



Town of Redcliff

DESIGN GUIDELINES

Prepared By:

TOWN OF REDCLIFF

May 2014



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(Reprinted by Permission of Trojan Industries Inc.)

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1. GENERAL CONDITIONS AND ENGINEERING PROCEDURES FOR MUNICIPAL DEVELOPMENT

1.1 GENERAL CONDITIONS

1.1.1 Scope

The developer is required to enter into a subdivision development agreement. Any conditions in the subdivision development agreement will supersede information contained in these design standards.

These design standards shall apply to the design and installation of the municipal infrastructure within new subdivisions and developments within the Town of Redcliff. They apply to the design and installation of storm and sanitary sewers, water mains, roads and sidewalks, together with their respective connections and appurtenances, and any other services that are required to be designed and/or installed.

These design standards also apply to the installation of water, sanitary sewer, and storm sewer services to existing properties, including surface reconstruction; the installation or alterations to roads, sidewalks, curb and gutter adjacent to existing properties; and the surface drainage of commercial, industrial, institutional and multifamily developments within the Town of Redcliff.

These design standards do not cover the design or installation of street lighting, ornamental lighting, power, gas, telephone and television services, but does include coordination with the various utility companies. The general location of such services must be approved by the Town.

The Standard Drawings, as referred to in various sections, will form an integral part of these design standards. Refer to latest editions of Town Construction Standards.

No departure from these design standards will be permitted except with written approval of the Town Engineer. The Town Engineer may give verbal approval to revisions that he considers being sufficiently minor. A Change Order shall be issued recording such revision.

1.1.2 Definitions

In these design standards, unless the context otherwise indicates, the following words shall have the meaning hereinafter assigned to them.

“Applicant”/“Developer” shall mean a person who has applied for the subdivision, development or installation to serve an existing parcel of land, whether as the Town or an agent for the Town of the land included therein.

“Contractor” will mean any person, persons or corporations that shall undertake the installation of Municipal Services on behalf of either the Applicant or the Town

“Developer’s Engineer” shall mean a qualified Professional Engineer registered and licensed to practice in the Province of Alberta, who is appointed or engaged by the Developer to be responsible for the design and preparation of drawings and specifications and provision of engineering supervision during the construction of the municipal improvements for the development area.

“Town Engineer” means the Town Manager of Engineering of the Town of Redcliff or the assigned designate.



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GENERAL CONDITIONS AND ENGINEERING PROCEDURES FOR MUNICIPAL DEVELOPMENT

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“Town shall mean or refer to the Town of Redcliff, in the Province of Alberta.

“Municipal Improvements” or “infrastructure” shall mean both underground and surface structures including, but not necessarily limited to, watermains, Sanitary sewer systems, storm drainage systems, roadways, walkways, park areas, shallow utilities, signage, fencing, street lighting, and other improvements as required by the Town, all of which shall become the property of the Town to operate and maintain.

“Prime Contractor” as defined by Occupational Health and Safety Act of Alberta.

1.2 PROCEDURE

1.2.1 Engineering Design

The Applicant shall retain the services of a Professional Engineer, registered and licensed to practice in the Province of Alberta, who shall be responsible for the design and preparation of drawings and specifications for all infrastructure (except natural gas, electric, lighting, telephone, cable, and power) to be constructed within and/or related to the proposed development area, as required, within the Town of Redcliff. All required municipal improvements shall be designed in accordance with accepted engineering practices and shall meet or exceed the Town of Redcliff Design Guidelines and Construction Standards as set out herein. If landscaping plans are deemed required by the Town Engineer the landscape plans will be prepared and stamped by a Landscape Architect or a Professional Engineer as required by Provincial Legislation.

For the installation of services or municipal infrastructure to serve an existing property, the applicant shall make application in writing on the appropriate form provided by the Town. These applications do not necessarily require engineer design; however, the applicant must provide proof that the installation will conform to these design standards. If the Town Engineer deems it necessary that the installation be monitored by a professional engineer, the applicant shall pay all costs for the monitoring.

The Design drawings must show all existing and proposed services. It shall be the responsibility of the Developer’s Engineer to coordinate with the utility companies to establish the location of their existing and proposed services.

The Developer’s Engineer shall be responsible for carrying out all surveys and investigations necessary to prepare the design. It shall further be the responsibility of the Developer’s Engineer to identify the need for any easements or additional right-of-way required. The plans and related documents shall be prepared by a qualified licensed Alberta Land Surveyor at the Developer’s expense.

The Developer’s Engineer shall bring to the attention of the Applicant the need for any right-of-way, outside the subdivision, that the Applicant will have to obtain. The applicant shall provide proof of right-of-way to the Town prior to the installation of services on such properties. Rights-of-way shall be assigned in the name of the Town or, as applicable, the utility company. The applicant is to pay all costs associated with registering the right-of-way and fulfill all terms and conditions associated with establishing rights-of-way.

While the Developer’s Engineer may arrange to have certain portions of the work carried out by other qualified persons, he shall remain responsible for the coordination of the work and certification of its quality and accuracy.



1.2.2 Geotechnical Report

As part of the Subdivision application, the Developer shall submit a Geotechnical Engineering Report, prepared by a qualified Professional Engineer that identifies and evaluates the subsurface ground characteristics of the subdivision development area. Each lot within the subdivision may be required (as noted on each building grade certificate) to have a foundation soil bearing investigation and certificate prior to Building Permit being issued. See Section 2.1.9.

Such report shall identify soil types and conditions, including frost susceptibility; soil stability, water table elevations, and footing design recommendation as well as any potential difficulties that could be encountered during the construction of the municipal improvements.

At the requirement of the Town, additional geotechnical information may be requested outlining recommended design and construction requirements and techniques that may have to be followed to satisfactorily develop the subdivision, particularly related to water and sewer main construction and roadway structures.

1.2.3 Submission of Engineering Design

Upon completion of the design drawings, the Developer's Engineer will submit to the Town Engineer, two (2) complete sets of stamped and signed drawings and specifications of the proposed works, including the following:

- a) Calculations of sanitary and storm sewer capacity, as shown on the overall sewer and water plan, and pipe loading, where these services are to be installed.
- b) Water distribution analysis as specified in Water Distribution Systems.
- c) A print of the register able plan of the subdivision (if not already supplied by the Applicant).
- d) A copy of the soils investigation report, judged by the Town to be pertinent to the stage of subdivision.
- e) A copy of the Contract Documents proposed for construction purposes.

All proposed streets should be named on the drawings. All street names are to be approved by Town Council as per street naming Bylaw 1365/2003.

1.2.4 Design Review

All design drawings, specifications, and relevant data will be examined by the Town Engineer, and any revisions directed to the Developer's Engineer and/or marked on the prints during the review shall be incorporated in the final design drawings.

1.2.5 Design Approval

Upon completion of all revisions, the Developer's Engineer shall submit four (4) complete sets of Contract Drawings and Specifications; and one electronic copy to the Town Engineer.

When the design is approved, the Town Engineer shall stamp "Approved for Construction" on the drawings, returning one set of the drawings to the Developer's Engineer, or issue a letter advising that the design is accepted and listing any conditions of acceptance.

No work will be commenced within any new parcel of land or any of the services to be provided by the Applicant until the Town has examined and stamped the revised Contract Drawings.



1.2.6 Rights-of-Way and Easements

Where easement or right-of-way documents are deemed necessary, they will be prepared by a registered Land Surveyor at the Applicant's expense. Rights-of-way and/or easements will be provided for all utilities not located on streets, lanes, or utility lots, including rights-of-way for ditches or water courses accommodating surface runoff. Rights-of-way shall be registered in the name of the Town or, as appropriate, in the name of the utility company. Ownership to be confirmed with the Town.

1.2.7 Construction Approval

Upon receipt of "Approved for Construction" drawings and specifications, the Applicant may proceed to install Municipal services subject to:

- a) Satisfactory execution of a Development Agreement pertaining to the development or subdivision.
- b) "Letter of Authorization or copy of notification letter" from Alberta Environment, through the Developer's Engineer, and a copy received by the Town Engineer.
- c) A list of materials that are being installed and a construction schedule submitted to the Town's engineering office.

A copy of all approved drawings and specifications will be maintained by the applicant at the construction site during the installation of services and be made readily available to Town representatives.

Underground subdivision services will not be permitted to operate as part of existing Municipal services until the respective subdivision services have been inspected, tested by the Developer's Engineer and the test results have been approved in writing by the Town Engineer.

1.2.8 Engineering Supervision

The applicant shall retain the services of an Engineer who shall be responsible for the layout to ensure finished construction conforms to the lines and grades shown on the approved plans for inspection and approval of all materials to be used, and for supervision of installation of all services, that are the responsibility of the Applicant. The Developer's Engineer, or his authorized representative, shall be available at all times to visit the site during the installation of services.

The Developer's Engineer will be responsible for maintaining field surveys and recording of all "as-built" drawings.

In addition to supervision carried out by the Developer's Engineer, the Town Engineer, or his agent, may periodically inspect any work being completed. The Town Engineer will bring the use of any unacceptable materials or practices to the attention of the Contractor and/or the Developer's Engineer.

If remedial action is not taken to the satisfaction of the Town Engineer, he may order the work to cease until such time as the corrective action has been taken.

If the Developer's Engineer wishes to make any changes in the design, either before or during the execution of the work, he will first submit a marked print, showing proposed revisions, to the Town Engineer. If approval is granted for revision, the original drawing will be immediately revised and new prints issued.

1.2.9 Testing

It will be the responsibility of the Developer's Engineer to ensure that testing of all materials called for in the specifications is carried out by an accredited testing firm. Copies of all test results shall be



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GENERAL CONDITIONS AND ENGINEERING PROCEDURES FOR MUNICIPAL DEVELOPMENT

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forwarded to the Town Engineer as soon as possible after completing the tests. The costs of the tests shall be borne by the Developer.

1.2.10 As-Built Drawings

Within three weeks of the Construction Completion Certificate of the underground improvements, the Developer's Engineer shall deliver to the Town Engineer "as-built" prints indicating the service connections, tie-ins, invert charts on plan/profiles, and service invert elevations on lot grading plans. All as-built plans must also be submitted in digital format compatible with the Town's latest version of AutoCAD.

No development permits or building permits will be processed until the Town receives a set of as-built prints, including completed design building grade forms for **each lot**. As an exception, one show home may be constructed with the written approval by the Town Engineer, provided the subdivision design grades have been submitted and approved.

Within two months of completion of roadway base course asphalt and top lift if applicable, the Developer's Engineer will deliver two complete sets of prints, digital pdf and digital AutoCAD drawings (compatible with the Town's latest AutoCAD software version) of the as-built records to the Town Engineer.

1.2.11 Substantial Performance

When the Contractor is of the opinion that the Work is substantially performed, he may issue a notice to the Engineer on behalf of the Town requesting an inspection of the work.

The Engineer, on behalf of the Town, shall, within five (5) working days of receipt of the notice, make an inspection and assessment of the Work. The Engineer shall, within five (5) days of his inspection, notify the Contractor, in writing, of his approval or disapproval to issue a Substantial Performance Certificate. Refer to section 1.3

A Substantial Performance Certificate shall, state that the Work, or a substantial part of the Work, under the Contract or a Subcontract is ready for use; or is being used for the purposes intended. The Engineer shall separately identify the cost of completing or correcting any unfinished Work; list the items of the Work that cannot be completed expeditiously on account of climatic or other reasons beyond the control of the Contractor or Subcontractor, and that do not impair the usefulness of the Work for the purposes intended.

However contractors' negligence's to finish all items of work may result in rejection of the Substantial Performance Certificate.

The Engineer shall, in his absolute discretion, determine the Deficiency Holdback and certify a list of defects and/or deficiencies in the Work.

Upon issuance of Substantial Performance Certificate contractor will post the signed certificate copy of it in a conspicuous place on the job site to which the certificate relates so that persons working or furnishing materials have reasonable opportunity of seeing the certificate.

Similarly, the engineer and the owner can place the signed copy of the Substantial Performance Certificate in such a location in their office which is visible to the public.



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1.2.12 Municipal Acceptance and Maintenance Period

The Developer shall apply for a Construction Completion Certificate (CCC) for each group of improvements for each stage of development. A Construction Completion Certificate will be required by the Developer from the Town for each group of the following improvements to be constructed and installed by the Developer; namely:

- a) Sanitary and storm sewers, and water distribution system, including service connections for water and sewer.
- b) Sidewalks, curbs and gutters, ditches and culverts, concrete walkways, and paved and gravelled lanes.
- c) Paved Roads, including line painting and traffic signage (if required).
- d) Landscaping, including boulevards, uniform fencing, and subdivision signage.

The Town Engineer shall be given 7 days notice to attend CCC and FAC inspections. Blank forms for CCC and FAC, refer to section 1.4 and 1.5

The Developer (or developer’s representative) shall make application to the Town for the issuance of a Construction Completion Certificate. It is strongly recommended to send this application to Town within 45 days of the construction completion. No such application will be considered by the Town unless it is requested in respect of all of the Development Area or one or more approved stages of development.

The Town may issue a Construction Completion Certificate, or provide a list of deficiencies that must be corrected in order to obtain a Construction Completion Certificate. The details of the process will be outlined in the development agreement.

The Developer shall maintain all Municipal Improvements constructed pursuant to this Agreement to the standard to which they were constructed, reasonable wear and tear excepted, for the period commencing upon the issuance of a Construction Completion Certificate and continuing for the periods as stated in the table below:

Table for Maintenance Period

Underground Services and Utilities	- 24 months
Roads and Sidewalks	- 24 months
Uniform Fencing, grass and sod for landscape areas	- 24 months

Upon completion of the Maintenance Period, and after final inspection and correction of all deficiencies thereof, a Final Acceptance Certificate (FAC) will be issued by the Town Engineer or the designate, upon application by the developer.

1.2.13 Development Permits

No Development Permits will be issued by the Planning and Development Department until the subdivision is registered, all essential services have been provided as specified in the Development Agreement, and underground utility service as-built prints have been submitted and accepted by the Town Engineer.

1.2.14 Existing Utilities

Prior to connecting to existing utilities, the Town’s Utilities Department shall be given a minimum of two working days notification of the work being done.

Once operational, hydrants or main line valves shall only be operated by Town staff.



No sanitary sewers will be used to discharge storm water.

1.2.15 Road Closures and Construction Within Road Rights-of-Way

In the event that a road must be partially or fully closed due to construction activity, the party causing this event will provide all detours, signs, flag persons, barricades, and other safety requirements necessary to provide for the orderly control of traffic around the construction area. A traffic accommodation must be submitted to the Town (Engineering Department and Public Services) for review and once approved, distributed to affected agencies.

1.2.16 Survey Control System

The Developer shall provide a survey control system within, and adjacent to the subdivision. The survey control system shall consist of survey monuments of a design mutually acceptable to the Town and Alberta Environment, Land Administration Division. The survey monuments shall be placed so as to be inter-visible between adjacent pairs and spaced approximately 300 metres apart. Measurements shall be made between monuments, and connection shall be made to existing geodetic monuments to not less than third order specifications, as defined by the Geodetic Survey of Canada, to establish vertical and horizontal coordinates based on a three degree transverse Mercator projection. The Town and Alberta Environment, Land Administration Division, shall be provided with the survey measurements, to the satisfaction of the Director of Surveys, Alberta Environment, Land Administration Division, for the survey control system.

The Developer shall undertake to preserve all existing and new monuments and, should it be necessary to destroy a monument, the Developer shall establish a new one in lieu thereof and provide the Town and Alberta Environment, Land Administration Division, with survey measurements for it to the satisfaction of the Director of Surveys.

Any legal pins disturbed or removed during construction must be replaced prior to Final Acceptance by the Town. The Developer shall supply a certificate from a registered legal survey that all lot and corner pins are intact.



DESIGN GUIDELINES

**GENERAL CONDITIONS AND ENGINEERING
PROCEDURES FOR MUNICIPAL DEVELOPMENT**



**PERMIT TO CONSTRUCT
On Town Property/Public
Lands**

Town of Redcliff
Box 40, #1- 3rd Street N.E.
Redcliff, AB. T0J 2P0
Tel. (403) 548-3618
Fax. (403) 548-6623

Project Address: _____

Roll #: _____ Lot: _____ Block: _____ Plan: _____

Application Date: _____
(yy/mm/dd)

Applicants Name: _____	Contractor
Name: _____	Billing Address: _____
Address: _____	Address: _____
Town/Prov.: _____	Town/Prov.: _____
Telephone: _____	Telephone: _____
Fax: _____	Fax: _____
	Postal Code: _____

Type of Work Proposed:

Concrete Work

- Sidewalk
- Curb and Gutter
- Driveway Approach
- Asphalt
- Pavement Cut

Utilities

- Water – size and type: _____
- Sewer – size and type: _____
- Storm – size and type: _____
- Gas - size and type: _____
- Telephone
- Cable

Open Ditch Inspection Date: : _____
(yy/mm/dd)

Closed Ditch Inspection Date: _____
(yy/mm/dd)

Inspector: _____

Approved: : _____ Rejected: _____

Reasons for Rejection: _____

Roads

- Road closure
- Paving & gravelling
- Dust control
- Pavement markings
- Signage
- Street Cleaning

Length of time for Road Closure: _____

Boulevards/Green spaces

- Trees
- Turf
- Rock

Other

Project Description:

Drawing attached Yes \ No

Project Start Date: _____
(yy/mm/dd)

Estimated Completion Date: _____
(yy/mm/dd)



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GENERAL CONDITIONS AND ENGINEERING PROCEDURES FOR MUNICIPAL DEVELOPMENT

Conditions

1. All work is to meet the Town of Redcliff engineering standards. Failure to have work inspected will result in the removal of backfill material at the cost of the builder to allow inspector access to work in question.
2. A two-year warranty is to be given to any work and repair beginning on the date of completion.
3. The Town's approved Traffic accommodation plan from the Engineering Department must be followed.
4. Occupational Health and Safety standards must be met (vests, PPE, excavation side slopes, etc.).
5. Any excavation on roadways must be backfilled and cold mix placed in the hole within 48 hours. Hot mix must be placed in hole by October 31 of that year.
6. Inspection is mandatory for all utilities – bedded in sand, all joints and connections exposed
 Note: inspections outside of normal working hours (8:00 AM to 5:00 PM, Mon – Fri) will be subject to a fee of \$50.00.
7. Street must be returned to clean condition prior to opening road to public. Street abutting construction site must be kept clean at all times.
8. All field testing results must be submitted to the Town's Engineering Department for approval.

I, _____, acknowledge that I have received, read and understand all of the above, and I further acknowledge my commitment to the conditions stated in this form.

Date

Applicant's Signature

Print Name

DECISION:

The application to construct is hereby :

1. Approved subject to the following conditions:
2. Refused for the following reasons:

CONDITIONS OF APPROVAL \ REASONS FOR REFUSAL:

Town representative

The personal information on this form is collected under the authority of Section 33 (c) of the Alberta Freedom of Information and Protection of Privacy Act (FOIP) for the purpose of application for Permit to Construct. If you have any question about the information being collected, contact the Town of Redcliff FOIP Coordinator at 403-548-3618



DESIGN GUIDELINES

GENERAL CONDITIONS AND ENGINEERING PROCEDURES FOR MUNICIPAL DEVELOPMENT

1.3 CERTIFICATE OF SUBSTANTIAL PERFORMANCE OF THE CONTRACT UNDER SECTION 19 OF THE CONSTRUCTION LIEN ACT, JULY 2012

 <p>Town of Redcliff</p>	<p>SUBSTANTIAL PERFORMANCE CERTIFICATE</p>
--	---

Development Area: _____ Development Name: _____

Developer: _____

THIS IS TO CERTIFY THAT THE CONTRACT FOR THE FOLLOWING IMPROVEMENT

Description: _____

TO THE ABOVE PREMISES WAS SUBSTANTIALLY PERFORMED ON:

Date: _____

THE WORK IS BEING USED FOR THE PURPOSES INTENDED AND THE WORK TO BE COMPLETED UNDER THE CONTRACT IS CAPABLE OF COMPLETION OR CORRECTION AT A COST NOT EXCEEDING \$ _____

Date this certificate was signed:

Date: _____

PAYMENT CERTIFIER:

per: _____

Name of Owner: Address for Service:	Town of Redcliff Engineering Department 1 - 3 rd Street NE Mail: P.O. Box 40 Redcliff, AB T0J 2P0	Phone:
Name of Contractor: Address for Service:		Phone:
Name of Certifier:		Phone:

A. Office to which claim for lien and affidavit must be given to preserve lien (where liens do not attach to premises)

Town of Redcliff
Engineering Department
1 - 3rd Street NE
Mail: P.O. Box 40
Redcliff, AB T0J 2P0



DESIGN GUIDELINES

**GENERAL CONDITIONS AND ENGINEERING
PROCEDURES FOR MUNICIPAL DEVELOPMENT**

1.4 CONSTRUCTION COMPLETION CERTIFICATE

 <p style="font-size: 1.2em; margin-top: 10px;">Town of Redcliff</p>	<p style="font-size: 1.2em; margin-top: 10px;">CONSTRUCTION COMPLETION CERTIFICATE</p>
<p>Development Area: _____ Development Name: _____</p> <p>Developer: _____ Subdivision No. (if applicable): _____</p> <p>Contractor: _____ Service Agreement / Contract Date: _____</p> <p>Municipal Improvement: _____</p> <p>Location of Municipal Improvement referred to herein is as shown, outlined in red, on the plan on the reverse hereof (or see attached).</p> <p>Date of Application: _____</p> <p>PURSUANT TO THE DEVELOPMENT AGREEMENT, I _____ OF THE FIRM "DEVELOPER'S ENGINEERS", HEREBY CERTIFY THAT AS OF THE ABOVE DATE, THE SAID MUNICIPAL IMPROVEMENT IS COMPLETE AND CONSTRUCTED IN ACCORDANCE WITH THE SERVICING STANDARDS AS SET OUT IN THE DEVELOPMENT AGREEMENT, AND I HEREBY RECOMMEND THIS MUNICIPAL IMPROVEMENT FOR ACCEPTANCE.</p> <p>_____ Project Engineer (Seal) (Developer's Engineering Firm) Date: _____</p> <p>_____ Signing Officer (Developer's Engineering Firm) Date: _____</p> <p>_____ Authorized Town Inspector Date: _____</p> <p>Approved on (date): _____ Town Engineer: _____</p> <p>Conditions: _____ (or see attached report)</p> <p>Rejected on (date): _____ Town Engineer: _____</p> <p>Reason for rejection: _____ (or see attached report)</p> <p>I HEREBY CERTIFY THAT THE ITEMS LISTED AS REASONS FOR CONDITIONAL APPROVAL OR FOR REJECTION HAVE BEEN CORRECTED.</p> <p>_____ Project Engineer (Seal) (Developer's Engineering Firm) Date: _____</p> <p>Approved: _____ Date: _____ Town Engineer</p> <p>Date Maintenance Period to Start: _____</p> <p>Date Maintenance Period to Expire: _____</p>	



DESIGN GUIDELINES

GENERAL CONDITIONS AND ENGINEERING PROCEDURES FOR MUNICIPAL DEVELOPMENT

1.5 FINAL ACCEPTANCE CERTIFICATE

 <p style="font-size: 1.2em; margin-top: 10px;">Town of Redcliff</p>	<p style="font-size: 1.2em; margin-top: 10px;">FINAL ACCEPTANCE CERTIFICATE</p>
<p>Development Area: _____ Development Name: _____</p> <p>Developer: _____ Subdivision No. (if applicable): _____</p> <p>Contractor: _____ Service Agreement / Contract Date: _____</p> <p>Municipal Improvement: _____</p> <p>Location of Municipal Improvement referred to herein is as shown, outlined in red, on the plan on the reverse hereof (or see attached).</p> <p>Date of Application: _____</p> <p>Maintenance Expiry Date: _____</p> <p>PURSUANT TO THE DEVELOPMENT AGREEMENT, I _____ OF THE FIRM "DEVELOPER'S ENGINEERS", HEREBY CERTIFY THAT AS OF THE ABOVE DATE, THE SAID MUNICIPAL IMPROVEMENT MEETS ALL REQUIREMENTS FOR FINAL ACCEPTANCE AS SPECIFIED IN THE DEVELOPMENT AGREEMENT AND I HEREBY RECOMMEND THIS MUNICIPAL IMPROVEMENT FOR FINAL ACCEPTANCE.</p> <p>_____ Date: _____ Project Engineer (Seal) (Developer's Engineering Firm)</p> <p>_____ Date: _____ Signing Officer (Developer's Engineering Firm)</p> <p>_____ Date: _____ Authorized Town Inspector</p> <p>Approved on (date): _____ Town Engineer: _____</p> <p>Conditions: _____ (or see attached report)</p> <p>Rejected on (date): _____ Town Engineer: _____</p> <p>Reason for rejection: _____ (or see attached report)</p> <p>I HEREBY CERTIFY THAT THE ITEMS LISTED AS REASONS FOR REJECTION HAVE BEEN CORRECTED.</p> <p>_____ Date: _____ Project Engineer (Seal) (Developer's Engineering Firm)</p> <p>Approved: _____ Date: _____ Town Engineer</p>	

END OF SECTION



2. PREPARATION OF ENGINEERING DRAWINGS

2.1 DESIGN DRAWINGS

2.1.1 Scope

The following specifications will govern the preparation of Engineering Drawings for all Municipal Developments.

2.1.2 Drawing Size

The Standard Drawing size 24" X 36" will be used.

2.1.3 Scales

Urban Residential/industrial and Rural Industrial drawings shall be prepared using the following scales:

Overall Plans	1:1000 or 1:500
Plan/Profile	Horizontal 1:500 Vertical 1:50
Cross-Sections	Horizontal 1:100 Vertical 1:50

Rural Residential drawings shall be prepared using the following scales:

Overall Plans	1:2000
Plan/Profile	Horizontal 1:1000 Vertical 1:100
Cross-Sections	Horizontal 1:1000 Vertical 1:100

Scale overall plans so drawing is clear, uncluttered, and text is legible.

2.1.4 Drawing Technique

Points of drawing technique that are significant to the preparation of drawings are as follows:

- a) Care in ensuring balanced distribution of detail throughout the drawing.
- b) Letters and figures shall be clearly legible, 2 mm size or larger (Leroy or equivalent), well-spaced, properly formed and proportioned.
- c) Lines shall be uniform in weight and density.
- d) Dimensioning shall be in the metric system. Dimensioning of a drawing is extremely important and should be such that it will not be misinterpreted. Dimensions should be given from an iron pin, lot line, a centreline or any other reference that can be readily established. Wherever possible, all dimensions shall be provided to a minimum of two (2) property lines.



2.1.5 Title Block

All drawings must clearly show the following in the title block:

- a) Developer's / Town's Name.
- b) Developer's Engineer or consulting engineering name.
- c) Subdivision name, civic and legal address if available including staging and / or phasing.
- d) Drawing name, number and issue date.
- e) Drawing scale, including horizontal and vertical axis.
- f) Space for dates and signature of the designer, draftsman, reviewer or checker, and approving professional or principal.
- g) Space for professional stamps and permits.
- h) Space for revisions, including number, date, description, and approved signature.

2.1.6 General Requirements for All Drawings

Elevations will be relative to the Geodetic datum. The reference bench marks and elevations will be shown on the design drawings.

A north arrow, the name of the subdivision and, where appropriate, phase as included in the Development Agreement, adjacent lots and plan numbers, street names and the legal description of the parcel being subdivided, will all be shown on the drawing. In general, the north arrows should be orientated toward the top of the plan.

An Engineer's stamp and Permit to Practice stamp, signed by an Engineer registered in the Province of Alberta, will be shown on the engineering drawings.

2.1.7 Required Engineering Drawings

The following plans will form a part of the design drawings set:

Cover Sheet:

This will show the name of the subdivision, stage of development, location plan, Town logo, and names of the Developer and Developer's Engineer. Space permitting, the index plan may be included here. A key plan of Town of Redcliff, or a significant portion thereof, shall be included, illustrating the location of the development or project.

Index Plan:

This plan will be prepared on a scale of 1:1000, or a reduction thereof to fit the standard size sheet, and will indicate that portion of the street that relates to a particular plan/profile sheet.

Road, Sidewalk and Lanes Plan:

This plan will be drawn to a scale of 1:1000 and will show all locations and widths of roads, lanes, sidewalks, walkways, trails and right-of-way widths and alignment, as well as all proposed approaches, catch basins and fencing.



Storm Layout Plan

This plan will be drawn to a scale of 1:1000 and will indicate the alignment, location, size, type, grade and length of all sanitary sewer including manholes and catch basins.

Water Layout Plan

This plan will be drawn to a scale of 1:1000 and will indicate alignment, location, size and type of all watermains, including valves, ties, bends, hydrants, couplers, and plugs.

Building Grade Plan

This plan will be drawn to a scale of 1:1000 and will indicate finished lot corner elevations, grades and direction of flow, service locations, minimum finished grades, lowest top of footing and sanitary service elevation at property line.

Overland Drainage Plan

This plan will be drawn to a scale of 1:1000 and will indicate contours at 0.5 m spacing. Areas of trapped lows will be shown shaded and direction of surface drainage with slopes shown along roadways will also be shown.

Storm Drainage Plan

This plan will be drawn to a scale of 1:1000 and will indicate drainage areas (in Ha), including storm sewer and manholes. A table showing storm design calculations will also be included.

Detailed Plan/Profile drawings:

Plan/Profile drawings shall be drawn to a scale of 1:500. The profile portion shall have a 10 times vertical exaggeration.

2.1.8 Detailed Plan/Profile

Generally, all underground services and surface improvement profiles are shown on the same drawing. The plan portions of the sheet shall be above the profile (surface and underground features should be separated into two views), the profile shall be below the plan views, and the title blocks, revisions, legends, company stamps, and similar features will be placed along the side and/or bottom of the sheet.

The following information will be included on the detailed plan/profile drawings:

Requirements for Sanitary and Storm Sewer:

The following information will be shown on the profile:

- a) Size, type, class of pipe and class of bedding.
- b) Length and percent grades between manholes.
- c) Invert elevations at both inlet and outlet of manholes.
- d) Rim elevations at finished grade.

The following information will be shown on the plan:



- a) Tie location of manholes, cleanouts, and other appurtenances to property lines.
- b) Pipe offsets from property line.

The following additional information will also be shown on an appropriate part of the drawing:

- a) Manholes shall be numbered.
- b) Where the sanitary sewer or water and storm drain are to be installed in a common trench, detail a typical cross-section showing distance between pipes, class of pipe and bedding.

Requirements for Water:

- a) Tie location of hydrants, water valves, and other appurtenances to property lines. Note the offset of the main from the property line.
- b) Indicate extent of work required in making the connection to the existing water main.
- c) Indicate the size, type, class of pipe and bedding on the plan.

Requirements for Roads:

- a) Both plan and profile must be tied to a property pin, preferably near or at 0 +000 chainage.
- b) Show the road width and the curb offsets measured from the property line to the curb face.
- c) Chainages of the BC and EC of horizontal curves will be shown together with the delta angle, radius, tangent length and arc length for each curb.
- d) The percent grade, to two decimal places, shall be shown on the profile, together with the following information on vertical curves:
 - 1) The chainages and elevations of BVC, EVC and PVI.
 - 2) The external value, "E";
 - 3) The length of vertical curve.
 - 4) The elevation and chainage of the low spot of sag curves or the high spot of crest curves.
- e) Road profiles will show the Lip-of-Gutter elevations.
- f) The profile will be shown at true centreline length and projected above the plan in as close a relationship as possible.
- g) Locate manholes (using road chainage) and show leads between the catch basin and manhole.
- h) Label limits of construction.

2.1.9 Building Grade Plan Requirements

This plan will include:

- a) Invert and location of sewer and water services.
- b) Design lowest top of footing elevation.
- c) Proposed finished lot corner elevations.



- d) Proposed finished lot elevations at grade break points.
- e) Critical (undisturbed) native ground elevation.
- f) A site plan prepared by survey company.
- g) The grading plan will identify lots with weak subsoil conditions and have a notation indicating the requirement for a geotechnical engineer's footing design.
- h) The grading plan will identify all lots with areas of 1.0 m of fill or greater, with these lots shaded a different colour.
- i) Suggested garage location.
- j) Surface shallow utility infrastructure (pedestals, transformers, light standards, etc.) directly adjacent to the lot, and associated UROW's/Easements.
- k) Fire hydrants directly adjacent to the lot.

2.1.10 Power, Gas, Telephone and Cable Utility Plan Requirements

This plan will include:

- a) Street Light Locations.
- b) Dimension of all Easements.
- c) Location of pedestals, transformers, cabinets, and other hardware.
- d) Lot Numbers.
- e) Street and Avenue, names etc.
- f) Existing shallow utility line locations, based on actual field locates and a site survey.

2.2 AS-BUILT DRAWINGS

2.2.1 Scope

This procedure pertains to the as-built drawings of the following services:

- a) Storm and sanitary sewers, watermains, roads, curbs & gutters, sidewalks, culverts and other miscellaneous permanent structures.

2.2.2 General

The as-built drawings shall be affixed with the stamp and seal of a Professional Engineer who, by signing, is certifying the information to be accurate and correct.

The as-built drawings will clearly show the locations of all services, curb stops, valves, hydrants and manholes, using right angle measurement from survey pins or property lines.

Red line as-built drawings are to be submitted for review, indicating changes.

Two complete sets of the as-built drawings are to be submitted to the Town Engineer, within three months of the installations.



The as-built drawings referred to in this section will also be submitted to the Town Engineer in digital format, as per the following requirements:

- a) Must be compatible with the Town version of AutoCAD.
- b) Accompanied by a layer list and description.
- c) Will conform to layering and symbol standards as established by the Town or their consultant.
- d) Be submitted on CD ROM.

On as-built drawings submitted to the Town, the following information will be included on each drawing:

- a) Date of completion.
- b) Name of the contractor.
- c) Date on which "as-built" details were added.

2.2.3 Storm and Sanitary Sewer

The following information will be included for storm and sanitary sewer systems:

- a) Size, pipe material, pipe class, bedding and location of mains.
- b) Location of manholes, cleanouts, and other appurtenances.
- c) Grades, lengths, inverts of mains and rim elevation.
- d) Profile of pipe top and bottom.
- e) Corrected flow calculations.

2.2.4 Water

The following information will be included for water systems:

- a) Size, type and location of pipe.
- b) Location of valves, tees, hydrants and other appurtenances.
- c) Profile of pipe top and invert.

2.2.5 Road, Curb, Sidewalks

The following information will be included for roads, curbs, and sidewalk:

- a) Location of curbs, sidewalks and elevations of tops-of-curb or lip-of-gutter.
- b) Top-of-curb or lip-of-the gutter for each curb.
- c) End of curb, sidewalks and pavement.
- d) Type of road structure on overall road plan and each plan profile.
- e) A typical cross-section referencing the above and representing all conditions.



2.2.6 Water, Sanitary, and Storm Services Connections

A table on each plan/profile drawing will be prepared giving the following information with respect to service connections:

- a) Lot, Block, and Plan number.
- b) Distance of service saddle from the downstream manholes.
- c) Invert elevation at the end of sanitary and storm service.

The service connection provided to each lot will be shown on the plan and the location triangulated to the property lot corners.

The typical location of the curb stop will be identified on each plan/profile, (i.e. 2.65m F.O.W., 0.30m B.O.W.) by means of a table chart.

2.2.7 Mechanical Systems

Where the subdivision includes mechanical systems, such as lift stations, the Developer will provide design calculations and detailed drawings of the facility, as well as three (3) operation/maintenance manuals, including the make and model of all equipment, to the satisfaction of the Town.

2.2.8 Building Grade Forms

Prior to issuance of a Construction Completion Certificate for water, sanitary, and storm services, the Developer shall provide to the Town the relevant Building Grade Form for each lot in the Development.

As outlined in the Development Agreement, Development Permits or building permits will not be released until all of the conditions outlined in the Development Agreement are met.

Building Grade Information:

The following information shall be shown on the Building Grade Form:

- a) Water, sanitary, and/or storm services location and inverts at property line or easement line.
- b) Design lowest top of footing elevation.
- c) Proposed finished lot corner elevations.
- d) Minimum finished grade at midpoint of lot.
- e) Proposed finished lot elevation at grade break point.
- f) Critical native (undisturbed) ground elevation.
- g) Identify if the lot will require a Foundation Soil Bearing Investigation and Certification by checking off the appropriate field on the form.
- h) Power, telephone, and cable television service location.
- i) Sidewalk and boulevard width.
- j) Surface shallow utility infrastructure (pedestals, transformers, light standards, etc.) directly adjacent to the lot, and associated UROW's/Easements.
- k) Fire hydrants directly adjacent to the lot.
- l) Suggested garage location.



- m) Arrows indicating the lot drainage pattern.
- n) Location of the street and lane.
- o) Minimum building opening elevation (MBOE). This must be a minimum of 300mm above the trap low high water elevation in a 1:100 year storm event.

This information shall be provided in the form as shown on the sample Building Grade Form.

Grade slips will be numbered as follows:

Lot Number - Block Number

(For example: The Building Grade Form for Lot 35 of Block B, shall be numbered 35-B.)

The accurate registered plan number and civic address (if available) must also be provided on the Building Grade Form.

The Building Grade Forms are also to be given to the Developer, who then distributes to purchasers of the lot(s). It is the Developer's (and subsequently the purchaser's) responsibility to review all information contained on the building grade forms.

END OF SECTION



DESIGN GUIDELINES

PREPARATION OF ENGINEERING DRAWING

TOWN OF REDCLIFF PLANNING & ENGINEERING DEPARTMENT #1 - 3rd STREET N.W. REDCLIFF, AB PHONE: (403) 548-9283		<h3>BUILDING GRADE FORM</h3>		GRADE SLIP NO. 3-15	
		JOB NO. 12345678		SUBDIVISION KIPLING PH 3	
ADDRESS XXX - REDCLIFF WAY SE		DEVELOPER TOWN OF REDCLIFF		CONSULTANT TOWN OF REDCLIFF	
LOT 3	BLOCK 15	REG'D PLAN NO. XXXXXXX		BUILDER _____	
ADDRESS _____				REPRESENTATIVE _____	
ADDRESS _____				PHONE NO. _____	

PROPOSED BUILDING GRADES

ALL ELEVATIONS ARE: METRIC GEODETIC

LEGEND

- H UTILITY PEDESTAL
- TRANSFORMER
- STREET LIGHT
- FIRE HYDRANT
- XX.XX REAR GRADE AT PROPERTY LINE
- XX.XX DISTANCE OF SHALLOW UTILITY SERVICES FROM E (WHERE APPLICABLE)
- SA XX.XX SANITARY INVERT INSIDE PROPERTY
- LTF. XX.XX LOWEST TOP OF FOOTING
- MFG. XX.XX MINIMUM FINISHED GRADE
- MBOE. XX.XX MINIMUM BUILDING OPENING ELEVATION
- CRIT. XX.X (F. SER.) CRITICAL ELEVATION (NATIVE GROUND)
- X (XXX) SERVICING FROM FRONT OF LOT (R REFERS TO REAR OF LOT)
- LOT NUMBER
- HOUSE NUMBER
- LOT DRAINAGE PATTERN ARROWS
- SUGGESTED DRIVEWAY LOCATION
- UTILITY RIGHT OF WAY
- DISTANCE OF WATER & SANITARY SERVICES FROM E (WHERE APPLICABLE)
- XX.XX FRONT GRADE AT PROPERTY LINE
- XX.XX SERVICE LOCATION INTO LOT

UTILITY RIGHT OF WAYS ARE X.Xm WIDE UNLESS OTHERWISE STATED

ADDITIONAL REQUIREMENTS

	FRONT	REAR	CENTERED	REFER TO PLAN	SIZE	TYPE	YES	NO
SANITARY	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	100mm	PVC	<input checked="" type="checkbox"/>	<input type="checkbox"/>
STORM (WTD)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>
WATER	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	25mm	PVC	<input checked="" type="checkbox"/>	<input type="checkbox"/>

BUILDING SETBACKS 8m FRONT 8m BACK 1.5m SIDE

GROUND WATER DRAIN WITH BACKFLOW PREVENTER TO SEWER REQUIRED (WTD)

GROUND WATER DRAIN TO SUMP PUMP REQUIRED

WATER PRESSURE REDUCING VALVE REQUIRED (PRV)

SERVICE INSTALLED 3.50m INSIDE OF PROPERTY

HIGH SULFATE CONCENTRATIONS PRESENT IN THE SOIL SULPHATE RESISTANT CEMENT (TYPE 80) REQUIRED

ADDITIONAL SULPHATE REQUIREMENTS (SEE NOTE BELOW)

FOUNDATION SOIL BEARING INVESTIGATION AND CERTIFICATION REQUIRED (SEE NOTE BELOW)

GEOTECHNICAL RESTRICTIONS APPLY

UTILITY EASEMENTS

FOOTING ELEVATION CHECK REQUIRED PRIOR TO POURING (MAX. 100MM DEVIATION) (NOTIFY ENGINEER 48 HOURS IN ADVANCE - FOR LOTS PURCHASED FROM THE TOWN, THE FOOTING CHECK IS ARRANGED BY AND THE COST IS COVERED BY THE TOWN) (TOWN OF REDCLIFF PLANNING AND ENGINEERING, OFFICE: (403) 548-9283; CELL: (403) 548-4378)

MINIMUM GRADE CHECK REQUIRED PRIOR TO COMPLETION (MAX. 100MM DEVIATION) (NOTIFY ENGINEER 48 HOURS IN ADVANCE - COST COVERED BY THE TOWN OF REDCLIFF FOR TOWN SOLD LOTS)

(TOWN OF REDCLIFF PLANNING AND ENGINEERING, OFFICE: (403) 548-9283; CELL - (403) 548-4378)

1. IT IS THE RESPONSIBILITY OF THE BUILDER TO ENSURE THE FOOTINGS ARE PLACED ON A PROPER BASE THAT IS FREE FROM FROST, EXCESSIVE MOISTURE AND DELETERIOUS MATERIALS AND HAVE APPROPRIATE FROST PROTECTION WHEN COMPLETE.

2. LIST OTHER CONSTRAINTS BELOW.

3. NOTES: * COSTS OF ANY UNEXPECTED FILL MATERIAL ENCOUNTERED AFTER EXCAVATION IS COMPLETED INCLUDING ANY ADDITIONAL EXCAVATION OR DESIGN SHALL BE AT THE COST OF THE PROPERTY OWNER.

* IF PROPOSED FOOTING IS ABOVE CRITICAL ELEVATION (NATIVE GROUND) A FOUNDATION SOIL BEARING INVESTIGATION AND CERTIFICATION IS REQUIRED.

PLAN

UTILITY RIGHT OF WAYS ARE 3.5m WIDE UNLESS OTHERWISE STATED

I CERTIFY THAT THE FINAL HOUSE PLANS PROVIDED, IN THE BUILDING PERMIT APPLICATION, ARE THE SAME AS PROCESSES UNDER THIS GRADE SLIP AND THAT I UNDERSTAND THE INFORMATION AND THE REQUIREMENTS CONTAINED HEREIN AND WILL BUILD ACCORDINGLY.

AUTHORIZED BUILDER'S REPRESENTATIVE _____

SIGNATURE _____ DATE _____

THE INFORMATION CONTAINED HEREIN IS BASED ON THE APPROVED BUILDING GRADE PLAN FOR THIS SUBDIVISION.

APPROVED BY AUTHORIZED TOWN REPRESENTATIVE _____

SIGNATURE _____ DATE _____



3. WATER DISTRIBUTION SYSTEM

3.1 GENERAL

The design of the water system shall conform to the latest version of the “Standards and Guidelines for Municipal Waterworks, Wastewater, and Storm Drainage Systems in Alberta”, as published by Alberta Environment and Sustainable Resource Development (AESRD) and as amended by these Guidelines and Standard Details.

3.1.1 Municipal Water System

The Contractor may be required to tie into a municipal water system or to shut off system valves to undertake the proposed Work. When this is required, the Contractor shall:

- a) Notify the Municipality of the proposed Work and schedule.
- b) Supply all water necessary for the Work and obtain written permission from the Municipality prior to using any hydrants.
- c) Obtain written permission prior to operating any of the Municipality’s valves and/or hydrants. The Contractor shall be held responsible for any damage done to the hydrants or surrounding area. The Municipality may require their own personnel to operate their valves and/or hydrants.
- d) Make an agreement with the Municipality for payment of water used.
- e) Be responsible for the supply of all water necessary for the Work.
- f) Provide 24 hours notice to any property in the Town affected by water service disruption.
- g) Supply an alternative water service if the water disruption is longer than 4 hours.
- h) For establishments relying on an uninterrupted water source for their operations, an alternative water source shall be provided.
- i) The above noted requirements shall be done at the Contractor’s cost.

3.2 DESIGN REQUIREMENTS

The minimum size of a water distribution main shall be 200 mm diameter for residential, 200 mm diameter for commercial, and a 300 mm diameter grid for industrial. For industrial, where 300mm grid spacing is less than 400m, a 200mm interconnecting main shall be acceptable; otherwise, a 250mm main shall be used.

PVC Pipe shall be used and the value of “C” in the Hazen-Williams formula shall be 120 for all types of pipes.

Per capita consumption for residential area shall be:

Average Daily Demand	-	340 lcd
Maximum Daily Demand	-	1.8 x Average Demands
Peak Hourly Demand	-	3.0 x Average Demands

The design population shall be the ultimate for the area under consideration.



For non-residential developments, the minimum water consumption rate shall be equal to 0.2 litres per second per hectare. The applied peaking factor shall be $P_f = 10Q^{-0.45}$ to a maximum of 25 and a minimum of 2.5, Q being in litres per second. Where possible, water demand shall be based upon site specific requirements for identified uses. Fire flow requirements are to be included in all calculations.

An analysis will be made for Peak Hour Demand, and mains shall be sized such that there will be a minimum residual pressure of 276 kPa (40 psi) at ground level at any location in the system.

Separate analysis shall be made for Maximum Demand plus Fire Flow. The residual pressure at any location at the ground level shall not be less than 140 kPa. (20 psi).

Under peak hour flow conditions, the main pipe network flow velocity should not exceed 1.8 m/s, and under maximum day demand plus fire flow conditions, the flow velocity should not exceed 2.5 m/s.

Fire flow requirements shall be calculated in accordance with the Fire Underwriters Survey publication entitled "Water Supply for Public Fire Protection – a Guide to Recommended Practice", latest revision thereof. Generally these are: for single family residential 67 l/second, for multi-family residential 90 l/sec, for Institutional 90 l/sec, commercial 190 l/sec, and light industrial 230 l/sec.

Where the size of the area to be developed warrants, or if required by the Town, a network analysis will be carried out and all relevant information will be submitted with the design documents.

Water main looping will be required where the number of lots exceed 20 lots.

3.2.1 Water Main - Location and Installation

Mains shall be installed to provide a minimum depth of cover of 2.5 metres below the final finished surface grade. Maximum depth of cover shall be 3.0 m unless authorized in writing by the Town Engineer. Additional depth may be required under roadways. It is preferred all water main be designed for 2.5m depth where possible.

Mains shall be located in accordance with the Roadway Cross-Section Standard Drawings.

A minimum of a 3m horizontal separation shall be maintained between a water main and any sanitary sewer main. Watermains shall cross above sewers with a sufficient vertical separation to allow for proper bedding and support of the mains. The recommended minimum vertical separation is 0.1m.

Where it is necessary for the watermain to cross **below** the sewer, the watermain shall be protected by providing:

1. a vertical separation of at least 0.5 m from watermain crown to sewer invert;
2. structural support of the sewer to prevent excessive joint deflection and settling; and
3. centering of the length of watermain at the point of crossing so that the joints are equidistant from the sewer.

The minimum requirement for pipe bedding shall be Class "C" bedding. Refer to drawing C-101 in the 2014 Construction Standards.

Water main installation shall be in accordance with manufacturer's requirements and these Specifications.



In designing a feeder main, or a distribution main without services connecting at the high points, an air release valve or hydrant shall be placed at significant high points and a flushing chamber shall be placed at significant low points in the water main profile to allow purging of stale water or trapped air. Refer to drawing A – 105 in the construction standards for air release valve and flushing chamber.

3.2.2 Hydrant - Location and Installation

The maximum allowable spacing between fire hydrants shall be 180m in single-family residential areas and 90m in multiple-family residential, school, and industrial/commercial areas.

Hydrant locations shall be such that the distance to any building shall be no greater than 90m. For the case of multi-family and/or commercial buildings with standpipes, the distance shall be 75m unobstructed driving distances, between hydrant and standpipe.

Hydrants on the distribution main will be installed at the projection of property lines, except:

- a) Where the hydrants are installed at the intersections, they shall be installed adjacent to the cut-off corners of the lot.
- b) Where the hydrants are installed in a cul-de-sac, they will not be installed within the turning circle but shall be located at the tangent points.
- c) Where a hydrant and sanitary manhole fall on the same property line projection, the manhole will be moved a minimum of 5 metres away from a hydrant.

Hydrants shall be located to conform with curb and sidewalk design and shall be installed as follows:

- a) The center of the barrel is to be 2.0 m from the face-of-curb or 0.5 m back of walk. With rural cross-sections, install hydrants 1.0 m from property line.
- b) The maximum distance from the face of the curb to the hydrant shall be 3.5 metres.
- c) Shall be installed in accordance with the Standard Drawing and the Engineering Specifications outlined in these Documents.
- d) Hydrants shall be plugged, non-draining;
- e) A gate valve will be provided on each hydrant lead;
- f) Cathodic protection to be installed as per typical details.
- g) All bolts to be stainless steel.
- h) All barrels to be epoxy coated.

Additional hydrants shall be installed at high value properties if deemed necessary by the Town.

3.2.3 Valve - Location and Installation

All valve boxes located in streets shall be left flush with the base course asphalt. Immediately prior to the final lift of asphalt being placed, these valve boxes shall be raised to final grade.

Valves on the distribution mains will be installed:

- a) At the projection of a property line at intersections or in mid-block, for urban sections. One meter from property line for rural sections.
- b) With two valves at a tee and three valves at a cross.



- c) Main Valves should be located such that no more than 24 single family lots and one hydrant are involved in a shutdown during watermain repair or replacement. There should be no more than four (4) valves required to shut down any section of line.

Distribution main valves shall be located such that during a shutdown:

- a) No more than one hydrant is taken out of service;
- b) No more than four valves are required to affect a shutdown;
- c) No more than twenty residential units are taken out of service by a shutdown, including cul-de-sacs; and
- d) Valves shall be installed in accordance with the Contract Specifications for the project and as per the Standard Drawing.

3.2.4 Valve Box

Valve box shall be Trojan Industries Type C, or equal. Valve box shall consist of a cast iron bonnet of sufficient size to fit over the valve, and an adjustable cast iron top box with lid.

Valve boxes shall be of suitable length for depth of bury specified for mains, with possible adjustment of 300 mm up or down from this length.

Valve box extensions shall be cast iron suitable for use with the valve box to be installed.

All cast iron surfaces to have a bituminous coating for corrosion resistance.

3.3 THRUST BLOCK

At all hydrants, plugs, tees, crosses, bends of more than 22 degrees, and all other points of concentrated thrust, provide reaction blocking (thrust blocks), as detailed in drawings A-101 to A-103 of the construction standards, to prevent movement. Place reaction blocking against solid undisturbed ground. Details provided herein are intended to be general, and are based upon soil load values of 7300 kg/m² or more. Where soil will not provide this load value, provide additional bands and clamps, or provide more substantial reaction blocking, as required to take the anticipated reaction. Place blocking to provide access to pipe and fittings for repairs or future extensions of the line.

Thrust blocking shall be Type 50 sulfate resistant concrete having a minimum compressive strength of 25 MPa at 28 days.

Pipe restraint devices shall be used separately or in conjunction with thrust blocks, where identified as being required, and shall be in accordance with the manufacturer's recommendation. All restraint devices shall be stainless steel or suitable, resistant to corrosion, to the satisfaction of the Town.

3.4 HYDROSTATIC PRESSURE TESTING

Tests shall be made only after completion of services, partial or complete backfill, and a minimum of 24 hours after the pipe has been filled with water. No test will be applied until at least 36 hours after the last concrete reaction or thrust block has been cast with high early strength cement, or at least seven days after the last concrete reaction or thrust block has been cast with sulfate resistant cement. The duration of each test shall be two (2) hours. Test pressure will be 2.0 times the normal system operating pressures or 1,035 kPa (150 psi), whichever is greater. Test pipeline in sections not exceeding 365 meters in length.



3.4.1 Disinfection

All water mains will be disinfected in accordance with AWWA specification C651, latest revision.

Before being placed in service, and before certification of completion by the Engineer, all installed mains will be disinfected according to the AWWA Standard C651-05 "Disinfecting Water Mains" and tested for bacterial content and chlorine residual.

On completing the chlorination of the mains, the Contractor shall set the system in operation as directed by the Engineer.

Dechlorination of the chlorinated water may be required in some circumstances before discharging the water to the environment, in order to meet the regulatory requirements of The Town of Redcliff or Alberta AESRD. Dechlorination, if required, is to be performed by adding neutralizing chemicals (ANSI/AWWA C651-92, Appendix 9C) to the chlorinated water as it is flushed from the system and before it enters the receiving environment.

3.4.2 Cathodic Protection

All buried fittings and valves shall be cathodically protected with a 2.3 kg (5.07 lbs) Zinc Anode, and all hydrants shall be cathodically protected with a 5.5 kg (12.12 lbs) Zinc Anode., per Standard Details.

Zinc Anodes shall conform to ASTM B418-73, Type II.

Lead Wires No. 10A WG/7, two metres long.

Wire shall be connected to fittings with a cadweld.

A minimum of three litres of water shall be poured on each Anode to initiate the Anode's operation.

3.4.3 Flushing of Existing and New Water Mains

Prior to flushing of any water mains, the Town of Redcliff Engineering Office and the Town's Utilities Department will receive a minimum of two working days notice. Only Town personnel will operate existing valves.

3.4.4 Usage of Town Water

The Developer's Engineer shall be responsible for calculating the water used for flushing of mains. This calculation shall be submitted to the Town at the time of the Construction Completion Certificate (CCC). The Developer shall be responsible for the cost of the water used to flush the mains and shall be invoiced accordingly. The cost of this water shall be calculated using the current charges, as may be amended from time to time, as outlined in the Water Rates Bylaw.

END OF SECTION



4. SANITARY SEWERAGE SYSTEM

4.1 DESIGN FACTORS

The sanitary sewerage system shall be of sufficient capacity to carry peak flows plus infiltration. Foundation weeping tile (by gravity or sump pump) and roof leaders shall **not** be connected for discharge into the sanitary sewer system. The following factors shall be used in design of sanitary sewerage systems:

a) Residential

Population estimates for the purpose of system design shall be based upon the actual lotting proposed for the development and a persons/dwelling estimate of not less than 4.0.

The Town reserves the right to require additional system capacity to accommodate potential future subdividing of larger lots.

Average Sewage Flow - 340 lcd
Peaking Factor - $1 + 14 / (4 + p^{0.5})$
(Harmon's Formula)

Where p equals the equivalent population in 1,000's

Infiltration - 0.28 L/s/ha

b) Commercial, Industrial and Institutional:

Average Sewage Flow - Commercial: 40,000 l/ha/d
Industrial: 20,000 l/ha/d
Peak Flow - 3.0 x Average Flow
Infiltration - 0.28 l/s/ha (24,000 l/ha/d)
Minimum Velocity - 0.61 m/s

Pipe sizing shall be determined by using the Manning's Formula with an "N" value of 0.013 for concrete and 0.011 for PVC.

The minimum size for sanitary sewer mains shall be 200 mm diameter for residential and 250 mm for industrial/commercial areas.

Minimum pipe slopes shall be designed to maintain a minimum self-cleansing velocity of 0.6 m/s. Maximum velocity should not exceed 3.0 m/s.

Sanitary sewers may have to be oversized to conform to the Town's Sanitary Sewer planning.

The Town council has adopted (council meeting Dec 08, 2014) a level of service criteria for the existing development in Town using 1:50 year, 4th Quartile, 24 hour Huff rainfall distribution (ISL Engineering recommendation as part of inflow and infiltration Investigation) to represent a typical distribution of heavy sanitary response.



4.2 FLOW VELOCITIES AND MINIMUM SLOPE

The following minimum slopes must be used:

4.2.1 Table: Minimum Design Slopes for Sanitary Sewers

Sewer Diameter (mm)	Minimum Design Slope (%)
200	0.40
250	0.28
300	0.22
375	0.15
450	0.12
525	0.10
600	0.08

4.3 SEWER MAIN INSTALLATION AND LOCATION

Mains shall be installed to provide a minimum depth of 2.5 m from top of pipe to final finished grade at the surface.

Mains shall be installed to provide adequate sewer service connection depth at the property line

Mains shall be located within the road right-of-way in accordance with the Roadway Cross-Section Standard Drawings.

Pipe bedding shall be provided for all mains in accordance with the Standard Drawings.

4.4 MANHOLE INSTALLATION, LOCATION, AND TYPE

Manholes shall be located at the end of each line, at all changes in pipe size, grade or alignment. The distance cannot be greater than 120m for sewers 375 mm diameter or less. The distance cannot be greater than 150 m for sewers 450 mm to 750 mm diameter.

The downstream invert in a manhole shall be a minimum of 30 mm lower than the lowest upstream invert. At a change in direction, the drop shall be at least 60 mm.

Manholes shall be installed as shown on Standard Drawings. Manhole bases shall be pre-cast, concrete poured bases, vaults or pre-cast tees. Pre-benched manholes shall be used when possible.

All manholes shall be 1200 mm inside diameter for all pipe 600 mm diameter and less. For pipe exceeding 600 mm diameter, 1500 mm manholes, or specially designed manholes, or precast manhole vaults, including tee riser manholes may be used. All joints shall be watertight.

An interior drop manhole shall be used where invert levels of inlet and outlet pipes differ by more than 750 mm.

Approved Safety platforms are required for Manhole 5.0 m or deeper. Refer to drawing B-105 in the Construction Standards.

Manhole frames and covers to be Trojan Industries Inc. Type TF-39. All manhole covers are to be clearly stamped "Sanitary Sewer" complete with the Town of Redcliff logo.



4.5 CURVED SEWERS

Curved sewers will be permitted, with the following restrictions:

- a) The sewer shall be laid as a simple curve with a radius equal to or greater than that recommended by the pipe manufacturer. Minimum radius shall not be less than 60 m.
- b) Manholes shall be located at the beginning and end of the curve.
- c) Manholes shall be located at intervals not greater than 90 m along the curve.
- d) The main shall run parallel to the curb or street centreline.
- e) The minimum grade for sewers on curve shall be 50% greater than the minimum grade required for straight runs of sewers.

4.6 INSPECTION AND TESTING

Prior to issuance of the Construction Completion Certificate of the project, all sewer mains shall be tested as follows:

- a) Closed Circuit Television Inspection
All sections of sanitary sewers shall be inspected with closed circuit television camera equipment prior to F.A.C. A written report and a colour VHS video tape or DVD/CD-ROM format shall be submitted to the Town for approval and records.
- b) Leakage Test:
The Town Engineer may require each section of sewer main and service connections to be tested for water tightness by an exfiltration test and/or infiltration test. In areas where the water table rises up to the sewer pipe invert or higher, each section of the sewer main and service connections shall be tested for water tightness by an infiltration test. In all other situations, an exfiltration test shall be conducted. The test results shall be recorded for each section of the main tested and the results forwarded to the Town Engineer.

4.7 LIFT STATIONS

Lift stations shall be designed in accordance with Alberta Environment Guidelines. Lift stations shall be duplex Xylem Systems, with the following standard items:

- a) Overhead steel crane rail to match others Public Services has in Service (min 2.3m high).
- b) Logimatic duplex pump controller.
- c) Interior lighting and exterior street lighting.
- d) Dexon heater sized correctly for lift station.
- e) Milltronics level controller with float backups.
- f) Automatic telephone alarm.
- g) Breaker and plug to match the Town's portable generator.
- h) Flow meter if required.

END OF SECTION



5. STORM DRAINAGE SYSTEM

5.1 DESIGN FACTORS

The storm sewers or storm drainage system shall be designed as a separate system and shall be of sufficient capacity to carry storm runoff from the ultimate development the area is zoned for. The storm system should be designed considering both the minor and major drainage systems.

The minor system comprises of piping, manholes, catch basins and outfall structures. The minor system shall convey runoff from snowmelt and rainfall events to adequate receiving water (river, stream, lake or pond) without sustaining any surface ponding or excessive surface flows for events up to and including a 1-in-5-year return period. Where required by the Town Engineer, high value commercial areas shall have their minor systems designed to accommodate a 1-in-10-year return period event.

The major system comprises the street system, detention facilities, parkland and any other land required to convey runoff from events up to and including a 1-in-100 year return period to the receiving water. The major system shall be evaluated in a manner sufficient to determine that no flooding that may cause significant property damage (e.g. flooding of buildings) occurs during the 100 year event.

Effluent from sanitary sewers and any drainage from industrial, agricultural or commercial operations that may potentially be contaminated shall not be discharged to the storm sewers.

Roof leaders of residential buildings shall be splashed on the surface and shall not be connected to the storm sewer system. Roof drainage from one-family and two-family dwellings shall discharge to grassed or pervious areas. The point of discharge shall be a sufficient distance (i.e. at least 2.0 m) to ensure the water flows away from the building. Roof drainage from apartment buildings, commercial areas, and industrial areas may discharge to the storm sewer, without the drainage crossing a sidewalk, if approved in writing by the Town Engineer.

The post development runoffs rates from properties shall not exceed the existing pre-development runoff rates being discharged to the storm drainage system, thus resulting in a no net increase to the storm drainage system.

Where pre-development runoff rates are considered excessive for the existing drainage system, the developer shall consider alternatives to reduce the existing runoff to a level acceptable by the Town Engineer.

The 1:100 year 24 hour duration predevelopment flow rate (or maximum allowable release rate) for the Town is 0.21 m³/s/km² (2.1 L/s/ha)-Town-wide Storm System Evaluation Study July 2012 by GENIVAR.

The developer shall provide these designs and calculations to the Town of Redcliff for approval.

Ponding of runoff on roofs, parking lots or landscaped areas to reduce runoff rates must be considered.

All development shall provide sump pumps to discharge weeping tile water to grassed surface areas or splash pad. Splash pads are required to insure positive drainage away from the building. Should the Geotechnical Report indicate a high water table, the Town may request other alternatives to surface discharge of weeping tile.



No sump pump connections to the storm system are allowed unless approved in writing by the Town Engineer.

Control shall be provided to minimize sediment discharge to the storm sewers. This shall be in the form of properly graded and surfaced streets and lanes, landscaping, sediment control structures at pond and lake inlets, or other means where appropriate.

The following criteria shall be used in the design of the minor storm sewer system:

- a) For areas less than 65 ha, the Rational Method shall be used to design the storm sewer system:

$$Q=2.78 CIA$$

- Where Q = the design peak flow rate in litres per second
- I = the intensity of rainfall in millimetres per hour, corresponding to the time of concentration
- A = the contributing area in hectares
- C = the runoff coefficient

- b) The five year rainfall intensity table shall be used as shown on Table 5.1.

- c) The following runoff coefficients shall be used for the 1-in-5 year analysis:

Parks	=	0.15
Residential	=	0.30
Industrial	=	0.70
Commercial	=	0.70
Multiple Family	=	0.70

- d) The weighted average of pervious and impervious area runoff coefficients shall be estimated from the following equation:

$$C = (C_p * A_p + C_i * A_i) / (A_p + A_i)$$

In these standards, where the subscripts “p” and “i” indicate the pervious and impervious surfaces, respectively, $C_p = 0.15$ and $C_i = 0.90$. The Town generally uses 0.3 for landscaped areas and 0.7 for gravel areas.

- e) The duration of rainfall used to determine the intensity is equal to the time of concentration. The time of concentration is comprised of the overland time to the storm sewer inlet and the time of travel in the conduit. The overland flow time to curbside in residential and commercial areas shall not exceed 10 minutes in duration (specific overland flow times shall be computed separately for industrial and undeveloped areas by using an appropriate estimation method). Gutter flow time shall not exceed 5 minutes and shall be estimated based on methods outlined in “Modern Sewer Design” (AISI, 1980). The time of travel in the conduit shall be based on the pipe flow velocity.

- f) The Modified Rational Method shall be used for the design of drainage systems where the specified design storm has a return period of more than 10 years. Typically this includes the design of overland conveyances and on-site storage for site developments. The Modified Rational Method incorporates a modifier to increase the runoff coefficient for larger events to account for the inherent inaccuracy of the Rational method when carrying out computations for such events. The runoff coefficient in the formula for runoff shall be increased by the following factors, up to a maximum runoff coefficient of 1.00:

25 year add 10%



50 year	add 20%
100 year	add 25%

On-site storage shall be designed by tabular methods such as APWA #49 incorporating Modified Rational Methods to detain the differences between runoff from the Major system design event (1:100 year return event) and permitted discharge rates into the storm sewer (minor) system.

For areas greater than 65 ha:

- a) Computer models shall be used to determine design flows and the sizing of systems that contain non-pipe stormwater management facilities (e.g. detention ponds) or systems that include a significant amount of undeveloped land.
- b) The selection of an appropriate computer model shall be based on an understanding of the principles, assumptions and limitations in relation to the system being designed.
- c) Wherever possible, the computer model shall be calibrated. In all analyses, the parameters used, the drainage boundaries, the pipe network and its connectivity shall be clearly identified on an overall drawing, computer printouts and a design summary report.
- d) The critical design rainfall hydrograph shall be selected. Both the AES Distribution (for long duration) and the Chicago Distribution (for short duration) will be evaluated.
- e) The storm duration of an event is critical for the system being designed and shall be used to determine pipe sizes. The 5 year 4-hour Chicago Distribution event shall be selected. For systems involving storage design, both short duration and longer duration events such as the AES 24 hour event should be evaluated.
- f) For major developments: preliminary engineering, Area Structure Plan and a Functional Servicing Report must be submitted for Town approval. The Town's Legislative Department must be consulted for the requirements of the Area Structure Plan.

5.2 STORM SEWER MAINS

Sewer Mains:

The minimum size of storm sewer mains shall be 300 mm diameter.

Pipe classes shall be determined to withstand subsequent superimposed loadings.

Various factors affecting the pipe class shall be taken into account, and pipe class shall be evaluated as per standard engineering practice.

The minimum velocity within a piped system shall be 0.60 m/s. Where greater velocities in excess of 3 m/s are attained, special provisions shall be made to protect against displacement by erosion or impact.

Pipe sizing shall be determined by utilizing the Manning's Formula, using an "N" value of 0.013 for concrete pipe and 0.011 for PVC pipe.

Storm sewer pipe shall be designed to convey the design flow when flowing full, with the hydraulic grade line at the pipe crown. All pipe crown elevations shall match at manhole junctions.



Surface water shall not be permitted to run a distance greater than 250 m along gutters without provision of interception by the first catch basin. Within the piped drainage system, or on Collector or Arterial roadways, surface runoff shall not run a distance greater than 120 m without interception.

Surface water shall be intercepted with a sufficient number of catch basins such that the inlet capacity is sufficient to receive the design storm water flow. Catch basin capacity shall be considered, as shown on Table 5.2, where values are given for sag conditions and on slope conditions based upon inlet grate type.

Minimum gutter grade shall be 0.60%. Cul-de-sacs and curb returns are minimum 0.8% to 1%.

Roadway ditches and swales will efficiently convey run-off through the storm drainage system. Roadway ditches and swales will not be used for stormwater detention or retention.

5.2.1 Table: Minimum Design Slopes for Storm Sewers

Storm Sewer Size	Concrete Pipe, n = 0.013 (%)	PVC Pipe, n = 0.011 (%)
250mm	1.00	1.00
300mm	0.28	0.20
375mm	0.22	0.15
450mm	0.18	0.12
525mm	0.16	0.10
600mm	0.13	0.09
675mm	0.11	0.08
750mm	0.10	0.07
≥900mm	0.09	0.06

The design engineer should always keep in mind that fulfilling the requirements of minimum slope can ensure the minimum velocity, but the capacity of the sewer main will be reduced and may not carry the estimated quantity of run-off. Therefore the provision of high percentage of slope is always recommended to obtain maximum capacity (viable) for each specific size of sewer main.

Catch Basins

- a) Catch basin barrels with pre-cast base and pre-cast slab top shall be:
 - 1) 900mm I.D. pipe barrel conforming to CSA-A257 2. Joints to be confined O-ring to CSA-A 257.3 using rubber gasket.
 - 2) Catch basin manholes shall be 1200 mm in diameter in accordance with the Standard Drawing.
 - 3) Catch basin manholes shall be used in place of a catch basin when the lead exceeds 30 m in length or one catch basin discharges into another.
 - 4) Catch basins and catch basin manholes shall have a sump.
- b) Catch basin frames and covers shall be:
 - 1) Standard frame, grate and 2 piece side inlet curb component for use with 900 mm barrel by Trojan Industries Inc. TF-51 and K-1A for straight faced curb and gutter.
 - 2) Top inlet standard round lane paving frame and grate by Trojan Industries Inc. TF-38 for swales or lanes.



- 3) Top inlet standard round top frame and grate by Trojan Industries Inc. Type TF-39 or T-K1 grate for landscaped areas.
 - 4) Frame and grate by Trojan Industries Inc. Type K2 or K-7 catch basins for rolled curb and gutter.
- c) Catch basin leads:
- 1) The minimum size of catch basin leads shall be 250 mm diameter with a minimum grade of 1.0%.
 - 2) The minimum grade on a 300 mm catch basin lead shall be 1.0%.
 - 3) Two catch basins may be connected in series. The catch basin lead connecting to the storm sewer manhole shall be 300 mm at a minimum slope of 1.0%.
 - 4) The maximum length of a catch basin lead shall be 30 m.
 - 5) If a lead of over 30 m in length is required, a catch basin manhole shall be installed at the upper end.
 - 6) Catch basin leads shall have a minimum cover of 1.2 m to obvert.
 - 7) Catch basins leads shall be connected to a manhole, not directly to the main.

Catch Basins shall be “twinned” (two basins built side by side) and interconnected at points where there is a large trapped drainage catchment area, accumulation, or where a large amount of water after bypassing upstream catch basins which are situated on a very long steep street.

Inlet control devices (where required) must be shown on all drawings.

Catch basin spacing shall range from 90m to 150m, with closer spacing required for flat grades and at all corners where storm sewers exist, except in the case of a high corner (i.e. Drainage away from corner in both directions).

The maximum length of drainage in lanes shall be 350m. The length of drainage in a lane is to be minimized where possible. Where CB's are located in lanes, it is necessary to compact utility trenches and pave 1.0 m in each direction from the catchbasin. Trap lows in lanes should be avoided when possible.

5.3 STORM SEWER INSTALLATION AND LOCATION

Mains shall be installed to provide a minimum depth to pipe obvert of 1.5m below final finished grade.

Mains shall be installed in accordance with cross sectional drawings located in the Standard Drawings.

Pipe bedding shall be provided for all mains in accordance with the Standard Drawings.

5.4 MANHOLE INSTALLATION, LOCATION, AND TYPE

Transitions are size, grade or direction of sewer pipes are to be accomplished by means of manholes except in the case of a curved sewer.

The maximum distance between manholes shall be 120m. In all cases, a manhole is required at the upper end of a sewer for maintenance purposes. Manhole spacing on storm sewers greater than 750 mm in diameter may exceed 150 m if approved by the Town Engineer.



Benching in manholes shall be provided to minimize hydraulic losses. The downstream invert in a manhole shall be a minimum of 30 mm lower than the lowest upstream invert. At a change in direction, the drop shall be at least 60 mm. If an influent pipe diameter is greater than 525 mm and the bend is greater than 45 degrees or if the outflow pipe velocity exceeds 1.5 m/s, then minor losses shall be considered (see AISI, 1980).

Types of manholes to be used in the storm system include:

1. For pipe 600mm in diameter or smaller use a Type 5A manhole, except where a three or four way junction occurs, in which case a Type 1 or Type 1S manhole must be used.
2. For pipe 675mm in diameter or larger use a Type 1 or Type 1S manhole which has a square poured in place bottom section and pre-cast 1200 diameter upper section.
3. Pre-cast tee-riser manholes will be accepted for 1200mm diameter or larger trunks where there is no change in pipe size, direction or grade. Tee riser manholes must be bedded in concrete to the springline of the pipe.

Manhole frames and covers to be Trojan Industries Inc. Type TF-39. All manhole covers are to be clearly stamped "Storm Sewer" complete with the Town of Redcliff logo.

5.5 CONNECTIONS TO STORM SEWERS

Only catch basins and private commercial storm services shall be connected to the Town's storm sewer. See Commercial Storm Drainage and Service Connections Section 5.10.

5.6 CURVED SEWERS

Curved sewers will be permitted, with the following restrictions:

- a) The sewer shall be laid as a simple curve, with a radius equal to or greater than 90 m or the manufacturer's minimum recommended radius, whichever is larger.
- b) Manholes shall be located at the beginning and end of the curve.
- c) Manholes shall be located at intervals not greater than 90 m along the curve.
- d) The main shall run parallel to the curb or street centreline.
- e) The minimum grade for sewers on curve shall be 50% greater than the minimum grade required for straight runs of sewers.

5.7 INSPECTION AND TESTING

Refer to Sanitary Sewerage System Section 4.6.

5.8 STORMWATER MANAGEMENT FACILITIES

Design Requirements Common to Stormwater Management Storage Facilities

- a) General

The design of stormwater management facilities shall conform to Best Management Practices. The use of stormwater facilities may be required to reduce peak flow rates to downstream sewer systems and/or watercourses, or to provide a temporary receiving area for peak major drainage flows. Their approximate location and size must be identified at the time of the Subdivision Outline Plan approval to avoid



conflicts with adjacent land uses. The effects of the maximum pond water levels shall be considered in the design of the minor system and lot grading. If possible, the crown elevations of the pipes in the first manhole upstream of a pond shall be at or above the maximum pond level during the five-year storm event.

b) Geotechnical Considerations

Soils investigation specific to the detention facility shall be undertaken to determine the soil's permeability and salinity (or other potential contaminants), and the height of the groundwater table. Where the facility is sited above a shallow aquifer the potential for groundwater contamination must be minimized. Where the pond bottom is below the water table, weeping tile systems may be required to keep the pond bottom dry enough to support grass growth and maintenance equipment traffic.

c) Sediment Control

A sediment control plan is required as a part of the Stormwater Management Study to define measures that must be taken for the control of sediment into the pond and into the receiving stream.

Master Drainage Plan

a) The Master Drainage Plan shall be prepared and used in developing and comparing alternatives, and to select the optimum storage and drainage solution for a development area. This Master Plan should provide, as a minimum, the following information:

- 1) Detailed description of the development area, including proposed street layout, locations of parks, direction of overland flow, natural storage and drainage sub-catchment boundaries, etc.
- 2) Identify and quantify the amount of upstream drainage entering onto the proposed development lands, including all points of entry.
- 3) Identify the impact of the proposed development on the watershed.
- 4) Identify all existing flow channels, drainage patterns or routes, and containment areas.
- 5) Identify the point(s) of discharge from the lands, as well as the type and calculated capacity of the receiving drainage facility(s), whether natural, man-made, or a combination of both.
- 6) Provide details of water quality enhancement facilities.
- 7) Identify all licensing requirements as may be required by Alberta Environment Enhancement.
- 8) Post-development hydrographs for the 5-year and 100-year events to be determined at key points in the system.
- 9) Delineation of flood lines for the 100-year design storm for creeks or watercourses.
- 10) Description and discussion of storage alternatives. All alternative storage and runoff control methods shall be reviewed and shall include, but not be limited to:

- retention storage;
- detention storage;



- off-line stream storage;
- channel storage;
- on-line storage; and
- wet ponds (retention storage) or dry ponds (detention storage).

In reviewing the alternatives, the optimum number and location of the stormwater facilities shall be determined, bearing in mind the total system.

11) Detailed description of the selected alternatives.

Design Standards for Lakes and Wet Ponds

- a) Land that is adjacent to a lake that is subject to flooding, as per the design standard established, but is part of the development parcel, will carry easements to allow Town forces right of access though the lands to the waters edge to carry out normal maintenance operations.
- b) Public land that is permanently under water shall be designated P.U.L. (Public Utility Lot). Private land that is subject to flooding due to the operation of the lake shall carry a flooding easement up to the 1:100 year storm level.
- c) The storage capacity shall be determined at the Master Drainage Plan stage along with the hydraulic performance criteria.
- d) The minimum surface area of any lake or combination thereof shall be 2.0 hectares.
- e) The annual volume exchange shall be twice per year.
- f) General design parameters for side slopes are as follows:
 - maximum side slopes above active storage zone are 4:1 to 5:1
 - maximum interior side slopes in active storage zone are 5:1 to 7:1
 - maximum exterior side slopes are 3:1.
- g) Maximum water fluctuation for a one-in-five year storm event should not exceed one metre.
- h) The minimum depth from normal water level to lake bottom should be 2.5 metres.
- i) The inlets and outlets are to be fully submerged at least one metre below normal water level to crown of pipe.
- j) The lake bed is to be composed of impervious material.
- k) No dead bay areas shall be permitted unless special circulatory provisions are made.
- l) The first manhole in the minor system, the connecting or interconnecting pipe system, shall have an invert that is at or above the normal water level.
- m) The lake design shall include an approved sedimentation removal process for control of heavy solids to the lake during the development of the basin.
- n) A sedimentation measurement system shall be included for control and recording of siltation during long term performance of the lake.
- o) The edge treatment or shore protection required shall be compatible with adjacent land use. The standard used shall meet the criteria of low maintenance, safety and ease of access to the water edge. The recommended guideline is approved rip-rap rock material varying in size from 50 to 100 mm, for a thickness of 0.3 metres and extending



- in a vertical distance of 0.6 metres below and above the normal water level, and encased in Gabion baskets.
- p) Lake design must provide for vehicular access for maintenance and emergency purposes.
 - q) Approved lighting shall be provided at the interface between the lake high water levels and any adjacent public lands.
 - r) Approved fencing will be required where necessary for safety purposes.
 - s) Approved signage shall be installed to warn of anticipated water level fluctuations, with demarcation of maximum water levels to be expected for design conditions. Warning signs will be designed by the Developer and approved by the Town Engineer.
 - t) An approved fresh water well system is required to maintain the lake water levels during extended dry hot periods.

Emergency Spillway Provisions

The feasibility of an emergency overflow spillway is to be evaluated for each storage facility (wet or dry) design, and, where feasible, such provisions are to be incorporated in the pond design.

As part of the pond design process, the probable frequency of operation of the spillway should be determined. Where it is not possible to provide an emergency spillway route, the design is to include an analysis of the impact of over-topping the pond and a significant freeboard above the 100-year level.

The functional requirements of the spillway, and the impact analysis for the absence of one, are to consider the possible consequences of blockage of the system outlet or overloading due to the run-off events, such that the storage capacity of the facility may be partially or completely unavailable at the beginning of a run-off event.

Design Standards for Dry Detention Ponds

Dry pond (detention) storage is the storm water management method where the storm run-off is collected and the excess run-off is temporarily detained for a short period of time, and released after the storm run-off from the contributing area has ended. Generally, low flows do not enter the pond.

Dry ponds should have gentle side slopes and be aesthetically contoured and landscaped to provide an attractive feature for the subdivision. Where possible, and as agreed by the Town Engineer, they should be associated with municipal reserve areas to take advantage of the joint use ability of the facilities (e.g. extension of sport fields or passive park uses into the detention pond). Active park uses should not be located adjacent to the inlet/outlet facilities nor in areas that flood frequently (more than twice per year on average). The Town should be contacted to provide input to the design of detention facilities from the concept stage through to detailed design and construction.

Safety Provisions at Inlets and Outlets

All inlet and outlet structures associated with dry ponds shall have grates provided over their openings to restrict access and prevent entry into the sewers by unauthorized persons. A maximum clear bar space of 150mm shall be used for gratings.

Grated outlet structures are to be designed with a hydraulic capacity of at least twice the required capacity to allow for possible plugging. Further, the velocity of the flow passing through the grating



should not exceed 1.0 m/sec. Appropriate fencing and guard rails are to be provided to restrict access and reduce the hazard presented by the structure head and wingwalls.

Design Parameters

The following general design parameters should be considered for a dry pond in a residential subdivision:

- a) Storage capacity for up to the 100-year storm event.
- b) Detention time to be determined based on downstream capacity; recommended maximum detention time is 24 hours.
- c) Maximum active retention storage depth of 1.5m. The maximum water level should be below adjacent house basement footings (a greater freeboard may be required if an emergency overflow route cannot be provided).
- d) Maximum interior sideslopes of 5:1 (7:1 is recommended).
- e) Maximum exterior sideslopes of 3.5:1.
- f) Minimum freeboard of 0.6m above 1:100 year high water level (a greater freeboard may be required if an emergency overflow route cannot be provided).
- g) Maximum 5:1 ratio of effective length to effective width measured at 100 year high water level.
- h) Dimensions must be acceptable to the Town when the bottom of the pond is to be used for recreational facilities.
- i) Minimum lateral slope in the bottom of the pond of 1.0% (2.0% is preferred) and a minimum longitudinal slope of 1.0% (2.0% is preferred),
- j) Low flow bypass for flows from minor events to be provided.
- k) French drains are to be provided within pond bottom where water table is near pond bottom.
- l) Address all safety issues (particularly during operation).

Wet Detention Ponds (Residential Subdivision)

Wet pond (retention) storage functions the same as dry pond detention except that a portion of the stormwater is permanently retained.

If approved, the developer will be responsible for all construction costs in excess of the cost to construct the original dry pond facility. The Developer will also be required to establish maintenance of the pond.



Design of a wet pond is to be in accordance with the Alberta Environment & Sustainable Resource Development's (AESRD) 2013 publication entitled "Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems", Part 5, Stormwater Management Guidelines Section 5.3.5.1.7. Some general design parameters to consider are:

- a) 2.0 ha minimum water surface area.
- b) Maximum sideslopes of 7:1 between the high water level and 1.0 m below normal water level.
- c) Minimum permanent pool depth of 2.0 m
- d) Maximum 1:100 year storage depth of 1.5 m
- e) Sediment forebays required at each inlet.
- f) Hard edge treatment required along lake perimeter.
- g) Minimum freeboard depth of 0.6 m. House footings must be above freeboard elevation.
- h) Provide access for maintenance and emergency equipment.
- i) Design of outlet control structure to be capable of maintaining permanent pool depth and capable of draining the permanent pool for maintenance purposes.

Trapped Low Storage and Major Overland Flow

Trapped low storage in low points on roadways shall not be used to replace or offset runoff storage volume requirements in storm water management facilities. Each trapped low shall have an overland escape route for excess accumulations of runoff. Overflow from the trapped low must spill across Public lands, not on private property, unless otherwise approved and drainage swales with corresponding utility right of ways have been provided.

Any property adjacent to a trapped low where the spill elevation will cause the pond to encroach onto private property must have a drainage restrictive covenant and caveat registered on the title of the affected property. A drainage restrictive covenant will not be required when the spill elevation is such that the maximum depth of pocket or depression storage on a street is less than 150mm, measured above the lowest point at the lip of gutter. The lowest permissible building opening elevation on properties adjacent to a trapped low shall be set at 300mm above the higher of the spill elevation or the high water elevation at the trapped low for the 1:100 year event post development conditions.

Roadway grades shall be designed such that trapped lows shall have a maximum spill elevation of 300mm measured above the lowest point of the gutter.

Trapped low storage is not allowed in lanes or walkways unless approved otherwise.

5.9 OUTFALLS

Outfall structures shall be placed at the end of all storm sewers discharging to an open channel, watercourse, river or other receiving water body such as a lake. The purpose of the structure is to reduce velocities and prevent erosion. All outfall structures must be approved by Alberta Environment. It is the responsibility of the Developer to obtain the necessary approvals and permits from the above mentioned Authorities.



The outfall structure may be a chute, spillway drop structures and energy dissipaters, stilling basin or plunge pool with head wall. A cut off wall is required at the end of the outfall apron to prevent undermining of the structure.

Obverts of outfall pipes shall be at least 150 mm above the 5-year flood level in the receiving stream. Inverts of outfall pipes shall be above winter ice level, otherwise outfall pipes shall be submerged below the bottom of ice level. In addition, outfalls shall be located to avoid damage from moving ice during breakup.

If the downstream channel is relatively flat, the apron shall be 150 mm to 225 mm above the channel invert to prevent collection of debris on the apron.

Rip-rap and a filter layer shall be placed downstream of the outfall structure, where required to prevent erosion. Where erosion control or bank stability work must be done, preservation of watercourse aesthetics and wildlife habitat must be considered.

Weeping tile shall be placed under the structure to reduce any water pressure behind the head wall.

Grills or trash bars shall be placed over all storm sewer outlets to prevent access.

Railings shall be placed along the head wall and wingwalls of the outfall structure.

Outfalls shall be landscaped designed with low maintenance, to aesthetically blend in with surrounding areas.

Measures, such as detention ponds, should be incorporated in new developments to prevent any increase in the amount of erosion and downstream flooding to existing receiving streams.

5.10 COMMERCIAL OR INDUSTRIAL STORM DRAINAGE AND SERVICE CONNECTIONS

Prior to a development permit being issued by the Development Officer for construction on a commercial or industrial property, a number of conditions must be met according to the Land Use By-Law(1698/2011). They are listed on the The detailed site drainage plan (Item Number 3) will be discussed in this section. Development permit application requirements. Section 16.

Three copies of the detailed site drainage plan are to be submitted to the Development Officer for his distribution to various parties, one being the Engineering Department. The drawings should adhere to the drafting standards mentioned in previous sections of the Design Guidelines and must be stamped and signed by a qualified Professional Engineer. *Site drainage plans submitted by an Alberta Land Surveyor are unacceptable.*

All commercial, institutional, industrial, horticultural and multi-family developments (excluding duplex lots) shall limit the surface drainage release rate to 40 l/sec/ha, and provide on-site detention for the excess volume of storm water generated by a 1:100 post-development rainfall event.

The following items are to be included on the detailed site drainage plan:

- computation of site area
- finished grade elevations



- paved and unpaved areas (indicated by hatching or text)
- surface drainage patterns (arrows indicating direction of flow) with watershed boundaries
- catch basins with both top and invert elevations
- storm water retention areas with calculations

The Modified Rational Method may be used to calculate the storm retention volumes required per site and all plans are checked based on the Rational Method of Design.

See the City of Calgary's Water Resources Department "Stormwater Management and Design Manual", 2011, Appendix B for full calculation method and charts used.

The storm water retention calculations may be represented in chart form on the detailed site drainage plan and must include the following:

- allowable discharge to main (Q1) and actual discharge to main from retention area (Qa); where $Qa \leq Q1$
- list of runoff coefficients used
- area breakdown (paved, gravel, landscaped, roof, etc)
- roughness coefficient used (PVC = 0.011, concrete = 0.013)
- storage volume required and volume achieved at site
- top of pond elevation
- rainfall intensity
- size/type of ICD used, if necessary.

Where the property is used to convey runoff from multiple lots, a road right-of-way or public park, the means of conveyance shall be designed appropriately and the full width of flow under the design 1:100 year rainfall event shall be covered by a caveat or UROW registered against the property title to the benefit of the Town of Redcliff. The overland flow depth and velocity shall not exceed Alberta Environment Stormwater Management guidelines, as per the table below.

Permissible Depths for Submerged Objects

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

Note: Based on a 20-kg child and concrete-lined channels.
Larger persons may be able to withstand deeper flows.

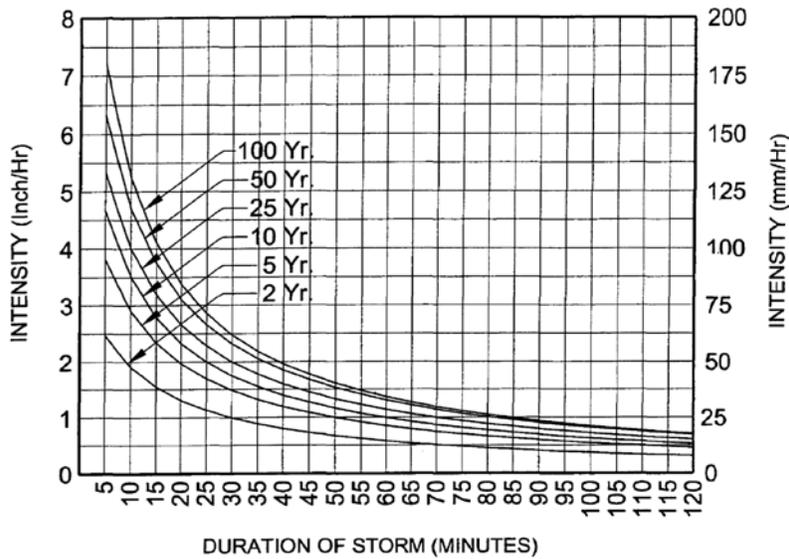
Sanitary sewer manholes and cleanouts that may be required on Commercial/Industrial properties are not to be located within the trapped low or detention/retention areas in order to prevent infiltration into the sanitary sewerage system.



GRAPH 5.10.1

RAINFALL INTENSITIES

I-D-F CURVES



- Notes: 1. Based on City of Medicine Hat Design Standards
 2. Maximum Initial time of Concentration is 10 minutes.

For Catch Basin Flow-By Capture Curve, please refer to Appendix B.

The IDF curve data in Table 5.2 shall be used. This data was derived from Atmospheric Environment Service (AES) rainfall data and curves. The formula that shall be used to calculate rainfall intensity is:

$$I = \frac{A}{(T + B)^C}$$

Where: I – Intensity in mm/hr
 T – Time in minutes
 A,B,C – Parameters for the design storm

Table 5.10.3: IDF Curve Data

Return Period	A	B	C
2	282.62	2.0	0.729
5	368.98	1.0	0.712
10	445.08	1.0	0.713
25	484.65	0	0.695
50	548.66	0	0.695
100	610.24	0	0.695



5.10.1 SERVICE CONNECTIONS

Service connections are required to provide storm sewer service. All expenses to install service connections are the Developer's responsibility.

Service connections are to be made directly to the Town's storm sewer at right angles. Placement, size, material, and slope of service connection must be indicated on the detailed site drainage plan.

Direct connection to the Town's storm sewer is permitted. However, a manhole is required on a main for a service connection when any of the following conditions apply:

- the diameter of the service connection line is greater than one half the diameter of the Town's storm sewer main
- the length of the service connection from the final private catch basin to the main is greater than 30m; and
- the size of the service is greater than the largest standard saddle available from the pipe manufacturer for the type and size of main the service is tying into.

END OF SECTION



6. SEWER AND WATER SERVICE CONNECTIONS

6.1 SERVICE CONNECTIONS – MINIMUM REQUIREMENTS

The minimum size of service connections to a single-family dwelling shall be as follows:

Sanitary Sewer	100 mm diameter
Water Service	25 mm diameter

The minimum grade on a 100 mm sewer service shall be 2.0% and on a 150 mm service shall be 1.0%.

The maximum size of a commercial water service shall be 50mm, with the exception of a service for horticultural use, which may be 75mm.

Connection to a main sewer line shall be by means of a tapped service saddle (full wrap) at the top quadrant of the main on existing mains. In-line tees may be used upon prior approval of the Town.

Where bends are utilized, the long radius type or a combination of 22½ degree bends and straight pipe shall be used.

For water services sized 50 mm and smaller, the tapping shall be 45° to the horizontal position on the distribution main. Hot tapping may be permitted upon prior approval of the Town Engineer.

Water mains shall be tapped under pressure.

All water services to be direct tapped or utilize stainless steel/bronze service clamps.

6.2 SANITARY SEWER SERVICE

Service pipe shall be PVC SDR 35 building service pipe. For service pipe with a depth of cover greater than 2.8 m use PVC SDR 28.

Service fittings shall be either in-line tees or saddle tees, complete with gasket and stainless steel straps and nuts.

6.3 SERVICE CONNECTIONS – INSTALLATION REQUIREMENTS

Where the water service is 50 mm or smaller in size, the water and sanitary services shall be installed in a common trench 4 m offset by property line.

The services shall be installed so that, when facing the lot being served, the water service is on the right of the sanitary service. The service pipe should not be extended into the sewer main to block any sewer camera inspection of the main.

The minimum depth of cover over the water and sanitary services at the property line shall be 2.8 m and the maximum shall be 3.5 m, per the Standard Drawing.

Where the sewer services are required to connect to mains in excess of 4.50 m deep, risers shall be installed to within 3.60 m of finished surface.

Corporation main stops and curb stops shall be installed in accordance with the Standard Drawing. Material to be Trojan or approved equal.



Service box for residential service to have adjustable sliding top section, standard block iron pipe with threaded top. Top section to be 600 mm in length, with a minimum ID of 35 mm and a 10 mm set screw. The service box shall be adjustable from 2.5 to 3.5 m bury. The threaded steel cap shall have a slotted top with a 19 mm pentagon brass plug.

The casing shall be standard block iron pipe with an OD of 33.5 mm. The rod should be T-304 stainless steel, 12.5 mm diameter by 2.2 m long, complete with standard pig tail for 25 mm ID pipe and welded bottom bracket with an 8 mm cored hole. Rod to be complete with a 6 mm diameter cotter pin of sufficient length.

Box bottom boot to be cast or ductile iron, factory coated, with a clear opening to allow curb stop access. The boot is to attach to the casing by means of a threaded joint.

Curb stops shall be installed at property or easement lines as shown on the Standard Drawing.

Sewer services shall be installed at property or easement lines as shown on the Standard Drawing, and shall be properly capped or plugged to prevent the entry of earth, water or deleterious material into the pipe.

All services shall be laid on 75 mm of granular bedding, and the bedding material shall be placed up to springline of the pipe.

Painted stakes of 50 mm x 100 mm size shall be extended from the end of the service connections to a minimum of 0.70 m above the ground level, per the Standard Drawing.

The Developer shall employ a CSA approved material testing firm to complete the tests as outlined in Table 8.2. One copy of the results shall be submitted to the Town for their review.

6.4 SERVICE CONNECTION REPORT

The Developer's Engineer shall provide detailed as-built drawings for all installed service connections, with such drawings providing information related to pipe dimensions, invert elevations, depth of service lines, location of services relative to property line(s), manholes and/or watermain valves.

END OF SECTION



7. ROADWAYS

This section includes guidelines for the design of roads, lanes, sidewalks, ditches, culvert crossings and driveway approaches.

7.1 REFERENCE STANDARDS

Design details or procedures not specified in this section shall be determined in accordance with the current editions of the following Reference Standards:

Government of Alberta:

- Traffic Safety Act

Alberta Transportation:

- Highway Geometric Design Guide
- Pavement Design Manual

Transportation Association of Canada (TAC):

- Geometric Design Guide for Canadian Roads (TAC Standards)
- Manual of Uniform Traffic Control Devices for Canada (MUTCD)
- Guide for the Design of Roadway Lighting
- Pedestrian Crossing Control Manual
- Canadian Guide to Neighborhood Traffic Calming

Institute of Transportation Engineers (ITE):

- Trip Generation Manual
- Transportation and Land Development
- Manual of Traffic Signal Design
- Traffic Access and Impact Studies for Site Development - Recommended Practice



7.2 ROADWAY CLASSIFICATIONS

The following roadway classifications and designations have been adopted for use by the Town of Redcliff:

Arterial	Undivided Major Roadway (Broadway Avenue E & Saamis Drive SE, 10th Avenue NE and Mitchell Street NE)	Urban Sections	Standard Section
			Downtown Section
			4 Lane Road
		Rural Section	Standard Section
Collector	Industrial / Commercial Collector Roadway	Urban Sections	Standard section with various sidewalk and trail options.
			Low impact development section with various sidewalk and trail options.
			Industrial / Commercial Collector Roadway - Two Way Lane
			4 Lane Road
		Rural Sections	Standard section
			Low impact development section
	Residential Collector Roadway	Urban Sections	Standard section with various sidewalk and trail options.
		Rural Section	Standard Section
Local Road	Local Industrial / Commercial Roadway		Standard Section
			Low Impact Development Section
	Local Residential Roadway		Rural Section
			Monolithic Sidewalk Section
			Separate Sidewalk Section
			Parking on One Side Section
			Low Impact Development Section
			Rural Section
			Rural Section with Expanded Ditches
			Downtown Section
		Public Service Section	

7.3 GEOMETRIC DESIGN STANDARDS

Street classification and designation shall be in accordance with the classification system outlined in the Transportation Association of Canada (TAC) Manual - Geometric Design Standards for Canadian Roads and Streets latest edition.

The following are general minimum requirements and shall be used in the design of streets.

Street cross-sections shall be as defined by Table 7.1 (pages 54 & 55) and Construction Standard Drawings. Curb and gutter will be required in some areas, at the discretion of the Town.

Straight face curb and gutter shall be constructed on all streets, in accordance with the design Drawings. With written approval by the Town Engineer, rolled curb and gutter may be constructed in accordance with the drawings.



Sidewalk locations shall be in accordance with the Standard Roadway Drawings. Wider sidewalks may be required in areas of high pedestrian activity, as determined by the Town Engineer.

Rear lanes (alleys) shall have a surfaced width of 5.5 m within a 6.0 m right-of-way. Where rear lane traffic activity is expected to be high, such as for certain commercial developments, a wider surfaced width and right-of-way may be required as determined by the Town Engineer.

All driveways shall be constructed to give a minimum of 1.5 m clearance from any structure, (e.g. hydrants, light standards, service pedestals), and shall be constructed in accordance with the Standard Drawing.

Curb ramps shall be constructed in accordance with Standard Drawing.

7.4 VERTICAL ALIGNMENT

Minimum gutter grades around all curves and along all tangents shall not be less than 0.6%. Minimum gutter grades on curb returns shall be 1.0%.

Maximum gutter grades shall not exceed those defined by Table 7.1 (pages 54 & 55).

All roadways shall be crowned or shall have a crossfall as shown on the applicable standard drawings. The standard crossfall rate is 2.0%.

The grades at intersections for all roadway classifications shall not exceed 2% for a minimum distance of thirty (30) metres, measured from the shoulder edge of the receiving road.

All vertical curves shall be designed to meet or exceed the following minimum requirements:

K VALUE

Design Speed (km/h)	Crest	Sag*	Minimum Length (m)
50	7	6	50
60	15	10	60
70	22	15	70

K = L/A

L = length of vertical curve in metres

A = algebraic difference in grades percent

* = based on comfort control and assumes street lighting

The maximum superelevation is shown in Table 7.1.

Rear lanes (alleys) shall have a minimum longitudinal grade of 0.6%. If gravel-surfaced, the lane shall be sloped at 3.0% from outside edge to center of lane. If paved, the lane shall be sloped at 3.0% from outside edge to center of lane. Paved lanes that have a centre swale must be approved in writing by the Town and shall have slopes of 3.0%. See Standard Drawings D-123 in the Town of Redcliff Construction Standards.

7.5 HORIZONTAL ALIGNMENT

The minimum radius is relative to the Road Classification, the design speed and the maximum superelevation (see Table 7.1).

All horizontal curves shall be designed to meet the minimum design requirements shown in Table 7.1.



Minimum edge of pavement radius for cul-de-sacs is 12.0m in residential areas and 15.0m in industrial areas.

Maximum cul-de-sac length shall be 120.0m.

The approach to commercial/industrial properties or property corner cut without curb and gutter is 15m.

Where curb and gutter exists the flares at intersecting roadways shall have the following minimum radius from shoulder to shoulder

- Residential access and local 10.0 metres
- Residential collector 15.0 metres
- Industrial local and collector 15.0 metres

All flares must be maintained within property lines.

7.5.1 Curb Returns

Curb returns shall be design as per vehicle turning paths following TAC guidelines. Curb returns at residential local street intersections shall be constructed to a radius of 9.25 m at lip of gutter.

Curb returns at residential local street to collector street intersections shall be constructed to a radius of 10.75 m at lip of gutter.

In industrial/commercial areas, the radius should be 12.25 m to accommodate truck turning movements.

For arterial street intersections the curb returns shall be designed in consideration of the type and volume of the turning traffic. Two and three centred curves, with or without islands, may be required.

Curb ramps are required at all intersections which have sidewalks.

7.6 CULVERTS AND DRAINAGE

- I. The minimum allowable ditch grade shall be 0.5%. Ditch grades in excess of 2.0% shall be protected against erosion through rock ditch checks, silt fences, Enviroberm fences and/or erosion control blankets. Typical ditch check installations are illustrated in the Standard Detail Drawings.
- II. Ditch side slopes and back slopes shall not be steeper than 3:1.
- III. The minimum ditch bottom width shall be 3.0 metres along arterial roads and 1.0 m along the collector and local roadways, sloping away from the roadway at a minimum of 5.0%.
- IV. Culvert size requirements shall be determined through the storm water drainage analysis; however, the minimum size culverts shall be as follows:
 - Roadway cross culvert 600 mm (24 inch)
 - Residential approach culvert 300 mm (12 inch)
 - Industrial approach culvert 500 mm (20 inch)
- V. Culverts shall be new galvanized C.S.P. (corrugated steel pipe) with a minimum wall thickness of 1.6 mm, or as required by the loading criteria.



- VI. All culverts shall be installed in accordance with the manufacturer's recommendations. In high density residential developments, all culverts shall be installed with bevelled end sections on both the inlet and outlet sides, with the invert extended to the toe of the side slope.
- VII. All culverts, except those in industrial developments, shall be installed to provide a minimum depth of cover of 300 mm or one-half the culverts diameter, whichever is greater. This should be measured from the finished shoulder grade of the roadway to the top of the culvert as shown on the Standard Detail Drawing. Installation. Culverts in industrial developments shall be installed to provide a minimum depth of cover of 500 mm or one-half the culverts diameter, whichever is greater, as measured from the finished shoulder grade of the roadway to the top of the culvert.
- VIII. Rip-rap shall be placed around the inlet and outlet of each culvert, with the rip-rap extending a minimum of 1.0 metre beyond the ends of the culvert. Rip-rap material shall consist of rock ranging in size from 150 mm to 350 mm with 50 % of the rock material being larger than 200 mm. Refer to the Town's Construction Standards for detailed rip-rap specifications. A typical rip-rap installation is illustrated in the Standard Detail Drawing D-143. A Geotextile fabric wrap and suitable clay seal and seepage cut off at the inlet be provided to prevent the free passage of seepage water under the culvert.

7.7 ROAD APPROACHES

This sub-section outlines the requirements respecting the design and construction of approaches within subdivision developments.

- I. Residential approaches shall typically be located as follows:
 - For low density residential, the approach shall typically be located to provide the best and most direct access to the building site on the lot.
 - For internal high-density residential lots, the approach shall typically be centered on the lot frontage.
- II. A residential approach shall not exceed eight (8.0) metres in width; and industrial lot approach shall not exceed fifteen (15.0) metres in width. Any deviation from these maximum widths requires the approval Town Engineer.
- III. All approaches shall be constructed to the same structure as the adjoining roadways, with asphalt surfacing extending to the following limits:
 - Low-density residential – 1.5 m past road shoulder,
 - High-density residential – 6.0 m past road shoulder,
 - Industrial/commercial – to property line.
- IV. All residential subdivision development shall require the Developer to construct one approach to each lot, consistent with the standard outlined herein.
- V. Approaches to industrial/commercial lots are required to be constructed by the Developer where the access locations are known. Where access locations cannot reasonably be determined, the Town may choose to have the Developer provide materials and/or securities to permit future construction of the approaches.



For commercial and industrial approaches in areas without curb and gutter, the maximum approach width shall be 15m. Approach widths of greater than 15m must be approved by the Town Engineer. The flares are to be maintained within the property lines and the radii of the flares should be at least 12.25m to accommodate truck turning movements.

7.8 ROAD SURFACE FINISHES

- I. The Town presently approves two types of roadway surface finishes:
 - Gravelled surface,
 - Asphaltic concrete (hot mix asphalt) pavement surface (A.C.P.)
- II. Roadways in all subdivision developments shall be surfaced with asphaltic concrete pavement (hot mix asphalt).
- III. Irrespective of the roadway surface finish approved by the Town for a specific development, good roadway industry construction practices and techniques shall be employed at all times. Furthermore, roadway subgrade and base construction shall be undertaken with the view that an asphaltic concrete pavement will ultimately be placed as the surface finish for the roadway.
- IV. Should a gravelled surface be approved, even for an interim period, the surface gravel shall be a minimum compacted layer of 75 mm depth of 20 mm crushed gravel. All approaches shall be similarly treated.

7.9 PAVEMENT STRUCTURE

All roadways other than rear lanes (alleys) shall be paved with hot mix asphalt. A geotechnical report with recommended pavement designs shall be conducted by a Professional Engineer and submitted to the Town for review.

Paved roadways shall be designed in accordance with the Asphalt Institute Method of pavement design, using minimum design loadings of 8,165 kg (18,000 pound) axle loads. The design parameters, such as traffic count, percentage of trucks, California Bearing Ratio (CBR), are to be outlined to the Town Engineer. The Town reserves the right to request the Developer to engage an engineering agency to carry out tests, prior to paving, to confirm adequacy of design.

Minimum pavement structure requirements shall be as per typical details in Town Construction Standards. An independent pavement design is required for all developments. Additional pavement structure strengths and/or materials may be required in areas with poor subgrade materials, pending the results of the geotechnical investigation.

Alternative pavement designs, such as soil cement base, may be considered. Approval of alternate pavement designs must be obtained in writing from the Town Engineer prior to submission of design drawings.

Gravel surfacing is permitted on rear lanes (alleys). Aggregate base material shall be used to a minimum depth of 150 mm, with 100 mm placed during initial construction and 50 mm placed during the final year of the maintenance period.

7.10 RIGHT-OF-WAY PREPARATORY REQUIREMENTS

The entire road right-of-way (R.O.W.) shall be cleared of all vegetation (trees, shrubs, brush, etc.) including removal of all tree roots and stumps. All such material shall be removed from the site for disposal at approved locations. No burying of this material, or any portion thereof, shall be permitted within the R.O.W.



Organic soil and material are not acceptable as subgrade materials and shall be stripped within the roadway, ditch and back slope portion of the new construction. Organic soils (horizon A) shall be stockpiled in approved locations for the re-spreading on the ditches and backslopes after completion of the roadway construction.

7.11 TRAFFIC IMPACT ASSESSMENT (TIA)

Engineering studies assessing the impact of development-generated traffic may be required to be submitted to the Town preceding an approval of:

- Annexation
- Land Use Reclassification
- Area Structure Plan and Related FSR
- Subdivision
- Development Permit
- Road Closures
- Variance in Access Requirements

A TIA will be required if:

- A development can be expected to generate more than 100 new peak-hour trips on intersecting or adjacent roadways.
- Where traffic problems such as high accident rates, traffic congestion, short cutting or access problems are being experienced in the area, regardless of the magnitude of peak hour volumes generated by the development.
- Change in land use may change directional distribution of site generated traffic by greater than 20%.

Variances to the above may be permitted at the Town's discretion.

Additional guidance may be obtained from the Town's Engineering Department.

The scope of a TIA shall generally incorporate the following information and criteria:

- Design horizon year for the development shall be the build-out year of the development or as stipulated in the reference standards.
- Background traffic volumes shall be consistent with the time horizons used in the Town's current Transportation Network Study.
- Intersection Level of Service and Capacity criteria shall not fall below LOS C for new developments and LOS D for redevelopment in built up areas.
- Level of Service for individual approaches and movements to an intersection shall be subject to the Town's review and discretion.
- Mitigate measures, right-of-way requirements, improvements (including traffic control devices) and cost allocation.



DESIGN GUIDELINES

ROADWAYS

**TABLE 7.1
SUMMARY OF RECOMMENDED DESIGN STANDARDS FOR STREETS**

Classification	Type	Traffic Volumes (vpd)	Posted Speed (km/h)	Right-of-Way Width (m)	Pavement Width (m)	Travel Lanes	Parking Lanes	Maximum Gradients (%)	Maximum Superelevation (m/m)
Expressway	Rural	>20,000	80 to 110	55.0 (min)	14.8	4 (min) @ 3.7m	None	4.0	0.04 - 0.06
Downtown Undivided Commercial Major Roadway	Urban	5,000 - 20,000	50	30.0 (min)	26.0	2 @ 3.7m Driving 2 @ 3.5m Maneuver	2 @ 5.8m	5.0	0.04 - 0.06
Undivided Major Roadway	Urban	5,000 - 20,000	50 or 60	30.0 (min)	14.8	2 @ 3.7m	2.5m*	5.0	0.04 - 0.06
	Rural		50 to 80		13.0	2 @ 4.5m	None	5.0	0.04 - 0.06
Industrial/Commercial Collector Roadway	Urban	1,000 - 12,000	50 or 60	25.0 (min)	9.0	2 @ 4.5m	2.5m*	6.0	0.02 - 0.04
	Rural		50 or 60		8.0	2 @ 4.0m	None	6.0	0.02 - 0.04
Residential Collector Roadway	Urban	1,000 - 8,000	50	25.0 (min)	13.0	2 @ 4.0m	2.5m*	6.0	0.02 - 0.04
	Rural		50		9.0	2 @ 4.5m	None	6.0	0.02 - 0.04
Downtown Commercial Roadway	Urban	1,000 - 8,000	50	20.0 (min)	15.3	2 @ 3.5m	5.8m Angled and 2.5m Parallel	6.0	0.02 - 0.04
Public Service Roadway	Urban	1,000 - 8,000	50	20.0 (min)	10.5	2 @ 3.0m	2 @ 2.25m	6.0	0.02 - 0.04
Local Industrial / Commercial Roadway	Urban	< 5,000	50	18.0 (min)	11.0	2 @ 3.25m	None	6.0	0.015 - 0.02
	Rural		50	20.0 (min)	9.0	2 @ 4.5m	None	6.0	0.015 - 0.02
Local Residential Roadway	Urban	< 2,000	50	16.0 (min)	10.5	2 @ 3.0m	2 @ 2.25m	6.0	0.015 - 0.02
	Rural		50	20.0 (min)	8.0	2 @ 4.0m	None	6.0	0.015 - 0.02

* Parking may be restricted during peak hour traffic.

Table 7.1 continued on next page.



DESIGN GUIDELINES

ROADWAYS

**TABLE 7.1 (CONT'D)
SUMMARY OF RECOMMENDED DESIGN STANDARDS FOR STREETS**

Classification	Type	Minimum Radius of Curvature (m)	Minimum Intersection Spacing (m)	Minimum Corner Cuts at Intersections	Sidewalks / Trails	Lighting Poles and Other Obstructions	Parking Features	Direct Access Control
Expressway	Rural	In accordance with TAC Standards	800	In accordance with TAC Standards	Prohibited	3.10m (min) from Lip of Gutter or Edge of Asphalt	Prohibited	Restricted
Downtown Undivided Commercial Major Roadway	Urban	In accordance with TAC Standards	100	In accordance with TAC Standards	Both Sides	0.75m (min) from Lip of Gutter	45° Angled	Restricted ³
Undivided Major Roadway	Urban	In accordance with TAC Standards	200	In accordance with TAC Standards	Separate and Multi-Use Trail (if required)	1.6m (min) from Lip of Gutter	As Required	Restricted ⁴
	Rural				None	3.0m (min) from Edge of Asphalt	Prohibited	
Industrial/Commercial Collector Roadway	Urban	In accordance with TAC Standards	100	In accordance with TAC Standards	Separate and Multi-Use Trail (if required)	1.0m (min) from Lip of Gutter	Permitted	Restricted ⁵
	Rural				None	3.3m (min) from Edge of Asphalt	Prohibited	
Residential Collector Roadway	Urban	In accordance with TAC Standards	60	In accordance with TAC Standards	One Side	2.45 (min) from Lip of Gutter	Permitted	Permitted
	Rural	In accordance with TAC Standards			None	2.3m (min) from Edge of Asphalt	Prohibited	
Downtown Commercial Roadway	Urban	In accordance with TAC Standards	60	In accordance with TAC Standards	Both Sides	0.65m (min) from Lip of Gutter	Angled and Parallel	Restricted
Public Service Roadway	Urban	In accordance with TAC Standards	60	In accordance with TAC Standards	Monolithic and Multi-Use Trail (if required)	1.2m (min) from Lip of Gutter	Angled or Parallel	Restricted
Local Industrial / Commercial Roadway	Urban	In accordance with TAC Standards	60	In accordance with TAC Standards	Separate and Multi-Use Trail (if required)	1.0m (min) from Lip of Gutter	Permitted	Permitted
	Rural	In accordance with TAC Standards	200		None	2.3m (min) from Edge of Asphalt	Prohibited	
Local Residential Roadway	Urban	In accordance with TAC Standards	60	In accordance with TAC Standards	Both Sides	1.95m (min) from Lip of Gutter	Permitted	Permitted
	Rural	In accordance with TAC Standards			None	1.0m (min) from Edge of Asphalt	Prohibited	



DESIGN GUIDELINES

ROADWAYS

- Notes:
1. Access is available to abutting industrial/commercial property and multi-family subject to traffic and design condition. A minimum driveway to intersection spacing of 200 m should be maintained for new construction, and generally restricted to right turns in and out. In the case of large developments with large amounts of traffic an all turns access complete with left turn bays, right turn channelization and potentially signal lights should be reviewed.
 2. On street parking should be prohibited in new developments.
 3. Access is available to abutting industrial/commercial property and multi-family subject to traffic and design condition. Driveway access to the road is not recommended but can be allowed for specific business uses such as drive through and gas stations but should be limited and restricted if possible.
 4. Driveways are permitted on Undivided Major roadways; however, a minimum driveway/intersection spacing of 200 m should be maintained for new construction.
 5. Driveways are permitted on Industrial/Commercial Collector roadways; however, a minimum driveway/intersection spacing of 120 m should be maintained for new construction.



DESIGN GUIDELINES

ROADWAYS

TABLE 7.2 TEST FREQUENCY			
Specification	Type of Test	Recommended Test Frequency	Remark:
Trenching, Backfilling and Compaction for sewers, catch basins leads, watermains and hydrants sewer and water service connections, shallow utilities, and for Electrical Installation	Density Test: -Trench longer than 15 m -Trench shorter than 15 m	2 tests per 600 mm of depth for every 100 m of trench length 3 tests per trench	Testing will vary with location of project and consequences of trench settlement.
Roadway Excavation, Backfill and Compaction	Grading/Fill Compaction: Subgrade Preparation Proof Rolling:	1 density test per 2000 sq. m of compacted lift 1 density test per 1000 sq. m of compacted subgrade lift Entire project	
Aggregate: General Granular Sub-base Granular Base	Source Sampling: Compaction: Proof Rolling:	1 sieve analysis per 500 tonnes of asphalt aggregate for crushing control 1 sieve analysis per 2500 tonnes of base and subbase aggregate 1 density test per 1500 sq. m of compacted granular lift of road Entire project	Required 2 weeks prior to commencing work
Stabilization: Lime	Source Sampling: Test Area: Proof Rolling:	400 sq. m to establish and demonstrate work methods and timing At completion of curing period	Required 2 weeks prior to commencing work
Soil Cement	Source Sampling (aggregate): Mix Design: Thickness Test: Compaction Test: Strength Test:	1 sieve analysis per 2500 tonnes 1 core sample per 1000 sq. m of soil cement in place 1 density test per 1000 sq. m of soil cement in place 1 7-day compressive strength test per 1000 tonne of soil cement	Required 2 weeks prior to commencing work Required 2 weeks prior to commencing work Areas suspected to have inadequate thickness
Topsoil	Topsoil Analysis: -On-site Sources -Contractor Supplied	1 analysis report for each topsoil source Contractor to supply 1 litre sample of each topsoil type for testing	Required 4 weeks prior to commencing work
Asphaltic Concrete Paving	Mix Design: Density/Thickness Test: Mix Proportions:	3 cores per 600 tonnes of asphalt pavement 1 Marshall per 600 tonnes of mix, with a minimum of 1 test from each full day's production	Required 2 weeks prior to commencing work
Water Main	Hydrostatic/ leakage test* Bacteria/Chlorine Test *	Test section not to exceed 365 m in length	Provide Town at least 24 hours notice
Storm Sewer Sanitary Sewer	Television and Photographic Inspections:	Upon completion of sewer installation, after backfilling	Performed by Contractor
Force Mains	Hydrostatic/ leakage tests *	Test section not to exceed 365 m in length	Provide Town at least 24 hours notice
Concrete Curbs and Gutters, Walks, Medians, Driveways and Swales General Concrete Slip Formed Concrete	Mix Design: Slump Test: Air Content Test: Strength Test:	1 per 20 cu. m for each class of concrete poured, min. 1 per day 1 per 20 cu. m for each class of concrete poured, min. 1 per day 1 per 20 cu. m for each class of concrete poured, min. 1 per day	Required 2 weeks prior to commencing work Every truck until consistency is established Every truck until consistency is established
*Tests to be witnessed by Town			



8. TRAFFIC CONTROL DEVICES, STREET NAME SIGNS & PAVEMENT MARKINGS

Plans shall be provided to the Town Engineer that depicts the locations and details of all traffic control devices (traffic signs and traffic signals), street name signs and pavement markings.

All traffic control devices and pavement markings shall be designed and installed in accordance with the manual "Uniform Traffic Control Devices for Canada" as issued and revised from time to time by the Transportation Association of Canada (formerly RTAC).

Guide and information signing shall be designed and installed in accordance with the "Urban Guide and Information Sign Manual" as issued by the Alberta Government.

Street signing shall be standard aluminum, white on green, with a minimum vertical dimension of 150 mm.

8.1 MATERIALS

All signs shall utilize Hi-Intensity reflective material to ASTM-D4956, Type III.

All sign posts shall be U Channel, galvanized Schedule 40 steel or round 2 5/8 OD Steel.

Along arterial streets and at arterial street intersections, pavement markings shall be of a "permanent" type, inlaid thermoplastic. Painted markings are acceptable elsewhere.

8.2 INSTALLATION

All traffic control signs shall be mounted to provide 2.0 m vertical clearance to the lowest portion of the sign, unless otherwise approved by the Town Engineer.

All signs shall be mounted to provide a minimum of 0.3 m of horizontal clearance from back of curb or back of walk. Where there is no curb or walk within the right-of-way, the sign location is to be approved by the Town.

END OF SECTION



9. STREET LIGHTING

9.1 GENERAL

The City of Medicine Hat provides street lighting for the Town. Standards for industrial developments shall be determined by the Town during the initial planning stages of the proposed development.

All street lighting cables in new subdivisions shall be installed underground. Additional street lights in neighbourhoods with overhead cabling may be installed overhead if approved by the Town Engineer.

9.2 DESIGN

The Developer shall coordinate the location of street lights to ensure that they do not interfere with other utilities and driveways.

Street lights shall be provided for each internal park area that does not abut onto a lighted street. A street light shall be located at the point where each walkway opens out onto the park area.

9.3 COSTS

Any capital contribution that the utility company may charge for installation of underground street lighting shall be paid by the Developer.

END OF SECTION



10. LOT GRADING

10.1 DESIGN

The grading design shall complement the overall design of both the minor and major storm drainage system. In general, the lots shall be graded and sloped in such a manner that a minimum of surface run-off water will be conducted to other properties. Where surface drainage swales direct run-off from one lot to the next, the necessary drainage easements shall be registered concurrently with the plan of subdivision.

Reserves and public lands shall be graded to drain towards developed streets and/or storm sewer catch basins or drainage channels.

Boulevard areas shall be graded to provide a minimum slope of 2% from property line to top of curb.

Commercial and industrial lots shall be graded to drain to on-site storm sewer catch basins.

In cases where the backyard slopes towards the building, provisions are required to keep the runoff at least 3.0 m away from the building, with the possibility of draining the surface water along the lot lines onto the streets.

Where drainage swales are provided on rear property lines in laneless subdivisions, the developer shall provide an approved concrete drainage swale. The drainage swale shall be provided on one side of the property line and be placed in a drainage easement.

The maximum slope draining towards property lines shall not exceed 10% within 1.5 metres of the property line. The slope away from buildings shall meet the minimum requirements of the Alberta Building Code (2% slope at all corners). Downspouts from eaves troughs and discharges hoses from sump pumps shall not discharge within 0.6 metres from the property line.

10.2 RETAINING WALLS

Where extremes in elevation of adjoining lots require the construction of a retaining wall, it shall be indicated on the proposed grading plan. No work or construction will be permitted on the building lots without a commitment by either owner of the two lots involved to construct the retaining wall at the time of construction of the proposed building.

The retaining wall shall be designed by a qualified geotechnical engineer.

END OF SECTION



11. SHALLOW UTILITY COMPANIES

The following guidelines apply to all developers for the construction of municipal improvements, as well as Utility companies wishing to repair, replace or otherwise modify their existing services, within the Town of Redcliff.

11.1 ELECTRICAL POWER, TELEPHONE, GAS, AND CABLE TV SERVICES

11.1.1 General

Utility Companies provide Electrical Power service, Gas Service, Telephone and internet service, and Cable TV service.

11.1.2 Rights-of-Way

Where required, the Developer shall provide right-of-way and easements of sufficient size and location to satisfy the above mentioned Utility Companies.

Utilities shall be located according to the Standard Drawings, or as directed in writing by Town Engineer.

All easements on Town property shall be registered in the name of the Town of Redcliff.

11.1.3 Design and Installation

An approval must be obtained from the Town of Redcliff for any excavation on Town property.

Design and installation of utilities shall be provided by the City of Medicine Hat, Telus, Shaw Cable or Bell Canada in accordance with their respective standards, and meeting these general requirements.

To protect persons from injury and to avoid property damage, adequate barricades, construction signs, warning lights and guards, as required, shall be placed. Whenever required, watchmen shall be provided to prevent accidents.

Backfill material shall be native soil material excavated from the ditch/trench or Fillcrete, at the discretion of the Town Engineer. Sand must be substituted for poor existing soils. Poor existing soils are defined as organic soils, peat, black loam, sod, clay that has hardened and stones. Backfill material shall be compacted to 98% density of the maximum density of a standard proctor compaction test within boulevards and 100% within streets under concrete, asphalt structures or lanes. All backfill material may be subject to the approval of the Town Engineer.

Augering, in some instances, may be required. In cases where augering is necessary, the diameter of the augered hole shall not be over 50 mm greater than the diameter of the duct to be installed.

11.1.4 Costs

Any capital contribution that the utility company may charge for installation of the above services shall be paid by the developer.

END OF SECTION



12. LANDSCAPING

12.1 GENERAL PLANNING GUIDELINES

12.1.1 Definitions

Environmental Reserve:

Land dedicated at the time of subdivision that is set aside to protect unstable, environmentally sensitive or significant natural areas, or to protect shorelands and flood-prone areas. Environmental Reserve consists of swamps, gullies, ravines, coulees, natural drainage courses, areas subject to flooding, steep slopes, and a strip not less than 6 meters in width at the edge of any lake, river, stream or other body of water, under the authority of Section 664 of the Municipal Government Act (RSA 2000, Chapter M-26).

Municipal & School Reserve:

Land provided by the registered owner to the municipality for development of functional open space within the urban environment. Land dedicated at the time of subdivision specifically for school grounds and building sites or provided to a school authority after subdivision by the Town, based on an agreement between the Town and the school authority. These items fall under the authority of Sections 666 & 667 of the Municipal Government Act (RSA 2000, Chapter M-26).

Public Open Space:

Any parcel of land or water which is set aside and managed by the Parks and Outdoor Recreation Department, for a diverse range of environmental, leisure and recreational activities and opportunities. Generally parks environmental reserves, and open spaces are used for either active or passive recreational activities, however they may also include areas which contain significant ecological, aesthetic, or cultural features and may be used for environmental protection.

Maintained Parks:

Parks that require on-going maintenance such as grounds maintenance, tree maintenance and trail maintenance.

12.2 GENERAL PLANNING REQUIREMENTS

Methods of establishment, maintenance and irrigation of the proposed landscape design should be outlined in the development proposal. The quality and extent of the proposed landscape established on the site and the areas of natural vegetation preserved shall be the minimum standard to be maintained on the site for the life of the development.

All Municipal Reserve land is to be developed to a turf grass standard including grading, topsoil supply and spread, irrigation installation and tree planting; except where designated to remain as a natural area.

In areas where some cut and fill is necessary, the earthwork should be done in a manner that is compatible with the natural land-form. Avoid unnatural, continuous slopes of the same gradient. Modulate contours and blend with the existing natural slopes.

Each park site is to be provided with water and electrical service.



All Municipal Reserve land is to be developed with an automated irrigation system installed for all turf areas.

Trails and trail linkages are to be provided. Ensure regional trail alignments correspond to Area Structure Plans, ensure local trails link directly or indirectly to regional trails, and avoid isolated and disjointed trails.

When traffic is disrupted due to construction, the developer will provide and maintain temporary roadways and walkways for vehicular and pedestrian traffic.

Provide adequate and safe pedestrian access to recreation open space.

Lighting may be required at trails and activity nodes, subject to the review and approval of the Town of Redcliff.

Provide sixty trees (60) per hectare of landscaped area provided. Preservation of existing mature trees may fulfill all, or a portion of the tree planting requirements, depending on the quality and size of the existing trees when reviewed on-site by the Town of Redcliff.

Tree planting for public roads rights-of-way are to be approved in conjunction with the Engineering Department and the Public Services Department to ensure proper sight clearances from roads, intersections and clearance utilities.

Do not plant directly over utility lines or proposed utility line locations or directly under existing power lines. Coordinate with the Town's Public Works Department to verify appropriate locations.

In the case of pipelines, a crossing agreement is required from the utility company. Restoration of any disturbed land is the developer's responsibility, and must be carried out to an approved town standard.

Ensure no construction of permanent structures, other than trails, storm ponds, and associated structural components or interpretive elements, in natural areas or environmental reserves within the 1:100 year flood plain.

All development proposals should detail the intended methods of protecting the natural systems during construction. The design of the development should consider the protection of natural features during regular use of the development after construction. At no time shall encroachment into any natural area that has been set aside for preservation occur without the express written consent of the Town of Redcliff. Environmental Reserves and other designated spaces shall contain post and chain fencing and be otherwise protected from adjoining construction.

Any natural areas designated for preservation that are damaged during construction must be rehabilitated and re-vegetated to the satisfaction of the Town of Redcliff. Replanting should be done with indigenous tree, shrub and grass species in natural areas where existing vegetation has been disturbed or destroyed.

Design the maintained parkland to complement the natural areas when one occurs adjacent to the other. With the exception of straight line boulevard tree planting or formal plantings in park areas, planting should be sensitive to the ecological patterns in the area, and blend in with the existing vegetation.



Ensure that any recreational development proposed will not damage the natural environment. Protection and management of the natural or cultural environment is the primary concern, and recreational use is only a secondary objective.

Provide visual and noise protection for residential areas from major roads in conjunction with the Town of Redcliff Engineering Department.

All environmental reserves adjacent to residential areas must be fenced with post and chain installed on Town property. All Municipal Reserves must have a standard curb along the property line to prevent vehicular access to the municipal reserve.

Public open space site furnishings must be indicated on the final landscape plans and be provided by the developer in accordance with the direction and approval of the Engineering Department.

Site furnishings shall complement and enhance the natural setting. Details which are consistent with local materials, color and style should be utilized. All site furnishings are to be vandal resistant where possible.

All playground installation must conform to CAN/CSA - Z614 - M90; A Guideline on Children's Play Spaces and Equipment. All site plans, playground designs, construction material, playground suppliers and playground development must be approved by the Town of Redcliff. The Town will determine the acceptability of materials and the extent of the playground development.

12.3 OPEN SPACES CATEGORIES

The design guidelines will be organized under four main categories and appropriate sub-categories.

12.3.1 Natural Areas And Environmental Reserves

Natural areas are an important component in the overall open space system. Activities in natural areas may include nature oriented outdoor recreation such as viewing and studying nature, bird and animal watching, hiking and other trail uses.

- Size varies depending on natural features being protected or other specific requirements.
- Pedestrian access may be restricted to trails, in areas of environmental sensitivity.
- Provide sitting and picnic areas with benches, trash receptacles and picnic tables.

12.3.2 Maintained Parkland

Small Amenity Parks

- Small scale open space for residents close to the periphery of a neighbourhood, which focuses on passive recreation and aesthetic appeal.
- Size range from 0.4 ha (1 acre) to 0.8 ha (2 acres).
- No more than two (2) amenity parks per neighbourhood.
- Not less than 400 meters from Neighbourhood Park, and not more than 400 meters from neighbourhood periphery.
- Located on local or collector streets.
- Provide one (1) creative play structure.



- Provide sitting and picnic areas with benches, trash receptacles and picnic tables where possible.
- Maintain natural areas where possible.

Neighborhood Parks

- Larger than Amenity Parks, intended to satisfy active and passive recreational needs of the neighbourhood (approximately 5000 residents).
- Size range from 1.2 ha (3 acres) to 5.7 ha (14 acres).
- Within 600 meters of most residences in the neighbourhood.
- Centrally located in neighbourhood.
- Located on local or collector streets.
- Elementary Schools may be located adjacent to Neighbourhood Parks.
- Provide one creative play structure
- Provide sitting and picnic areas with benches, trash receptacles and picnic tables
- Maintain natural areas where possible

12.3.3 Linear Open Spaces

For planning purposes, the linear open spaces category is divided into four sections:

Linear Park

The Linear Park is intended to provide a safe connection between parks and other destinations through non-motorized means of transportation.

Trail Systems

Trails can be located in the Municipal Reserve. Trails may also be located through Environmental Reserve areas, building or environmental setbacks, utility easements, utility right-of-ways, and road right-of-ways and boulevards where approved. Small parcels of municipal reserve with low developable potential will be accepted as part of the municipal reserve dedication where these parcels are required to connect trails to the overall trail system.

Boulevards and Buffers

Boulevards and residential front yards form an important part of the open space system by providing visual relief between the roadways and other land uses. Buffers adjacent to residential areas also provide visual screening and noise attenuation from conflicting land uses.

Boulevards and buffers provided by the developer along all roadways shall be part of the public road right-of-way and not constitute a part of the municipal reserve dedication. Landscape islands in cul-de-sacs or medians are permitted only if treated in a low or no maintenance manner and approved by the Parks and Outdoor Recreation Department. Islands and boulevards are not to be credited as municipal reserve dedication.



Utility Easements and Right-Of-Ways

Utility easements and rights-of-way may also function as an integral part of the open space system. These lands may be desirable as pedestrian links connecting open space areas. Stormwater facilities (both wet and dry ponds) can also be utilized within the open space system.

Utility easements and rights-of-way will not be credited towards the Municipal Reserve dedication. Stormwater lakes shall be designated as a public utility and will not be credited towards the Municipal Reserve dedication.

12.3.4 Open-Spaces Requirements

Municipal Reserve contribution to linear parks should be a maximum of 10% of the gross land area of the neighbourhood.

Maximum distance between service vehicle and pedestrian access points should be 500 meters.

Where a regional or local trail which is part of the Town of Redcliff Structure Plans crosses through the parcel of land being developed, the developer will be responsible for the cost of constructing such trails. Trail proposals shall be reviewed and approved by the Parks and Outdoor Recreation Department. Trail layout should be designed to connect the residential areas with the park activity nodes and other centers such as schools, commercial areas, etc. Regional trails should not be within 5 metres of play area surfaces, and links to the trail system from play structure sites should be established.

Conflicts between vehicular and pedestrian traffic should be minimized. Avoid sections on-street in order to maximize continuity of trail system. All trails should be barrier free wherever possible.

Trails developed in natural areas should be designed and sited to minimize physical and visible disturbance to landform or vegetation. Minimize damage to Environmental Reserve parcels by careful trail route selection, by sensitive use of retaining structures, and by grading side slopes to minimize disturbances.

The developer is responsible for rehabilitation of areas disturbed by trails passing through natural areas.

Boulevards and buffers should provide a transition between roadways and parks. Planting and grading in boulevards should blend in with natural vegetation patterns and park planting.

Use existing vegetation to screen development from viewpoints that occur at higher or lower elevations. Use existing slopes and topography to buffer views.

All areas are to be properly graded, topsoil is to be supplied and spread and turf established.

Two (2) trees are to be planted per residential lot with at least one (1) tree planted in the front yard away from sanitary and water services. The trees are to be 1.75 meters to 2.5 meters in height, or 50 mm caliper.

Preservation of existing mature trees within the road right-of-way or within the front yard setback may fulfil all, or a portion of the tree planting requirements depending on the size and quality of the existing trees when reviewed on-site by the Town of Redcliff.



Minimize clearing widths for underground utility lines to mitigate unsightly cut lines through existing tree cover. Utilize the same trench or cleared right-of-way for more than one utility where possible. Allow natural re-growth to occur in right- of-way over deep utility lines. Blend utility easements into park areas in as natural a manner as possible.

Park space is desirable adjacent to stormwater lakes, provided that the lake and associated grading is designed in conjunction with the park and appears as natural as possible.

Naturalize straight cut lines for utilities by replanting with trees and shrubs. Naturalize stormwater ponds, and re-graded or disturbed areas, with groupings of native trees and shrubs. Design proposed contours in a curvilinear form rather than a straight line form.

12.4 SITE PREPARATION

12.4.1 Design Guidelines

The objective of this Section is to provide the foundation to create attractive, stable open spaces.

12.4.2 Site Preparation Requirements

Sub-grade elevation shall be the final grade minus surfacing material depth.

Seeded areas:	150 mm below final design grade
Sodded areas:	150 mm below final design grade
Shrub beds:	450 mm below final design grade
Playground sites:	300 mm below final design grade
Gravelled areas:	225 mm below final design grade
Paved areas:	as per site specific design
Concrete sidewalks:	as per site specific design

Slopes along property line or perimeter of construction area where design contours must match existing elevations shall not exceed 4:1. Slopes in areas to be mowed shall not exceed 4:1. Make changes in grade natural. Blend slopes into level areas.

When necessary, adjust manhole frames and covers, valve boxes, hydrants or any other appurtenance to design grade.

Drainage patterns that direct surface runoff onto roads and ditches must be approved by the Engineering Department. Existing drainage courses should be maintained and incorporated into the development wherever possible.

Public lands shall not discharge surface runoff onto adjacent private lands, and wherever possible, should enhance the overall drainage of the area.

Grading may allow water to pond in natural areas only, where infiltration is desired; however, water should percolate within eight hours of a rainfall. This will allow an area to recharge natural groundwater levels. This work must be approved by the Engineering Department prior to the work commencing.

Drainage must be designed so that water is not retained on public walkways or trails.



12.5 TOPSOIL AND FINISH GRADING

Ensure that finished grade sheets flush at surface structures, and at existing grades of project boundaries and property lines.

12.5.1 Active Open Space

Spread manufactured growing medium of one (1) part peat moss, one (1) part sand, and two (2) parts of topsoil evenly over entire area, to obtain a minimum growing medium depth of 150 mm after settlement (sand is required only if soil conditions warrant).

12.5.2 Boulevards/Passive Open Space

Spread topsoil evenly over entire area to obtain a minimum depth of 150 mm after settlement.

12.5.3 Shrub Bed Area Topsoil Depths

- 600 mm for shrub beds
- 450 mm for flower beds

12.5.4 Seeded and Sodded Area Topsoil Depths

- 150mm for seeded areas
- 130mm for sodded areas

12.6 SEEDING AND SODDING

12.6.1 Seeding and Sodding Requirements

On sites where the application of a seed mix is appropriate, the seed mix must be approved by the Town of Redcliff and applied to an acceptable standard.

The proposed seed mixture details and breakdown (certificates of analysis) must be submitted to the Town of Redcliff to be approved by the Parks and Outdoor Recreation Department prior to the purchase and application of the said mixture. On slopes 2:1 or greater, install an approved erosion control blanket over the seeded area.

Proposed sod type must be Certified No. 1 grade-cultivated turf grass sod, grown and sold in accordance with Landscape Alberta Nursery Trades Association (LANTA) classifications, with strong fibrous root system and free of stones or burned or bare spots.

12.7 TREES, SHRUBS AND GROUNDCOVERS

12.7.1 Tree Size and Species Mix

Tree Species required in this section are to be 30% coniferous and 70% deciduous unless demonstrated by the consultant or developer that the species mix should be different to successfully integrate the project with adjacent natural vegetation patterns.

Coniferous tree sizes at time of planting shall be as follows:

- 25% - 1.5 meter height
- 50% - 2.0 meter height
- 25% - 2.5 meter height

Deciduous tree sizes at time of planting shall be as follows:



- 50% - 50 mm caliper
- 50% - 85 mm caliper

12.7.2 Shrub Size and Species Mix

Shrub species required in this section are to be 40% coniferous and 60% deciduous unless demonstrated by the consultant or developer that the species mix should be different to successfully integrate the project with adjacent natural vegetation patterns.

Coniferous & Deciduous shrub sizes at time of planting shall be as follows:

- 50% - 2 gallon potted.
- 50% - 5 gallon potted.

12.7.3 Recommended Plant Species

The following trees and shrubs are native to the Province of Alberta. They are recommended for landscape planting in the Town of Redcliff.

Plant Material for ER's and Natural Areas

COMMON NAME	BOTANICAL NAME
CONIFEROUS TREES	
Siberian Larch	Larix sibirica
White Spruce	Picea glauca
Colorado Spruce	Picea pungens
Bristlecone Pine	Pinus aristata
Swiss Stone Pine	Pinus cembra
Eastern White Pine	Pinus strobus
Scots Pine	Pinus sylvestris
Douglas Fir	Pseudotsuga menziesii Glauca
CONIFEROUS SHRUBS	
Common Juniper	Juniperus communis
Horizontal Juniper	Juniperus horizontalis
Mugo Pine	Pinus mugo
DECIDUOUS TREES	
Paper Birch	Betula papyrifera
Hackberry	Celtis occidentalis
Great Plains Cottonwood	Populus sargentii (male only)
Trembling Aspen	Populus tremuloides

COMMON NAME	BOTANICAL NAME
DECIDUOUS SHRUBS	
Amur Maple	Acer ginnala
Saskatoon	Amelanchier alnifolia
Red Osier Dogwood	Cornus sericea
Wolf Willow	Elaeagnus commutata
Potentilla	Potentilla fruticosa
Alpine Currant	Ribes alpinum
Prickly Rose	Rosa acicularis
Common Wild Rose	Rosa woodsii
Dwarf Arctic Willow	Salix purpurea Nana'
Red Berried Elder	Sambucus racemosa
Silver Buffaloberry	Shepherdia argentea
Russet Buffaloberry	Shepherdia Canadensis
Snowberry	Symphoricarpos albus
American Highbush Cranberry	Viburnum trilobum
Nannyberry	Viburnum lentago

Plant Material for Manicured Parks

COMMON NAME	BOTANICAL NAME
DECIDUOUS SHRUBS	
Tratarian Dogwood	Cornus alba
Silver Leaf Dogwood	Cornua alba 'Argenteo-marginata'
Mottled Dogwood	Cornus alba 'Gouchaultii'
Siberian Coral Dogwood	Cornus alba siberica
Golden Twig Dogwood	Cornus sericea 'Flaviramea'
Kelsey Dwarf Dogwood	Cornussericea 'Kelsey'
Hedge Cotoneaster	Cotoneaster acutifolia
European Cotoneaster	Cotoneaster intergerrimus
Waterton Mockorange	Philadelphus lewisii 'Waterton'

Annabelle Hydrangea	Hydrangea aborescens 'Annabelle'
Pee Gee Hydrangea	Hydrangea paniculata 'Grandiflora'
Sweetberry Honeysuckle	Lonicera caerulea edulis
Arnold Red Honeysuckle	Lonicera tatarica 'Arnold Red'
Clavey's Dwarf Honeysuckle	Lonicera xyloseoides 'Clavey's Dwarf'
Ninebark	Physocarpus opulifolius
Nanking Cherry	Prunus tomentosa
Double Floweing Plum	Prunus trilobata 'Multiplex'
Blue Fox Willow	Salix brachycarpa 'Blue Fox'



Gold Plume Elder	Sambucus racemosa 'Plumosa Aurea'
COMMON NAME	BOTANICAL NAME
DECIDUOUS SHRUBS	
Bridalwreath Spirea	Spiraea x vanhouttei
Goldflame Spirea	Spiraea x bumalda 'Goldflame'
Three-lobed Spirea	Spiraea trilobata
Dwarf Korean Lilac	Svringja meveri 'Palabin'
Miss Kim Lilac	Syringa patula Miss Kim'
Late Lilac	Syringa villosa
CONIFEROUS TREES	
Columnar Colorado Spruce	Picea pungens Fastigiata'
Blue Colorado Spruce	Picea pungens Glauca'
Ponderosa Pine	Pinus ponderosa
Columnar Scots Pine	Pinus sylvestris 'Fastigiata
CONIFEROUS SHRUBS	
Gold Coast Juniper	Juniperus chinensis 'Goldcoast'
Blue Pfitzer Juniper	Juniperus chinensis 'Pfitzerana Glauca'
Medora Juniper	Juniperus scopulorum Medora'
Moonglow Juniper	Juniperus scopulorum 'Moonglow'
Wichita Blue Juniper	Juniperus scopulorum 'Wichita Blue'
Dwarf Mugo Pine	Pinus mugo pumilo
Holmstrup Cedar	Thuja occidentalis Holmstrup
Wares Siberian Cedar	Thuja occidentalis 'Wareana

COMMON NAME	BOTANICAL NAME
DECIDUOUS TREES	
Silver Maple	Acer saccharinum
Ohio Buckeye	Aesculus glabra
Cutleaf Weeping birch	Betula pendula 'Gracilis
Toba Hawthorn	Crataegus mordenensis 'Toba
Snowbird Hawthorn	Crataegus x mordenensis 'Snowbird'
Russian Olive	Elaeagnus angustifolia
Manchurian Ash	Fraxinus mandshurica
Mancan Ash	Fraxinus mandshurica 'Mancana'
Black Ash	Fraxinus nigra
Falgold Black Ash	Fraxinus nigra 'Fallgold'
Foothills Green Ash	Fraxinus pennsylvanica Foothills'
Prairiespire Green Ash	Fraxinus pennsylvanica Prairiespire'
Honey Locust	Gleditsia tricanthos inermis
Black Walnut	Juglans nigra
Siberian Columnar Crab	Malus baccata 'Columnaris'
Rudolph Flowering Crab	Malus 'Rudolph'
Strathmore Crab	Malus 'Strathmore'

Thunderchild Crab	Malus 'Thunderchild'
Swedish Columnar Aspen	Populus tremula' Erecta
Tower Poplar	Populus x canescens 'Tower
Amur Cherry	Prunus maackii
Mayday Tree	Prunus padus commutata
Pincherry	Prunus pennsylvanica
Schubert Chokecherry	Prunus virginiana 'Schubert'
American Mountain Ash	Sorbus americana
European Mountain Ash	Sorbus aucuparia
Pyramidal Mountain Ash	Sorbus aucuparia 'Fastigiata'
Showy Mountain Ash	Sorbus decora
Ivory Silk Japanese Tree	Syringa reticulata 'Ivory Silk'
Lilac	Syringa sp.
Little Leaf Linden	Tilia cordata
Norlin Linden	Tilia cordata 'Roland'
Dropmore Linden	Tilia x flavescens 'Dropmore'
D.E.D. Resistant Discovery	Ulmus davidiana var. japonica 'Discovery'
Elm	Ulmus

Plant Material for Boulevards

COMMON NAME	BOTANICAL NAME
CONIFEROUS TREES	
Columnar Colorado Spruce	Picea pungens 'Fastigiata
Blue Colorado Spruce	Picea pungens 'Glauca'
Ponderosa Pine	Pinus ponderosa
Columnar Scots Pine	Pinus sylvestris Fastigiata
DECIDUOUS TREES	
Silver Maple	Acer saccharinum
Ohio Buckeye	Aesculus glabra
Toba Hawthorn	Crataegus mordenensis Toba
Snowbird Hawthorn	Crataegus x mordenensis 'Snowbird'

Russian Olive	Elaeagnus angustifolia
Manchurian Ash	Fraxinus mandshurica
Mancan Ash	Fraxinus nigra
Black Ash	Fraxinus nigra
Falgold Black Ash	Fraxinus nigra 'Fallgold'
Foothills Green Ash	Fraxinus pennsylvanica 'Foothills'
Prairiespire Green Ash	Fraxinus pennsylvanica Prairiespire
Honey Locust	Gleditsia tricanthos inermis
Black Walnut	Juglans nigra
Siberian Columnar Crab	Malus baccata Columnaris'
Rudolph Flowering Crab	Malus 'Rudolph'
Strathmore Crab	Malus 'Strathmore
Thunderchild Crab	Malus 'Thunderchild
Amur Cherry	Prunus maackii
Mayday Tree	Prunus padus commutata



Pincherry	Prunus pennsylvanica
Schubert Chokecherry	Prunus virginiana 'Schubert'
American Mountain Ash	Sorbus americana
European Mountain Ash	Sorbus aucuparia
Pyramidal Mountain Ash	Sorbus aucuparia 'Fastigiata
Showy Mountain Ash	Sorbus decora
Little Leaf Linden	Tilia cordata
Norlin Linden	Tilia cordata 'Roland'
Dropmore Linden	Tilia x flavescens 'Dropmore'
D.E.D. Resistant Discovery	Ulmus davidiana var. japonica 'Discovery'
Elm	Ulmus
COMMON NAME	BOTANICAL NAME
CONIFEROUS SHRUBS	
Gold Coast Juniper	Juniperus chinensis 'Goldcoast'
Blue Pfitzer Juniper	Juniperus chinensis 'Pfitzerana Glauca'
Medora Juniper	Juniperus scopulorum 'Medora'
Moonglow Juniper	Juniperus scopulorum 'Moonglow'
Wichita Blue Juniper	Juniperus scopulorum 'Wichita Blue'
Dwarf Mugo Pine	Pinus mugo pumilo
Holmstrup Cedar	Thuja occidentalis 'Holmstrup'
Wares Siberian Cedar	Thuja occidentalis 'Wareana'
DECIDUOUS SHRUBS	
Tratarian Dogwood	Cornus alba
Silver Leaf Dogwood	Cornua alba 'Argenteo-marginata'
Mottled Dogwood	Cornus alba 'Gouchaultii'
Siberian Coral Dogwood	Cornus alba siberica
Golden Twig Dogwood	Cornus sericea 'Flaviramea'
Kelsey Dwarf Dogwood	Cornussericea 'Kelsey'
Hedge Cotoneaster	Cotoneaster acutifolia
European Cotoneaster	Cotoneaster intergerrimus
Waterton Mockorange	Philadelphus lewisii 'Waterton'
Annabelle Hydrangea	Hydrangea aborescens 'Annabelle'
Pee Gee Hydrangea	Hydrangea paniculata 'Grandiflora'
Sweetberry Honeysuckle	Lonicera caerulea edulis
Arnold Red Honeysuckle	Lonicera tatarica 'Arnold Red'
Clavey's Dwarf Honeysuckle	Lonicera xyloseoides 'Clavey's Dwarf'
Ninebark	Physocarpus opulifolius
Nanking Cherry	Prunus tomentosa
Double Floweing Plum	Prunus trilobata 'Multiplex'
Blue Fox Willow	Salix brachycarpa 'Blue Fox'
Gold Plume Elder	Sambucus racemosa 'Plumosa Aurea'
Bridalwreath Spirea	Spiraea x vanhouttei
Goldflame Spirea	Spiraea x bumalda 'Goldflame'
Three-lobed Spirea	Spiraea trilobata
Dwarf Korean Lilac	Syringa meyeri 'Palabin'
Miss Kim Lilac	Syringa patula 'Miss Kim'
Late Lilac	Syringa villosa

Plant Material for Medians

COMMON NAME	BOTANICAL NAME
DECIDUOUS TREES	
Toba Hawthorn	Crataegus mordenensis 'Toba'
Snowbird Hawthorn	Crataegus x mordenensis 'Snowbird'
Manchurian Ash	Fraxinus mandshurica
Honey Locust	Gleditsia tricanthos inermis
Siberian Columnar Crab	Malus baccata 'Columnaris'
Rudolph Flowering Crab	Malus Rudolph'
Strathmore Crab	Malus 'Strathmore'
Thunderchild Crab	Malus 'Thunderchild'

Amur Cherry	Prunus maackii
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COMMON NAME	BOTANICAL NAME
Mayday Tree	<i>Prunus padus commutata</i>
Pincherry	<i>Prunus pennsylvanica</i>
Schubert Chokecherry	<i>Prunus virginiana</i> Schubert
European Mountain Ash	<i>Sorbus aucuparia</i>
Pyramidal Mountain Ash	<i>Sorbus aucuparia</i> 'Fastigiata'
Showy Mountain Ash	<i>Sorbus decora</i>
Little Leaf Linden	<i>Tilia cordata</i>
Norlin Linden	<i>Tilia cordata</i> 'Roland'
Dropmore Linden	<i>Tilia x flavescens</i> 'Dropmore'

The Redcliff area is characterized by a long growing season, low annual precipitation, temperature fluctuations and Chinook winds. All these facts combine to limit the species of plants that will survive in this region. It is important to stress that plant maintenance and seasonal protection are necessary to ensure survival, even of plants that are hardy to this region.

12.7.4 Setback Requirements

Planting is not allowed within the utility right-of-way, and the following table shows setback requirements for trees planted beyond the UROW boundary.

UTILITIES	DECIDUOUS	CONIFEROUS
	Service Mains	Service Mains
DEEP	Medians Blvds Parallel to Tree Line	Medians Blvds Parallel to Tree Line
Sanitary	0 m 2.5 m 3.0 m	0 m 3.0 m 4.0 m
Storm (4.5M deep)	0 m 2.5 m 3.0 m	0 m 3.0 m 4.0 m
Water	0 m 2.5 m 3.0 m	0 m** 3.0 m 4.0 m
Hydrants	N/A 2.5 m 2.5 m	N/A 3.0 m 4.0 m
SHALLOW		
Gas	2.0 m 2.0 m	2.0 m* 2.0 m*
Telus	1.5 m 1.5 m	2.0 m* 2.0 m*
Shaw	1.5 m 1.5 m	2.0 m* 2.0 m*
Electrical	1.5 m 1.5 m	2.0 m* 2.0 m*
Overhead (to outside conductor)	7.0 m to 9.0 m	7.0 m to 9.0 m
Transformers (within URW)	N/A Tree planting not permitted in Utility Rights-of-Way	N/A Tree planting not permitted in Utility Rights-of-Way
Street Light Poles	4.0 m to 5.0 m	min 4.0 m

*A 3.0 meter separation may be required at the discretion of the utilities. Pipe joints are not permitted on water or sewer services located under medians.

**Pipe joints are not permitted on water or sewer services located under medians.

12.7.5 Trees, Shrubs and Groundcover Requirements

Use only deciduous trees in medians, and plant in a single straight line. Deciduous and coniferous trees are allowed in boulevards. Deciduous and coniferous shrubs are allowed in residential boulevards that are not maintained by the Town of Redcliff.

Use trees of-one species on individual boulevards to give continuity, unless approved otherwise by the Parks and Outdoor Recreation Department. Size of street trees to be a minimum of 85 mm caliper.



Islands in cul-de-sacs or medians must be landscaped with low or no maintenance materials approved by the Parks and Outdoor Recreation Department.

Including town boulevards, trees shall be planted in the overall minimum ratio of sixty (60) trees per hectare of landscaped area provided.

Deciduous trees overhanging pedestrian facilities are to have a minimum 2.0 meters branch height. Deciduous trees near intersections are to have a minimum branch height of 2.4 meters. Deciduous trees overhanging traffic lanes are to have a minimum branch height of 3.5 meters.

Majority of the plant material shall be planted in clusters or natural groupings.

Spacing of individual trees within clusters will vary depending on the mature spread (a maximum overlap of 30% of the mature spread is desirable). Spacing of clusters should vary, minimum 9.0 meters to maximum 30.5 meters.

Use a variety of plant material, both coniferous and deciduous. Design plant grouping to appear as natural as possible. Poplar planting should be minimized and when used in the landscape care should be taken to plant male trees as they do not produce cotton "fuzz". The maximum poplar planting ratio shall be 15% of the total trees planted.

Coniferous trees must be planted a minimum of 8.0 meters from a collector or arterial road due to potential damage from salt spray. Deciduous trees may be planted up to 2.0 meters from the edge of any roadway. Deciduous trees planted in medians must be a minimum of 750 mm from back of concrete curbs.

Tree planting should be strategically spaced to avoid blocking street light illumination levels, sight lines in the vicinity of intersections, pedestrian crossings, and traffic signs.

Existing plant material to be retained must be identified on plans by species, size and exact location. Transplanting of existing vegetation is subject to the same conditions as that of planting nursery stock.

Wood mulch (all species except *Fraxinus*) should be applied to all evergreen tree wells and planting beds to aid in maintenance, to a depth of 150 mm.

If trees are less than 3.5 meters from vertical elements and hard surfaces or private property lines the trees must be placed in mulch beds.

12.8 IRRIGATION

12.8.1 Design Guidelines

The objective of this section is to build irrigation systems that apply a consistent, even, measurable amount of water to the landscape over a period of time. The system design will consider water cost and conservation, long term durability and maintenance cost, safety issues, aesthetic issues, and site specific requirements. The relative importance of these considerations will vary from project to project, and require the attention of a qualified and experienced designer.

12.8.2 Prequalifications

All irrigation work shall be done by a suitably experienced and qualified irrigation contractor, having trained and competent personnel adequate for the scope of the work.



12.8.3 Submittals

Prepare and submit a 1:500 scaled design of the proposed irrigation system for approval.

A suitably scaled as-built drawing shall be provided upon completion. All components of the irrigation system shall be shown as installed, with clear measurements from an identifiable reference point to the location of the controller and its circuit breaker, master valve, zone control valves, main water connection, blow out connection, pump and its electrical connections, and any other similar features.

Report any conflicts or conditions that vary from the design immediately to the Parks and Outdoor Recreation Department.

12.8.4 Irrigation Requirements

Protection of existing site conditions, existing landscape features, plant material, and structures shall be protected from damage.

Ensure that there is compliance with the relevant codes and regulations both in the design and during the conduct of the work involved in the project.

Parks Water Service

The Parks Water Service for irrigation shall be designed and installed in accordance with the Town of Redcliff Construction and Standards.

The Parks Water Service shall be of sufficient size to provide the flow required to meet the peak evapotranspiration rate for the site, and the peak crop water requirements of the proposed landscape within the allotted watering window.

A backflow prevention device shall be installed on each irrigation service. Provision shall be made at the point of connection for a combination master valve / water meter.

Watering Window

The Watering Window shall be established based on the peak water demand for the site, scheduled sporting events, maintenance routines, the nature of the proposed site uses, the water requirements of the proposed plant material, and the soil characteristics of the site.

The Watering Window shall not exceed 8 hours per watering day, and shall commence between the hours of 10 p.m. and 6 a.m. An irrigation watering schedule for peak periods shall be included in the irrigation design drawing.

Sprinklers

The maximum spacing shall be equal to 45% of the head to head spacing recommended by the manufacturer.

The selection of pop-up or riser style sprinklers must consider safety, maintenance, risk of vandalism, and appearance on the site. Pop-up or riser height must consider the related plant material, its growth potential, interfering landscape features, and arrive at a solution which provides optimum coverage for as long as possible.

All sprinklers must be suitably adjustable and located so as to keep the water within the landscaped area and minimize overthrow. Consult with the Parks and Recreation Department regarding type of sprinkler head before proceeding with design.



Pipe

The velocity of flow in any piping must not exceed 1.5 meters (5 feet) per second.

Pipe routing must take site elevation changes into consideration to minimize low head drainage.

Selection of the strength or flexibility of the pipe material and its installation criteria must consider site specific requirements such as frost, traffic, soil depth etc.

Pipe sizing and routing must include pressure loss calculations to ensure that the required pressure will be delivered under all circumstances and that pressure variation within the lateral does not exceed 15%.

Zoning

All sprinklers grouped into a zone must have the same precipitation rates, matched through the arcs of coverage. The potential for low head drainage must be minimized for each zone.

The areas of the landscape that have different water requirements must be identified and a determination made as to the significance of these differences and whether they require separate zoning. The type of plant material and its location on site (sun exposure and natural drainage), and varying soil and slope conditions must be considered.

Controls

Controllers must be C.S.A. approved. Moisture sensors or other 'rain off' devices are recommended for effective water management. Valves must meet the pressure and flow requirements of the zone being controlled.

Pressure Control

Valves must meet the pressure and flow requirements of the zone being controlled.

The design must include suitable regulation of the pressure throughout the irrigation system. The pressure variation within each zone from the first to the last head must not exceed 15%.

The pressure at every head must be within the range recommended by the manufacturer of the head/nozzle combination being used.

Winterizing

The system design must make the water connection and all the system components safe from winter freezing damage.

A suitable and convenient blow out point and connection is the most desirable method of purging the system of water.

If mainline drain valves, which are not recommended, are used, there must be a suitable sump and drainage.

Low Volume/Micro Irrigation

Any low volume irrigation included in a system must be separately zoned.

Filtration and pressure control as recommended by the manufacturer of the low volume devices must be provided together with suitable controller capabilities.



Control Wire

Control wire must be sized to the length of its run using the recommendations of the manufacturer of the zone control valves being wired.

Control wire shall be color-coded and sequenced.

12.9 TRAILS AND TRAIL SYSTEMS

12.9.1 Trail Requirements

Slope Requirements

Less than 3% to 5% is required if to be wheelchair accessible. Less than 5% is ideal, although 5% to 8% is acceptable. More than 12 to 15% - switchbacks or stairs are required.

Safety Requirements

Provide 1.0 meter clear of all obstacles on both sides, and 3.5 meters clear of obstacles overhead. Avoid locating trails over manholes. Ensure a 2.5 meter minimum clearance from park water services.

Set-back pathways a minimum of 1.0 meter from face of curb, and a minimum distance of 10 meters from residential property lines, where possible.

Safety railing shall be installed when a trail is within 2.0 meters of the top of a 2:1 slope or steeper, and the slope is greater than 1.0 meter in depth. Minimum railing height and design to meet current building code standards.

Trail Junctions

Where possible, ensure trails join at right angles. Provide widening of trails with radius of 4 meters where trails join other trails.

Trail Entrances

Extend trail to street curb in all cases. Ensure trail joins street at right angles and widens on both sides with radius of 4.0 meters.

Provide a curb-cut and a standard removable steel bollard where access is to Environmental Reserve, Natural Area or Regional Trail. Line up entrances for visual continuity where trail route crosses street. Ensure no catch basins located at entrance.

Sightlines

Where possible, ensure no obstructions to visibility within 5.0 meters of junction with other trails and streets (trees, shrubs, utility boxes, fences, etc.)

Criteria for Bicycles

- Ensure no catch basins located at entrance.
- Under 3%: Acceptable.
- 3% to 5%: Not longer than 200 meters.
- 5% to 8%: Not longer than 50 meters, and keep bicycles and pedestrians separate and avoid curves and constrictions.
- Over 10%: Re-route or provide stairs.



Stair Requirements

Where possible, avoid use within a trail network, and install bicycle ramp along one side where stairs are unavoidable.

Access Barriers

Removable bollards shall be located at access points to trails accessing streets, where vehicle access to the trail system should be controlled. Locate bollards as follows:

- Installed in centre of 3.0 meter trail
- Wooden, non-removable bollards on either side of 3.0 meter trail.
- Bollards are to be 150 mm x 150 mm pressure treated timber with a minimum height of 750 mm above trail surface.

12.10 AMENITIES

12.10.1 Design Guidelines

The objective of this Section is to provide designers and developers with a comprehensive amenity guideline to provide continuity throughout the Town of Redcliff.

12.10.2 Amenity Requirements

Signage for residential development or parks shall be complementary to the current signage, and in scale with the pedestrian environment. Blend signage into the landscape and site development rather than allowing it to dominate with larger signs and taller poles.

Benches will be provided at the developer's expense as follows:

- One (1) bench to be located at each pathway entrance I exit, and one (1) additional bench per kilometer of lineal pathway, and two (2) benches per play structure.

Trash receptacles will be provided and installed at the developer's expense as follows:

- One (1) trash receptacle to be located at each pathway entrance I exit, and one (1) additional trash receptacle per kilometer of lineal pathway, one (1) per play structure, and two (2) per ball diamond or soccer pitch.

The trash receptacle should accommodate a standard 75 litre receptacle that will hold a 66 cm x 91cm (26" x 36") plastic garbage bag. Haul-All trash receptacles are to be used at all trail heads.

Fencing proposals on arterial and collector roadways are to be reviewed and approved by the Engineering Department prior to construction. Fencing will be required around school areas, walkways and utility lots in addition to arterial roadways, unless otherwise approved. All standard fences will be constructed on private property approximately 150 mm from the property line.

A post and chain fence system may be used in passive park areas to control access along roadways. See typical detail in Town Construction Standards.

Maintenance access points to open space must be considered and coordinated with the Parks and Outdoor Recreation Department.



12.11 PLAYGROUND FACILITIES

Playground Facilities Requirements

All playground development must include a low compact surface with a resilient, washed, coarse sand base to a minimum depth of 300 mm placed in an approved retainer. A minimum of 5 pieces of traditional equipment shall be installed within a single retained area.

Consideration for handicapped children in the playground design and layout should be made where possible. It is recommended that all submitted designs should include some form of barrier free design.

Play elements of each play lot shall provide for the recreational requirements of the child as well as stimulate the senses and cognitive or motor development aspects of the child's learning process.

In addition to structural equipment, such as swings and platforms, open turf areas shall be provided. Protection from the elements and the provision of sunny and shaded areas shall be provided. Contouring and mounding of the larger sites shall be considered to provide for a varied play experience.

Seating areas for supervising adults (passive area) and durable trash receptacles shall be provided on all sites.

Play equipment shall be separated from walkways and turf areas. Equipment which promotes play by a large number of children at one time shall be located to minimize congestion around other equipment, entrance ways or walkways.

Swings and other moving equipment shall be located towards the outside of the play lot to reduce conflicts with pedestrian movements.

Safety of the equipment users and minimizing liability of the Town of Redcliff shall be a priority in the development of all play lot sites.

Protrusions (nuts, bolts, etc.) shall be minimized or adequately protected where protrusions are unavoidable. Vandal resistant hardware shall be utilized to prevent equipment tampering.

Playground sites shall be located on a well-drained area not conflicting with sports field play areas.

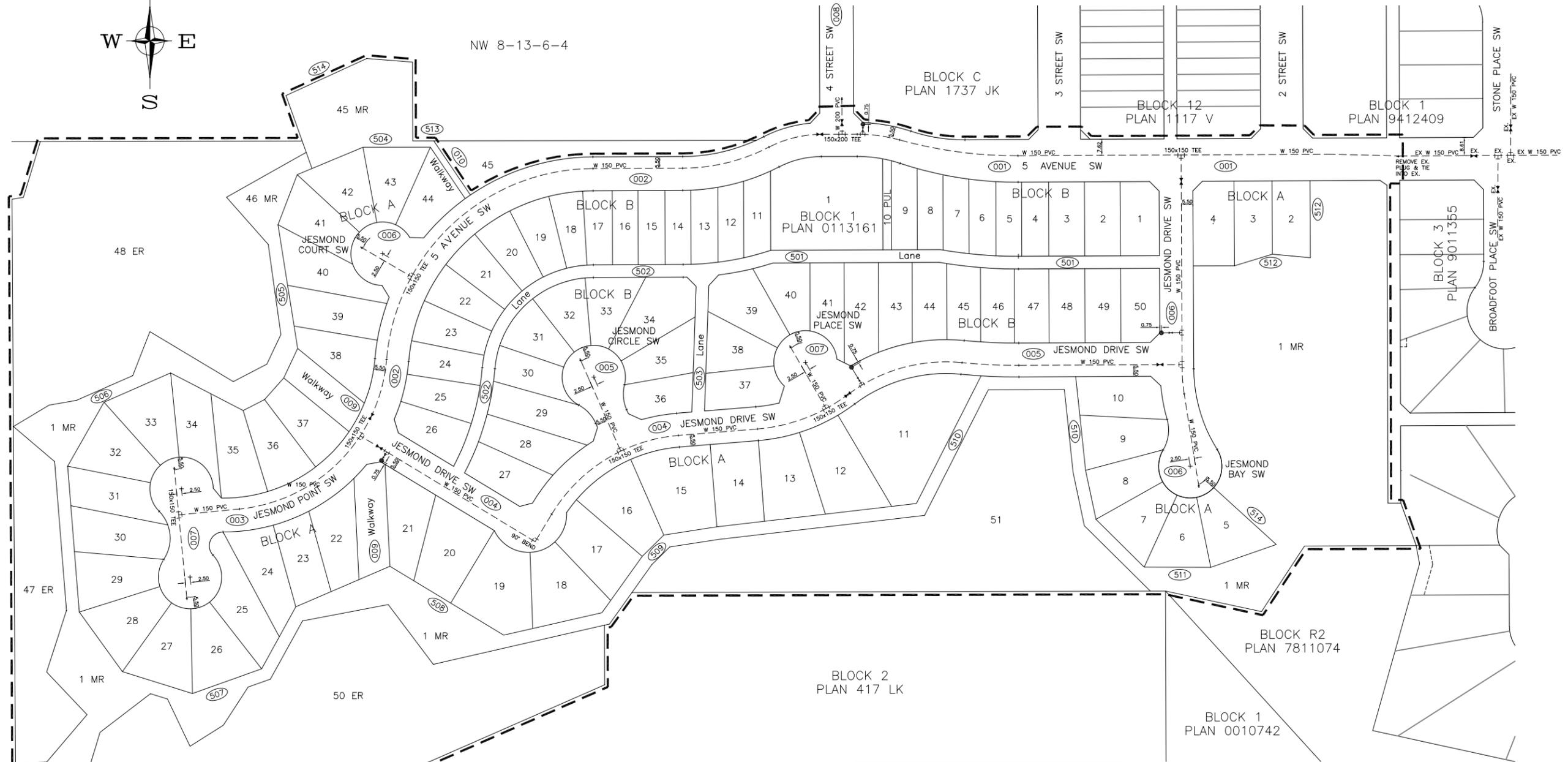
END OF SECTION

APPENDIX A

Sample Drawings



NW 8-13-6-4



LEGEND	
	CONSTRUCTION BOUNDARY
	PROPOSED WATERMAIN
	EXISTING WATERMAIN
	PROPOSED HYDRANT COMPLETE WITH VALVE
	EXISTING HYDRANT COMPLETE WITH VALVE
	PROPOSED VALVE
	EXISTING VALVE
	PLUG & CLAMP
	BLOCK PROFILE DRAWING NUMBER

NOTES	
1.	ALL WATERMANS SHALL BE PVC (POLY VINYL CHLORIDE) DR 18, CLASS 150, CL. OD. WITH BELL AND SPIGOT ENDS.
2.	ALL PROPOSED VALVES SHALL BE ON THE PROPERTY LINE UNLESS NOTED OTHERWISE.
3.	ALL SPECIALS, VALVES, AND HYDRANTS SHALL BE COATED AS REQUIRED AND SHALL BE PROTECTED FURTHER BY ZINC ANODES CAD-WELDED TO THE IRON BODY OF THE FITTING. ANODES SHALL BE SIZED AS FOLLOWS: HYDRANTS AND VALVES: 2.3 kg ANODES SPECIAL FITTINGS, TAPPING SADDLES, ETC.: 1.4 kg ANODES
4.	ALL HYDRANTS SHALL BE OF THE McAVITY COMPRESSION TYPE AND SHALL BE EQUIPPED WITH A SEPARATE VALVE.
5.	ALL DISTRIBUTION VALVES SHALL BE EQUIPPED WITH A 50 mm SQUARE OPERATING NUT AND SHALL TURN RIGHT TO CLOSE.

**PERMIT TO PRACTICE
TOWN OF REDCLIFF**

Signature: _____
Date: _____

PERMIT NUMBER: P 5554

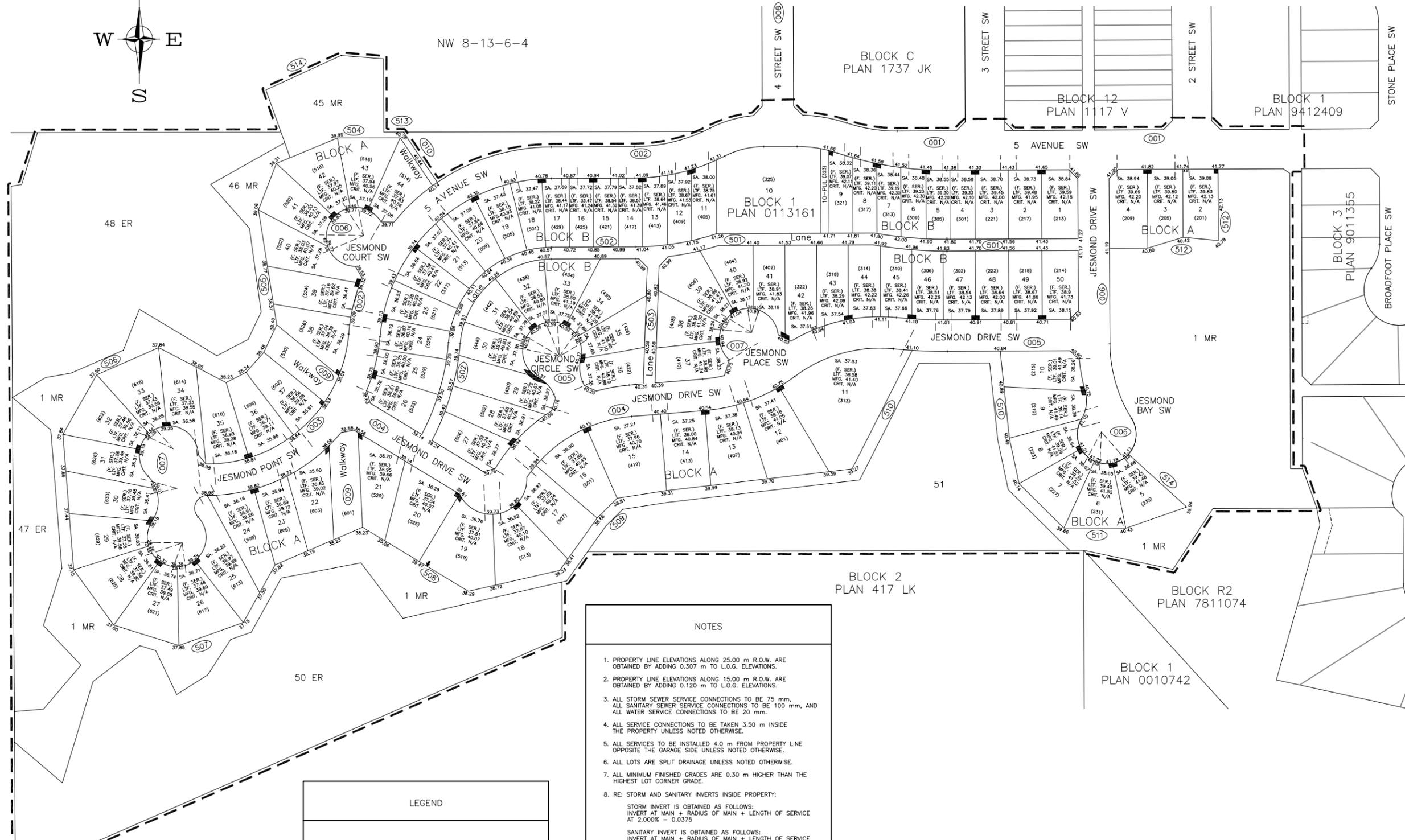
The Association of Professional Engineers,
Geologists and Geophysicists of Alberta

	ISSUED FOR TENDER	03/17/04	CWB
TOWN OF REDCLIFF WEST SIDE SOUTH			
WATER LAYOUT			
SCALE:	1 : 1000	DESIGN:	G. de V./C.W.B.
DATE:	MARCH 17, 2004	DRAWN:	G. de V./C.W.B.
CHK.	G. de V.	DWG. No.:	WSS-SP4

NO.	DESCRIPTION	DATE	BY



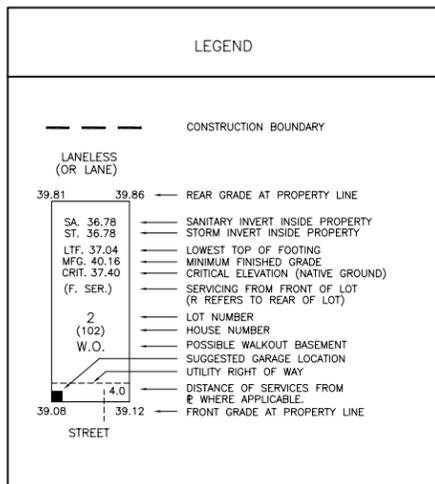
NW 8-13-6-4



NOTES

- PROPERTY LINE ELEVATIONS ALONG 25.00 m R.O.W. ARE OBTAINED BY ADDING 0.307 m TO L.O.G. ELEVATIONS.
- PROPERTY LINE ELEVATIONS ALONG 15.00 m R.O.W. ARE OBTAINED BY ADDING 0.120 m TO L.O.G. ELEVATIONS.
- ALL STORM SEWER SERVICE CONNECTIONS TO BE 75 mm, ALL SANITARY SEWER SERVICE CONNECTIONS TO BE 100 mm, AND ALL WATER SERVICE CONNECTIONS TO BE 20 mm.
- ALL SERVICE CONNECTIONS TO BE TAKEN 3.50 m INSIDE THE PROPERTY UNLESS NOTED OTHERWISE.
- ALL SERVICES TO BE INSTALLED 4.0 m FROM PROPERTY LINE OPPOSITE THE GARAGE SIDE UNLESS NOTED OTHERWISE.
- ALL LOTS ARE SPLIT DRAINAGE UNLESS NOTED OTHERWISE.
- ALL MINIMUM FINISHED GRADES ARE 0.30 m HIGHER THAN THE HIGHEST LOT CORNER GRADE.
- RE: STORM AND SANITARY INVERTS INSIDE PROPERTY:
STORM INVERT IS OBTAINED AS FOLLOWS:
INVERT AT MAIN + RADIUS OF MAIN + LENGTH OF SERVICE AT 2.000% - 0.0375
SANITARY INVERT IS OBTAINED AS FOLLOWS:
INVERT AT MAIN + RADIUS OF MAIN + LENGTH OF SERVICE AT 2.000% - 0.050
WHEREVER BOTH STORM AND SANITARY MAINS ARE PRESENT, THE HIGHEST OF THE TWO ABOVE DICTATE THE COMMON INVERT ELEVATION FOR BOTH.
- THE LOWEST TOP OF FOOTING ELEVATION IS OBTAINED BY ADDING 0.750 m TO THE HIGHEST OF EITHER THE STORM OR SANITARY INVERT INSIDE THE PROPERTY.
- VIEWING THE TRENCH FROM THE LOT THE WATER SERVICE IS LOCATED ON THE CENTRE LINE (UNLESS NOTED OTHERWISE) WITH THE CURB BOX SET TO GRADE AT STANDARD LINE ASSIGNMENT. THE STORM SEWER SERVICE IS LOCATED 0.30 m TO THE RIGHT OF THE CURB BOX AND THE SANITARY SEWER SERVICE IS LOCATED 0.30 m TO THE LEFT OF THE CURB BOX.
- SEWER SERVICES MUST TERMINATE WITH A BELL END AND AN APPROVED PLUG SHALL BE PLACED IN THE THE BELL END.
- STORM SEWER LEAD TO MAIN SHALL BE WITH APPROVED 100 mm TEES, SADDLES, OR MANUFACTURED TEE WITHIN STORM MAIN. MANUFACTURED APPROVED REDUCER SHALL BE USED TO JOIN THE 75 mm LEAD TO THE 100 mm TEE.
- THE DEPTH OF THE WATER SERVICE AT THE PROPERTY LINE SHALL BE 2.70 m IN LANE (OR LANELESS) BELOW FINAL GRADE OR IN STREET BELOW FINAL GRADE, IF THE SITE MATERIAL IS CLAY. THIS DEPTH SHALL BE INCREASED TO 3.30 m IF THE SITE MATERIAL IS GRAVEL.
- ALL ELEVATIONS ARE PRECEDED BY 7.

LEGEND



**PERMIT TO PRACTICE
TOWN OF REDCLIFF**
Signature _____
Date _____
PERMIT NUMBER: P 5554
The Association of Professional Engineers,
Geologists and Geophysicists of Alberta

1	ISSUED FOR TENDER	03/17/04	C.W.B.
NO.	DESCRIPTION	DATE	BY
REVISIONS			

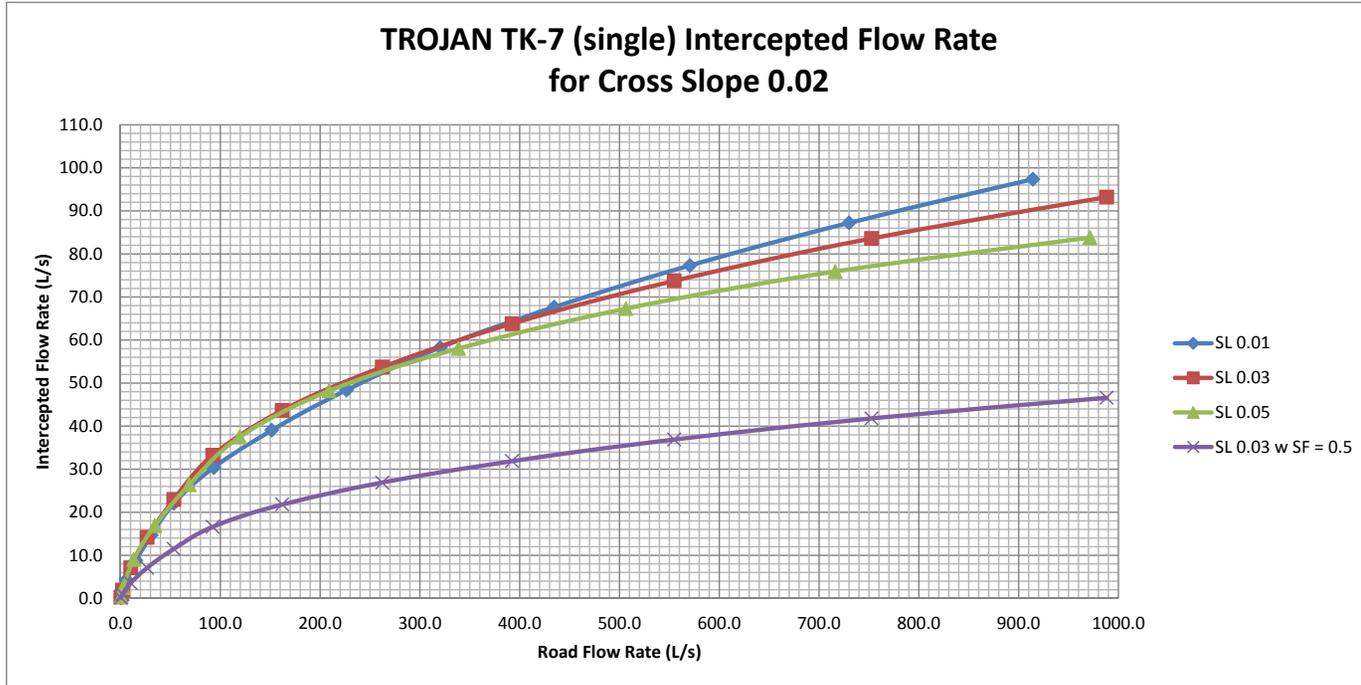


BUILDING GRADE PLAN
SCALE: 1 : 1000
DESIGN: G. de V./C.W.B.
DATE: MARCH 17, 2004
DRAWN: G. de V./C.W.B.
CHK: G. de V.
DWG. No.: WSS-SP5

APPENDIX B

Catch Basin Flow-by Capture Curves

(Reprinted by Permission of Trojan Industries Inc.)



SL 0.01

depth (m)	Road Flow (L/s)	Intercepted (L/s)	Velocity (m/s)
0.010	0.2	0.2	0.21
0.020	1.1	1.1	0.34
0.030	5.9	4.3	0.45
0.040	15.3	8.8	0.54
0.050	30.8	14.7	0.63
0.060	53.3	22.1	0.71
0.070	93.5	30.4	0.79
0.080	151.4	39.1	0.87
0.090	226.5	48.4	0.94
0.100	320.3	58.3	1.00
0.110	434.5	67.6	1.07
0.120	570.5	77.3	1.14
0.130	730.0	87.2	1.20
0.140	914.3	97.4	1.26

SL 0.03

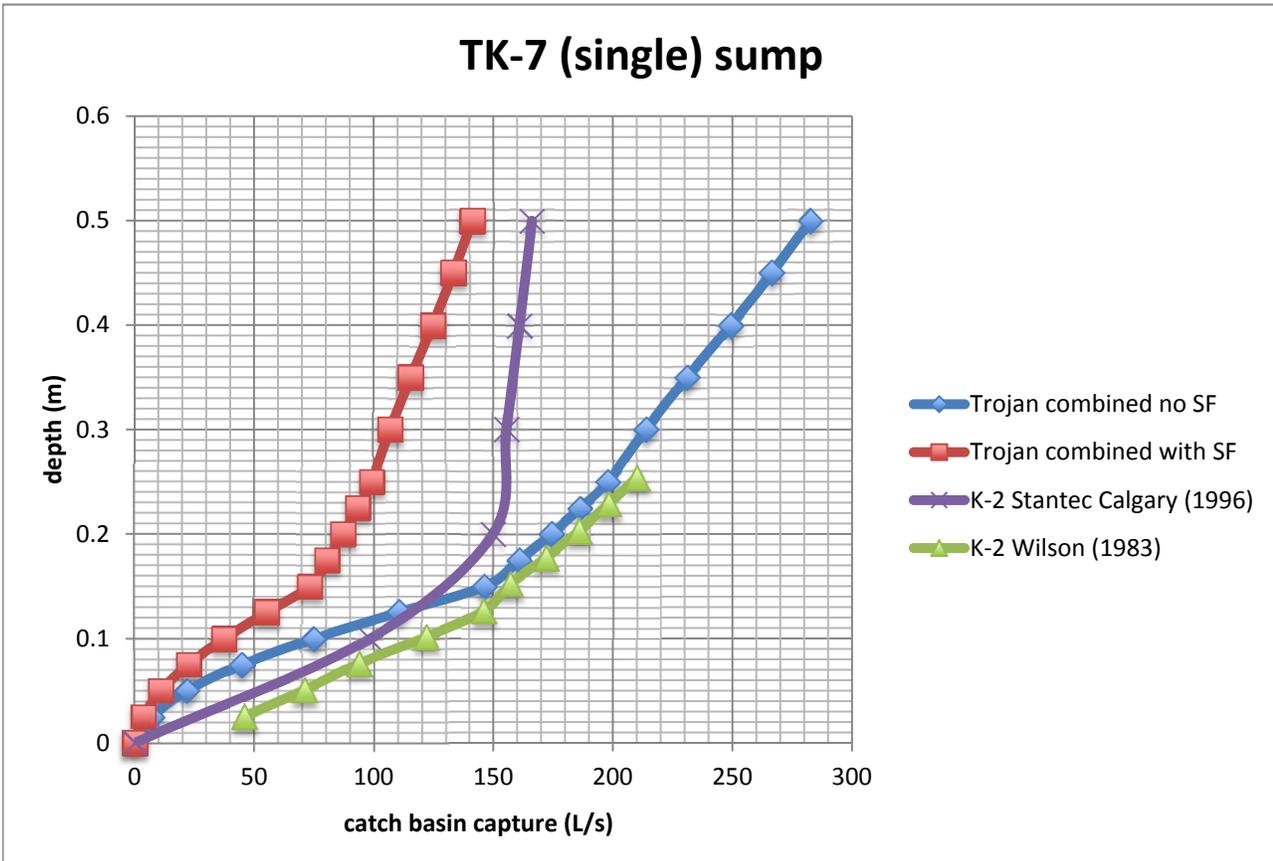
depth (m)	Road Flow (L/s)	Intercepted (L/s)	Velocity (m/s)	SL 0.03 w SF = 0.5 (L/s)
0.010	0.3	0.3	0.37	0.2
0.020	2.0	1.9	0.59	1.0
0.030	10.1	7.1	0.78	3.5
0.040	26.6	14.2	0.94	7.1
0.050	53.3	23.0	1.09	11.5
0.060	92.3	33.2	1.24	16.6
0.070	161.9	43.7	1.37	21.8
0.080	262.3	53.7	1.50	26.9
0.090	392.3	63.8	1.62	31.9
0.100	554.8	73.8	1.74	36.9
0.110	752.5	83.6	1.86	41.8
0.120	988.2	93.2	1.97	46.6

SL 0.05

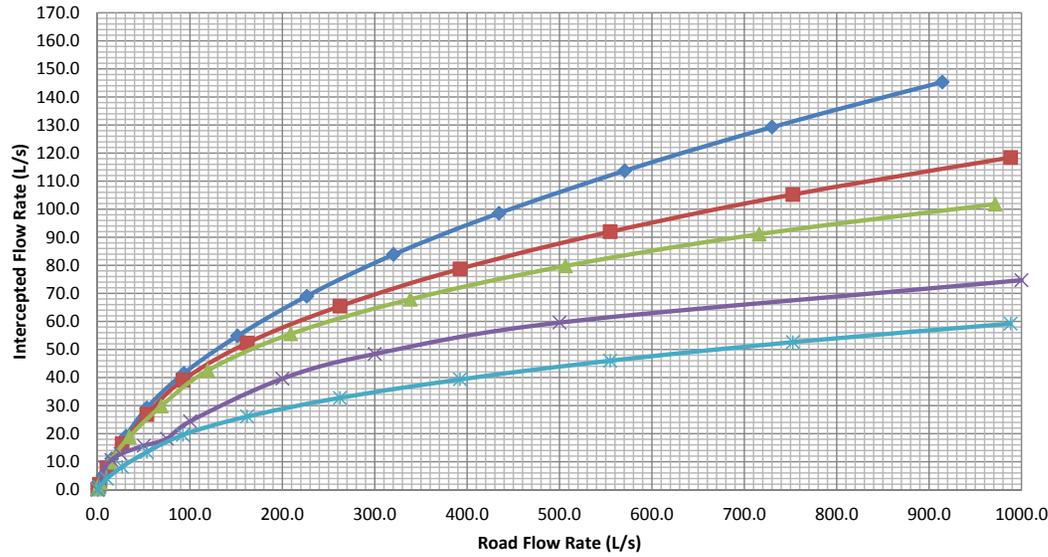
depth (m)	Road Flow (L/s)	Intercepted (L/s)	Velocity (m/s)
0.010	0.4	0.4	0.48
0.020	2.5	2.5	0.76
0.030	13.1	9.0	1.00
0.040	34.3	16.9	1.22
0.050	68.8	26.4	1.41
0.060	119.2	37.5	1.60
0.070	209.0	48.2	1.77
0.080	338.6	58.0	1.93
0.090	506.4	67.3	2.09
0.100	716.2	75.9	2.25
0.110	971.5	83.8	2.40

TK-7 (single) sump condition

Trojan (2014) without safety factor		Trojan with SF	K-2 Wilson (1983)		K-2 Stantec Calgary (1996)	
depth (m)	Q combined (L/s)	Q combined (L/s)	depth (m)	Q (L/s)	depth (m)	Q (L/s)
0	0	0	0.025	46	0.000	0
0.025	7	4	0.051	71	0.100	98
0.050	22	11	0.076	94	0.200	150
0.075	45	22	0.102	122	0.300	156
0.100	75	38	0.127	146	0.400	161
0.125	111	55	0.152	157	0.500	166
0.150	147	73	0.178	172		
0.175	161	80	0.203	186		
0.200	174	87	0.229	198		
0.225	186	93	0.254	210		
0.250	198	99				
0.300	214	107				
0.350	231	115				
0.400	249	125				
0.450	266	133				
0.500	283	141				



TROJAN DK-7 (double) Intercepted Flow Rate for Cross Slope 0.02



K2 Stantec Calgary (1996)

Road Flow (L/s)	Intercepted (L/s)
0	0.0
8	8.0
15	10.6
25	12.8
50	15.7
75	18.2
100	24.4
200	39.6
300	48.4
500	59.6
1000	74.7

SL 0.01

Depth (m)	Road Flow (L/s)	Intercepted (L/s)	Velocity (m/s)
0.010	0.2	0.2	0.21
0.020	1.1	1.1	0.34
0.030	5.9	5.0	0.45
0.040	15.3	11.0	0.54
0.050	30.8	19.1	0.63
0.060	53.3	29.2	0.71
0.070	93.5	41.5	0.79
0.080	151.4	54.8	0.87
0.090	226.5	69.0	0.94
0.100	320.3	83.9	1.00
0.110	434.5	98.5	1.07
0.120	570.5	113.7	1.14
0.130	730.0	129.3	1.20
0.140	914.3	145.3	1.26

SL 0.03

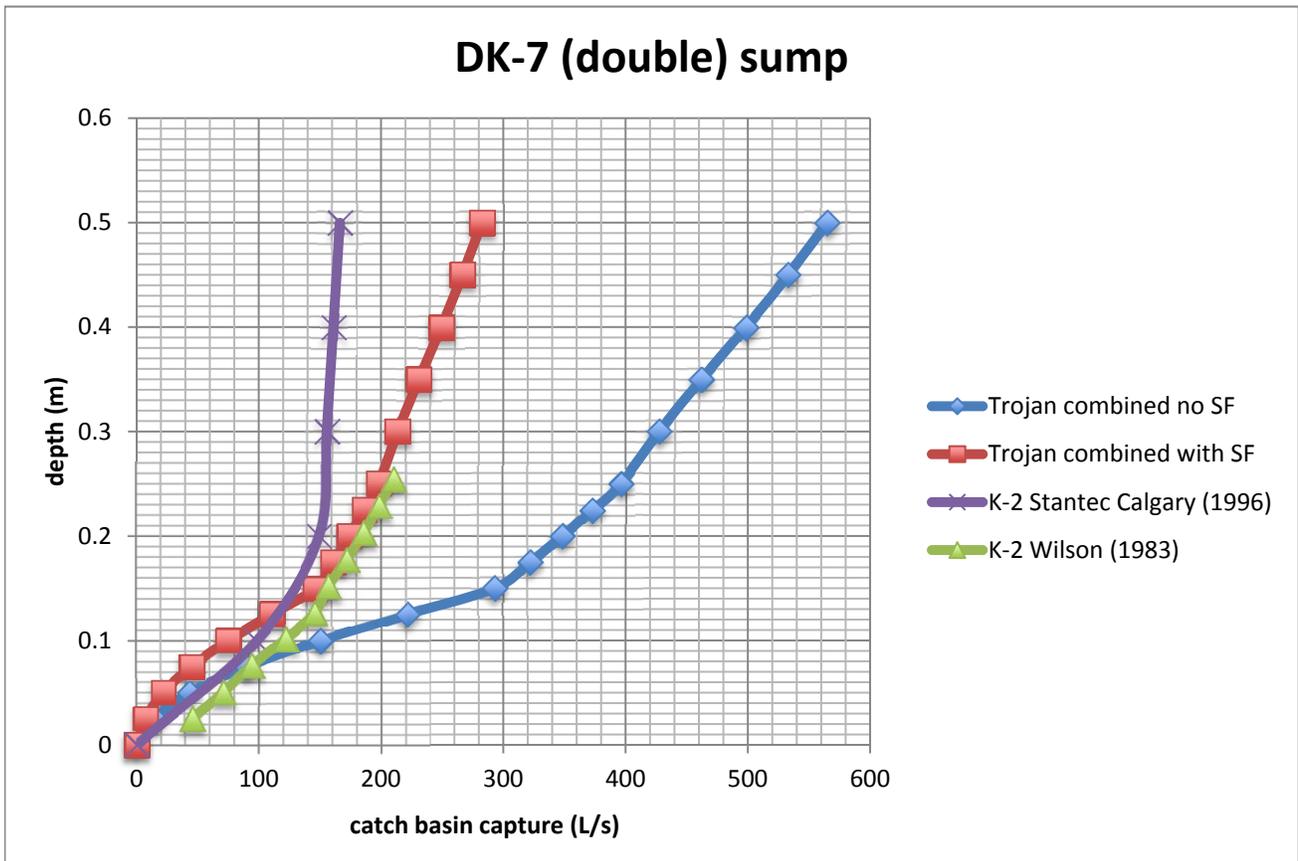
Depth (m)	Road Flow (L/s)	Intercepted (L/s)	Velocity (m/s)	SL 0.03 w SF=0.5 (L/s)
0.010	0.3	0.3	0.37	0.2
0.020	2.0	1.9	0.59	1.0
0.030	10.1	7.9	0.78	3.9
0.040	26.6	16.4	0.94	8.2
0.050	53.3	26.9	1.09	13.4
0.060	92.3	39.1	1.24	19.5
0.070	161.9	52.3	1.37	26.2
0.080	262.3	65.5	1.50	32.7
0.090	392.3	78.7	1.62	39.4
0.100	554.8	92.0	1.74	46.0
0.110	752.5	105.2	1.86	52.6
0.120	988.2	118.4	1.97	59.2

SL 0.05

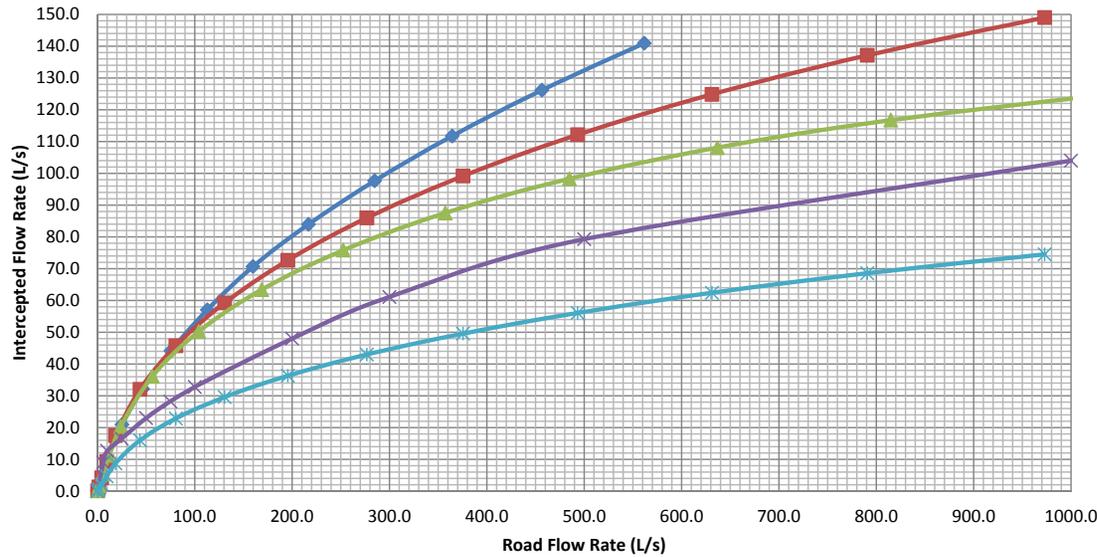
Depth (m)	Road Flow (L/s)	Intercepted (L/s)	Velocity (m/s)
0.010	0.4	0.4	0.48
0.020	2.5	2.5	0.76
0.030	13.1	9.8	1.00
0.040	34.3	18.8	1.22
0.050	68.8	29.8	1.41
0.060	119.2	42.5	1.60
0.070	209.0	55.6	1.77
0.080	338.6	67.9	1.93
0.090	506.4	79.8	2.09
0.100	716.2	91.1	2.25
0.110	971.5	101.8	2.40

DK-7 (double) sump condition

Trojan (2014) without safety factor		Trojan with SF	K-2 Wilson (1983)		K-2 Stantec Calgary (1996)	
depth (m)	Q combined (L/s)	Q combined (L/s)	depth (m)	Q (L/s)	depth (m)	Q (L/s)
0	0	0	0.025	46	0.000	0
0.025	15	7	0.051	71	0.100	98
0.050	43	22	0.076	94	0.200	150
0.075	90	45	0.102	122	0.300	156
0.100	150	75	0.127	146	0.400	161
0.125	221	111	0.152	157	0.500	166
0.150	293	147	0.178	172		
0.175	322	161	0.203	186		
0.200	348	174	0.229	198		
0.225	373	186	0.254	210		
0.250	396	198				
0.300	427	214				
0.350	462	231				
0.400	499	249				
0.450	533	266				
0.500	565	283				



TROJAN TF-51 (with side inlet) Intercepted Flow Rate for Cross Slope 0.02



C Stantec Calgary (1996)

Road Flow (L/s)	Intercepted (L/s)
0	0.0
6	9.0
10	12.7
25	16.5
50	23.0
75	28.2
100	32.8
200	48.0
300	61.1
500	79.3
1000	104.0

SL 0.01

Depth (m)	Road Flow (L/s)	Intercepted (L/s)	Velocity (m/s)
0.010	0.1	0.1	0.21
0.020	0.9	0.8	0.34
0.030	2.6	2.5	0.45
0.040	5.5	5.4	0.54
0.050	10.7	10.5	0.63
0.060	25.3	21.0	0.71
0.070	46.5	32.2	0.79
0.080	75.5	44.2	0.87
0.090	112.9	57.0	0.94
0.100	159.8	70.7	1.00
0.110	216.8	84.0	1.07
0.120	284.8	97.7	1.14
0.130	364.4	111.7	1.20
0.140	456.5	126.2	1.26
0.150	561.7	141.0	1.32

SL 0.03

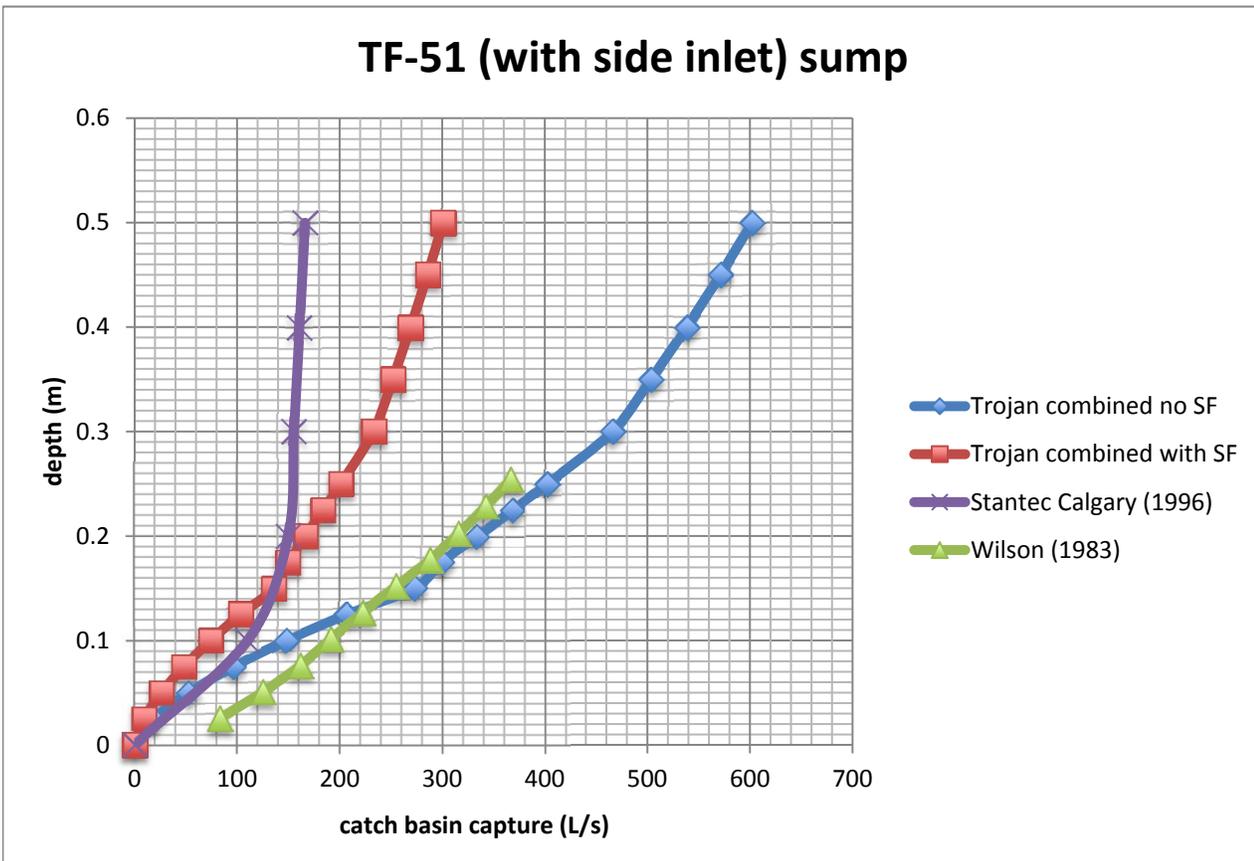
Depth (m)	Road Flow (L/s)	Intercepted (L/s)	Velocity (m/s)	SL 0.03 w SF = 0.5 (L/s)
0.010	0.2	0.1	0.37	0.1
0.020	1.5	1.3	0.59	0.7
0.030	4.4	4.2	0.78	2.1
0.040	9.6	9.3	0.94	4.7
0.050	18.6	17.5	1.09	8.8
0.060	43.8	32.0	1.24	16.0
0.070	80.6	45.8	1.37	22.9
0.080	130.7	59.2	1.50	29.6
0.090	195.6	72.7	1.62	36.3
0.100	276.8	86.0	1.74	43.0
0.110	375.5	99.2	1.86	49.6
0.120	493.3	112.2	1.97	56.1
0.130	631.2	124.9	2.07	62.4
0.140	790.7	137.2	2.18	68.6
0.150	972.9	149.0	2.28	74.5

SL 0.05

Depth (m)	Road Flow (L/s)	Intercepted (L/s)	Velocity (m/s)
0.010	0.3	0.1	0.48
0.020	1.9	1.7	0.76
0.030	5.7	5.4	1.00
0.040	12.4	11.2	1.22
0.050	24.0	20.4	1.41
0.060	56.5	36.1	1.60
0.070	104.1	50.2	1.77
0.080	168.7	63.4	1.93
0.090	252.5	75.8	2.09
0.100	357.3	87.5	2.25
0.110	484.8	98.3	2.40
0.120	636.8	108.1	2.54
0.130	814.9	116.8	2.68
0.140	1020.8	124.2	2.82

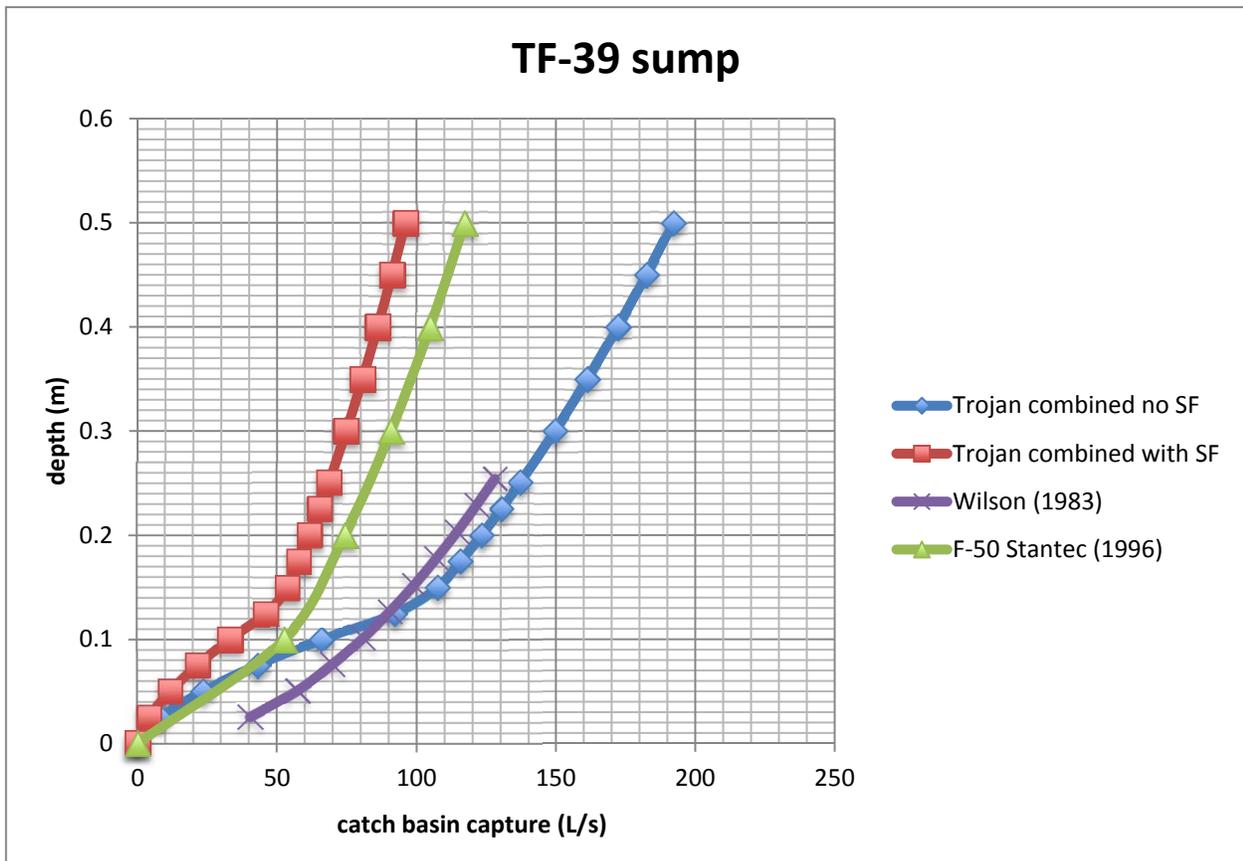
TF-51 (with side inlet) sump condition

Trojan (2014) without safety factor		Trojan with SF	Wilson (1983)		Stantec Calgary (1996)	
depth (m)	Q combined (L/s)	Q combined (L/s)	depth (m)	Q (L/s)	depth (m)	Q (L/s)
0	0	0	0.025	83	0.000	0
0.025	19	9	0.051	125	0.100	110
0.050	52	26	0.076	162	0.200	150
0.075	96	48	0.102	191	0.300	156
0.100	148	74	0.127	223	0.400	161
0.125	207	104	0.152	255	0.500	166
0.150	273	136	0.178	288		
0.175	300	150	0.203	316		
0.200	334	167	0.229	342		
0.225	368	184	0.254	366		
0.250	402	201				
0.300	466	233				
0.350	503	252				
0.400	538	269				
0.450	571	286				
0.500	602	301				



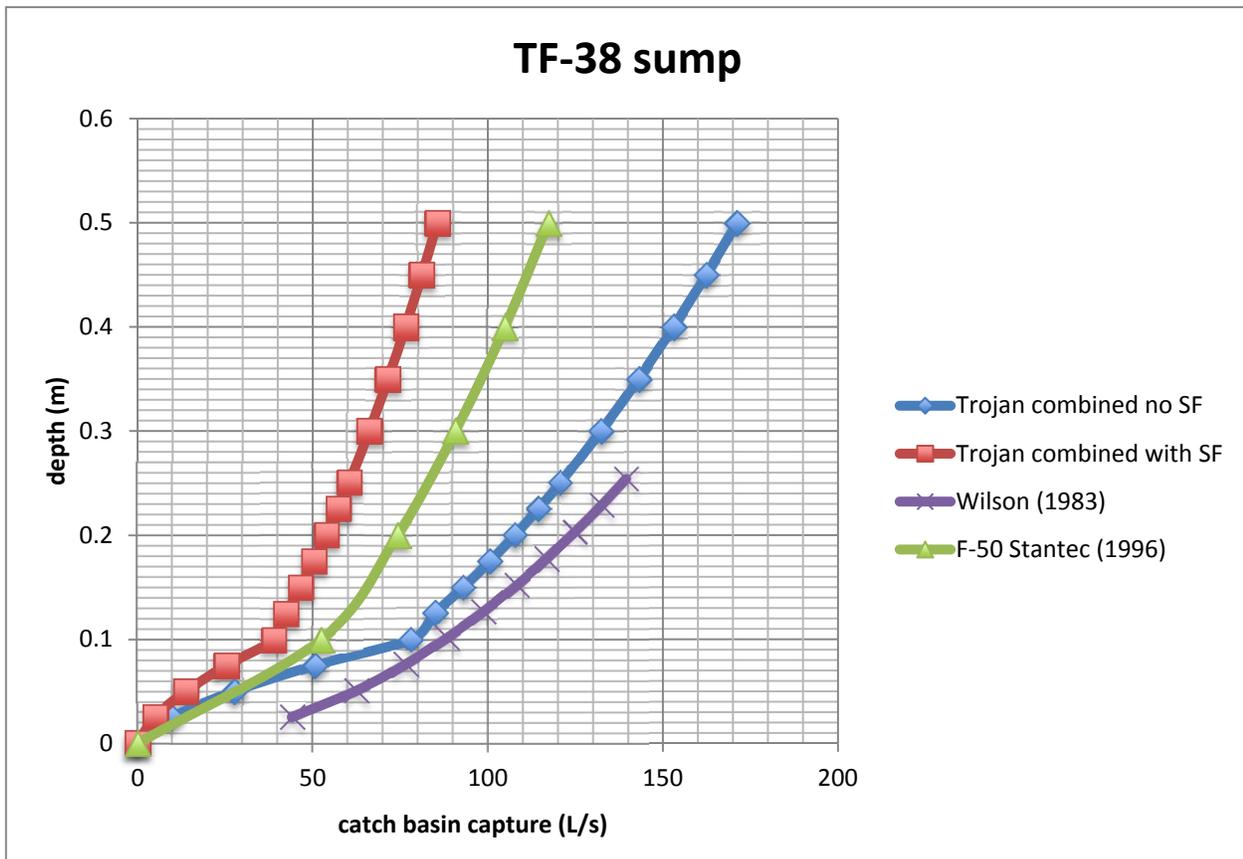
TF-39 sump condition

Trojan (2014) without safety factor		Trojan with SF		Wilson (1983)		F-50 Stantec (1996)	
depth (m)	Q combined (L/s)	Q combined (L/s)	depth (m)	Q (L/s)	depth (m)	Q (L/s)	Q (L/s)
0	0	0	0.025	40	0.000	0	
0.025	8	4	0.051	57	0.100	52	
0.050	23	12	0.076	70	0.200	74	
0.075	43	21	0.102	81	0.300	91	
0.100	66	33	0.127	90	0.400	105	
0.125	92	46	0.152	99	0.500	117	
0.150	107	54	0.178	107			
0.175	116	58	0.203	114			
0.200	123	62	0.229	121			
0.225	130	65	0.254	128			
0.250	137	69					
0.300	150	75					
0.350	161	81					
0.400	172	86					
0.450	182	91					
0.500	192	96					



TF-38 sump condition

Trojan (2014) without safety factor		Trojan with SF	Wilson (1983)		F-50 Stantec (1996)	
depth	Q combined	Q combined	depth	Q	depth	Q
(m)	(L/s)	(L/s)	(m)	(L/s)	(m)	(L/s)
0	0	0	0.025	44	0.000	0
0.025	10	5	0.051	63	0.100	52
0.050	28	14	0.076	77	0.200	74
0.075	51	25	0.102	88	0.300	91
0.100	78	39	0.127	99	0.400	105
0.125	85	42	0.152	108	0.500	117
0.150	93	47	0.178	117		
0.175	101	50	0.203	125		
0.200	108	54	0.229	133		
0.225	114	57	0.254	140		
0.250	121	60				
0.300	132	66				
0.350	143	72				
0.400	153	76				
0.450	162	81				
0.500	171	86				



APPENDIX C

Roadway Classifications (2012 Transportation Master Plan)

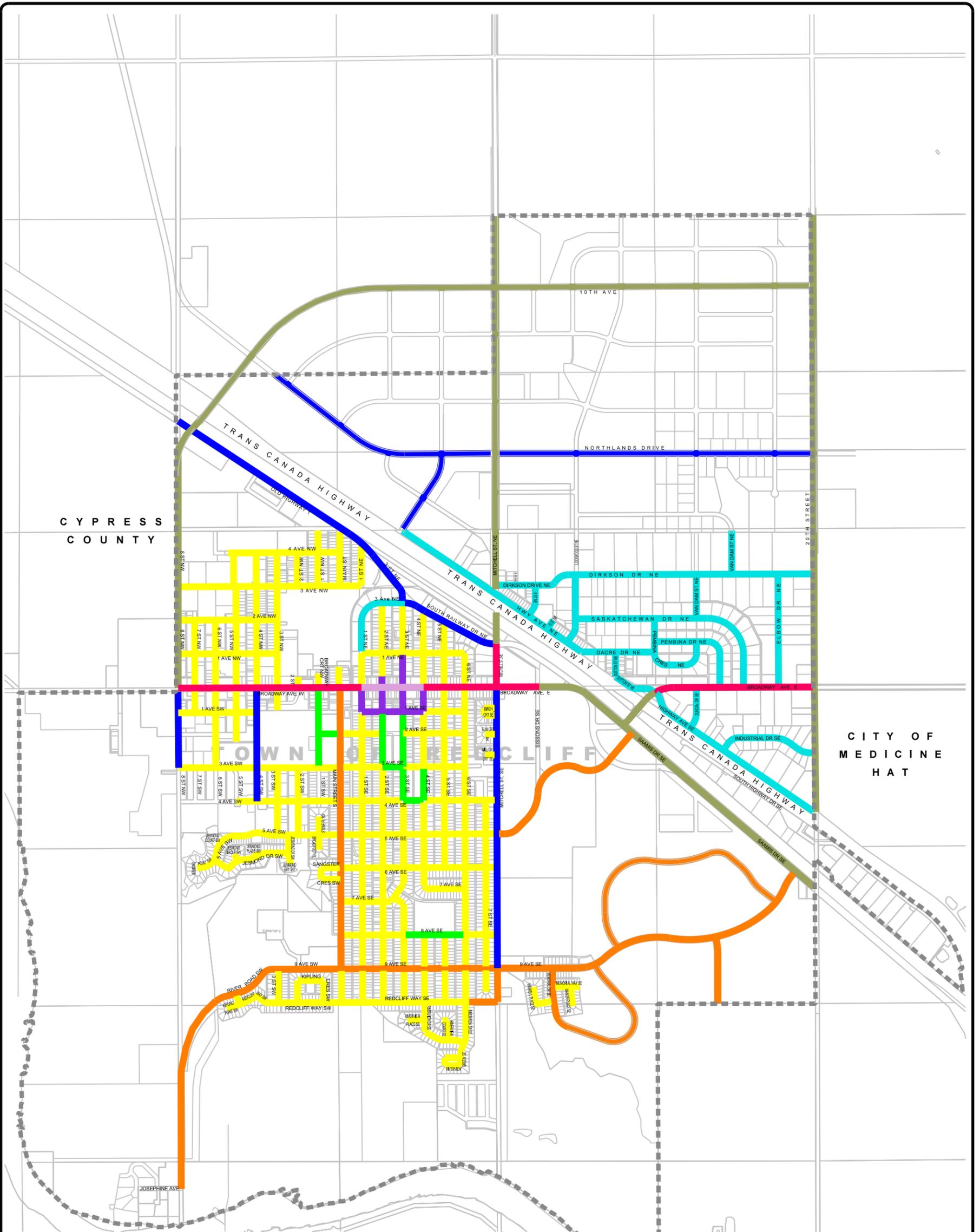


FIGURE 2.2.3.1

RECOMMENDED FULL BUILD-OUT ROAD NETWORK

NEW ROADWAY CLASSIFICATION SYSTEM
2010 REDCLIFF ROADWAY SYSTEM MASTER PLAN

SCALE 1 : 20000
October 2012