____ to _____ Sta.

Watermain Size(s) _____

Pipe Material: _____

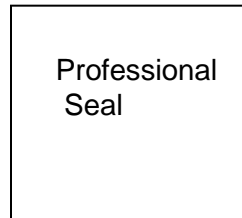
Date of Certificate _____

Sample Location(s) ID: _____

The test sample(s) identified above have been collected in accordance with AWWA standard C651 and delivered to a certified laboratory for testing. Chain of custody of the sample(s) was observed from the time of collection to the time of delivery at the laboratory.

All test results provided by the laboratory were within the limits set forth in AWWA standard C651.

(Consulting Engineer Signature)



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SCHEDULE "F" (Cont'd)

Form F-9 CERTIFICATE OF WATERMAIN COMMISSIONING

Project Description: _____

City Drawing No: _____

I hereby certify that the watermain(s) installed in this project has been installed according to MMCD and City of Abbotsford Development Bylaw Supplementary specifications and that:

- All watermain(s) passed pressure tests;
- All watermain(s) met 24 hour chlorine residual requirements, and
- A sealed bacteriological test certificate has been provided.

(Consulting Engineer's

Signature)

