



CITY OF WETASKIWIN

MINIMUM DESIGN GUIDELINES AND CONSTRUCTION STANDARDS FOR DEVELOPMENTS

December, 2009

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DESIGN GUIDELINES

1. FORWARD

This manual is intended to provide an information guide to set standards governing design, preparation and submission of plans and specifications for construction of municipal improvements in the City of Wetaskiwin. It is intended for use by Developers, Engineering Consultants, Utility Companies and City Departments. These standards are provided to set out the "minimum" allowable levels to which the requisite improvements are to be built. In instances where the standards do not cover a particular situation or occurrence, good engineering judgement shall be used. All development shall comply with the City of Wetaskiwin Land Use Bylaw.

No departure from these standards shall be permitted without the written approval of the Public Works Superintendent. Minor revisions may be given verbal approval by the Public Works Superintendent, but a change order shall be issued to record such revisions.

The City of Wetaskiwin Engineering Department address is:

Wetaskiwin Civic Building (Second Floor)
4904 – 51st Street
Wetaskiwin, Alberta

Mailing Address:
Box 6210
Wetaskiwin, AB
T9A 2E9

Phone : (780) 361-4400 (main switchboard)
Phone : (780) 361-4434 (Engineering Direct)
Fax: (780) 352-8266
E-Mail: engineering@wetaskiwin.ca

END OF SECTION

2. GENERAL CONDITIONS AND ENGINEERING PROCEDURES FOR MUNICIPAL DEVELOPMENT

2.1 GENERAL CONDITIONS

2.1.1 Scope

These design standards shall apply to the design and installation of the municipal infrastructure within new subdivisions and developments within the City of Wetaskiwin. They apply to the design and installation of storm and sanitary sewers, water mains, roads and sidewalks together with their respective connections and appurtenances, landscaping, 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 and landscaping of commercial, industrial, institutional and multi family developments within the City of Wetaskiwin

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 City.

The Standard Drawings, as referred to in various sections, will form an integral part of these design standards.

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

2.1.2 Definitions

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

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

“City, Municipal, Municipality” shall refer to the City of Wetaskiwin.

“Consulting Engineer” will mean the professional engineer retained by the Applicant to be responsible for the design, layout and supervision of installation, recording of as-built information and performing those duties in connection with the provision of Municipal Services as set out in these design standards. The Consulting Engineer must be licensed to practice in the Province of Alberta.

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

“Deep Utilities” will mean Sanitary Sewer mains, Storm Sewer mains, Storm Water Management ponds, Water mains and lot services.

“Landscape Architect” will mean a person duly registered in the Province of Alberta, to be responsible for the design and layout of the landscaping component of the project.

“Municipal Services” will mean all of the installations and improvements to be constructed and installed in the development area.

“Public Works Superintendent” means the Public Works Superintendent of the City of Wetaskiwin or his assigned designate.

“Prime Contractor” as defined by O.H.& S.

“Shallow Utilities” will mean services for power, gas, cable television and telephone plus all of their appurtenances.

“Surface Improvements” will mean curb, gutter and sidewalk, roadway construction, asphalt and boulevard rough grading.

2.2 PROCEDURE

2.2.1 Engineering Design

Except for the installation of services or municipal infrastructure to serve an existing property, the Applicant will retain a Consulting Engineer who shall be responsible for the design and preparation of drawings and specifications for all infrastructure (except lighting, telephone, cable television and power) as required within the City of Wetaskiwin. If landscaping plans are deemed required by the Public Works Superintendent the landscape plans will be prepared and stamped by a Landscape Architect.

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 City. 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 Public Works Superintendent 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 is the responsibility of the Consulting Engineer to coordinate with the utility companies to establish the location of their existing and proposed services.

The Consulting Engineer shall bring to the attention of the Applicant, the need for any right-of-way, outside the subdivision, which the Applicant will have to obtain. The applicant shall provide proof of right of way to the City prior to the installation of services on such properties.

2.2.2 Submission Of Engineering Design

Upon completion of the design drawings, the Consulting Engineer will submit to the Public Works Superintendent, two 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 City 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, names to be approved by the Public Works Superintendent.

2.2.3 Design Review

All design drawings, specifications, and relevant data will be examined by the Public Works Superintendent, and any revisions directed to the Consulting Engineer and/or marked on the prints during the review shall be incorporated in the final design drawings.

2.2.4 Design Approval

Upon completion of all revisions, the Consulting Engineer shall submit four (4) complete sets of Contract Drawings and Specifications to the Public Works Superintendent.

When the design is approved, the Public Works Superintendent shall stamp "Approved for Construction" on the drawings and return one set of the drawings to the Consulting Engineer.

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

2.2.5 Right-of-Ways 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. Right-of-ways and/or easements will be provided for all utilities not located on streets, lanes, or utility lots, including right-of-ways for ditches or watercourses accommodating surface runoff.

2.2.6 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" from Alberta Environment, through the Applicant's Consulting Engineer, and a copy received by the Public Works Superintendent.
- c) A list of materials that are being installed and a construction schedule submitted to the City'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 City 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 Consulting

Engineer and the test results have been approved in writing, by the Public Works Superintendent.

2.2.7 Engineering Supervision

The applicant shall retain the services of the Consulting Engineer who shall be responsible for the layout, inspection and approval of materials and the supervision of installation of all services that are the responsibility of the Applicant. The Consulting Engineer or his authorized representative shall be available at all times to visit the site during the installation of services.

The Consulting Engineer will be responsible for maintaining field surveys.

In addition to supervision carried out by the Consulting Engineer, the Public Works Superintendent may periodically inspect any work being completed.. The Public Works Superintendent will bring the use of any unacceptable materials or practices to the attention of the Contractor and/or the Consulting Engineer. If remedial action is not taken to the satisfaction of the Public Works Superintendent, he may order the work to cease.

If the Consulting Engineer/Landscape Architect 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 Public Works Superintendent. If approval is granted for revision, the original drawing will be immediately revised and new prints issued.

2.2.8 Testing

It will be the responsibility of the Consulting Engineer to ensure that all required tests are submitted prior to acceptance by the City.

2.2.9 As-Built Drawings

Within three weeks of the Construction Completion Certificate of the underground improvements, the Consulting Engineer shall deliver to the Public Works Superintendent "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 City's mapping system.

No development permits will be processed until the City receives a set of as-built prints, including completed Building Grade Certificate for each lot. As an exception, one show home may be constructed with the written approval of the Public Works Superintendent, provided the subdivision design grades have been submitted and approved.

Within three months of completion of roadway base course asphalt, the Consulting Engineer will deliver good quality Mylar sepias of the "as-built" drawings, one complete set of prints and a digital copy (in the City's latest AutoCAD software version) of the as-built records to the Public Works Superintendent.

2.2.10 Municipal Acceptance and Maintenance Period

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

- a) Site Pre-grading including rough lot grading, rough street grading and berms.

- b) Deep Utilities including sanitary sewer, storm sewers (including Storm Water Management ponds), water distribution system, including service connections for water and sewer.
- c) Surface Improvements including Sidewalks, curbs and gutters, catch basins, walkways (concrete and asphalt), Roads and Lanes (asphalt and gravel).
- d) Landscaping including boulevards, uniform fencing, trees, parks, street signage, subdivision signage and shallow utilities.

The Developer shall make application to the City for the issuance of a Construction Completion Certificate. No such application will be considered by the Public Works Superintendent unless it is requested in respect of all of the Development Area or one or more approved stages of development.

The City may issue a Construction Completion Certificate; issue a Conditional 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
Uniform Fencing		- 12 months
Roads and Sidewalks		- 24 months
Park Landscaping:	Trees and Shrubs	- 24 months
	Grass	- 12 months
Blvd. Landscaping:	Trees and Shrubs	- 24 months
	Sod	- 12 months
		(or upon satisfactory knitting and catch.)
	Grass	- 12 months

Upon completion of the required Maintenance Period, a Final Inspection shall be completed and all deficiencies from this inspection repaired, a Final Acceptance Certificate (FAC) shall be issued by the Public Works Superintendent.

2.2.11 Development Permits

No Development Permits will be issued until the subdivision plan is registered, all essential services have been provided as specified in the Development Agreement, the required Construction Completion Certificates have been issued and underground utility service as-built prints have been submitted and accepted by the Public Works Superintendent.

2.2.12 Existing Utilities

Prior to connecting to existing utilities, the City's Utilities Department shall be given a minimum of two working days notification of the work being done. All exterior valves shall be operated by City of Wetaskiwin Utilities Staff only.

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

No sanitary sewers will be used to discharge storm water.

2.2.13 Road Closures and Construction Within Road Right-of-Ways

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, etc. necessary to provide for the orderly control of traffic around the construction area.

2.2.14 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 both the City 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 City and 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 City and Alberta Environment, Land Administration Division, with survey measurements for it to the satisfaction of the Director of Surveys.

The Developer, prior to Final Acceptance by the City, must replace any legal pins, disturbed or removed during construction. The Developer shall supply a certificate from a registered legal survey that all lot and corner pins are intact.

2.3 PERMIT TO CONSTRUCT ON CITY PROPERTY



**Application for
PERMIT TO CONSTRUCT
(On City Property)**

City of Wetaskiwin
Public Works and Engineering
4705 – 50 Avenue
Wetaskiwin, AB. T9A 2E9
Tel. (780) 361 – 4436
Fax. (780) 352 - 0101

Application Date : _____	Roll Number : _____
Applicant Name: _____	PTC Number : _____
Address: _____	Contractor Name : _____
City/Province: _____	Address: _____
Postal Code: _____	City/Province: _____
Telephone: _____	Postal Code _____
Fax: _____	Telephone: _____
	Fax: _____

Construction Address: _____

Estimated Start of Project : _____ Estimated Completion of Project : _____

Type of Construction Work Proposed

<u>Concrete</u>	Type	Area	<u>Utilities</u>	Type	Length/Size
<input type="checkbox"/>	Sidewalk	_____	See Note *	<input type="checkbox"/>	New Water _____
<input type="checkbox"/>	Curb and Gutter	_____		<input type="checkbox"/>	Ex. Water _____
<input type="checkbox"/>	Driveway Approach	_____		<input type="checkbox"/>	Sewer _____
				<input type="checkbox"/>	Storm _____
				<input type="checkbox"/>	Gas _____
Roads	Type	Area		<input type="checkbox"/>	Telephone _____
<input type="checkbox"/>	Paving/Graveling	_____		<input type="checkbox"/>	Cable _____
<input type="checkbox"/>	Dust Control	_____		<input type="checkbox"/>	Electric _____
<input type="checkbox"/>	Pavement markings	_____			
<input type="checkbox"/>	Signage	_____			
<input type="checkbox"/>	Street Cleaning	_____			
<input type="checkbox"/>	Road Closure	_____	Boulevards	Type	Notes
<input type="checkbox"/>	Excavation	_____		<input type="checkbox"/>	Trees _____
	Road Closure Duration: _____			<input type="checkbox"/>	Turf _____
<input type="checkbox"/>	Drawing Attached	_____	Other	<input type="checkbox"/>	Rock _____
				<input type="checkbox"/>	_____

***Note* New Water Service Connection subject to fee as follows :**

1. 50mm or less (5/8" to 2") \$150.00
2. Larger than 50mm \$250.00

Construction Description: _____

Conditions

1. All work is to meet the City of Wetaskiwin design 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 Construction Completion Inspection will be required prior to the start of any warranty period.
3. A one-year warranty is to be given to any work and repair beginning on the date of Construction Completion Inspection.
4. The city standards for traffic control must be met.
5. Occupational Health and Safety standards must be met (vests, excavation side slopes, etc.).
6. Any excavation on roadways must be backfilled to grade the same day (unless authorization is gained from the Public Works Superintendent) and cold mix must be placed in the hole within 48 hours. Hot mix must be placed in hole by October 31 of the same year.
7. Curb/gutter and sidewalk must be returned to a safe condition the same day. A temporary cold mix patch may be used to bring the sidewalk to this condition, with permanent repairs being completed within 30 days.
8. Inspection by City Utilities Staff 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.
9. Street must be returned to clean condition prior to opening road to public. Street abutting construction site must be kept clean at all times.

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 _____

To be filled by city representative

The application for a Permit to Construct is hereby :


- 1. Approved, subject to the following conditions
- 2. Refused, as a result of the following:

 City Representative

The personal information on this form is collected under the authority of Section 32 (c) of the Alberta Freedom of Information and Protection of Privacy Act, Section 642 of the Municipal Government Act and/or Section 39 of the Safety Codes Act. The information will be used to process your application(s) and your name and address may be included on the reports that are available to the public.

Office Use Only	
Pre-Inspection Date	_____
Notes	_____
Post-Inspection Date	_____
Notes	_____
Inspection Approved	Inspector _____

2.4 CONSTRUCTION COMPLETION CERTIFICATE

 <div style="text-align: center; margin-top: 10px;"> <h2 style="margin: 0;">City of Wetaskiwin</h2> <p style="margin: 0;">Public Works & Engineering</p> </div>	<h2 style="margin: 0;">Construction Completion Certificate</h2>
<p>Development Area: _____ Date of Application : _____</p> <p>Developer: _____ Permit or Subdivision # : _____</p> <p>Contractor: _____</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>PURSUANT TO THE DEVELOPMENT AGREEMENT, I _____ OF THE FIRM _____ "CONSULTING 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 APPROVAL.</p> <p>_____ Date : _____</p> <p>Project Engineer (Consulting Engineering Firm)</p> <p>_____ Date: _____</p> <p>Signing Officer (Consulting Engineering Firm)</p> <p>_____ Date: _____</p> <p>Authorized City Inspector</p> <p>Approved on: _____ Public Works Superintendent _____</p> <p>Conditional Approval: _____ Public Works Superintendent _____</p> <p>Conditions / Deficiencies : (See attached report) _____</p> <p>Rejected on: _____ Public Works Superintendent _____</p> <p>Reason for rejection: (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>Date: _____ Project Engineer (Seal) (Consulting Engineering Firm)</p> <p>Date: _____ Approved: _____</p> <p style="text-align: center;">Public Works Superintendent</p> <p>Date Maintenance Period to Start: _____</p> <p>Date Maintenance Period to Expire: _____</p>	

2.5 FINAL ACCEPTANCE CERTIFICATE

 <p style="text-align: center; font-size: 1.2em; margin: 0;">City of Wetaskiwin</p> <p style="text-align: center; margin: 0;">Public Works & Engineering</p>	<p style="font-size: 1.2em; margin: 0;">Final Acceptance Certificate</p>
<p>Development or Subdivision : _____ Date of Application : _____</p> <p>Developer : _____ Permit or Subdivision # : _____</p> <p>Contractor : _____</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>Maintenance Expiry Date : _____</p> <p>PURSUANT TO THE DEVELOPMENT AGREEMENT, I _____ OF THE FIRM _____ "CONSULTING 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>_____</p> <p>Project Engineer (Consulting Engineering Firm)</p> <p>_____</p> <p>Signing Officer (Consulting Engineering Firm)</p> <p>_____</p> <p>Authorized City Inspector</p>	<p>Date : _____</p> <p>Date : _____</p> <p>Date : _____</p>
<p>Approved on : _____</p> <p>Rejected on : _____</p> <p>Reason for rejection: (See attached report) _____</p>	<p>_____</p> <p>Public Works Superintendent</p> <p>_____</p> <p>Public Works Superintendent</p>
<p>I HEREBY CERTIFY THAT THE ITEMS LISTED AS REASONS FOR REJECTION HAVE BEEN CORRECTED.</p>	
<p>_____</p> <p>Project Engineer (Consulting Engineering Firm)</p> <p>Approved : _____</p> <p style="text-align: center;">Public Works Superintendent</p>	<p>Date : _____</p> <p>Date : _____</p>

3. PREPARATION OF ENGINEERING DRAWINGS

3.1 DESIGN DRAWINGS

3.1.1 Scope

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

3.1.2 Drawing Size, Material

The Standard Drawing size of 610 mm (24") x 914 mm (36") will be used.

Originals will be prepared in ink on Mylar sheets.

3.1.3 Scales

Engineering:

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

Landscape:

Landscape layout plans for Subdivision	
Boulevard Planting	1:500 or 1:1000
Landscape layout plans for parks, commercial and multi-family developments	1:250 or 1:500
Planting plans	1:250 or 1:500

3.1.4 Drawing Technique

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

- Care in ensuring balanced distribution of detail throughout the drawing.
- Letters and figures shall be clearly legible, 2 mm size or larger (Leroy or equivalent), well spaced, properly formed and proportioned.
- Lines shall be uniform in weight and density.
- 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 centerline or any other reference that can be readily established. All dimensions will be in the SI system.

3.1.5 General Requirements for All Drawings

Elevations will be relative to the Geodetic datum. Bench mark numbers, locations and elevations can be obtained from Engineering Services. 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.

Landscape drawings will be stamped by a Landscape Architect registered in the Province of Alberta.

3.1.6 Required Engineering and Landscape 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, City logo, and names of the Developer and Consulting Engineer. Space permitting, the index plan may be included here.

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 which relates to a particular plan/profile sheet.

Sanitary Sewer, Storm Sewer and Water Main Overall Plan:

This plan will be drawn to a scale of 1:1000 and will indicate the alignments and locations of mains, size of mains, valves, hydrants, manholes, catch basins, storm catchment areas with areas labeled in hectares, direction of sewer main flows and locations of appurtenances. Sanitary and storm design calculations charts will be included on this drawing.

Road, Sidewalk and Walkway Plan:

This plan will be drawn to a scale of 1:1000 and will indicate all locations and widths of roads, sidewalks, walkways, and locations of catch basins.

Lot Grading Plan:

This plan will be drawn to a scale of 1:1000 and will indicate the original contours at 0.5 m intervals.

Park and Boulevard Landscape Plan:

A landscape layout plan and a planting plan are required. If the size and complexity of the project permit, the two plans may be combined.

Power, Gas, Telephone and Cable:

This plan will indicate the alignments of power, gas, telephone and cable and shall be drawn to a scale of 1:1000.

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.

3.1.7 Detailed Plan/Profile

Generally, all underground services and surface improvement profiles are shown on the same drawing. The plan portion of the sheet shall be at the top and the title blocks, revisions, legends and company stamps, etc. will be placed along the 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) Sewer profiles shall be drawn showing 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 the location of hydrants and other appurtenances to the nearest iron pin.
- b) Show the offset of the main from the property line and locate the end of the main to the nearest iron pin.
- c) Indicate extent of work required in making the connection to the existing water main.
- d) Indicate the size, type, class of pipe, bedding and CSA specification number on the plan.

Requirements for Roads:

- a) Both plan and profile must be tied to an iron pin, preferably near or at 0 + 00 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 chainage 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 Top of Curb or Lip of Gutter elevations.
 - f) The profile will be shown at true centerline length and projected above the plan in as close relationship as possible.
 - g) Locate catch basins (using road chainage) and show leads between the catch basin and the main.
 - h) Label limits of construction.

3.1.8 Lot Grading Plan Requirements

This plan will include:

- a) Invert and location of sewer and water services.
- b) Proposed top of curb or back of walk elevations.
- c) Existing and proposed contours at 0.5m intervals.
- d) Proposed finished lot corner elevations.
- e) Proposed finished lot elevations on side property lines at 6.0, 12.0 and 18.0 meters back from the front property line.
- f) Proposed finished lot elevations on side property lines at 6.0 meters from the rear property line.
- g) Distances from a property pin to the proposed grade break points on property lines that divide properties.
- h) Proposed finished lot elevations at grade break points.
- i) Standard detailed drawings shall govern the lot grading design, and critical swales elevations will be calculated as per the types shown.
- j) The lot grading plan will have the following note: "The surveyor shall design and stake out the house elevations and finished grades at house to meet the building code slope requirements for drainage to critical swales".
- k) The grading plan will identify lots with weak subsoil conditions and have a notation indicating the requirement for a geo-technical engineer's footing design.
- l) The grading plan will identify all lots with areas of 1.0 m of fill or greater and shall be shaded a different color.
- m) Direction of surface drainage and critical swale elevations on side property lines.

3.1.9 Park and Boulevard Landscape Plan Requirements

Parks and Boulevards Multi-Family, Commercial and Industrial Projects:

The plans will include:

- a) Clear definition of the site boundary of parks.
- b) Contour lines at 0.5 m intervals.
- c) Landscaping up to the back curb of the adjoining City roads.
- d) Clear designation of all paved and landscaped surfaces.

- e) Existing vegetation adjoining boulevards and park boundaries.
- f) Clear definition of all existing trees, shrubs and plant communities on the site to be:
 - 1) removed,
 - 2) retained and protected during construction, or
 - 3) relocated and protected during construction;
- g) All proposed buildings, retaining walls, ramps, outdoor furniture, curbs, berms and swales (with cross-sections), entry features, gazebos, bridges, signage, raised planters, municipal boulevards and buffer strips, sidewalks, trails and public utility lots.
- h) Construction details, elevations or cross-sections of any landscape components where necessary to clearly communicate the design intent.
- i) Proposed locations of all trees and shrubs. Canopy diameters will be shown at 75-100% of the maximum for the type in the 'Alberta Horticultural Guide'; this requirement will be relaxed for designs intended to simulate native vegetation communities. All plants will be clearly labelled and cross referenced to a schedule incorporated in the drawings.
- j) Proposed location and shape of areas of plants too small to be shown individually, clearly labeled and cross referenced to a schedule incorporated in the drawings.
- k) Planting details conforming to the City's current standards.
- l) Plant Schedule, including common and scientific names, conforming to the rules of the International Code of Nomenclature for Cultivated Plants and in accordance with the latest edition of standardized plant names and:
 - 1) for coniferous trees: height and rootball diameters;
 - 2) for deciduous trees: height range and caliper, root ball diameter and description (balled and burlapped, bare root, tree spade, etc.) and in addition for boulevard trees: height of clear stems;
 - 3) for shrubs, vines, low ground covers, and climbers: a combination as used in the latest edition of the 'Canadian Standards for Nursery Stock' published by the Canadian Nursery Trades Association and Landscape Canada, of height and number of canes, age, spread, number and length of runners, container or rootball size or, alternatively, minimum root spread;
- m) Plant descriptions and terminology conforming to the latest edition of the Canadian Standards for Nursery Stock'.
- n) Information provided by the City about the Construction Completion Certificate, maintenance period, and Final Acceptance Certificate.

3.1.10 Power, Gas, Telephone and Cable Utility Plan Requirements

This plan will include:

- a) Street Names, House numbers.
- b) Street Light locations.
- c) Dimension of all Easements.
- d) Location of pedestals, transformers, cabinets, etc.
- e) Lot Numbers, Block numbers, Plan Number.

3.2 AS-BUILT DRAWINGS

3.2.1 Scope

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

- a) Storm and sanitary sewers, water mains, roads, curbs, sidewalks, culverts and other miscellaneous permanent structures.
- b) Landscape layouts and planting plans for all projects on land to which the City holds title.

3.2.2 General

The complete and overall 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 cocks valves, hydrants and manholes using right angle measurement from survey pins.

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

The complete and overall as-built drawings are to be submitted to the Public Works Superintendent's office on high quality mylar sepia sheets, within three months of the installations, along with two complete sets of prints.

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

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

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

- a) Date of overall completion and completion dates for the various subcontractors.
- b) Name of the contractor and their sub contractors.
- c) Date on which "as-built" details were added.

3.2.3 Storm and Sanitary Sewer

- 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.

3.2.4 Water

- a) Size, type and location of pipe.

- b) Location of valves, tees, hydrants and other appurtenances.
- c) Profile of pipe top and invert.
- d) Hydrant numbering (numbers are to be supplied by the City).

3.2.5 Road, Curb, Sidewalks

- a) Location of curbs, sidewalks and elevations of top of curbs 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.

3.2.6 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 number.
- b) Distance of service saddle from the downstream manholes.
- c) Invert elevation at the end of sanitary, water and/or storm services.
- d) Invert at CC location for water and sewer.

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. 0.3 m F.O.W., 2.65 m B.O.W.) by means of a table chart.

3.2.7 Building Grade Certificates

General

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

As outlined in the Development Agreement, Development Permits will not be released until all of the conditions outlined in the Development Agreement, Part Three – Development Permits are met.

Building Grade Information

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

- a) Water, sanitary, and/or storm services location and inverts at property line and 1 m. past easement (URW) line.
- b) Power, telephone, and cable television service location.
- c) Sidewalk and boulevard width.
- d) Easements.

- e) Lot corner surface elevations.
- f) Landscape elevations at front of house.
- g) Lot drainage pattern.
- h) Streetlights, transformers, pedestals, hydrants, etc.

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

3.2.8 Landscape Layout and Planting Plans

The original approved landscape layout and planting plans will be amended to reflect any changes effected during construction and the resultant as-built drawings will be submitted to the City's Engineering Department.

END OF SECTION

4. WATER DISTRIBUTION SYSTEM

4.1 GENERAL

The design of the water system shall conform to the "Standards and Guidelines for Municipal Waterworks, Wastewater, and Storm Drainage Systems in Alberta", as published by Alberta Environmental Protection Services and as amended by these Guidelines and Standard Details.

4.1.1 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 will require that all exterior valves and hydrants shall be operated by City of Wetaskiwin Utilities Staff only.
- 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 owner 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.

4.2 DESIGN REQUIREMENTS

The minimum size of distribution main shall be 200 mm diameter.

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 shall be:

Average Daily Demand	-	395 L/person/d
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, based upon the approved zoning By-law requirements.

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 150 kPa. (21 psi).

Fire flow requirements shall be in accordance with the Fire Underwriters Survey publication entitled "Water Supply for Public Fire Protection – a Guide to Recommended Practice", latest revision thereof.

Where the size of the area to be developed warrants, or if required by the City, 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.

4.2.1 Water Main - Location and Installation

Mains shall be installed to provide a minimum depth of cover of 2.75 meters below the final finished surface grade. Maximum depth of cover shall be 3.0 m unless authorized in writing by the Public Works Superintendent.

Mains shall be located within the road in accordance with the Roadway Cross-Section Standard Drawing No.'s D -111 to D -115.

In all cases a distance of 3.0 m from the centerline of a road shall be maintained.

A minimum of a 3 m horizontal separation shall be maintained between a water main and any sewer main.

The minimum requirement for pipe bedding shall be Class "B" bedding (Standard Drawing No. C-101).

Water main installation shall be in accordance with the Engineering Specifications outlined in the Contract Documents for the project.

4.2.2 Hydrant - Location and Installation

The maximum allowable spacing between fire hydrants shall be 150 m in single family residential areas and 90 m 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 75 m. For the case of multi-family and/or commercial buildings with standpipes, the distance shall be 45 m 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.
- d) Where a hydrant and sanitary manhole fall on the same property line projection, the manhole will be moved a minimum of 5 meters 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 m back of face of curb or 0.5 m back of walk.
- b) The maximum distance from the face of the curb to the hydrant shall be 3.5 meters.
- c) Shall be installed in accordance with Standard Drawing Number A-103 and the Engineering Specifications outlined in the Contract Documents.
- d) Gravel drainage pit shall be provided at the bottom of the hydrant;
- e) A gate valve will be provided on each hydrant lead, 1 m. from center of barrel;
- f) Cathodic protection to be installed as per Drawing A-117.

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

4.2.3 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 property line.
- b) With a minimum of two valves at a tee and a minimum of three valves at a cross.

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 Standard Drawing No.'s A-109 and A-123.

4.3 THRUST BLOCK

Thrust blocks will be provided as per Standard Drawing No. A-107.

4.4 HYDROSTATIC PRESSURE TESTING

All Hydrostatic testing of the watermain shall be done in accordance with A.W.W.A. Standard C605, latest revision. 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 standard 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, whichever is greater.

4.4.1 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(latest revision) "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 City of Wetaskiwin or Alberta Environmental Protection. Dechlorination, if required, is to be performed by adding neutralizing chemicals (AWWA C651(latest revision), Appendix B) to the chlorinated water as it is flushed from the system and before it enters the receiving environment.

4.4.2 Cathodic Protection

All buried fittings and valves, shall be cathodically protected with a 5.5 kg Zinc Anode, and all hydrants shall be cathodically protected with a 5.5 kg Zinc Anode, per Standard Details A-117.

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

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

Wire shall be connected to fittings with a cadweld.

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

4.4.3 Flushing of Existing and New Water Mains

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

4.4.4 Usage of City Water

The Developer's Consultant shall be responsible for calculating the water used for flushing of mains. This calculation shall be submitted to the City at the time of the C.C.C. 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

5. SANITARY SEWERAGE SYSTEM

5.1 DESIGN FACTORS

The sanitary sewerage system shall be of sufficient capacity to carry peak flows plus infiltration. The following factors shall be used in design of sanitary sewerage systems:

a) Residential

Population Density (based upon zoning)

R1 - 95 people/hectare

R2 - 105 people/hectare

R3 - 230 people/hectare

R4 - 250 people/hectare

Average Sewage Flow - 395 L/persons/d

Peaking Factor - $1 + 14 / (4 + p^{1/2})$

(Harmon's Formula)

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

Infiltration - 0.20 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 utilizing the Manning's Formula using an "N" value of 0.013.

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 as recommended by Alberta Environment's "Standards and Guidelines for Municipal Waterworks, Wastewater, and Storm Drainage Systems in Alberta".

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

5.2 SEWER MAIN INSTALLATION AND LOCATION

Mains shall be installed to provide a minimum depth of 2.75 m to obvert below final finished grade at the surface.

Mains shall be installed to provide adequate sewer service connection depth at the property line (refer to Section 8).

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 Standard Drawing No. C-101.

5.3 MANHOLE INSTALLATION AND LOCATION

Manholes shall be located at the end of each line, at all changes in pipe size, grade or alignment, at all junctions, and at intervals no greater than 120 m along the length of the sewer.

Inverts in manholes at changes in direction shall have at least 25 mm fall across manhole. To maintain a continuous energy gradient through manholes, the obvert (crown) elevation of the lowest upstream pipe shall be equal to, or higher than the obvert of the downstream pipe.

Manholes shall be installed as shown on Standard Drawings. Manhole bases shall be pre-cast slabs, 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 900 mm diameter and less. For pipe exceeding 900 mm diameter, manhole diameter shall be pipe diameter plus 600 mm, or a Tee-Riser shall be used.

Manhole frames and covers to be Type F-39 in landscaped areas, Type NF-80 in paved areas and Type NF-90 gasketed in sags. All manhole covers are to be clearly stamped "Sanitary Sewer".

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

All joints shall be watertight.

Safety platforms at intermediate levels are required for manholes greater than 5.0 m in depth when measured from the top of the frame to the lowest invert.

5.4 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 centerline.
- e) The minimum grade for sewers on curve shall be 50% greater than the minimum grade required for straight runs of sewers.

5.5 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 video tape, in VHS format, shall be submitted to the City for their approval and records.

- b) Leakage Test:

The Public Works Superintendent may require each section of sewer main and service connections to be tested for water tightness by an exfiltration test and/or infiltration test.

END OF SECTION

6. STORM DRAINAGE SYSTEM

6.1 DESIGN FACTORS

The storm sewers 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 sewer 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 an 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 Public Works Superintendent, high value commercial areas shall have their minor systems designed to accommodate a 1 in 10-year return period event.

The major system comprises of 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 1.0 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 Public Works Superintendent.

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

Where predevelopment 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 Public Works Superintendent.

The developer shall provide these designs and calculations to the City of Wetaskiwin 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 City 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 Public Works Superintendent.

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, i.e.:

$$Q = 2.78 CIA$$

Where

- Q = the design peak flow rate in liters per second
- I = the intensity of rainfall in millimeters 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 6.1.

- c) The following runoff coefficients shall be used:

Parks	=	0.15
Residential	=	0.35
Industrial	=	0.70
Commercial	=	0.70
Multiple Family	=	0.70
Paved Areas	=	0.90

- 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 $C_i = 0.90$.

- 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). Gutter flow time shall not exceed 5 minutes and shall be estimated based on methods outlined in “Modern Sewer Design” (AIS, 1980). The time of travel in the conduit shall be based on the pipe flow velocity.

For areas greater than 65 ha:

- a) Computer models shall be used to determine design flows and the sizing of systems which 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 hyetograph 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.

The minimum velocity shall be 1 m/s. Where 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.

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 local roadways 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 7.7, where values are given for sag conditions and on slope conditions based upon inlet grate type.

Minimum gutter grade shall be 0.50%. Cul-de-sacs and curb returns are minimum 0.8% to 1%.

6.2 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.

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 (Standard Drawing No. B-114). 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 Standard Drawing No. B-115.

- 3) Catch basin manholes shall be used in place of a catch basin when the lead exceeds 30 m in length.
 - 4) Catch basins are to have 500 mm deep sumps.
- 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 equal to Norwood F-51 for straight faced curb and gutter.
 - 2) Top inlet standard round top equal to Norwood F-38 for swales or lanes.
 - 3) Top inlet standard round top equal to Norwood F-39 grate for landscaped areas.
- 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.

6.3 STORM SEWER INSTALLATION AND LOCATION

Mains shall be installed to provide a minimum depth to pipe obvert of 1.50 m below final finished grade.

Pipe bedding shall be provided for all mains in accordance with Standard Drawing No. C-101.

6.4 MANHOLE INSTALLATION AND LOCATION

Manhole spacing on storm sewers greater than 750 mm in diameter may exceed 120 m if approved by the Public Works Superintendent.

Benching in manholes shall be provided to minimize hydraulic losses. The downstream invert in a manhole shall be a minimum of 25 mm lower than the lowest upstream invert. At a change in direction, the drop shall be at least 50 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).

Tee riser manholes may be utilized on lines 900 mm diameter and larger. Tee riser manholes must be bedded in concrete to the springline of the pipe.

6.5 CONNECTIONS TO STORM SEWERS

Only catch basins and site surface drains shall be connected to a storm sewer.

6.6 CURVED SEWERS

Refer to (Sanitary Sewerage System).

6.7 INSPECTION AND TESTING

Refer to (Sanitary Sewerage System)

6.8 Stormwater Management Facilities

Design Requirements Common to Stormwater Management Storage Facilities

a) General

The use of stormwater facilities may be required to reduce peak flow rates to downstream sewer systems and/or water courses, 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 which 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 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) Post-development hydrographs for the 5 year and 100 year events to be determined at key points in the system.
- 3) Delineation of flood lines for the 100 year design storm for creeks or watercourses.
- 4) 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;
- offline stream storage;
- channel storage;
- online 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.

5) Detailed description of the selected alternatives.

Design Standards for Lakes and Wet Ponds

- a) Land that is adjacent to a lake which is subject to flooding, as per the design standard established, but is part of the development parcel, will carry easements to allow City forces right of access though their 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) Side slopes shall be designated as shown in detail Drawing B-117.
- g) Maximum water fluctuation for a one in five year storm event should not exceed one meter.
- h) The minimum depth from normal water level to lake bottom should be 2.5 meters.
- i) The inlets and outlets are to be fully submerged at least one meter 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 which 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 allow ease of access to the water edge. The recommended guideline is approved riprap rock material varying in size from 50 to 100 mm, for a thickness of 0.3 meters and extending in a vertical distance of 0.6 meters 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. Appropriate signage for public safety will be supplied and installed by the Developer. All warning signs will be designed by the Developer and approved by the Public Works Superintendent prior to installation.
- 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.

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 Public Works Superintendent, 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 Parks Department 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 4:1 ratio of effective length to effective width measured at 100 year high water level.
- h) Dimensions must be acceptable to the Department 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 0.5% (1.0% 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.

The current Stormwater Management Policy does not permit the use of wet ponds. However, their use may be approved by Council as an exception to the Policy. 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 a maintenance of the pond.

Design of a wet pond is to be in accordance with the Alberta Environment publication entitled "Stormwater Management Guidelines for The Province of Alberta". 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) Water recirculation and make-up system required.
- i) Provide access for maintenance and emergency equipment.
- j) Design of outlet control structure to be capable of maintaining permanent pool depth and capable of draining the permanent pool for maintenance purposes.

6.9 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.

Riprap 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.

TABLE 6.1 RAINFALL INTENSITIES

Duration (minutes)	Rainfall Intensity (mm/hr.)		
	5 Year	10 Year	100 Year
10	66.0	79.0	120
11	62.0	74.1	112
12	58.5	69.9	106
13	55.5	66.3	100
14	52.9	63.1	95.5
15	50.5	60.3	91.1
16	48.4	57.4	87.2
17	46.5	55.4	83.7
18	44.8	53.4	80.5
19	43.2	51.5	77.6
20	41.8	49.7	75.0
21	40.4	48.1	72.5
22	39.2	46.7	70.3
23	38.1	45.3	68.2
24	37.0	44.0	66.3
25	36.0	42.9	64.5
26	35.1	41.7	62.8
27	34.2	40.7	61.2
28	33.4	39.7	59.7
29	32.7	38.8	58.3
30	31.9	37.9	57
60	20.2	12.9	35.6
120	12.8	15.1	22.3
360	6.18	7.23	10.6
720	3.91	4.56	6.60
1440	2.47	2.87	4.13

- Notes: 1. Based on AES data at Edmonton Municipal Airport for period 1914 to 1980 (66 years).
 2. Maximum Initial time of Concentration is 10 minutes.

TABLE 6.2 CATCH BASIN CAPACITIES (L/s)
 For design purposes, catch basin capacities in liters/second, are approximately as follows:

Norwood Model	Sump Condition*	Continuous Slope**	
		Capture	Overflow
F-51 (with side inlet)	190	30	95
F-51-G (grate only)	155	35	85
F-33	75	10	30
F-35	40	-	-
F-38	85	15	45
F-39	80	15	40
F-49	105	20	50

*based on 100mm depth of ponding
 **based on 50mm depth on 1% slope



STORM DRAINAGE SYSTEM
END OF SECTION

7. SEWER AND WATER SERVICE CONNECTIONS

7.1 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

All dwellings (excluding condominiums, apartments, basement suites) shall have an individual service for each unit. The service connection for each unit shall be the same as required for a single family dwelling.

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

Connection to a main sewer line shall be by means of a saddle at the top quadrant of the main on existing mains, and by means of in-line tees for new mains.

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 at the 2 to 3 o'clock position on the distribution main.

Water mains shall be taped under pressure.

All water services to be direct tapped or utilize service clamps.

7.2 SANITARY SEWER SERVICE

Service pipe shall be PVC SDR 28 building service pipe.

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

7.3 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 to each lot. The services shall be installed at either the right or left propertyline as either a double service or a single service (Standard Drawing C-109).

The services shall be installed so that, when facing the lot being served, the water service is on the right of the sanitary service.

Where two services are installed in a common trench, they shall be installed per Standard Drawing C-109.

The minimum depth of cover over the water and sanitary services at the property line shall be 2.60 m and the maximum shall be 2.8 m, per Standard Drawing C-109.

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 Standard Drawing No. C-109.

Where a copper service is installed, there shall be a vertical or horizontal loop near the corporation main stop. The water service shall have either a vertical or a horizontal gooseneck installed as well as being snaked in the trench to allow for thermal contraction.

Curb stops shall be installed 0.30 m. onto Road R.O.W. as shown on Standard Drawings D-110 to D-115.

Sewer services shall be installed 1.0 m. past easement lines as shown on Standard Drawing No's. D-110 to D-115, and shall be properly capped.

All services shall be laid on 75 mm of granular bedding and the bedding material shall be placed up to a level of 300 mm above the crown of the highest service in the trench.

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 Standard Drawing C-109.

The Developer shall employ a CSA approved material testing firm to complete the tests as outlined in Table 7.2. One copy of the results shall be submitted to the City for their review.

END OF SECTION

8. ROADWAYS

8.1 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 9.1 and Standard Drawings.

Straight face curb and gutter shall be constructed on all streets in accordance with Drawing D-141. With written approval by the Public Works Superintendent, rolled curb and gutter may be constructed in accordance with Drawing D-142.

Separate Sidewalks shall be preferred although conditions requiring monolithic sidewalks may occur. Separate sidewalks shall be 1.5 m wide and shall be constructed in accordance with Standard Drawing No. D-145 with written approval by the Public Works Superintendent. Monolithic curb, gutter and sidewalks may be constructed in accordance with Standard Drawing No. D-120 and No. D-144. Sidewalks shall be clear of all obstructions including surface utilities. Sidewalk locations shall be in accordance with Standard Roadway Drawings No's. D-110 through D-115. Wider sidewalks may be required in areas of high pedestrian activity, as determined by the Public Works Superintendent.

Rear lanes (alleys) shall have a surfaced width of 4 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 Public Works Superintendent.

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 Standard Drawing No. D-122.

Curb ramps shall be constructed in accordance with Standard Drawing No's. D-125, D-126, D-127, D-128, D-131.

8.2 VERTICAL ALIGNMENT

Minimum gutter grades around all curves and along all tangents shall not be less than 0.5%. Minimum gutter grades on curb returns shall be 0.8%.

Maximum gutter grades shall not exceed those defined by Table 9.1.

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

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 meters
- A = algebraic difference in grades percent
- * = based on comfort control and assumes street lighting

The maximum superelevation is shown in Table 9.1.

Rear lanes (alleys) shall have a minimum longitudinal grade of 0.6%. If gravel-surfaced, the lane shall be cross sloped to one side at 3.0%. If paved, the lane shall be cross sloped to one side at 2.0%. Paved lanes that have a centre swale must be approved in writing by the Public Works Superintendent and shall be have cross slopes of 2.0%.

8.3 HORIZONTAL ALIGNMENT

The minimum radius is relative to the Road Classification, the design speed and the maximum superelevation (see Table 9.1).

All horizontal curves shall be designed to meet the minimum design requirements shown in Table 9.1.

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 m.

8.3.1 Curb Returns

Curb returns at residential local street intersections shall be constructed to a radius of 8.0m at face of curb.

Curb returns at residential collector street intersections shall be constructed to a radius of 12.5m at face of curb.

In industrial/commercial areas the face of curb radius should be 15.0m 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 centered curves, with or without islands, may be required.

Pararamps are required at all intersections which have sidewalks.

8.3.2 Access Approaches

Access approaches shall maintain a minimum setback distance from intersections according to the following table, unless otherwise approved by the Public Works Superintendent. Distances are measured from the end of the radii at the intersection to the nearest portion of the approach.

	FOUR LANE ROAD	TWO LANE ROAD
RESIDENTIAL	20 m	20 m
COMMERCIAL	30 m	20 m
INDUSTRIAL	30 m	20 m

Standard widths of approaches are as follows, unless otherwise approved by the Public Works Superintendent :

- Residential – 8 m
- Commercial – 12 m
- Industrial – 12 m

8.4 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 Public Works Superintendent 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), etc., are to be outlined to the Public Works Superintendent. The City reserves the right to request the Developer to engage an engineering agency to carry out tests, prior to paving, to confirm adequacy of design.

The following are the minimum pavement structure requirements. 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.

Street	Residential Land Use	Industrial/Commercial Land Use
Local	150 mm Subgrade Prep. to 100% SPD 250 mm Aggregate Base Course 90mm Asphaltic Concrete Surface(Light Duty)-2 lifts 50 mm/40 mm final*	300 mm Subgrade Prep. to 100% SPD 250 mm Aggregate Base Course 100 mm Asphaltic Concrete Surface (Heavy Duty)
Collector	150 mm Subgrade Prep. to 100% SPD 300 mm Aggregate Base Course 100 mm Asphaltic Concrete Surface (Heavy Duty)	300 mm Subgrade Prep. to 100% SPD 350 mm Aggregate Base Course 100 mm Asphaltic concrete Surface (Heavy Duty)
Arterial	300 mm Subgrade Prep. to 100% SPD 350 mm Aggregate Base Course 125 mm Asphaltic Concrete Surface(Heavy Duty)	300 mm Subgrade Prep. to 100% SPD 350 mm Aggregate Base Course 125 mm Asphaltic Concrete Surface (Heavy Duty)

Note: *The final 40 mm lift of asphaltic concrete shall be placed in the second year of the maintenance period 60 days prior to FAC.

Alternative pavement designs, such as soil cement base, may be considered. Approval of alternate pavement designs must be obtained in writing from the Public Works Superintendent 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 200 mm, with 150 mm placed during initial construction and 50 mm placed during the final year of the maintenance period.

TABLE 9.1
SUMMARY OF RECOMMENDED DESIGN STANDARDS FOR STREETS (TAC 1999)

Classification	Traffic Volumes (vpd)	Design Speed ^a (km/h)	Right-of-Way Width (m)	Pavement Widths (m)	Travel Lanes	Parking Lanes	Maximum Gradients (%)	Maximum Superelevation (m/m)
Undivided Arterials	5,000-12,000	60 - 70	30.0	14.8	4-3.7 m	outside lanes	5	.04 - .06
Divided Arterials	12,000-30,000	60 - 90	36 ^b	20.4	4-3.7 m	none	3	.04 - .06
Major Residential Collector UAU 60	2,500-5,000	60	24.0	14.0	2 – 3.7 m	2 – 3.3 m	6	.025 - .04
Minor Residential Collector UCU 60	1,000-2,500	60	20	11.0	2 – 3 m	2 –2.5 m	6	.025 - .04
Local Residential ULU 50	Up to 1,000	60	18	10.0	2 – 3 m	2 –2 m	6	.025
Local Industrial	N/A	60	18.5 ^d	12.0	N/A	Optional	6	.025
Industrial Collector	N/A	60 - 70	22.0	14.0	N/A	Optional	6	.025
Cul-de-sac	Up to 1,000	60	18	10.0	N/A	N/A	6	.025

Classification	Minimum Radius of Curvature (m)	Minimum Intersection Spacing (m)	Minimum Corner Cuts at Intersections	Sidewalks	Lighting Poles and Other Obstructions	Parking	Access
Undivided Arterials	170	150	30 m Radius	Separate, 1 or 2 sides	2.5 m min. from face of curb or behind sidewalk	Restricted	Restricted ^g
Divided Arterials	190	200		Separate, 1 or 2 sides	2.5 m min. from face of curb or behind sidewalk	Prohibited	Restricted ^g
Minor and Major Residential Collectors	150	60	Major - 10 m. Minor – 6 m.	Separate, both sides	2.0 m min. From face of curb 1.5 m min. from face of curb	Permitted	Permitted ^f
Local Residential	90	60	6 m	Both sides	1.8 m min. From face of curb	Permitted	Permitted
Local Industrial	90	60	6 m	Optional	1.65 m min. From face of curb	Optional	Permitted
Industrial Collector	150	60	10 m	Optional	2.25 m min. From face of curb	Optional	Some Restrictions
Cul-de sac	90	60	6 m	Separate or mono, 1 or 2 sides	1.65 m from face of curb	Permitted	Permitted

- Notes:
- a. Posted speed to be 10 km/h less than design speed.
 - b. Land for noise attenuation will be in addition to the road right-of-way requirement.
 - c. Additional travel lane width may be required to accommodate cyclists, e.g. on arterials the outside lanes are 4.2 m wide.
 - d. Additional right-of-way required where rural roadway cross-section is used for initial stage.
 - e. Prohibited for residential land uses.
 - f. Rear lane (alley) access preferred.

TABLE 9.2
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 City 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 City 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 City

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

Plans shall be provided to the Public Works Superintendent which depict 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.

9.1.1 Materials

All signs shall utilize High Intensity reflectorized material to ASTM-D4956, Type III.

All sign posts shall be U Channel, galvanized Schedule 40 steel unless otherwise approved in writing by the Public Works Superintendent.

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

9.1.2 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 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.

END OF SECTION

10. STREET LIGHTING

10.1.1 General

The following standards are applicable to all types of development in the City of Wetaskiwin, except for industrial developments. Standards for industrial developments shall be determined by the City 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 Superintendent of public works.

10.1.2 Design

Street lighting posts with fixtures shall be steel posts, comparable to the existing posts within the neighbourhood, for the several types of streets. Wooden Poles may be permitted in existing neighbourhoods where additional lighting is being added and wooden poles presently exist.

The location and density of street lights shall provide the following minimum lighting levels:

- a) Street lighting fixtures shall be high pressure sodium type.
- b) Street lighting design shall be approved by the present Electric Power Franchisee.

10.1.3 Location

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 offset from roadways and sidewalks in accordance with Table 9.1.

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.

All street light standards shall be galvanized in a manner comparable to the existing standards within the City.

10.1.4 Costs

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

All investment costs by Fortis, for street lighting, shall be returned to the City of Wetaskiwin, not to the developer.

END OF SECTION

11. LOT GRADING

11.1 DESIGN

The grading design shall compliment the overall design of both the minor and major storm sewer 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 runoff 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.

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.

To ensure that there is proper drainage along the sideyards between houses, there is a requirement to provide adequate slope for drainage away from buildings that will meet the minimum requirements of the Alberta Building Code. The City of Wetaskiwin has set a minimum sideyard slope grade of 5% and a maximum sideyard slope grade of 15% within the 1.5 metres sideyard of the property line. The recommended sideyard slope grade shall be 10%.

Downspouts from eavestroughs and discharges hoses from sump pumps shall not discharge within 0.6 metres from the property line. All grading, sump pump discharges and down spouts shall be located so that they do not affect any other lot. Sump pump discharge lines shall not discharge within 5 m. of the back of any walkway or within 6 m. of the back of any curb.

11.2 REQUIREMENTS DURING HOUSE CONSTRUCTION PHASE

Upon the completion of site development construction, the performance of the required Construction Completion Certificate inspections and the submission of the proper asbuilts(including Building Grade Certificates), the City of Wetaskiwin will accept submissions for development permits for construction of dwelling structures. The Developer will be responsible for providing the house builders with the Building Grade Certificate so that they can be presented with the applications for Development Permits.

The Developer or building contractors will submit plot plans and all required applications for permits, etc. for constructing homes to the City of Wetaskiwin for approval. The plot plans submitted to the City shall contain all of the items listed below to ensure that approval process

proceeds smoothly and without delay. We are providing a list of the requirements for both new developments and in fill lots in older areas.

11.2.1 BUILDING PLOT PLAN REQUIREMENTS FOR NEW DEVELOPMENT

This plan will include:

- a) Lot, Block and Registered Plan number
- b) Lot dimensions from registered legal plan
- c) Invert and location of sewer and water services
- d) Original ground elevations at all proposed elevation locations plus lanes where applicable.
- e) Proposed top of curb or back of walk elevations.
- f) Proposed finished lot corner elevations.
- g) Proposed finished lot elevations on side property lines at 6.0, 12.0 and 18.0 meters back from the front property line.
- h) Proposed finished lot elevations on side property lines at 6.0 meters from the rear property line.
- i) Proposed finished lot elevations at grade break points.
- j) Distances from a property pin to the proposed grade break points on property lines that divide properties.
- k) Critical swale elevations will be shown when applicable.
- l) The Building Plot Plan shall follow the City of Wetaskiwin Minimum Design Standards in relation to the acceptable sideyard slope grades design and stake out the house elevations and finished grades at house to meet the minimum building code slope requirements for drainage to critical swales (sideyard and around the house).
- m) The plot plan will identify whether or not the affected lot is in an area with weak subsoil conditions or in an area with a fill of 1 m. or greater and have a notation indicating the requirement for a geo-technical engineer's footing design.
- n) The grading plan will identify all lots with areas of 1.0 m of fill or greater and shall be shaded a different color or hatch pattern.
- o) Direction of surface drainage, critical swale elevations and grades on side property lines.
- p) The plot plan shall also show all proposed elevations for the finished main floor, bottom of footing and garage floor where applicable.

11.2.2 Building Plot Plan Requirements for In Fill Lots in existing areas

This plan will include:

- a) Lot, Block and Registered Plan number
- b) Lot dimensions from registered legal plan
- c) Invert and location of sewer and water services (if available)
- d) Original ground elevations at all proposed elevation locations, center of lanes, window wells and finished main floor of existing buildings on either side, back of walk / curb, center of street where applicable.
- e) Proposed finished lot corner elevations.
- f) Proposed finished lot elevations on side property lines at 6.0, 12.0 and 18.0 meters back from the front property line.

- g) Proposed finished lot elevations on side property lines at 6.0 meters from the rear property line.
- h) Proposed finished lot elevations at grade break points.
- i) Distances from a property pin to the proposed grade break points on property lines that divide properties.
- j) Critical swale elevations will be shown when applicable.
- k) The Building Plot Plan shall follow the City of Wetaskiwin Minimum Design Standards in relation to the acceptable sideyard slope grades design and stake out the house elevations and finished grades at house to meet the minimum building code slope requirements for drainage to critical swales (sideyard and around the house).
- l) The plot plan will identify whether or not the affected lot is in an area with weak subsoil conditions or in an area with a fill of 1 m. or greater and have a notation indicating the requirement for a geo-technical engineer's footing design.
- m) The grading plan will identify all lots with areas of 1.0 m of fill or greater and shall be shaded a different color or hatch pattern.
- n) Direction of surface drainage, critical swale elevations and grades on side property lines.
- o) The plot plan shall also show all proposed elevations for the finished main floor, bottom of footing and garage floor where applicable.

11.2.3 Lot Grading plan for New Development and In fill Lots in Existing Areas

- .1 In New Development Areas, any Surveyor doing plot plans shall apply to the City of Wetaskiwin Engineering Department for a copy of the Approved and Stamped Grading Plan to ensure that they have the correct information for doing plot plans.
- .2 For In fill lots within an existing area, the Surveyor shall provide all of the details listed above in 11.2.2 to ensure that the lot grading does not negatively affect the lots on either side of this new building.

11.2.4 Asbuilt Requirements.

In an effort to ensure that the plot plan and approved lot grading plan is being followed, the City of Wetaskiwin is requiring that the following asbuilt information be provided. The asbuilt information required is :

- .1 Top of footing
- .2 Finished rough grade (sideyard and house) and sideyard measurements.

All asbuilt information shall be provided and stamped by an Alberta Land Surveyor or a Professional Engineer to ensure their authenticity.

11.3 RETAINING WALLS

Where extremes in elevation of adjoining lots require the construction of a retaining wall, such shall be indicated on the proposed grading plan and no work or construction will be permitted on the building lots which are the subject of or adjacent to the said retaining wall without a

commitment by either owner of the two lots involved to construct such retaining wall at the time of construction of the proposed building.

END OF SECTION

12. LANDSCAPING

12.1 DESCRIPTION

The work under landscaping includes the following:

Site Preparation
Seeding and/or Sodding
Planting.

12.2 SCOPE

This section covers the following areas:

Boulevards

- a) Areas between curb and sidewalk.
- b) To be topsoiled and sodded by Developer.
- c) Plant material as per Landscape Design Requirements.

Buffer Strip

- a) Areas separating arterial roads from residential property.
- b) To be topsoiled and sodded by Developer.
- c) Plant material as per Landscape Design Requirements.

Utility Lots and/or Walkways

- a) To be topsoiled and seeded by Developer.
- b) Plant material as per Landscape Design Requirements.

Median Strips and Traffic Islands

To be topsoiled and seeded by Developer.

Public Service and Recreation Lands

- a) To be topsoiled and seeded by Developer.
- b) Plant material as per Landscape Design Requirements.
- c) City may accept cash in lieu of additional park development (\$300 per lot).

For fencing requirements see Uniform Fencing.

No landscaping shall commence until the landscaping plan has been approved by the Public Works Superintendent.

12.3 LANDSCAPE DESIGN REQUIREMENTS

12.3.1 General Requirements

Landscape specifications for rough site work, topsoil, seed and sod, trees, shrubs and ground covers, and mulches refer to other sections.

Where possible, trees will be set back a minimum distance from above and below grade utilities and property lines as specified in this section.

Trees will be set back a minimum of 2.0 m from back of curb, walk or verge and 3.0 m from water and sewer service lines, and shall be installed with a root barrier as required.

Shrubs, at maturity, from the drip line will be set back a minimum of 450 mm from back of curb, walk, verge or back of turf landscape edging.

All plant materials shall be as specified on the approved plant list on landscape drawings.

Planting bed layouts to be designed to facilitate easy maneuverability of large turf maintenance and cutting equipment. Minimum 2 m setback from fence lines.

Uniform or screen fences constructed adjacent to public lands will be positioned wholly on adjacent privately-owned lands.

The screen and uniform fencing to meet City standards. See Section on Uniform Fencing.

Furniture may be provided by the Developer and placed at strategic locations. The following setbacks to be respected:

- a) Benches - 1.0 m back of walkway.
- b) Waste Receptacles - 250 mm back of walkway.
- c) Picnic Tables - designed in clusters to the satisfaction of the Public Works Superintendent.

Furniture to meet City Standards. All furniture will be anchored to concrete bases.

No annual plantings will be approved in planting beds to be maintained by the City of Wetaskiwin.

12.3.2 Residential Boulevards

Boulevards with separate walks must be graded, topsoiled, and sodded or seeded between the back of curb and the walk by the Developer to the satisfaction of the Public Works Superintendent.

12.3.3 Collector Roadways

Collector boulevards must be graded, topsoiled, sodded or seeded, and landscaped by the Developer to the satisfaction of the Public Works Superintendent.

Boulevards may be designed to include planting beds, shrubs and ground covers.

Minimum shrub size to be five gallon potted and planted 1.0 m o.c. Minimum shrub height and spread will be 600 mm, subject to availability.

12.3.4 Development Permit Landscaping on City Lands

In the event the Developer is redeveloping existing facilities or previously serviced lands, the Development Officer may require the landscape plans to be approved by Public Works Superintendent prior to the issuance of a development permit.

12.3.5 Medians and Entry Features

Landscaped road islands, medians and entry features must be topsoiled, sodded and may be planted with shrubs and ground covers by the Developer to the satisfaction of the Public Works Superintendent. All road island, median and entry feature designs must be low maintenance.

Shrub planting design will consider important vehicular sightlines.

Shrubs will be massed within planting beds. Minimum shrub size to be five gallon potted and planted 1.0 m o.c. or appropriate to species. Minimum shrub height and spread will be 600 mm, subject to availability.

Planting beds to be designed complete with weed liners and landscape edging. Approved herbicides to be applied if necessary to prevent weed growth during maintenance period.

If turf areas are designed within road islands and medians, total consolidated turf area to be greater than 75 m².

Freestanding architectural features, i.e. signs, sculptures, light poles, entry gates located within turf areas, should be designed to minimize mowing requirements.

Paving stone and paving stone header, concrete or other special hard surfaced verge or walks to the satisfaction of the Public Works Superintendent.

Planting Cross-Section Detail of road islands and medians drawn at an appropriate scale showing all underground utilities within 3.0 m of planting root zones, limits to road base and subbases and the limits of the compacted verge base materials in relation to organic soils, mulches and to the root zones of shrubs.

Planting Plan Detail of road islands and medians drawn at an appropriate scale showing all underground utility alignments within 3.0 m of road island; curb face; back of curb, verge or walk, shrub setbacks; proposed planting and spacing; landscaped edging, mulches and freestanding features, i.e. signs, gates, pedestals, sculptures, light poles, etc.

Planting Cross-Section Detail and Planting Plan Detail to be cross referenced to engineering and landscape plans and details which support proposed design solution.

Lighting, if provided, shall be to the satisfaction of the Public Works Superintendent.

Sewers and other underground utilities should not be aligned under landscaped road islands and medians to avoid conflicts with landscape improvements.

12.3.6 Walkways

Walkway right-of-way must be graded, topsoiled, seeded or sodded, and planted with trees and ground covers by the Developer to the satisfaction of the Public Works Superintendent.

There shall be a minimum of four trees per every 35 linear metres of walkway right-of-way. Trees and ground covers as specified by "Plant Materials Appropriate for 6 m Walkway Right-of-Way".

Where possible, trees will be set back a minimum distance of 1.0 m from adjacent private property lines.

Trees shall be grouped in rows. Tree groupings shall be positioned on either side of the walk and groupings will be staggered. Minimum deciduous tree caliper 60 mm. Minimum coniferous tree height is 2.5 m. Tree mix shall be 100% deciduous in walkway right-of-way.

Ground covers will be massed within planting beds. Minimum ground cover size to be three gallon pot planted 750 mm on center. Suggest trees be positioned within planting beds.

Planting beds shall be designed complete with weed liners and landscape edging. Approved herbicides to be applied if required to prevent weed growth during maintenance period.

Furniture meeting City Standards may be provided by the Developer and placed at strategic locations within the walkway right-of-way.

Screen and uniform fences, if provided by the Developer, shall meet the specifications in Section on Uniform Fencing. Uniform or screen fences constructed adjacent to public lands will be positioned wholly on adjacent privately owned lands.

Walks may be required within walkway or top-of-bank right-of-way to the satisfaction of the Public Works Superintendent. Walkway may be asphalt or concrete as required by the Public Works Superintendent.

PLANT MATERIALS APPROPRIATE FOR 6 M WALKWAY RIGHT-OF-WAY	
The following lists a variety of plant materials approved for use by the City of Wetaskiwin in walkway right-of-way 6 m and wider.	
Common Name	Minimum Spacing (Meters)
TREES	
Black Ash	8.0
Linden	6.0
Pin Cherry	4.0
Schubert Chokecherry	4.0
Columnar Aspen	4.0
GROUND COVER	
Juniper	--
Periwinkle	--
Phlox	--
Thyme	--

Note: The Developer may suggest other trees, tree form shrubs and ground covers for walkway right-of-way depending on specific site constraints. These will be reviewed by the Public Works Superintendent. on an individual project basis.

The following design issues to be considered by the Developer recommending alternative plant materials:

Maintaining adequate year round sightlines through the walkway right-of-way for pedestrian safety and security.

Suggested minimum 2 m (6 foot) branching height for all trees to allow adequate pedestrian clearance beneath tree branches.

Low maintenance hardy plant species common to northern Alberta.

horizontal root growth and no sucker-type roots to avoid encroachment into adjoining privately-owned lands.

Pyramidal/columnar tree forms to avoid tree branches overhanging into adjoining privately owned lands.

12.3.7 Pipelines and Major Utility Corridors

Utility corridors must be graded, topsoiled, seeded or sodded and landscaped by the Developer to the satisfaction of the Public Works Superintendent.

Utility corridors must be planted with a minimum of 30 trees per acre designed and massed into major groupings. Minimum deciduous tree caliper 60 mm. Minimum coniferous tree height 2.5 m. Tree mix of 60% coniferous and 40% deciduous required.

Shrubs may be substituted for trees at the rate of five shrubs to one tree, to a minimum of 15 trees per acre, with approval by the Public Works Superintendent.

Shrubs will be massed within large planting beds to create major focal areas within the rights-of-way. Minimum shrub size to be five gallon pot planted 1.0 m o.c. Minimum shrub height and spread will be 600 mm, subject to availability. Suggest trees be positioned within planting beds.

Planting bed layouts to provide a minimum width of turf areas between planting beds of 2.0 m and shall include landscape edging.

Planting beds shall be designed complete with weed liners. Approved herbicides to be applied if necessary to prevent weed growth during maintenance period.

Healthy or vigorous trees within or abutting the utility corridor shall be preserved wherever possible.

Approved furniture may be provided by the Developer and placed at strategic locations within the utility corridor.

Screen and uniform fences, if provided by the Developer, shall meet the specifications herein.

Walks, if provided within the rights-of-way, shall be to the satisfaction of the Public Works Superintendent.

Lighting, if provided, shall be to the satisfaction of the Public Works Superintendent.

ELECTRICAL/POWER CORRIDORS / RIGHT-OF-WAY PLANT LIST		
Common Name	Height at Maturity	
Hedge Material - Suitable for planting near a power line.		
Caragana - Common	3 m	10 feet
- Globe	1 m	3 feet
- Pygmy	1 m	3 feet
Cherry - Nanking	2 m	7 feet
Cotoneaster - Hedge	2 m	7 feet
Cranberry - Nannyberry	5 m	16 feet
- Wayfaring Tree	3 m	10 feet
Dogwood - Red Osier	2 m	7 feet
Honeysuckle - Clavey's Dwarf	1 m	3 feet
- Tartarian	3 m	7 feet
- Zabels	2 m	10 feet
Lilac - Common	3 m	10 feet
- Late	3 m	10 feet
Principia	3 m	10 feet
Potentilla	1 m	3 feet
Caution - May plant near a power line.		
Pin Cherry	5 m	16 feet
Western Chokecherry	5 m	16 feet
Black Cherry	6 m	20 feet
Tartarian Maple	6 m	20 feet
Amur Maple	4 m	13 feet
Flowering Crabapples	5 m	16 feet
Hawthorns	5 m	16 feet
Showy Mountain Ash	5 m	16 feet
Green's Mountain Ash	5 m	16 feet
French Pussy-Willow	5 m	16 feet
Mugo Pine	6 m	20 feet
Pyramidal White Cedar	5 m	16 feet
Montgomery Blue Spruce	3 m	10 feet
Caragana	3 m	10 feet
Hedge Cotoneaster	2 m	7 feet
Highbrush Cranberry	3 m	10 feet
Nannyberry	5 m	16 feet
Dogwood	3 m	10 feet
Elder	4 m	13 feet
Honeysuckle	3 m	10 feet
Lilac	5 m	16 feet
Saskatoon	4 m	13 feet

DO NOT plant within eight meters of a power line.		
Trembling Aspen	8 m	60 feet
Balsam Poplar	20 m	65 feet
Northwest Poplar	20 m	65 feet
Plains Cottonwood	30 m	90 feet
White Spruce	15 m	50 feet
Colorado Blue Spruce	15 m	50 feet
Manitoba Maple	14 m	45 feet
Laurel Leaved Willow	15 m	50 feet
Golden Leaved Willow	15 m	50 feet
Sharp Leaf Willow	10 m	35 feet
Green Ash	15 m	50 feet
Patmore Green Ash	15 m	50 feet
American Elm	20 m	65 feet
Brandon Elm	15 m	50 feet
Siberian Elm	12 m	40 feet
Paper Birch	12 m	40 feet
European White Birch	12 m	40 feet
Cut-Leaved Weeping Birch	20 m	65 feet
Slender Weeping Birch	12 m	40 feet

PIPELINES AND OTHER MAJOR UNDERGROUND UTILITY CORRIDORS / RIGHT-OF-WAY PLANT LIST	
Common Name	Planting Size - Height
Coniferous: - Pines	(min.) 2.0 m
- Spruce	2.0 m
- Fir	2.0 m
Large Deciduous:	Caliper
- Silver Maple	(min.) 50 mm
- Black Ash	50 mm
- Patmore Green Ash	50 mm
- Summit Green Ash	50 mm
- Larch	50 mm
- American Elm	50 mm
- Harbin Chinese Elm	50 mm
- Linden Laurel Leaf Willow	50 mm
Small Deciduous:	Caliper
- Amur Maple	50 mm
- Crabapple	50 mm
- Amur Cherry	50 mm
- Pincer	50 mm
- Schubert Chokecherry	50 mm
- Bur Oak	50 mm
- Mountain Ash	50 mm
- Lilac	50 mm

12.3.8 Storm water Management Facilities

Dry pond and areas surrounding new storm water management lake facilities must be graded, topsoiled, seeded or sodded, and landscaped by the Developer to the satisfaction of the Public Works Superintendent.

Plant materials will be selected to respect hydrological and soil saturation characteristics of the facility.

Public lands within the facility must be planted within a minimum of 30 trees per landscaped acre above normal water line and designed and massed into major groupings. Minimum deciduous tree caliper 60 mm. Minimum coniferous tree height 2.5 m. Tree mix 60% coniferous and 40% deciduous suggested.

Shrubs may be substituted for trees at a rate of five shrubs for one tree, to a minimum of 15 trees per landscaped area, with approval from the Public Works Superintendent.

Shrubs to be massed within large planting beds above the 1:5 year flood line to create major focal areas on the slopes of the dry pond. Minimum shrub size to be five gallon pot planted 1 m o.c. or appropriate to species. Minimum shrub height and spread 600 mm, subject to availability. Suggest trees be positioned within planting beds.

Planting bed layouts will provide a minimum width of turf areas between planting beds of 2.0 m. Landscape edging may be required in formal shrub beds.

Planting beds shall be designed complete with weed liners. Use of weed liners for planting beds located in flood prone areas is strongly recommended.

Major storm sewer outlets/inlets should be landscaped with plant materials and large rockery to provide visual screening and security buffering for pedestrians and dry pond users.

Where possible, relatively flat open areas should be designed to encourage active recreational uses.

Approved furniture may be provided by the Developer and placed at strategic locations within the dry pond.

Lighting, if provided, to be to the satisfaction of the Public Works Superintendent.

Special or unique features, i.e. artificially pumped dry streams, special play courts, bridges and architectural and structural features will be designed and sealed by recognized accredited professionals.

12.3.9 Natural Areas

Existing natural and naturalized areas impacted by the proposed improvements which cannot be protected during construction must be re-naturalized with native plant materials having regard for the surrounding environment, new drainage patterns, soil conditions, and ecological rehabilitation.

The Developer will determine the level of restoration to be completed in consultation with the Public Works Superintendent.

The Developer will design an appropriate mix of native trees, shrubs, ground covers and wild seed mixes to rehabilitate impacted naturalized areas.

The Developer will design any required subsurface drainage, surface drainage and erosion control measures in the rehabilitation area.

The Developer shall, if required, coordinate this rehabilitation with other consultants to implement geotechnical, structural and bioengineering principles and recommendations.

The landscape drawings will identify all plant communities to be established and all other information necessary to implement the proposed improvements.

The Developer will specify all tree, shrub and ground cover sizes. No minimum or maximum sizes are specified. Tree mix to match natural setting.

Forestry stock, seedlings, deciduous tree whips, and propagated and rooted cuttings are acceptable for use.

All plant materials to be nursery stock or obtained from Provincial Government sources.

The Landscape Architect will identify appropriate planting installation specifications and detailing on landscape drawings.

“Round-Up” or other approved herbicides may be used to eradicate natural slopes prior to planting of trees and shrubs. Herbicide shall be applied by a licensed applicator.

12.4 SITE PREPARATION

12.4.1 Materials

Fill Material - Fill materials, where required, shall be free of stones, clods, sticks, roots, concrete, any toxic materials (e.g. salt, oil, etc.) and other objectionable extraneous matter and debris. These materials shall be removed from the site and disposed of.

Topsoil - Topsoil shall be natural fertile agricultural soil, capable of sustaining vigorous plant growth. It shall be best quality, weed free and shall be approved by the Public Works Superintendent.

12.4.2 Subgrade Preparation

The subgrade shall be completely free of live quack grass roots.

The subgrade shall be graded and rolled to a firm and even surface.

The final subgrade shall be 150 mm below the adjacent top of curb and/or sidewalk.

The final surface shall be sloped so that there is no runoff onto adjacent property, or any ponding.

12.4.3 Existing Utility Appurtenances and Features

All existing utility appurtenances shall be adjusted to final finished grade elevations.

All existing features, e.g. trees, shrubs, monuments, curbs, sidewalks, etc., shall be protected against any damage.

12.5 PLACING OF TOPSOIL

General - The topsoil shall be compacted to a firmness sufficient to show a heel imprint of not more than 3 mm deep, but the upper 50 mm shall be of fine texture and free of stones or lumps 6 mm or larger. Sufficient allowance shall be made for any settlement. Minimum depth of topsoil is 150 mm for seeded areas and 100 mm for sodded areas.

Boulevards - The finished topsoil level shall conform to the adjacent curb and sidewalk elevations and must provide for adequate drainage of sidewalk areas after turf establishment.

Buffer Strips - The finished topsoil level shall slope uniformly from the property line towards the back of the sidewalk at not less than 2%.

Utility Lots and Walkways - Where sidewalks are present, a swale shall be provided at a distance of at least one meter from either side of the sidewalk. The grade must be sloped away from the sidewalk at a minimum grade of 1%.

Median Strips and Traffic Islands - The finished topsoil level shall be even from top of curb to top of curb.

Parks and Environmental Reserves - Rough grade to required levels, profiles and contours and make ready to receive surface treatment. Blend slopes into level area. Produce a uniform contoured grade, with the use of rototiller, harrow, float or roller as required.

The prepared seed bed must be inspected and approved by the Public Works Superintendent before seeding commences.

12.6 SEEDING

12.6.1 Seeding - Materials

Fertilizer - Fertilizer shall be selected and applied as determined by a soils test. Soil test results shall be submitted to the Public Works Superintendent for approval.

Grass Seed - Grass seed shall be certified seed comprised of the following varieties mixed in the proportion by weight shown and testing Canada #1 or better for purity and germination:

Kentucky Blue Grass	35%
Creeping Red Fescue	65%

Crested Wheat Grass (Only to be used if prior approval is obtained from the Public Works Superintendent.)

Grass seed to be applied at a rate of 3 kg/100 m².

12.6.2 Seeding - Execution

Fine grade area to a smooth, uniform grade with a loose textured surface free of stones, branches, roots, etc., 20 mm in diameter and larger. All areas must drain and positive drainage away from buildings must be assured.

Apply fertilizer at a rate determined by soil test results.

Seeding may be done immediately thereafter, provided the bed has remained in good, friable condition and has not become muddy or hard. If it has become hard, it shall be tilled to friable condition.

Seeding shall be applied at 3 kg/100 m².

The seed may be sown by:

Hand application, by using a cyclone type seeder with the seed applied in two directions in equal amounts and to be rolled by a compaction grass roller.

Mechanical application, by use of a calibrated specialized grass seeder that has a seed compaction roller. (This is the preferred method on parks and other large level areas.)

Hydro seeding by applying an approved turf-fibre at a rate of 1,350 kg (dry matter) per hectare when applying the seed.

12.7 SODDING**12.7.1 Sodding - Materials**

Fertilizer - Fertilizer shall be selected and applied as determined by a soils test. Soil test results to be submitted to the Public Works Superintendent for approval.

Sod - All sod shall be certified and composed of the following varieties of grass:

Kentucky Blue Grass	35%
Creeping Red Fescue	65%

Sod shall be well rooted, vigorous and healthy, free from disease, insect pests, weeds or other grasses, stones or other extraneous material.

Sod shall be machine stripped at a uniform thickness of 25 mm (± 5 mm). The thickness shall be determined at the time of stripping and shall exclude top growth and thatch.

Wooden pegs required to hold sod in place on slopes shall have dimensions of approximately 25 mm x 50 mm x 300 mm. Metal pegs will not be accepted.

12.7.2 Sodding - Execution

Fine grade area to a smooth, uniform grade with a loose textured surface free of stones, branches, roots, etc., 20 mm in diameter and larger. All areas must drain and positive drainage away from buildings must be assured.

The fertilizer shall be applied on the finished surface by a mechanical distributor, thoroughly and evenly incorporated with the soil to a depth not exceeding 75 mm.

The fertilizer rate of application shall be established by soil tests.

Sodding may be done immediately thereafter, provided the bed has remained in good, friable condition and has not become muddy or hard. If it has become hard, it shall be tilled to friable condition.

Sod shall be laid such that their long dimension is parallel to the direction of the slope and in a manner that permits alternating of joints.

Sod shall be fitted tightly together with no visible joint. The finished surface of the turn shall be true to line and grade, firm and free of irregularities and voids.

Sod laid on slope of two (2) horizontal to one (1) vertical or steeper shall be held in place by wooden pegs. Pegs shall be driven flush with sod.

12.7.3 Maintenance

General - Maintenance shall include all measures necessary to establish and maintain all seeded and sodded areas in a healthy, vigorous growing condition, including, but not limited to:

- a) Mowing - First cutting should occur when the grass is a minimum of 75 mm high and covers 100% of the seeded or sodded areas. Cut as required to maintain grass at a minimum height of 65 mm.
- b) Watering - When required, and with sufficient amounts to ensure germination and prevent grass and underlying soil from drying out.
- c) Fertilizing - Including all required supplementary fertilizer applications as necessary to establish a vigorous growing stand of grass.
- d) Weed Control - Shall be carried out when required to keep seeded areas reasonably free of weeds. When herbicides are used, they shall be applied in accordance with manufacturer's recommendations and by a licensed applicator. Any damage resulting from the Contractor's use of herbicides shall be remedied at his own expense.

Re-seed, or re-sod in the case of sodding, all areas which are deteriorating or which are bare, burned out, or are thin, and repair all damages resulting from erosion and wash-outs at the Contractor's expense.

At time of final inspection, all seeded or sodded areas shall have a healthy, even, vigorously growing stand of grass, free of diseases, weeds, bare, thin, or burned-out areas.

Maintenance shall include the erection and removal of all temporary protection fences, barriers and signs, where deemed necessary, and all other work incidental to proper maintenance.

All damaged grass, as a result of negligence on the part of the Contractor, shall be replaced at the Contractor's expense. Only upon issuance of Final Acceptance Certificate by the Public Works Superintendent, shall the Contractor cease maintenance work of the seeded or sodded area.

The maintenance period of seeded areas is to be two (2) years and sodded areas shall be one (1) year from the date of issuance of a Completion Certificate.

The Public Works Superintendent reserves the right to reject the seeded or sodded areas if he is not satisfied with its appearance and the Contractor must re-establish the area, by removing any or all parts of the rejected work and by supplying any or all new topsoil, seed, sod (in the case of sodding), peat moss, fertilizer and labour necessary for such an operation and must do so at his own expense.

The Public Works Superintendent shall inspect the landscaped areas upon written request by the Contractor. The request shall be received at least ten (10) days before the anticipated date of inspection.

12.8 PLANTING (TREES AND SHRUBS)

12.8.1 Materials

The Developer shall furnish and plant all plant material agreed to in the Development Agreement. All plant material shall conform to the horticultural standards of the "Canadian Nursery Trades Association".

Minimum planting requirements are specified in Section on Landscape Design Requirements.

The City may request higher levels of plantings, depending upon the location and type of development proposed.

All plants shall be typical of their species or variety and shall have a normal growth habit. They shall be sound, healthy and vigorous, well branched, and densely foliated when in leaf. They shall be free from disease and insect pests, eggs or larvae. They shall have healthy, well-developed root systems.

All plants shall be nursery grown unless specifically authorized to be collected from native stands or established wood lots.

Substitutions will not be permitted, unless written proof is submitted that specific plants or sizes are unobtainable and such substitutions are acceptable to the Public Works Superintendent.

Bare root (B/R) shrubs shall be dug with adequate fibrous roots retained. The roots of these plants shall be covered with a uniformly thick coating of mud being puddled immediately after they are dug, or packed in moist straw, shingle tow or moss.

Balled and burlapped (B/B) plants shall be dug with firm natural balls of earth of sufficient diameter and depth to include most of the fibrous roots.

Container growth stock shall have been grown in a container long enough for the root system to have developed sufficient to hold its soil together firm and whole. No plants shall be loose in the container.

Undersized root systems will be rejected. All plant matter is subject to the approval of the Public Works Superintendent.

Plant material shall be delivered to the job site and stored, handled and planted with the producer's label intact. All plant material must be handled in a professional manner. Damaged, sick or diseased plants must be removed from the site immediately and be replaced.

Tree stakes shall be 2.1 m in length and of the steel U-bar or T-bar type. Tree ties shall be a number ten (10) gauge galvanized wire and shall be inserted into a 20 mm length or 10 mm diameter polythene plastic tubing. Wire for tree guying shall be a double strand of number nine (9) gauge galvanized wire.

Mulch shall be wood chips, ground bark, bark peelings, peat, hay or straw.

Arrangements for suitable water shall be undertaken by the Contractor.

12.8.2 Site Preparation

At least 24 hours notice shall be given to the Public Works Superintendent. prior to commencement of planting. The Contractor shall stake the location of all plantings. Developer's representatives to ensure all setbacks have been properly met.

Boulevard shall be excavated to its required depth, and made ready to receive topsoil and tree planting.

No filling of boulevards or medians with topsoil is to commence until tree locations have been approved by the Public Works Superintendent, or his representative.

The Contractor shall be responsible for planting at correct grade and alignment.

The planting and boulevard construction work may be carried out in phases.

12.8.3 Planting Operations

Tree pits shall be excavated with vertical sides 300 mm greater in diameter than the ball of earth or spread of roots of the tree and sufficiently deep to allow for a 150 mm layer of the planting mixture beneath the ball or roots. All pits to be scarified a minimum of 90 mm.

Shrubs shall be planted in pits 300 mm greater than the spread of the roots and 450 mm deep below the finished grade, and as necessary to properly set the plant at finished grade. See Standard Detail L001.

The depth of planting beds and pits shall be adjusted to permit a minimum of 225 mm of the planting mixture under balls or roots of all plants.

If pits are prepared and backfilled with the planting mixture to grade, prior to planting, their location (except in boulevards) shall be marked by 25 mm x 50 mm stakes sticking above grade by 100 mm so that when planting proceeds they can easily be found.

Plants shall be set in the centre of pits, plumb and straight, and at such a level that after settlement the crown of the plant will be 25 mm lower than the surrounding finished grade. No planting, except ground covers, vines and herbaceous plant material, shall be placed closer than 600 mm to the edge of shrub beds, hard surfaces, or building foundations.

When approximately two-thirds of the plant pit has been backfilled with soil mix, 8-24-24 fertilizer shall be applied at the following rates:

- | | |
|---|--|
| a) Shade Trees | 0.5 kg per 25 mm of caliper |
| b) Small Trees | 0.25 kg per 25 mm of caliper |
| c) Shrubs | 0.06 kg per 300 mm of height |
| d) Evergreens | 0.03 kg per 300 mm of height or spread |
| e) Vines, Ground Cover, Herbaceous Plants | 0.03 kg per plant |

The fertilizer shall be distributed evenly over the pit area. The pit shall be filled with water and the soil allowed to settle around the roots.

When balled and burlapped trees are set, the soil mixture shall be compacted around the base of balls to fill all voids. All burlap, ropes and wires shall then be removed from the tops of the balls.

Roots of bare roots shall be properly spread out and the topsoil mixture carefully worked in among them. Any broken or frayed roots shall be cut off cleanly.

After the water has been absorbed the plant pit shall be filled with soil mix.

Immediately after the plant mix is backfilled, a shallow basin (approximately 100 mm deep), slightly larger than the pit, shall be formed with a ridge of soil to facilitate watering and water retention.

After the surface is sufficiently dried, the top of the pit shall be spaded to a depth of approximately 25 mm to avoid evaporation.

12.8.4 Staking and Guying

For deciduous trees (less than 1.0 m in height), the following procedure will be observed:

Each tree shall be supported with a tree stake. This tree stake will be driven into the ground 450 mm to 600 mm below grade in a vertical position with the open side facing the street and located so that it is between the tree and the curb. Where trees are not adjacent to a street, all stakes are to be placed 150 mm northwest of the tree.

The tree shall be supported with one (1) tree tie. This tie shall be placed around the tree and the stake, as close as possible to the top of the stake, with the tie being below rather than just above a branch.

The tree stake and tie are to be attached as per Standard Drawing No. L-002.

For evergreens less than 2.45 m in height and deciduous trees greater than 1 m in height with a caliper less than 75 mm, the following procedure is to be followed:

- a) Each tree shall be supported by two (2) steel U or T-bars driven securely into the ground without injury to the root ball.
- b) Each tree shall be fastened at the top of the stakes with two (2) ties.
- c) The tree stakes and ties are to be attached as per Standard Drawing No. L-002.

For guying of deciduous and evergreen trees, the following procedure will be observed:

All deciduous trees over 75 mm caliper and all evergreens exceeding 2.45 m height shall be done with three (3) guys, spaced equally about each tree.

Each guy shall be attached to the tree trunk at an angle of 60E at about 3/5 of the height of the tree and anchored at the ground by means of a wooden stake, 50 mm x 50 mm x 600 mm, driven securely into the ground. Trees 4.3 metres in height or greater, or 100 mm caliper or larger, shall be staked with a wooden stake 50 mm x 100 mm x 750 mm in length or 15 mm diameter reinforcing steel bars 760 mm long.

Guys, stakes and ties to be placed as per Standard Drawing No. L-003.

12.8.5 Pruning

All plants shall be pruned after planting. The amount of pruning shall be limited to the minimum necessary to remove dead or injured branches and to compensate for the loss of roots as a result of the transplanting operations. Pruning shall be done in such a manner as to preserve the natural character of the plants. Leaders shall not be removed. Only clean, sharp tools shall be used. All cuts shall be clean and flush, leaving no stubs.

Cuts, bruises or scars on the bark shall be traced back to living tissue and removed. The affected areas shall be shaped so as not to retain water, and all treated areas shall be painted with an approved tree paint.

12.8.6 Digging of Plants

All plants shall be dug and delivered to the site as specified on the plant list and approved landscape plan.

Plants specified "B/R" shall be moved with bare roots. They shall be dug and moved while dormant, with the major portion of the fibrous root system provided. Immediately after digging, the root system shall be wrapped or puddled and shall be kept moist to prevent drying out until planted on the site.

All plants specified "B/B" shall be moved with solid balls wrapped in burlap.

No plants shall be used when the ball of earth surrounding the roots has been cracked or broken preparatory to or during the process of planting, or when the burlap, staves and ropes, required in connection with their transplanting, have been removed.

The sizes of root balls for trees shall be as specified below. Ball sizes are minimum and shall be adjusted according to growth habits or plants. At any rate, ball sizes shall be sufficiently large to contain at least 75% of the fibrous root system.

DECIDUOUS TREES		
Root (mm)	Root Ball Diameter (mm)	Machine Ball Diameter (mm)
24 - 45	610	
50	760	1,110
75	915	1,420
100	1,065	1,675
125	1,370	1,675
150	1,470	2,336
200	1,825	2,236
250	2,285	2,336

NOTE: Caliper size determined 150 mm above finished grade.

Deciduous trees larger than 75 mm caliper shall be moved by machine (spade).

CONIFEROUS TREES		
Height (mm)	Root Ball Diameter (mm)	Machine Ball Diameter (mm)
1.50 - 1.75	760	1,110
1.75 - 2.00	915	1,110
2.00 - 2.25	1,065	1,420
2.25 - 2.50	1,220	1,420
2.50 - 2.75	1,370	1,675

For deciduous trees with a caliper of more than 250 mm and for coniferous trees over 2.75 m in height, root ball diameter shall be increased 150 mm for every additional 25 mm in caliper, or every 300 mm in height.

NOTE: Coniferous trees larger than 2.75 m in height shall be machine moved with a 2,300 mm diameter or larger spade.

All plant materials shall conform to the measurement specified in the Plant List and landscape plan. Plants larger than specified may be used if approved by the Public Works Superintendent. If larger plants are used, the ball of earth shall be increased in proportion to the size of the plant.

All plants shall be measured when the branches are in their normal position. Height and spread dimensions specified refer to the main body of the plant and not from branch tip to root base or from branch tip to branch tip. Where trees are measured by caliper, reference is made to the diameter of the trunk measured 300 mm above ground as the tree stands in the nursery.

12.8.7 Maintenance

Maintenance of trees shall include protective or preventative spraying when required.

Maintenance shall include resetting to proper grade position of settled plants, and planting saucer repair. Defective work shall be corrected as soon as possible after it becomes apparent and weather and season permits. Upon completion of planting, and prior to construction

completion, excess soil and debris shall be removed from the site and any damage to structures, etc., resulting from planting operations shall be repaired.

12.8.8 Guarantee Period

The maintenance period for all planted material shall be two (2) years; 730 days from the date of issuance of a Completion Certificate.

Any plant that is dead, not true to name or size as specified, or not in satisfactory growth, as determined by the Public Works Superintendent., shall be removed from the site. In case of any question regarding the condition and satisfactory establishment of a rejected plant, the Contractor may elect to allow such a plant to remain through another complete growing season at which time the rejected plant, if found to be dead or in an unhealthy or badly impaired condition, shall be replaced by the Contractor.

12.9 UNIFORM FENCING

Uniform wood fencing shall be constructed in accordance with Standard Drawings or as approved by the Public Works Superintendent.

Colour of stain shall be approved by the Public Works Superintendent.

Chain link fencing and gates shall be constructed in accordance with Standard Drawings.

Uniform fencing shall be constructed adjacent to and at the following locations:

- a) arterial roadways,
- b) parks and play fields,
- c) public walkways and utility lots,
- d) school sites,
- e) City owned lands - e.g. fire hall sites, etc.,
- f) multiple family sites,
- g) neighbourhood commercial sites,
- h) institutional sites, and
- i) other areas as required by the City.

Wooden fencing shall be installed where residential property adjoins the above mentioned facilities. The City requires chain link fencing where playgrounds, parks and school sites are adjacent to roadways.

Pedestrian gates may be installed on all residential lots which back onto a public park or in special purpose areas such as valley lots. Gates shall be located approximately at the mid-point of each lot and shall be constructed to open inwards onto the private property.

Wood rail fencing may be approved by the Public Works Superintendent for selected park or walkway areas.

12.9.1 Maintenance Period

The applicant shall be responsible for, and at his own expense to remedy, any defect, fault or deficiency in the completed works during a twenty-four (24) month maintenance period.

END OF SECTION

13. 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 City of Wetaskiwin.

13.1 ELECTRICAL POWER SERVICE – TELEPHONE SERVICE – CABLE TV SERVICE

13.1.1 General

Private Utility Companies provide Electrical Power service, Telephone service, and Cable TV service.

13.1.2 Rights of Way

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

Utilities shall be located in a 3.0 m. easement as per Standard Drawings D-110 through D-116 or as directed in writing by the Public Works Superintendent.

All easements on private property shall be registered in the name of the City of Wetaskiwin.

13.1.3 Installation

An approval must be obtained from the City of Wetaskiwin for any excavation on City property.

All distribution cables shall be installed in one common 0.3 m minimum wide trench at the required alignment. All power and communication cable trenches on the road allowance shall be at a minimum of 1.5 m below finished grade level. The trench bottom shall be free of stones, loose earth and sharp objects.

Power, telephone, or cable TV cables shall maintain a minimum distance of 3.0 m from any valve, hydrant, catch basin, manhole, vault and sanitary and storm sewer lines. A minimum 3.0 m clearance is required to any water lines.

A minimum clearance of 0.3 m in all directions is to be maintained when crossing gas service lines.

Extreme care must be taken when backfilling so as not to disturb any Legal survey pins. Any survey pins disturbed during installation shall be replaced at the Utility company's expense.

Trenches shall not be left open, with cables exposed, longer than forty-eight (48) hours without permission of the Public Works Superintendent. In such cases, the open trenches shall be properly marked and barricades with flashers provided by the developer. In locations where flooding of the trenches may occur, or the open trench creates a public hazard, the Director may, at his discretion, require the excavation to be appropriately covered.

The use of trench digging machinery will be permitted, except where its operations will cause damage to trees, buildings, fences, or other existing structures or municipal infrastructure above or below the ground. At such locations, hand digging shall be employed to avoid damage.

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 Public Works Superintendent. 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 95% density of the maximum density of a standard proctor compaction test within boulevards and 98% within streets under concrete or asphalt structures or lanes. All backfill material may be subject to the approval of the Public Works Superintendent.

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.

13.1.4 Costs

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

13.2 GAS SERVICE

13.2.1 General

A private Utility Company provides gas service.

13.2.2 Rights of Way

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

Utilities shall be located in a 3.0 m. easement as per Standard Drawing's D-110 through D-116 or as directed in writing by the Public Works Superintendent.

All easements on private property shall be registered in the name of the City of Wetaskiwin.

13.2.3 Installation

An approval must be obtained from the City of Wetaskiwin for any excavation on City property.

Gas lines shall maintain a minimum distance of 3.0 m from any valve, hydrant, catch basin, manhole, vault and sanitary and storm sewer lines. A minimum 3.0 m clearance is required to any water lines.

Extreme care must be taken when backfilling so as not to disturb any Legal survey pins. Any survey pins disturbed during installation shall be replaced at the Utility Company's expense.

All gas trenches on the road allowance shall be at a minimum of 1 m. below finished grade level. Trenches shall be a minimum of 300 mm wide. The trench bottom shall be free of stones, loose earth and sharp objects.

Trenches shall not be left open, with gas lines exposed, longer than forty-eight (48) hours without permission of the Public Works Superintendent. In such cases, the open trenches shall

be properly marked and barricades with flashers provided by the developer. In locations where flooding of the trenches may occur, or the open trench creates public hazard, the Public Works Superintendent may, at his discretion, require the excavation to be appropriately covered.

The use of trench digging machinery will be permitted, except where its operations will cause damage to trees, buildings, fences, or other existing structures or municipal infrastructure above or below the ground. At such locations, hand digging shall be employed to avoid damage.

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 Public Works Superintendent. 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 95% density of the maximum density of a standard proctor compaction test within boulevards and 98% within streets under concrete or asphalt structures or lanes. All backfill material may be subject to the approval of the Public Works Superintendent.

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.

13.2.4 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

CONSTRUCTION STANDARDS

14. AGGREGATES GENERAL

14.1 GENERAL

This section specifies general requirements for supplying and processing of aggregates to be stockpiled or incorporated into work. Specific requirements for physical properties of aggregates not provided in this section are given in related work sections.

14.1.1 Source Approval

Source of materials to be incorporated into work or stockpiled requires approval.

Inform Engineer of proposed source of aggregates and provide access for sampling at least two weeks prior to commencing production.

If, in opinion of Engineer, materials from proposed source do not meet, or cannot reasonably be processed to meet specified requirements, produce an alternative source or demonstrate that material from source in question can be processed to meet specified requirements.

Should a change of material source be proposed during work, advise Engineer two weeks in advance of proposed change to allow sampling and testing.

Acceptance of a material at source does not preclude future rejection if it is subsequently found to lack uniformity, or if it fails to conform to requirements specified, or if its field performance is found to be unsatisfactory.

14.1.2 Production Sampling

Aggregate will be subject to continual sampling during production.

Provide Engineer with ready access to source and processed material for purpose of sampling and testing.

Bear the cost of sampling and testing of aggregates in order to meet design gradations and specifications.

Measurement for Payment

No measurement to be made under this section. Include costs in items of work that require aggregates.

14.2 PRODUCTS

14.2.1 General

All imported backfill, granular material, gravel and screened rock shall be suitable for the uses intended.

Aggregate shall be sound, hard, durable material free from soft, thin, elongated, or laminated particles, organic material, or other deleterious substances.

Flat elongated particles are those whose greatest dimension exceeds five times their least dimension.

Fine aggregates satisfying requirements of applicable section shall be one, or a blend of following:

- a) Natural sand
- b) Manufactured sand and/or fines
- c) Screenings produced in crushing of quarried rock, boulders, gravel or slag.

Course aggregates satisfying requirements of applicable section shall be one of following:

- a) Crushed rock or slag.
- b) Gravel composed of naturally formed particals of stone.

14.2.2 Materials

Gradation: To be within the limit and for the types of materials specified below, when tested to ASTM C117 and ASTM C136, and having a smooth curve without sharp breaks when plotted on a semi-log grading chart to ASTM E11

Production of Manufactured Fines: Manufactured fines are defined as that portion of the material passing the 5,000 sieve size which is produced by the crushing process.

In the event the manufactured fines in the total combined aggregate do not meet the requirement for the specified Asphaltic Concrete Mix, extra manufactured fines shall be produced by screening the pitrun material so that the screened material contains no more than 5% material passing a 5,000 sieve. This screened material shall then be crushed so that 100% passes the 10,000 sieve and a minimum of 95% passes the 5,000 sieve. All material produced by this crushing process shall be placed in a separate stockpile and designated as manufactured fines.

Moisture Content: As specified in specific sections.

Bedding Sand: Bedding sand shall be free from organic material and meet the following gradation:

Sieve Size (mm)	% Passing by Mass
12.5	100
5.0	90 – 100
1.25	55 – 85
0.315	10 – 35
0.08	0 - 5

The liquid limit shall not exceed 25 and the Plasticity Index shall not exceed 6.

Granular Material (imported Sand): Imported sand shall be free from rubbish, rubble, organic material, vegetation, clay lumps and meet the gradation of bedding sand.

Granular Material (Imported Gravel): Imported gravel shall be a well graded mixture of sand and gravel meeting the following gradation:

Sieve Size (mm)	% Passing by Mass
80	100
50	80 – 100
25	50 – 75
5	25 – 55
0.08	2 – 10

Screened Rock: Screened rock shall be composed of sound, hard uncoated particles free from clay lumps, flaky particles, soft shale, friable materials, roots, vegetable matter and frozen lumps meeting the following gradation:

Sieve Size (mm)	% Passing by Mass
50	100
40	95 – 100
20	5 – 10
10	0 – 5
5	0 – 5

14.3 EXECUTION

14.3.1 Processing

Process aggregate uniformly using methods that prevent contamination, segregation, and degradation.

Split and combine aggregates if required to obtain gradation requirements specified. Use approved methods and equipment. Do not blend in stockpiles.

Blending to increase percentage of crushed particles or decrease percentage of flat and elongated particles is permitted.

Wash aggregates, if required to meet specifications. Use only equipment approved by Engineer.

14.3.2 Handling

Handle and transport aggregates to avoid segregation, contamination and degradation.

14.3.3 Stockpiling

Stockpile aggregates on site in location indicated or designated. Do not stockpile on completed pavement surfaces where damage to pavement may result.

Stockpile aggregates in sufficient quantities to meet project schedules.

Stockpiling sites shall be level, well drained, and of adequate bearing capacity and stability to support stockpiled materials.

Expect where stockpiled on acceptably stabilized areas, provide a compacted sand base not less than 300mm in depth to prevent contamination of the aggregate or, if permitted, stockpile aggregates on ground but do not incorporate bottom 300mm of pile into work.

Separate aggregates by substantial dividers or stockpile far enough apart to prevent intermixing.

Reject intermixed or contaminated materials. Remove and dispose of rejected materials as directed within 48 hours of rejection.

Stockpile materials in uniform layers of thickness as follows:

- a) Max 1m for course aggregate and base course materials
- b) Max 2m for fine aggregate and subbase materials.
- c) Max 1.5m for other materials

Complete each layer over entire stockpile area before beginning next layer.

Uniformly spot-dump aggregates delivered to stockpile in trucks and build up stockpile as specified.

Coning of piles or spilling of material over edges of pile will not be permitted. Stacking conveyors will not be permitted for stockpiling road base and graded seal coat aggregates.

During winter operations, prevent ice and snow from becoming mixed into stockpile or in material being removed from stockpile.

14.3.4 Stockpile Cleanup

Leave stockpile site in a tidy, well drained condition, free of standing surface water.

Remove any unused aggregates as directed.

END OF SECTION

15. TRENCHING AND BACKFILLING FOR UTILITIES

15.1 GENERAL

Trenching and backfilling to be carried out in accordance with Alberta Occupational Health and Safety Regulations, Part 10.

15.1.1 Work Included

Provide all labour, products and equipment for trenching and backfilling for utilities, including but not limited to:

- a) watermains
- b) sanitary sewers
- c) storm sewers
- d) manholes, valve boxes
- e) lot service connections
- f) shoring, sheet piling
- g) dewatering

15.2 EXECUTION

15.2.1 Excavation

Excavate to lines and to design depth shown or as required by the Engineer to provide satisfactory bearing. Excavate unsuitable soil from trench bottoms as required by the Engineer. Backfill with screened rock material specified to the required level and compact to provide uniform bearing.

No additional compensation will be paid for any changes due to deterioration of excavations caused by activities or neglect of the contractor.

Level and clean excavation bottoms free from loose material and debris.

Where excavation is made below depth shown through error, fill to required depth with 20 MPa compressive strength concrete or screened rock at no additional cost to Owner.

Provide firm undisturbed earth or rock bearings for granular bedding below pipelines and structures.

Excavate for structures to widths sufficient for formwork construction. Place no concrete or masonry until Engineer has inspected excavation.

Where concrete is to be placed, thaw excavation bottom if frozen, and protect from further freezing.

Maximum lengths for open trenches are 30 meters ahead of pipe laying crew and 200 meters behind, unless otherwise permitted by Engineer.

Where pipelines are constructed through fills and embankments, surface elevations will generally at least be 250 mm above top of pipeline prior to excavation.

Where trenches are excavated in existing pavements, saw cut the pavement to neat lines.

15.2.2 Rocks and Boulders

Remove boulders to provide 150 mm minimum clearance under pipes. Backfill with granular and compact at required level to provide suitable bearing, at no additional cost if boulders are less than 0.4 cubic meters.

Boulders larger than 0.4 cubic meters and material which cannot be removed with pick and bar will be classified as rock by the Engineer. Notify Engineer when rock is encountered for classification and measurement.

Excavate rock to provide 150 mm minimum clearance on each side and under pipes. Backfill with granular and compact at required level to provide suitable bearing. Rock excavation will be paid for as unclassified work.

Prior to commencing blasting operations, obtain written approval from authorities having jurisdiction and from the Engineer. Employ licensed workers only.

15.2.3 Shoring, Bracing and Sheet Piling

Provide all shoring, bracing and sheet piling required for support and protection of earth banks at excavations.

Erect all shoring, bracing and sheet piling independent of utilities and structures.

Shore and brace sides of trenches and excavations in accordance with Workers' Compensation Board Regulations.

Maintain during backfilling and remove in stages as backfilling progresses or as approved by the Engineer.

Remove all shoring, bracing and sheet piling unless otherwise permitted by the Engineer. If shoring is allowed to remain, cut off to a level at least 600 mm below finish grade.

Pre-fabricated cages or shields may be used, at the discretion of the Engineer, to supplement or replace conventional shoring provided they conform with all applicable safety regulations, and permit the proper placing and tamping of bedding material under and around utility pipes.

15.2.4 Backfilling - General Requirements

Bedding of pipes and utilities and backfill to 300 mm above top of pipes and utilities is included in other sections.

Backfill trenches and excavations with excavated earth material. Remove all rocks larger than 200 mm in diameter from earth backfill.

Place and compact all backfill in maximum 300 mm deep loose layers, prior to compaction.

Compact site material used as trench backfill in all areas from 300 mm above top of pipe to 300 mm below bottom of granular base for roads to a density not less than 95% of Standard Proctor Density, as defined herein, and carried out at a moisture content of within 3% of optimum moisture content. Remove any free water in the trench prior to placing additional lifts. Note that if moisture content is too high and densities not initially attainable the contractor will make every reasonable attempt to dry the material by whatever means available (ie. discing, spreading, etc.) should the Engineer deem the material to be "unworkable" the use of imported granular backfill may be required. Compact the final 300 mm below road or lane granular base to not less than 100% of Standard Proctor Density.

Compaction results will be based on a minimum of one density test per 150 lineal meters of trench for each 1.5 meters of depth. If a density test indicates insufficient compaction at any depth, then two more densities, which are proportionally representative of trench length will be taken at that depth. Then, if the average of the three tests is below the required density, the contractor will re-excavate and re-compact to meet the specified density.

Place and compact evenly around structures to prevent damage or displacement. Grade surface to direct water away.

Stockpile spread or remove excess excavated earth material where directed by the Engineer.

Remove and dispose of boulders off site at no additional cost.

Where additional pipes are to be, or have been laid, crossing the trench being backfilled and at a higher elevation, take special care to ensure the backfill is compacted to a minimum of 97% of Standard Proctor Density from the lower pipeline up to the obvert elevation of the higher pipeline.

Where imported material is called for by written direction of the Engineer, place the specified depth of granular material to the elevations provided and compact to specified Standard Proctor Densities.

Where filter fabric is called for by written direction of the engineer, place fabric to the overall dimensions specified.

15.2.5 Settlement

Be responsible for all settlement of backfill that may take place during a period of two (2) years after date of completion certificate.

When notified of any such settlement, promptly repair same, or make arrangement for others to do so at the contractor's expense. Failure to do so will result in the Owner making appropriate arrangements at the Contractor's expense and at no cost to the Owner.

Pay the cost of all damages that may be caused by such settlements, including but not limited to repair and/or replacement of concrete sidewalks, curb and gutter and asphaltic concrete pavement.

END OF SECTION

16. SUBGRADE PREPARATION

16.1 GENERAL

16.1.1 Work Included

The work described in this section pertains to the preparation and construction of the subgrade.

16.2 DEFINITIONS

16.2.1 Subgrade

Subgrade is that material immediately beneath the compacted granular course as detailed on the drawings.

16.2.2 Common Excavation

Common excavation shall consist of all materials such as earth, topsoil, organic material, muskeg, clay, hardpan, shale, silt, sand, gravel, fractured bedrock, cobbles and frozen material, removed from the roadway and placed in fill or embankment areas, or otherwise disposed as approved by the Engineer. Excavation shall be to the lines and grades indicated on the plans, or as directed by the Engineer. Schedule work to utilize all excavation materials completely. Borrowing materials will be authorized only after excavated materials have been utilized.

16.3 EXECUTION

16.3.1 Scarify and Compact

In excavation areas, the top 150mm of the subgrade shall be scarified and compacted to 95% Standard Proctor Density at optimum moisture content. In lieu of sub-grade preparation a geotextile filter fabric will be accepted.

No stones or boulders larger than 100mm in diameter shall be left within the top 200mm of the subgrade unless otherwise directed by the Engineer.

16.3.2 Overexcavation

Notify the Engineer whenever unsuitable materials are encountered.

Materials which cannot be compacted to the specified density due to a high or low moisture content shall be dried or watered by the Contractor to their optimum moisture content in order to achieve the specified compaction.

All common excavation materials below subgrade elevation which, in the opinion of the Engineer, are considered unsuitable, shall be removed and disposed in a site located by the Contractor, and approved by the Engineer.

16.3.3 Stockpiling of Material

To facilitate the Work, the Contractor may stockpile embankment material. Such material shall be piled at a location determined by the Contractor, approved by the Engineer, and in such a manner that it will not endanger persons, the Work, or adjacent properties, and ensure proper

drainage is maintained. If the construction site does not facilitate stockpiling, the Contractor shall haul material to an approved location.

16.3.4 Excavation Waste

All common and rock excavation deemed unsuitable for use in embankments, or in excess of that required for embankment, shall be disposed at locations determined by the Contractor and approved by the Engineer.

All disposal areas shall be left in a neat and tidy condition satisfactory to the Engineer. Excavation materials shall be graded smooth to promote surface drainage and not to impede existing surface drainage by the Contractor to the approval of the Engineer.

16.3.5 Common Embankment (for site grading)

Embankment placed on lots and within the road right of way, but not under the road structure, shall be uniformly constructed to the typical cross-section and grades shown on the plans or as set out by the Engineer, and shall include the formation, compaction and shaping of the embankment.

The full depth of fills shall be constructed of suitable material in layers not exceeding 200mm compactive depth. Each layer shall be compacted to 95% Standard Proctor Density (SPD) at optimum moisture content. All fills greater than 1.0m are to be compacted to 95% SPD.

Do not place material in free standing water. Drain all areas before placing materials.

Materials which cannot be compacted to the specified density due to high or low moisture content shall be dried or watered by the Contractor to their optimum moisture content as necessary to achieve the specified compaction.

16.3.6 Shaping and Finishing

The finished compacted subgrade shall be constructed to within 30mm of the design section. Localized soft spots that develop in the finished subgrade due to poor work shall be corrected by excavating the material to a depth approved by the Engineer, and replacing it with suitable subgrade material compacted in place.

Subgrade shall be true to the design cross-section.

Maintain and keep ditches open and free from debris to permit ready flow of surface water, and until final acceptance of the Work.

16.4 TESTS

Field density and moisture content tests shall be carried out by a representative approved by the Engineer in accordance with the following ASTM standards:

Standard Proctor Compaction Test	ASTM ' D698, Methods (A) and (B) ASTM D1556 or
In-Place Density Test	ASTM D2167 or ASTM D2922 and D3017.

The frequency of field density and moisture content tests shall be at minimum 1 test per 100 metres of constructed roadway and at various locations left and right of centre line, or as directed by the Engineer.

Before approval by the Engineer, the subgrade shall conform to the compaction requirements specified and shall show no visible subsidence or deflection under the wheels of a loaded gravel truck. Such trucks shall be provided by the Contractor, as the Engineer requires, for proof rolling of the subgrade.

END OF SECTION

17. GEOTEXTILE

17.1 GENERAL

This Section specifies requirements for the supply and installation of non-woven and woven geotextile filter fabric.

Non-woven geotextile filter fabric shall be used as a separate membrane for rip-rap or hydraulic filter for drainage systems.

Woven geotextile filter fabric shall be used when in the opinion of the Engineer the foundation conditions are considered soft and unstable.

17.1.1 Mill Certificates

At least one week prior to the commencement of Work the Contractor shall submit a sample of the geotextile filter fabric to be used in the Work with copies of mill test data and Manufacturers Certificate of Compliance that the geotextile filter material delivered to the job site meets the requirements of this section.

17.1.2 Approval

The Contractor shall obtain written approval of the Engineer for the geotextile filter fabric material to be used in the Work.

17.1.3 Delivery And Storage

During delivery and storage, protect the geotextile filter fabric from direct sunlight, ultraviolet rays, mud, dirt, dust, moisture, debris and rodents.

17.2 PRODUCTS

17.2.1 Material

The geotextile filter fabric shall be rot-proof, unaffected by the actions of oil or salt water and not subject to attacks by insects or rodents.

The geotextile filter fabric shall be supplied in rolls of minimum width of 3.0m and minimum 50m lengths.

17.2.2 Physical Properties

The non-woven and woven geotextile filter fabric shall meet the specifications and physical properties in accordance with the following table of minimum average roll value properties (MARV's) for each.

Specifications and Physical Properties		
	Non- Woven	Woven
Grab Strength	650 N	1275 N
Elongation (Failure)	50%	15%
Puncture Strength	275 N	275 N
Burst Strength	2.1 MPa	3.6 MPa
Trapezoidal Tear	250 N	475 N
Minimum Fabric Lap to be	300mm	1000mm

17.3 EXECUTION

Where geotextile fabric is specified, the sloped or horizontal surface shall be graded to provide a smooth, uniform surface. All stumps, large rocks, brush or other debris that could damage the fabric shall be removed. All holes and depressions shall be filled so that the fabric does not bridge them. Loose soils shall be replaced.

The fabric shall be laid parallel to the slope direction in one continuous length from toe of slope to upper extent of fabric. It shall be placed in a loose fashion, however creases, folds, wrinkles and tensile stresses shall be avoided. Adjacent strips of fabric shall be overlapped as specified, except where placed underwater, the minimum lap width shall be 1m. Overlaps shall be pinned using 6mm diameter steel pins fitted with washers and spaced at 1m intervals along the overlaps.

The top edge of the filter fabric shall be anchored by digging a 300mm deep trench, inserting the top edge of the fabric and backfilling with compacted soil.

Riprap placement shall commence at the base of the filter fabric area and proceed up the slope. The height of drop of rip-rap shall be limited to 1.0m or less, and the rip-rap shall not be allowed to roll down the slope. Heavy equipment will not be permitted to operate directly on the geotextile.

17.4 PROTECTION

After installation the filter fabric shall be covered with overlaying layer within 3 days of placement.

Do not permit passage of any vehicle or equipment directly on geotextile at any time.

Protect geotextile material from displacement and damage until and during placement of the rip-rap, granular material or the gabion mat.

Care shall be taken to prevent puncturing or tearing the geotextile. Any damage shall be repaired by use of patches that extend at least 1m beyond the perimeter of the tear or puncture.

Remove and replace damaged or deteriorated geotextile, as directed by the Engineer.

END OF SECTION

18. RIP – RAP

18.1 GENERAL

18.1.1 Definition

Riprap is a protective covering consisting of hand-laid or randomly deposited rock, sacked concrete or sacked cement stabilized material which is placed on exposed surfaces for protection against erosion and wave action.

18.1.2 Work Included

Work of this Section consists of supplying, hauling, and placing of riprap as specified and as shown on Drawings.

18.1.3 Approval

The Contractor shall have the riprap material approved by the Engineer in writing prior to delivery to the site. The approval of rock samples from a particular source or quarry site shall not necessarily be construed as approval of all material from that location.

Delivery and handling of riprap shall be subject to Engineer's approval and shall be as such as to minimize segregation and breakage and damage.

Material which has deteriorated or does not meet specified requirements shall be removed from site.

18.1.4 Quality Assurance

Sampling and testing of materials, as required by Engineer for testing the quality of riprap.

18.1.5 Job Conditions

Suspend placement operations whenever climatic conditions, as determined by the Engineer, are unsatisfactory for placing riprap fill to requirements of this Specification.

Do not permit or cause material to slide or roll down slopes.

When placing riprap do not disturb satisfactorily placed material or structures already in place.

Sequence delivery of material to Site in a manner to minimize stockpiling and in any event obtain approval from Company to stockpile.

18.2 PRODUCTS

18.2.1 General

The rock supplied shall be hard, durable and angular in shape, resistant to weathering and water action, free of overburden, spoil, shale seams and organic material. No sandstone will be permitted. The minimum dimension of any single rock shall be not less than one third of its maximum dimension. The minimum acceptable unit weight of the rock is 2.5t/m³

The rock riprap shall be free from seams, cracks or other structural defects to meet the following specified size distribution.

		Class 1
Nominal Mass	Kg	40
Nominal Diameter	or mm	300
None heavier than:	Kg	130
	or mm	450
No less than 20% or more than 50% heavier than:	Kg	70
	or mm	350
No less than 50% or more than 80% heavier than:	Kg	40
	or mm	300
100% heavier than:	Kg	10
	or mm	200

Percentages are by mass. Sizes are equivalent spherical diameters, and are for guidance only.

18.3 EXECUTION

18.3.1 Preparation

Prepare surfaces to receive riprap to lines and grades as shown on the Drawings.

18.3.2 Inspection

Do not place riprap until foundation to receive it has been approved by the Engineer.

18.3.3 Installation

Placing

The rock riprap shall be placed on a non woven geotextile filter fabric unless otherwise noted on the drawings or in the specifications.

The hand laid rock riprap erosion protection shall be placed in the areas indicated on the drawings or as designated by the Engineer.

Place riprap by suitable mechanical equipment so that no intermixing of foundation material and rip-rap is allowed to occur during placing and that minimum breakage of rock fragments will occur and that the mass is stable.

Riprap need not be compacted but shall be dumped and graded off to same regular surface and in such manner that larger rock fragments are uniformly disturbed and smaller rock fragments fill voids between larger pieces.

Hand placing will be required only to extend to secure results specified above in the areas where mechanical equipment cannot operate adequately.

Do not place riprap against structures until permission is obtained from the Engineer.

The riprap stones shall be placed on the surface to be covered as shown by the plans or as directed by the Engineer, on slopes not exceeding 1½ H:1V starting with the larger stones on the bottom row. Riprap shall be placed on the prepared surface such that the weight of the stone is carried by the subgrade and not by the underlying stones. Riprap shall be placed proceeding upward from the bottom. Voids between riprap shall be filled with broken rock fragments.

Care shall be taken not to puncture the geotextile filter fabric when placing the riprap. Any damaged filter fabric shall be repaired or replaced as requested by the Engineer.

END OF SECTION

19. WATERMAINS

19.1 GENERAL

19.1.1 Work Included

Provide all labour, products and equipment required for the work, including but not limited to:

- a) bedding under and over pipe
- b) watermains and appurtenances
- c) testing watermains
- d) flushing and disinfecting watermains
- e) connection to existing systems
- f) thrust blocks

19.1.2 Quality Standards and Assurances

Products, workmanship and testing shall conform to standards specified in this section.

All products and workmanship may be subject to inspection by the Engineer.

Perform all tests required by the specification and by authorities having jurisdiction.

Notify the Engineer and authorities in ample time before testing to permit inspection and allow tests to be witnessed.

Do not cover any work before inspection and testing unless authorized by the Engineer in writing.

Remove or repair defective products or work which fails to meet specified requirements as directed by Engineer, at no additional cost to Owner.

19.2 PRODUCTS

19.2.1 Polyvinyl Chloride (PVC) Water Pipe

Polyvinyl chloride water pipe shall be equivalent to cast iron pipe outside diameter meeting CAN3-B.137.3 M86 (AWWA C900 (latest version), C905 (latest version)).

Pipe shall be Class 150 (dimension ratio 18) and pipe must be blue in color.

Pipe joints shall be integral gasketed bell ends. Couplings shall be permitted only for closures or special connections.

Gaskets shall conform to AWWA C111.

An affidavit of compliance shall be provided if requested.

19.2.2 Water Pipe Fitting

Cast iron or ductile iron fittings shall meet the requirements of AWWA Specification C110-77. Pressure rating shall be 1.1 MPa.

Joints on fittings shall be the same as specified for pipe.

Fittings shall be externally and internally coated with bituminous material approved by waterworks service.

PVC fittings shall be to AWWA C907 (latest version), CAN3-B.137.3, pressure Class 150, which are designed to accommodate the pipe for which they are used.

PVC fittings shall be gasketed bell end type similar to pipe except where adaptors are required in which case flanged or threaded joints may be permitted subject to approval by the Engineer. Gaskets to conform to AWWA C111.

Cast ductile iron couplings to be robar couplings or approved equal complete with ANSI 303 stainless steel nuts & bolts compatible with outside diameters of pipes to be joined in locations approved or specified by the Engineer.

19.2.3 Gate Valves (NRS)

Valves shall be iron body, bronze mounted, double disc or solid-wedge, with full 360 degree rubber to cast iron resilient seat gate valves approved for potable water use, meeting AWWA Specification C509-80 and the following:

Valves to be bronze mounted with a grade of bronze completely resistant to de-zincification by water having a ph of 9.0

Valve ends shall be consistent with the type of joint used for pipe and fittings except where otherwise detailed.

Valves to be supplied with either bronze or type 304 stainless steel stems.

Working pressure 1035 kPa.

Valve interior to be epoxy coated for corrosion protection.

Valves shall close by turning clockwise and be a non-rising stem type and be equipped with a 50 mm square operating nut. Valve stem shall be equipped with "O-Ring" type seals.

Exterior to be factory coated.

All exterior bolts and nuts must be T304 or type 3145.5 stainless steel.

19.2.4 Valve Boxes

Valve boxes shall be Norwood Foundry Type A, 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. Approved PVC bonnets and an adjustable cast iron top box with lid shall also be accepted for use.

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.

19.2.5 Hydrants

Hydrants are to be of the post type, dry barrel hydrant with compression shut-off conforming to AWWA Specification C502-80, having the following features:

Working pressure of 1035 kPa.

Two hose connections at 180 deg., 63 mm ID with threads to Alberta Mutual Standard.

One pumper connection, 100 mm OD, outlet nozzles to be fastened by a thread connection with Storz connection.

150 mm riser barrel, 125 mm bottom valve.

Minimum distance from flange to bonnet will be 600 mm.

Main connection to be 150 mm ductile iron size rubber gasketed bell end joint.

Self Draining hydrants (or as determined by site condition)

Number 6 operating nut with five sides.

Hydrant to open counterclockwise.

All hydrants will be painted Tremclad Yellow (No. 270-97X).

Ground line breakway system: 2.75 m from invert to flange, including a 450 mm top extension spool section with hydrant rod coupled at extension.

Minimum 710 mm from top of operating nut to bottom of base flange.

All exposed nuts and bolts to be T304 or type 3145.5 stainless steel.

Interface between removable parts of main valve and hydrant body shall be bronze to bronze.

Hydrants shall be of the same type and make as presently used in the City of Wetaskiwin (Canada Valve, McAvity).

19.2.6 Watermain Plugs

Watermain plugs shall be of standard manufacture to suit type of pipe and pipe joint specified.

19.2.7 Air Relief Valve & Flushing Chamber

Valve and chamber shall conform to the detail drawing referenced or attached.

19.3 EXECUTION

19.3.1 Bedding Pipes

Excavate trenches to widths not less than 300 mm greater than pipe diameter. Maximum width at top of pipe zone shall not exceed outside pipe diameter plus 600 mm, plus allowance for timbering, if required.

Excavate below bottom of trench at joints as required to provide working space. Body of pipe to rest on minimum 100 mm firmly compacted sand bedding throughout its length.

Place sand bedding for PVC pipe as per trench bedding and installation and backfill Class B granular surround as detailed in the Structural drawing attached. If site material meets bedding sand specification requirements, it may be used to replace the top 200 mm of bedding sand.

For trench in rock, bed pipe on minimum of 150 mm of compacted sand.

19.3.2 Laying and Jointing Pipe

Carefully lower pipe and specials into trench using proper appliances. While suspended, inspect for defects. Remove foreign materials from inside of pipe. Unless otherwise directed, lay pipe from lower end of line upward.

Lay pipe true to line and establish grading using laser level or measurement rod and sight rails.

Cut pipe accurately to bring valves, fittings and hydrants to correct position.

At all hydrants, plugs, tees, crosses, bends of more than 22 degrees and all other points of concentrated thrust, provide reaction blocking as detailed to prevent movement. Place reaction blocking against solid undisturbed ground. Details are based on soil load values of 7323 kg per square meter, or more. Where soil will not provide this load value, provide bands and clamps to take reaction. Refer also to special thrust block details. Place blocking to provide access to pipe and fittings for repairs or extensions of line.

Install turned wood or plastic plugs, properly sized, in pipe and fittings to prevent ingress of water, mud, dirt and debris at all times. Do not use rags, clothing or other means.

Install slip type rubber gasket joints to manufacturer's directions. If requested, provide copies of manufacturer's directions on site for reference and obtain technical assistance from manufacturer or representative.

Ensure that valve box can be adjusted up or down at least 300 mm. It is intended that valve boxes installed at this time to finished crushed gravel elevation, will be raised at the time of paving without having to supply a new upper extension.

19.3.3 Setting and Jointing Valves

Check and ensure stuffing glands on valves are properly packed before installation.

Set valves accurately in position, set valve box carefully over hood with shaft vertical and cap at proper level plus or minus 50 mm from elevations provided by the Engineer.

Anchor valves to prevent movement under unbalanced pressure conditions when recommended by pipe manufacturer. Include cost of anchorage in unit price for valves.

Check operation of valves in presence of Engineer before testing and after testing.

19.3.4 Setting and Jointing Hydrants

Set hydrants and hydrant valves on pressure treated timber blocking as per the details. Ensure hydrant stock and valve box are truly vertical.

Locate hydrants and valves as per the drawings within the following tolerances: 50 mm horizontal, 15 mm vertical.

Face pumper nozzles to roadway with hose nozzles parallel to roadway. No portion of the hydrant or nozzle cap shall be within 150 mm of the sidewalk.

Concrete thrust blocks will be required at hydrants and hydrant valves as detailed.

Ensure that regular maintenance of hydrants is carried out for the duration of the maintenance period. Pay all costs for maintenance such as repainting, draining prior to freeze-up, etc.

19.3.5 Thrust Blocks

Do concrete work in accordance with Section – Curb, Gutter and Sidewalks.

Cement to be sulfate resistant Portland cement.

Place concrete thrust blocks between undisturbed ground, tees, plugs, caps, bends, reducers, hydrants, and fittings.

Keep joints and couplings free of concrete.

Do not backfill over concrete within 24 hours after placing.

19.3.6 Testing Watermains

All watermain testing shall be in accordance with AWWA C605 Section 7.3 (latest revision).

Watermain testing may be carried out when all the following conditions have been met:

- a) a section of watermain not exceeding 365 meters in length has been completed.
- b) the section has been carefully filled with water and allowed to sit for at least 24 hours.
- c) reaction or thrust blocking within the section has reached 15.0 MPa design strength.

If all the conditions have been met, apply a constant pressure of 1035 KPa a minimum of two hours to mains, hydrants, valves and services. Make good all defects at no additional cost to Owner. Ensure all water service connections are turned off at curb stops to avoid damage to private plumbing.

Conduct leakage tests after completion of pressure testing. Conduct leakage tests at 1035 KPa in accordance with AWWA C600-82 procedures.

Allowable leakage will be calculated using the following formula:

Allowable leakage = $N \times D \times P \times 0.5 \div 128320$ = Liters per hour

Where N = Number of joints; D = nominal diameter of pipes (mm); and P = average test pressure (kPa).

If test leakage in any section is greater than permitted by AWWA Standards, locate and repair defective pipe joints at no additional cost until leakage is within permitted allowance. Test pipelines in sections not exceeding 365 m in length.

Provide all equipment and labour for tests and include costs in prices for watermains.

19.3.7 Flushing and Disinfecting Watermains

After completing satisfactory hydrostatic tests and before placing into service, flush all mains to remove as much foreign matter as possible from system. Flush at minimum velocity of 0.8 meters per second as required by AWWA C651 Section 7.4 (latest revision) procedures (250 mm line requires 2 - 50 mm openings to provide the required flushing velocity).

After flushing, disinfect mains by pumping chlorine solution into mains through a special main cock at beginning of line near source of water. Do not use hydrants at point of application for disinfectant.

Introduce disinfectant according to AWWA C651 Section 7.4 (latest revision) and to approval of Engineer and Provincial Ministry of Health.

Conform to AWWA C651 Section 7.4 (latest revision) for quantity of disinfectant, method of distribution throughout system and final flushing.

After final flushing and before placing watermain in service, the Engineer will collect samples in sterile bottles from an approved sampling point. The sampling is to be witnessed by local authorities as necessary. Samples will be submitted to Provincial Ministry of Health for testing and test results forwarded to Local Authorities. Heterotrophic plate counts will be provided.

If initial disinfection fails to produce satisfactory results, repeat disinfection until satisfactory samples are obtained.

Include costs for flushing, disinfecting and testing, including any necessary repetitions, in the prices for watermains.

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 City of Wetaskiwin or Alberta Environmental Protection. Dechlorination, if required, is to be performed by adding neutralizing chemicals (AWWA C651 (latest version), Appendix B) to the chlorinated water as it is flushed from the system and before it enters the receiving environment.

19.3.8 Markers

A 50 mm by 100 mm stake, from 600 mm below ground to 600 mm above ground level shall be placed at each water valve, the top 600 mm to be painted blue.

END OF SECTION

20. SANITARY SEWER MAINS

20.1 GENERAL

20.1.1 Work Included

Provide all labour, products and equipment required for the work, including but not limited to:

- a) bedding under and over piping
- b) sanitary sewers and appurtenances
- c) culverts
- d) cleaning sewers
- e) testing sewers
- f) connection to existing systems

20.1.2 Quality Standards and Assurances

Products, workmanship and testing shall conform to standards specified in this section. All products and workmanship are subject to inspection by the Engineer.

Perform all tests required by the specifications and by authorities having jurisdiction.

Notify the Engineer and authorities in ample time before testing to permit inspection and to allow tests to be witnessed.

Do not cover any work before inspection and testing unless authorized by Engineer in writing.

Remove or repair defective products or work which fails to meet specified requirements as directed by the Engineer, at the Contractor's expense.

20.2 PRODUCTS

20.2.1 Sewer Pipe

To be type called for in the schedule of quantities or shown on drawings and meet the requirements noted in subsequent clauses of this section.

Non-reinforced pipe and fittings to CAN/CSA-A259.1 Class 3, designated for flexible rubber gasket joints to CAN/CSA-A257.3.

Reinforced concrete pipe meeting ASTM Specification C76- CSA-A257.2-M92.

PVC pipe and fittings - DR 35 meeting ASTM Specification D3034 and CSA-B182.2 and CSA-B182.1 may be utilized for mains up to and including 375 mm diameter with prior approval of the Engineer.

Cement - sulfate resisting Portland for all concrete pipe, meeting Type 50 CSA-A5.

20.2.2 Pipe Joints

For all sewers - as recommended by pipe manufacturer, to produce watertight joints with infiltration within specified limits.

Concrete pipe - rubber gasket to ASTM C443, and CAN/CSA A257.3-M92

PVC - rubber gasket to ASTM 03212 or ASTM F477.

20.2.3 Pre-cast Concrete Manhole Units

To meet requirements of ASTM C478 and CSA A257.4 to dimensions shown on drawings.

Cement - sulfate resisting Portland, CSA A5, Type 50.

Manhole steps shall be 19 mm diameter, galvanized iron safety rungs spaced at a maximum distance of 400 mm center to center for full height.

Pre-cast bases to be minimum 20.7 MPa concrete.

20.2.4 Concrete Blocks and Bricks

Solid concrete, conforming to CSA A165.1 and 165.2 and ASTM C139, not less than 128 mm thick for block, standard dimensions for brick, true to shape, free from cracks and surface defects, compressive strength not less than 17.2 MPa, absorbing not more than 8% water by weight during 24 hours immersion test performed after drying.

Cement - sulfate resisting Portland CSA A5, Type 50.

20.2.5 Mortar

For pipe joints and all other parts of the work, one part sulfate resisting Portland cement to two parts clean sand, by volume.

20.2.6 Cast Iron Frame, Covers and Grates

For manholes and catch basins, close-grained grey cast iron, meeting ASTM A48, Class 20, true in form and dimension, free from faults, sponginess, cracks, blowholes and other defects. Cast steel to conform to ASTM A27, grade 70-36. Substitution of ductile iron meeting ASTM A445 for cast iron or cast steel shall be subject to approval of Engineer.

Machine or grind frames, covers and grates to even non-rocking bearing surfaces.

Hot dip in asphaltic varnish.

Manhole covers and frames:

- a) Sanitary - Norwood Foundry Model F-39, or approved equal
- b) Sanitary - Norwood Foundry Model NF 80 or approved equal
- c) Sanitary - Norwood Foundry Model NF 90 or approved equal

20.2.7 Manhole Steps

Safety type, 19 mm diameter solid steel bar, hot dip galvanized after fabrication.

20.2.8 Safety Platforms

Safety platforms shall be aluminum grates to MSU Mississauga or approved equal.

To be installed according to manufacturer's recommendations.

To be installed on manholes greater than 5.0 meters in depth when measured from the top of the frame to the lowest invert.

20.2.9 Concrete

Ready-mixed concrete, sulfate resisting, Portland cement CSA A5, Type 50, 20 MPa compressive strength at 28 days of age, to CSA A23.1

20.2.10 Reinforcing Steel

CSA G30.12 or G30.13, 34.5 MPa minimum yield , Grade 50 all deformed except where noted otherwise. Use Grade 40 for ties.

20.2.11 Sewer Pipe Tests and Rejection

Include all costs for testing, supply and delivery of specimens to testing laboratory and replacing defective material.

The Engineer reserves the right to select, either on site or at the manufacturer's stockpile, 0.5% of total length of each category of pipe for testing, minimum number of lengths as follows:

- a) for each category of over 100 lineal meters - 4 lengths
- b) for each category of over 50 lineal meters and less than 100 lineal meters - 2 lengths
- c) for each category of less than 50 lineal meters - 1 length.

Where the engineer has selected full sized pipe specimens for load tests, deliver these specimens to an approved testing laboratory. Results of the tests shall be mailed directly to Engineer in triplicate. Pipe will be accepted, based on certified factory tests, provided they are done under supervision of an independent testing agency. All pipe tests shall be performed in accordance with ASTM Specifications.

Should any specimens fail to meet test requirements, test two additional selected specimens for each failure. Pipe will be acceptable only if all re-test specimens meet requirements. Should test results be unsatisfactory, all or part of pipe supplied may be rejected and payment withheld until satisfactory tests of pipe in place are conducted.

Inspect pipe on delivery and reject any that fails to meet specified requirements. Replace rejected pipe with satisfactory pipe without delay. Mark all rejected pipe plainly as "Rejected" and immediately remove from site.

The engineer may require submission of a manufacturer's report verifying satisfactory random testing of the pipe designated for this project.

20.3 EXECUTION

20.3.1 Bedding Sewers

Excavate trenches to widths not less than 300 mm greater than pipe diameter. Maximum width at top shall not exceed outside pipe diameter plus 600 mm.

Bed pipe per trench bedding and initial backfill Class "B" granular surround conditions for plastic pipe and Granular Foundation from concrete pipe, as detailed in the standard drawings attached.

Obtain engineers approval for all materials to be used in the pipe bedding zone.

20.3.2 Laying and Jointing Pipe

Commence laying at lower end of line, lay pipes and specials true to line and grade, socket ends up grade, joints close and evenly butted all around pipe. Take special care to prevent sagging of spigot end in hub and provide true, even invert surface throughout entire length of sewer. Excavate at end of each pipe to provide rest for socket, sufficient to permit proper jointing. Clean pipe interior, remove all dirt, mud and other extraneous materials.

20.3.3 Infiltration /Exfiltration Testing

Total infiltration of groundwater into whole of system or exfiltration, shall not exceed 5.0 liters per mm of internal pipe diameter per kilometer per day including manholes, for PVC pipe, and 20 liters per mm of internal pipe diameter per km per day including manholes for concrete and clay tile pipe. Where such leakage is exceeded, repair sewer mains, at no additional cost to Owner, so total infiltration is within specified limits.

During construction and immediately on completion of a manhole, measure infiltration at new manhole. If amount exceeds specified limit, make necessary repairs immediately to reduce infiltration to allowable limit. Failure to comply with this requirement will be sufficient cause for Engineer to stop sewer laying work until repairs have been made.

20.3.4 Cleaning Sewer Mains

On completion of construction of mains and services, flush and string, (in readiness for TV inspection) all mains until all deposits of earth or other material are removed. If new system connects to an existing system, plug outgoing line at manhole at junction and remove dirt and debris at that manhole. Do not permit debris from new construction to enter existing system. Pay all costs for repairs where damages occur due to negligence. Pay all costs of water from the municipal authority.

During flushing operations, check all manholes. If depth of flow in any manhole is greater than should be anticipated, bucket main and remove obstructions in pipe line. Pay all costs for required repairs.

Whenever practicable, flush out in runs not over 250 meters. Remove all foreign material from each run before proceeding with next.

20.3.5 Testing

If required by the Engineer, perform pill test after cleaning sewer mains. Through each section of main, pull wood or metal ball with diameter 50 mm less than inside pipe diameter. If pill does not readily pull through, uncover pipe and make good defects at no cost to Owner.

Pill test is not required on lines 216 mm diameter and larger if they are visually inspected in a satisfactory manner.

T.V. Testing - the Contractor, at his cost will carry out a T.V. inspection of all sanitary and storm sewer mains. All defects identified by the T.V. inspection shall be corrected by the contractor at the contractor's expense. The contractor shall be responsible for the cost of flushing and stringing the mains prior to TV inspection. If additional TV inspection is required to verify correction of defective work, it will be at the contractor's cost. The Contractor shall provide a copy of the video tape recordings and a written report to the Owner for record purposes.

20.3.6 Manholes

Construct manholes as shown on drawings, unless otherwise permitted in writing by Engineer. Submit full details of any proposed alternative construction with bid.

For cast-in-place concrete for manholes, conform to CSA A23.1.

Place manholes accurately, plumb, in alignment and at exact plan location.

Construct manholes watertight and complete, including finishing flow bottoms, as work proceeds. Do not lay pipe in advance more than two manholes ahead of last completed manholes.

Shape bottoms accurately for necessary flows as shown on drawings or as directed by Engineer. In manholes with sewers 610 mm in diameter and smaller, form invert through manhole with half-round pipe. In manholes containing lot services, shape bottoms to provide slopes required to ensure no build up of sewage occurs in manholes.

Place stubs for future lines accurately and plug watertight. Shape flow bottoms to suit future lines.

At all bends through manholes, provide 50 mm drop in invert from inlet to outlet.

Support pipes at manholes to prevent shearing or settlement. Where not detailed use concrete fill, concrete or timber beam, or suitably compacted gravel.

During construction, plug pipes at manholes to prevent entry of concrete and mortar. Remove plugs immediately after construction is completed.

Set covers accurately within 15 mm of correct grade. On sloping streets, set covers to match slopes.

Set all precast concrete sections, bricks, blocks and frames in mortar. Tool joints smooth and point all voids after setting.

All sanitary manhole barrels are to be sealed with rubber neck to prevent infiltration.

END OF SECTION

21. STORM SEWER MAINS

21.1 GENERAL

21.1.1 Work Included

Provide all labour, products and equipment required for the work, including but not limited to:

- a) bedding under and over piping
- b) storm sewers and appurtenances
- c) culverts
- d) cleaning sewers
- e) testing sewers
- f) connection to existing systems

21.1.2 Quality Standards and Assurances

Products, workmanship and testing shall conform to standards specified in this section. All products and workmanship are subject to inspection by the Engineer.

Perform all tests required by the specifications and by authorities having jurisdiction.

Notify the Engineer and authorities in ample time before testing to permit inspection and to allow tests to be witnessed.

Do not cover any work before inspection and testing unless authorized by Engineer in writing.

Remove or repair defective products or work which fails to meet specified requirements as directed by the Engineer, at the Contractor's expense.

21.2 PRODUCTS

21.2.1 Sewer Pipe

To be type called for in the schedule of quantities or shown on drawings and meet the requirements noted in subsequent clauses of this section.

Non-reinforced pipe and fittings to CAN/CSA-A259.1 class 3, designated for flexible rubber gasket joints to CAN/CSA-A257.3.

Reinforced concrete pipe meeting ASTM Specification C76-70 CSA-A257.2-M92.

PVC pipe and fittings - DR 35 meeting ASTM Specification D3034 and CSA-B182.2 and CSA-B182.1 may be utilized for mains up to and including 375 mm diameter with prior approval of the Engineer.

Ribbed PVC pipe and fittings to meet CSA B182.4, ASTM F794 with pipe stiffness of 320 kPa as measured in accordance with ASTM D2412. Maximum long term deflection is less than 7.5%

Cement - sulfate resisting Portland for all concrete pipe, meeting Type 50 CSA-A5.

21.2.2 Pipe Joints

For all sewers - as recommended by pipe manufacturer, to produce watertight joints with infiltration within specified limits.

Concrete pipe - rubber gasket to ASTM C443 and CSA A257.3.

PVC - rubber gasket to ASTM 03212 or ASTM F477.

21.2.3 Pre-cast Concrete Manhole Units

To meet requirements of ASTM C478 and CSA A257.4 to dimensions shown on drawings.

Cement - sulfate resisting Portland, CSA A5, Type 50.

Manhole steps shall be 19 mm diameter, galvanized iron safety rungs spaced at a maximum distance of 400 mm center to center for full height.

Pre-cast bases to be minimum 20.7 MPa concrete.

21.2.4 Concrete Blocks and Bricks

Solid concrete, conforming to CSA A165.1 and 165.2 and ASTM C139, not less than 128 mm thick for block, standard dimensions for brick, true to shape, free from cracks and surface defects, compressive strength not less than 17.2 MPa, absorbing not more than 8% water by weight during 24 hours immersion test performed after drying.

Cement - sulfate resisting Portland CSA A5, Type 50.

21.2.5 Catch Basins

To meet requirements of ASTM C478 and CSA A257.2, 910 mm diameter reinforced concrete riser, reinforced pre-cast concrete base slab, to details shown on drawings.

Cement - sulfate resisting Portland CSA A5, Type 50.

21.2.6 Catch Basin Lead Pipes

Catch basin lead pipes shall be:

- a) Non-reinforced concrete pipe to meet CSA A257.1
- b) PVC pipe DR 35 to meet ASTM D3034 or approved equivalent.

Pipe diameter shall be 250mm diameter for single catch basins and 300mm diameter for twinned catch basins with a minimum grade of 2%.

21.2.7 Mortar

For pipe joints and all other parts of the work, one part sulfate resisting Portland cement to two parts clean sand, by volume.

21.2.8 Cast Iron Frame, Covers and Grates

For manholes and catch basins, close-grained grey cast iron, meeting ASTM A48, Class 20, true in form and dimension, free from faults, sponginess, cracks, blowholes and other defects. Cast steel to conform to ASTM A27, grade 70-36. Substitution of ductile iron meeting ASTM A445 for cast iron or cast steel shall be subject to approval of Engineer.

Machine or grind frames, covers and grates to even non-rocking bearing surfaces.

Hot dip in asphaltic varnish.

Manhole covers and frames:

- a) Storm - Norwood Foundry Model F-39, or approved equal

Catch basin covers and frames:

- a) Rolled monolithic curb and gutter - Norwood Foundry Model F-33
- b) Round Top Catch Basin - Norwood Foundry Model F-38
- c) Side inlet - Norwood Foundry Model F-51.

21.2.9 Manhole Steps

Safety type, 19 mm diameter solid steel bar, hot dip galvanized after fabrication.

21.2.10 Safety Platforms

Safety platforms shall be aluminum grates to MSU Mississauga or approved equal.

To be installed according to manufacturer's recommendations.

To be installed on manholes greater than 5.0 meters in depth when measured from the top of the frame to the lowest invert.

21.2.11 Concrete

Ready-mixed concrete, sulfate resisting, Portland cement CSA A5, Type 50, 20 MPa compressive strength at 28 days of age, to CSA A23.1

21.2.12 Reinforcing Steel

CSA G30.12 or G30.13, 34.5 MPa minimum yield , Grade 50 all deformed except where noted otherwise. Use Grade 40 for ties.

21.2.13 Sewer Pipe Tests and Rejection

Include all costs for testing, supply and delivery of specimens to testing laboratory and replacing defective material.

The Engineer reserves the right to select, either on site or at the manufacturer's stockpile, 0.5% of total length of each category of pipe for testing, minimum number of lengths as follows:

- a) for each category of over 100 lineal meters - 4 lengths
- b) for each category of over 50 lineal meters and less than 100 lineal meters - 2 lengths
- c) for each category of less than 50 lineal meters - 1 length.

Where the engineer has selected full sized pipe specimens for load tests, deliver these specimens to an approved testing laboratory. Results of the tests shall be mailed directly to Engineer in triplicate. Pipe will be accepted, based on certified factory tests, provided they are done under supervision of an independent testing agency. All pipe tests shall be performed in accordance with ASTM Specifications.

Should any specimens fail to meet test requirements, test two additional selected specimens for each failure. Pipe will be acceptable only if all re-test specimens meet requirements. Should test results be unsatisfactory, all or part of pipe supplied may be rejected and payment withheld until satisfactory tests of pipe in place are conducted.

Inspect pipe on delivery and reject any that fails to meet specified requirements. Replace rejected pipe with satisfactory pipe without delay. Mark all rejected pipe plainly as "Rejected" and immediately remove from site.

The engineer may require submission of a manufacturer's report verifying satisfactory random testing of the pipe designated for this project.

21.3 EXECUTION

21.3.1 Bedding Sewers

Excavate trenches to widths not less than 300 mm greater than pipe diameter. Maximum width at top shall not exceed outside pipe diameter plus 600 mm.

Bed pipe per trench bedding and initial backfill Class "B" granular surround conditions for plastic pipe and Granular Foundation from concrete pipe, as detailed in the standard drawings attached.

- a) obtain engineers approval for all materials to be used in the pipe bedding zone.

21.3.2 Laying and Jointing Pipe

Commence laying at lower end of line, lay pipes and specials true to line and grade, socket ends up grade, joints close and evenly butted all around pipe. Take special care to prevent sagging of spigot end in hub and provide true, even invert surface throughout entire length of sewer. Excavate at end of each pipe to provide rest for socket, sufficient to permit proper jointing. Clean pipe interior, remove all dirt, mud and other extraneous materials.

21.3.3 Infiltration /Exfiltration Testing

Total infiltration of groundwater into whole of system or exfiltration, shall not exceed 5.0 liters per mm of internal pipe diameter per kilometer per day including manholes, for PVC pipe, and 20 liters per mm of internal pipe diameter per km per day including manholes for concrete and clay tile pipe. Where such leakage is exceeded, repair sewer mains, at no additional cost to Owner, so total infiltration is within specified limits.

During construction and immediately on completion of a manhole, measure infiltration at new manhole. If amount exceeds specified limit, make necessary repairs immediately to reduce infiltration to allowable limit. Failure to comply with this requirement will be sufficient cause for Engineer to stop sewer laying work until repairs have been made.

21.3.4 Cleaning Sewer Mains

On completion of construction of mains and services, flush and string, (in readiness for TV inspection) all mains until all deposits of earth or other material are removed. If new system connects to an existing system, plug outgoing line at manhole at junction and remove dirt and debris at that manhole. Do not permit debris from new construction to enter existing system. Pay all costs for repairs where damages occur due to negligence. Pay all costs of water from the municipal authority.

During flushing operations, check all manholes. If depth of flow in any manhole is greater than should be anticipated, bucket main and remove obstructions in pipe line. Pay all costs for required repairs.

Whenever practicable, flush out in runs not over 250 meters. Remove all foreign material from each run before proceeding with next.

21.3.5 Testing

If required by the Engineer, perform pill test after cleaning sewer mains. Through each section of main, pull wood or metal ball with diameter 50 mm less than inside pipe diameter. If pill does not readily pull through, uncover pipe and make good defects at no cost to Owner.

Pill test is not required on lines 216 mm diameter and larger if they are visually inspected in a satisfactory manner.

T.V. Testing - the Contractor, at his cost, will carry out a T.V. inspection of all sanitary and storm sewer mains. All defects identified by the T.V. inspection shall be corrected by the contractor at the contractor's expense. The contractor shall be responsible for the cost of flushing and stringing the mains prior to TV inspection. If additional TV inspection is required to verify correction of defective work, it will be at the contractor's cost. The Contractor shall provide a copy of the video tape recordings and a written report to the Owner for record purposes.

21.3.6 Manholes

Construct manholes as shown on drawings, unless otherwise permitted in writing by Engineer. Submit full details of any proposed alternative construction with bid.

For cast-in-place concrete for manholes, conform to CSA A23.1.

Place manholes accurately, plumb, in alignment and at exact plan location.

Construct manholes watertight and complete, including finishing flow bottoms, as work proceeds. Do not lay pipe in advance more than two manholes ahead of last completed manholes.

Shape bottoms accurately for necessary flows as shown on drawings or as directed by Engineer. On manholes with sewers 610 mm diameter and smaller, form invert through manhole with half-round pipe. At manholes containing lot services shape bottoms to provide slopes required to ensure no build up of sewage occurs in manholes.

Place stubs for future lines accurately and plug watertight. Shape flow bottoms to suit future lines.

At all bends through manholes, provide 50 mm drop in invert from inlet to outlet.

Support pipes at manholes to prevent shearing or settlement. Where not detailed use concrete fill, concrete or timber beam, or suitably compacted gravel.

During construction, plug pipes at manholes to prevent entry of concrete and mortar. Remove plugs immediately after construction is completed.

Set covers accurately within 15 mm of correct grade. On sloping streets, set covers to match slopes.

Set all precast concrete sections, bricks, blocks and frames in mortar. Tool joints smooth and point all voids after setting.

All sanitary manhole barrels are to be sealed with rubber neck to prevent infiltration. Gaskets for storm manholes only, may be omitted at the discretion of the Engineer.

END OF SECTION

22. LOT SERVICE CONNECTIONS

22.1 GENERAL

22.1.1 Work Included

Provide all labour, products and equipment required for the lot service connections, including but not limited to:

- a) water service piping
- b) sewer service piping
- c) corporation cocks, connection to main
- d) curb stops, service boxes, service markers

22.1.2 Quality Standards and Assurances

Products and workmanship shall conform to applicable municipal and provincial standards and to specifications.

All products and workmanship will be subject to inspection by the Engineer.

Perform all tests required by authorities having jurisdiction. Test water and disinfect services with mains.

Notify the Engineer and authorities in ample time before testing to permit inspection and to allow tests to be witnessed.

Do not cover work before inspection and testing unless authorized by Engineer in writing.

Remove or repair defective products or work which fails to meet specified requirements as directed by Engineer, at Contractor's expense.

22.2 PRODUCTS

22.2.1 Service Pipe, Fittings

Underground copper service pipe - type K soft copper for a diameter of 25 mm and less, and Type K copper and approved PVC materials for diameters greater than 25 mm.

Main or corporation cocks – Compression type AWWA thread.

Curb stops – Copper to copper ball valve without a drain. Curb stops 38 mm or larger shall be ball bearing type.

Couplings – Standard Brass Compression type.

Service Boxes – Epoxy coated extension type for a maximum extension of 3.5 m, complete with stainless steel operating rod, brass clevis and key. Service box to be supported on a cast iron piece nailed to a pressure treated preserved wood plank.

Service Clamps – Bronze double strap conforming to Smith-Blair 323 or approved stainless steel AWWA Boss.

5.5 kg Zinc Anode Protection to be installed as indicated on Drawing No. C-109.

Service boxes to be adjustable from 2.4 m to 3.0 m bury, unless otherwise noted on drawings.

22.2.2 Sewer Service Pipe

PVC, SDR 28.

22.2.3 Sewer Saddles

Manufactured tee saddles, gasketed joints secured with double steel clamps.

22.2.4 Sand Bags

Bags to be new material and in a condition acceptable to the Engineer. Sand to be clean and free from debris, conforming to imported sand requirements as specified in section 02161 Trenching and Backfilling for Utilities.

22.2.5 Rigid Foamed Urethane Insulation

Density (ASTM D1622) not less than 28.8 kg/cubic meter. (Nominal 32.0 kg).

Closed cell content (ASTM D2856) not less than 90%.

Water absorption (ASTM D2842) not greater than 0.34 kg/square meter.

Initial thermal conductivity (ASTM D2326) (K Factor) not greater than watts/meter degree Celsius.

Dimensional stability (ASTM D2126)

Compressive strength (ASTM D1621) not less than 206.8 kPa at 10% deflection.

22.3 EXECUTION

22.3.1 Water Services

Use tapping machine to drill, tap and thread corporation main stop into main. Use special care to prevent cuttings falling into main. Wherever possible, tap main under pressure and obtain written approval from the Engineer to do otherwise.

Lay copper service pipe to designated location and connect to existing service lines. Service connections shall be tapped into the upper portion of the watermain at an angle of at least 45 degrees from the horizontal. Tappings shall have a minimum spacing of at least 600 mm. Attach curb stop and set service box to grade where required.

Brace boxes securely to keep plumb during backfilling. Test for operation both before and after pressure test.

Where curb stop is located under sidewalk, concrete slab or other structure, set top of extension service box flush with surface and fill hole around pipe neatly with concrete.

Use service clamps on all services tapped into 150 mm mains and on 25 mm and larger services tapped into 200 mm to 300 mm AC lines. In all other cases, use service clamps where size of main stop is larger than recommended for size of main.

Place water service lines at least 2.7 m below final finished grade elevations, unless otherwise directed.

Lay water service lines in same trench with sewer service line. Install sanitary services on left side of water service as viewed from main towards property line. Install storm sewer service on right side of water service as viewed from main towards property line. Paint last 1 m of sanitary service pipe red. Paint last storm service pipe green. Make all connections to existing services using appropriate couplings.

Lot service connections to residential lots (R.1 and R.2) shall be installed inside property line to easement line for lane servicing; and to property line, or easement line if an easement exists, for street servicing. (as shown on the drawings) Water services connections to residential lots (R.1 and R.2) shall be 0.15 m short of the easement line for lane servicing and 0.15 m outside property line or easement line if an easement exists, for street servicing.

The Engineer may require the delivery of curb stop risers to the public works yard. The Contractor shall confirm this requirement with the Engineer and shall provide evidence of a receipt signed by the Public Works employee accordingly.

22.3.2 Sewer Services

Connect services to mains with manufactured tee or wye fittings placed in mains, or by cutting into mains and installing manufactured tee saddles or wye saddles and 45 degree bends. A 150mm x 100mm reducer shall be installed at property line to transition from the 150mm connection at the main to the 100mm Lot Service Pipe. Take care to avoid cracking pipe and remove all cuttings from pipe. Secure joint between saddle and main with mortar or other means acceptable to Engineer.

Do not allow spigots or other obstructions to project into main. Lay service pipe to an even gradient as directed.

Install service lines as detailed, at locations and to grade designated by grade sheet provided in field. Install services at right angle to main, unless otherwise specified.

Bends permitted only at three locations – 45 degree bend with wye or 22.5 degree bend with tee connection at main, 45 degree bend at top of riser and 22.5 degree bend maximum at property line for house service connection between these points.

Support service lines adequately to prevent dislocation, buckling or settlement. When water lines must be laid below sewer lines, ensure that backfill over water lines is adequately compacted to prevent settlement or dislocation of sewers.

When a connection cannot be made directly to a house service line, plug end of sewer service to prevent entry of water and dirt.

Install service risers only where noted on the lot grading plan. Ensure adequate support for the riser section utilizing sandbags or screened rock.

22.3.3 Markers

A 50 mm by 100 mm marker stake, from invert elevation to 600 mm above ground level shall be placed at the end of each water service line, the top 600 mm to be painted blue. Place a 100mm diameter white PVC pipe over the water service box from 600mm below ground to 600mm above ground.

END OF SECTION

23. ADJUSTMENT OF APPURTENANCES

23.1 GENERAL

23.1.1 Work Included

The work described in this section pertains to the adjustments of all appurtenances.

23.2 EXECUTION

23.2.1 Valve and Curb Boxes Adjustments

Valve box tops and curb box tops shall be adjusted so that the top of the box is set exactly to the required elevation. The Contractor shall shorten or lengthen the boxes and stems as required and block the boxes to prevent any settlement. The adjustments shall be made so that the boxes are plumb and the valves operate effectively. The rock guard and operating nut are to be located no closer than 300mm below the proposed finished grade.

23.2.2 Manhole And Catch Basin Adjustments

Manhole and catch basin frames shall be adjusted so that the top of the cover is set exactly to the required elevation.

Where it is necessary to raise manhole frames it shall be done with approved precast rings or blocks meeting the requirements of the current issue of ASTM C478. Joints between slab top blocks, and frame shall be mortared, and the joints finished flush and smooth. Joints between slab top, precast rings, and frame shall be made watertight utilizing preformed bituminous gaskets or other approved sealant. Under no circumstances shall the depth from the rim of the manhole to the first ladder rung be more than 800mm.

23.2.3 Damaged Appurtenances

The Contractor shall replace any appurtenances damaged by his work or forces. Any existing damaged appurtenances found within the proposed work zone shall be replaced by the Contractor as approved by the Engineer at an agreed lump sum price.

23.2.4 Final Adjustment Elevations

The tops of valve boxes, manholes, and catch basins shall be set to the design elevations, or as approved by the Engineer. Generally, the following shall apply for setting the final elevations of the tops of the appurtenances.

- a) in asphaltic pavement, 5mm below the finished surface elevation for manhole frames.
- b) in concrete curb & gutter, 10mm below gutter elevation for catch basin frames.
- c) in gravel roadways/lanes, 50mm below the surface.
- d) in landscape areas, 50mm above the final surface, providing a smooth transition to match the surrounding areas.

END OF SECTION

24. CULVERTS

24.1 GENERAL

24.1.1 Definition

Culverts shall mean galvanized corrugated steel pipes acting as drainage conduits to conduct the flow of surface drainage water.

24.1.2 Terminology

CSP shall mean Corrugated Steel Pipe.

CSP Arch means Corrugated Steel Pipe Arch.

SPCSP means Structural Plate Corrugated Steel Pipe

24.1.3 References

The latest version of the publications listed below form part of this Specification to the extent specified in this Section:

CSA Standard G401

Corrugated Steel Pipe Institute (CSPI):

501-78 Metric Specification for Corrugated Steel Pipe Products.

24.1.4 Quality Assurance

Supply, fabricate and install CSP culverts strictly in accordance with manufacturer's instructions and recommendations and as specified.

24.1.5 Product Delivery and Handling

Deliver to site, handle and store pipes, sections, fittings and hardware in a manner to prevent distortion or bending and damage to metal or galvanized coating.

24.1.6 Job Conditions

Protect CSP pipes before, during and after installation and protect installed work and materials.

In the event of damage, make repairs or replacements necessary to Engineer's approval.

24.2 PRODUCTS

24.2.1 Materials

Culvert pipe shall be galvanized corrugated steel pipe complying with CSA Standard G401.

Culvert pipes up to 600mm diameter shall have a wall thickness of 1.6mm and larger pipe up to and including 900 mm diameter, shall have minimum 2.0 mm wall thickness.

Specified wall thicknesses shall not include the thickness of galvanized coating.

The zinc coating mass shall be not less than 1100g/m² when tested by the single spot test.

Corrugation profile for the pipes shall be 68 x 13 mm.

End sections (square or beveled as indicated), couplers, fittings and hardware shall match the culvert pipe.

24.3 EXECUTION

Trench shall be properly drained and free of unsuitable material prior to placing and compaction of bedding material.

24.3.1 Trenching and Excavation

The excavation for the culvert base shall be carried to a depth of not less than 150 mm below the invert grade, as established by the Engineer and shall be of sufficient width to permit pipe assembly and to accommodate operation of compaction equipment on either side of the culvert.

24.3.2 Culvert Bedding

Place minimum 150 mm thick layer of compacted granular material on bottom of excavation. Place material in uniform layers not exceeding 150 mm thickness, and compact each layer to at least 95% Standard Proctor Density before placing succeeding layer. Any soft and yielding or other unsuitable material below this level shall be removed to the depth required by the Engineer and backfilled with approved granular material compacted to a uniform density of 95% of Standard Proctor Density throughout the entire length of the culvert.

The base for culverts installed along main water courses or through yielding areas shall consist of gravel bedding compacted to the excavated depth and extending over a width of three (3) times the diameter of the pipe. The depth of this base shall be not less than 300 mm. An impervious compacted bedding material shall be provided for a minimum length of 3 m or three (3) times the diameter of the pipe, whichever is greater, at the inlet end of the culvert to achieve a seal against seepage.

Trench line and grade requires the Engineer's approval prior to placing bedding material or pipe.

Do not backfill until pipe grade and alignment are checked and accepted by the Engineer.

24.3.3 Laying Corrugated Steel Pipe Culverts

Commence pipe placing at downstream end on the prepared granular bedding with separated sections securely joined together by means of a coupling band.

The couplers are to match thickness and corrugations of the pipe.

Corrugations of pipes and couplers must mate before tightening and joints shall be tapped with a mallet during tightening to ensure proper seating of couplers.

Do not allow water to flow through pipes during construction except as permitted by the Engineer.

All culverts shall be laid so that the horizontal seams fall at the sides of the culverts.

The pipe shall be laid true to line and grade as established by the Engineer and the pipe shall be carefully handled to prevent damage to the galvanized coating. Damaged pipe sections shall be immediately reported to the Engineer and repaired and replaced according to his direction. Damaged protective coating shall receive two coats of zinc rich paint.

Centerline of culvert shall not vary from the designated horizontal alignment by more than 75 mm. Invert grade shall not vary from the designated invert grade elevation by more than 12 mm provided positive flow is maintained.

24.3.4 Culvert Backfill

After assembly of the culvert on the bedding, the culvert shall be backfilled with approved granular and random backfill. Backfill shall be brought up on both sides of the culvert simultaneously in 150mm lifts and shall be compacted with a method approved by the Engineer to a minimum density of 95% Standard Proctor.

The backfill shall be spread and compacted in 150 mm layers and special care shall be taken to ensure proper filling and compacting under the haunches and within the culvert corrugations. Heavy equipment shall not be allowed over the culvert until a minimum of 0.5 m of fill is obtained above the crown of the pipe.

24.3.5 Rock Rip – Rap

The ends of the culvert shall be finished with the placement of rock rip – rap as shown in the detailed sketches.

24.3.6 Adjustment and Cleaning

Inlet and outlet ends and waterway through the pipe shall be kept free from debris or foreign matter, to prevent restriction to flow of water through the culvert.

END OF SECTION

25. GRANULAR SUB-BASE

25.1 GENERAL

25.1.1 Work Included

The work described in this section pertains to granular sub-base material as detailed on the drawings.

25.2 PRODUCTS

25.2.1 Granular Sub-base

Granular sub-base is the material lying above the subgrade and below the base course. The gradation to be utilized shall be as designated by the Engineer.

25.2.2 Gradation

The granular subbase material shall consist of rock, gravel, and sand consisting of hard, clean, durable material, free from coatings of silt, clay or other deleterious materials and contain no organic matter.

The following gradation shall apply to pit run granular sub-base courses:

Sieve Size (mm)	%Passing by Mass
150.000	100
80.0	80 – 100
25.0	50 – 80
5.0	25 – 55
0.080	2– 10

25.2.3 Approval

Preliminary approval of the material as represented in the test results shall not constitute general acceptance of all material in the deposit or source of supply, and acceptance shall be subject to confirming field tests taken at the discretion of the Engineer. Materials may be considered unsuitable, even though particle sizes are within the limits of the gradation sizes required, if any characteristic precludes satisfactory compaction or if the material fails to provide a roadway suitable for traffic. The acceptability of the final material will be determined by the Engineer.

25.2.4 Quality

The material shall consist of durable rock or gravel. The granular sub-base shall not contain any organic or other deleterious materials. The material shall have a minimum California Bearing Ratio of 55% at the specified compaction as determined by the current issue of ASTM D1883.

25.3 EXECUTION

25.3.1 Placement

The granular sub-base material shall not be placed until the underlying subgrade has been inspected and approved by the Engineer.

Unless otherwise specified, the granular material shall be placed in uniform layers not exceeding 200mm in thickness before compaction. The material shall be placed by mechanical spreaders or deposited in windrows and leveled with a suitable motor grader.

25.3.2 Compaction

The material shall be compacted by rolling with a pneumatic-tired or vibrating roller of a type approved by the Engineer. The material shall be compacted near optimum moisture content to 98% Standard Proctor Density.

If the moisture content exceeds the optimum during compaction, the material shall be aerated by mechanical means until the material has been dried sufficiently to obtain the specified density.

If the moisture content is below optimum, water shall be added by an acceptable applicator and in such quantities to achieve specified compaction.

25.3.3 Shaping and Finishing

A motor grader shall be used in conjunction with the compaction equipment to keep the finished surface of each layer even and uniform. The finished surface of the granular sub-base shall conform to the required cross-section and grades as shown on the drawings or as directed by the Engineer, within a tolerance of 30mm. The sub-base material shall be uniform and show no signs of segregation.

25.3.4 Tests

Field density, moisture content and sieve analysis tests will be carried out by the representative of the Engineer to ensure that the material is satisfactory.

The frequency of field density and moisture content tests shall be 1 test per approximately 100 meters of constructed roadway and at various locations offset left and right of centre line, or as directed by the Engineer.

All sieve tests should comply with the gradation limits as stated in above.

The Contractor will, as the Engineer requires, provide a loaded gravel truck with operator for visual checks of soft spots.

END OF SECTION

26. GRANULAR BASE COURSE

26.1 GENERAL

26.1.1 Work Included

The work described in this section pertains to base course gravel as detailed on the drawings.

26.2 PRODUCTS

26.2.1 Gradation

Granular base material shall consist of crushed rock and/or crushed gravel and sand consisting of hard, clean, durable material, free from coatings of silt, clay or other deleterious materials, and containing no organic matter. The base course aggregate shall meet the following gradation requirements when tested to ASTM C136 and C117, (AASHTO T11 and T27):

Sieve Size (mm)	Passing by Mass
20.000	100
16.000	84 - 94
10.000	63 - 86
5.000	40 - 67
1.250	20 - 43
0.630	14 - 34
0.315	9 - 26
0.160	5 - 18
0.080	2 - 10

A minimum of 60% by weight of the material retained on the 5,000 sieve shall have at least 2 fractured faces. Other properties shall be as follows:

Liquid Limit:	maximum 25, ASTM D423-66
Plasticity Index:	maximum 6, ASTM D424-59
Los Angeles Abrasion	
Gradation "B":	35% maximum loss by mass, ASTM C131-76
Sand Equivalent:	minimum of 35%, ASTM D2419-74

26.2.2 Approval

Preliminary approval of the material as represented in the test results shall not constitute general acceptance of all material in the deposit or source of supply, and acceptance shall be subject to confirming field tests taken at the discretion of the Engineer.

Materials may be considered unsuitable even though particle sizes are within the limits of the gradation sizes required, if particle shapes are thin or elongated, if any other characteristic precludes satisfactory compaction or if the material fails to provide a roadway suitable for traffic.

The acceptability of the final material will be determined by the Engineer.

26.2.3 Quality

The material shall consist of durable rock or gravel. The base course shall not contain any organic or other deleterious materials. The material shall have a minimum California Bearing Ratio of 55%, as determined by the current issue of ASTM D1883 at the specified compaction.

26.3 EXECUTION**26.3.1 Placement**

The granular base course material shall not be placed until the underlying subgrade or granular sub-base course has been inspected and approved by the Engineer. The subgrade or sub-base shall be shaped to cross section shown on the drawings, or as directed by the Engineer, and shall be maintained free of ruts, waves, and undulations by what ever means are necessary.

Unless otherwise specified, the granular material shall be placed in uniform layers not exceeding a 200mm compactive depth. The material shall be placed by mechanical spreaders or deposited in windrows and levelled with a suitable motor grader.

When called in the contract temporary material shall be placed from the granular base course level to the lip of gutter, with a 1% crown. The following year this material shall be excavated, reshaped and re-compacted prior to paving. Any additional material shall be used as sub-base material in lanes or as directed by the Engineer.

26.3.2 Compaction

The material shall be compacted by rolling with a pneumatic-tired or vibrating roller of a type approved by the Engineer. The material shall be compacted near the optimum moisture content to 100% Standard Proctor Density.

For temporary material, compaction shall be 95% Standard Proctor Density.

If the moisture content exceeds the optimum during compaction, the material shall be aerated by mechanical means until it has dried sufficiently to obtain the specified compaction.

If the moisture content is below the optimum, water shall be added by an acceptable applicator and in such quantities to achieve the specified moisture content.

26.3.3 Shaping and Finishing

A motor grader shall be used in conjunction with compaction equipment to keep the finished surface of each layer even and uniform.

The finished surface of the granular base course shall conform to the required cross-section and grade as shown on the drawings or as directed by the Engineer, within a tolerance of plus or minus 20mm.

The granular base course shall be uniform and show no signs of segregation of the material placed.

26.3.4 Tests

Field density, moisture content and sieve analysis tests will be carried out by the representative of the Engineer to ensure that the material is satisfactory.

The frequency of field density and moisture content tests shall be 1 test per approximately 100 meters of constructed roadway and at various locations offset left and right of centre line, or as directed by the Engineer.

The Contractor will, as the Engineer requires, provide a loaded gravel truck with operator for visual proof rolling of soft spots. The granular surface course shall show no visible subsidence of deflection under the wheels of the truck.

END OF SECTION

27. HOT MIX ASPHALTIC CONCRETE

27.1 GENERAL

27.1.1 Work Included

The work described in this section is that required for construction of a hot-mix asphaltic concrete surface course.

27.2 PRODUCTS

27.2.1 Aggregates

The Contractor shall submit to the Engineer at least ten (10) work days before start of paving, a mix design using the Marshall Method and performed by an independent testing laboratory acceptable to the Engineer. The Contractor shall submit a separate mix design for each change in the supplier or source of materials. No mixing of asphaltic concrete shall proceed until the job mix formula or any subsequent change is approved by the Engineer.

Preliminary approval of the aggregate as represented by the samples shall not constitute general acceptance of all material in the deposits or source of supply; acceptance shall be subject to field tests taken at the discretion of the Engineer.

Materials may be considered unsuitable even though particle sizes are within the limits of the gradation sizes required if particle shapes are thin or elongated or any other characteristic precludes satisfactory compaction, or if the material fails to provide a pavement suitable for traffic. The acceptability of the final material will be determined by the Engineer.

27.2.2 Gradation

Aggregate shall consist of hard, durable, uniformly graded, crushed gravel, free of coatings of silt or clay, and shall not contain organic or soft materials that break up when alternately frozen and thawed, or wetted and dried, nor other deleterious materials.

Coarse aggregate is aggregate retained on the 5 000 μm sieve. Fine aggregate is aggregate passing the 5 000 μm sieve.

The combined aggregates shall meet the following gradation requirements when tested to ASTM C136 and C117.

Sieve Size (μm)	% Passing by Mass
12 500	100
10 000	83 - 92
5 000	55 - 70
1 250	26 - 45
630	18 - 38
315	12 - 30
160	8 - 20
80	4 - 10

Additional properties that shall be met are as follows:

Plasticity Index:,	Non Plastic, ASTM D424-59
Los Angeles Abrasion Gradation "B":	35% maximum loss by mass, ASTM C131-76

27.2.3 Asphalt Cement

The asphalt cement shall be uniform in character, free of water and shall not foam when heated to 175 degrees Celsius and it shall have a penetration value of 150-200 dmm at 25°C and shall meet all specifications as to viscosity, flash point, thin film oven test and solubility established by Alberta Transportation for the Premium Grade 150 – 200 (A) Asphalt Cement.

27.2.4 Design Mix

A qualified testing laboratory engaged by the Contractor shall be employed to prepare a mix design and job mix formula for the aggregate on which the tender is based. The mix design and job mix formula shall be submitted to the Engineer for approval a minimum of 10 days prior to paving. No paving shall commence before the Engineer's approval is given for the mix design or job mix formula.

The laboratory mix design shall be based on the Marshall Method. Absorption of asphalt into the aggregate shall be taken into account using the ASTM bulk specific gravity of the aggregate in calculating optimum asphalt content.

The mix design shall meet the following specifications:

		Local Residential Only
Number of compaction blows each face of specimen:	75	50
Min. Stability (kN) at 60 degrees Celsius:	10	5.3
Flow (mm):	2 to 3.5	2 to 4
% Air Voids total mix:	3.5 to 4	3.5 to 4
% Voids in Mineral Aggregate (min):		
at 3.5% air voids	13.5	13.5
at 4% air voids	14	14
% aggregate Voids Filled with Asphalt:	65 to 75	65 to 78
Retained Stability (%) (min):	70	70
Minimum Theoretical Film Thickness (µm)		
Design Air Voids (%)		
4.0 and 3.9	6.0	6.5
3.7 and 3.8	6.1	6.6
3.5 and 3.6	6.2	6.7
Crushed Fragments: minimum material retained on the 5 000 µm with two crushed faces:	70	60
Manufactured fines content as a percentage of fine aggregate mass (minimum)	70	50

The mix produced shall conform to the job mix formula approved by the Engineer and to the following tolerances:

- a) The percent of asphalt in the mix shall not vary by more than 0.3% from the percentage indicated in the approved mix design.
- b) The mixing temperature for asphaltic materials shall not vary from those specified in the job mix formula by more than 9 degree Celsius. In no case shall the mixing temperature exceed the maximum mix temperature indicated from the asphalt temperature-viscosity curve data.

27.2.5 Data

The Contract shall make available to the Engineer any of the following upon request:

Temperature-viscosity data or curves, as obtained from the refineries, for the various grades and types of asphaltic material.

All test data performed by the testing company licensed to practice in the Province of Alberta.

27.2.6 Changes

The Contractor shall notify the Engineer of all proposed changes in the mix proportions. No changes shall be made until a representative of the Engineer is there to witness the change.

27.3 EXECUTION

27.3.1 Transportation

The mixture shall be transported from the mixing plant to the work in vehicles with tight metal bottoms previously cleaned of all foreign materials. The vehicle shall be suitably insulated, and each load shall be covered with canvas or other suitable material of sufficient size to protect it from weather conditions.

The inside surface of the box may be lubricated with a light coating of soap or detergent solution; petroleum derivatives shall not be permitted. Any accumulation of asphaltic material which has collected in the box shall be thoroughly cleaned before loading with hot mix. Trucks shall be clean of mud or any substance which could contaminate the working area.

27.3.2 Preparation of Existing Surface

General

Before the asphalt mix is placed, dirt and other objectionable material shall be removed from the surface to be paved, by brooming or other methods and a tack coat shall be applied .

Contact edges of existing mats and contact faces of curb, gutters, manholes, sidewalks and other structures shall be coated with a film of liquid asphalt material before placing the asphalt mix.

Preliminary Leveling

Areas that require preliminary levelling will be identified. Generally areas that show depressions, rutting or other deformations to a depth of 15 mm or greater will be designated for preliminary levelling and all the following shall apply for acceptance.

- a) asphalt mix for preliminary leveling shall be spread by means of a motor grader or other approved method.
- b) only pneumatic tired rollers will be allowed for compaction, and a minimum density of 91.0% of the Marshall density, is required.
- c) preliminary leveling is intended to be a separate operation and shall not be done as part of the construction of the subsequent lift of asphaltic concrete pavement.

27.3.3 Placing

Unless otherwise permitted by the Engineer, the mixture shall be spread by a mechanical self-powered paver, with an automatic leveling device and automatic grade control capable of spreading the mix without segregation or tearing, in thicknesses varying from 12mm to 150mm and in widths greater than 3.0m and to true line, grade and cross-section as shown on the plans.

The mixture shall be laid at a temperature not lower than 120 degrees Celsius or higher than 140 degrees Celsius. The air temperature shall not be less than 2 degrees Celsius and rising, no frost shall be present and the roads dry.

Where the asphaltic surface course is to be placed in 2 lifts, the first lift shall be placed, finished and compacted for the full width as shown on the drawings, prior to commencing on the second lift. The maximum lift thickness is 75 mm.

In placing the second lift, the individual mixture spreads shall be aligned in a manner such that the longitudinal joints in each layer will not coincide.

In narrow areas, deep or irregular sections, intersections, turnouts or driveways, where it is impractical to spread with a paver, the Contractor may use hand methods as directed by the Engineer.

27.3.4 Weather Limitations

The mixture shall not be placed:

- a) during periods of rain or when there is an imminent danger of rain;
- b) during excessive winds; or
- c) when air temperature is 2 degrees Celsius or cooler or frost is present on the surface.

27.3.5 Joints

The mixture shall be laid so that all longitudinal joints are made while the first mat of the 2 being laid is still hot. A narrow strip along the edge of a mat which is joined with another asphalt mat shall be left without rolling until the adjoining mat has been placed against it. The joint which is formed shall be rolled immediately after the adjacent mat has been placed to ensure a bonding of the material while the asphalt is still hot.

Transverse joints shall be carefully constructed and thoroughly compacted to provide a smooth-riding surface. Joints shall be straight-edged to assure smoothness and true alignment and shall be offset at least 1 meter from joints of adjacent mats.

All concrete or metal structures such as gutters, manholes, etc. shall be painted with an approved bituminous material prior to placing the asphalt.

27.3.6 Tolerance and Penalties

The pavement shall have the thickness specified on the Engineer’s drawings. Areas suspected to be deficient shall be cored, as directed by the Engineer, on the basis of 1 core for every 1000 square meters of pavement. At least 1 core shall be taken at the designated Marshall location.

Should the asphalt be found to be deficient in thickness, the Contractor will be permitted to take 2 additional cores in an effort to isolate and confirm the deficient areas. The location of the two additional cores shall be located no further than half way between the deficient core, and the next adjacent core, or contract boundary.

The exact location of the core locations are to be determined by the Contractor, and approved by the Engineer. The Contractor shall be responsible for all costs associated with the recoring of the asphalt.

A deficiency penalty shall be assessed according to the following:

Thickness Deficiency (mm)	Payment Reduction Factor %
0 to 5	0
6 to 9	10
10 to 12	25
13 to 15	50
Over 15	Remove and Replace

No additional payment will be made to the Contractor for greater thicknesses.

The Contractor shall fill all core holes within a maximum period of 24 hours.

27.3.7 Densities

Densities shall be based on core samples, each of which shall represent approximately 1000 square meters per constructed lift. Asphalt densities are specified as 97% of the standard laboratory Marshall. A minimum of 1 Marshall per day shall be performed with 1 core sample taken at a designated Marshall location.

If any core fails to meet the density specified, no more than 2 additional cores may be taken by the Contractor within 1 meter of the first core sample, and the average density of the three cores shall represent the area. No additional rolling to achieve a more favourable density shall be allowed WITHOUT THE WRITTEN CONSENT of the Engineer. The Contractor shall be responsible for all costs associated with the re-coring of the asphalt.

If the densities are less than specified, a deficiency penalty shall be assessed according to the following:

Field Density	Payment Reduction Factor (%)
97.0 to 96.6	0
96.59 to 96.1	3
96.09 to 95.6	12
95.59 to 95.0	25
<95.0	Remove and Replace

All asphalt below 95% standard Marshall density shall be removed and replaced at the Contractor's expense.

No adjustment to the unit price is to be made for areas with a density higher than that specified.

27.3.8 Smoothness

The surface of the compacted pavement shall be true to the required grade and cross-section with a smooth riding quality acceptable to the Engineer.

In addition to the above, when checked with a 3.0 meter straight-edge, held in successive positions parallel or perpendicular to the center line and in contact with the surface, the pavement surface shall not deviate from the straight-edge by more than 3mm.

If, in the opinion of the Engineer, an objectionable riding surface exists, the Contractor shall either grind and resurface with an asphalt overlay or remove and replace the asphalt surface.

27.3.9 Texture

The completed pavement shall have a tightly knit texture and shall be free from segregation and surface cracking. Mixes that are excessively tender or difficult to roll shall be redesigned by the Engineer in order to remedy the situation. The new design shall meet all of the requirements of this section, and shall be submitted to the Engineer for approval at least three (3) working days prior to its use.

27.3.10 Traffic

No traffic shall be allowed on the finished surface until it has cooled to atmospheric temperature.

END OF SECTION

28. PRIME, TACK AND FOG COATS

28.1 GENERAL

28.1.1 Definitions

Prime Coat:

Prime coat shall be the application of bituminous material to previously prepared granular base course, prior to placing bituminous surfacing materials.

Tack Coat:

Tack coat shall be the application of bituminous material to a previously constructed paving surface of any type in preparation of placing bituminous surfacing materials, and against curb and gutter faces, manholes, valves and other appurtenances in the street to be paved.

Fog Coat:

Fog coat shall be the application of bituminous material to seal small cracks and surface voids on surface materials.

Fog coat shall only be required if, in the opinion of the Engineer, the asphalt is open in texture.

28.2 PRODUCTS

28.2.1 Prime Coat

The bituminous material for priming the base course shall be liquid asphalt. The asphalt types may vary from medium curing (MC) type MC-30 to MC-250; from slow setting (SS) type SS-1 to SS-1H or a special emulsified asphalt primer S.E.P. to suit the condition of the base.

28.2.2 Tack Coat

The bituminous material for tacking the existing asphalt surface shall be liquid asphalt. The asphalt types may vary from rapid curing (RC) type RC-30 to RC-250; from slow setting (SS) type SS-1 to SS-1H depending on conditions to suit the base. The SS emulsion shall be diluted by adding an equal amount of water prior to application.

28.2.3 Fog Coat

The bituminous material for sealing the surface course if specified shall be liquid asphalt. The asphalt types may be slow setting (SS) type SS-1 or medium curing (MC) type MC-30 depending on the surface material to be sealed.

28.2.4 Sand Blotter

The materials for sand cover shall consist of clean granular mineral material approved by the Engineer, all of which shall pass a 5,000 sieve.

28.3 EXECUTION

28.3.1 Equipment

Cleaning equipment shall consist of power brooms, flushers, and whatever hand scrapers may be necessary to remove all foreign material.

The pressure distributor used for applying asphaltic material shall distribute the asphaltic material at an even temperature, uniformly on variable widths of surface up to 5 meters. Uniform spray without atomization shall be determined and controlled from 0.2 to 5.4 liters per minute (L/m) with uniform pressure, and with an allowable variation from any specified rate not exceeding 0.1 L/m.

Suitable means for accurately indicating the temperature of the asphaltic material shall be provided at all times. The thermometer well shall be so placed as not to be in contact with a heating tube.

If provided with heating attachments the distributor shall be so equipped and operated that the asphaltic material shall be circulated or agitated throughout the entire heating process.

28.3.2 Preparation

Immediately prior to applying the asphalt primer, tack or fog coat, the surface shall be brought to uniform cross-section by patching all depressions and defective areas using an approved patching material and by removing all bumps and irregularities.

All loose and foreign material shall be removed by light sweeping.

28.3.3 Application

Obtain Engineer’s approval of existing surface before applying asphalt prime, tack or fog coats. Clean surface as required.

Upon the prepared surface the asphalt shall be applied uniformly at a rate of from 0.50 to 1.50 litres/square meter (L/m²) for asphalt primer, and at a rate of from 0.25 to 0.90 L/m² for tack coat. The asphalt primer, tack or fog coat shall be applied only when the surface is dry or slightly damp, unless otherwise allowed by the Engineer in writing, or only when the air temperature in the shade is above 10°C.

The application temperature of the asphalt primer, tack or fog coat shall be as follows:

Rapid Curing Asphalt:	
RC-30	51 – 68°C
RC-70	74 – 88°C
RC-250	100 – 110°C
Medium Curing Asphalt:	
MC-30	51 – 68°C
MC-70	74 – 88°C
MC-250	100 – 110°C

Emulsified Asphalt:	
SS-1	20 – 50°C
SS-1H	20 – 50°C
Special Emulsified Primer Asphalt	
S.E.P.	15 – 50°C

Coat contact surfaces of curbs, gutters, headers, manholes and like structures with a thin uniform coat of asphalt material. Do not prime or tack surfaces that will be visible when paving is complete. Work adjacent to the roadway shall be completely protected from the application operation by a suitable covering. Any unnecessary splashing of the concrete shall be cleaned.

Do not apply asphalt coat when air temperature is less than 5°C or when rain is forecast within 2 hours.

The Contractor shall maintain the primed surface until the surface course has been placed. Maintenance shall include spreading any additional sand and patching any breaks in the primed surface with additional asphaltic material.

The asphalt primer should preferably be entirely absorbed by the base course and therefore require no sand cover. If, however, the asphalt has not been completely absorbed 24 hours after application, just sufficient sand shall be spread over the surface to blot up excess asphalt and prevent it from being picked up by any traffic.

Traffic shall not be permitted to travel on tack or fog coat until cured. The Contractor shall use flagmen, if required, and signage to control traffic until the tack or fog coat has cured.

Traffic shall not be permitted to travel on prime coat until 6 hours after application or until it has cured. After this period of time, excess asphalt material remaining on the surface shall be blotted by sand before traffic is permitted to travel on the surface.

END OF SECTION

29. PAVEMENT MARKINGS

29.1 GENERAL

29.1.1 Samples

If requested by the Engineer, submit the following material sample quantities at least 4 weeks prior to commencing work.

- a) Two 1 L samples of each type of paint.
- b) One 1 kg sample of glass beads.
- c) Sampling to CGSB 1-GP-71.

Mark samples with name of project and its location, paint manufacturer's name and address, name of paint, CGSB specification number and formulation number and batch number.

29.2 PRODUCTS

29.2.1 Painted Markings

To CGSB 1_GP_74M, alkyd traffic paint.

Colour: to CGSB 1_GP_12C, yellow 505_308, white 513_301.

Thinner: to CAN/CGSB_1.5.

29.2.2 Permanent Markings

The use of other permanent marking materials that do not meet the following requirements will be subject to approval by the Engineer. Acceptance during the warranty period will be based on the following:

- a) not lift from the pavement,
- b) exhibit no material loss within 4 weeks of installation,
- c) not deteriorated by contact with sodium, calcium chloride or traffic residue,
- d) show no appreciable deformation or discoloration under exposure to traffic and road temperatures between -40°C and 40°C and,
- e) maintain their original dimension and placement without chipping or cracking.

Cold Plastic Marking: two-component, cold-extruded and cold-curing, having a specific gravity of 1.9 minimum at 25°C .

Hot Thermoplastic Marking: hot-extruded, having a specific gravity of 2.0 minimum at 25°C , having a softening point of 90°C minimum according to ASTM E28.

Both cold and hot plastic markings shall conform to the following:

- a) Water Absorption: 0.5% maximum by mass retained water after 24 hour immersion, according to ASTM D570 Procedure A.

- b) Impact Resistance: minimum 1.13 J at 25°C when material is cast into bar of 25 mm² cross-section by 75 mm long, with 25 mm extending above vice jaws in a cantilever beam (Izod type) tester using the 2.82 J scale, according to ASTM D256 Method C.
- c) Abrasion Resistance: maximum weight loss of 0.50 g when subjected to 200 revolutions on Taber abrader at 25°C using H-22 Calibrade wheels weighted to 500 g with sample kept continuously wet with distilled water. Prepare test sample with representative material placed on 100 mm square plate, 3 ±0.1 mm thick.
- d) Chemical Resistance: Test samples of 50 mm square, no degradation after exposure to:
 - 1) 24 hours immersion in 5% NaCl.
 - 2) 24 hours immersion in 5% CaCl.
 - 3) 1 hour spot test with mineral oil.
- e) No deterioration when in direct contact with asphalt cement in asphalt materials, or with sodium chloride, calcium chloride or other de-icing chemicals.
- f) Non-toxic and not harmful to persons or property when in hardened state.
- g) No discoloration from sunlight ultraviolet exposure and no bond failure for warranted life of material.

Glass Beads: minimum 80% true spherical shape; clear of cloudiness, dark inclusions, trapped air, or other defects; and conforming to the following:

- a) Index of Refraction: 1.5 minimum when tested in liquid immersion at 25°C according to CGSB 1-GP-71 Method 49.1.
- b) Gradation of glass beads for mixing with and for surface application on thermoplastic material, tested according to ASTM D1214:

Sieve Size (mm)	% Passing by Mass
850	90 – 100
300	15 – 50
180	0 – 10

Premarking Paint: as reviewed by Engineer.

Groove Filler: LRS 424 or approved equal.

29.3 MIX FORMULATION

Glass Sphere Content: minimum 20%, maximum 30% by mass of thermoplastic material.

White Colour: brilliant white, 70% minimum when measured with the Gardner Multi-Purpose Reflectometer 0, 45° daylight luminous directional reflectance, with a green filter.

Yellow Colour: conforming to CGSB Colour #505-308 or U.S. Federal Standard 595a, Colour Chip 33538, 45% minimum when measured with the Gardner Multi-Purpose Reflectometer 0, 45° daylight luminous directional reflectance, with a green filter. Colour tolerance to be within limits of U.S. Department of Transport Yellow Tolerance Chart PR#1 December 1972.

No formulation change unless approved by Engineer. Any significant change will be subject to field trials.

29.4 EXECUTION

29.4.1 Equipment Requirements

Paint applicator to be an approved pressure type distributor capable of applying paint in single, double and dashed lines. Applicator to be capable of applying marking components uniformly, at rates specified, and to dimensions as indicated, and to have positive shut-off.

Grooving machine subject to Engineer's approval.

29.4.2 Condition of Surfaces

Pavement surface to be dry, free from ponded water, frost, ice, dust, oil, grease and other foreign materials.

Remove conflicting markings.

29.4.3 Traffic Control

Conduct all traffic control to the requirements as specified.

29.4.4 Paint Application

Lay out pavement markings and review with Engineer.

Apply paint only when air temperature is above 10°C, wind speed is less than 60 km/h and no rain is forecast within next 4 hours.

Apply traffic paint evenly at rate of 3.0 m²/L.

Paint lines to be of uniform colour and density with sharp edges.

Thoroughly clean distributor tank before refilling with paint of different colour.

29.4.5 Cold Plastic Application

Mix components and apply cold plastic marking according to manufacturer's surface application procedure, to a thickness of 2 mm minimum and 3.0 mm maximum.

Apply when ambient temperature is between -10°C and 30°C.

Apply glass beads to surface of extruded material before it has set, at a rate of 140 to 250 g/m².

Let marking cure into a hardened state.

29.4.6 Hot Thermoplastic Application

Cut groove into pavement surface to designated width and depth. Remove grindings and haul to designated location. Sweep or airblast groove clean and dry.

Heat material and apply according to manufacturer's hot extrusion process.

Fill groove with hot molten material. Do not overfill more than 3.0 mm above pavement surface.

Apply glass beads to surface of extruded material while it is still molten at a rate of 140 to 250 g/m².

Trim surplus material to give clean straight edges.

Let marking cool to a hardened state.

29.4.7 Protection and Cleanup

Do not permit traffic over applied markings until they have adequately hardened.

Protect surrounding areas and structures from disfiguration and damage. Repair any damage as directed by the Engineer.

On completion of work, clean up and leave site free of debris and waste matter.

29.4.8 Tolerance

Painted Marking:

Paint markings to be within plus or minus 12 mm of dimensions indicated.

Remove incorrect markings.

Cold Plastic Marking:

Measurement: The quality assurance laboratory will measure suspect markings with a surface micrometer. The average of 5 measurements will represent 300 m of marking, or one job site, whichever is less.

Thickness Deficiencies: Where a significant number of deficiencies occur in the work, involving average thicknesses greater than 3.0 mm or less than 1.8 mm, the Engineer may order removal and replacement, or application of additional material.

If surface dishing deeper than 0.5 mm occurs, the Engineer may order removal and replacement.

The quality assurance laboratory will determine the width of suspect markings by the average of 5 measurements representing 300 m of marking, or one job site, whichever is less.

Hot Thermoplastic Marking

Measurement: The quality assurance laboratory will core suspect markings. The average thickness of 3 cores will represent 300 m of marking, or one job site, whichever is less.

Overfill Thickness: That portion of marking above pavement surface will receive no additional payment. If overfill exceeds 3.0 mm, the Engineer may order removal and replacement of marking.

Groove Thickness Deficiencies: Where a significant number of deficiencies occur, involving average thicknesses less than 70% of that specified, the Engineer may order removal and replacement.

If surface dishing deeper than 0.5 mm occurs, the Engineer may order removal and replacement. Variations in asphalt surface profile may be taken into consideration.

The quality assurance laboratory will determine the groove width of suspect markings by average measurement of 3 cores representing 300 m of marking, or one job site, whichever is less.

Width Deficiencies

Where a significant number of deficiencies occur greater than 10 mm in average widths of cold plastic, or in average groove widths of hot thermoplastic, the Engineer may order removal and replacement.

29.5 PROTECTION OF COMPLETED WORK

Protect pavement markings until dry.

END OF SECTION

30. CURB, GUTTER & SIDEWALKS

30.1 GENERAL

Products, Concrete Materials, Execution and Methods of Concrete Construction shall be in accordance with CSA CAN3-A23.1 or as modified in this section.

30.1.1 Work Included

The work described in this section pertains to the construction of concrete curbs, gutters, sidewalks, crossings and paving stones.

30.2 PRODUCTS

30.2.1 Portland Cement

- a) Portland cement shall conform CAN 3 – A5M, latest revision thereof. All concrete shall be made with type 50 sulfate resistant cement
- b) Portland cement shall meet the requirements of CSA Standard Portland A5-M cement and shall be Type 10 normal (after September 15).

30.2.2 Aggregates

The fine and coarse aggregate used in the concrete mix shall conform to the following specifications:

- a) Fine Aggregate: CSA CAN3-A23.1, Clause 5.3.
- b) Coarse Aggregate: CSA CAN3-A23.1, Clause 5.4. Table 2 Group 1 (28-5)

<u>Sieve Size</u>	<u>% Passing by Weight</u>
40 mm	100
28 mm	95 – 100
14 mm	30 – 65
5 mm	1 – 10
2.5 mm	0 - 5

30.2.3 Admixtures

All admixtures used to enhance the concrete shall conform to the following specifications:

- a) Air Entrainment: ASTM C260
- b) Chemical: ASTM C494
- c) Calcium Chloride: ASTM C494

The use of calcium chloride shall only be used when approved by the Engineer, but in no case will the amount added be greater than 2% of the cement weight. It shall not be used when the air temperature is above 4°C.

- a) Fly ash shall not exceed 10% by weight of cement, and it shall conform to the requirements of CAN/CSA-A23.5. Only approved compatible superplasticizing admixtures and air entraining agents shall be used with the fly ash. The Engineer may require characteristic

data for fly ash to prove conformance to the standards. After September 1st no portion of the specified cement content may be replaced with fly ash unless approved in writing.

30.2.4 Reinforcing Steel

Reinforcing bars shall be deformed bars in accordance with CSA Standard Specification G30.12-M1977.

Cold drawn wire or welded wire fabric for concrete reinforcement shall be 150x150 and conform to the requirements of CSA Standard Specification G30.3-1972.

30.2.5 Expansion Joint Filler

Joint filler shall conform to CGSB Standard Specification for polyurethane sealing compound #19-GP-15 or ASTM Standard Specification for SIKA FLEX 1A.

30.2.6 Membrane Curing Compound

Resin-base impervious curing compound shall conform to ASTM Standard Specification C309 Type 1D-Type B. The curing compound shall contain white fugitive dye.

30.2.7 Preformed Expansion Joint Filler

Preformed expansion joint filler shall conform to ASTM Standard Specification D-1752.

30.2.8 Concrete

Concrete mixes shall be designed by a qualified testing laboratory engaged by the Contractor. The mix design shall be submitted to the Engineer for approval a minimum of 10 days prior to delivery of any concrete to the site. The specified compressive strength at 28 days shall be 30Mpa. The strength level of 30Mpa shall be considered to be achieved if averages of all sets of 3 consecutive strength tests equal or exceed the specified strength, and no individual strength test is less than 20Mpa.

The concrete shall contain not less than 315kg of Portland Cement per cubic meter of concrete produced.

The air content of the concrete shall be maintained between the limits of 6-8%.

The minimum slump permissible will be that which will allow the concrete to be placed efficiently and provide a homogeneous mass. The maximum allowable slump shall be 70mm +/- 10mm for all hand-poured concrete and 40mm +/-10mm for all machine-poured concrete.

30.2.9 Retempering With Air

If, due to a low air entrainment percentage, as specified, the Engineer feels it is necessary to add an approved air-entraining agent on site, placement of concrete shall stop to allow the concrete truck's drum to turn at mixing speed for a minimum of 3 minutes. Should the air content of the concrete not conform to specifications after retempering, then the concrete shall be rejected.

The Engineer has the right to withdraw permission to add an air-entraining agent to the mix and reject the concrete if this practice is being abused.

30.2.10 Retempering With Water

If, due to a low slump as specified, the Engineer feels it is necessary to add water to the mix, it shall be injected into the drum under such pressure and direction of flow that it conforms to the specifications in ASTM C-94, Appendix XI. Placement of concrete shall stop at that point to allow the concrete truck's drum to turn at mixing speed for a minimum of 3 minutes. Should the slump of the concrete not conform to specifications, after retempering, then the concrete shall be rejected.

The Engineer has the right to withdraw permission to add water to the mix and reject the concrete if this practice is being abused.

30.3 EXECUTION

30.3.1 Placing Concrete

Concrete shall not be placed until the subgrade, sub-base and base course materials have been completed, and approved by the Engineer. The base shall be sufficiently moist to prevent absorption of water from the concrete, and free from mud or water pondage.

The concrete shall be placed within 90 minutes of initial mixing at the plant, or before the drum on the concrete truck has turned 300 revolutions. Complete discharge of concrete shall not exceed 2 hours. The concrete shall be transported by methods which will prevent segregation and deposited on the subgrade so that as little handling as possible is required.

Concrete shall be placed continuously until a complete section between expansion joints has been poured.

The concrete shall be thoroughly consolidated against and along the faces of the forms. Hand spreading shall be done with shovels, not with rakes, in order that the concrete will not be segregated. Precautions should be taken to prevent overworking of the concrete.

Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods which shall prevent the separation or loss of the ingredients. It shall be deposited in the forms as near as practicable to its final position to avoid rehandling.

The sequence of concrete placement shall be arranged so that concrete which has partially hardened shall not be subjected to injurious vibration.

The vertical free fall height of concrete shall not exceed 1.0m. For falls greater than 1.0m chutes or tremies shall be used.

During placement, concrete shall be sufficiently tamped or vibrated with suitable equipment to secure a close bond with the reinforcement, eliminate entrapped air voids and ensure a homogeneous structure with adequate consolidation.

The rate of delivery of mixed concrete shall be such that the interval between the placing of successive truck loads shall not exceed 30 minutes. If the time exceeds 30 minutes, then a construction joint shall be formed.

After the initial set of the concrete, neither the forms or the concrete structure shall be jarred and no strain shall be placed on the ends of projecting reinforcement.

Construct all pararamps and crossings monolithically to the dimensions and at locations specified.

30.3.2 Joints

Curb, gutter and sidewalk contraction joints shall be constructed at 3.0m intervals and as detailed on the standard drawings, and shall not be less than 50mm deep. Contraction joint widths shall not be greater than 5mm.

Midway between each contraction joint on the sidewalk, a surface joint, 13mm deep, shall be constructed. These joints shall not extend into curb and gutter.

A surface joint shall be constructed longitudinally at the location shown on the standard drawings and shall continue through all driveways and lane crossings.

A construction joint shall be formed at the end of every pour. This joint shall be constructed in a "V" shape, as directed by the Engineer, and using 10 M rebars 600mm long, spaced every 500mm.

10 M bars at 500mm on centre shall be dowelled and epoxied into the back of the existing curb prior to placing concrete.

30.3.3 Finishing

Sidewalk surfaces, either separate or monolithic with curb and gutter, shall be struck off and screeded to the slope, cross-section and elevation shown on the drawings or as directed by the Engineer. The surface shall be consolidated and smoothed using a wood float. Light-steel trowelling shall be used followed by a uniform brush finish. Sidewalk shall be edged at all joints to prevent chipping of the concrete.

The exposed surfaces of concrete curbs and gutters, either separate or monolithic with sidewalks, shall be finished by means of a wood floating, light-steel trowelling and uniform brushing, and all edges shall be rounded to the required radius. No patching will be allowed.

Pararamps, and crossings to lanes and private property shall be struck off and screeded to the required slope and cross-section. The finished surface shall be brushed as specified above.

All edges, including contraction or surface joints, shall be tooled for a width of 50mm and rounded to a radius of 6mm. The brush grooves shall be transverse on the sidewalk and longitudinal on the curb and gutter. The finished surface shall have no exposed aggregate or honeycomb.

If there is evidence of excess water on the concrete surface, finishing shall be delayed until the excess water has evaporated.

Surface grooves made by the broom shall not be more than 3 mm deep. Before brushing, all surplus water shall be removed from the brush.

30.3.4 Curing

Immediately after finishing, the concrete surface shall be protected by applying a membrane curing compound. After finishing and removal of forms if necessary, all exposed surfaces shall be wetted with water and then thoroughly sprayed with membrane curing compound. The membrane curing compound shall be applied in accordance with the manufacturer's instructions with an approved pressurized spray.

The curing compound shall be applied in such a manner as to cover the entire surface thoroughly and completely with a uniform film at a rate which shall depend on the roughness of the surface of the concrete, but in no case at less than 0.25 liters per square meter of concrete surface.

30.3.5 Backfilling

Unless otherwise directed by the Engineer, the Contractor shall backfill along the back of the curb edges, to the top of the concrete, within 3 to 7 days of the placing of the concrete. The backfill shall be mechanically tamped in maximum lifts of 150mm, to a minimum of 95% Standard Proctor Density and to a distance of 300mm from the back of the walk or curb.

Where landscaping is to be carried out immediately after completion of the walks or curbs and gutters, the backfilling shall be left 100mm low to allow for the topsoil.

30.3.6 Forming

Forms shall be steel or wood of sufficient strength to resist the pressure of wet concrete, and the supply shall be sufficient to permit their remaining in place until hydration has occurred, or longer if the Engineer considers it necessary. The Contractor shall remove all face forms to allow for a smooth brush finish. The use of bent, twisted, battered or worn-out forms will not be permitted. Forms will be checked for alignment and elevation by the Engineer before concrete is poured, and shall be cleaned and oiled before each use.

Where required, reinforcement shall be secured in the location shown on the standard drawings and shall be free from mill scale, grease and rust prior to placing concrete. Forms shall be held securely by approved methods to prevent movement and bulging when the concrete is placed. Forms must be approved by the Engineer before concrete is poured.

Curbs having a radius of less than 40m shall be constructed with flexible forms. A sufficient length of form (not less than 50 meters) shall be placed and checked before concrete is poured to ensure true line and grade. The forms shall be well staked, braced or otherwise held rigidly true to the established line and grade. The Engineer may, at any time, reject the use of any forms considered unsatisfactory.

30.3.7 Mechanical Extruding Machines

Slip-form paving machines or concrete, extruding machines may be used for placing concrete provided they have received the approval of the Engineer prior to commencement of the work and meet the following requirements:

- a) The vibrators on the equipment shall be capable of producing a dense mass with a smooth surface, free of honeycombing.
- b) The equipment shall include automatic grade and line controls which shall be used at all times.

Commence placement of concrete only after the subgrade has been prepared and approved by the Engineer.

Any special grading or preparation of the base required by the Contractor to accommodate equipment shall be the responsibility of the Contractor, and shall restore the roadway and boulevards to their original condition within 3 to 7 days of the initial disturbance.

The extruded concrete shall be checked for alignment and elevation by the Engineer while the concrete is being placed. All incorrectly placed or misaligned work shall be immediately removed while the concrete is still wet, and the work redone to the proper specifications using whatever means are required.

Whenever possible, the forming and placing of concrete by conventional hand pouring methods (as may be required at corners, crossings and catch basins) shall be carried out in conjunction with the extruding machine operation. Where this procedure is not practical, the "tie-ins" shall be completed within 3 days of construction of the adjacent extruded section, using 10 M rebar at all joints. All "tie-ins" shall be completed in 1 continuous pour.

30.3.8 Consolidation

The concrete shall be consolidated by means of an approved vibrating screed or, in the case of curb and gutter only, by means of a poker or pencil vibrator not exceeding 50mm in diameter.

Particular care shall be given to placing and tamping along the faces of the forms to ensure a dense, smooth surface.

Vibrations shall be of sufficient duration to thoroughly compact the concrete but not long enough to cause segregation. Vibrators shall not be used for moving concrete.

30.3.9 Inspection

All exposed concrete surfaces shall be checked by the Contractor with a 3m straight-edge, and any water pockets or deviations in line or grade exceeding a total of 6mm shall be corrected immediately.

Differences in elevation at any given point from that given by the design shall not exceed 13mm, and the maximum variation shall not be greater than 13mm.

Deviations in horizontal alignment at any given point from that given by the design shall not exceed 25mm, and the fluctuations in the horizontal alignment shall not be greater than 25mm.

Concrete not meeting the above criteria shall be replaced.

30.3.10 Field Tests

Testing shall be performed by a qualified CSA testing laboratory in accordance with the following:

- a) Samples of concrete shall be obtained in accordance with CSA Test Method A23.2-1C for sampling plastic concrete.

- b) Test cylinders shall be made and stored in accordance with CSA Test Method A23.2-3C. No less than 1 strength test shall be made from samples from each 150 cubic meters of concrete placed, and in no case shall there be less than 1 test from each day's pour. Each strength test shall consist of 3 test cylinders, 1 tested at 7 days and 2 at 28 days.
- c) Air content determinations shall be made in accordance with CSA Test Method A23.2-7C, air content of plastic concrete by the volumetric method.

During construction start-up, every load or batch of concrete shall be tested until such time as satisfactory control of the air content has been established. Air content tests taken with the test cylinders will be sufficient once satisfactory control has been established. Whenever a test falls outside the specified limits, the testing frequency shall revert to 1 test per load or batch until satisfactory control is re-established. Any concrete that falls outside specified air control levels shall be rejected from use.

Slump tests made in accordance with CSA Test Method A23.2-5C, Slump of Concrete, shall be made in conjunction with each strength test.

30.3.11 Cleanup

As the work progresses, the Contractor shall clean up the site, and all areas in which work has been done shall be left in a neat and presentable condition. All gutters and street drainage ditches that have been blocked as a result of the Contractor's operation shall be restored or repaired.

The Contractor shall dispose of all surplus excavated material, organic soil, rock, boulders and pieces of concrete and masonry at an approved location.

30.3.12 Protection

The Contractor shall be responsible for keeping all animals and pedestrians off the newly constructed sidewalks or curb until completely set. The Contractor shall also be responsible for keeping all vehicles off the work for a period of 3 days after the concrete has been finished.

30.3.13 Deficiency Penalty

Where there are variations from specified design strength, the following Deficiency penalty shall be assessed based on the 28-day, laboratory-cured cylinders.

- a) When the concrete strength of any set exceeds 95% of design strength, no deficiency penalty will be administered.
- b) When the concrete strength of any set is greater than 80% but less than 95% of design strength, the deficiency penalty will be administered as follows:

$$Q \left[P \times \frac{2(A - B)}{A} \right]$$

- Where:
- P = unit price
 - A = specified strength
 - B = average 28 day cylinder strength
 - Q = quantity of deficient concrete

- c) If the concrete strength of any set is less than 80% of design strength, the work represented by that set of cylinders will be rejected and replaced by the Contractor.

END OF SECTION

31. REGULATORY ROADWAY SIGNS

31.1 GENERAL

31.1.1 Design Requirements

Sign supports and appurtenances to be capable of withstanding summation of following loads:

- a) Wind and ice loading specified to be consistent with anticipated loads in locality of installation. Refer to National Building Code of Canada and/or applicable provincial building code.
- b) Dead load of signboards, sign supports and appurtenances.
- c) Ice load on one face of signboards and around surface of all structural members and appurtenances.

Structural deflections and vibration in accordance with American Association of State Highway and Transportation Officials (AASHTO), "Specifications for the Design and Construction of Structural Supports for Highway Signs".

31.1.2 Shop Drawings

Submit shop drawings for signage structures indicating product data and design.

31.2 PRODUCTS

31.2.1 Sign Supports

Steel posts: to CAN_G40.21, 3.1 m long, flanged "U" shaped in cross section, measuring 65 mm wide by 30 mm deep. Metal thickness: 4.5 mm. Hot dipped galvanized: to CAN/CSA_G164

Base plates for mounted signs: to ASTM B209M.

Fasteners: bolts, nuts, washers and other hardware for roadside signs to be cast aluminum alloy, or galvanized steel.

31.2.2 Signboards

Aluminum sheet shall be tension leveled, sign grade aluminum and conform to ASTM B209M, Alloys 6061-T6 or 5052-H38 pre-cut to required dimensions. Minimum thickness to be 1.6 mm for signboards up to 750 mm wide. Minimum thickness to be 2.0 mm for signboards 750 to 1200 mm wide.

Connecting straps and brackets to ASTM B209M.

Reflective sheeting shall meet or exceed the minimum requirements specified in ASTM-D4956 Performance Requirements Type III, High Intensity Retro reflective Sheeting.

31.2.3 Fabrication

Signboards:

Aluminum blanks: Degrease, etch and bonderize with chemical conversion coating. Clean surfaces with xylene thinner. Dry. Aluminum signboards are to be painted before installation.

Spray and bake face of signboards with two coats of enamel in accordance with CAN/CGSB_1.104.

Sign identification:

Apply sign number and date of installation with 25 mm high stencil painted black letters on lower left back face of each signboard.

31.3 EXECUTION

31.3.1 Installation

Sign Support:

- a) Erect supports as indicated. Where separate concrete footings have been placed, erect posts with base plates resting on aluminum nuts and restrained with nuts and washers.
- b) Coat underside of base plate with corrosion protective paint before installation.
- c) Close open aluminum tubes and posts with aluminum cap.
- d) Erect posts plumb and square to details as indicated.
- e) Single channel steel posts are to be driven to required depth without damage to posts. If rock or concrete is encountered, auger hole to required depth and set post in sand.
- f) In finished concrete or asphalt surfaces, backfill with concrete or grout. Protect from adverse conditions until cured.
- g) Wooden post installations are to be excavated with an auger. Compact bottom of hole to provide firm foundation. Set post and backfill in 150 mm layers with excavated material. Compact each layer before placing each subsequent layer.
- h) Permissible tolerance is ± 12 mm departure from vertical.

Signboard:

- a) Fasten signboards to supporting posts and brackets as indicated.
- b) Use strapping with crimped or bolted connections where signs fastened to utility poles.

31.3.2 Protection

Place temporary covering on signboards where required. Covering to be capable of withstanding rain, snow and wind and be non-injurious to signboard. Replace deteriorated covering and remove covers as reviewed by Engineer.

31.3.3 Correcting Defects

Correct defects, identified by Engineer, in consistency of reflectivity, colour or illumination.

END OF SECTION

32. ASPHALTIC CONCRETE PAVEMENT MILLING

32.1 GENERAL

This section specifies requirements for milling or grinding existing asphalt pavement to lines, grades, and typical cross sections indicated on plans or as established by the Engineer.

32.1.1 Protection

Protect existing pavement, utility appurtenances, traffic detector loops, home runs, light units, and structures from damages. In event of damage immediately replace or make repairs to approval of the Engineer and at no additional cost to the Owner.

32.2 EXECUTION

32.2.1 Preparation

Inspect site and verify with the Engineer areas designated for milling.

Arrange for temporary traffic control in areas where signal light traffic detector loops and home runs are to be removed.

32.2.2 Equipment

Use cold milling or grinding equipment capable of removing part of asphalt pavement surface to depths or grades indicated with a tolerance of +/- 10mm within areas designated.

Sweeping and collecting equipment capable of removing all residue from planning operation.

Apply water as necessary during milling operation to suppress dust.

32.2.3 Asphalt Removal

Mill asphalt pavement to grade and cross section dimensions indicated or as directed by the Engineer.

Exercise care to avoid disturbance to pavement or other work designated to remain.

Keep drainage system clear of loose and waste materials.

Asphalt is to be removed to a uniform level including areas surrounding valves, manholes or other appurtenances.

Remove all residue materials resulting from milling operation.

Milling may be restricted on designated roads and streets with particular time frames throughout the week. The Contractor shall abide by these restrictions.

Surface to be left in a condition that can be reopened to traffic following removal of grindings.

32.2.4 Disposal of Materials

Removed pavement material is the property of the Owner and is to be stockpiled at a location designated by the Engineer.

32.2.5 Finish Tolerances

Milled surfaces to be within +/- 10mm of specified grade but not uniformly high or low.

END OF SECTION

33. ASPHALT PAVEMENT CRACK ROUTING AND SEALING

33.1 GENERAL

The Work Consists of routing, cleaning and drying cracks in pavement surfaces, supplying crack sealant material and sealing the routed cracks with the sealant.

33.2 MATERIAL

Hot poured rubberised asphalt products generally accepted for this work are Husky 1G11, CRAFCO 522, KOCH 9030 or Beram 195LM.

The use of other materials will be subject to the approval of the Engineer. In situations where the Contractor obtains approval to use a material not included in the above list, he shall provide the Engineer with the following information 5 days prior to commencing the Work:

- a) Name and mailing address of the crack sealant supplier and manufacturer
- b) Name of crack sealant product to be supplied
- c) Written confirmation from the manufacturer that the crack sealant to be supplied meets all specified requirements along with test results that demonstrate that the product meet all specified requirements.

The Contractor shall verify that the crack sealant delivered and used in the Work is the type and grade ordered.

33.3 PROCEDURE

No Work shall be performed during rain or snow or when the pavement surface is wet.

The crack sealant shall not be applied when the pavement temperature is below 10 Celsius.

Unless otherwise directed by the Engineer, all cracks between 2mm and 12mm in width shall be routed and sealed. All cracks shall be routed to a minimum width of 20mm and a depth of 10mm.

Prior to the application of crack sealant, the entire road surface shall be cleaned ensuring all loose material and moisture is removed from the routed cracks and surrounding areas.

Crack sealant shall be heated and applied in accordance with the manufacturer's recommendations. Routed cracks shall be filled with crack sealant such that upon cooling the sealant shall not be more than 3mm below the pavement surface.

Excessive crack sealant shall be removed from the pavement surface immediately following application. Traffic shall be kept off sealed cracks until the crack sealant has cured. At locations such as intersections where this is not practical, the Contractor shall prevent tracking by applying a blotting agent to the crack sealant. When a blotting agent is used, it shall not be applied until the sealant has cooled sufficiently to prevent inclusion of the blotting agent into the sealant.

When necessary, the Contractor shall supply one of the following blotting agents:

- a) Screened sand with a maximum topsize of 2mm
- b) Cement
- c) Flyash

The use of other blotting agents shall be subject to the approval of the Engineer.

Fuel, asphalt and any other spills shall be cleaned up to the satisfaction of the Engineer at the Contractor's expense.

33.4 SAMPLING AND TESTING

The Contractor shall supply material samples to the Engineer for QA (Audit) testing purposes when requested.

33.5 ACCEPTANCE CRITERIA

Evaluation of the Work will be based on a visual inspection by the Engineer. To be acceptable, the Work must conform with the following:

- a) All routed cracks conform with the specified rout profile
- b) The rout conforms to the path of the crack with no part of the crack outside or touching the edge of the rout cross section
- c) all routed cracks have been sealed
- d) at least 95% of the cracks treated have been filled with an adequate amount of crack sealant material.

Failure to comply with the acceptable criteria will result in the Contractor re-treating all failed cracks at his own expense.

END OF SECTION

34. ASPHALTIC PAVEMENT CRACK SEALING

34.1 GENERAL

The work consists of supplying crack sealant and sealing cracks in asphalt concrete pavement.

34.2 MATERIALS

The type and grade of asphalt/emulsified asphalt material generally accepted for this work are Alberta Transportation designated EC101 or HC200.

The use of other materials will be subject to the approval of the Engineer. In situations where the Contractor obtains approval to use a material not included in the "Recognized Products List", he shall provide the Engineer with the following information 5 days prior to commencing the Work.

- a) Name and mailing address of crack sealant supplier and manufacturer
- b) Name of crack sealant product to be supplied
- c) Written confirmation from the manufacturer that the crack sealant to be supplied meets all specified requirements along with test results that demonstrate that the product meets all specified requirements.

The Contractor shall verify that all crack sealant delivered and used in the Work is the type and grade ordered.

34.3 PROCEDURE

No Work shall be performed during rain or snow or when the pavement surface or cracks are wet.

Crack sealant shall not be applied when the atmospheric temperature at the work site is below 10 degrees Celsius.

All cracks within the entire width of the pavement surface, which are between 5mm and 25mm in width, shall be sealed.

Prior to the application of crack sealant, the Contractor shall ensure that the road surface adjacent to the cracks is clean.

Hot Pour crack sealant shall be heated to the temperature specified by the manufacturer. Overheating will not be permitted.

Crack sealant shall be applied within the manufacturer's specified temperature range. Crack sealant shall be applied so that the crack is flush filled immediately following application and a thin overband of sealant extends approximately 25mm beyond the edges of the crack. Excess crack sealant shall be removed from the pavement surface immediately following application. Removal shall involve the use of a squeegee, starting from the centreline and proceeding to the shoulder.

Traffic shall be kept off sealed cracks until the crack sealant will not track under action of traffic. At locations such as intersections where this is not practical, the Contractor shall prevent tracking by applying a blotting agent to the crack sealant.

When necessary, the Contractor shall supply one of the following blotting agents:

- a) screened sand with a maximum topsize of 2mm
- b) cement
- c) flyash

The use of other products shall be subject to the approval of the Engineer.

Fuel, asphalt and other spills shall be cleaned up to the satisfactory of the Engineer at the Contractor's expense.

34.4 SAMPLING AND TESTING

The Contractor shall supply material samples to the Engineer for QA (Audit) testing purposes when requested.

34.5 ACCEPTANCE CRITERIA

Evaluation of the Work will be based on a visual inspection by the Engineer. To be acceptable, all applicable cracks must be treated as specified herein and at least 95% of the treated cracks must contain an adequate quantity of crack sealant material.

Failure to comply with the acceptable criteria will result in the Contractor re-treating all failed cracks at his own expense.

EC101

**Specification for Cold Pour Rubber Filled
Bituminous Emulsified Pavement Crack Sealant**

Cold pour rubber filled bituminous emulsified pavement crack sealant shall conform to the requirements specified in the following table, for the grade designated by the Engineer:

Asphalt Grade Requirements	EC-101		Test Method	
	Minimum	Maximum	Alberta Transportation	A.S.T.M
Uniformity	Pass		9.1	-
Viscosity @ 25°C, Krebs units	70	90	9.2	D562
Solids Content by Evaporation, % by mass	59	-	9.3	D244
Ash Content, % by mass	-	2.0	9.4	-
Rate of Curing, %	-	-	9.5	-
24 hour	50	-	-	-
6 days	80	-	-	-
Low Temperature Flexibility	Pass		9.6	-
Elastic Recovery, %	40	-	9.7	-

HC200

Specifications for Hot Pour Bituminous Crack Sealant

Hot pour bituminous crack sealant shall conform to the requirements specified in the following table, for the grade designated by the Engineer:

Asphalt Grade Requirements	HC200		A.S.T.M Test Method
	Minimum	Maximum	
Softening Point, °C	80	95	D36
Flash Point, C.O.C. , °C	230	-	D92
Penetration	-	-	D5
@ 0 °C, 200g, 60 sec.	30	-	-
@25 °C, 100g, 5 sec.	55	60	-
@46 °C, 50g, 5 sec.	-	150	-
Ductility @ 25 °C	45	-	D113
Solubility in Trichloroethylene, % by mass	98	-	D2042
Viscosity @ 177 °C, mm ² /s	-	1200	D2170

END OF SECTION

35. LIST OF STANDARD DRAWINGS

A-103	Off-Line Hydrant Detail
A-107	Thrust Block Details
A-109	Valve Box Construction Details
A-117	Typical Anode Installation At Valves - Iron Fittings And Hydrants
A-118	Air Relief Valve and Flushing Chamber
A-123	Main Valve Casing Detail
B-113	Trash Grate Inlet
B-114	Storm Catch Basin Assembly c/w 500 mm Sump
B-115	Catch Basin Manhole
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B-117	Typical Dry Pond Detail
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C-101	Pipe Bedding Details
C-109	Single And Double Service Layout
D-110	Residential - Local
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D-113	Residential Collector - Minor
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D-115	Industrial - Local (URBAN)
D-116	Rural Residential Road Standard Cross-Section
D-117	Typical Trail Cross-Sections
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D-121	Industrial/ Commercial Curb and Gutter Crossing
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D-124	Asphalt Speed Bump
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D-126	Types of Para-Ramps
D-127	Para-Ramp Details
D-131	Para-Ramp Details at Centre of Curb Return
D-139	Pinned Concrete Curb
D-140	500mm Curb & Gutter For Arterial Roadways
D-141	250mm Standard Curb & Gutter
D-142	250mm Rolled Curb and Gutter

D-143	1.2m / 1.50m Standard Monolithic Sidewalk
D-144	1.2m / 1.50m Rolled Monolithic Sidewalk
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D-146	Concrete Drainage Swales
D-147	Typical Catch Basin installation 150 Curb & 250 Gutter
E-101	Typical Lot Grading
E-102	Building Grade Certificate
L-001	Shrub Planting Detail
L-002	Coniferous Planting - 64 mm Calibre and Under
L-003	Tree Circle Section
L-004	Wood Screen Fence
L-005	Wood Screen Fence – Brick Column Detail
L-006	Chain Link Fence

END OF SECTION