DESIGN AND CONSTRUCTION STANDARDS

The Town of Calmar

2020

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1.0 GENERAL SUBDIVISION AND DEVELOPMENT PLANNING

1.1 Purpose

1.2 Definitions & Abbreviations

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

- "Applicant" shall mean a person or corporation who has applied for approval of a proposed development subdivision or to service an existing parcel of land, whether as the owner or an agent for the owner of the land included therein.
- "Town" or his authorized representative shall mean a Town employee who for the time being is acting for the Town in their respective positions, or any person engaged by the Town to act for the Town.
- "Consulting Engineer" of “Consultant” shall mean the professional engineer or other professional retained by the Applicant to be responsible for the design, layout and supervision of installation, preparing record drawings 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" shall mean any person, persons or corporation which shall undertake the installation of Municipal Services on behalf of either the Applicant or the Town.
- "Developer": shall mean the person or entity that has executed a Development Agreement with the Town, in which Agreement the Developer has undertaken to comply with the specified technical standards and requirements of the Town.
- "Developer's Responsibilities": any specification statement referring to acts to be performed or materials to be furnished by the Applicant, Consulting Engineer or Contractor shall be construed to be directed to the Developer, who shall in turn ensure that the acts are performed or materials are furnished by the Applicant, Consulting Engineer or Contractor. The Developer shall be responsible to the Town for compliance with the Design Specifications by his Contractor.
- "Municipal Improvement": is any addition or modification or proposed addition or modification to a service or facility the Town of Calmar will ultimately be responsible for. These include, but are not necessarily limited to, watermains, sewers, roadways, walkways, park areas, signs, street lights, landscaping and fencing.
- "Municipal, Municipality or Town" shall refer to the Town of Calmar.

1.3 Subdivision and Development Planning

1.3.1 Development Brief

The development of new areas or redevelopment of existing areas within Calmar requires subdivision and/or development approval in accordance with procedures and requirements of the *Municipal Government Act.*

At the time of subdivision or development permit application, the Developer shall provide a Development Brief to the Town. The brief shall describe the items listed in Section 1.3.3. The Town shall review the brief to ensure Town standards are met, and provide comment to the Developer to identify compliance with or non-conformance to Town standards.

1.3.2 Developer's Consultant

The Applicant/Developer shall engage a Consultant to undertake conceptual design, detailed design, general engineering, construction inspection and preparation of record drawings, for the proposed development. The engineer shall design these services in accordance with accepted engineering practices and to achieve or exceed the minimum standards as set out herein or established by government bodies. All plans and documents shall utilize the Standard Metric System of Units (SI).

The Consultant shall be registered with The Associations of Professional Engineers and Geoscientists of Alberta, and must have a Permit to Practice.

1.3.3 Development Brief Submission Requirements

Further to 1.3.1, the Developer shall submit a Design Brief that will include drawings at a scale of 1:1000 m or 1:2000 m of the proposed development outlining the concept of lots, blocks and street patterns.

The following information shall be included on one or more copies of the above drawings:

- Preliminary subdivision plan.
- Lot grading plan.
- Contours of existing land surface relative to geodetic elevation datum.
- Location and size of water mains.
- Location and size of sanitary sewer mains, lift stations and the like.
- Location and size of storm sewer mains, and storm water management facilities
- Curb face to curb face road widths.
- Impact of servicing requirements on existing facilities.
- Environmental Reserves (ER), Municipal Reserves (MR), & required easements.
- Emergency access routes.
- Any other information that the Developer considers necessary to aid the Town in assessing and considering the proposed development.

1.3.4 Subdivision and Development Design

The Developer shall design their subdivision and/or development in accordance with the following:

a) Plans, Bylaws and Master Plans

The design of the subdivision and/or development shall conform to the Town's Municipal Development Plan, Land Use Bylaw, Master Water, Sewer, and Drainage Plans and Transportation concepts.

b) Existing Subdivision and Development Context

The proposed subdivision and/or development shall consider the overall development of the Town, future subdivision and development of adjacent areas, and consideration of existing services to prevent overloading.

The inclusion of oversize services to provide sufficient capacity for future developments shall be carried out at the expense of the Developer or as agreed to in a Development Agreement.

c) Approvals

Prior to the submission of detailed plans, the Developer should seek the necessary approvals to accommodate proposed zoning, density, lot sizes, and rights-of-way

d) Rights-of-way and Easements:

Rights-of-way and/or easements shall be provided for all utilities not located on streets, lanes, or utility lots, including rights-of-way for back of lot drainage, ditches or watercourses accommodating surface runoff and shallow utilities.

Subdivisions requiring curves on roads should reflect right-of-way boundaries with the same curves or sufficient size corner cut-offs to accommodate the curves as well as utilities and municipal services required to be installed in the boulevard.

1.3.5 Municipal Services

a) Servicing Regulations

The type and extent of servicing shall be in accordance with the Development Agreement and the "Approved" plans, specifications and regulations for each municipal improvement.

b) Service Connections

All lots shall be serviced with sanitary, water, storm, power, telephone, cable T.V., gas, and highspeed internet. Services shall extend directly into the lot and shall not route through adjacent parcels. Cross lot servicing will not be permitted.

c) Canada Post Mailboxes

The location of Canada Post's infrastructure shall be coordinated with Canada Post by the Developer.

1.3.6 Existing Improvements

a) Connections to Existing Facilities:

The Developer shall file a request for a connection to existing facilities with the Town at least 72 hours prior to starting work on this connection. In the event existing services must be cut off, the Developer will notify all affected customers of this fact. The Developer must have all material, equipment and labour on hand as necessary to complete this connection in the shortest possible time before he will receive approval to make this connection. Depending upon the length of service interruption, the Developer may have to provide temporary services to the affected customers.

b) Interference with Existing Services:

Any of the services to be installed by the Developer shall be installed in such a manner as to least interfere with existing services. Any additional cost incurred by the Town on account of the installation of services by the Developer shall be the sole responsibility of the Developer.

c) Temporary Closing of Roads:

In the event that a road must be partially or fully closed for a crossing or connection, the Developer shall provide all detours, signs, flagmen, barricades, etc. necessary to provide for the orderly control of traffic around the construction area. The Town must be notified at least 72 hours in advance of any road closures and appropriate permits obtained by the Developer, from the Town.

d) Road Crossings:

Any existing facilities disturbed during construction shall be returned as a minimum requirement to their original condition. Where it is necessary to excavate an existing road or lane for the purpose of providing an open trench crossing (for a water or sewer main, gas main, telephone cable, etc.) such excavation must be reinstated to the satisfaction of the Town. To within 1.5m of finished ground, material shall achieve a density equal to 95% of a Standard Proctor Density or greater. Moisture content shall be limited to a maximum of 5% over the optimum moisture content for the material. Within the uppermost 1.5m of the trench, material shall achieve a density equal to 98% of Standard Proctor Density or greater. The Developer shall be responsible to repair any trench settlements which may occur within two years from installation of the service.

e) Standards:

The standards outlined herein are intended to be the minimum standards. Where conditions dictate and good engineering practice requires higher standards than those indicated, they shall be incorporated into the design. It shall be the Developer's responsibility to develop the subdivision in accordance with standards which are acceptable to the Town and which conform to good engineering and construction practices. If a relevant government body or approval agency has approved standards which exceed the Town's minimum standards, the higher standards shall prevail. Generally, no departure from these design standards shall be permitted except with the written approval from the Town.

f) Materials:

Materials installed shall be tested to confirm compliance with the most recent standard of either AWWA, ASTM, or CSA.

1.4 Submission Requirements

1.4.1 Engineering Design Standards

a) All services shall be designed and installed as detailed in Section 2 – Design Standards according to the procedure as set out in this section.

b) These design standards shall apply to the design and installation of Municipal Services within the Town of Calmar. They apply to the design and installation of storm and sanitary sewers, watermains, landscaping and roads, together with their respective connections and appurtenances and any other services which are required to be designed and/or installed.

c) These design standards do not cover the design or installation (other than alignment) of street lighting, ornamental lighting, power, gas and communications, but do include coordination with the various utility companies.

d) The Standard Details as referred to in various sections shall form an integral part of these design standards.

e) No departure from these design standards shall be permitted except with the written approval by the Town.

1.4.2 Engineering Design Review

a) Detailed Design

i) The Applicant shall retain a Consultant who shall be responsible for the design and preparation of drawings and specifications for all services (except natural gas) as required within the Town of Calmar. These services shall be designed in accordance with Section 2.0 – Design Standards.
ii) The Design Drawings are to conform to the requirements listed in Section 1.5 – Engineering Design Drawings.
iii) The Design Drawings shall show all existing and proposed services. It shall be the Consultant's responsibility to coordinate with the utility companies to establish the location of their existing and proposed services.
iv) All proposed streets shall be named on the drawings. Names to have been approved by the Town prior to the submission of drawings.

b) Detailed Design Review

i) The Consultant shall submit four sets of Detailed Design Drawings to the Town for review. The Town's review of the Detailed Design Drawings is only for general compliance with the Town's Development standards as detailed in this document.
ii) Upon completion of design review, the Town shall approve the drawings and return one set to the Consultant. Review approval does not, in any manner, imply approval of the technical aspects of the reviewed design.
iii) No work will be started within any parcel of land or on any of the services to be provided by the Applicant until the Town has provided approval to proceed.

1.4.3 Right-of-Way Documents

a) Where easement or right-of-way documents are deemed necessary, they shall be prepared and registered at Land Titles by a registered Land Surveyor at the Applicants expense.

b) The Consultant shall bring to the attention of the Applicant and the Town the need for any rights-of-way outside the subdivision which the Applicant may have to obtain.

1.4.4 Crossing Agreements

a) Where oil and gas pipeline Crossing Agreements are deemed necessary, they shall be obtained from the pipeline owner at the Applicants expense.

b) It is the responsibility of the Applicant to complete a title search with the Alberta Energy Regulator (AER), or current governing body, to determine the existence of any pipelines in use or abandoned.

c) The Consultant shall bring to the attention of the Applicant and the Town the need for any oil and gas pipeline Crossing Agreements which the applicant may have to obtain.

1.4.5 Construction Approval

a) Upon receipt of approved Contract Drawings and Specifications, the Applicant may proceed to install Municipal Services subject to:

   i) Satisfactory execution of Development Agreement or a Development Permit if applicable.
   ii) Subdivision Approval.
   iii) Obtaining appropriate Municipal, Provincial and Federal Permits (e.g. Water Act, Environmental Protection Enhancement Act, Extension of Services, etc.)

b) A copy of all approved drawings and specifications shall be maintained at the construction site during the installation of services.

c) Underground subdivision services shall not be permitted to operate as part of existing Municipal Services until the respective subdivision services have been inspected, tested and approved in writing by the Town. This is generally upon receipt of an approved Construction Completion Certificate by the Developer from the Town.

1.4.6 Engineering Supervision

a) The Developer shall ensure a satisfactory level of quality assurance during construction and shall employ a registered engineer to monitor of all phases of the project including franchise utilities. The Developer shall also employ an accredited materials testing firm to carry out materials testing in accordance with the guidelines provided in Section 4.0 – Construction Specifications. The material testing firm shall be directed by the Developer's Engineer and provide reports and test results to the Town in a timely manner.

b) In addition to supervision carried out by the Consulting Engineer, the Town, or a representative from the Town, may periodically review the work and assist in coordinating the subdivision works with any related Municipal works. The Town shall 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 Town, he may order the work to cease.

c) If the Consulting Engineer wishes to make any changes in design either before or during the execution of the work, he shall first submit a marked print showing proposed revisions to the Town. If approval is granted for revision, the original drawing shall be immediately revised and new prints issued. These two operations may be carried out simultaneously.

1.4.7 Survey Control System

a) The Developer shall provide survey control monuments at a maximum spacing of 300m with a minimum of two other intermediate markers within clear view of the primary control points.

b) The Developer shall undertake to preserve all existing and new monuments and should it be necessary to destroy a monument, the Developer shall establish a new one in lieu thereof and provide the Town with survey measurements for it.

c) Final lot and subdivision definition by posting in accordance with the approved legal plan shall be subsequent to the completion of all utilities construction including shallow bury utilities and associated street hardware.

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

1.4.8 Testing

It shall be the responsibility of the Consulting Engineer to ensure that all testing requirements listed in Section 4.0 – Construction Specifications are administered. The Town shall be advised at least 72 hours prior to any testing and may witness the test. Testing results are to be sent to the Town in a timely manner for their review.

1.4.9 Record Drawings

Within two months of completion of all services to be installed, the Consulting Engineer shall deliver record drawings to the Town, in a reproducible format.

1.4.10 Construction Completion Certification (CCC)

The following inspections and reviews shall be carried out prior to the issuance of a Construction Completion Certificate (CCC):

a) A pre-inspection by the developers representative and Contractor to ensure completeness.

b) A joint inspection of all completed improvements by all parties including the Developer's representative, Town representative and Contractor.

c) A review by the Town of all materials testing results.

d) A review by the Town of all closed circuit video inspection (CCTV) reports on sanitary and storm sewer construction (submitted in electronic format).

e) The submission of record information within two (2) months.

f) Building permits will not be issued prior to issuance of a Construction Completion Certificate.

g) The applicant shall be responsible for, at his own expense to remedy any defect, fault of deficiency in the completed works during a twenty-four (24) month maintenance period. The maintenance period shall commence from the date of issuance of the Construction Completion Certificate.

h) The applicant shall complete the standard Construction Completion Certificate located in Section 3.17.

1.4.11 Final Acceptance Certification (FAC)

The following inspections and reviews shall be carried out prior to the issuance of a Final Acceptance Certificate (FAC):

a) A pre-inspection by the developers representative and Contractor to ensure completeness

b) A joint inspection of all completed improvements by all parties including the Developer's representative, Town representative and Contractor

c) The correction of identified deficiencies and re-inspection.

d) A review of all materials testing results for any deficiency correction and the final lift of asphalt.

e) A review by the Town of all closed circuit video inspection (CCTV) reports on sanitary and storm sewer construction (submitted in digital format).

f) Provision of a one (1) year materials warranty by the paving contractor on the final asphalt lift.

g) A land surveyor's report on the evidence and replacement of property legal posts and plans indicating the establishment of Alberta Survey Control Monuments (ASCM).

h) Satisfactory submission of all record information.

i) Any further testing, arising out of the fore going submissions, which the Town may request at their discretion.

j) The applicant shall complete and submit the standard Final Acceptance Certificate located in Section 3.18.

1.4.12 Building Permits

No building permits shall be issued until the subdivision plan is registered, all essential services have been provided, completed and inspected as specified in the Development Agreement or Development Permit, and a Construction Completion Certificate (CCC) has been issued by the Town. An exception may be considered for the construction of a "show home".

1.5 Engineering Design Drawings

The following specification shall govern the preparation of Engineering Drawings for all Municipal Services.

1.5.1 General Requirements

a) The Standard Drawing size of 559 mm x 864 mm (22" x 34") shall be used.

b) Originals shall be prepared by computer aided drafting software.

c) Use plan profile sheets with profile at bottom of sheet. Leave enough clear space in the lower part of plan for title block and legend. Title block to identify Developer, the Developer's Engineer, the name and stage of the project, provision for engineering stamps and seals and provision for recording dates, legends and changes in status of the drawings.

d) Drawings scales to conform to:

Overall plans	1:1000			
Plan/Profile	Horizontal	1:500m	Vertical	1:50m
Cross Sections	Horizontal	1:100m	Vertical	1:50m

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

i) Care in ensuring balanced distribution of detail throughout the drawing.
ii) Letters and figures shall be clearly legible, 2 mm size or larger (Leroy or equivalent), well spaced, properly formed and proportioned.
iii) Lines shall be uniform in weight and density.

iv) Dimensioning of a drawing should be such that it will not be misinterpreted. Dimensions should be given from an iron pin, lot line, chainage station, a centre line or any other reference that can be readily established.

f) Elevations shall be relative to the Alberta Survey Control system. The reference Alberta Survey Control Monument (ASCM) and elevation shall be shown on the design drawing.

g) Where there is more than one profile, clearly identify each.

h) A north arrow, adjacent lots and plan numbers, street names, and the legal description of the parcel being subdivided, shall be shown on the drawings. In general the north arrows should be orientated towards the top of the plan.

1.5.2 Overall Plans

The following overall plans shall form a part of the whole design drawing set.

a) Cover Sheet

This will show the name of the subdivision, the location, stage and year of development and names of the developer and consulting engineer.

b) 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.

c) Lot Grading Plan

i) An overall plan shall be drawn to a scale of 1:1000 and will indicate at a minimum:
ii) the original contours

(1) proposed finished lot corner elevations at back corners of the lot
(2) proposed top of curb elevations at front corners of the lot
(3) proposed lot grades
(4) sewer connection inverts
(5) directions of surface drainage flows
(6) hydrants
(7) street lighting standards
(8) pedestals
(9) transformer
(10) catchbasins, manholes
(11) mailbox locations.

iii) Individual detailed plot plans in a 210 mm x 280 mm (82" x 11") format summarizing the above mentioned information is required for each lot prior to issuance of a Building Permit. Plot plans are to be prepared by a legal surveyor or professional engineer.

d) Road, Sidewalk and Walkway Plan

i) This plan will be drawn to a scale of 1:1000 and will indicate:

(1) all locations, names and widths of roads,
(2) sidewalks and walkways

(3) show detail of typical road cross-section including:
(4) road structure
(5) height of crown in millimetres
(6) wick drains
(7) locations of catch basins

e) Sanitary Sewer, Storm Sewer and Watermain Overall Plan

i) This plan will be drawn to a scale of 1:1000 and will indicate:
ii) the alignments and locations of mains
iii) size of mains
iv) direction of flows
v) locations of appurtenances. All manholes, fire hydrants and water valves shall be numbered to conform to the Town's numbering system.

f) Sanitary Basin Plan

i) Show and label sanitary mains and manholes
ii) Sanitary main flow arrows
iii) Sanitary catchment boundaries
iv) provide tables indicating the design factors used for sanitary sewer design along with the hydraulic design calculations for each manhole to manhole section in each system
v) identify within the overall development the stage represented by the drawings being submitted

g) Storm Basin Plan

i) show and label storm mains and manholes
ii) Show main flow arrows
iii) Storm catchment boundaries
iv) provide tables indicating the design factors used for storm sewer design along with the hydraulic design calculations for each manhole to manhole section in each system
v) provide plans indicating the overall development area showing the storm sewers, storm water management and storage facilities and all receiving channels or drainage facilities
vi) provide a table showing minimum bottom of footing elevations where lots border a storm pond
vii) identify within the overall development the stage represented by the drawings being submitted
viii) indicate the location and direction of major overland flows and receiving water course
ix) show overall surface drainage including roads, P.U.L.s, back of lot swales and parks
x) show storm catchment areas
xi) show storm pond cross-sections complete with labelled sideslopes
xii) show normal and high water levels for storm pond

h) Erosion and Sediment Control Plan

i) Site runoff direction
ii) Road names
iii) Stockpile locations (if applicable)
iv) Stripping and grading limits
v) Silt fence locations
vi) Interim storm discharge locations
vii) Swales/ditches
viii) Silt fence detail

1.5.3 Detailed Plan/Profile

Generally all underground services and surface improvement profiles shall be shown on the same drawing. The following information shall be included on the detailed plan/profile drawings.

a) Requirements for Water

i) Show the location of hydrants, valves, tees, crosses, and other fittings tied to the nearest iron pin. Hydrants and valves are also to be dimensioned to two property lines.
ii) Show the offset of the main from the property line and locate the end of the main to the nearest iron pin.
iii) Indicate extent of work required in making connections to existing watermains.
iv) Indicate the size, type, class of pipe and class of bedding on the plan.
v) A profile of the watermain shall be required showing invert elevations at all grade changes. Storm and sanitary mains shall also be shown on this profile.
vi) Valves and fire hydrants to be numbered to conform to Town standards.
vii) Indicate clearance at crossings.

b) Requirements for Sanitary and Storm Sewer

i) The following information shall be shown on the profile:

(1) Size, type, class of pipe and class of bedding.
(2) Sewer profiles shall be drawn showing length and percent grades between manholes.
(3) Invert elevations at both inlet and outlet of manholes.
(4) Storm sewer pipe capacity, design flow and velocity calculated for a 1:5year rainfall event. Full flow and partial flow velocities to be included.
(5) Sanitary sewer pipe capacity, design flow and velocity.

ii) The following information shall be shown on the plan:

(1) Dimension of manholes, cleanouts, and other appurtenances to property lines.
(2) Pipe offsets from property line.

iii) The following additional information shall also be shown on an appropriate part of the drawing:

(1) Manholes shall be numbered in accordance with Town standards.
(2) Where the sanitary sewer or water and storm sewer are to be installed in a common trench, detail a typical cross section showing distance between pipes, class of pipe and bedding.

c) Requirements for Roads

i) Both plan and profile must be dimensioned to property lines, preferably near or at 0 + 00 chainage.
ii) The plan should be referenced to the cadastral coordinate system with appropriate ties to Alberta Survey Control Monuments (ASCM) for layout purposes.
iii) Show the road width and the curb offsets measured from the property line to the curb face.
iv) Chainages of the BC and EC of horizontal curves shall be shown together with the delta angle, radius, tangent length and arc length for each curb. If the plan is referenced to the cadastral coordinate system, coordinates shall be provided for the BC, EL and CC of each curve.

v) The percent grade to two decimal places shall be shown on the profile together with the following information on vertical curves.

(1) The chainage coordinate and elevations of BVC, EVC and PVI;
(2) K valve of vertical curve;
(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.

vi) Road profiles shall show the centreline pavement and lip of gutter elevations.
vii) The profile shall be shown at true centreline length and projected above or below the plan in as close relationship as possible.
viii) Locate catch basins (using road chainage) and show leads between the catch basin and the mainline manhole.

1.5.4 Standard Details

Provide all applicable standard details located in Section 3.0.

1.5.5 Landscaping Plan(s)

a) General Landscape Plan Requirements

General Landscape Plan drawing submissions are to include, but not limited to, the following:

i) Scale of 1:500 or larger;
ii) shall utilize the cadastral, and engineering road, sidewalk and walkway plan as a base;
iii) Designated use of adjacent land parcels and development stages. Identify stages as existing or proposed;
iv) Location and description of all trees and shrubs to be protected;
v) any park furniture or playground equipment being installed;
vi) Approximate of estimated location of land uses, building perimeters, and landscaping on adjacent sites;
vii) Surface treatments i.e. sod, seed, mulch beds, etc.;
viii) Clearly identify extents of intended mown vs non-mown turf areas;
ix) Adjacent public area features such as streets, lanes, driveways, vehicle entrances, street furniture, and boulevard trees;
x) Overhead, surface, and underground utilities and limit of easements and the relationship between tree planting and shallow utilities must be clearly indicated.
xi) Outlines of all site structures including: building footprints at grade, and location & type of underground structures and overhangs within first two stories;
xii) Building entrances, porches, decks, steps, walkways, other hard surfacing, or hard landscaping features, parking areas, curbs, lighting, fencing, walls, screens, recreational facilities, and garbage collection areas including information on materials colours, & patterns; (As applicable)
xiii) Existing and final site grading, including established lot boundaries, elevations, berming shown in half-meter contours, direction of site drainage, swales, ditches, constructed wetlands and wet ponds locations or alignments, proposed catch-basin rim elevations, top-and-bottom of retaining wall elevations, and existing elevations of plant material to be retained; (unless otherwise included with the engineering drawings)
xiv) The height, material, and colour of all fencing, screening, & walls;

xv) Existing trees and shrubs which are labelled, and sizes that are graphically illustrated by the mature size of the plant material. This is to include a plant list with the common name, botanical name, size, and condition of health. In Addition, caliper of tree trunks shall be noted. The landscape plan shall graphically illustrate the spread of the trees to be removed or relocated by the proposed construction;
xvi) Proposed trees, shrubs, perennials and groundcovers with a corresponding plant list identifying the common name, botanical name, quantity, size, and method of planting;
xvii) Details: Fencing, Features, Amenities, Planting, Hard Surface, Tree Protection;
xviii) Stamp and signature by a landscape architect registered with the Alberta Association of Landscape Architects;

b) Storm Water Management Facility Plan Requirement

Storm Water Management Facility plan requirements in addition to those noted in section 1.5.5 – General Landscape Plan Requirements:

i) Normal water line labelled;
ii) 1:5 year flood line labelled;
iii) 1:25 year flood line labelled;
iv) 1:100 year flood line labelled;
v) High water line labelled;
vi) Planting bed extents and layout;
vii) Planting list;
viii) Boat ramp or access detail;

c) Landscape Planting Plan Requirements

Landscape Planting plan requirements in addition to those noted in section 1.5.5 – General Landscape Plan Requirements:

i) Where existing trees are identified and used to meet quantity requirements on planting plans, they must be included within the plant list and be subject to CCC and FAC inspection;
ii) Minimum planting quantity requirements;
iii) Locations for all proposed plant material referenced to plant list;
iv) Seed/Sod mixes with application rates;
v) Plant material graphic symbols shall represent mature spread of shrubs as per “Trees and Shrubs for the Prairies” document.
vi) Tree symbols are to be drawn at mature spread, as per the recommended tree spacing.
vii) Shrub symbols shall be shown at mature size with no overlap. Tree and Groundcover symbols may be overlapped at the discretion of the Town;

1.5.6 Shallow Utility Plan

Shallow utility plan to include:

a) alignments for gas, power, and communications

b) all road crossings complete with the number and size of conduits

c) location of water and sewer service locations

d) location of all infrastructure surface features including hydrants, catch basins, manholes, valves, street lights, pedestals, transformers and project fencing

1.5.7 Record Drawings

a) General

i) The record drawings shall clearly show the location of all services as installed using offsets from property lines.
ii) On record drawings submitted to the Town, the following information shall be included on each drawing:

(1) Date of completion;
(2) Name of Contractor;
(3) Date on which record details were added.

iii) Record drawings are to include:

(1) two sets of signed and sealed drawings in paper print format.
(2) an electronic PDF file of the signed and sealed drawings
(3) an electronic file in AutoCAD format compatible with the Town's software.

iv) The Record drawings are to be submitted to the Town within two (2) months of the installations.

b) Storm and Sanitary Sewer

i) Size, pipe material, pipe class and location of mains;
ii) Location of manholes, cleanouts, and other appurtenances numbered in accordance with the Town's number system.
iii) Grades, lengths and inverts of mains.
iv) Storm sewer pipe capacity, design flow and velocity calculated for a 1:5year rainfall event. Full flow and partial flow velocities to be included.
v) Sanitary sewer pipe capacity, design flow and velocity.
vi) Design calculations for storm and sanitary sewer flows.

c) Water

i) Size, type and location of pipe;
ii) Location of valves, tees, hydrants and other appurtenances number in accordance with the Town's number system.
iii) Profile of pipe.

d) Road, Curb, Sidewalks

i) Location of curbs, sidewalks and elevations of curbs;
ii) Lip of gutter profiles for each curb;
iii) End of curb, sidewalks and pavement;
iv) Type of road structure.

e) Water and Sanitary Service Connections

i) Provide a table indicating the lot and block number of each service along with type of service (single or double) distance from both front property pins, invert elevation of the sanitary sewer service at the main and at the property line and diameter of water service.

ii) Details shall be provided for any service which is not 90 degrees to the main. Servicing charts shall be provided immediately upon issuance of a Construction Completion Certificate.

iii) Records shall be provided within 4 months of construction completion or prior to the issuance of the first occupancy permit within the development.

f) Individual Plot Lot Plans

i) Individual lot plans shall be submitted for each lot. Lot plan shall be in 210 mm x 280 mm (8½" x 11") format. The Town will review and approved plans following a visual inspection of the lot grading.

2.0 DESIGN STANDARDS

2.1 Roadway Design

2.1.1 Roadway Geometric Design Standards

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

i) Street classification and designation shall be in accordance with the classification system outlined in the Roads and Transportation Association of Canada (RTAC) Manual Geometric Design Standards for Canadian Roads and Streets.
ii) Street cross-sections shall be as defined by Table 2.1 and Standard Details.
iii) Concrete curb and gutter shall be constructed on all streets in accordance with Standard Details.
iv) Separate sidewalks shall be 1.5 m wide and shall be constructed in accordance with the Standard Details. Monolithic curb, gutter and sidewalks shall have a 1.5 m sidewalk width in accordance with Standard Details. Sidewalks shall be clear of all obstructions including surface utilities. Sidewalk locations shall be in accordance with Standard Details. Wider sidewalks may be required in areas of high pedestrian activity, as determined by the Town.
v) Rear residential lanes (alleys) shall have a surfaced width of 4.0 m within a 6.0 m right-of-way. Where rear lane traffic activity is expected to be high, such as for certain commercial developments, a wider surfaced width and right-of-way may be required as determined by the Town.
vi) All driveways shall be constructed to give a minimum of 1.8 m clearance from any structure, e.g. hydrants, light standards, service pedestals and shall be constructed in accordance with Standard Details.
vii) Curb Ramps shall be constructed in accordance with Standard Details.

b) Vertical Alignment

i) Minimum gutter grades around all curves and along all tangents shall not be less than 0.6%. Minimum gutter grades on curb returns shall be 0.8%.
ii) Maximum gutter grades shall not exceed those defined by Table 2.1.
iii) All roadways shall be crowned or shall have a crossfall as shown on the applicable Standard Details. The standard crossfall rate is 2.5%.
iv) All vertical curves shall be designed to meet or exceed the following minimum requirements:

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

K = L/A
L = length of vertical curve in metres
A = Algebraic difference in grades percent
* = based on comfort control and assumes street lighting

v) The maximum superelevation is shown in Table 2.1.
vi) Paved rear lane (alleys) shall have a minimum longitudinal centre swale grade of 0.75% with an inverted 2.5% crown.

Table 2.1: Summary Of Recommended Design Standards For Streets

Classification	Traffic Volumes (vpd)	Target Speed (km/h)	Right-of- Way Width (m)	Pavement Widths (m)	Travel Lanes	Parking	Maximum Gradients (%)	Maximum Superelevation (m/m)
Arterial	5,000-12,000	60	30.0b	15.8	4	Not Permitted	5	.04 - .06
Residential Collector	1,000-5,000	40	20.0	11.5	2	Permitted	7	n/a
Local Residential	Up to 1,000	40	18.0	10.0	2	Permitted	8	n/a
Local Industrial	N/A	40	30.0	9.0	2	Not Permitted	6	n/a
Industrial Collector	N/A	40	30.0	9.0	2	Not Permitted	6	n/a

Classification	Minimum Radius of Curvature (m)	Minimum Intersection Spacing (m)	Minimum Corner Cuts at Intersections	Sidewalks	Lighting Poles and Other Obstructions	Access
Arterials	170	150	30 m Radius	Separate + Shared Use Path	2.5 m min. from face of curb	Restricted
Residential Collectors	150	60	10 m	Separate walks; both sides	2.0 m min. from face of curb	Some Restrictions
Local Residential	90	60	6 m	Mono; min one side	2.2 m min. from face of curb	Permitted
Local Industrial	90	60	6 m	Optional	1.65 m min. from face of curb	Permitted
Industrial Collector	150	60	10 m	Optional	2.25 m min. from face of curb	Some Restrictions

Notes:
a) Land for noise attenuation will be in addition to the road right-of-way requirement.
b) Additional travel lane width may be required to accommodate cyclists.

c) Horizontal Alignment

i) The minimum radius is relative to the road classification, the design speed and the maximum superelevation (see Table 2.1)
ii) All horizontal curves shall be designed to meet the minimum design requirements shown in Table 2.1.
iii) Minimum edge of pavement radius for cul-de-sacs is 11 m in residential areas and 14 m in industrial areas.
iv) Maximum cul-de-sac length shall be 100 m.

d) Curb Returns

i) Curb returns at residential local street intersections shall be constructed to a radius of 7.5 m.
ii) Curb returns at residential collector street intersections shall be constructed to a radius of 12.5 m.
iii) In industrial/commercial areas the radius should be 15 m to accommodate truck turning movements.
iv) For arterial street intersections the curb returns shall be designed in consideration of the type and volume of the turning traffic. Two and three centred curves with or without islands may be required.
v) Curb ramps are required at all intersections which have sidewalks.
vi) Low profile curb and gutter shall be required along both sides of residential roads.
vii) Vertical face curb and gutter shall be required along park areas, commercial and multi-family sites.

2.1.2 Road Structures

a) Asphaltic Concrete Pavement

i) All roadways shall be paved with hot mix asphalt. A geotechnical report with recommended pavement designs shall be conducted by a Professional Engineer employed by a recognized engineering agency and submitted to the Town for review. The consultant must conduct materials sampling from the development area and perform specific tests to determine the structural requirements for pavement design.
ii) Pavement design shall be based on the following criteria applied to Asphalt Institute and American Association of State Highway Officials (AASHO) design methods.

Road Classification	Design Traffic Number (DTN)	Equipment Standard Axle Loads (ESAL)
Local Residential	2.7	30,000
Local Industrial/Commercial	20.5	150,000
Minor Collector	13.7	100,000
Minor Collector	41	300,000
Major Collector	27.5	200,000
Major Collector	82	600,000
Minor Arterial	135	1,000,000
Major Arterial	410	3,000,000

iii) With the exception of arterial roadways, all asphalt surfacing shall be in two stages with the second lift scheduled within sixty (60) days of the date of Final Acceptance. The final lift shall proceed only after all other surface and underground deficiencies have been rectified and the roadway has passed a roll test.

iv) The Town reserves the right to request the Developer to engage a geotechnical engineering agency to carry out CBR tests on the subgrade prior to paving to confirm adequacy of design.
v) Alternative pavement designs, such as soil cement base, may be approved by the Town. Approval of alternate pavement designs must be obtained in writing from the Town prior to submission of design drawings.

b) Prime Coats and Tack Coats

i) Prime coats shall be the application of bituminous material to subgrade or previously prepared gravel base course prior to placing bituminous surfacing materials.
ii) Tack coats 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 gutter faces, manholes, valves and other appurtenances in the street to be paved.

2.1.3 Traffic Control, Signage & Pavement Markings

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

b) 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 (TAC).

c) Guide and information signing shall be designed and installed in accordance with the latest version of the “Highway Guide and Information Sign Manual” provided by Alberta Transportation.

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

2.1.4 Street Lighting

a) General

The following design and construction standards shall be applied for street lighting within all developments in the Town of Calmar:

i) Fortis Underground Electrical Distribution System (UEDS)
ii) Transportation Association of Canada Guide for the Design of Roadway Lighting
iii) Lighting requirements for industrial development shall be determined with the Town during the initial planning stages of the proposed development.
iv) Street light luminaires shall meet Fortis requirements.
v) Design and construction of street lighting at Alberta highway intersections shall also consider Alberta Transportation design and construction requirements.

b) Location

i) The Developer shall coordinate the location of street lights to ensure that they do not interfere with the other utilities and driveways.
ii) Street lights placement shall be offset from the projection of common property lines between two lots.

iii) Street lights shall be offset from roadway and sidewalks in accordance with TAC Geometric Design Guide clear zone design specifications.
iv) 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.
v) All street light standards shall be galvanized and shall be painted in a manner comparable to the existing standards within the Town.

c) Costs

i) Any capital contribution that the utility company may charge for installation of underground street lighting shall be paid by the Developer.
ii) The Developer shall pay all charges to the utility company for the operation and maintenance of street lights installed in the subdivision until occupancy of 50% of the Subdivision Area has been reached. At that time, the Town will assume payment of operation and maintenance charges to the utility company.

2.1.5 Sidewalks and Paths

a) Residential streets shall have monolithic sidewalks, on a minimum of one side of the road.

b) Roadways fronting multi-family and commercial sites require sidewalks 1.5m in width.

c) The extent of sidewalks along park areas shall be at the discretion of the Town. Where parks form a connection between neighbourhoods or links with school sites, sidewalk will be required along one or both sides of roadways.

d) Multi-Use Paths shall be located as directed by the Town and shall be asphalt or concrete surface, no less than 3.0m wide unless approved for special circumstances.

2.2 Stormwater Design

2.2.1 Overall Objective

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

b) The minor system comprises 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.

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

d) The storm drainage system shall be designed to meet the following level of service:

i) Avoid all property damage and flooding and minimize inconvenience to the public due to runoff from 1 in 5 year and more frequent rainfall events.
ii) Avoid significant property damage from a 1 in 100 year return frequency rainfall event.

iii) Avoid loss of life and injuries and minimize damage to property, through control of runoff during unusual or infrequent storm events with high-intensity rainfall and large runoff volume.
iv) Avoid degradation of receiving watercourses, by implementing erosion and sediment control measures.

2.2.2 Stormwater Runoff Analysis

The Rational Method may be used for detail design of minor storm systems with catchment areas less than 65 ha. The Rational Method shall not be used to design stormwater management storage facilities. For areas greater than 65 ha, a computer model shall be developed.

a) Rational Method

The rational method is defined as:

i) $Q = CIA / 360$

Q = discharge in m^3/s
C = runoff coefficient
I = average rainfall intensity in mm/hr
A = drainage area in hectares

ii) Rainfall Intensity

(1) Rainfall IDF curves for the City of Edmonton for selected return frequency events are presented in Table 2.2.
(2) The value of the design rainfall intensity, for the rational formula is selected from the appropriate intensity duration frequency (IDF) curve, with a duration chosen to coincide with the Time of Concentration, Tc. The Time of Concentration for runoff flow is the time required for runoff flow to become established and reach the design location from the furthest point within the contributing catchment area.
(3) Determination of Tc requires estimation of two components, the "inlet time" and "travel time".
(4) The inlet time is the time for flow from the extreme limits of the catchment to reach the first point of inflow into the defined conveyance system. It is dependent upon the imperviousness and the size of the catchment.
(5) The travel time is the length of time required for flow to travel within the conveyance system from the point of inflow to the design location.
(6) Appropriate values for inlet time may be selected from Table 2.7. This specifies values with respect to imperviousness and size of the catchment.

Table 2.2: IDF Curves – Intensity Table

Edmonton 11 Rain Gauges Upper Bound - IDF Period: 1984-2015
Maximum Years of Record = 32
IDF Intensity (mm/hr)

Time		Return Frequency						
Minutes	Hours	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr
5		66	89	108.6	138	162.2	188.4	217.8
6		61.3	83.2	101.9	129.9	152.9	178.1	206.8
7		57.2	78.3	96.1	122.9	144.7	169	197.1
8		53.8	73.9	91.1	116.7	137.5	160.9	188.4
9		50.8	70.1	86.6	111.1	131.1	153.7	180.6
10		48.2	66.7	82.6	106.2	125.3	147.2	173.5
11		45.8	63.7	79	101.7	120.1	141.3	167
12		43.8	61	75.7	97.7	115.4	136	161.1
13		41.9	58.6	72.7	93.9	111.1	131.1	155.6
14		40.2	56.3	70	90.6	107.1	126.6	150.5
15	0.25	38.7	54.3	67.6	87.4	103.5	122.4	145.9
16		37.2	52.4	65.3	84.6	100.2	118.6	141.5
17		36	50.7	63.2	81.9	97	115	137.5
18		34.8	49.1	61.2	79.4	94.1	111.7	133.7
19		33.7	47.6	59.4	77.1	91.4	108.6	130.1
20		32.6	46.2	57.7	74.9	88.9	105.7	126.8
21		31.7	44.9	56.1	72.9	86.6	102.9	123.6
22		30.8	43.7	54.6	71	84.3	100.4	120.7
23		30	42.6	53.2	69.2	82.2	97.9	117.9
24		29.2	41.5	51.9	67.5	80.3	95.6	115.2
25		28.5	40.5	50.7	65.9	78.4	93.5	112.7
26		27.8	39.5	49.5	64.4	76.6	91.4	110.3
27		27.1	38.6	48.4	63	74.9	89.5	108
28		26.5	37.8	47.3	61.6	73.4	87.6	105.9
29		25.9	37	46.3	60.3	71.8	85.8	103.8
30	0.5	25.4	36.2	45.3	59.1	70.4	84.2	101.8
31		24.8	35.5	44.4	57.9	69	82.5	100
32		24.3	34.8	43.6	56.8	67.7	81	98.1
33		23.9	34.1	42.7	55.7	66.4	79.5	96.4
34		23.4	33.5	41.9	54.7	65.2	78.1	94.8
35		23	32.9	41.2	53.7	64.1	76.8	93.2
36		22.5	32.3	40.4	52.7	63	75.5	91.6
37		22.1	31.7	39.7	51.8	61.9	74.2	90.2
38		21.8	31.2	39.1	50.9	60.9	73	88.7
39		21.4	30.7	38.4	50.1	59.9	71.9	87.4
40		21	30.2	37.8	49.3	58.9	70.8	86
41		20.7	29.7	37.2	48.5	58	69.7	84.8

Time		Return Frequency						
Minutes	Hours	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr
42		20.4	29.2	36.6	47.8	57.1	68.7	83.5
43		20	28.8	36.1	47	56.3	67.7	82.4
44		19.7	28.3	35.5	46.3	55.5	66.7	81.2
45	0.75	19.4	27.9	35	45.7	54.7	65.8	80.1
46		19.2	27.5	34.5	45	53.9	64.8	79
47		18.9	27.1	34	44.4	53.2	64	78
48		18.6	26.8	33.5	43.8	52.5	63.1	77
49		18.4	26.4	33.1	43.2	51.8	62.3	76
50		18.1	26.1	32.6	42.6	51.1	61.5	75
51		17.9	25.7	32.2	42.1	50.4	60.7	74.1
52		17.6	25.4	31.8	41.5	49.8	60	73.2
53		17.4	25.1	31.4	41	49.2	59.3	72.3
54		17.2	24.8	31	40.5	48.6	58.5	71.5
55		17	24.5	30.6	40	48	57.9	70.7
56		16.8	24.2	30.3	39.5	47.4	57.2	69.9
57		16.6	23.9	29.9	39	46.9	56.5	69.1
58		16.4	23.6	29.6	38.6	46.3	55.9	68.3
59		16.2	23.3	29.2	38.1	45.8	55.3	67.6
60	1	16	23.1	28.9	37.7	45.3	54.7	66.8
61		15.8	22.8	28.6	37.3	44.8	54.1	66.1
62		15.7	22.6	28.3	36.9	44.3	53.5	65.5
63		15.5	22.3	27.9	36.5	43.9	53	64.8
64		15.3	22.1	27.6	36.1	43.4	52.4	64.1
65		15.2	21.8	27.4	35.7	42.9	51.9	63.5
66		15	21.6	27.1	35.3	42.5	51.4	62.9
67		14.8	21.4	26.8	35	42.1	50.9	62.3
68		14.7	21.2	26.5	34.6	41.7	50.4	61.7
69		14.5	21	26.3	34.3	41.3	49.9	61.1
70		14.4	20.8	26	33.9	40.9	49.4	60.5
71		14.3	20.6	25.8	33.6	40.5	49	59.9
72		14.1	20.4	25.5	33.3	40.1	48.5	59.4
73		14	20.2	25.3	33	39.7	48.1	58.9
74		13.9	20	25	32.7	39.4	47.6	58.3
75	1.25	13.7	19.8	24.8	32.4	39	47.2	57.8
76		13.6	19.6	24.6	32.1	38.6	46.8	57.3
77		13.5	19.5	24.4	31.8	38.3	46.4	56.8
78		13.4	19.3	24.1	31.5	38	46	56.4

Time		Return Frequency						
Minutes	Hours	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr
79		13.2	19.1	23.9	31.2	37.6	45.6	55.9
80		13.1	19	23.7	31	37.3	45.2	55.4
81		13	18.8	23.5	30.7	37	44.8	55
82		12.9	18.6	23.3	30.4	36.7	44.5	54.5
83		12.8	18.5	23.1	30.2	36.4	44.1	54.1
84		12.7	18.3	22.9	29.9	36.1	43.7	53.6
85		12.6	18.2	22.7	29.7	35.8	43.4	53.2
86		12.5	18	22.6	29.4	35.5	43.1	52.8
87		12.4	17.9	22.4	29.2	35.2	42.7	52.4
88		12.3	17.8	22.2	29	35	42.4	52
89		12.2	17.6	22	28.7	34.7	42.1	51.6
90	1.5	12.1	17.5	21.8	28.5	34.4	41.8	51.2
120	2	9.9	14.3	17.8	23.3	28.2	34.3	42.2
180	3	7.4	10.7	13.3	17.4	21.1	25.8	31.8
240	4	6	8.7	10.8	14.1	17.2	21.1	26
300	5	5.1	7.4	9.2	11.9	14.6	18	22.2
360	6	4.5	6.5	8	10.4	12.8	15.8	19.5
420	7	4	5.8	7.2	9.3	11.5	14.1	17.4
480	8	3.6	5.3	6.5	8.4	10.4	12.8	15.8
540	9	3.4	4.9	6	7.7	9.5	11.8	14.5
600	10	3.1	4.5	5.5	7.1	8.8	10.9	13.5
660	11	2.9	4.2	5.1	6.6	8.2	10.2	12.6
720	12	2.7	3.9	4.8	6.2	7.7	9.6	11.8
780	13	2.6	3.7	4.5	5.8	7.3	9	11.1
840	14	2.4	3.5	4.3	5.5	6.9	8.6	10.5
900	15	2.3	3.3	4.1	5.3	6.5	8.1	10
960	16	2.2	3.2	3.9	5	6.2	7.8	9.6
1020	17	2.1	3.1	3.7	4.8	6	7.4	9.2
1080	18	2	2.9	3.6	4.6	5.7	7.1	8.8
1140	19	1.9	2.8	3.4	4.4	5.5	6.8	8.4
1200	20	1.9	2.7	3.3	4.2	5.3	6.6	8.1
1260	21	1.8	2.6	3.2	4.1	5.1	6.4	7.8
1320	22	1.7	2.5	3.1	3.9	4.9	6.2	7.6
1380	23	1.7	2.4	3	3.8	4.8	6	7.3
1440	24	1.6	2.4	2.9	3.7	4.6	5.8	7.1

Table 2.3: IDF Curves – Intensity Table-Summary

Edmonton 13 Rain Gauges Upper Bound - IDF Period: 1984-2015
Maximum Years of Record = 32
IDF Intensity (mm/hr)

Time		Return Frequency						
Minutes	Hours	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr
5	0.083	66	89	108.6	138	162.2	188.4	217.8
10	0.167	48.2	66.7	82.6	106.2	125.3	147.2	173.5
15	0.25	38.7	54.3	67.6	87.4	103.5	122.4	145.9
20	0.333	32.6	46.2	57.7	74.9	88.9	105.7	126.8
25	0.417	28.5	40.5	50.7	65.9	78.4	93.5	112.7
30	0.5	25.4	36.2	45.3	59.1	70.4	84.2	101.8
35	0.583	23	32.9	41.2	53.7	64.1	76.8	93.2
40	0.667	21	30.2	37.8	49.3	58.9	70.8	86
45	0.75	19.4	27.9	35	45.7	54.7	65.8	80.1
50	0.833	18.1	26.1	32.6	42.6	51.1	61.5	75
55	0.917	17	24.5	30.6	40	48	57.9	70.7
60	1	16	23.1	28.9	37.7	45.3	54.7	66.8
120	2	9.9	14.3	17.8	23.3	28.2	34.3	42.2
180	3	7.4	10.7	13.3	17.4	21.1	25.8	31.8
240	4	6	8.7	10.8	14.1	17.2	21.1	26
360	6	4.5	6.5	8	10.4	12.8	15.8	19.5
720	12	2.7	3.9	4.8	6.2	7.7	9.6	11.8
1440	24	1.6	2.4	2.9	3.7	4.6	5.8	7.1

Table 2.4: IDF Parameters

$Rate = a*(t+c)^b$	Return Frequency						
Parameters	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr
a (t in min)	337	498.1	665.2	909.9	1027.7	1200.5	1498.1
b	-0.732	-0.735	-0.748	-0.757	-0.742	-0.733	-0.735
c (min)	4.3	5.4	6.3	7.1	7	7.5	8.8
R^2	0.994	0.997	0.998	0.998	0.998	0.997	0.994

Table 2.5: Chicago Distribution (Modified): 4-Hr Design Storm Data (mm/hr)

Edmonton 11 Rain Gauges Upper Bound, IDF-Period: 1984-2015
Maximum Years of Record = 32
Chicago Type Distribution - Design Storm (5-Minute Increment)

Time	Return Frequency						
(min)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr
0	0	0	0	0	0	0	0
5	1.73	2.52	3.01	3.82	4.92	6.25	7.76
10	1.82	2.65	3.18	4.04	5.19	6.58	8.18
15	1.93	2.8	3.36	4.28	5.49	6.97	8.67
20	2.05	2.98	3.58	4.56	5.84	7.41	9.22
25	2.18	3.18	3.83	4.89	6.25	7.92	9.87
30	2.34	3.42	4.13	5.27	6.73	8.52	10.63
35	2.53	3.7	4.48	5.74	7.31	9.24	11.54
40	2.76	4.04	4.91	6.31	8.01	10.12	12.65
45	3.05	4.47	5.45	7.02	8.89	11.22	14.04
50	3.42	5.03	6.15	7.95	10.03	12.63	15.85
55	3.91	5.77	7.1	9.2	11.57	14.54	18.28
60	4.61	6.83	8.45	11	13.76	17.26	21.74
65	5.69	8.47	10.55	13.82	17.18	21.48	27.11
70	7.61	11.37	14.32	18.89	23.26	28.94	36.59
75	12.07	18.13	23.11	30.69	37.26	45.9	57.82
80	47.05	65.15	80.55	103.56	122.26	143.62	169.27
85	47.05	65.15	80.55	103.56	122.26	143.62	169.27
90	21.85	32.56	41.62	55.17	66.01	80	99.06
95	13.85	20.82	26.6	35.36	42.79	52.54	66.05
100	10.28	15.44	19.62	26.01	31.74	39.26	49.58
105	8.26	12.37	15.62	20.63	25.34	31.48	39.81
110	6.95	10.38	13.03	17.15	21.18	26.4	33.37
115	6.03	8.98	11.22	14.72	18.26	22.81	28.81
120	5.35	7.95	9.89	12.93	16.1	20.14	25.42
125	4.83	7.15	8.86	11.55	14.43	18.08	22.79
130	4.4	6.51	8.04	10.46	13.1	16.44	20.7
135	4.06	5.99	7.37	9.57	12.02	15.1	18.99
140	3.77	5.55	6.82	8.83	11.12	13.98	17.57
145	3.53	5.19	6.35	8.21	10.36	13.04	16.36
150	3.31	4.87	5.95	7.68	9.71	12.23	15.33
155	3.13	4.6	5.6	7.22	9.14	11.52	14.44
160	2.97	4.35	5.3	6.82	8.65	10.91	13.65
165	2.83	4.14	5.03	6.46	8.21	10.36	12.96
170	2.7	3.95	4.79	6.15	7.82	9.87	12.34
175	2.58	3.78	4.58	5.87	7.47	9.44	11.79
180	2.48	3.62	4.38	5.61	7.15	9.04	11.29

Time	Return Frequency						
(min)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr
185	2.38	3.48	4.21	5.38	6.86	8.68	10.83
190	2.3	3.35	4.04	5.17	6.6	8.36	10.42
195	2.22	3.23	3.9	4.98	6.36	8.06	10.04
200	2.14	3.12	3.76	4.8	6.14	7.78	9.69
205	2.08	3.02	3.64	4.64	5.94	7.53	9.37
210	2.01	2.93	3.52	4.49	5.75	7.29	9.07
215	1.95	2.84	3.41	4.35	5.57	7.07	8.8
220	1.9	2.76	3.31	4.21	5.41	6.86	8.54
225	1.85	2.69	3.22	4.09	5.26	6.67	8.3
230	1.8	2.62	3.13	3.98	5.12	6.49	8.07
235	1.75	2.55	3.05	3.87	4.98	6.33	7.86
240	1.71	2.49	2.97	3.77	4.86	6.17	7.66

Table 2.6: Huff Distribution: Design Storm for Lake Drawdown Analysis Only

Edmonton 11 Rain Gauges Upper Bound, IDF-Period: 1984-2015
Maximum Years of Record = 32
Storm Duration = 24 hours
Huff Distribution (First-Quartile 50% Probability), mm/hr

Time		Return Frequency						
Minutes	Hours	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr
0	0	0	0	0	0	0	0	0
15		0.29	0.42	0.52	0.66	0.83	1.03	1.28
30		0.59	0.85	1.03	1.32	1.66	2.07	2.55
45		0.88	1.27	1.55	1.98	2.49	3.1	3.83
60	1	1.18	1.7	2.06	2.64	3.32	4.14	5.1
75		1.57	2.26	2.75	3.52	4.42	5.51	6.8
90		2.35	3.39	4.12	5.27	6.62	8.26	10.18
105		3.12	4.52	5.49	7.03	8.82	11	13.56
120	2	3.9	5.64	6.85	8.78	11.02	13.74	16.94
135		4.68	6.77	8.22	10.53	13.22	16.48	20.33
150		5.21	7.53	9.14	11.71	14.7	18.33	22.6
165		5.35	7.74	9.39	12.03	15.11	18.84	23.23
180	3	5.49	7.94	9.65	12.36	15.51	19.34	23.85
195		5.64	8.15	9.9	12.68	15.92	19.85	24.47
210		5.78	8.36	10.15	13	16.32	20.35	25.1
225		5.69	8.23	9.99	12.8	16.07	20.04	24.7
240	4	5.45	7.87	9.56	12.25	15.37	19.17	23.64
255		5.2	7.52	9.13	11.69	14.68	18.3	22.57
270		4.95	7.16	8.7	11.14	13.98	17.44	21.5
285		4.71	6.81	8.26	10.59	13.29	16.57	20.43
300	5	4.47	6.46	7.84	10.05	12.61	15.72	19.39
315		4.23	6.11	7.42	9.51	11.93	14.88	18.35
330		3.99	5.77	7	8.97	11.26	14.04	17.31
345		3.75	5.42	6.58	8.43	10.58	13.2	16.27
360	6	3.51	5.07	6.16	7.89	9.91	12.36	15.24
375		3.29	4.76	5.78	7.4	9.29	11.59	14.29
390		3.07	4.44	5.39	6.91	8.67	10.82	13.34
405		2.85	4.13	5.01	6.42	8.06	10.05	12.39
420	7	2.64	3.81	4.63	5.93	7.44	9.28	11.44
435		2.43	3.51	4.27	5.47	6.86	8.56	10.55
450		2.28	3.3	4	5.13	6.44	8.03	9.9
465		2.13	3.08	3.74	4.79	6.01	7.5	9.24
480	8	1.98	2.86	3.47	4.45	5.59	6.97	8.59
495		1.83	2.64	3.21	4.11	5.16	6.44	7.94

Time		Return Frequency						
Minutes	Hours	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr
510		1.71	2.48	3.01	3.85	4.84	6.03	7.44
525		1.65	2.39	2.9	3.72	4.67	5.82	7.17
540	9	1.59	2.3	2.79	3.58	4.49	5.6	6.91
555		1.53	2.21	2.69	3.44	4.32	5.38	6.64
570		1.47	2.12	2.58	3.3	4.14	5.17	6.37
585		1.41	2.03	2.47	3.16	3.97	4.95	6.1
600	10	1.34	1.94	2.36	3.02	3.8	4.73	5.84
615		1.28	1.86	2.25	2.89	3.62	4.52	5.57
630		1.22	1.77	2.15	2.75	3.45	4.3	5.3
645		1.16	1.68	2.04	2.61	3.28	4.09	5.04
660	11	1.1	1.6	1.94	2.48	3.12	3.89	4.79
675		1.05	1.52	1.84	2.36	2.96	3.7	4.56
690		1	1.44	1.75	2.24	2.81	3.5	4.32
705		0.94	1.36	1.65	2.11	2.65	3.31	4.08
720	12	0.89	1.28	1.56	1.99	2.5	3.12	3.84
735		0.86	1.24	1.51	1.93	2.42	3.02	3.73
750		0.83	1.2	1.46	1.87	2.35	2.93	3.61
765		0.8	1.16	1.41	1.81	2.27	2.83	3.49
780	13	0.78	1.12	1.36	1.75	2.19	2.73	3.37
795		0.75	1.08	1.31	1.68	2.11	2.63	3.25
810		0.71	1.03	1.25	1.6	2.01	2.51	3.1
825		0.68	0.98	1.19	1.53	1.92	2.39	2.95
840	14	0.65	0.93	1.13	1.45	1.82	2.27	2.8
855		0.61	0.88	1.07	1.37	1.72	2.15	2.65
870		0.59	0.85	1.03	1.32	1.66	2.07	2.55
885		0.58	0.84	1.02	1.31	1.64	2.04	2.52
900	15	0.57	0.83	1.01	1.29	1.62	2.02	2.49
915		0.57	0.82	1	1.28	1.6	2	2.46
930		0.56	0.81	0.98	1.26	1.58	1.97	2.43
945		0.55	0.8	0.97	1.24	1.56	1.95	2.4
960	16	0.55	0.79	0.96	1.23	1.54	1.92	2.37
975		0.54	0.78	0.95	1.21	1.52	1.9	2.34
990		0.53	0.77	0.94	1.2	1.5	1.88	2.31
1005		0.53	0.76	0.92	1.18	1.49	1.85	2.28

Time		Return Frequency						
Minutes	Hours	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr
1020	17	0.52	0.75	0.91	1.17	1.47	1.83	2.25
1035		0.51	0.74	0.9	1.15	1.45	1.8	2.22
1050		0.51	0.73	0.89	1.14	1.43	1.78	2.2
1065		0.5	0.72	0.88	1.12	1.41	1.76	2.17
1080	18	0.49	0.71	0.86	1.11	1.39	1.73	2.14
1095		0.49	0.7	0.85	1.09	1.37	1.71	2.11
1110		0.48	0.69	0.84	1.08	1.35	1.68	2.08
1125		0.47	0.68	0.83	1.06	1.33	1.66	2.05
1140	19	0.46	0.67	0.82	1.05	1.31	1.64	2.02
1155		0.46	0.66	0.8	1.03	1.29	1.61	1.98
1170		0.44	0.64	0.78	1	1.25	1.56	1.92
1185		0.43	0.62	0.75	0.97	1.21	1.51	1.86
1200	20	0.42	0.6	0.73	0.93	1.17	1.46	1.8
1215		0.4	0.58	0.71	0.9	1.13	1.41	1.74
1230		0.39	0.56	0.68	0.87	1.1	1.37	1.68
1245		0.37	0.54	0.66	0.84	1.06	1.32	1.63
1260	21	0.36	0.52	0.63	0.81	1.02	1.27	1.57
1275		0.35	0.5	0.61	0.78	0.98	1.22	1.51
1290		0.33	0.48	0.59	0.75	0.94	1.17	1.45
1305		0.32	0.46	0.56	0.72	0.9	1.13	1.39
1320	22	0.31	0.44	0.54	0.69	0.86	1.08	1.33
1335		0.29	0.42	0.51	0.66	0.83	1.03	1.27
1350		0.28	0.4	0.49	0.63	0.79	0.98	1.21
1365		0.27	0.38	0.47	0.6	0.75	0.93	1.15
1380	23	0.25	0.36	0.44	0.57	0.71	0.89	1.09
1395		0.24	0.34	0.42	0.53	0.67	0.84	1.03
1410		0.22	0.32	0.39	0.5	0.63	0.79	0.97
1425		0.21	0.3	0.37	0.47	0.59	0.74	0.91
1440	24	0.2	0.28	0.35	0.44	0.56	0.69	0.85

Table 2.7: Design Inlet Time

	Impervious (%)		
Catchment Area (A)	**30**	**50**	**>70**
A = 8ha or less	8	8	5
8 ha < A < 40 ha	9.2	9.2	6
A = 40 ha or more	10.4	10.4	7.25

vi) Runoff Coefficients

(1) The value of the design rainfall intensity, I, for the rational formula is selected from the appropriate intensity duration frequency (IDF) curve, with a duration chosen to coincide with the time of concentration. The time of concentration for runoff flow is the time required for runoff flow to become established and reach the design location from the furthest point within the contributing catchment area.

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

$$C = \frac{CpAp + Ci\,Ai}{Ap + Ai}$$

Where the subscripts p and i indicate the pervious and impervious surfaces, respectively. In these standards Cp = 0.15 and Ci = 0.90.

Table 2.8: Storm Runoff Coefficients & Imperviousness According to Zoning

Zoning Classification	Runoff Coefficient (C)[1]	Impervious (%)
Single Family Residential	0.5	40 - 65
Multi Family Residential	0.65	40 - 90
Urban Services	0.65	40 - 90
Industrial	0.5	40 - 70
Commercial	0.9	40 - 100
Parks & Recreation	0.3	10 - 50

1. Minimum design values to be used without specific area analysis. To be used only or calculation of peak runoff rates by the rational method.
2. Typical ranges based on land use bylaw site coverage limits and typical paving practices.

Table 2.9: Runoff Coefficients and Impervious According to Land Use

Land Use	Runoff Coefficient (C)[1]
Asphalt, concrete, roof areas	0.95
Gravel	0.65
Grass/Soft Landscaping	0.20
Clay Soil	0.40

1. Minimum design values to be used without specific area analysis. To be used only or calculation of peak runoff rates by the rational method.

b) Computer Modelling

For areas greater than 65 ha:

i) 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.
ii) 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. SWMM models are preferred for the design of drainage systems.
iii) 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.

2.2.3 Minor Systems

a) Mains

i) Storm sewer pipe shall be designed to convey the design flow when flowing full with the hydraulic gradeline at the pipe crown
ii) Manning's 'n' = 0.013.
iii) Minimum flow velocity = 0.60m/s
iv) Maximum flow velocity = 3.0m/s
v) Curved sewers will be permitted with the following restrictions:

(1) The sewer shall be laid as a simple curve with a radius equal to or greater than 90 m or the manufacturers minimum recommended radius, whichever is larger.
(2) Manholes shall be located at the beginning and end of the curve.
(3) Manholes shall be located at intervals not greater than 90 m along the curve.
(4) The main shall run parallel to the curb or street centreline.
(5) Curved sewer design gradients shall be increased by a factor of 1.5.

b) Manholes

i) Not to exceed 120m spacing.
ii) Minimum of 1200mm diameter.
iii) Located at all changes in pipe diameter, gradient or at ends of mains.
iv) The downstream invert in a manhole shall be a minimum of 30mm lower than the lowest upstream invert. At a change in direction, the drop shall be 60mm.
v) All pipe crown elevations shall match at manhole junctions.
vi) Safety platforms at intermediate levels are required for manholes greater than 5.0m in depth.

c) Catchbasins

i) Not to exceed 120m spacing.
ii) Catchbasins to be a minimum of 600mm dia.
iii) Catchbasin lead minimum size shall be 250mm.
iv) Minimum lead gradient of 2.0%.
v) Maximum lead length of 30m.
vi) Minimum depth of cover to top of pipe of 1.5m.
vii) Frame and cover types shall be used for various curb types and applications as follows:

Frame and Cover Type	Curb Type	Allowable Application
K-7 or DK-7	Rolled curb	Residential areas
F-36 or F-51	Straight face	Catch basin only
F-38	No curb	Swales and lanes
F-39	No curb	Paved or Landscaped areas

viii) Catch basins shall be evaluated to ensure they have sufficient capacity to collect flows. Calculations shall be provided as part of the engineering drawing submission.
ix) All leads shall connect to a manhole or catchbasin manhole. In-line main connections are not permitted on municipal systems.

d) Culverts

i) Parks and pathways = 300mm minimum dia.
ii) Commercial and rural = 600mm minimum dia.
iii) Culverts and bridge designs should consider backwater effects over a range of flows.
iv) The design shall take into account nominal design capacity and its performance during the 100 year event.

e) Outfalls

i) Outfall structure 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 meet all necessary Provincial and Federal regulations. It is the responsibility of the Developer to obtain the necessary approvals and permits from the above mentioned Authorities.
ii) The outfall structure may be a chute, spillway, stilling basin or plunge pool with headwall. A cut off wall is required at the end of the outfall apron to prevent undermining of the structure.
iii) 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.
iv) 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.
v) Rip rap and a filter layer shall be placed downstream of the outfall structure where required to prevent erosion.
vi) Weeping tile shall be placed under the structure to reduce any water pressure behind the headwall.
vii) Grills shall be placed over all storm sewer outlets to prevent access.
viii) Railings shall be placed along the headwall and wing walls of the outfall structure.
ix) Outfalls shall be landscaped to blend in with surrounding areas.

f) Receiving Waters

i) Measures shall be incorporated in new developments to prevent any increase in the amount of downstream erosion.
ii) If a development will cause downstream erosion despite the use of on-site peak run-off rate controls, appropriate measures shall be constructed in the downstream areas.
iii) Preservation of watercourse aesthetics and wildlife habitat shall be considered in erosion and bank stability work.

2.2.4 Major System

a) Wet Ponds or Engineered Wetlands

i) Soils investigation specific to the stormwater management facility shall be undertaken to determine appropriate design factors.
ii) Shall be constructed of impervious soils to minimize water loss during dry weather periods.
iii) The facility design shall consider the aesthetic implications of shape, grading and landscape features.
iv) An emergency overflow system shall drain to a receiving stream, if possible, for storms greater than the 100 year event.
v) The effects of the maximum pond water levels shall be considered in the design of the minor system and lot grading. The hydraulic gradeline elevations for the minor system piping shall be calculated starting from the maximum pond level during the 5 year storm event.
vi) The pond's outlet capacity shall be that the pond shall drain and reach normal water level within 72 hours of reaching maximum water level during the 100 year event. All inhabited building space, including basements, shall be constructed above the 100 year flood level.
vii) An overflow channel and overland drainage route must be provided to the satisfaction of the Town and the design of the pond and permitted water level fluctuations must ensure that:

(1) The lowest basement weeping tile of any building on a lot adjacent to the lake shall be a minimum of 300 mm above the 1:100 year high water level.
(2) The lowest manhole invert shall be at or above the normal water level elevation.
(3) The pipe obvert at the lowest manhole immediately upstream of the pond shall be above the high water level during a one in five year storm event.
(4) A minimum distance of six metres shall be maintained from any basement wall to the 1 in 100 year high water level.
(5) The inlet to the pond must be above the normal water level or below ice level.
(6) The minimum surface area at normal water level shall be 2 hectares.
(7) The minimum depth of the pond, at normal water level, will be 2.5 metres.
(8) The lake bottom and side slopes will be composed of an impervious material.
(9) No dead bay areas will be permitted.
(10) Shoreline erosion protection is required.
(11) The design will incorporate a semi-annual turnover at average annual precipitation.
(12) Submerged inlets/outlets are preferred and will be constructed such that the tops are a minimum of 1.0 m below normal water level.
(13) Inlets/outlets not submerged will require fencing along adjacent shoreline for 5.0 m in each direction from the centre line of pipe. All inlets/outlets will be provided with a grate permanently fixed to the structure.
(14) Every pond will be sterilized during construction to prevent weed growth.
(15) Minimum width of the water surface at the normal water level will be 25 metres.
(16) A silt trap will be provided at the inlet of each pond.
(17) Sideslopes above normal water shall have a maximum slope of 7.1.
(18) Sideslopes from 1.0m below NWL to pond bottom shall be a maximum of 3:1.

viii) An operation and maintenance document is to be provided to the Town prior to FAC. The document is to include operation, maintenance, service and repair instructions complete with parts lists for all mechanized and electrical equipment incorporated into the design.

b) Dry Ponds

All dry ponds shall be off-line storage areas designed to temporarily detain excess runoff. The dry ponds shall:

i) Not exceed 1.5 m depth of water for the 1 in 100 year event.
ii) Have flow bypass for flows from minor events.
iii) Have a bottom with a minimum longitudinal slope of 1%.
iv) Have a bottom with a minimum lateral slope of 1.0%.
v) Have a French drain where longitudinal slopes are less than 2%.
vi) Have side slopes flatter than 7 (horizontal) to 1 (vertical).
vii) Have length, width and depth dimensions that are acceptable to the Town.
viii) Have the bottom and sides sodded or grassed.
ix) Have trash bars on inlets and outlets to preclude access by children.
x) Address all safety issues (particularly during operation).

c) Lot Grading and Surface Drainage Design

i) The major drainage system shall be assessed with respect to the 1 in 100 year return period event.
ii) The grading of streets and the layout of the major drainage system shall be assessed, relative to the following guidelines, during the 100 year event:

(1) Continuity of the overland flow routes between adjacent developments shall be maintained.
(2) Arterials should have at least two lanes which are not inundated parallel with the direction of flow. Where the major system crosses an arterial, the depth of flow should be less than 0.05 m.
(3) Collectors should have at least one lane which is not inundated parallel with the direction of flow. Where the major system crosses a collector; this depth of flow should be less than 0.10 m.
(4) Local roads should have a depth of water no more than 0.05 m above the crown. Where the major system crosses a local road, the depth of flow should be less than 0.15 m.
(5) The depth of water at curbside should be less than 0.35 m for all roadways.

iii) The grading of lots shall meet the following requirements:

(1) Designs shall provide that maximum flooding or ponding shall be 600mm below the lowest anticipated ground elevation at buildings. Overflow routes and provisions shall be designed such that the maximum ponding depth is nor more than 300mm.
(2) Generally all residential lots shall be designed to drain to the front. The ground adjacent to the building is to be at a minimum slope of 10% or more for 1.5m, draining water away from the building to the property lines. Outside this zone, surface grades shall be generally 2.0% to 6.0% with a minimum grade of 2.0% drainage throughout. Maximum grades are not to exceed 20%.
(3) Where the rear portion of one lot drains through an abutting lot, the slope of the downstream lot shall be 3.0% or greater, and a 2m wide drainage easement shall also be provided.
(4) Drainage from lots shall be by the formation of swale depressions along the proposed property lines. Swales shall be completed in accordance with approved engineering drawings.

(5) Swales draining more than three lots from one side or six lots from two sides shall have a 500mm wide concrete gutter along the invert (50mm channel depth, 200mm thickness concrete). Swales collecting and conveying flows from more than two properties are not to be routed along the side yard of a single family or duplex lot. The minimum gradient for concrete swales is 0.75%. Swales without a concrete channel shall have a minimum longitudinal gradient of 2.0%.
(6) Roof drainage down spouts shall discharge to the ground surface. A splash pad, provided by the house builder, shall be placed at each down spout location or other such approved device and orientated to ensure discharge occurs at least 1.5m from the face of the building.
(7) Lot grading plan details are located in Section 3.0 of this document.

2.3 Wastewater Design

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 sewage systems:

a) Generation Rates

i) Residential

Population Density (based on zoning)	R1 - 95 people/hectare R2 - 105 people/hectare R3 - 230 people/hectare R4 - 250 people/hectare
Average Sewage Flow	350 L/persons/d

ii) 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

b) Peaking Factors

Peaking Factor (Harmon's Formula) $\frac{1 + 14}{(4 + p^{½})}$

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

c) Inflow/Infiltration

i) Infiltration 0.28 L/s/ha

(1) An allowance of 0.28 litres/second/hectare shall be applied to all sewer design flow capacity calculations. This allowance would apply to the total drainage area on the basis of upstream area calculations (manhole to manhole).
(2) An allowance shall be made for inflow through manholes in sags by the addition of 0.4 litres/second for each manhole.

d) Manning's Roughness Coefficient

Pipe sizing shall be determined by utilizing the Manning's Formula using "N" value of 0.013.

e) Sewer Capacity

i) The total design sewer capacity shall be the combination of:

(1) peak dry weather flow
(2) infiltration allowance
(3) inflow for sag manholes

ii) New sewers shall be designed with full flow capacity not exceeding 80% of the sewer diameter based on a maximum utilization of 86% of the pipe hydraulic capacity

$$\text{Full Sewer Flow Capacity} = \frac{\text{Estimated Total Design Peak Flow Rate}}{0.86}$$

iii) Sanitary sewers may have to be oversized to conform to the Town's Master Sanitary Sewer Plan.
iv) There shall be no connection of roof drainage and weeping tile systems to the sanitary sewer system.

f) Flow Velocity

i) Minimum flow velocity shall be 0.6m/s
ii) Maximum flow velocity shall be 3.0m/s

g) Pipe Slope

i) Minimum pipe slopes shall be:

Pipe diameter (mm)	**% gradient**
200	0.40
250	0.28
300	0.22
375 and larger	0.15

ii) Curved sewer design gradients shall be increased by a factor of 1.5.
iii) Short laterals (cul-de-sacs) and uppermost sections shall be 0.8% minimum.

h) Mains

i) The minimum size for sanitary sewer mains shall be 200 mm diameter for residential and 250 mm for industrial/commercial areas.
ii) Mains shall be installed to provide a minimum depth of 3.0 m to obvert below final finished grade at the surface or shall be insulated to the satisfaction of the Town.
iii) Mains shall be installed to provide adequate sewer service connection depth at the property line.
iv) All sanitary sewers shall generally be located along the centreline of the road right-of-way. Mains shall be located within the road right-of-way in accordance with the road cross sections.
v) Sanitary sewers shall be located a minimum of 3.0m horizontally from any watermain and 2.0m horizontally from any gas line.
vi) Curved sewers will be permitted with the following restrictions:

(1) The sewer shall be laid as a simple curve with a radius equal to or greater than 90 m or the manufacturers minimum recommended radius, whichever is larger.
(2) Manholes shall be located at the beginning and end of the curve.

(3) Manholes shall be located at intervals not greater than 90 m along the curve.
(4) The main shall run parallel to the curb or street centreline.
(5) Curved sewer design gradients shall be increased by a factor of 1.5.

vii) Water main crossings shall be as follows:

(1) Normally pass over sanitary sewers. Where the water main passes under a sanitary sewer, maintain a minimum separation of 0.5m (crown to sewer invert).
(2) Oblique crossings shall not be permitted (less than 80°)
(3) Designed to provide structural support for both pipes with pipe joints located equidistant from the intersection of the crossing

i) Manholes

i) Manholes shall be located at the end of each line, at all changes in pipe size, grade and alignment.
ii) The maximum distance between manholes shall not exceed 120 m.
iii) The downstream invert in a manhole shall be a minimum of 30mm lower than the lowest upstream invert. At a change in direction, the drop shall be 60mm.
iv) Manholes shall be installed as shown on the Standard Details.
v) Drop manholes are required for invert grade differences greater than 300 mm in sanitary sewer manholes. For 200 mm and 250 mm mains, internal drops may be used. Benching is required for invert grade differences 300 mm or less. No more than two internal drops in one manhole.

j) Lift Stations and Force Mains

i) Shall be subject to review and approval by the Town.

2.4 Water Distribution Design

2.4.1 Population Density

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

Population Density	**R1 - 95 people/hectare**
(based upon zoning)	R2 - 105 people/hectare
	R3 - 230 people/hectare
	R4 - 250 people/hectare

2.4.2 Consumption

a) Per capita consumption shall be:

i)	Residential Average Daily Demand -	360 L/person/d
ii)	Commercial/Light Industrial Average Daily Demand	22,500 L/hectare/day
iii)	Maximum Daily Demand	1.8 x Average Demand
iv)	Peak Hourly Demand	3.0 x Average Demand

b) An analysis shall be made for Peak Hour Demand and mains shall be sized such that there will be a minimum residual pressure of 275 kPa (40 psi) at ground level at any location in the system.

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

2.4.3 Fire Demand

a) The system shall be designed to meet the criteria contained in “Water Supply for Public Fire Protection, 1999" (or latest edition) as produced by the Fire Underwriters Survey.

b) The minimum design fire flow for any watermain providing fire protection shall be as follows, plus allowance for peak day demand:

i)	Commercial Zoning	270 l/s
ii)	Urban Services (Institutional), Public Education Services	180 l/s
iii)	Medium and High Density Residential	180 l/s
iv)	Single Family and Low Density Residential	100 l/s

c) The minimum residual pressure at any location in the distribution system at ground level under fire flow conditions shall be 140 kPa (20 psi).

2.4.4 Operating Pressure

The normal operating pressure range for residential distribution shall be between 350 kPa (50psi) to 550 kPa (80psi).

2.4.5 Flow Velocity

Velocities not to exceed 3.0 m/s under all operating conditions.

2.4.6 Roughness

The maximum Hazen & Williams coefficient of friction (C) for watermain sizing shall be C=120.

2.4.7 Mains

a) The minimum size of distribution main shall be 200mm diameter for single family residential, 200 mm for multi family development and 250 mm for industrial/commercial. 150mm diameter watermains may be allowed in cul-de-sacs upon approval of the Town. Oversizing may be required by the Town.

b) Mains shall be installed to provide a minimum depth of 3.0 m to invert below final finished surface grade.

c) Mains shall be located within the road right-of-way in accordance with the Roadway Cross Sections.

d) A minimum of 3 m separation shall be maintained between a watermain and any sewer main.

e) Water distribution systems in new subdivisions shall be looped internally and shall have more than one primary feeder main supplying the distribution system in the development area. The Town may waive this requirement temporarily provided the Developer can demonstrate that the necessary fire flows can be delivered via the single connection. In any event, a maximum of 50 lots may be serviced temporarily without looping of the system. The Developer shall provide looping internally within the subdivision as well as a second connection to the

development within two (2) years of the issuance of a Construction Completion Certificate on the first phase of development.

f) In cul-de-sacs, the watermain shall be looped except where the overall length of the cul-de-sac from the intersection curb line to the end of the bulb is 120m or less. A flush point shall be provided at the termination point of all dead end lines.

2.4.8 Hydrants

a) The maximum allowable spacing between fire hydrants shall be 150m in single family residential areas, 120m in multiple-family residential and school areas, and 90 m in industrial/commercial areas.

b) Hydrant locations shall be such that the distance to any building shall be not greater than 75 m.

c) Hydrants on the distribution mains shall be installed:

i) At the projection of property lines except:
ii) Where the hydrants are installed at the intersections, they shall be installed at the beginning of curb returns
iii) Where the hydrants are installed on a cul-de-sac, they shall be installed at the intersection of the cul-de-sac and adjacent collector roadway.

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

i) Areas with no sidewalk - hydrant is to be no more than 2 m from back of curb.
ii) Areas with monolithic sidewalk - hydrant is to be no more than 0.75 m from back of walk.
iii) Areas with separate sidewalk - hydrant is to be no less than 1.0 m and no more than 1.8 m from back of curb.
iv) Hydrants shall be no closer than 0.30 m and no more than 3.0 m from back of curb.

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

f) All hydrants shall be on a minimum of 150 mm feeder line. Such feeder line shall be a maximum length of 7.5 metres from the main, otherwise a larger diameter line shall be considered.

2.4.9 Valves

a) Valves on the distribution mains shall be installed:

i) At the projection of property lines at mid-block.
ii) At the projection of property lines at intersections.

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

i) No more than one hydrant is taken out of service.
ii) No more than three valves are required for a shutdown.
iii) No more than one standard Town block is taken out of service by a shutdown.
iv) Valves shall be installed in accordance with the Standard Details.

2.4.10 Thrust Blocks

All valves, hydrants, tees, bends and end plugs shall be thrust blocked in accordance with the detail indicated on the Standard Details.

2.5 Services

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

   i) Sanitary Sewer 100 mm diameter
   ii) Water Service 25 mm diameter

b) Non-residential developments or multi-family units shall have services sized to meet specific requirements. Each individual residence shall have separate services.

c) The minimum grade on a sewer service shall be 2.0%.

d) Connection to a main sewer line shall be by means of a saddle at the top quadrant of the main.

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

f) For water services size 50 mm and smaller, the tapping shall be at the 2 to 3 o'clock position on the distribution main.

g) Watermains shall be tapped under pressure if already in service.

h) All water services must utilize service clamps.

2.6 Utilities

2.6.1 Natural Gas Service

Natural Gas service is provided under Franchise Agreement by AltaGas Ltd., of Leduc, Alberta.

a) Right-of-Way

   i) Where required, the Developer shall provide rights-of-way and easements of sufficient size and location to satisfy the gas company. Refer to Standard Details for preferred locations.
   ii) All easements shall be registered in the name of Town of Calmar.

b) Installation

   i) The Developer and AltaGas Ltd. shall obtain Town approval for the method installation including excavation and backfilling requirements.
   ii) The Developer shall coordinate the location of gas services to ensure that they do not interfere with other utilities.
   iii) Where gas distribution is installed at the front of lots, gas service to individual lots shall be installed such that the gas meter can be placed at the side or the rear of the dwelling. Where gas meters are placed at the side of the dwelling unit, the gas meter shall be placed on the side of the dwelling opposite the driveway. Gas meters shall not be permitted at the front of the dwelling unit.

iv) An Excavation Permit must be obtained from the Town of Calmar for any excavation on Town property.

c) Costs

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

2.6.2 Communications/Cable Service

a) Communication/cable services to be installed shall be underground.

b) Where possible, services to be located in the same trench as power.

c) Rights-of-Way

i) Where required, the Developer shall provide rights-of-way and easements of sufficient size and location to satisfy the communication/cable company.
ii) All easements shall be registered in the name of the Town of Calmar.

d) Installation

i) The Developer and the communication/cable company shall determine the method and by whom the trenches for cables shall be dug and compacted.
ii) The Developer shall coordinate the location of service boxes to ensure that they do not conflict with driveways or interfere with other utilities. Alignments to be approved by the Town.
iii) An Excavation Permit must be obtained from the Town of Calmar for any excavation on Town property.
iv) Service pedestals to be located on the intersection of lot lines where possible.

e) Costs

i) Any capital contribution that the utility company may charge for installation of services, shall be paid by the Developer.

2.6.3 Power Service

a) Electrical power service is provided under Franchise Agreement by TransAlta Utilities Ltd.

b) Power services to be installed by TransAlta Utilities and shall be underground. Where possible, power and communications/cable shall run in a common trench.

c) Rights-of-Way

i) Where required, the Developer shall provide rights-of-way and easements of sufficient size and location to satisfy TransAlta Utilities.
ii) All easements shall be registered in the name of the Town of Calmar.
iii) See Standard Details for preferred alignments in road right-of-ways.

d) Installation

i) The Developer and TransAlta Utilities shall obtain Town approval for the method of installation including excavation and backfilling requirements.

ii) The Developer shall coordinate the location of power service boxes and transformers to ensure that they do not conflict with driveways or interfere with other utilities. Alignments to be approved by the Town.
iii) An Excavation Permit must be obtained from the Town of Calmar for an excavation on Town property.

e) Costs

i) Any capital contribution that the utility company may charge for installation of electrical services, shall be paid by the Developer.

2.7 Landscaping

2.7.1 Open Space Planting Requirements

a) A minimum of 70 trees per hectare is required for all Municipal Reserves, Parkland, and Open Space areas. Justification must be provided on the drawing if any columnar form trees are being proposed.

This area shall be calculated as the total area of parkland, minus retained tree stand areas. Credit for individual retained specimen trees may be considered by the Town.

A minimum of 60% Deciduous to 40% Coniferous is required. Justification may be requested by the town if this quantity cannot be reached due to site restraints. Acceptance & variances shall be at the Towns discretion.

Shrubs may be substituted for trees at the rate of seven shrubs to 1 tree, for a maximum of 10% of the total number of trees required for the site.

Where naturalization planting is appropriate and being used, within the open space area, plant material may be substituted per the following within the naturalized area for a maximum of 10% of the total number of full size trees required for the site. (1) Full Size Tree for:

i) (2) Potted Tree (40mm CAL.)
ii) (5) Potted Tree (20mm CAL.)
iii) (7) Shrubs (5 Gal. Pot)
iv) (25) Tree / Shrub Whips or Plugs (Min 100mm Pot)

* Emergent plant material does not qualify for tree substitution.

2.7.2 School and Park Sites

a) Program requirements for new school and park sites vary from site to site, depending on school type, park size, and the requirement for a Community League envelope. Designers are advised to contact the Town of Calmar staff to determine the program for a specific site before proceeding with design. Discussions with Town of Calmar staff shall include space requirements for School Sites, Sports Field Requirements, and Passive Recreation Areas.

b) School and park sites may have other specific design considerations and requirements including, but not limited to, the following:

i) A school bus drop-off zone with adequate roadway frontage to accommodate bus parking.

ii) Avoid access points to the schools, playgrounds, and community leagues through/across vehicular movement areas.
iii) Locating playgrounds centrally between schools and adjacent pathways is desirable. Wherever possible playgrounds should also have visual connection to any publically accessible heated areas / structures but not be in their shadow over winter.
iv) Major activity nodes such as rinks, tennis courts, parking lots, and playgrounds should be located as far from adjacent private property as possible.
v) Connecting walkways through school and park sites are recommended to encourage neighborhood walkability.
vi) Drainage from general park areas is to be directed around school sites, as these sites are considered to be separate properties.
vii) Drainage from general park areas is to be directed away from critical areas such as buildings on community league sites.
viii) Drainage is to be directed away from playgrounds to reduce the potential for flooding.

2.7.3 Sports Fields

a) Sports Fields require a minimum 3.0m safety setback beyond the field of play in all directions. The setback must be turf with no vertical objects, and without hard or granular surfacing. For ball diamonds, this also extends to a line 10.0m beyond and parallel to an extension of the backstop, down the first and third baselines, and behind the backstops. Larger setbacks to property lines are generally desired, dependent on field orientation and level of play. Contact the Town of Calmar for more information.

Contact the Town of Calmar for sizes, slopes and other sports field design requirements

Design of sports fields shall comply with the governing standard of the sport including orientation, sizes, surfacing requirements and required equipment.

2.7.4 Playgrounds

a) All new or upgraded playgrounds must meet the current CSA Z614 Children's Play-spaces and Equipment. The Landscape Architect must consult with the Town of Calmar prior to proceeding with design work

2.7.5 Road Right of Ways

a) All Landscape in Road Right-of-Ways to conform to Tree Setbacks from Road, Walks, & Utilities

b) Collector Road Boulevards

i) Trees shall be planted on collector roads at a spacing that is appropriate for the variety selected. The minimum quantity requirement is (1) tree per 10 linear meters, on both sides of the collector roadway.

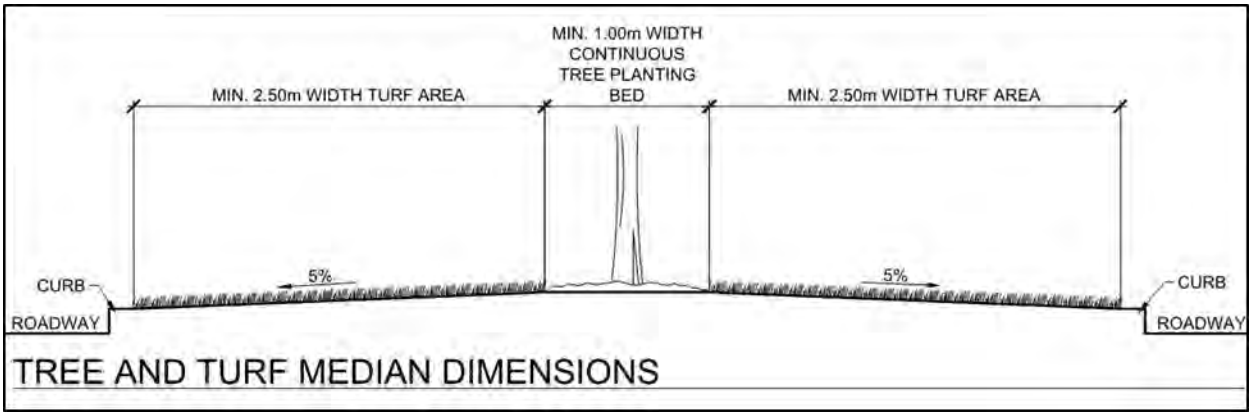
c) Arterial Road Boulevards

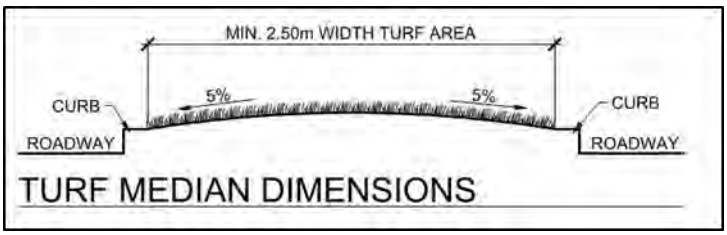
i) Arterial R.O.W. must be graded, top-soiled, seeded or sodded, and landscaped to the satisfaction of the Town of Calmar.
ii) There shall be the equivalent of one row of boulevard trees at 10m lineal spacing on each side of the arterial roadway.
iii) There shall be the equivalent of one row of boulevard trees at 10m lineal spacing in 4.5m full width or wider arterial medians.

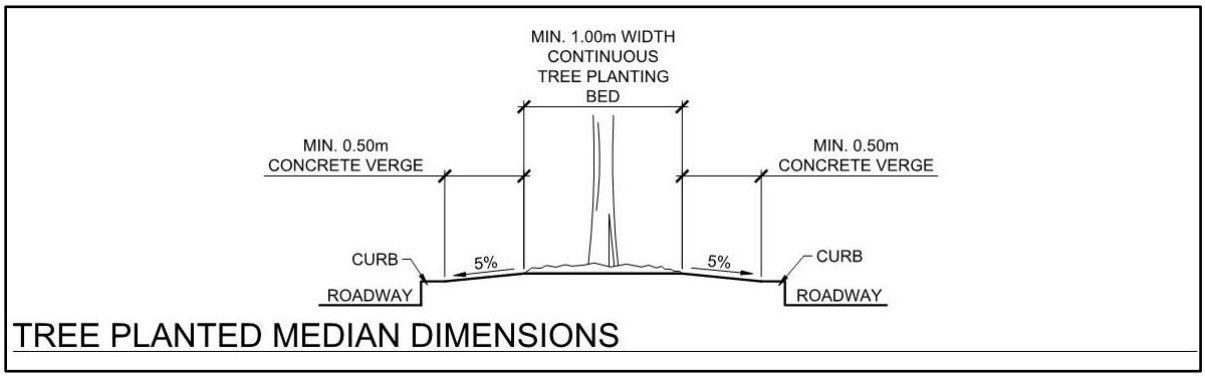
iv) There shall be the equivalent of one row of shrubs spaced at 1.2m along both sides of the roadway placed in planting beds behind the walkway on each side of the arterial.
v) Within commercial and school zones, the requirement for shrubs along an arterial roadway is waived, but where opportunities exist, shrub planting in these areas is encouraged.
vi) Where possible, new utility locations shall be adjusted accordingly to accommodate landscaping.
vii) When roadway construction is staged, landscaping is required only on the portion being developed.

d) Islands & Medians

i) All road islands and medians shall be low maintenance. Designs shall include, where appropriate, trees, shrubs, groundcovers, mulch, and sod to the satisfaction of the Town. Shrubs and groundcovers must be low growing with a maximum mature height of 1000mm at maturity.
ii) A 500mm concrete verge is required on either side of a planting bed island or median.
iii) All vertical features (street signage, light poles, etc.) will be located within a mulch area, or, a concrete nose shall be provided at an appropriate size to include the mentioned structures.
iv) Trees planted in center medians shall be installed in continuous mulched beds 1m minimum width.
v) The required cross slope shall not be less than 5% from center of island to curb.
vi) Turf in center medians and islands shall allow a driven mower to remain parallel to traffic with both wheels on the median. Turf shall not be installed in a median that does not accommodate a driven mower (3.65m width) with overhang onto adjacent roadway. See schematic'(s) below for clarification.







TREE PLANTED MEDIAN DIMENSIONS

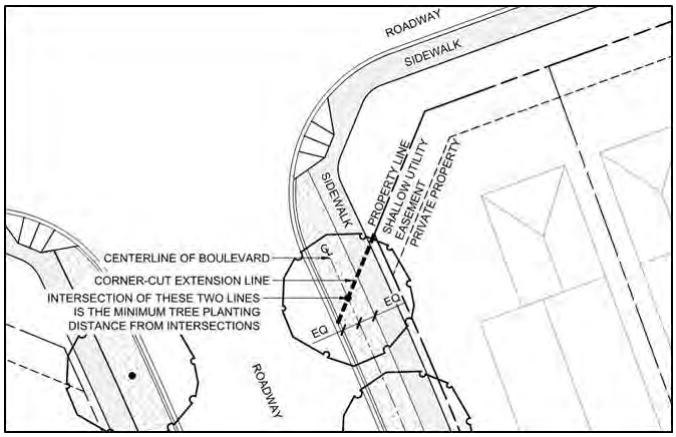
vii) Cross sections and planting details of the proposed island or median treatment shall be provided and display the following information:

(1) Planting soil depth, width, & type;
(2) Turf, and mulch locations, depths, and type;
(3) Above and below ground utility alignments within 3.0m of road island;
(4) Curb face;
(5) Back of curb, verge, or walk;
(6) Dimensions for tree and shrub setbacks;
(7) Freestanding features (i.e. signs, sculptures, light poles);
(8) Private property lines;

viii) Above and below grade utilities should not be located under the landscaped road islands or medians to avoid conflicts with landscape improvements.

e) Corner Cuts & Entrance Features

i) All corner cut & entrance feature planting shall be low maintenance. Designs shall include, where appropriate, trees, shrubs, groundcovers, mulch, and sod to the satisfaction of the Town.
ii) Free standing architectural features shall not be located within turf areas unless appropriate consideration is given to maintenance and mowing requirements (i.e. signs, sculptures, light poles)
iii) Due to sightline concerns no tree planting shall occur beyond where the center of the boulevard and the corner cut chamfer extension intersect. Site specific restrictions or variances may be required at the discretion of the Town of Calmar. See schematic below for clarification.



f) Walkways

i) R.O.W. areas must be graded, top-soiled, seeded or sodded, and planted with trees and shrubs to the satisfaction of the Town.
ii) There shall be a minimum of four trees per 35 linear meters of walkway R.O.W. shrubs may be substituted at the rate of seven shrubs per tree.
iii) Trees must be contained within mulched beds.
iv) There shall be no shrubs with a mature spread of over 1.0m.
v) Perennials & groundcovers are not recommended although exceptions may be made by the Town of Calmar for very hardy species.
vi) Furniture may be provided by the Developer and placed at strategic locations within a walkway R.O.W. upon approval from the Town of Calmar.
vii) Bollard barrier post standards and spacing must be approved by the Town of Calmar, and, where mulch beds are proposed, included within the mulched bed for ease of maintenance.
viii) Where possible below grade utilities should be located under hard surface walkways to avoid conflict with landscape improvements.
ix) When reviewing the proposed plant material the following design issues will be considered:

(1) Maintain adequate year-round sight lines through the walkway R.O.W. for pedestrian safety and security;
(2) Maintain a minimum 2.5m branching height for all deciduous trees in R.O.W.'s at maturity to allow adequate pedestrian clearance beneath tree branches;
(3) Plant material shall be low maintenance and hardy to Calmar's climate;
(4) Shrubs with horizontal root habits shall not be allowed along private property lines;
(5) Encourage use of pyramidal / columnar tree forms to avoid tree branches overhanging into adjoining private property;

2.7.6 Utility Corridors

a) Utility corridors that may be landscaped are to be planted with a minimum of 70 trees per hectare designed and massed into major groupings in mulched tree beds. Minimum deciduous tree caliper shall be 50mm. Minimum coniferous tree height shall be 2.0m.

b) In the event that the Utility Authority will not allow landscaping in the R.O.W., the requirement for all, or a portion, of the landscaping will be waived.

c) The Developer / Landscape Architect is to contact the Utility Authority to determine landscape standards and to review designs and achieve permission in the form of a Servicing Agreement. The Servicing Agreement is to be submitted with any landscape plans submitted to the Town of Calmar for review.

d) The Developer / Landscape Architect shall provide to the Town of Calmar written confirmation from the Utility Authority when landscaping in utility corridors is not approved.

e) Shrubs shall be massed within large mulched planting beds.

f) Furniture may be provided by the Developer and placed at strategic locations within the utility corridor to the satisfaction of the Town.

g) Contact the appropriate utility company regarding acceptable tree species, sizes, and locations on utility R.O.W.'s.

h) The Landscape Architect is to circulate the drawings to the utility company and achieve approval.

2.7.7 High Pressure Natural Gas Right of Ways

a) These guidelines will provide for some limited development without compromising the safety and/or integrity of high-pressure natural gas facilities. These guidelines apply to odorized natural gas high pressure, above 100 psi or 740 kPa, pipeline R.O.W. Requirements for high pressure natural gas right of ways include:

b) Authorization must be requested and approved by all utilities for all development on R.O.W.'s

c) Developments that may be allowed:

i) Contouring – cover cannot be reduced over the pipeline but may be increased. The total cover cannot exceed 2.0m over the pipeline. This will allow access to the pipeline for repairs without having to shore of excessively back slope the excavation. Contouring must not restrict access to the R.O.W.
ii) Parallel walkways – must be located between the pipeline and the nearest boundary of the R.O.W. but must not encroach onto the R.O.W. by more than 3.0m nor be constructed over the pipeline.
iii) Trees – shall be planted no closer than 5.0m from the pipeline, have a mature height of no more than 10.0m. The mature canopy cannot extend over the pipeline.
iv) Shrubs – shall be hand planted with a minimum setback of 2.0m from the pipeline, and have a maximum mature height of 2.0m.
v) Lighting – shall be installed a maximum of 1.0m from the R.O.W. boundary on the same side as the walkway and shall be served by underground cabling.
vi) The responsibility for maintaining any of the above developments on the R.O.W. shall rest with the Town of Calmar once FAC is granted, unless otherwise negotiated.
vii) Appropriate signage of these developed R.O.W.'s may be provided and maintained by the Developer and/or the Town of Calmar.
viii) Any other proposed developments and/or use for these R.O.W.'s are not permitted.
ix) Non-compliance due to already approved deviations shall be allowed to continue until redevelopment occurs.
x) Development is not permitted on a R.O.W. that contains an un-odorized pipeline.

2.7.8 Stormwater Management Facilities

a) Constructed wetlands, dry ponds, wet ponds, and areas surrounding new storm water management facilities must be graded, top-soiled, seeded or sodded, and landscaped by the Developer to the satisfaction of the Town of Calmar. Requirements may include the following:

i) Landscaping must be naturalized below the 1 in 5 year flood line.
ii) Plant material shall be selected to respect soil characteristics, side slopes, sun orientation, design of the facility, and its intended use.
iii) Public Lands within the facility must be planted with a minimum of 70 trees per hectare.
iv) In wet ponds this area shall be calculated as above the normal water line.
v) In dry ponds the area shall be calculated above the 5 year water line.
vi) A limited number of flood tolerant trees may be planted below the 1 in 5 year flood line and may count towards the required quantities at the discretion of the Town of Calmar.
vii) Shrubs above the 1 in 5 year flood level shall be massed within large planting beds to create major focal areas on the slopes of the pond. Trees are permitted within mulched planting beds.
viii) Above the 1 in 5 year flood level, all planting beds shall have a minimum depth of 100mm deciduous wood chip mulch or approved alternate.

ix) Plant material appropriate to withstand flood conditions may be located below the 1 in 5 year flood line.

x) Mulch is not permitted below the 1 in 5 year flood line. Planting beds below the 1 in 5 year flood line are difficult to maintain and must adhere to the following conditions:

(1) Must be weed and erosion free at CCC & FAC Inspections;
(2) Erosion control is recommended around the perimeter of the Storm Water Management Facility where adjacent land is bare soil or undeveloped;
(3) 'Brush Blanket' may be installed in these planting beds during plant material establishment to minimize weed competition. Blanket must be removed and seed must be placed and established in these areas prior to FAC inspection;
(4) Weeds are to be removed on a monthly basis;
(5) Shrub overlap of 20% mature size is recommended to encourage a stable weed-free, erosion-free environment. The use of fast growing plant material is encouraged;

xi) Furniture may be provided by the Developer and placed at strategic locations within the Public Utility Lot at the discretion of the town of Calmar.

xii) Area must be kept free from weeds between construction commencement and issuance of FAC. Failure to do so will result in control by the Town of Calmar, and all costs shall be borne by the Developer / Contractor.

xiii) The site must be designed to permit access of maintenance vehicles, including water and pruning trucks with man-lifts.

xiv) The following signage shall be provided by the developer before issuance of CCC. Signs shall be installed between high-water line and normal water line. Signs to be maintained by contractor until issuance of FAC. All required signage to be clearly identified on the landscape plans for Town approval:

(1) No Swimming – Installed between high water line and normal water line;
(2) No Boating – Installed between high water line and normal water line;
(3) No Skating – Installed between high water line and normal water line;
(4) No Motorized Vehicles – Installed at all entrance points to Storm Water Management Facility;
(5) Neighborhood Information Sign – Installed at a strategic location to be coordinated with the Town of Calmar:

- Sign to include clear graphic representation of any and all non-maintained areas. This includes naturalized tree stands, naturalized grass areas & slopes, etc.
- Developer shall obtain written approval from the Town of Calmar of the sign's design prior to producing or manufacturing final product.

2.7.9 Naturalization

a) Naturalization is encouraged when it provides ecosystem function (e.g. water filtration, water retention, slope stability, wildlife habitat or corridors, etc.) and where aesthetically appropriate and maintenance concerns are addressed. Requirements for naturalization areas may include the following:

i) Naturalized areas in the Town of Calmar will require the following signage:

(1) Neighborhood Information Sign – Installed at a strategic location to be coordinated with the Town of Calmar
(2) Sign to include clear graphic representation of any and all non-maintained areas. This includes naturalized tree stands, naturalized grass areas & slopes, etc;

ii) Developer shall obtain written approval from the Town of Calmar of the sign's design prior to producing or manufacturing final product;
iii) Naturalization may be a requirement when natural tree stands or natural open areas are removed or impacted during construction or other related activities.
iv) Naturalized areas shall be a minimum setback of 30m from any playgrounds.
v) The Landscape Architect shall design an appropriate mix of native trees, shrubs, groundcovers, and wildflower seed mixes.
vi) The Landscape drawings shall identify all plant communities to be established and all other information necessary to implement the proposed landscape improvements. Site characteristics including slope soil & orientation, shall be taken into account when specifying species and size of plant material.
vii) The Landscape Architect shall design any required subsurface drainage, surface drainage, and erosion control measures in the restoration area and, if required, coordinate this with other consultants to implement geotechnical, structural, and bioengineering principles.
viii) The Landscape Architect shall specify all tree, shrub, and groundcover sizes. To promote biodiversity and a healthy growing environment, it is recommended that 10% of all plant material, where appropriate, be of larger sizes. Larger material (trees or larger shrubs) shall be at least 40mm caliper size (deciduous), 2.5m height (coniferous), and 5 gallon pot size (shrubs).
ix) Forestry stock, seedlings, deciduous tree whips and propagated/rooted cuttings are acceptable for use from an approved source.
x) All plant material to be nursery grown stock, with exception of native spaded plugs and plant material.
xi) Collected plant material may be used subject to prior approval by the Town. Landscape drawings shall identify areas to be planted with collected material and also indicate the site from where source material has originated.
xii) The guide for acceptable levels of naturalization planting (plugs, whips, and bare root specimens) survival at FAC inspection shall be a minimum survival rate of 80%, with a minimum density of one plant per square meter. Large, concentrated patches of dead plant material will not be accepted.
xiii) All existing natural sites must be cleaned and checked for hazards such as old barbed wire fences, abandoned structures, basements, and any other objects that may be hazardous to citizens.

2.7.10 Plant Material

a) General Planting Requirements

i) To minimize the visual impacts, and reduce spread, of pests & disease, the Town of Calmar encourages planting a diversity of tree species hardy to the Calmar area.
ii) Coniferous tree planting is encouraged, where possible, to provide an enhanced level of winter interest to public space within the Town of Calmar.

b) Soil Volume Requirements

i) Increased soil volumes have proven to improve overall health and lifespan of trees. The Town of Calmar encourages Developers and Landscape Architects to maximize the potential soil availability for proposed trees.
ii) Any tree in an urban environment that will be surrounded by hard surface area shall be provided a minimum soil volume of 16m³.
iii) Trees within Arterial R.O.W. boulevards & medians shall be provided a minimum soil volume of 14m³.
iv) The Town of Calmar also encourages increased soil volumes in Collector and Local boulevard scenarios.

v) In the event the site does not allow for the minimum required soil volume, the Developer / Landscape architect is responsible for coordinating alternative with the Town of Calmar.
vi) Shrub planting shall receive a minimum soil depth of 450mm.
vii) Perennial planting shall receive a minimum soil depth of 300mm.
viii) All seed, sod, and naturalized grass areas shall receive a minimum soil depth of 200mm.

c) Plant Material Sizes

i) Plant Material Minimum Sizes:

(1) Unless noted otherwise and/or approved by the Town all tree planting shall be between 60-65mm caliper for deciduous trees and a minimum 2.5m height for coniferous trees. With the exception of naturalized areas.
(2) Shrub size at planting shall be a minimum of 300mm height for deciduous shrubs and 450mm spread for coniferous shrubs;
(3) If proposed trees are less than the minimum caliper, additional plant material may be required. Approval per the Town's discretion.

d) Tree Protection Zone

i) Where sod will not be placed until completion of all construction activities, protection of boulevard trees is required.
ii) For trees within 3m of active construction or construction traffic, trees shall be protected on all sides with minimum 1.2m height 10mm thick plywood, setback 1m from trunk of tree.
iii) For trees 3-5m from active construction or construction traffic, trees shall be protected on all sides with minimum 1.2m height snow fencing, setback 1m from trunk of tree.

e) Approved Tree Species, Spread, and Spacing Requirements

Botanical Name	Common Name	Spacing
Deciduous Trees *(boulevard / roadway)*		
*Caragana arborescens 'Sutherland'	Sutherland Caragana	3m
*Caragana x mordensis 'Snowbird'	Snowbird Hawthorn	5m
*Caragana x mordensis 'Toba'	Toba Hawthorn	5m
Fraxinus pensylvanica 'Foothills'	Foothills Green Ash	8m
Fraxinus pensylvanica 'Patmore'	Patmore Green Ash	8m
Fraxinus pensylvanica 'Prairie Spire'	Prairie Spire Green Ash	8m
Fraxinus pensylvanica 'Trojan'	Trojan Green Ash	8m
*Malus x 'Spring Snow'	Spring Snow Crabapple	5m
Quercus macrocarpa	Bur Oak	8m
Tilia americana 'True North'	True North Linden	8m
Tilia x flavescens 'Dropmore'	Dropmore Linden	8m
Tilia cordata	Little Leaf Linden	8m
Tilia cordata 'Greenspire'	Greenspire Linden	8m
Ulmus americana	American Elm	10m
Ulmus americana 'Brandon'	Brandon Elm	8m
Ulmus americana 'Patmore'	Patmore Elm	8m

Botanical Name	Common Name	Spacing
Deciduous Trees *(Storm Water Management Facility – below 1:5 year flood line)*		
Acer negundo	Manitoba Maple	8m
Betula papyifera	Paper Birch	6m
Fraxinus pensylvanica 'Foothills'	Foothills Green Ash	8m
Fraxinus pensylvanica 'Patmore'	Patmore Green Ash	8m
Fraxinus pensylvanica 'Prairie Spire'	Prairie Spire Green Ash	8m
Fraxinus pensylvanica 'Trojan'	Trojan Green Ash	8m
Populus x 'Assiniboine'	Assiniboine Poplar	8m
Populus x 'Northwest'	Northwest Poplar	10m
Populus tremuloides	Trembling Aspen	5m
Salix alba 'Vitellina'	Golden Willow	10m
Salix pentandra	Laurel Leaf Willow	10m
Deciduous Trees *(Parks & Open Space)*		
Acer ginnala	Amur Maple	4m
Acer negundo	Manitoba Maple	8m
Acer saccharinum 'Silver Cloud'	Silver Cloud Silver Maple	10m
Acer tataricum 'GarAnn'	Hot Wings Tatarian Maple	6m
Aesculus glabra	Ohio Buckeye	5m
Alnus hirsute 'Harbin'	Pririe Horizon Alder	8m
Betula papyifera	Paper Birch	6m
Caragana arborescens 'Sutherland'	Sutherland Caragana	3m
Caragana x mordenensis 'Snowbird'	Snowbird Hawthorn	5m
Caragana x mordenensis 'Toba'	Toba Hawthorn	5m
Elaugnus angustifolia	Russian Olive	8m
Fraxinus pensylvanica 'Foothills'	Foothills Green Ash	8m
Fraxinus pensylvanica 'Patmore'	Patmore Green Ash	8m
Fraxinus pensylvanica 'Prairie Spire'	Prairie Spire Green Ash	8m
Fraxinus pensylvanica 'Trojan'	Trojan Green Ash	8m
Malus 'Big River'	Big River Crabapple	4m
Malus 'Dolgo'	Dolgo Crabapple	5m
Malus 'Gladiator'	Gladiator Crabapple	3m
Malus 'Royalty'	Royalty Crabapple	4m
Malus 'Rudolph'	Rudolph Flowering Crabapple	5m
Malus x 'Spring Snow'	Spring Snow Crabapple	5m
Malus x 'Thunderchild'	Thunderchild Crabapple	5m
Populus x 'Assiniboine'	Assiniboine Poplar	8m
Populus x 'Northwest'	Northwest Poplar	10m
Populus tremuloides	Trembling Aspen	5m
Prunus padus	Mayday	8m
Prunus pensylvanica	Pin Cherry	6m
Quercus Macrocarpa	Bur Oak	8m
Salix pentandra	Laurel Leaf Willow	10m
Sorbus americana	American Mountain Ash	6m

Botanical Name	Common Name	Spacing
Sorbus aucuparia ‘Black Hawk’	Black Hawk Mountain Ash	5m
Sorbus aucuparia ‘Fastigiata’	Pyramidal Mountain Ash	4m
Sorbus aucuparia ‘Rossica’	Russian Mountain Ash	4m
Sorbus decora	Showy Mountain Ash	4m
Syringa reticulate ‘Ivory Silk’	Japanese Tree Lilac	5m
Tilia americana ‘True North’	True North Linden	8m
Tilia x flavescens ‘Dropmore’	Dropmore Linden	8m
Tilia cordata ‘Greenspire’	Greenspire Linden	8m
Ulmus americana	American Elm	10m
Ulmus americana ‘Brandon’	Brandon Elm	8m
Ulmus americana ‘Patmore’	Patmore Elm	8m
Coniferous Trees		
Larix sibirica	Siberian Larch	5m
Picea glauca	White Spruce	4m
Picea pungens	Colorado Green Spruce	4m
Picea pungens ‘Glauca’	Colorado Blue Spruce	4m
Pinus cembra	Swiss Stone Pine	4m
Pinus contorta latifolia	Lodgepole Pine	3m
Pinus ponderosa	Ponderosa Pine	6m
Pinus sylvestris	Scots Pine	10m
Pinus uncinata	Mountain Pine	3m

i) For accent purposes only and will be reviewed on a site specific basis. Special attention should be paid towards location and quantity.

f) Plant Material Setbacks, Sizing & Spacing

i) Where possible, trees shall be setback a minimum distance, measured from the center of the tree trunk, from above and below grade utilities, property lines, walkways, & roads as follows:

Tree Setbacks from Utilities and Property Lines	
Distance from Light Standards / Power Hardware	3.5m
Distance from Fire Hydrants	3.5m
Distance from Stop Signs	3.5m
Distance from Yield Signs	3.5m
Distance from Transit Zones (ensure trees do not obstruct sightlines)	3.5m
Distance from Other Signs	2.0m
Distance from Private Property on Walkway R.O.W.	1.0m
Distance from Private Property on Open Parkland	3.0m
Distance from Private Property on Boulevards	1.0m
Distance from Shallow Underground Utilities	1.0m
Distance from Gas or Oil R.O.W.	Contact Utility

Distance from Deep Underground Utilities	1.5m
Distance from Sanitary and Storm Sewers	1.8m
Distance to Sanitary and Storm Sewers and Manholes	2.0m
Distance from Water Mains	2.5m
Distance from overhead power utilities shall be as established by the Utility Authority	
Tree Setbacks from Walkways and Roads	
Arterial Road Median Curb Face	2.0m
Collector Road Median Curb Face	1.5m
Local Road Median Curb Face	1.5m
Arterial Road Boulevard Curb Face	1.5m
Collector Road Boulevard Curb Face	1.5m
Local Road Boulevard Curb Face	1.5m
Distance from Driveways	2.0m
Distance from Sidewalks	1.0m

ii) The Town suggests that all landscape improvements and plant material shall have increased setbacks from underground utilities.

iii) There shall be no excavations undertaken within 1.0m of any underground utilities unless:

(1) The excavation is done under direct control of the operator of the utility system.
(2) The excavation method is acceptable.

iv) In the event that the mechanical tree digging equipment cannot maintain a minimum clearance of 1.0m from shallow utilities during installation, the pertinent Utility Authority must be contacted for approval and/or safety procedures (e.g. hand digging). Any additional costs incurred will be at the Developers expense. Drawings are to note that the approval for plantings have been received from the Utility Authority, and identify the plant material affected. It should be noted that deep utilities require a minimum offset.

v) Planting distances from low, intermediate, and high-pressure pipelines are to be observed as dictated by the Pipeline Authority.

vi) Setback distances apply to all tree and tree form shrub species. Species with suckering root systems or large hanging canopies may require increased setbacks at the discretion of the Town.

vii) Setbacks for coniferous trees are to be no less that the distances indicated above, but will be reviewed and approved on a case by case basis in regard to concerns over potential mature size. Coniferous trees must maintain minimum clearances from vertical structures at mature spread.

viii) Groups of coniferous trees shall be placed in mulched beds with appropriate spacing.

ix) Planting of Populus species on parkland adjacent to private property is generally not recommended, although exceptions may be made at the discretion of the Town in the following ways:

(1) Northwest Poplar, Balsam Poplar, and Cottonwood are a minimum of 15m from private property lines;
(2) Northwest Poplar, Balsam Poplar, and Cottonwood are a minimum of 10m from all hard surface areas, unless site specific construction details are used;
(3) All other populous species including columnar varieties are a minimum of 10m from private property lines and 5.0m from hard surface areas;

(4) Allowances may be made at the discretion of the Town if there is special construction mitigation in place, such as a root barrier;

g) Shrub Plantings

i) All shrub / perennial beds shall contain 100mm depth shredded wood mulch over HD landscape fabric.
ii) Shrub setbacks from shrub bed edges shall reflect mature diameter with the entire shrub contained within the bed extents.
iii) Planting bed locations should accommodate the use of large turf maintenance equipment. Provide a minimum 3.65m clearance between the edge of a bed and obstructions such as fencing, furniture, buildings, individual trees, etc. Where possible, shrub beds should be designed with tapered or flowing edges (angle shall be noticeably less than 90 degrees) to allow for ease of mowing, and eliminate the need for hand trimming.
iv) Where turf is between planting beds and adjacent vertical structures the minimum distance shall be 3.65m
v) On drawings, shrub symbols should be shown at mature size with no overlap.
vi) Perennials and groundcovers may be overlapped at the discretion of the city.
vii) The intent is to achieve balance between aesthetic impact, shrub health, and maintenance concerns.
viii) There shall be a minimum 3.0m planting setback of shrub beds from play space envelopes (playground equipment, splash parks, etc.).
ix) On school playground sites, there shall be no shrub beds within 30m of the playground envelope.
x) All walkway bollards to be contained within mulched planting beds.
xi) Minimum shrub spacing shall be based on spread at maturity. With the exception of naturalized areas

h) Perennial Planting

i) Perennial planting in mulched beds will be reviewed on an individual basis and accepted at the discretion of the Town of Calmar.
ii) Only low maintenance, non-invasive, and hardy perennials will be accepted.

i) Annual Planting

i) Although Annual plantings are not encouraged, proposed Annuals will be reviewed on an individual basis. Alternate or additional maintenance and warranty processes may be required at the discretion of the Town of Calmar.

j) Seed & Sod

i) Landscape drawings to clearly identify the intended surface treatment for Town of Calmar approval.
ii) Town of Calmar encourages sod installation in public space, where appropriate, to minimize soil erosion.
iii) Where seed is specified, the drawings must include the intended mix, along with the application type, and application rate. Refer to Town of Calmar Specifications for Seeding for additional information.

iv) The following identify specific seed mixes for typical applications for various development contexts within the Town of Calmar. Alternate seed mixes will be considered at the town's discretion.

(1) Recommended Seed Mixes:

- Park / Open Space (maintained)

  30% Touchdown Kentucky Bluegrass
  30% Banff Kentucky Bluegrass
  30% Creeping Red Fescue
  20% Fiesta II Perennial Rye Grass

- Standard Roadway Landscaping (maintained)

  30% Argyll Kentucky Bluegrass
  30% Kentucky Bluegrass
  30% Creeping Red Fescue
  10% Annual Rye Grass

- Restoration Seed Mix (native)

  15% Awned Wheatgrass
  15% Slender Wheatgrass
  15% Western Wheatgrass
  5% Sloughgrass
  5% Idaho Fescue
  5% Alkali Bluegrass
  5% Junegrass
  5% Sandberg
  20% Green Needlegrass
  10% Rocky Mountain Fescue

- Naturalization: Wet Meadow (non-maintained)

  10% Awned Wheatgrass
  10% Western Wheatgrass
  10% Sloughgrass
  20% Tufted Hair Grass
  15% Giant Wild Rye
  30% Fowl Bluegrass
  5% Annual Ryegrass

- Naturalization: Dry Meadow (non-maintained)

  20% Junegrass
  20% Rough Fescue
  10% Green Needlegrass
  15% Streambank Wheatgrass
  20% Northern Wheatgrass
  10% Sheeps Fescue
  5% Annual Ryegrass

- Naturalization: Grassland Wet Seed Mix (spring flooding with dry conditions)

  20% Northern Wheatgrass
  20% Slender Wheatgrass
  20% Nodding Bromegrass
  7.5% Tufted Hair Grass
  7.5% Tickle Grass
  10% Sloughgrass
  10% Alkali Bluegrass
  10% Annual Ryegrass

v) Wildflower Mixes shall be specified on the drawings by the Landscape Architect for Town review and approval.

k) Weed Control

i) Noxious weeds must be controlled in accordance with the Provincial Weed Control Act. Prohibited noxious weeds must be eradicated in accordance with the Provincial Weed Control Act throughout the development and construction process.
ii) Aquatic invasive species shall be controlled as per the Fisheries (Alberta) Act.
iii) Landscaped areas must be kept generally weed free and free from noxious weeds between construction commencement and issuance of FAC. Failure to do so will result in control action by the Town, and all costs shall be borne by the Developer / Contractor.

2.7.11 Site Specific Features

a) Fencing

i) Fencing plans shall be included with all engineering drawing submissions.
ii) All fencing shall conform to requirements as outlined in the project servicing agreement.
iii) Fencing shall be constructed adjacent to and at the following locations:

(1) Arterial Roadways
(2) Parks and Playfields
(3) Public Walkways and Utility Lots
(4) School Sites
(5) Town owned lands e.g. Firehall sites etc.
(6) Multi-Family Sites
(7) Neighbourhood Commercial Sites
(8) Institutional Sites and
(9) Other areas as required by the Town.

iv) All fencing shall maintain a minimum 150mm offset from adjacent property line.
v) Gates shall be installed on all residential lots which back onto public park space. Gates shall be located approximately at the mid-point of each lot and shall be constructed to open inwards onto the private property.
vi) Alternative styles of fencing may be proposed, subject to approval by the Town.

b) Fencing Adjacent to Open Space

i) School, and park sites are to be separated from private development by permanent fencing. Fences including the concrete pile must constructed entirely within private property. Fencing is to be minimum 1.2m height and suitable for restraining pets.

ii) Fencing adjacent to parkland with formalized sports fields or future sports fields shall be a minimum 1.8m height and suitable to protect against stray balls. All fencing surrounding these lands to meet this criteria as sports fields are subject to future re-alignments.
iii) Park sites, open space, and parkland, that is adjacent public space / roadway shall be enclosed with Temporary Post & Rail Fence to protect from traffic damage during landscape establishment.
iv) Refer to Standard Detail's for fencing details.
v) Post and rail fence may be removed by the Town of Calmar upon future park establishment.

c) Boulders

i) Boulders are to always be located within mulched beds or other non-mowed areas to minimize maintenance requirements.
ii) Boulders are to be immovable by hand and located in visible areas to minimize public safety hazards.
iii) All boulders to be clearly shown and identified on the landscape drawings for approval by the Town.

d) Site Furniture

i) Furniture such as benches, picnic tables, and waste receptacles may be provided on parkland if appropriately located and approved by the town.
ii) Vandal-proof hardware (tamper resistant and locking) is required for all site furniture with a minimum of one per waste receptacle, two per bench, and two per picnic table.
iii) All site furniture shall be placed on a concrete pad or secured with a concrete footing.
iv) The concrete pad should extend 150mm beyond the outside edges of the site furniture to accommodate mowing.
v) Concrete pad shall be located to allow 3.65m mowing separation from any vertical structure for any adjacent turf areas.
vi) Setbacks shall be maintained from the face of the amenity as follows:

(1) Benches: 1.0mm from back of walkway;
(2) Waste Receptacles: 600mm from back of walkway;
(3) Waste Receptacles: 3.0m from benches;
(4) Picnic Tables: 1.0mm from back of walkway;

3.0 CONSTRUCTION SPECIFICATIONS

3.1 Roadways

3.1.1 Subgrade

This section specifies the requirements for working and compacting subgrade soil.

a) DEFINITIONS

i) **Prepared Subgrade** - Soil immediately below a pavement structure or slab, compacted to a depth of 150 mm, 300 mm or as specified.
ii) **Maximum Density -** The dry unit mass of a soil sample at optimum moisture content as determined in a laboratory according to ASTM D698 Method A.
iii) **Testing Frequency -** The quality assurance laboratory will take a minimum of one field density test for each 1,000 m^2 of compacted subgrade lift according to ASTM D1556, ASTM D2167, or ASTM D2922 for comparison with a maximum density determined according to ASTM D698 Method A, or as directed by the Engineer.

b) MATERIALS

i) Use only compacted dry material with no deleterious material approved by the Engineer.

c) EQUIPMENT

i) Use equipment designed for and capable of disking, scarifying, spreading, spraying water, compacting and trimming soil to specified depth.

d) SUBGRADE PREPARATION

i) Loosen soil to required depth. Work soil with cultivating and mixing equipment until soil is pulverized into pieces no larger than 25 mm maximum dimension, exclusive of stones.
ii) Remove soft or other unstable material that will not compact properly and fill resulting depressions with approved material.
iii) Shape and compact subgrade to meet the following tolerances:

(1) 6 mm maximum variation above subgrade elevation.
(2) 25 mm maximum variation below subgrade elevation.

iv) Do scarifying, blading, moisture adjustment, compacting or other methods of work as necessary to provide a thoroughly compacted subgrade shaped to grades and cross sections indicated or directed.
v) Finish side slopes to a neat condition, suitable for seeding, true to lines and grades indicated.

(1) Remove boulders encountered in cut slopes and fill resulting cavities.
(2) Hand finish slopes that cannot be finished satisfactorily by use of machine.

e) PROOF ROLLING

i) For proof rolling, use a single axle dual wheeled truck loaded to minimum 9100 kg on the rear axle. Tires to be inflated to a minimum 275 kPa.

ii) Engineer may authorize use of other acceptable proof rolling equipment.
iii) Proof roll subgrade at the level directed by the Engineer.
iv) Where proof rolling reveals areas of defective subgrade, remove and replace to requirements of this section at no extra cost to the Owner.

f) MAINTENANCE

i) Maintain road surfaces until next course of material is placed or until project or that portion thereof is accepted. Repair and retest as required by the Engineer, if damaged.

g) REQUIRED DENSITY

i) A minimum of 100% of the maximum density for each 150 mm of subgrade under pavement structure, and a minimum of 95% of the maximum density for each 150 mm of subgrade under concrete walks, curb ramps, slab and private crossings.

3.1.2 Granular Base

This section specifies requirements for supplying, producing, placing and compacting crushed gravel or quarried stone as a granular base to lines, grades and typical cross-sections indicated on plans or as directed.

a) MATERIALS

i) Gradation to be within the limits specified for the two (2) types of granular material specified hereinafter when tested to ASTM C136 and ASTM C117, (AASHTO T11 and T27) and having a smooth curve without sharp breaks when plotted on a semi-log grading chart to ASTM E11-70.

(1) 20 mm minus Gravel

Sieve Size	% Passing by Weight
20.0 mm	100
12.5 mm	60 - 95
5.0 mm	35 - 65
2.00 mm	25 - 55
0.400 mm	10 - 30
0.080 mm	2 - 10

(2) 50 mm minus Gravel

Sieve Size	% Passing by Weight
50.0 mm	100
40.0 mm	85 - 100
20.0 mm	60 - 95
5.0 mm	25 - 60
2.0 mm	15 - 45
0.400 mm	5 - 25
0.080 mm	2 - 8

(3) Liquid Limit:

ASTM D423 (AASHTO T89)
Maximum 25

(4) Plasticity Index:

ASTM D424 (AASHTO T90)
Maximum 6

(5) Los Angeles Abrasion;

ASTM C131 (AASHTO T96)
Max. percentage loss by weight: 45

(6) Crushed Fragments: At least 60% of fragments within each of following size ranges to have at least 1 freshly fractured face:

Passing		Retained on
50.0 mm	to	38.0 mm
38.0 mm	to	19.0 mm
19.0 mm	to	5.0 mm

b) PLACING

i) Do not place granular base until finished subbase or subgrade surface is inspected and approved.
ii) Place material only on a clean unfrozen surface, properly shaped and compacted and free from snow and ice.
iii) Begin spreading base material on a crown line or on high side of a one-way slope.
iv) Place using methods, which do not lead to segregation or degradation of aggregate.
v) For spreading and shaping material, use spreader boxes having adjustable templates or screeds, which will place material in uniform layers of required thickness.
vi) Place material in uniform layers not exceeding 150 mm when compacted or to such other depth as approved by Engineer.
vii) Shape each layer to a smooth contour and compact to specify density before succeeding layer is placed.
viii) Remove and replace that portion of a layer in which material becomes segregated during spreading.

c) COMPACTING

i) Compact to a density not less than 100% of Standard Proctor.
ii) Shape and roll alternately to obtain a smooth, even and uniformly compacted base.
iii) Apply water as necessary during compacting to obtain specified density. If material is excessively moist, aerate by scarifying with suitable equipment until moisture content is corrected.
iv) In areas not accessible to rolling equipment, compact to specified density with approved mechanical tampers.

d) FINISH TOLERANCES

i) Finished base surface shall be within ±13mm of established grade but not uniformly high or low.
ii) Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

e) PROOF ROLLING

i) For proof rolling, use a single axle dual wheeled truck loaded to a minimum 9100 kg. on the rear axle. Tires to be inflated to a minimum 275 kPa.
ii) Engineer may authorize use of other acceptable proof rolling equipment.
iii) Proof roll top of base upon completion of fine grading and compaction.
iv) Where proof rolling reveals areas of defective subgrade:

(1) Remove base, subbase and subgrade material to depth and extent directed.
(2) Backfill excavated subgrade with approved common or borrow material and compact.
(3) Replace sub-base material and compact.
(4) Replace base material and compact.
(5) There shall be no payment for the repair of granular base caused by defective subgrade.

v) Where proof rolling reveals defective base or subbase, remove defective materials to depth and extent directed and replace with new materials at no extra cost to the Owner.

f) MAINTENANCE

i) Maintain finished base in a condition conforming to this section until succeeding material is applied or until acceptance by the Engineer.

3.1.3 Asphaltic Concrete Pavement

This section specifies requirements for producing and placing hot mix asphaltic concrete for pavement base, surface or overlay including supply of aggregates and bituminous binder.

a) DEFINITIONS

i) Overlay: paving over an existing pavement for rehabilitation purposes and not as part of a new pavement structure (pavement thickness varies).
ii) Paving: paving where a lift or lifts form part of the total pavement structure (pavement thickness is specified).

b) QUALITY ASSURANCE

i) Source Sampling

(1) At least two weeks prior to commencing work, inform the Engineer of proposed source of aggregates and provide access for sampling.

ii) Delivery and Storage

(1) Deliver and stockpile aggregates. Stockpile minimum 50% of total amount of aggregate required before commencing asphalt production.
(2) When necessary to blend aggregates from one or more sources to produce required gradation, do not blend in stockpiles.
(3) When dryer drum mixing plant is used, stockpile fine aggregate separately from coarse aggregate.
(4) Provide approved storage, heating tanks and pumping facilities for asphalt cement.

iii) Quality Control Plan

iv) Before beginning hot mix asphalt production, submit quality control plan, including the following recommended tests and frequency for each mix type produced to Engineer:

(1) Three Marshall specimens per test
(2) Asphalt content
(3) Air Voids
(4) Stability and flow
(5) Film thickness
(6) Moisture content in the mix
(7) Gradation in mix
(8) Plant discharge temperature
(9) Asphalt storage temperature
(10) Frequency: A minimum of two tests per day in full production (four hours or more)

v) Thickness Cores

(1) The quality assurance laboratory will take a minimum of one core per 1,000m^2 of asphalt pavement and determine the thickness of the entire mat.
(2) If the initial core thickness is deficient at the completion of paving, that initial thickness is discarded and three new cores will be taken within 10 m of the original core location at a minimum spacing of 2.5 m between cores. The average thickness of the three new cores will represent that area.

vi) Density Specimen Sampling and Testing

(1) The quality assurance laboratory will determine the density of laboratory compacted Marshall Specimens at a minimum frequency of one Marshall Density for every 1,000 tonnes of hot mix, or day's production, whichever is less.
(2) Drill cores from a compacted mat placed from the same load of hot mix from which Marshall specimens were taken, or from suspect compacted mat, and test for density.
(3) A single core is initially taken representing the quantity of hot mix asphalt in not more than 1,000 m^2 of mat, with a minimum of one taken from a day's production. If the initial core density is below specified, that initial density is discarded and three new cores will be taken within 10 m of the original core location at a minimum spacing of 2.5 m between core holes. The average of the three new cores represents that area.
(4) Pavement compaction will be accepted on the basis of the ratio (in percent) of the core density to the density of the Marshall specimen. If cores were drilled from a mat where no Marshall specimen was taken, acceptance will be based on the ratio of the core density to the average of all Marshall specimens to date.

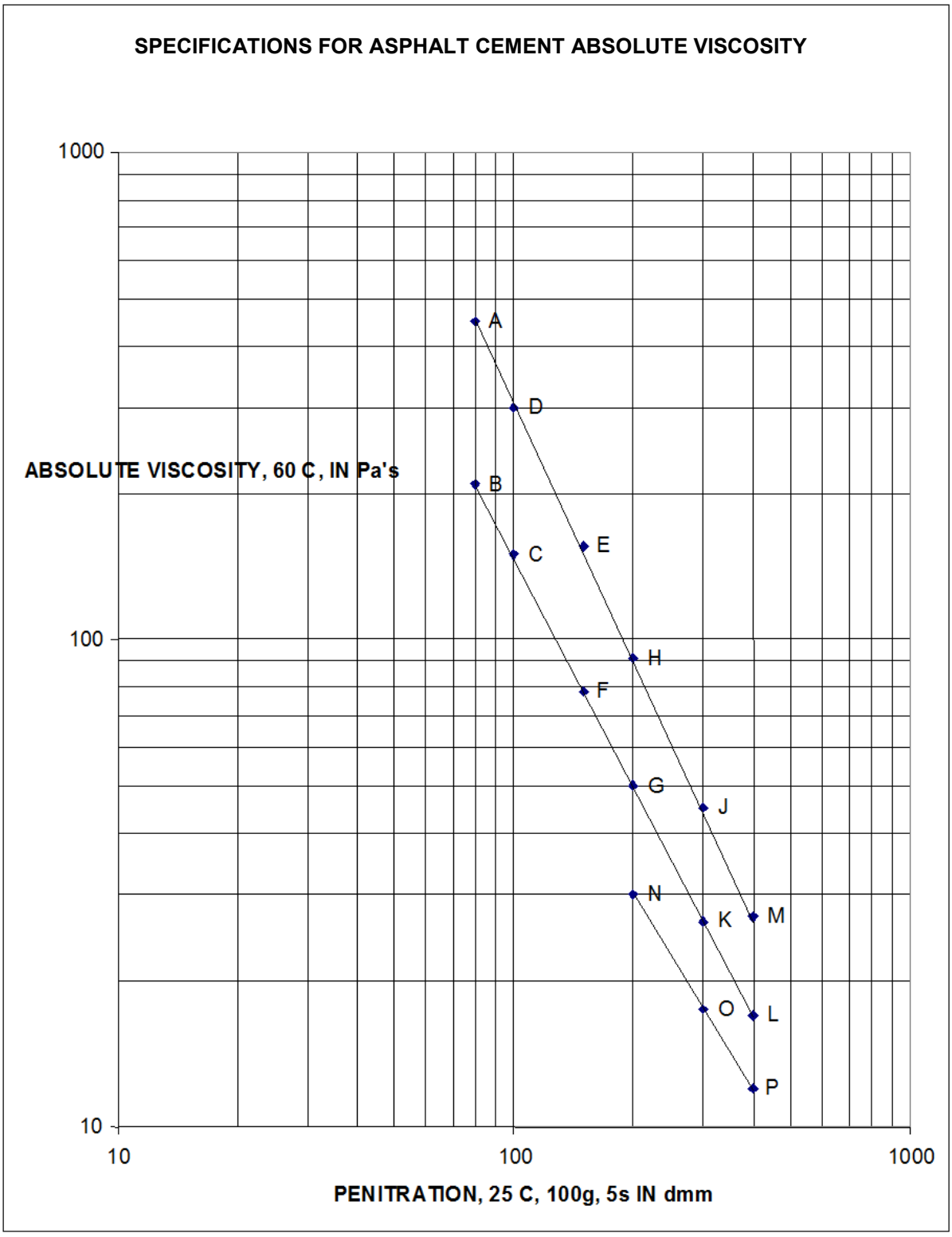
c) MATERIALS

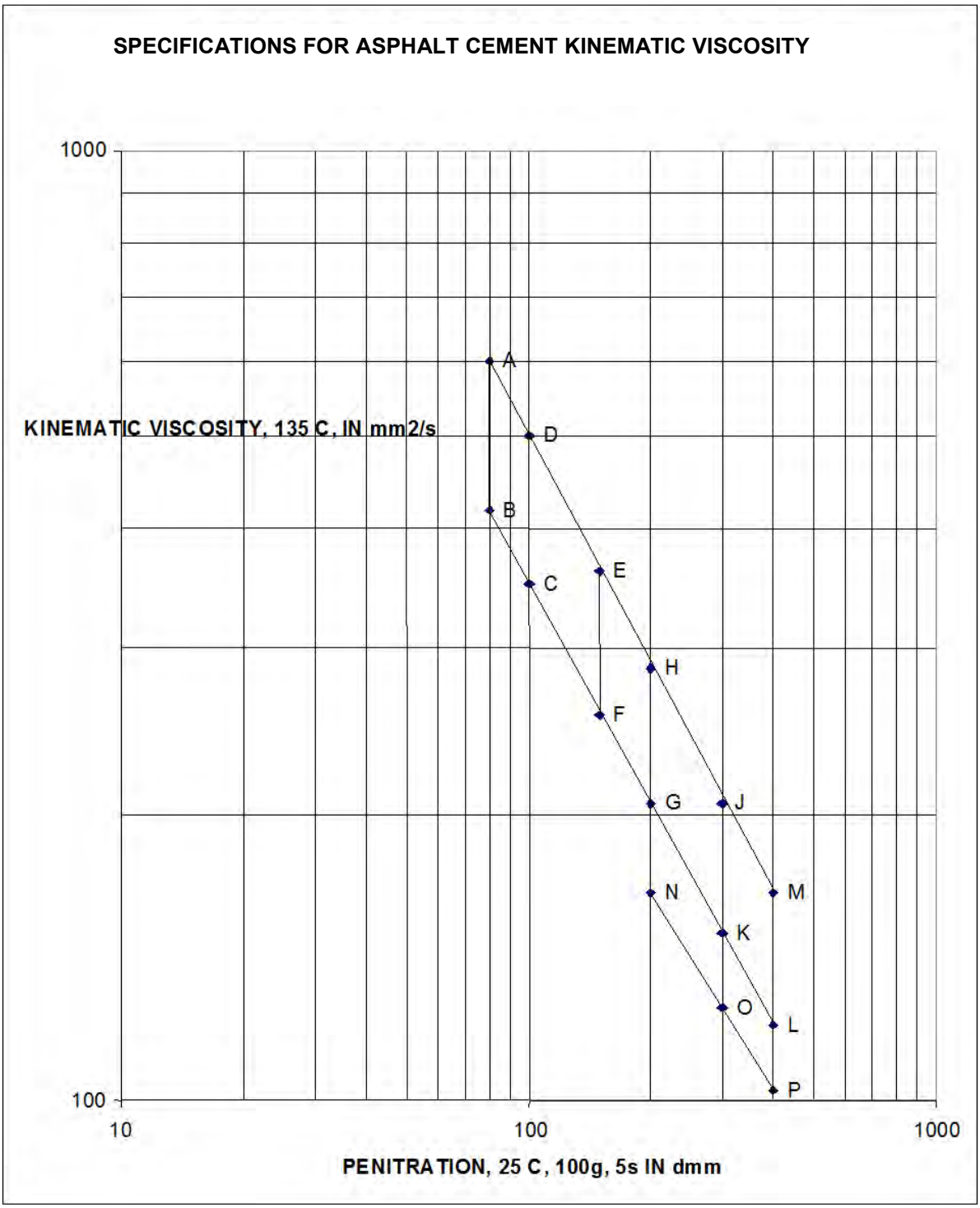
i) Asphalt cement: premium grade 80-100 (A) or 150-200 (A).

Specifications for Premium Grade Asphalt Cements

TEST CHARACTERISTICS	A.S.T.M. TEST METHOD	PREMIUM GRADES OF ASPHALT CEMENTS					
		80-100 (A)			150-200 (A)		
Absolute Viscosity, 60°C, Pa – s	D2171	The viscosity and penetration values must fall within the area bounded by A-B-C-D-A plotted as straight lines on a full logarithmic plot (log-log), with the coordinates of the points as follows:			The viscosity and penetration values must fall within the area bounded by E-F-G-H-E plotted as straight lines on a full logarithmic plot (log-log), with the coordinates of the points as follows:		
Penetration, 25°C, 100g, 5s, dmm	D5	Pt.	Abs. Visc.	Pen.	Pt.	Abs. Visc.	Pen.
		A	450	80	E	155	150
		B	208	80	F	70	150
		C	150	100	G	50	200
		D	300	100	H	92	200
Kinematic Viscosity, 135°C, sq. mm/s	D2170	The viscosity and penetration values must fall within the area bounded by A-B-C-D-A plotted as straight lines on a full logarithmic plot (log-log), with the coordinates of the points as follows:			The viscosity and penetration values must fall within the area bounded by E-F-G-H-E plotted as straight lines on a full logarithmic plot (log-log), with the coordinates of the points as follows:		
Penetration, 25°C, 100g, 5s, dmm	D5	Pt.	Kin. Visc.	Pen.	Pt.	Kin. Visc.	Pen.
		A	600	80	E	360	150
		B	417	80	F	225	150
		C	350	100	G	205	200
		D	500	100	H	285	200
Flash Point, Cleveland Open Cup, °C minimum	D92	235			205		
Solubility in Trichloroethylene, % minimum	D2042	99.5			99.5		
Tests on Residue from Thin Film Oven Test: Ratio of Absolute Viscosity of Residue from Thin-Film Oven Test to Original Absolute Viscosity, maximum:	D1754 D2171	4.0			4.0		
Ductility, 25°C, cm, maximum	D113	100			100		
Ductility, 15.6°C, cm, minimum		-			-		

General Requirement:
The asphalt shall be prepared by the refining of petroleum. It shall be uniform in character and shall not be heated to 175°C. The temperature at delivery to the site shall be between 135°C and 175°C.


SPECIFICATIONS FOR ASPHALT CEMENT ABSOLUTE VISCOSITY
ABSOLUTE VISCOSITY, 60 C, IN Pa's
1000
100
10
10
100
1000
PENITRATION, 25 C, 100g, 5s IN dmm
A
D
B
E
C
H
F
G
J
N
K
M
O
L
P


SPECIFICATIONS FOR ASPHALT CEMENT KINEMATIC VISCOSITY
1000
KINEMATIC VISCOSITY, 135 C, IN mm2/s
100
10
100
1000
PENITRATION, 25 C, 100g, 5s IN dmm
A
B
C
D
E
F
G
H
J
K
L
M
N
O
P

ii) Aggregates

(1) Coarse aggregate is aggregate retained on 5.0 mm sieve and fine aggregate is aggregate passing the 5.0 mm sieve.
(2) Do not use aggregates having known polishing characteristics in mixes for surface courses.
(3) Gradation of aggregates blended to job mix formula to be within the following limits when tested to ASTM C117 and ASTM C136 (AASHTO T27 and T11) and giving smooth curve without sharp breaks when plotted on semi-log grading chart:

Aggregate Properties

Mix Designation	**Sand Course**	**Surface Course**	**Base Course**
Sieve Size	**4.75mm**	**12.5mm**	**25mm**
25 000	100		100
20 000			90 – 100
12 500		100	62 – 88
10 000		78 – 94	45 – 80
5 000	85 – 95	53 – 80	30 – 65
2 000	60 – 90		
1 250		32 – 54	12 – 38
630		24 – 44	8 – 30
400	25 – 75		
315		16 – 32	4 – 22
160		8 – 22	2 – 15
80	5 - 15	4 - 10	1 - 7

(4) Sand equivalent to ASTM D2419 (AASHTO T176), Minimum 50, Sand Course 30
(5) Magnesium Sulphate soundness to ASTM C88 (AASHTO T104) % loss by mass, coarse aggregate: 18, fine aggregate: 20
(6) Los Angeles Abrasion to ASTM C131 (AASHTO T96) maximum % loss by mass, coarse aggregate: 40
(7) Absorption to ASTM C127 (AAHSTO T85) maximum % by mass, coarse aggregate: 1.75
(8) Loss by washing to ASTM C117 (AASHTO T11) maximum % passing 0.080 mm sieve, coarse aggregate: 1.5
(9) Lightweight particles to ASTM C123 (AASHTO T150) maximum % by mass less than 1.95 relative density: 1.5
(10) Flat and elongated particles (with length to thickness ratio greater than 5), maximum % by mass, coarse aggregate: 15
(11) Crushed fragments, minimum % by mass with minimum of two freshly fractured faces, coarse aggregate: 75% for 12.5 mm surface course; 90% for 25 mm base course

iii) Mineral Filler

(1) Finely ground particles of limestone, hydrated lime, Portland Cement or other approved non-plastic mineral matter, thoroughly dry and free from lumps.
(2) Add mineral filler when necessary to meet job mix aggregate gradation or as directed to improve mix properties.
(3) Mineral filler to be dry and free flowing when added to the aggregate.
(4) Plasticity index of mineral filler to be zero.

d) MIX DESIGN

i) Job mix design to be completed by an approved materials testing agency and submitted for approval to the Engineer at least two weeks prior to commencing paving operations.

ii) Design of mix by Marshall Method of Mix Design to the requirements below:

Mix Type	Sand Course	Surface Course	Base Course
Compaction blows on each face of test specimens		50	75
Minimum Marshall stability at 60 C, Kn	3.5	4.0	5.4
Flow value mm	5.0 maximum	2 - 4	2 - 4
Air voids in total mix, %	3 - 12	3 – 8	3 - 5
Voids in mineral aggregate, %	16	13	15

iii) Physical requirements to be measured as follows

(1) Marshall Road and Flow Index to ASTM D1559.
(2) Air Voids to ASTM D3203.
(3) Voids in Mineral Aggregate to ASTM C127 and ASTM C128 with allowance for volume of asphalt absorbed in aggregate.

iv) Submit the following with the mix design:

(1) Temperature of asphalt during mixing in the plant.
(2) Temperature of asphalt immediately prior to compaction.

v) Do not change mix design without prior approval of the Engineer. Should a change in material source be proposed a new mix design must be approved by the Engineer.

e) PLANT AND MIXING REQUIREMENTS

i) Batch and continuous mixing plants

(1) To ASTM D995.
(2) Heat asphalt cement and aggregate to mixing temperature which will normally correspond to climatic viscosity of asphalt cement (ASTM 02170) in range of 150 to 300 centostokes or 175°C whichever is less. Do not heat asphalt cement above this temperature.
(3) Before mixing, dry aggregates to a moisture content not greater than 0.5% by mass or to a lesser moisture content if required to meet mix design requirements.
(4) Make available current asphalt cement viscosity data at plant.
(5) Feed aggregates from individual stockpiles through separate bins to cold elevator feeders.
(6) Feed cold aggregates to plant in proportions that will ensure continuous operations.
(7) Immediately after drying, screen aggregates into hot storage bins in sizes to permit recombining into gradation meeting job-mix requirements.
(8) Store hot screened aggregates in a manner to minimize segregation and temperature loss.
(9) Maintain temperature of materials within ± 5°C of specified mix temperature during mixing.
(10) Mixing time:

- In batch plants, continue wet mixing as long as necessary to obtain a thoroughly blended mix but not less than 30 s or more than 75 s.
- In continuous mixing plants not less than 45 s.

ii) Dryer drum mixing plant:

(1) Feed aggregates to burner end of dryer drum by means of a multi-bin cold feed unit and blend to meet job-mix requirements by adjustments of variable speed feed belts and gates on each bin.
(2) Meter total flow of aggregate by an electronic weigh belt system with an indicator that can be monitored by plant operator and which is interlocked with asphalt pump so that proportions of aggregate and asphalt entering mixer remain constant.
(3) Provide for easy calibration of weighing systems for aggregates without having material enter mixer.
(4) Make provision for conveniently sampling the full flow of materials from the cold feed.
(5) Provide screens or other suitable devices to reject oversize particles or lumps of aggregate from cold feed prior to entering drum.
(6) Provide a system interlock which will stop all feed components if either asphalt or aggregate from any bin stops flowing.
(7) Accomplish heating and mixing of asphalt mix in an approved parallel flow dryer-mixer in which aggregate and asphalt enter drum at burner end and travel parallel to flame and exhaust gas stream. Control heating to prevent fracture of aggregate or excessive oxidation of asphalt. Equip system with automatic burner controls and provide for continuous temperature sensing of asphalt mixture at discharge, with a printing recorder that can be monitored by plant operator. Submit printed record of mix temperatures at end of each week.
(8) Mixing period and temperature to produce a uniform mixture in which particles are thoroughly coated, and moisture content of material as it leaves mixer to be less than 2%.

iii) Temporary storage of hot mix

(1) Provide mixture storage of sufficient capacity to permit continuous operation and designed to prevent segregation.
(2) Do not store asphalt mix in storage bins in excess of 3 H.

iv) While producing asphalt mix for this project, do not produce mix for other users unless separate storage and pumping facilities are provided for materials supplied for this project.

v) Mixing tolerances:

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

5.00 mm sieve and larger	±5.0
1.25 mm sieve	±4.0
0.63 mm sieve	±3.0
0.315 mm sieve	±3.0
0.160 mm sieve	±2.0
0.08 mm sieve	±1.0

(2) Permissible variation of asphalt cement from job mix, ±0.4%.
(3) Permissible variation of mix temperature at discharge from plant, 5 °C.

f) EQUIPMENT

i) Pavers: mechanical self-powered pavers with automatic screed controls, vibratory screed equipped with vibratory extensions and augers capable of spreading mix within specified tolerances, true to line, grade and crown indicated without segregation and tearing.
ii) Rollers: sufficient number of self-propelled rollers equipped with wetting and scraping devices to prevent adhesion of mix to drums or tires (petroleum derivatives not permitted for cleaning) of type and weight required to obtain specified density of compacted mix. Pneumatic-tired rollers are to be equipped with wind skirts.
iii) Haul trucks: of adequate size, speed and condition to ensure orderly and continuous operation and as follows:

(1) Boxes with tight metal bottoms.
(2) Covers of sufficient size and weight to completely cover and protect asphalt mix when truck fully loaded.
(3) In cool weather or for long hauls, insulate entire contact area of each truck box.

iv) Hand tools:

(1) Lutes or rakes with covered teeth during spreading and finishing operations.
(2) Tamping irons having mass not less than 12 kg and a bearing area not exceeding 310 cm^5 for compacting material along curbs, gutters and other structures inaccessible to roller. Mechanical compaction equipment, when approved by Engineer, may be used instead of tamping irons.
(3) Straight edges, 3.0 m in length, to test finished surface.

g) PREPARATION

i) Written notice of intention to begin paving operations to be given to Engineer 24 h in advance.
ii) When paving over existing asphalt surface, clean pavement surface. When levelling course is not required, patch and correct depressions and other irregularities to approval of Engineer before beginning paving operations.
iii) Apply prime coat or tack coat.
iv) Prior to laying mix, clean surfaces of loose and foreign material.
v) Paint contact surfaces of existing structures such as manholes, curbs or gutters with bituminous material prior to placing adjacent pavement.

h) TRANSPORTATION OF MIX

i) Transport mix to job site in vehicles cleaned of foreign material.
ii) Paint or spray truck beds with light oil, limewater, soap or detergent solution, at least once a day or as required. Elevate truck bed and thoroughly drain. No excess solution or use of gasoline, kerosene, or similar product will be permitted.
iii) Schedule delivery of material for placing in daylight, unless Engineer approves artificial light.
iv) Deliver material to paver at a uniform rate and in an amount within capacity of paving and compacting equipment.
v) Deliver loads continuously in covered vehicles and immediately spread and compact. Deliver and place mixes at a temperature within range directed, but not less than 135°C.

i) PLACING

i) Place asphaltic concrete to thicknesses, grades and lines indicated on drawings or directed by Engineer.
ii) Placing conditions:

(1) No paving is permitted when rain or snow is imminent, or when the surface to be paved is wet, icy, snow-covered or frozen, unless waived by the Engineer.
(2) No paving is permitted when air temperature and wind speed conditions are below the applicable mat curve, unless waived by the Engineer.
(3) Do not place hot-mix asphalt when pools of standing water exist on surface to be paved, during rain, or when surface is damp.

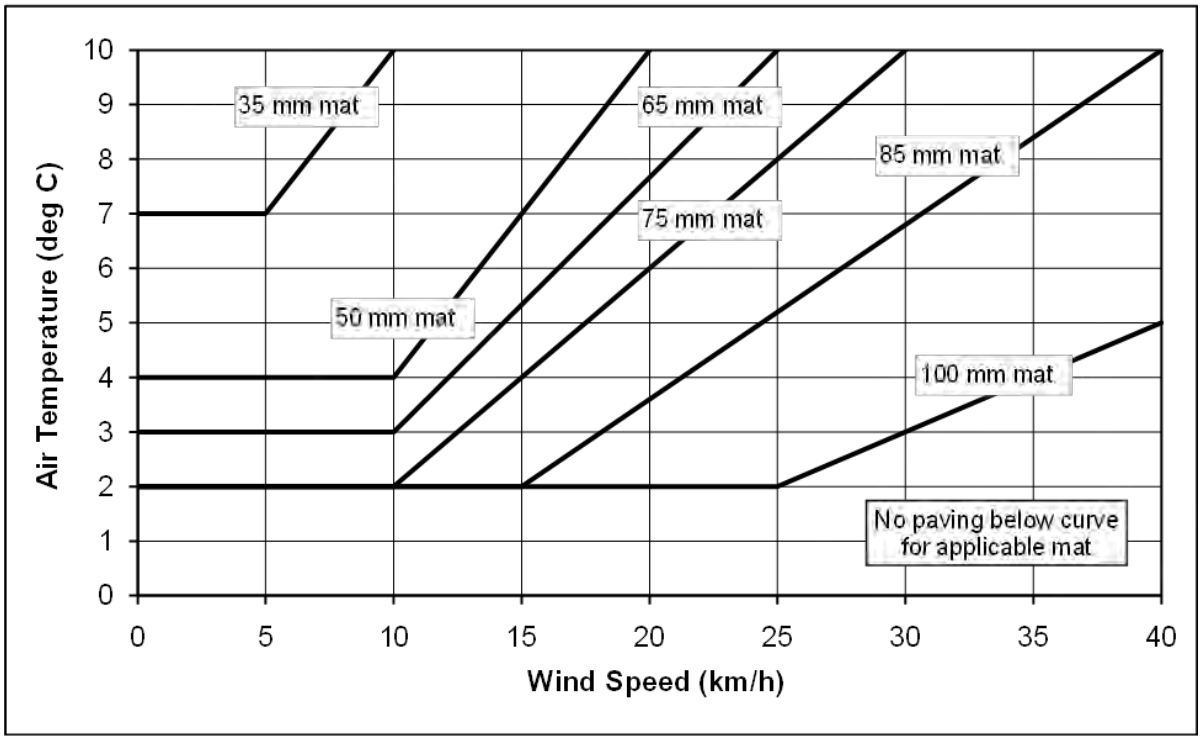
iii) Place asphalt concrete in compacted lifts of thickness approved by Engineer.
iv) Spread and strike off mixture with self-propelled mechanical finisher.

(1) Construct longitudinal joints and edges true to line markings. Lines for paver to follow parallel to centreline of proposed pavement. Position and operate paver to follow established line closely.
(2) When using pavers in echelon, have first paver follow marks or lines, and second paver follow edge of material placed by first paver. Work pavers as close together as possible and in no case permit them to be more than 30m apart.
(3) If segregation occurs, immediately suspend spreading operation until cause is determined and corrected.
(4) Correct irregularities in alignment left by paver by trimming directly behind machine.
(5) Correct irregularities in surface of pavement course directly behind paver. Remove by shovel or lute excess material forming high spots. Fill and smooth indented areas with hot mix. Do not broadcast material over such areas.
(6) Do not throw surplus material on freshly screeded surfaces.

v) When hand spreading is used:

(1) Wood or steel forms, approved and rigidly supported to assure correct grade and cross section, may be used. Use measuring blocks and intermediate strips to aid in obtaining required cross section.
(2) Distribute material uniformly. Do not broadcast material.
(3) During spreading operation, thoroughly loosen and uniformly distribute material by lutes or covered rakes. Reject material that has formed into lumps and does not break down readily.
(4) Following placing and before rolling, check surface with templates and straightedges and correct irregularities.
(5) Provide heating equipment to keep hand tools free from asphalt. Avoid high temperatures which may burn material. Do not use tools at a greater temperature than temperature of mix being placed.

Air Temperature and Wind Limitations on Paving



j) COMPACTING

i) All asphalt mix shall be thoroughly compacted, and after final rolling the finished surface of the mix shall be free of segregation, waves, hairline cracks and other obvious defects.

ii) General:

(1) Provide at least two rollers one of which must be pneumatic-tired type, and as many additional rollers as necessary to achieve specified pavement density within the available compaction time and compatible with the rate of hot-mix placement.
(2) Start rolling operations as soon as placed mixture can bear weight of roller without undue displacement of material or cracking of surface.
(3) Operate roller slowly initially to avoid displacement of material. For subsequent, rolling do not exceed 5 km/h for steel-wheeled rollers and 8km/h for pneumatic-tired rollers.
(4) Keep wheels of roller slightly moistened with water to prevent pick-up of material but do not over-water.
(5) Complete final rolling before the mat temperature reaches 80ºC.
(6) Where rolling causes displacement of material, loosen affected areas at once with lutes or shovels and restore to original grade of loose material before re-rolling.
(7) Do not permit heavy equipment or rollers to stand on finished surface before it has been compacted and has thoroughly cooled.
(8) When paving in echelon, leave unrolled 50 to 75 mm of edge which second paver is following and roll when joint between lanes is rolled.

k) JOINTS

i) General:

(1) Trim to vertical face to provide true surface and cross section against which new pavement may be laid. Remove loose particles.
(2) Paint joint face with thin coat of hot asphalt cement prior to placing of fresh mixture.
(3) Overlap previously laid strip with spreader by 100 mm.
(4) Remove surplus material from surface of previously laid strip. Do not dispose on surface of freshly laid strip.

ii) Transverse Joints:

(1) Construct and thoroughly compact transverse joints to provide a smooth riding surface.
(2) Stagger joint locations minimum 2 m.
(3) Offset transverse joint in succeeding lifts by at least 600 mm.

iii) Longitudinal Joints:

(1) Plan mats so that the surface longitudinal joint will be offset by not more than 150 mm from the centre of an indicated marking line between travel lanes. If permitted by the Engineer, the joint may be located at the centre of travel lane.
(2) Plan width of spread to provide for a minimum 150 mm offset of longitudinal joints in successive lifts.
(3) Create a longitudinal joint while the edge temperature of the first of two adjacent mats is above 80ºC. This may be accomplished by multiple pavers in staggered formation, or by limiting paver advance.
(4) Allow a 25 mm to 50 mm overlap between mats.
(5) Do not roll a 150 mm wide strip along the edge of first mat until the adjoining mat is placed. Roll the joined mat immediately to insure bonding while the joint temperature is above 80ºC.
(6) For surface lifts on freeways, arterial roadways, industrial/commercial roadways and collector roadways carefully roll off the edge of a mat if a minimum joint temperature of 80ºC cannot be maintained prior to the placement of the adjacent mat. Trim off the rolled asphalt to a width of 150 mm resulting in a clean vertical face to the full depth of the mat. Paint the exposed face with tack coat prior to placing the adjacent mat.
(7) Should this longitudinal joint treatment not be performed where required, the area of asphalt pavement will be assessed a pay factor of 95%. This pay factor will be applied to the price of the total quantity of asphalt placed in the mat area.
(8) A longitudinal joint shall be thoroughly compacted and shall meet surface tolerances.

iv) Construct feather joints so that thinner portion of joint contains fine graded material obtained by changed mix design or by raking out coarse aggregate in mix. Place and compact joint so that joint is smooth and without visible breaks in grade.

l) FINISH TOLERANCES

i) Finished asphalt surface to be within ±5mm of design elevation but not uniformly high or low.
ii) Finished asphalt surface not to have irregularities exceeding 5 mm when checked with a 3.0 m straight edge placed in any direction.

iii) The finished surface shall have a tightly knit texture free of visible signs of poor workmanship including, but not limited to, segregation, areas exhibiting excess or insufficient asphalt, improper matching of longitudinal and transverse joints, roller marks, cracking or tearing.

m) ASPHALT CONCRETE THICKNESS TOLERANCES

i) All asphaltic concrete pavement to be of thickness indicated on drawings.
ii) If the average core thickness is deficient that area of asphalt pavement will be assessed a pay factor applied to the price of the quantity of hot-mix in that mat area placed.

Asphalt Thickness Pay Factors

Thickness Deficiency (mm)	Pay Factor (%)
6.0	100.0
7.0	97.0
8.0	93.7
9.0	90.0
10.0	85.5
11.0	80.5
12.0	75.0
13.0	68.0
14.0	60.0
15.0	50.0
Over 15.0	Grind and resurface

iii) Asphalt pavement with excess thickness may be accepted with no claim for extra payment, if surface, grade tolerances and texture are met.

n) ASPHALT DENSITY TOLERANCES

i) Each mat of hot-mix asphalt placed shall be compacted to the following minimum density (% of Marshall Density) for the type of paving, or as indicated in the contract special provisions.

Minimum Density	Type of Paving
98%	All paving for freeways, arterials, industrial/commercial roadways and residential collector roadways.
96%	Paving local residential roadways.
97%	Alley paving.
97%	Rehabilitation overlay mat >40 mm thick.
96%	Rehabilitation overlay mat <35 mm thick; asphalt walk/bikeway.

ii) If the average core density is below the specified density the area represented by the mat in question may be accepted subject to a pay factor to be applied to the price of the quantity of hot-mix asphalt in that mat area.

Asphalt Density Pay Factors

98% Required		**97% Required**		**96% Required**	
Actual Density (%)	Pay Factor (%)	Actual Density (%)	Pay Factor (%)	Actual Density (%)	Pay Factor (%)
98.0	100.0	97.0	100.0	96.0	100.0
97.9	99.9	96.9	99.9	95.9	99.7
97.8	99.8	96.8	99.7	95.8	99.3
97.7	99.6	96.7	99.4	95.7	98.9
97.6	99.4	96.6	99.1	95.6	98.4
97.5	99.1	96.5	98.7	95.5	97.8
97.4	98.7	96.4	98.2	95.4	97.1
97.3	98.3	96.3	97.7	95.3	96.4
97.2	97.8	96.2	97.1	95.2	95.6
97.1	97.2	96.1	96.3	95.1	94.6
97.0	96.5	96.0	95.5	95.0	93.4
96.9	95.8	95.9	94.6	94.9	92.2
96.8	95.0	95.8	93.6	94.8	90.7
96.7	94.2	95.7	92.5	94.7	89.1
96.6	93.3	95.6	91.3	94.6	87.3
96.5	92.3	95.5	89.9	94.5	85.1
96.4	91.1	95.4	88.4	94.4	82.6
96.3	89.8	95.3	86.7	94.3	79.5
96.2	88.5	95.2	84.8	94.2	75.5
96.1	87.1	95.1	82.7	94.1	69.7
96.0	85.5	95.0	80.3	94.0	60.0
95.9	83.8	94.9	77.6		
95.8	82.0	94.8	74.3	Under 94.0	Reject
95.7	80.0	94.7	70.6		
95.6	77.7	94.6	66.0		
95.5	75.4	94.5	60.0		
95.4	73.0				
95.3	70.3	Under 94.5	Reject		
95.2	67.2				
95.1	63.7				
95.0	60.0				
Under 95.0	Reject				

Actual Density = % of Marshall Density
Pay Factor = % of contract price

3.1.4 Liquid Asphalt Coats

Asphalt Prime Coat – The supply and application of liquid asphalt to seal the surface of granular base courses or soil cement in accordance with these specifications.

Asphalt Tack Coat – The supply and application of liquid asphalt coat to provide a bond between an existing asphaltic concrete or Portland cement concrete surface and the underlying asphalt surface in accordance with these specifications.

a) SAMPLES

i) If requested, submit to Engineer one 4-litre container of asphalt material proposed for use in the work, at least two weeks prior to commencing operations.

b) MATERIALS

i) Liquid or emulsified asphalt materials as indicated below and conforming to the related properties.

	Liquid Asphalt Type & Grade	Application Rate litres/m^2	Concentration
Prime Coat	MC-30/70	1.5+/-0.5	100%
Tack Coat	SS-1 MC-30/70	0.5+/-0.2 0.3+/-0.1	50% 100%

ii) Dilute SS-1 emulsified asphalt with an equal amount of water.

c) EQUIPMENT

i) Provide distributor with such designed, equipped, maintained and operated asphalt material that even at heat it may be applied uniformly on variable widths of surface up to 4.6 m wide.
ii) Distributor to have following characteristics:

(1) Capable of distributing asphalt material in a uniform spray with atomization at the rate specified and temperature required.
(2) Equipped with a tachometer registering metre per second visibly located for truck driver to maintain constant speed required for application at specified rate.
(3) Pump equipped with a tachometer registering litres per minute passing through nozzles and readily visible to operator. Pump to operate by a separate power unit independent of truck power unit.
(4) Equipped with an easily read, accurate device which registers temperature of liquid in reservoir.
(5) Equipped with accurate volume measuring devices or a calibrated tank.

d) PREPARATION

i) Prepare surface to be coated to the applicable section. Have the surface approved by the Engineer before applying coating.
ii) Protect adjoining curb, gutter, walk, slabs, barrier, poles and other surfaces not intended for coating from overspray or spills. Remove any overspray or spills.

e) APPLICATION

i) Asphalt prime coat: apply prime coat while the granular base course or soil cement surface is still moist. Do not apply when rain is forecast. Do not allow traffic on prime coat within 6 hours of application or until the prime coat has cured.
ii) Asphalt tack coat: apply tack coat to an area to be paved in the next 24 hours. Do not apply tack coat unless the surface is dry and free of dust and other materials that could reduce the bond. Do not allow traffic on tack coat within two hours of application or until the tack coat has cured.
iii) Prevent overlap at junction spreads.
iv) Correct areas not sufficiently covered.
v) Where traffic is to be maintained, it shall be controlled at all times as directed by the Engineer.

f) USE OF SAND BLOTTER

i) If prime coat material fails to penetrate within a reasonable time, spread and blotter material in amounts required to absorb any excess asphalt material.
ii) Sweep up and remove excess blotter material.

Specifications for Medium Curing Asphalts

ASPHALT GRADE REQUIREMENTS	**ASTM TEST**	**MC-30**		**MC-70**	
		Min	**Max**	**Min**	**Max**
Flash Point, Open Tag, degrees C	D1310	38	-	-	-
Kinematic Viscosity at 60 C, mm^2/s	D2170	30	60	70	140
Distillation Test: % by volume of total distillate to 360 C	D402				
190 C		-	-	10	-
225 C		-	25	50	-
260 C		40	70	70	-
315 C		75	93	85	-
Residue from distillation to 360°C Volume % by difference		50		55	
Tests on Residue from Distillation: Penetration at 25°C, 100 g, 5 s, dmm	D5	120	250	80	120
Ductility at 25°C, cm	D113	100	-	100	-
Solubility in Trichloroethylene, % by mass	D2042	99.5	-	99.5	-
Water, % by mass or volume	D95	-	0.2	-	0.2
Delivery Temperature, C		35	55	55	75

Note: If the ductility at 25°C is < 100 cm, the material will be acceptable if the ductility at 15°C is >100 cm.

General Requirements: The asphalt shall not foam when heated to the application temperature range. The asphalt shall be produced by the refining of petroleum and shall be uniform in character.

Specifications for Anionic Emulsified Asphalts

ASPHALT GRADE REQUIREMENTS	ASTM TEST	SS-1	
		Min	Max
Viscosity at 25°C, SF s	D244	20	60
Residue by Distillation, % by mass	D244	55	-
Settlement in 5 days, % difference by mass	D244	-	5
Storage Stability Test 24 hour, % by mass	D244	-	1
Retained on No. 1000 sieve, % by mass	D244	-	0.10
Cement Mixing Test, % by mass	D244	-	2.0
Tests on Residue from Distillation: Penetration at 25°C, 100 g, 5 s, dmm	D5	100	200
Ductility at 25°C and 5 cm/minute, cm	D113	60	-
Solubility in Trichloroethylene, % by mass	D2042	97.5	-
Delivery Temperature, C		40	70

Notes: The upper limit on % residue is governed by the consistency limits. The test for settlement may be waived when the emulsified asphalt is used in less than 5 days time. The 24-hour storage test may be used in place of the 5-day settlement test. However, in case of dispute, the 5-day storage settlement test shall govern. CAN/CGSB-8.2-M Sieves, woven wire, metric shall be used for the sieve test.

General Requirements: All tests shall be performed within 15 days of the date of delivery. The asphalt shall be uniform in character and shall have a refined petroleum base.

3.1.5 Cement Stabilized Subgrade

Supply and spreading Portland cement subgrade soil. Mix in existing soil, cement and water, compacting and finishing to specified grade and cross section.

a) MATERIAL

   i) Portland cement: to CSA A5 Type 10 (normal).

b) EQUIPMENT REQUIREMENTS

   i) Equipment capable of breaking down, pulverizing soil, and combining soil and cement into a homogeneous mixture to a depth of 300 mm.
   ii) Equipment capable of distributing cement uniformly at a specified rate.
   iii) Equipment capable of attaining a minimum density of 100% of Standard Proctor Density to a depth of 300 mm.

c) TEST AREA

   i) If ordered by the Engineer, a test area determined by the Engineer will be constructed.

d) PROCEDURE

i) Application:

(1) Spread cement on the soil at a rate specified by the Engineer.

ii) Mixing:

(1) Mix the soil and cement to a depth as specified until homogenous and free of lumps.
(2) If required, add water and mix until mixture is at optimum moisture content.

iii) Compaction:

(1) Compaction cement stabilized soil to a minimum density of 100% Standard Proctor Density.

iv) Joints:

(1) When working in an area adjacent to an area already completed, the new work shall overlap the existing by 300 mm with no additional cost to the Owner.

v) Finishing Tolerances:

(1) 6 mm maximum variation above design elevation.
(2) 25 mm maximum variation below design elevation.

e) QUALITY ASSURANCE

i) Required density is a maximum of 100% of the maximum density for each 150 mm lift of stabilized subgrade. Maximum density is defined as the dry unit mass of a soil sample at optimum moisture content as determined according to ASTM D698 Method A.
ii) Testing frequency will be a minimum of one field density test for each 1000 m^2 of compacted subgrade lift according to ASTM D 2167 or ASTM D 2922.
iii) For proof rolling, use a single axle dual wheeled truck loaded to a minimum 9100 kg on the rear axle. Tires to be inflated to a minimum 275 kPa.
iv) Engineer may authorize use of other acceptable proof rolling equipment.
v) Where proof rolling reveals areas of defective subgrade, repair to the requirements of this section at no cost to the Owner.

3.1.6 General Concrete

a) MATERIALS

i) Cement: to CAN3-A5, Surface Concrete: Normal (Type 10), Subsurface Concrete: Sulfate Resistant (Type 50).
ii) Aggregates: to CAN3-A23.1. Fine and coarse aggregate shall each have no more than 1.0% ironstone and similar materials which are known to cause surface defects, such as pitting and popouts, as determined by ASTM C295, Petrographic Examination of Aggregates for Concrete. No aggregate from any one supplier or source shall be used unless a copy of test results thereof, performed by an independent testing laboratory approved by the Engineer, is first submitted to the Engineer at least 10 days before the intended use.

iii) Form stripping agent: colourless mineral oil, free of kerosene, with viscosity between 70 and 110 s Saybolt Universal 15 to 24 mm^2/s at 40°C, flashpoint minimum 150°C, open cup.
iv) Pan forms: removable steel as indicated.
v) Tubular column forms: round, spirally wound laminated fiber forms, internally treated with release material.
vi) Form ties: removable or snap-off metal ties, fixed or adjustable length, free of devices that will leave hole larger than 25 mm diameter and 10 mm deep in concrete surface.
vii) Joint filler: to ASTM D1751, D3408, D3406 (AASHTO M213).
viii) Admixtures:

(1) Air-entraining admixture to CAN3-A266.1.
(2) Chemical admixtures to CAN3-A266.2 and CAN3- A266.4. Engineer to approve accelerating or set retarding admixtures during cold and hot weather placing.

b) CONCRETE MIXES

i) Mix design to be completed by an approved materials testing agency and submitted for approval to the Engineer two weeks prior to concrete being placed.
ii) Except where indicated or specified otherwise, provide concrete mix:

(1) Compressive strength at 28 d, 30 MPa minimum.
(2) Class of exposure A, maximum water cement ratio of 0.45.
(3) Fine aggregate to CAN3-A23.1.
(4) Coarse aggregate to CAN3-A23.1, Table 3, Group 1, 28-5 nominal size.
(5) Entrained air 6% ± 1%.
(6) Slump at point of discharge, 25 to 100 mm.
(7) Maximum flyash content is 10% by mass of cement. No flyash permitted after September 1.
(8) Where 7 day strength is less than 65% of specified 28 d strength, provide additional curing and make changes to mix proportions to ensure specified 28 d strength is attained.

c) GENERAL

i) Do concrete work to CAN3-A23.1 unless otherwise directed by Engineer.
ii) Ensure that reinforcement and inserts are not disturbed during concrete placement.
iii) In locations where new concrete is joined to existing work, drill holes in existing concrete. Place steel dowels and pack solidly with non-shrink grout to positively position and anchor dowels.

d) HOT WEATHER CONCRETE

i) Hot weather concrete: air temperature at or above 25°C.
ii) Conform to the requirements of CAN3-A23.1 for Hot Weather Protection.
iii) Concrete temperature not to exceed 30°C.
iv) Retardant admixtures: to CAN3-A266.2, CAN3-A266.4 and approval of Engineer.

e) COLD WEATHER CONCRETE

i) Cold weather concrete: air temperature at or below 5°C.
ii) Conform to the requirements of CAN3-A23.1 for Cold Weather Protection.
iii) Concrete not to be placed on frozen subgrade or subbase.
iv) Metal forms to be heated if directed by Engineer.

v) Concrete delivered to have a temperature between 15°C and 32°C.
vi) After September 30 all concrete placed to attain specified 28 d strength in 7 d.
vii) Maintain air temperature of 18°C for 3 d by use of insulation or hoarding and heating around concrete.
viii) Accelerating admixture: to CAN3-A266.2, CAN3-A266.4 and approval of Engineer.

f) INSERTS

i) Set sleeves, ties, anchor bolts, pipe hangers and other inserts, openings and sleeves, specified in other sections. Sleeves, and openings greater than 100 mm square not indicated must be approved by Engineer.
ii) Place bolts and sleeves to setting details and secure in non- shrink grout.

g) DEFECTIVE CONCRETE

i) Concrete is defective when:

(1) Failing to meet any requirement of this specification.
(2) Concrete contains excessive honeycombing or embedded debris.
(3) Average of 3 consecutive 28 day strength tests for that class of concrete is less than the specified strength or one individual strength test is more than 3.5 MPa below the specified strength.

ii) For concrete deficient in strength the Engineer may, at his sole discretion, accept any portion of or all of the deficient concrete with the following price reductions:

Amount Under Specified Strength	Unit Price Reduction
Specified Strength or Greater	No reduction or 0%
0.01 MPa to 1.0 MPa	4%
1.01 MPa to 2.0 MPa	9%
2.01 MPa to 3.0 MPa	14%
3.01 MPa to 4.0 MPa	20%
4.01 MPa to 5.0 MPa	26%
5.01 MPa to 6.0 MPa	33%
More than 6.0 MPa	100% Reduction

iii) The application of an adjusted unit price does not relieve the contractor of the contract maintenance requirements.

h) REPAIR

i) Repair defective areas while concrete is still plastic, otherwise wait until curing is completed.
ii) Where directed, remove defective work and replace with new concrete.
iii) Where directed, grind off high surface irregularities.

3.1.7 Concrete Curbs, Curbs and Gutters, Sidewalks, Medians, Driveways and Swales

This section specifies requirements for constructing Portland cement concrete curbs, curbs and gutters, sidewalks, medians and driveways.

a) MATERIAL

i) Joint filler: to ASTM D1751 (AASHTO M213) 20 mm preformed, non-extruding, resilient, bituminous type or approved alternates.
ii) Curing compound to ASTM C309 with fugitive dye or plastic film to ASTM C171. Curing compound not to be applied where frost is expected within 14 days.
iii) Sealing solution: White pigmented sealer or other sealant approved by the Engineer.
iv) Form release agent: non-staining mineral type.

b) GRADE PREPARATION

i) Subgrade compacted to a density of 98% Standard Proctor.
ii) Concrete slab medians: not applicable.

c) GRANULAR BASE

i) Sidewalks, medians: 150 mm granular base compacted to a density of 100% of Standard Proctor.
ii) Concrete driveways and swales: 150 mm granular base compacted to a density of 100% of Standard Proctor.
iii) Concrete slab median: not applicable.

d) TIE TO EXISTING CONCRETE

i) Remove existing concrete back to an existing joint or sawcut a straight edge to tie to.
ii) In curb and gutter sections, drill two 10 mm diameter holes a minimum of 150 mm into the existing section at each end. One hole to be located at the midpoint of the gutter pan and the second hole in the midpoint of the curb section. When connecting sidewalk or slabs to curbs drill 10 mm diameter holes 100 mm deep at a spacing of 600 mm maximum.
iii) For flatwork, drill 10 mm diameter holes 150 mm deep at a spacing of 600 mm maximum or a minimum of three holes per connection whichever is greater.
iv) Butter drilled holes with concrete mortar.
v) Drive home 450 mm long 10 m rebar into each hole. Bars to extend at least 300 mm into new poured section.

e) FORMING

i) Form vertical surfaces to full depth using forming material that will not deform under loading by plastic concrete.
ii) Securely position forms to required lines and grades.
iii) Coat forms with non-staining mineral type forms release agent.
iv) Obtain approval of forms before placing concrete.

f) REINFORCING STEEL

i) Place steel to details indicated.

ii) Make laps of 500 mm where continuous reinforcement is required.
iii) Make laps of 300 mm width, where required for wire mesh.

g) CONCRETE

i) Finish exposed surfaces to a smooth uniform finish, free of open texturing and exposed aggregate. Do not work more mortar to surface than required. Do not use neat cement as a drier to facilitate finishing.
ii) Broom finish surface to provide non-skid texture.
iii) Round edges, including edges of joints, with 5 mm radius edging tool.
iv) Finish surfaces to within 6 mm in 3 m from line, level or grade as measured with a straight edge placed on surface.
v) Cure concrete to CAN3-A23.1 Section 21.1
vi) Seal all concrete as follows:
vii) Apply with spray method only, one coat of evenly applied white pigmented sealer.
viii) Ensure concrete surfaces are dry, free of dirt or dust, and at least one week old before applying coating.
ix) Apply according to manufacturer's specification.
x) Protect adjacent surfaces from spray.

h) EXPANSION AND CONTRACTION JOINTS

i) For all flatwork (sidewalks, medians and driveways) install contraction joints a minimum of 1/4 of the depth of slab and 6 mm wide at intervals of 1.5 m.
ii) For all flatwork (sidewalks, medians, and driveways) wider than 2.0 m a longitudinal contraction joint shall be included by either sawcutting or finishing. The contraction joint shall be a minimum of 1/4 of the depth of slab located at the midpoint of the slab or at a maximum 2-metre spacing. If the contraction joint is to be a sawcut, it shall be completed within 24 hours of concrete placement.
iii) For curb and gutter install contraction joints a minimum of 40 mm deep and 6 mm wide at intervals of 3.0 m. On 500 mm gutter sections, the back section of the gutter is to be deep cut with a trowel at each contraction joint.
iv) When sidewalk is adjacent to curb, make joints coincide.
v) Install isolation joints in concrete around manholes, poles, hydrants etc. and along length of concrete adjacent to concrete curb, building, or permanent structure.
vi) Install construction joints at the end of all reinforced sections.

i) BACKFILL

i) Allow concrete to cure for 7 days prior to backfilling.
ii) Backfill to designated elevations with suitable material, compact to 95% of Standard Proctor and shape to required contours as indicated or directed by the Engineer.
iii) Backfill within 500 mm of concrete is incidental to work done under this section.

j) REJECTION OF CONCRETE

i) Concrete work shall be subject to rejection at the Engineer's discretion for any of the following reasons:

(1) Misalignment of vertical or horizontal grade
(2) Gutters or swales which pond water
(3) Cracks in locations other than at joints
(4) Flaking or spalling of the surface
(5) Vertical displacements between adjoining sections or other forms of settlement
(6) Surfaces which are marked or damaged

(7) Failure to meet strength requirements
(8) Variance from design section as specified on the drawings
(9) Improper ties to existing concrete.
(10) Non-conformance to any requirement of the specifications or drawings.

3.1.8 Street Signing

This section specifies requirements for supply and installation of street and traffic control signs.

a) SHOP DRAWINGS

i) Supply proofs of all signs for review prior to manufacture of signs.
ii) Provide layout plan for review prior to installation.

b) SIGN MATERIAL

i) Aluminium – 0.081 gauge sign grade.

c) BACKGROUND MATERIAL

i) Stop, yield, keep right and overhead lane control signs will be 3M diamond grade cubed (DG3) Scotchlite sheeting and appropriate 3M ink.

d) MESSAGE MATERIAL

i) All other signs to be 3M High Intensity Prismatic (HIP) Scotchlite sheeting and appropriate 3M ink.

e) BRACKETS AND ATTACHMENTS

i) Brackets to be K-9 raw material - 6063 aluminium.
ii) H-clips to be extruded aluminum.
iii) Bolts to be 9.5 mm aluminum complete with nuts.
iv) Bandit Valustrap and Valuclips or equivalent.

f) POSTS AND BASES

i) Post for RB-25 and Hazard Marker to be 47.6 mm diameter extra strong pipe to ASTM A53. Length 2.5 m. Circular sign base 387 mm diameter cast iron to fit 47.6 mm diameter post.
ii) Standard post to be Unistrut Telespar single post type complete with appropriate connection hardware. Post to be 50 mm square 12 gauge. Post to be 4.0 m long for street name and advance street name signs. All others to be 3.5 m or 4.0 m long, as required to meet the clearance and embedding requirements.
iii) Armtech (or equivalent) 2-piece channel post (CSA G164) for signs up to 75 cm x 75 cm installed in landscaped boulevards.
iv) All posts and bases to be galvanized.

g) STANDARDS

i) All signing to be in accordance with the RTAC "Uniform Traffic Control Devices of Canada" and the Alberta Transportation "Urban Guide and Information Sign Manual".

h) STREET NAME SIGNS

i) ALR-1 signs to be 22.5 mm high extruded aluminium.
ii) Message is white on a green background and has no border.
iii) Letter height 150 mm. Message is printed on both sides of sign.
iv) Use Ave. for Avenue and St. for Street.
v) Mount 3.0 m above ground surface.
vi) Punch two 10 mm x 16 mm slotted holes, top and bottom of the left hand side of the sign where sign is to be mounted on street light standard.
vii) Mount sign to end bracket with 2 bolts.
viii) Mount on street light poles if located within 10 m of intersection otherwise on standard pole.
ix) Centre mount signs on Telespar posts.

i) ADVANCE STREET NAME SIGNS

i) ALR-3 signs to be minimum 300 mm x 600 mm.
ii) Message is white on green background with a 15 mm white border.
iii) Letter height – 200 mm.
iv) Use abbreviations.
v) Mount 3.0 m above ground surface.
vi) Mount on light pole if located within 10 m of location indicated in drawings otherwise on standard pole.

j) REGULATORY AND WARNING SIGNS

i) Colours, message and sign dimensions as per Uniform Traffic Control Devices manual, unless otherwise specified on the drawings.
ii) Mount bottom of signs at 2.0 m above ground surface and a minimum of 0.5 m clear of the face of curb.
iii) Mount on street light pole if located within 10 m of location indicated on drawings otherwise on standard poles. Standard poles to be embedded 1 m.
iv) Mount RB-25 and Hazard Marker on standard 2.5 m round pole complete with pole base on slab-on islands.

k) REJECTION

i) Signs bearing non-uniform letters or numerals, crooked borders, chipping or flattening of materials or other unworkmanlike defects will be rejected.
ii) All sharp edges and debris to be removed.

3.1.9 Painted Pavement Markings

This section specifies requirements for painted pavement markings.

a) MATERIALS

i) Paint:

(1) To CGSB 1-GP-74M, alkyd traffic paint.
(2) To CGSB 1-GP-149M, alkyd reflectorized traffic paint.
(3) Colour: to CGSB 1-GP-12.1C, yellow 505-308 white 513-301.

ii) Thinner: as specified by paint manufacturer.

b) EQUIPMENT REQUIREMENTS

i) Paint applicator to be an approved pressure type distributor capable of applying paint in single and dashed lines and that will ensure uniform application and having a positive shut off.
ii) Adequate warning signs and traffic channelization devices to minimize tracking by traffic.

c) CONDITION OF SURFACES

i) Pavement surface to be free from surface water, frost, ice, dust, oil, grease and other foreign materials.

d) APPLICATION

i) Pavement markings to be laid out by Contractor and layout approved by Engineer prior to application of paint.
ii) Unless otherwise approved by Engineer apply paint only when air temperature is above 10°C and no rain is forecast.
iii) Apply paint to pavement surface with an approved applicator to a dry thickness of 305µm (12 mils).
iv) Do not thin paint unless approved by the Engineer.
v) Symbols and letters to conform to dimensions indicated.
vi) Paint lines must be of uniform colour and density with sharp edges.
vii) Thoroughly clean distributor tank before refilling with paint of different colour.

e) TOLERANCE

i) Paint markings to be within ± 12 mm of dimensions specified.

f) PROTECTION OF COMPLETED WORK

i) Protect pavement markings until dry.

3.1.10 Plastic Pavement Markings

This work shall consist of the supply and installation of MMA spray plastic, cold plastic or hot thermoplastic markings as required by the drawings or as directed by the Engineer. Markings shall include yellow and white lane and dividing lines, white crosswalk bars and stop bars, white turn arrows and yellow and white hazard and delineation markings.

a) MATERIALS

i) MMA spray plastic shall conform to the following specification:

Tests	Minimum Requirements	Maximum Requirements	Test Method A.S.T.M.
Abrasion Resistance *(maximum loss/grams)	-	0.45g	D4060
Reflectance			
White -	75%	-	E1347
Yellow -	45%	-	

Tests	Minimum Requirements	Maximum Requirements	Test Method A.S.T.M.
Retroreflectance (with proper bead application)	200 millicandelas per square metre per lux		
Specific Gravity @ 25° C (77°F)	1.8	-	D792
Hardness	A-2 Shore 70		D2240
Water Absorption		0.5%	D570
Chemical resistance to	No signs of degradation after 7 days immersion		
anti-freeze			
brake fluid			
motor oil			
diesel fuel, gasoline			
calcium chloride			
sodium chloride			
transmission fluid			
Adhesion ** (to Portland Cement)	200 psi		
Skid Resistance (Field Base)	45 units		E303

*Abrasion resistance, maximum weight loss when subjected to 200 revolutions on Taber Abrader at 25°C using H-22 Calibrade wheels weighted to 500 grams with sample kept continuously wet with distilled water. Prepare test sample with representative material placed on 100mm square plate, 2±0.1mm thickness.

**Adhesion to asphalt is dependent on the tensile failure strength of the substrate. This compound shall be resistant to the effect of ultra-violet light.

ii) Cold Plastic Markings: two-component, cold-extruded and cold-curing, having a specific gravity of 1.9 minimum at 25° C, and conforming to paragraph 2.1.4 below.

iii) 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, and conforming to paragraph 2.1.4 below.

iv) Both cold and hot plastic markings shall conform to the following:

(1) Water Absorption: 0.5% maximum by mass retained water after 24-hour immersion, according to ASTM D570 Procedure A.

(2) Impact Resistance: minimum 1.13 J at 25° C when material is cast into bar 25 mm^2 cross-section by 75 mm long, with 25 mm extended above vice jaws in a cantilever beam (Izod type) tester using the 2.82 J scale, according to ASTM D256 Method C.

(3) Abrasion Resistance: Maximum weight loss of 0.60 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.

(4) Chemical Resistance: Test sample of 50 mm square, no degradation after exposure to:
24 hour immersion in 5% NaCl.
24 hour immersion in 5% CaCl.
1 hour spot test with mineral oil.

(5) No deterioration when in direct contact with asphalt cement in asphalt materials, or with sodium chloride, calcium chloride or other de-icing chemicals.

(6) Non-toxic and not harmful to persons or property when in hardened state.

(7) No discoloration from sunlight ultraviolet exposure and no bond failure for warranted life of material.
(8) Pre-marking Paint: As approved by the Engineer.
(9) Groove Filler: LRS 424 or approved equal.

b) MIX FORMULATION

i) White Colour: conforming to U.S. Federal Standard 595B Colour Number 37925, 70% minimum when measured with the Colour Guide Reflectometer 0,45° daylight luminous directional reflectance, with a green filter.
ii) Yellow Colour: conforming to U.S. Federal Standard 595B Colour Number 33538, 40% minimum when measured with the Colour Guide Reflectometer 0,45° daylight luminous directional reflectance, with a green filter.
iii) No formulation change unless approved by the Engineer. Any significant change will be subject to field trials.

c) EQUIPMENT

i) Grooving Machine, Applicators: subject to the Engineer's approval.

d) SITE PREPARATION

i) The contractor shall provide flagmen, barricades, and signing.
ii) Sweep or airblow pavement surface clean and dry.
iii) Remove conflicting markings.
iv) Do not apply plastic marking until premarkings have passed inspection by the Engineer.

e) MMA SPRAY PLASTIC APPLICATION

i) Mix components and apply MMA plastic markings according to manufacturer's surface application procedures, to a minimum thickness of 0.5 mm.
ii) Apply plastic markings in accordance with manufacturer's instructions and procedures.
iii) Apply glass beads to surface of extruded material before it has set, at a rate of 140 to 250 g/m^2.
iv) Do not permit traffic over applied markings until they have adequately hardened.

f) COLD PLASTIC APPLICATION

i) Mix components and apply cold plastic marking according to manufacturer's surface application procedure, to a thickness of 2.0 mm minimum and 3.0 mm maximum.
ii) Apply plastic markings in accordance with manufacturer's instructions and procedures.
iii) Apply glass beads to surface of extruded material before it has set, at a rate of 140 to 250 g/m^2.
iv) Do not permit traffic over applied markings until they have adequately hardened.

g) HOT THERMOPLASTIC APPLICATION

i) Cut groove into pavement surface to designated width and depth. Remove grindings and haul to a designated location. Sweep or airblast groove clean and dry.
ii) Heat material and apply according to manufacturer's hot extrusion process.
iii) Apply plastic markings in accordance with manufacturer's instructions and procedures.
iv) Fill groove with hot molten material. Do not overfill more than 3.0 mm above pavement surface.
v) Apply glass beads to surface of extruded material while it is still molten at a rate of 140 to 250 g/m^2.

vi) Trim surplus material to give clean straight edges.
vii) Do not permit traffic over applied markings until they have adequately hardened.

h) PROTECTION AND CLEANUP

i) Protect surrounding areas and structures from disfiguration and damage. Repair any damage as directed by the Engineer.
ii) On completion of work and prior to opening to traffic, clean up and leave site free of debris and waste matter.

i) THICKNESS TOLERANCE

i) MMA Spray Marking

(1) Measurement: The Engineer may measure suspect markings with a thickness gauge instrument. The average of 5 measurements will represent 300 m of marking, or one job site, whichever is less.
(2) Thickness Deficiencies: Where a significant number of deficiencies occur in the work, involving average thicknesses less than 0.5 mm, the Engineer may order removal and replacement or application of additional material.

ii) Cold Plastic Marking

(1) Measurement: The Engineer may 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.
(2) 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.
(3) 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.

iii) Thermoplastic Marking

(1) Measurement: The Engineer may core suspect markings. The average thickness of 3 cores will represent 300 m of marking, or one job site, whichever is less.
(2) 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.
(3) Groove Thickness Deficiencies: Where a significant number of deficiencies occur, involving average groove thicknesses less than 70% of that specified, the Engineer may order removal and replacement.
(4) 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.

j) WIDTH TOLERANCE

i) MMA Spray Marking

(1) The Engineer may determine the width of suspect markings by the average of 5 measurements representing 300 m of marking, or one job site, whichever is less.

ii) Cold Plastic Marking

(1) The Engineer may determine the width of suspect markings by the average of 5 measurements representing 300 m of marking, or one job site, whichever is less.

iii) Hot Thermoplastic Marking

(1) A quality assurance laboratory may determine the groove width of suspect markings by the average measurements of 3 cores representing 300 m of marking, or one job site, whichever is less.

iv) Width Deficiencies

(1) 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.

k) WARRANTY

i) The Contractor shall provide written confirmation that the materials as installed shall be guaranteed to remain intact within the following limits for a period of five years, while being subjected to traffic and normal summer and winter roadway maintenance procedures:

(1) The first (1st) year from the date stated in the Construction Completion Certificate, all lines shall be 100% intact.
(2) The second (2nd) year from the date stated in the Construction Completion Certificate, each line shall be 95% intact.
(3) The third (3rd) year from the date stated in the Construction Completion Certificate, each line shall be 90% intact.
(4) The fourth (4th) year from the date stated in the Construction Completion Certificate, each line shall be 85% intact.
(5) The fifth (5th) year from the date stated in the Construction Completion Certificate, each line shall be 80% intact.

ii) Defective material or improper installation that result in the materials requiring replacement shall be replaced by the Contractor at no cost to the Owner.

3.1.11 Testing

a) TESTING AND INSPECTION

i) The Developer shall employ a CSA approved material testing firm to complete the tests as outlined. One copy of all test results shall be submitted to the Town for their review.

Test Frequency

Specification	Type of Test	Minimum Test Frequency	Remark
Trenching, Backfilling Trenching, Backfilling & Compaction for Electrical Installation	**Density Test:**		
	Trench longer than 15 m	2 tests per 600 mm of depth for every 100 m of trench length	Testing will vary with location of project and consequences of trench settlement.
	trench shorter than 15 m	3 tests per trench	
Roadway Excavation, Backfill & Compaction	**Grading/Fill Compaction:**		
	Subgrade Preparation:	1 density test per 2000 sq.m of compacted lift	
	Proof Rolling:	1 density test per 1000 sq.m of compacted subgrade lift Entire project	
Aggregate: General Granular Sub-base Granular Base	Source Sampling:	1 sieve analysis per 500 tonnes (250 m;) of asphalt aggregate for crushing control	Required 2 weeks prior to commencing work
	Compaction:	1 sieve analysis per 2500 (1250 m;) tonnes of base and subbase aggregate	
	Proof Rolling	1 density test per 1500 sq.m of compacted granular lift of road Entire project	
Stabilization: Lime	Source Sampling:		
	Test Area:	400 sq.m to establish and demonstrate work methods and timing	Required 2 weeks prior to commencing work
	Proof Rolling:	At completion of curing period	
Soil Cement	Source Sampling (aggregate):		
	Mix Design:	1 sieve analysis per 2500 tonnes (1250 m;)	Required 2 weeks prior to commencing work Required 2 weeks prior to commencing work
	Thickness Test:	1 core sample per 1000 sq.m of soil cement in place	Areas suspected to have inadequate thickness
	Compaction Test:	1 density test per 1000 sq.m of soil cement in place	
	Strength Test:	1 7-day compressive strength test per 1000 tonne of soil cement	
Topsoil	Topsoil Analysis:		
	On-site Sources	1 analysis report for each topsoil source	Required 4 weeks prior to commencing work
	Constractor Supplied	Contractor to supply 1 litre sample of each topsoil type for testing	
Asphaltic Concrete Paving	Mix Design:		
	Density/Thickness Test:	3 cores per 6000 tonnes of asphalt pavement (5000 m5 for a 50 mm lift)	Required 2 weeks prior to commencing work
	Mix Proportions:	1 Marshall core per 6000 tonnes of mix, with a minimum of 1 test from each full day's production	
Watermain	Hydrostatic/Leakage Test: Bacteria/Chlorine Test:	Test section not to exceed 365 m in length	Provide Engineer at least 24 hours' notice
Storm Sewer Sanitary Sewer	Television and Photographic Inspections:	Upon completion of storm sewer installation, after backfilling	
Forcemains	Hydrostatic/Leakage Test:	Test section not to exceed 365 m in length	Provide Engineer at least 24 hours' notice
Concrete Curbs & Gutter, Walks, Medians, Driveways & Swales	Mix Design: Slump Test:	1 per 20 cu.m for each class of concrete poured, min.	Required 2 weeks prior to commencing work Every truck until consistency is established Every truck until consistency is established
General Concrete	Air Content Test:	1 per day	
Slip Formed Concrete	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	

3.2 Trenching, Backfilling and Compaction

3.2.1 General

This section specifies requirements for excavating trenches, backfilling and compacting for installation of pipelines, sewers, conduits and appurtenances.

a) DEFINITIONS

i) Solid Rock:

(1) Material excavated from solid masses of igneous, sedimentary or metamorphic rock, which, prior to its removal, was integral with its parent mass.
(2) Boulders or rock fragments having individual volume in excess of 0.5 m^3.

ii) Muck:

(1) Mixtures of soils and organic matter not suitable for foundation materials regardless of moisture content.

iii) Common Material:

(1) Deposits other than solid rock and muck.

iv) Imported Granular Backfill:

(1) Material, as specified and approved by the Engineer, imported to replace excavated material as backfill.

v) Bedding Material:

(1) Materials, as specified and approved by the Engineer, used in "pipe zone".

vi) Pipe Zone:

(1) Area of trench including and surrounding pipe as indicated on drawings.

vii) Topsoil:

(1) Material capable of supporting good agricultural growth and suitable for use in top dressing, landscaping and seeding.

viii) Untraveled Areas:

(1) Areas where vehicular or foot traffic do not regularly occur or are not anticipated at the completion of construction.

ix) Travelled Areas:

(1) Areas where vehicular or foot traffic may be anticipated, including roads, lanes, parking areas, driveways, pedestrian areas and road shoulders. Shoulders beside paved roads are areas accessible to vehicular traffic within 3 m from the edge of pavement. Road shoulders beside gravel roads are accessible to vehicular traffic within 3 m from the normally travelled roadway.

b) PROTECTION

i) Existing Buried Utilities

(1) Size, depth and location of existing utilities shown on drawings are for guidance only; completeness and accuracy are not guaranteed.
(2) Prior to commencing any excavation work, notify appropriate utility authorities (Alberta One-Call), establish location and state of use of buried services. Clearly mark such locations to prevent disturbance during work.
(3) Maintain and protect from damage, water, sewer, and gas, electric or other utilities encountered.
(4) Obtain direction of owner of utility and Engineer before moving or otherwise disturbing utility.

ii) Existing Surface Features:

(1) Protect existing buildings, trees and other plants, lawns, fencing, service poles, wires or paving located within right-of-way or adjoining properties from damage while work is in progress. Repair to Engineer's satisfaction any damage which may occur.
(2) Where excavation necessitates root or branch cutting, do so only under direct control of the Engineer.

iii) Shoring and Bracing:

(1) Whenever shoring, sheeting, timbering and bracing of excavations is required, engage services of a professional engineer to design and assume responsibility for adequacy of shoring and bracing. Professional engineer is to be registered in province or territory in which work is to be carried out.
(2) When requested by the Engineer, submit for review drawings and calculations signed and stamped by the professional engineer responsible for their preparation.
(3) Close sheeting, when required, to be designed and constructed to prevent adjacent soil or water from entering excavation.

iv) Access:

(1) Maintain unobstructed access to fire and police appurtenances, telephone, electric, water, sewer, gas or other public utilities and private properties.

v) Flooding:

(1) Protect open excavation against flooding and damage from surface water runoff.

3.2.2 Materials

a) IMPORTED GRANULAR BACKFILL

i) Clean, hard, durable uncoated particles, free from clay lumps, cementation, organic and other objectionable material meeting the following gradation limits:

Sieve Size	P/P
25 mm	100%
20.5 mm	60 – 86%
5 mm	36 – 75%
2.0 mm	26 – 60%
0.4 mm	12 – 43%
0.16 mm	6 – 20%
0.063 mm	2 – 10%

Sieve Size	P/P
63 mm	100%
20 mm	45 – 80%
5 mm	25 – 50%
0.075 mm	10% max

b) NATIVE BACKFILL

i) Approved material selected from trench excavation or other source, unfrozen and free from cinders, ashes, sods, refuse or other deleterious materials and with the natural water content within 5% of the optimum value for the Proctor compaction specified, based on the native soil, which is being used for backfill.

3.2.3 Installation

a) SITE PREPARATION

i) Remove trees, shrubs, vegetation, fences and other obstructions, ice and snow, from surfaces to be excavated within limits indicated.
ii) Strip top soil from within limits of excavation and stockpile as directed, for re-spreading after backfilling.

b) DEWATERING

i) Keep excavations dry while work is in progress.
ii) Dispose of water in a manner not detrimental to public health, environment, public and private property, or any portion of work completed or under construction.

c) EXCAVATION

i) Excavate to lines, grades, elevations and dimensions indicated on Drawings. Ground profiles are approximate only. The Engineer will set out precise line and grade. Allow the Engineer one working day advance notice to set out line and grade.
ii) Cut pavement or sidewalk neatly along limits of proposed excavation.
iii) Where edge of existing pavement is damaged because of trench excavation in shoulder, a minimum 450 mm width to be cut neatly and continuously and reinstated.
iv) Notify Engineer when soil at proposed elevation of trench bottom appears unsuitable for foundation of installation.
v) Remove unsuitable material from trench bottom to extent and depth directed by Engineer.
vi) Notify Engineer if new construction conflicts with discovered obstruction.
vii) Allow Engineer sufficient time to consider alternative alignment to avoid conflict with obstruction and modify alignment as directed by Engineer.

viii) Unless otherwise authorized by Engineer, do not excavate more than 30 m of trench in advance of installation operations and do not leave more than 15 m open at end of day's operation.
ix) Stockpile suitable excavated materials required for trench backfill in approved location. Sidecasting may not be approved.
x) Dispose of surplus and unsuitable material at the designated waste site. If no site is designated dispose of material at a site located by the Contractor at his expense and approved by the Engineer.
xi) Do not obstruct flow of surface drainage or natural watercourses.
xii) Obtain Engineer's approval for method of excavation.
xiii) Rock shall be excavated to a level 150 mm below the barrel of the pipe.

d) TRENCH BOTTOM PREPARATION

i) Where required due to removal of unsuitable material or unauthorized over-excavation, bring bottom of excavation to design grade with approved material.
ii) Compact trench bottom to a density at least equal to density of adjacent surrounding soil.

e) PRE-INSTALLATION INSPECTION

i) Excavations require inspection and approval prior to commencement of installation operations.

f) BACKFILLING

i) Do not proceed with trench backfilling operations until Engineer has inspected and approved installations.
ii) Use approved native or imported granular backfill material as indicated or directed.
iii) Backfilling around installations:

(1) Place bedding and surround material as specified.
(2) Do not backfill around or over cast-in-place concrete within 24 hours after placing.
(3) Place layers simultaneously on both sides of installed work to equalize loading.
(4) Place material by hand under, around and over installations until 600 mm of cover is provided. Dumping material directly on installations will not be permitted.

iv) Do not place backfill in freezing weather without written permission of Engineer.
v) Shoring, sheeting and bracing:

(1) Unless otherwise indicated, or directed by Engineer, remove sheeting and shoring from trench during backfilling operations.
(2) Do not remove bracing until backfilling has reached level of bracing.
(3) Pull sheeting in 150 mm increments until clear of installations, simultaneously placing and compacting backfill to fill voids left by pulled sheeting.
(4) Pull sheeting thereafter in increments that will ensure backfill is maintained at an elevation at least 450 mm above toe of sheeting.
(5) When sheeting is to remain in place, cut off tops at elevations indicated or directed.

vi) Place backfill material in uniform layers not exceeding 150 mm in compacted thickness up to subgrade elevation or top of trench. Compact each layer before placing succeeding layer to the required density, as defined below:

Required Compaction	Backfill Zone
Under existing or proposed road, alley, walk, streetlight or similar structure and within a distance from such structure equal to trench depth:	
100% of one-mould or 98.0% of standard proctor	From designated subgrade elevation or existing ground level, whichever is lower, to 1.5 m below
97.0% of one-mould or 95.0% of standard proctor	More than 1.5 m below
Adjacent to existing or proposed road, alley, walk, streetlight or similar structure and within a distance from the improvement equal to trench depth:	
92.0% of standard proctor	Through full depth of trench
Outside defined areas:	
90.0% of one-mould	Through full depth of trench

vii) Compact imported granular backfill material to a minimum density of 98% Standard Proctor. Imported granular backfill to be used in travelled areas.
viii) Compact using approved mechanical tamping devices, or by hand tamping to achieve specified compaction.

g) TEST FREQUENCY

i) Trench greater than 15 m in length: A minimum of two density tests per 600 mm of trench depth per 100 m of trench length. The tests shall be representative of the entire length of trench backfill, including around catch basins, manholes, valves and service connections. The Engineer or a qualified geotechnical representative may require additional testing as deemed necessary.
ii) Trench 15 m or less in length: A minimum of 3 density tests evenly spaced through the depth and length of the trench or as directed by the Engineer.
iii) If a density test result is less than the required density, that test result is discarded and 3 retests shall be performed on the area represented by the failed test. The average of the 3 retests shall represent the density of that area. If this average is less than the required density, the area shall be reworked to the full depth of the lift, and the soil moisture altered as necessary and re-compacted to the required density. If the area is not retested but is reworked and re-compacted, the area shall be tested at the normal testing frequencies.

h) RESTORATION

i) Replace topsoil as directed by the Engineer.
ii) Restore travelled areas to the pavement or concrete structure shown on the contract drawings.
iii) Clean and reinstate areas affected by work as directed.

3.3 Stormwater Sewers

3.3.1 General

This section specifies the requirements for supplying and installing storm sewer pipe.

a) SCHEDULING OF WORK

i) Schedule work to minimize interruptions to existing services.
ii) Maintain existing flow during construction.

iii) Submit schedule of expected interruptions to the Engineer for approval and adhere to approved schedule.

3.3.2 Materials

a) CONCRETE PIPE

i) Sulfate resistant (Type 50) pipe.
ii) Non-reinforced circular concrete pipe and fittings: to CAN/CSA – A257.1 (M92 (Class 3) and designed for flexible rubber gasket joints to CAN/CASA – A257.3 (M92).
iii) Reinforced circular concrete pipe and fittings: to CAN/CSA-A 257.2 and designed for flexible rubber gasket joints to CAN/CSA-A 257.3 (M92).
iv) Lifting holes:

(1) Pipe 900 mm and less in diameter; no lift holes.
(2) Pipe greater than 900 mm in diameter; lift holes not to exceed two in a piece of pipe.
(3) Provide prefabricated plugs to effectively seal lift holes after installation of pipe.

b) PLASTIC PIPE

i) Type PSM Poly (Vinyl Chloride) to ASTM D3034 and CSA B182.2.

(1) Standard Dimensional Ratio (SDR) 35, unless indicated otherwise on the drawings.
(2) Separate gasket and integral bell system.
(3) All joints to meet the requirements of Specification for Joints for Drain and Sewer Plastic Pipes using Flexible Elastromeric Seals (ASTM 03212).
(4) Nominal lengths, 4 or 6 m.

ii) PVC Profile Wall

(1) Extruded seamless pipe conforming to ASTM D1784 and CSA B182.4.
(2) Separate gasket and integral bell system
(3) All joints to meet the requirements of Specification for Joints for Drain and Sewer Plastic Pipes using Flexible Elastromeric Seals (ASTM 03212).
(4) Approved Pipe: Ultra-Rib manufactured by IPEX.
(5) Transition Fitting: required to connect to manholes shall be considered incidental to supply and installation of profile wall PVC pipe.

c) PIPE BEDDING MATERIALS

i) Granular material:

(1) Gradation to within specified limits when tested to ASTM C136 and ASTM C117 and giving smooth curve without sharp breaks when plotted on semi log grading chart.

ii) Bedding Sand:

(1) Natural sand or crushed rock screenings to following grading requirements:

CAN/C6SB-8.2-M	Percent Passing
10.0 mm	100
2.5 mm	80 min
0.63 mm	60 max
0.34 mm	30 max
0.15 mm	20 max
0.073 mm	15 max

(2) Liquid Limit: ASTM D423 Maximum 25.
(3) Plasticity Index: ASTM D424 Maximum 6.

iii) Coarse Granular:

Sieve Size	Percent Passing
25 mm	100
20 mm	95 - 100
10 mm	60 – 80
5 mm	40 – 60
2.5 mm	28 – 48
0.63 mm	13 – 29
0.34 mm	9 – 21
0.15 mm	6 – 15
0.075	4 - 10

iv) Washed Rock:

Sieve Size	Percent Passing
25.00 mm	100
5.00 mm	10 max
0.08 mm	2 max

d) CEMENT MORTAR

i) Concrete required for cradles, encasement, supports; 20 MPa Sulfate resistant (Type 50).
ii) Portland cement: to CAN3 A5 M Sulfate resistant (Type 50).
iii) Mortar to consist of one part Portland cement to two parts clean, sharp sand mixed with minimum amount of water to obtain optimum consistency for use intended. Do not use additives.

e) GASKETS

i) Rubber gaskets for joints as recommended by pipe manufacturer and to CSA A257.3 (ASTM C443). Gaskets for concrete sewer pipe shall be rubber, double finned gaskets conforming to ASTM Designation C443. "Tylox CR" gaskets have prior approval.

3.3.3 Installation

a) PREPARATION

i) Clean pipes and fittings of debris and water before installation. Carefully inspect materials for defects before installing. Remove defective materials from site.

b) TRENCHING AND BACKFILLING

i) Trench line and depth require approval prior to placing bedding material and pipe.

c) CONCRETE BEDDING AND ENCASEMENT

i) Place concrete to details indicated or directed.
ii) Pipe may be positioned on concrete blocks to facilitate placing of concrete. When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.
iii) Do not backfill over concrete within 24 hours after placing.

d) GRANULAR BEDDING

i) Place granular bedding materials to details indicated or directed.
ii) Shape bed true to grade and to provide continuous, uniform bearing surface for barrel of pipe. Do not use blocks when bedding pipe.
iii) Shape transverse depressions as required to receive bell if bell and spigot pipe is used.
iv) Compact full width of bed to a minimum density of 95% Standard Proctor.
v) Use washed rock in lieu of sand bedding material when directed.
vi) Fill excavation below bottom of specified bedding adjacent to manholes or catch basins with bedding material or common backfill as directed.

e) SOIL BEDDING

i) Where granular bedding material is not indicated, shape trench bottom so that pipe is fully supported over lower quarter of pipe circumference on undisturbed subgrade.
ii) Where trench bottom is rock and no bedding is indicated, lay pipe on a 150 mm cushion of granular material or approved bedding.

f) PIPES

i) Lay and join pipe in accordance with manufacturer's recommendations.
ii) Handle pipe by approved methods. Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.
iii) Lay pipes on prepared bed, true to line and grade with pipe inverts smooth and free of sags or high points. Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
iv) Commence laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
v) Do not exceed maximum joint deflection recommended by pipe manufacturer.
vi) Do not allow water to flow through pipes during construction except as may be permitted by the Engineer.
vii) Whenever work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
viii) Position and join pipes by approved methods. Do not use excavating equipment to force pipe sections together.
ix) Pipe Jointing:

(1) Install gaskets as recommended by the manufacturer.
(2) Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
(3) Align pipes carefully before joining.
(4) Maintain pipe joints free from mud, silt, gravel and other foreign material.
(5) Avoid displacing gasket or contaminating with dirt or other foreign material. Remove disturbed or dirty gaskets; clean, lubricate and replace before joining is attempted.
(6) Complete each joint before laying next length of pipe.
(7) Minimize joint deflection after joint has been made to avoid joint damage.
(8) Apply sufficient pressure in making joints to ensure joint is complete as outlined in manufacturer's recommendations.

x) When any stoppage of work occurs, block pipes as directed to prevent "creep" during downtime.
xi) Plug lifting holes with approved prefabricated plugs set in non shrink grout.
xii) Cut pipes as required for special inserts, fittings or closure pieces neatly, as recommended by pipe manufacturer without damaging pipe or its coating, leaving a smooth end at right angles to axis of pipe.
xiii) Make watertight connections to manholes and catch basins. Use non shrink grout when suitable gaskets are not available.
xiv) Television and photographic inspections:

(1) Perform a camera survey of the installed sewers.
(2) Provide a video tape copy of the survey to the Engineer conforming to the following:

– DVD format and/or CD-ROM.
– Running audio commentary of each pipe run.
– Written report and still photos of problem areas.

xv) Repair any problem areas revealed by camera survey.
xvi) Perform leakage tests on each section of sewer between successive manholes, including service connections per the Town’s construction specifications requirements.
xvii) Repair and retest sewer line as required, as directed by the Engineer until test results are acceptable.

3.4 Corrugated Steel Pipe Culverts

3.4.1 General

This section specifies the requirements for supplying and installing corrugated steel pipe culverts.

3.4.2 Materials

a) CORRUGATED STEEL PIPE

i) Corrugated steel pipe: to CSPI-501 Metric (Interim) Structural Plate Pipe, and CSA G401.
ii) Couplers: H330 or H500 Hugger Band or equal c/w O-ring gaskets for storm sewer installations Standard Annular Corrugated Coupler for culvert installations.
iii) Prefabricated end sections as indicated.

3.4.3 Installation

a) TRENCHING AND BACKFILL

i) Trench line and depth require Engineer's approval prior to placing bedding material or pipe.
ii) Do not backfill until pipe grade and alignment checked and accepted by the Engineer.

b) BEDDING

i) Excavation for the culvert base shall be to a depth of not less than 0.3 m below the culvert invert elevation, as established by the Engineer, and shall be of sufficient width to permit assembly of the pipe and the operation of compaction equipment on either side of the pipe. All soft, yielding, or unsuitable material at this level shall be removed to a depth as directed by the Engineer and replaced with granular or other acceptable material to provide a firm foundation of uniform density throughout the entire length of the pipe. The Contractor shall compact the exposed surface to a uniform density. The Contractor shall then construct and thoroughly compact the culvert bed to the established elevation using granular or other material acceptable to the Engineer. The width of the culvert bed shall be the culvert diameter +0.45m.
ii) Where gravel bedding or backfill is used, impervious, compacted clay cut-offs shall be constructed at both ends of the culvert MSD 35.

c) LAYING CORRUGATED STEEL PIPE CULVERTS

i) Commence pipe placing at downstream end.
ii) Lay pipe with outside circumferential laps facing upstream and longitudinal laps or seams at side or quarter points.
iii) Ensure bottom of pipe is in contact with shaped bed or compacted fill throughout its length.
iv) Place pipe surround material in maximum 150 mm lifts and compact to minimum density of 95% Standard Proctor. Material adjacent to "haunches" of pipe to be compacted using a hand tamper or a small diameter mechanical tamper approved by the Engineer.
v) Do not allow water to flow through pipes during construction except as permitted by the Engineer.

d) JOINTS: CORRUGATED STEEL CULVERTS

i) Corrugated steel pipe:

(1) Match corrugations or indentations of coupler with pipe sections before tightening.
(2) Tap couplers firmly as they are being tightened, to take up slack and ensure a snug fit.
(3) Insert and tighten bolts.

ii) Structural plate:

(1) Erect in final position by connecting plates with bolts at longitudinal and circumferential seams.
(2) Drift pins may be used to facilitate matching of holes.
(3) Place plates in sequence recommended by manufacturer with joints staggered so that not more than three plates come together at any one point.
(4) Draw bolts up tight, without overstress, before beginning backfill.

(5) Repair spots where damage has occurred to spelter coating by applying two coats of approved asphalt paint or two coats of zinc rich epoxy paint.

e) PROTECTION

(1) Do not allow construction or other traffic over pipe until protective fill is placed.

3.5 Sanitary Sewers

3.5.1 General

This section specifies requirements for supplying and installing gravity sanitary sewer pipe and service connections.

a) SCHEDULING OF WORK

i) Schedule work to minimize interruptions to existing services.
ii) Maintain existing sewage flows during construction.
iii) Submit schedule of expected interruptions for approval and adhere to approved schedule.

3.5.2 Materials

a) CONCRETE PIPE

i) Reinforced circular concrete pipe: CAN/CSA-A257.2 and designed for flexible rubber gasket joints.
ii) Rubber gaskets to be confined "O" ring and shall meet the specification of ASTM C443.

b) PLASTIC PIPE

i) Type PSM Poly (Vinyl Chloride) to CSA-B182.2.
ii) Standard Dimensional Ratio (SDR) 35, unless indicated otherwise on the drawings.
iii) Separate gasket and integral bell system.
iv) All joints to meet the requirements of Specification for Joints for Drain and Sewer Plastic Pipes using Flexible Elastromeric Seals (ASTM D3212).
v) Nominal lengths: 6 m.

c) SERVICE CONNECTIONS

i) Plastic pipe to CSA B182.1-M with push on joints.
ii) Plastic service saddles and tees.
iii) All clamps and/or metal fasteners to be stainless steel.

d) CEMENT MORTAR

i) Portland cement: to CAN 3- 5-M Sulfate resistant (Type 50).
ii) Mix mortar one part by volume of cement to two parts of clean, sharp sand mixed dry. Add only sufficient water after mixing to give optimum consistency for placement. Do not use additives.

e) PIPE BEDDING MATERIALS

i) Granular materials, general.

(1) Gradation shall be within specified limits when tested to ASTM C136 and ASTM C117 (AASHTO T11 and T27) and giving a smooth curve without sharp breaks when plotted on a semi log grading chart.

ii) Bedding Sand:
iii) Natural sand or crushed rock screenings to following grading requirements:

Sieve Size	Percent Passing
10.0 mm	100
5.0 mm	50 - 100
2.0 mm	30 - 90
0.40 mm	10 - 50
0.08 mm	0 - 10

iv) Bedding Stone: crushed stone or crushed gravel to following grading requirements:

Sieve Size	Percent Passing
20.0 mm	100
16.0 mm	75 - 100
12.5 mm	65 - 90
5.0 mm	35 - 55
2.0 mm	0

v) Concrete required for cradles, encasement, supports; 20 mPa sulfate resistant (Type 50) concrete.

f) INSULATION

i) If required in locations as shown on the drawings, the pipe shall be field insulated with extruded polystyrene board, Type HI 60 or approved equal as detailed.

3.5.3 Installation

a) PREPARATION

i) Clean pipes and fittings of debris and water before installation. Inspect materials for defects before installing. Remove defective materials from site.

b) TRENCHING AND BACKFILL

i) Trench line and depth require approval prior to placing bedding material and pipe.
ii) Do not backfill trenches until pipe grade and alignment have been checked and accepted.

c) GRANULAR BEDDING

i) Place granular bedding materials in accordance with details indicated or directed.
ii) Shape bed true to grade and to provide continuous, uniform bearing surface for barrel of pipe. Do not use blocks when bedding pipe.
iii) Shape transverse depressions as required to receive bell if bell and spigot pipe is used.
iv) Compact full width of bed to at least 95% Standard Proctor Density.
v) Use bedding stone in lieu of sand bedding material when directed. Use filter cloth to separate sand and bedding stone.

vi) Fill excavation below bottom of specified bedding adjacent to manholes or structures with bedding material.

d) PIPES

i) Lay and join pipes in accordance with manufacturer's recommendations.
ii) Handle pipe with approved equipment. Do not use chains or cables passed through pipe bore so that weight of pipe bears upon pipe ends.
iii) Lay pipes on prepared bed, true to line and grade, with pipe invert smooth and free of sags or high points. Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
iv) Commence laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
v) Do not exceed maximum joint deflection recommended by pipe manufacturer.
vi) Do not allow water to flow through pipe during construction, except as may be permitted by the Engineer.
vii) Whenever work is suspended, install a removable water tight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
viii) Position and join pipes by approved methods. Do not use excavating equipment to force pipe sections together.
ix) Pipe Jointing:

(1) Install gaskets in accordance with manufacturer's recommendations.
(2) Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
(3) Align pipes carefully before joining.
(4) Maintain pipe joints free from mud, silt, gravel and other foreign material.
(5) Avoid displacing gasket or contaminating with dirt or other foreign material. Gaskets so disturbed shall be removed, cleaned and lubricated and replaced before joining is attempted.
(6) Complete each joint before laying next length of pipe.
(7) Minimize joint deflection after joint has been made to avoid joint damage.
(8) At rigid structures, install pipe joints not more than 1.2 m from side of structure.
(9) Apply sufficient pressure in making joints to ensure joint is complete as outlined in manufacturer's recommendations.

x) Block pipes as directed when any stoppage of work occurs to prevent creep during downtime.
xi) Plug lifting holes with approved prefabricated plugs set in non shrink grout.
xii) Cut pipes as required for special inserts, fittings or closure pieces neatly, as recommended by pipe manufacturer without damaging pipe or its coating, leaving a smooth end at right angles to axis of pipe.
xiii) Make watertight connections to manholes. Use non shrink grout when suitable gaskets are not available.
xiv) Use prefabricated saddles or approved field connections for connecting pipes to existing sewer pipes. Joint of saddle to pipe shall be structurally sound and watertight.
xv) Upon completion of pipe laying and after the Engineer has inspected pipe joints, place specified granular material to dimensions indicated or directed.
xvi) Backfill remainder of trench.

e) SERVICE CONNECTIONS

i) Install pipe to CSA B182.11 and manufacturer's standard instructions and specifications.

ii) Service connections to main sewer to be Engineer approved saddles or tees. Do not use break in and mortar patch type joints.
iii) Service connection pipe shall not extend into interior of main sewer.
iv) Make up required horizontal and vertical bends from 45° bends or less, separated by a straight section of pipe with a minimum length of four pipe diameters. Use long sweep bends where applicable.
v) Plug service laterals with watertight caps or plugs as approved.
vi) Place location marker at ends of plugged or capped unconnected sewer lines. Each marker shall consist of a 50 x 100 mm stake extending from pipe end at pipe level to 1.0 m above grade. Paint exposed portion of stake red with designation SAN SWR LINE in black.

f) FIELD TESTING

i) Repair or replace pipe, pipe joint or bedding found defective.
ii) When directed by the Engineer, draw a tapered wooden plug with a diameter of 50 mm less than nominal pipe diameter through sewer to ensure that pipe is free of obstruction. Use a plug 95% of inside diameter in PVC pipe test.
iii) Remove foreign material from sewers and related appurtenances by flushing with water.
iv) Perform infiltration and exfiltration testing as soon as practicable after jointing and bedding are complete, and service connections have been installed.
v) Do infiltration and exfiltration testing as directed. Perform tests in the presence of Engineer. Notify the Engineer 24 hours in advance of proposed tests.
vi) Perform tests on each section of sewer between successive manholes, including service connections.
vii) Install watertight bulkheads in suitable manner to isolate test section from rest of pipeline.
viii) Exfiltration test:

(1) Fill test section with water in such a manner as to allow displacement of air in line. Maintain under nominal head for 24 hours to ensure absorption in pipe wall is complete before test measurements are commenced.
(2) Immediately prior to test period, add water to pipeline until there is a head of 1 m over interior crown of pipe measured at highest point of test section or water in manhole is 1 m above static groundwater level, whichever is greater.
(3) Duration of exfiltration test shall be two hours.
(4) Water loss at the end of test period shall not exceed maximum allowable exfiltration over any section of pipe between manholes.

ix) Infiltration test:

(1) Conduct infiltration test in lieu of exfiltration test where static groundwater level is 750 mm or more above top of pipe measured at highest point in line to be used.
(2) Do not interpolate a head greater than 750 mm to obtain an increase in allowable infiltration rate.
(3) Install a watertight plug at upstream end of pipeline test section.
(4) Discontinue pumping operations for at least 3 days before test measurements are to commence and during this time, keep at least one third of pipe invert perimeter thoroughly wet.
(5) Prevent damage to pipe and bedding material due to flotation and erosion.
(6) Place a 90° V notch weir, or other measuring device approved by the Engineer in invert of sewer at each manhole.
(7) Measure rate of flow over a minimum of 1 hour, with recorded flows for each 5-minute interval.

x) Infiltration or exfiltration shall not exceed following limits in litres per hour per 100 m of pipe, including service connections.

Nominal Pipe Diameter in mm	PVC Pipe	Concrete Pipe
100	2.08	8.33
125	2.60	10.42
150	3.13	12.50
200	4.17	16.67
250	5.21	20.83
300	6.25	25.00
350	7.29	29.17
400	8.33	33.33
450	9.38	37.50
500	10.42	41.67
550	11.46	45.83
600	12.50	50.00
700	14.58	58.33
800	16.67	66.67
900	18.75	75.00
1000	20.83	83.33
1100	22.92	91.67
1200	25.00	100.00

Values shown in columns 2 and 3 are in litres per hour per 100 metres of pipe. These limits are based upon the following:

- 20 L per day per mm diameter per 1 km concrete pipe
- 5 L per day per mm diameter per 1 km PVC pipe

xi) Repair and retest sewer line as required, until test results are within limits specified.
xii) Repair visible leaks regardless of test results.
xiii) Television and photographic inspections:

(1) Perform a camera survey of the installed sewers.
(2) Provide a video tape copy of the survey to the Engineer conforming to the following:

– DVD format.
– Running audio commentary of each pipe run.
– Written report and still photos of problem areas.

xiv) Repair any problem areas revealed by camera survey.

3.6 Manholes and Catchbasins

3.6.1 General

This section specifies the requirements for the supply and installation of manholes, catch basins and sewer appurtenances.

a) MATERIALS

i) Concrete:

(1) Cement: to CAN3 A5, Sulfate resistant (Type 50).
(2) Concrete mix design to produce minimum compressive strength of 25 MPa at 28 days and containing 25 mm maximum size coarse aggregate, with water/cement ratio to CAN3 A23.1, table 7 for class A exposure and 150 mm slump at time and point of deposit. Air entrainment to CAN3 A23.1, table 8 for class A exposure.

ii) Precast manhole sections: to ASTM C478, circular. Top sections eccentric cone or flat slab top type with opening offset for vertical ladder installation. Monolithic bases to be approved by the Engineer.
iii) Precast catch basin sections: to ASTM C139, ASTM C478.
iv) Sanitary manhole sections shall have confined "O" ring joints and rubber gaskets meeting requirements of CSA A257.3 and ASTM C443.
v) Storm manholes and catch basin sections shall be made watertight utilizing cement mortar or approved sealant.
vi) Manhole and catch basin pipe connection joints to be made watertight using cement mortar as shown on the detailed drawings.
vii) Mortar:

(1) Aggregate: to CSA A82.56.
(2) Cement: to CAN3 A8, Sulfate resistant (Type 50).

viii) Manhole ladder rungs: 20 mm diameter galvanized preformed steel rungs (drop step type).
ix) Adjusting rings: to ASTM C478. Maximum of three rings on any manhole or catch basin.
x) Concrete brick: to CSA A165.2. Maximum of 200 mm of brick on any manhole or catch basin.
xi) Frames, gratings, covers to plan dimensions and following requirements:

(1) Metal gratings and covers to bear evenly on frames. A frame with grating or cover to constitute one unit. Assemble and mark unit components before shipment.
(2) Gray iron castings to ASTM A48 strength class 30B.
(3) Castings to be sand blasted or cleaned and ground to eliminate surface imperfections.

xii) Safety Platforms shall consist of 2-piece removable aluminum grates supported on aluminum frames designed to fit in the standard manhole joint.

3.6.2 Installation

a) EXCAVATION AND BACKFILL

i) Obtain approval by the Engineer before installing manholes or catch basins.

b) MANHOLE AND CATCHBASIN INSTALLATION

i) Construct units to details indicated, plumb and true to alignment and grade.
ii) Complete units as pipe laying progresses. Maximum of three units behind point of pipe laying will be allowed.
iii) Pump excavation free of standing water and remove soft and foreign material before placing concrete base.
iv) Cast bottom slabs directly on undisturbed ground or when permitted by Engineer, set precast concrete base on a minimum of 30 – 100 mm granular material, compacted to a minimum density of 95% Standard Proctor.

v) For Precast Units:

(1) For Storm Manholes and Catch Basins: Set bottom section of precast unit in bed of cement mortar and bond to concrete slab or base. Make each successive joint watertight with approved cement mortar or approved rubber gaskets. Clean surplus mortar from interior surface of unit as work progresses.
(2) For Sanitary Manholes: Set bottom section and each successive section using "O" ring joints and rubber gaskets to produce a watertight joint.
(3) Plug lifting holes with concrete plugs set in cement mortar or mastic compound.
(4) All manholes over 7 metres in depth shall have an aluminum safety platform installed at their midpoint.

vi) For all sewers:

(1) Place stub outlets and bulkheads at elevations and in positions indicated.
(2) Bench to provide a smooth U shaped channel. Side height of channel to be 0.75 times full diameter of sewer. Slope adjacent floor at 10 to 1. Curve channels smoothly. Slope invert to establish sewer grade.

vii) Installing units in existing systems:

(1) Where a new unit is to be installed in an existing run of pipe, ensure full support of existing pipe during installation, and carefully remove that portion of existing pipe to dimensions required and install new unit as specified.
(2) Make joints watertight between new unit and existing pipe.
(3) Where deemed expedient to maintain service around existing pipes and when systems constructed under this project are ready to be put in operation, complete installation with appropriate break outs, removals, redirection of flows, blocking unused pipes or other necessary work.

viii) Set frame and cover to required elevation using 2 – 4 concrete rings to a maximum of 350mm. Make joints smooth and watertight by parging with cement mortar.
ix) Recess catch basin frame and cover 10 mm below gutter elevation and 10 mm behind the face of curb.
x) Recess manhole frame and cover 5 mm below finished surface elevation.
xi) Clean units of debris and foreign materials. Remove fins and sharp projections. Prevent debris from entering system.

3.7 Water

i) This section specifies requirements for supplying and installing pressure watermain pipe and appurtenances.

3.7.2 General

a) SCHEDULING OF WORK

i) Schedule work to minimize interruptions to existing services.
ii) Submit schedule of expected interruptions for approval by Engineer to adhere to interruption schedule as approved by the Engineer.
iii) Notify Engineer a minimum of 24 hours in advance of any interruption in service.
iv) Do not interrupt water service for more than 3 hours and confine this period between 10:00 and 16:00 hours local time unless otherwise authorized.

v) Notify fire department of any planned or accidental interruption of water supply to hydrants.

3.7.3 Materials

a) PIPE AND FITTINGS

i) All polyvinyl chloride pressure pipe and fittings shall conform to CSA B137.3 Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications. The pipe shall be made from clean, virgin approved class 12454 B PVC compound conforming to ASTM resin specification D1784. Clean reworked material generated from the manufacturer's own pipe production may be used. PVC water pipe shall be coloured blue and shall utilize integral bell gasket joints. Pipe to be delivered in 6 m nominal lengths.
ii) PVC Class Pipe and Fittings: To AWWA C900, pressure class 150 (DR18), for 100 mm through 300 mm diameter. To AWWA C905, pressure rating 165 (DR25) for greater than 300 mm diameter.
iii) PVC Series Pipe is to be designed for a pressure rating of 1620 kPa (235psi) and shall be designated DR18 with cast iron outside diameters. The pipe shall be hydrostatic proof tested at 2760 kPa (400psi). Fittings to AWWA C907, CSA B137.3, and designed for a pressure of 1620 kPa.
iv) PVC moulded fittings to CSA B137.2 Class 150.
v) All PE/HDPE pipe shall conform to AWWA C906 and shall have a dimension ratio (DR) of 11, unless otherwise specified.
vi) Fittings shall be attached using only heat fusion welding or suitable mechanical connections.
vii) Cast iron fittings from 75 mm to 1200 mm in diameter shall conform to the following specifications: ASTM A48, Class 30B and AWWA C 110/A21.10. Fittings shall be supplied with bell and spigot joints complete with rubber gaskets, to conform to the following specifications: AWWA C 111/A21.11. Cast iron fittings shall be encased in polyethylene in accordance with AWWA C 105.
viii) Cast Ductile Iron Couplings: to be Robar couplings or approved equal, complete with stainless steel nuts and bolts, compatible with outside diameters of pipes to be coupled in locations approved by the Engineer. All couplings to be wrapped with densotape after installation.
ix) All sub surface bolted connections in contact with the soil shall be made using stainless steel nuts and bolts and shall be wrapped in densotape (i.e., hydrants, valves, dresser couplings, etc.). Bolts and nuts shall be of ANSI type 304 stainless steel.
x) Thrust blocking shall be concrete having a minimum compressive strength of 20mPa at 28 days. Concrete shall be made using Type 50 sulphate resisting cement.
xi) Timber blocking shall be either hemlock or fir, which has been pressure creosote treated.

b) VALVES AND VALVE BOXES

i) Gate valves: to AWWA C509, standard iron body, resilient seated, bronze mounted wedge valves with non-rising stems, suitable for 1035 kPa with suitable connection joints.
ii) Valves to open counter clockwise.
iii) Cast iron valve boxes: bituminous coated three piece sliding type adjustable over a minimum of 450 mm complete with valve operating extension rod, 25 x 25 mm cross section, of such length that when set on valve operating 50 mm nut top of rod will not be more than 150mm below cover complete with a stone catcher flange. Base to be large round type with minimum diameter of 300 mm. Top of box to be marked "WATER".

c) SERVICE CONNECTIONS

i) Copper tubing to AWWA C800, Type K, ASTM B88.
ii) Copper pipe joints: to be of compression type suitable for 1035 kPa working pressure.
iii) Service Connections:

(1) Bronze saddle or stainless steel Type 304 saddle.
(2) Type 304 stainless steel strap and nuts.
(3) Single strap saddle for services 25 mm and less.
(4) Double strap saddle for services greater than 25 mm.

iv) Brass corporation stops: red brass to ASTM B62 compression type having threads to AWWA C800.
v) Brass inverted key type curb stops: red brass to ASTM B62 compression type. Curb stops to have adjustable bituminous coated cast iron service box with stem to suit depth of bury. Top of cast iron box marked "WATER".

d) HYDRANTS

i) Hydrants shall be of the same type and make as presently used by the Town.
ii) Contractor shall confirm type, make and outlet requirements with Engineer.
iii) Hydrants: Conform to AWWA 502 and/or AWWA 503; designed for working pressure of 1035 kPa with two 65 mm threaded hose outlets, 100 mm pumper outlet, 150 mm riser barrel, 125 mm bottom valve and 150 mm connection for main. Hydrants to open counter clockwise, threads to local standard. Depth of bury as indicated on the drawings.
iv) Provide key operated gate valve located 1 m from hydrant.
v) Hydrants shall be painted yellow or as approved by the Town.

e) PIPE BEDDING MATERIALS

i) Granular material:

(1) Gradation to be within specified limits when tested to ASTM C136 (AASHTO T11 and T27) and giving a smooth curve without sharp breaks when plotted on a semi log grading chart.
(2) Bedding Sand:

– Natural sand or crushed rock screenings to following grading requirements:

Sieve Size	Percent Passing
10.0 mm	100
5.0 mm	50 - 100
2.0 mm	30 - 90
0.40 mm	10 - 50
0.08 mm	0 - 10

(3) Bedding Stone: crushed stone or crushed gravel to following grading requirements:

Sieve Size	Percent Passing
20.0 mm	100
16.0 mm	75 - 100
12.5 mm	65 - 90
5.0 mm	35 - 55
2.0 mm	0

f) PIPE DISINFECTION

i) Sodium hypochlorite, calcium hypochlorite or liquid chlorine to AWWA B300 or AWWA B301 to disinfect watermains.

g) CATHODIC PROTECTION

i) Provide cathodic protection for steel, cast iron and ductile iron materials as required by municipal standards.

3.7.4 Installation

a) PREPARATION

i) Notify all consumers in writing at least 24 hours prior to any anticipated interruptions in their water service. Where possible, schedule interruptions to occur in non-peak hours. If interruption is to last longer than 8 hours, provide temporary water service to each house via the use of surface hoses connected to outside taps of each house.
ii) Clean pipes, fittings, valves, hydrants, and appurtenances of accumulated debris and water before installation. Carefully inspect materials for defects. Remove defective materials from site.

b) TRENCHING AND BACKFILL

i) Trench depth to provide minimum cover over pipe as indicated.
ii) Trench alignment and depth require Engineer's approval prior to placing bedding material or pipe.
iii) Do not backfill trenches until installed work has been checked and accepted by the Engineer.

c) GRANULAR BEDDING

i) Place granular bedding materials to details indicated or directed.
ii) Shape bed true to grade to provide continuous uniform bearing surface for pipe exterior. Do not use blocks when bedding pipe.
iii) Shape transverse depressions in bedding as required to make joints.
iv) Compact full width of bed to a minimum density of 95% Standard Proctor.
v) Place crushed stone instead of sand bedding material when directed.
vi) Fill any excavation below level of bottom of specified bedding with crushed stone and compact.

d) PIPE INSTALLATION

i) Lay and join PVC pipes to AWWA Manual of Practice M23 and manufacturer's standard instructions and specifications. Lay and join PE/HDPE pipes to AWWA M55 and in accordance with Plastics Pipe Institute Handbook of Polyethylene Pipe.
ii) Handle pipe by approved methods. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.
iii) Lay pipes on prepared bed, true to line and grade. Ensure barrel of each pipe is in contact with shaped bed throughout its full length. Take up and replace defective pipe. Correct pipe which is not in true alignment or grade or pipe which shows undue settlement after installation.
iv) Face socket ends of pipe in direction of laying. For mains on a grade of 2% or greater, face socket ends up grade.
v) Do not exceed permissible deflection at joints as recommended by pipe manufacturer.
vi) Keep jointing materials and installed pipe free of dirt and water and other foreign materials. Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
vii) Position and join pipes with approved equipment. Do not use excavating equipment to force pipe sections together.
viii) Cut pipes as required for specials, fittings or closure pieces, in a neat manner as recommended by pipe manufacturer, without damaging pipe or its coating and to leave a smooth end at right angles to axis of pipe.
ix) Align pipes carefully before jointing.
x) Apply approved joint lubricant to male (spigot) end only as per manufacturer's recommendations. Any taste or odour problems, which may occur due to the over-application of lubricant will be the Contractor’s responsibility to resolve. Action required may include high velocity flushing, pigging of lines or total removal and replacement depending upon the severity of the problem.
xi) Install gaskets to manufacturer's recommendations. Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
xii) Avoid displacing gasket or contaminating with dirt or other foreign material. Gaskets so disturbed or contaminated shall be removed, cleaned, and replaced before jointing is attempted again.
xiii) Complete each joint before laying next length of pipe.
xiv) Minimize deflection after joint has been made.
xv) Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.
xvi) Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by the Engineer.
xvii) When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.
xviii) Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.
xix) Do not lay pipe on frozen bedding.
xx) Protect hydrants, valves and appurtenances from freezing.
xxi) Upon completion of pipe laying and after the Engineer has inspected work in place, surround and cover pipes between joints with approved granular material placed to dimensions indicated or directed.
xxii) Hand place granular material in uniform layers not exceeding 150 mm thick to minimum 300 mm over top of pipe. Dumping of material directly on top of pipe is not permitted.
xxiii) Place layers uniformly and simultaneously on each side of pipe to prevent lateral displacement of pipe.
xxiv) Compact each layer to a minimum density of 95% Standard Proctor.

e) VALVE INSTALLATION

i) Install valves to manufacturer's recommendations at locations indicated.
ii) Support valves located in valve boxes or valve chambers by means of either concrete or treated wood blocks, located between valve and solid ground. Valves shall not be supported by pipe.

f) SERVICE CONNECTIONS

i) Building water service to terminate at property line opposite point of connection to main. Install coupling necessary for connection to building plumbing. If plumbing is already installed, make connection, otherwise cap or seal end of pipe and place temporary marker to locate pipe end.
ii) Do not install service connections until satisfactory completion of hydrostatic and leakage tests of water main.
iii) Construct service connections at right angles to watermain unless otherwise directed. Locate curb stops 300 mm inside right of way.
iv) Tappings on PVC pipe to be PVC valve tees.
v) Tappings for PE pipe shall be PE tapping tees or multi saddle tees.
vi) Employ only competent workmen equipped with suitable tools to carry out tapping of mains, cutting and flaring of pipes.
vii) Tap main at 2:00 o'clock or 10:00 o'clock position only; not closer to a joint nor closer to adjacent service connections than recommended by manufacturer, or 1 m, whichever is greater.
viii) Leave corporation stop valves fully open.
ix) In order to relieve strain on connections, install service pipe in "Goose Neck" form "laid over" into horizontal position. Service to be "snaked" in trench.
x) Install rigid stainless steel liners in small diameter plastic pipes with compression fittings.
xi) Install curb stop with corporation box on services 50 mm or less in diameter. Equip larger services with a gate valve and cast iron box. Set box plumb over stop and adjust top flush with final grade elevation. Leave curb stop valves fully closed.
xii) Place temporary location marker at ends of plugged or capped unconnected water lines. Each marker to consist of a 50 x 100 mm stake extending from pipe end at pipe level to 1 metre above grade. Paint exposed portion of stake red with designation "WATER SERVICE LINE" in black.

g) HYDRANTS

i) Install hydrants at locations indicated or directed.
ii) Install hydrants in accordance with AWWA Manual of Practice M 17.
iii) Install 150 mm gate valve and cast iron valve box on hydrant service leads as indicated.
iv) Set hydrants plumb, with hose outlets parallel with edge of pavement or curb line, with pumper connection facing roadway and with body flange set at elevation of 50 mm above final grade.
v) Place concrete thrust blocks as indicated and specified ensuring that drain holes are unobstructed.
vi) To provide proper draining for each hydrant, excavate a pit measuring not less than 1 x 1 x 0.5 m deep and backfill with coarse gravel or crushed stone to a level 150 mm above drain holes.
vii) Place appropriate sign on installed hydrants indicating whether or not they are in service during construction.

h) THRUST BLOCKS

i) Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings and undisturbed ground as indicated on the drawings or as directed by Engineer.
ii) Keep joints and couplings free of concrete.
iii) Do not backfill over concrete within 24h after placing.

i) HYDROSTATIC AND LEAKAGE TESTING

i) Provide labour, equipment and materials required to perform hydrostatic and leakage tests hereinafter described.
ii) Notify Engineer at least 24h in advance of all proposed tests. Perform tests in presence of Engineer.
iii) Where any section of system is provided with concrete thrust blocks, do not conduct tests until at least 7 days after placing concrete or 3 days if high early strength concrete is used.
iv) Test pipeline in sections not exceeding 365 m in length, unless otherwise authorized by the Engineer.
v) Before testing, bed and cover pipe in accordance with paragraph 3.4 to prevent movement or snaking of pipe line when test pressure is applied.
vi) Test procedure for PVC Pipe is as follows:

(1) Open valves.
(2) Expel air from main by slowly filling main with potable water. Install corporation stops at high points in main where no air vacuum release valves are installed. Remove stops after satisfactory completion of test and seal holes with plugs.
(3) Apply hydrostatic test pressure of 1035 kPa or 1.5 times the normal operating pressure based on elevation of lowest point in main and corrected to elevation of test gauge, for a period of two hours.
(4) Define leakage as amount of water supplied in order to maintain test pressure for 2 hours.
(5) Do not exceed allowable leakage as defined in AWWA C600 82 using the following formula (See Section 3.8 for Water Pressure and Leakage Test Calculations form):

$$\text{PVC pipe } L = \frac{HND(p^{0.5})}{128{,}320}$$

L - (allowable leakage in litres per hour)
N - number of joints
D - nominal diameter (mm)
P - test pressure (kPa)
(1.0 PSI = 6.9 kPa)
H - Test duration (hours)

vii) Test procedure for HDPE pipe is as follows:

(1) Pressure pipe section to 1.5 times pressure class. Vent and bleed-off trapped air as needed.
(2) Initial Expansion: Maintain 1.5 times pressure class for 4 hours. Add water as needed (not measured).
(3) Begin Test: Reduce 10psi (70 kPa) below 1.5 times pressure class. Monitor pressure for 1 hour.
(4) The pipe is acceptable if the pressure drop over 1 hour is 5% or less.

viii) Locate and repair defects if leakage is greater than amount specified.

ix) Repeat test until leakage is within specified allowance for full length of watermain.

j) FLUSHING AND DISINFECTING

i) The Engineer shall witness flushing and disinfecting operations. Notify the Engineer at least 4 days in advance of proposed date when disinfecting operations will commence.
ii) Flush watermains through available outlets with a sufficient flow to produce a velocity of 0.8 mls, within pipe for 10 min, or until foreign materials have been removed and flushed water is clear.

iii) Flushing flows shall be as follows:

Pipe Size (mm)	Flow (L/s) Minimum
150 and below	13
200	26
250	38
300	57
450	100

iv) Provide connections and pumps as required.
v) Open and close valves, hydrants and service connections to ensure thorough flushing.
vi) When flushing has been completed to satisfaction of the Engineer, introduce a strong solution of chlorine into watermain and ensure that it is distributed throughout entire system.
vii) Disinfect watermains to AWWA C651.
viii) A standard disinfection procedure consists of:

(1) Preventing contaminating materials from entering the watermain during storage, construction, or repair.
(2) Removing, by flushing and other means, those materials that may have entered the watermain.
(3) Chlorinating any residual contamination that may remain, and flushing the chlorinated water from the main.
(4) Determining the bacteriological quality by laboratory test after disinfection

ix) Take water samples at hydrants and service connections, in suitable sequence, to test for chlorine residual.
x) After adequate chlorine residual not less than 50 ppm has been obtained, leave system charged with chlorine solution for 24h. Further samples shall be taken to ensure that there is still not less than 10 ppm of chlorine residual remaining throughout system.
xi) Upon acceptance of disinfection by the Engineer, flush the entire system with distribution water until all chlorinated water has been expelled.

k) BACTERIOLOGICAL TESTS

i) Refer to AWWA C651, Section 7.1 with additional requirements for the minimum acceptable bacterial level as follows:

(1) A sample must show the absence of coliform organisms; and
(2) The total bacteria count shall not be greater than 300 organisms per millilitre.

ii) If 1 to 10 coliform organisms are detected in the initial sampling, then the site should be resampled. If the presence of coliforms is confirmed, the disinfection and bacteriological sampling procedures shall be repeated.

iii) If there are 10 or more coliform organisms and/or the total bacteria count is greater than 300, the disinfection and bacteriological sampling procedure shall be repeated.

iv) It shall be the responsibility of the Contractor to ensure water from newly constructed watermains will not be used for drinking or other domestic purposes until the mains have been disinfected, samples have been taken and certified by an approved laboratory as being free from bacterial contamination and approval is obtained from the Local Board of Health and the Engineer.

3.8 Water Pressure and Leakage Test Calculations

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Water Pressure and Leakage Test Calculations

Project: ______________________
Client: ______________________
Prepared For: ______________________

Allowable Leakage = Lm = (H*J*D*P^0.5) / 128300

Where: H= Test duration in hours; D = Pipe diameter (mm); J= Number of joints; P = Average test pressure in kPa

If test pressure is 1035 kPa and test duration is 2 hours then:

Lm =J*D/1994

____ mm C900 PVC Pipe			Number of Joints
Pipe		/6m/joints = Round to the nearest integer	
Fittings	**Number**	**Joints/Fitting**	
Plugs		* 1 =	
Bends		* 2 =	
Valves		* 2 =	
Tees		* 1 =	
Cross		* 4 =	
Hydrants		* 4 =	
		Total Joints	
		Allowable Leakage (Litres)	

____ mm C900 PVC Pipe			Number of Joints
Pipe		/6m/joints = Round to the nearest integer	
Fittings	**Number**	**Joints/Fitting**	
Plugs		* 1 =	
Bends		* 2 =	
Valves		* 2 =	
Tees		* 1 =	
Cross		* 4 =	
Hydrants		* 4 =	
		Total Joints	
		Allowable Leakage (Litres)	

____ mm C900 PVC Pipe			Number of Joints
Pipe		/6m/joints = Round to the nearest integer	
Fittings	**Number**	**Joints/Fitting**	
Plugs		* 1 =	
Bends		* 2 =	
Valves		* 2 =	
Tees		* 1 =	
Cross		* 4 =	
Hydrants		* 4 =	
		Total Joints	
		Allowable Leakage (Litres)	

Total Allowable Test Section leakage (Lm) = ____
Allowable Drop = Total allowable leakage /2.6 litres (cm) = ____

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3.9 Topsoil And Finished Grade

3.9.1 General

a) REFERENCES

i) American Society for Testing and Materials (ASTM):
ii) ASTM C602-95a (2001), Standard Specification for Agricultural Liming Materials
iii) ASTM D5268-92 (1997), Standard Specification for Topsoil Used for Landscaping Purposes
iv) Canadian Council of Ministers of the Environment (CCME)
v) CCME 106E, Guidelines for Compost Quality (1996)
vi) Standards Council of Canada
vii) CAN/BNQ 0413-200-M95 Amendment organiques – Compost (Organic Soil Conditioners - Compost)

b) SUBMITTALS

i) Provide submittals and wait for The Town's review and acceptance, before placement of any materials on site.
ii) Imported Topsoil: provide samples from each source intended for use. Samples shall weigh about 500 g and be packaged in clean containers. Provide the following information with topsoil sample: location of topsoil source, previous land use, and date of sampling. The sample shall be typical of the topsoil lot to be supplied and provide an accurate indication of colour, texture and organic content.
iii) Original copy of each soil analysis report and Agrologist's recommendations indicating recommended amendments for approval before delivering any topsoil to the site.
iv) Resubmit samples of soil amended as recommended by the report for verification of compliance with specified requirements.
v) Submit one copy of all new soil reports to The Town until approval.
vi) Submit product data for each type of product indicated.
vii) Submit product certificates for soil amendments and fertilisers, signed by the product manufacturer.
viii) Copies of all permits and licenses as applicable to the Work of this Contract.

c) SOURCE QUALITY CONTROL

i) Advise The Town of sources of topsoil and manufactured soil 28 days or more in advance of delivery.
ii) Provide samples of material in time to allow testing, review of test results and recommendations, and repetition of the testing and approval cycle if materials are rejected, before delivery.
iii) Provide samples of lime, if required, for laboratory tests, or provide manufacturer's certified tests of ECCE to the Agrologist.
iv) The contractor is responsible for providing and the cost of soil analysis, compost analysis, Agrologist recommendations, and requirements for amendments to supply topsoil as specified.

d) QUALITY ASSURANCE

i) Soil Testing Laboratory Qualifications: engage an independent soil testing laboratory, acceptable to the Consultant, with the experience and capability to conduct the testing indicated, that specialises in the types of tests to be performed. The laboratory shall be

accredited by the Standards Council of Canada for all specified tests and procedures for which such accreditation is available.

ii) Soil Analysis: furnish soil analysis stating test results for all parameters specified.

iii) Include any parameters necessary to determine conformance with applicable referenced standards and any analyses required by the Agrologist responsible for making recommendations. Indicate the test methods used. Test texture and organic content in accordance with ASTM D5268.

iv) Compost Analysis: determine if compost to be used conforms to specified requirements.

v) Lime Analysis: determine ECCE of lime, if lime is required, by testing or manufacturer's certification.

vi) Recommendations:

(1) Provide a report based on the soil and compost analyses, and with reference to the Contract Documents, prepared by an accredited and approved professional Agrologist.
(2) Report suitability of the soil for lawn and woody plant and herbaceous perennials growth.
(3) State all aspects of the soil analysis that indicate the soil does not conform to referenced standards.
(4) State the recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory soil for lawns and other plantings indicated or specified.
(5) Take into account and adjust recommendations for soil depths indicated and amendments already specified.

vii) The cost of soil testing and Agrologist's reports is the responsibility of the Contractor.

viii) Installer Qualifications: A qualified landscape installer whose work has resulted in the successful establishment of lawns and grasses.

ix) Installer's Field Supervision: Require Installer to maintain an experienced full- time supervisor on Project site when exterior planting is in progress.

x) Preinstallation Conference: Conduct conference at Project site to address quality of materials, inspection schedule and samples including, but not limited to, the following:

(1) Protection of existing trees and facilities.
(2) Landscape materials and installation procedures.
(3) Layout and staking of tree trenches and shrub beds before excavation.
(4) Verification of required soil depths at sod, shrub beds and tree trench locations before installation of topsoil and soil mix.

e) DELIVERY, STORAGE, AND HANDLING

i) Stockpile topsoil off-site, in a location dedicated to this project, or on Site in a location approved by the Owner.

ii) If stockpile is accessible to the public, never leave a slope that is steeper than the angle of repose unattended.

iii) Do not use stockpiled material that becomes intermingled with other material from the storage site.

3.9.2 Products

a) MATERIALS

i) Contractor to supply and install soil types as shown on drawings:

ii) Soil Types:

(1) Topsoil and Soil Mix: fertile natural loam, capable of sustaining healthy growth. Topsoil to be loose and friable, free of subsoil, clay lumps, stones more than 20 mm, live plants, roots or any other deleterious material greater than 20 mm diameter, free of litter, foreign matter and toxic materials harmful to plant growth. Topsoil containing construction debris, sod clumps, quackgrass or other noxious weeds is not acceptable.

(2) Soils are to meet the following requirements:

	Topsoil	**Soil Mix**
Coarse gravel (<19mm to 40mm)	0-3%	0-1%
All gravel (2mm to 40mm)	0-10%	0-5%
Very coarse sand (1 mm to 2 mm)	-	-
Coarse sand (0.5 mm to 1 mm)	-	-
Medium sand (0.25 mm to 0.50 mm)	-	-
Fine sand (0.15 mm to 0.25 mm)	-	-
Combined medium to very coarse sand (2 mm to 0.25 mm)	-	-
Combined very coarse sand, fine gravel and gravel	<40%	-
Sand (2 mm to 0.05 mm)	30-60%	50-70%
Silt (0.05 mm to 2 µm)	15-50%	10-25%
Clay (<2 µm)	15-30%	0-25%
Clay and silt combined	Maximum 60%	Maximum 35%
Textural Class	Loam, Sandy loam, Silt loam, Sandy clay loam	Sandy loam to Loam
Organic matter content %	4-10%	15-20%
pH (saturated paste)	6.0-7.5	6.0-7.5
EC dS / m (salinity)	<2	<2
SAR (sodium)	<5	<5
Total Organic Carbon (Aspen Parkland)	2.2-3.4%	-
Total Nitrogen (Aspen Parkland)	0.33%	-
Carbon : Nitrogen (C:N) Ratio	11:1	10:1 to 15:1
Calcium Carbonate Equivalent (%)	<2	
Saturation %	30-60	
Available Phosphorus	20 mg/kg to 60 mg/kg (or as required)	20 mg/kg to 60 mg/kg (or as required)
Total Phosphorus	N/A	
Available Potassium	300 kg/ha to 1000 kg/ha (or as required)	300 kg/ha to 1000 kg/ha (or as required)
Cation Exchange Capacity	-	-
Saturated Hydraulic Conductivity	-	-

(3) Compost: conforming to CCME Guidelines, Category A requirements, including:

- Trace elements
- Foreign matter (also conforming to CAN/BNQ 0413-M95, Type A)
- Pathogenic organism content

(4) Peat Moss: decomposed plants, fairly elastic and homogeneous, free of decomposed colloidal residue, wood, Sulphur and iron. Minimum of 80% organic matter by mass, pH value between 4.5 and 6.0. Furnished in an air-dry state, packed in standard bags or bales showing the name of the manufacturer.
(5) Sand: washed coarse sand, medium to coarse textured, free of impurities, chemical or organic matter.
(6) Lime: dry ground agricultural limestone containing a minimum 85% of total carbonates meeting gradation requirements: percentage passing by weight – 90% passing 1.0 mm sieve, 50% passing 0.125 mm sieve.
(7) Sulphur: finely crushed agricultural elemental Sulphur, free of impurities.
(8) Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4% nitrogen and 20% phosphoric acid.

3.9.3 Execution

a) EXAMINATION

i) Contractor shall advise The Town, in writing, of any conditions or defects encountered on the site before or during construction upon which the work of this section depends and which may adversely affect its performance.
ii) Do not commence work until these conditions or defects have been evaluated by The Town and corrective measures taken.
iii) Commencement of work shall imply acceptance of existing surfaces and conditions. No claims for damages or extras resulting in discovering such conditions or defects will be accepted later, except where such conditions could not have been known before commencing work.

b) VERIFICATION OF CONDITIONS

i) Inspect and verify that rough subgrade preparation and elevations conform to specified requirements before proceeding with the work of this section.
ii) If discrepancies occur, notify Consultant. Do not commence work until base conditions are corrected as instructed by the Consultant.

c) PROTECTION OF EXISTING WORK

i) Exercise caution against injury to, or defacement of, existing conditions. Repair or replace all items and site features damaged from installation operations to original or better condition at the Contractor's expense.
ii) Locate utility lines before the commencement of work and protect from damage.

d) PREPARATION OF SUBGRADE

i) Remove foreign material, undesirable plants, roots, stones more than 20 mm diameter, debris and soil contaminated with oil or gasoline, from the site. Do not bury foreign material beneath areas to be landscaped.
ii) Grade subgrade to eliminate uneven areas, low spots and ensure positive drainage.

(1) Maintain maximum 1:1 slope from the back of curb faces and pavement edges. Do not excavate vertically at pavements and curbs so as to compromise the structural integrity of adjacent sub-base material.

iii) Cultivate clayey or silty subsoil, if present, to a depth of 150 mm. Rip top 100 mm of granular soil.
iv) Immediately before spreading of topsoil for lawns, broadcast bonemeal, if specified by the Agrologist, onto the subsoil at a rate recommended by the Agrologist.
v) Re-cultivate clayey or silty subsoil compacted during hauling or spreading.

e) PLACEMENT AND SPREADING OF TOPSOIL

i) Do not place and spread topsoil/soil mix until the Consultant has approved subgrade preparation.
ii) Remove all surface debris, stones more than 20 mm diameter, soil clods, vegetation, roots, grass and weeds, litter and other foreign debris. Dispose of collected materials off-site.
iii) Place topsoil/soil mix in dry weather on loose, friable, and graded subgrade surface. Do not spread topsoil/soil mix when ground or topsoil is frozen, excessively wet, or otherwise in a condition detrimental to the Work, as determined by the Consultant.
iv) Evenly spread topsoil/soil mix to a uniform depth, which, after amendment, settlement and compaction, shall provide a minimum depth, unless specified otherwise, of:

(1) 200 mm depth topsoil for seeded areas
(2) 150 mm depth topsoil for sodded areas
(3) 600 mm depth soil mix for tree trenches
(4) 450 mm depth soil mix for shrubs, perennials and ornamental grasses
(5) As defined in the detail

v) Manually spread topsoil/soil mix around trees, plants and surface obstacles to prevent damage.
vi) Fine grade and loosen topsoil/soil mix. Eliminate rough spots and low areas to ensure positive drainage away from fences and walkways. Prepare a loose, friable bed using cultivation and subsequent raking. Maintain levels, profiles and contours of the subgrade.
vii) Float and leave surfaces smooth, uniform, and sufficiently firm against deep footprinting with a fine loose texture. Finish surface shall be clean, even and free from irregular surface changes.
viii) On larger surfaces, use hydraulic power box rake or similar mechanical equipment that will effectively and efficiently remove soil lumps, rocks and debris; fill and level low areas; and correct other grading deficiencies.
ix) Keep topsoil 25 mm below finish grade for sodded areas adjacent to walkways, curbs, edging materials, other hard surfaces, manholes, catchbasins, valve covers and crown of adjacent existing turf. Elsewhere, bring topsoil for sodded areas up to finished grade.
x) Keep soil mix 50 mm below finish grade for shrub beds adjacent to walkways, curbs, edging materials, other hard surfaces manholes, catchbasins, valve covers, and crown soil mix away from the edge to ensure positive drainage off the shrub bed. The high point of the soil mix in the bed should be no lower than the adjacent finished grade.
xi) Ensure topsoil elevations match Civil Engineering design. Ensure all beds have positive drainage away from buildings.
xii) Do not cover catch basins, valve covers or manholes. Cut smooth falls to catch basin rim, finish flush. Provide smooth transitions at top and bottom of slopes.
xiii) Ditches: finish ditches and swales to ensure proper flow and drainage. Conduct final rolling operations to produce a hard, uniform and smooth cross-section.

xiv) Compact the top 150 mm depth of topsoil/soil mix to 95% Standard Proctor Density (+/- 2.5%) Adjust soil depth after compacting to ensure minimum depths are maintained throughout the turf or bed area.
xv) Observe municipal bylaws and/or local rules for dust abatement and disturbance measures that need to be followed. The Contractor is responsible for any additional costs to provide the necessary measures. The Contractor will be responsible for any fines or penalties for not following the Bylaws or local rules.

f) SOIL CONDITIONING

i) Apply lime, peat moss, sulphur or other recommended soil conditioning at rates recommended by the Agrologist on placed rough-graded topsoil.
ii) Incorporate soil amendment well into the full depth of topsoil. Rototill (or other approved mechanical incorporation) amendment into the soil in perpendicular directions. Rototill entire area numerous times in one direction and then numerous times at right angles to initial direction, ensuring no surface debris, stones more than 20 mm diameter, soil clods, vegetation, roots, grass or weeds, litter or other foreign debris are present upon completion of disking.
iii) Minimise creation of dust and disturbance of neighbours as a result of incorporation.
iv) Observe municipal bylaws or local rules for dust abatement and disturbance.
v) Contractor to re-test amended topsoil to confirm compliance with soil analysis report. The Consultant will select locations for testing.

g) PROTECTION OF GRADED AREAS

i) Protect newly graded areas from traffic and erosion. Keep the site clean.
ii) Repair and reestablish grades in settled, eroded and rutted areas.

h) CLEAN-UP

i) Keep roadway, walkway, and surrounding areas free of soil and debris as a result of work done under this section at the end of each working day or as directed by the Owner.
ii) Dispose of surplus soil not required for fine grading and landscaping off-site.
iii) Restore stockpile sites on site to "rake clean" condition acceptable to the Owner.
iv) Dispose of unacceptable soil material off-site.

3.10 Seeding

3.10.1 General

a) RELATED REQUIREMENTS

i) Section 3.8 — Topsoil and Finish Grading
ii) Section 3.10 — Sodding
iii) Section 3.11 — Plant Material (Trees, Shrubs, and Perennials)
iv) Section 3.12 — Landscape Establishment Maintenance

b) REFERENCES

i) Turfgrass Producers International (TPI):

c) SUBMITTALS

i) The Town may require a seed germination test and all lawn seed must comply with Federal and Provincial seed laws.
ii) The Town may inspect all seed and sod installations and reject any product or installation that does not adhere to Town requirements.
iii) Submit invoice from seed supplier showing seed-mix type percentages.

d) DEFINITIONS

i) "Weeds" Includes but not limited to dandelions, jimsonweed, quack grass, horsetail, morning flory, rush grass, mustard, lambsquarter, chickweed, crabgrass, Canadian thistle, tansy, ragwort, Bermuda grass, bindweed, bent grass, perennial sorrel, brome grass, red root, pigweed, buckweed, scentless chamomile, toadflax, foxtail and perennial sow thistle.

e) QUALITY ASSURANCE

i) Site Supervisor: competent, experienced and knowledgeable to direct and supervise all staff and maintenance work of the contract. The supervisor shall possess a Landscape Journeyman Gardner certification or other similar qualification acceptable to Consultant. Submit supervisor's credentials for Consultant's approval before commencement of work.
ii) Weekly Site Visits: provide adequate site visits each week with sufficient staff to ensure that all required maintenance services are performed and completed on schedule in accordance with specifications.
iii) Site Security: Contractor's personnel shall carry personal identification at all times while on site. Identification shall be presented when requested by Consultant or other site security staff. All employees must check in with Consultant upon entering and leaving the premises where applicable.
iv) Submittals: Submit all required information and documents for Consultants approval where specified in contract documents and applicable to work of the contract and as requested by the Consultant.
v) Safety Precautions:

(1) Contractor shall supply and ensure that all workers use appropriate personal protective equipment as required by Alberta's Occupational Health and Safety Act, Regulations and Code.
(2) Contractor shall provide training and ensure all workers practice appropriate safety measures and safe use of tools and equipment by WHMIS (Workplace Hazardous Materials Information System).
(3) Owner reserves the right to have the Contractor remove any employee from the site if not wearing personal protective equipment or if not practicing safe work procedures.

vi) Regulatory Requirements: Perform work in accordance with all applicable laws, codes and regulations required by authorities having jurisdiction over such work and provide all permits required by local authorities.

f) DELIVERY, STORAGE, AND HANDLING

i) Use all means necessary to protect all materials before, during and after installation, and to protect the installed work and materials of other contractors.

ii) Deliver grass seed in the original containers, tagged with identification as to the analysis of seed mixture, percentages of seed, year of seed production, net weight, and date.
iii) Deliver seed to site only when required.
iv) Schedule deliveries to keep storage at the site to a minimum without causing delays.

g) SCHEDULING

i) Proceed with planting only when existing and forecast weather conditions permit.

h) MAINTENANCE PERIOD

i) Maintain all seeded areas between May 1st to October 31st (landscape growing season) for a minimum of two (2) years (24 months), commencing from Landscape Construction Completion Certification for the Work in Contract. See Section 32 99 00 – Landscape Establishment Maintenance for all maintenance requirements and details.
ii) Landscape maintenance shall not terminate at the end of the landscape growing season if additional months of maintenance are still in contract. Any incomplete weeks or months of maintenance shall be carried over to the following landscape growing season.
iii) The Town reserves the right to extend the maintenance period if the Contractor fails or neglects to provide proper and adequate maintenance services in accordance with contract specifications as determined by the Consultant.

i) WARRANTY

i) Satisfactory Seeded Area: At the end of the maintenance period, a healthy, well-rooted, even-coloured, viable lawn has been established, free of weeds, bare areas, and surface irregularities.
ii) Warranty work on turf between May 1st to October 31st (landscape growing season) for a minimum of two (2) years (24 months), commencing from Landscape Construction Completion Certification for the Work in Contract. See Section 32 99 00 – Exterior Landscape Maintenance for all maintenance requirements and details.
iii) During the warranty period, Contractor shall immediately remove and replace all grass which is dead or unhealthy or in unsatisfactory growing condition. Install replacement seed in accordance with contract specifications.
iv) The Town may accept work at the end of Warranty period provided:

(1) Seed is properly anchored into underlying topsoil, well established, vigorously growing and healthy.
(2) Seed is green, even coloured, free of weeds and other pests.
(3) Seed is free of bare and dead spots, ruts, undulations and settlement.
(4) Seed areas have been recently mowed and thoroughly watered.
(5) Seed areas are clean and free of all debris.
(6) Seed areas have received all required applications of turf fertilisation.

3.10.2 Products

a) SEED MIX

i) The Town will review and provide written acceptance/rejection for all requests by the contractor for substitution of seed mixes
ii) Shall be Certified Canada No. 1 mixture, free of disease, weed seeds, or foreign matter, minimum germination of 75%, minimum purity of 97% and conforming to the mixes detailed in the standards document or accepted alternates. All seed must be from a

recognized seed firm, meeting the requirements for the Seeds act for Canada No. 1 Seed. Seed shall be certified No. 1 grade. A germination test and/or weed seed analysis may be requested and all lawn seed must comply with federal and provincial seed laws.

b) MULCH

i) Material shall be wood cellulose fibre containing no contaminants.
ii) Fibre shall be supplied by a recognized supplier and shall have a certified weight and composition.
iii) Minimum application rate is 16 kg of air dry fibre per 100 m^2.
iv) Fibre shall be measured as it is fed into the seeder.

c) FERTILISER

i) Commercial Fertiliser: Commercial grade complete fertiliser of neutral character, consisting of fast and slow release nitrogen, 50% derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in amounts recommended by the Agrologist responsible for interpreting soil test results required for topsoil.

d) WATER

i) Water: clean, fresh, and free of substances or matter that would inhibit the vigorous and healthy growth of grass.
ii) Contractor shall supply clean water, equipment, methods of transportation, water tanker, hoses, attachments, and other accessories as necessary to adequately apply water to all sodded areas and for other work in the contract.
iii) Contractor shall bear all costs for the supply of water incurred during the contract period.

e) EQUIPMENT

i) Cultivators: capable of scarifying, discing, or harrowing.
ii) Dry Seeders: of the “Brillion” type, capable of rolling and covering the seed with 3mm to 6mm of soil; or of the cyclone type, with flexible wire mat drag.
iii) Hydro seeders: capable of thoroughly mixing water, seed, fertilizer and pulverized wood fibre and of uniformly spraying the mix at designated rate.
iv) Rollers: of suitable size and mass.

3.10.3 Execution

a) EXAMINATION

i) Examine areas to receive lawns and grass for compliance with requirements and other conditions affecting performance.
ii) Proceed with installation only after unsatisfactory conditions have been corrected.
iii) Commencement of work shall imply acceptance of existing surfaces and conditions and no claims for damages or extras resulting from such conditions or defects will be accepted later, except where such conditions could not have been known before commencing work.

b) PREPARATION

i) Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
ii) Remove weeds and debris.
iii) The work shall be done in calm weather, during the normal planting season for the type of seed mixture supplied.

c) FINAL SOIL PREPARATION

i) Do final soil preparation in accordance with TPI Section III, “Specifications for Fertiliser, pH Correction Materials and Final Soil Preparation”, except where seed is installed over grass paving structures.
ii) Till the top 100 mm of natural topsoil incorporating the amendments recommended by the Agrologist based on soil test results as specified in Section 32 91 21 — Topsoil and Finish Grading.

d) FERTILISING

i) Apply fertiliser before sodding, after a final grade is approved by Owner.
ii) Apply 12-51-0 or other similar granular starter fertiliser evenly at 3 kg/100 m^2 using a calibrated mechanical distributor.
iii) Lightly rake and incorporate fertiliser into topsoil.

e) MECHANICAL SEEDING

i) Do not seed when prepared topsoil is covered with frost, snow or standing water. Proceed with seeding operations only during favorable weather conditions in accordance with sound horticultural practices.
ii) Slopes flatter than 3:1, apply seed by mechanical dry spread (brillion or cyclone type) at a rate of 24 kg/1,000 m^2. Apply in two passes, each pass at a rate of 12 kg/1,000 m^2 at 90 degrees to each other. Lightly roll seeded area.
iii) Hand broadcast seeding is unacceptable under any conditions except for site specific repair work and pre-approved work in naturalization areas.
iv) Spread type 3 fertilizer evenly at the rate specified.
v) Thoroughly harrow the site after fertilization, on ground flatter than 3:1
vi) Sow the seed at the rate specified for the seed type, in 2 directions, 50% in one direction and remaining 50% of seed at right angles to first seeding pattern.

f) HYDRO SEEDING

i) Use a hydro seeder to seed slopes 3:1 or steeper with Parks Naturalization Mix. In other flatter areas use Canada #1 Mix and as specified in the landscape drawings.
ii) Mix seed with water mulch and fertilizer in the following suggested quantities to cover 4,000 m^2.

(1) Grass Seed: 80 kgs
(2) Mulch: 640 kgs
(3) Water: 6,400 litres
(4) Fertilizer: 140 kgs

iii) Hydroseeding should not be carried out in wind velocities which cause seed mix to be blown. The Town may determine if conditions are appropriate for application.
iv) Measure quantities of materials to be fed into the seeder, either by weight or by using another approved system.

v) Application rates:

(1) Grass Seeds 2.0kg per 100 m^2 or as specified for the seed type
(2) Water 106 L/100 m^2
(3) Mulch 16 kg/100 m^2 of sufficient to apply the specified amount of seed and fertilizer per 100 m^2
(4) Use type 3 fertilizer

vi) Thoroughly mix seed, fertilizer, mulch, binder (if specified) and water in a slurry and uniformly apply in one operation or apply seed and fertilizer mixture then cover with an approved mulch.

g) SEED GERMINATION

i) If seed fails to germinate within four growing months, re-cultivate and re-seed until germination takes place.
ii) Approximately six weeks after germination apply supplementary fertilizer 27-14-0, at a rate determined by topsoil analysis or such other fertilizer as may be deemed appropriate by the City.

h) CLEANUP AND PROTECTION

i) Promptly remove soil and debris created by lawn work from paved areas; clean wheels of vehicles before leaving the site to avoid tracking soil onto roads, walks, or other paved areas. Clear soil and rubble from catch basins, manholes, valves and other hard surface features.
ii) Collect all litter and other debris from the site during work of the contract.
iii) Remove and dispose of excess materials, soil, litter, debris, and grass clippings at an approved disposal site. Contractor shall be responsible for all disposal costs.
iv) Erect barricades and warning signs as required to protect newly planted areas from traffic; maintain barricades throughout the maintenance period and remove after the lawn is established.
v) Damaged sod resulting from inadequate protection shall be repaired with topsoil, fertiliser and new sod at Contractor's expense. All damages shall be repaired before final acceptance.

3.11 Sodding

3.11.1 General

a) RELATED REQUIREMENTS

i) Section 3.8 — Topsoil and Finish Grading
ii) Section 3.9 — Seeding
iii) Section 3.11 — Plant Material
iv) Section 3.12 — Landscape Establishment Maintenance

b) REFERENCES

i) Turfgrass Producers International (TPI):
ii) Guideline Specifications to Turfgrass Sodding (Revised 1995)

c) SUBMITTALS

i) Submit product data for each type of product indicated, including sod Certification for grass species and location of the source.
ii) Submit planting schedule indicating anticipated planting dates for each type of planting.
iii) Submit maintenance instructions indicating recommended procedures to be established by the Owner for maintenance of lawns following the required maintenance period.

d) DEFINITIONS

i) “Weeds” Includes but not limited to dandelions, jimsonweed, quack grass, horsetail, morning flory, rush grass, mustard, lambsquarter, chickweed, crabgrass, Canadian thistle, tansy, ragwort, Bermuda grass, bindweed, bent grass, perennial sorrel, brome grass, red root, pigweed, buckweed, scentless chamomile, toadflax, foxtail and perennial sow thistle.

e) QUALITY ASSURANCE

i) Site Supervisor: competent, experienced and knowledgeable to direct and supervise all staff and maintenance work of the contract. The supervisor shall possess a Landscape Journeyman Gardner certification or other similar qualification acceptable to the Consultant. Submit the supervisor’s credentials for the Consultant’s approval before commencement of work.
ii) Weekly Site Visits: provide adequate site visits each week with sufficient staff to ensure that all required maintenance services are performed and completed on schedule in accordance with specifications.
iii) Site Security: Contractor’s personnel shall carry personal identification at all times while on site. Identification shall be presented when requested by Consultant or other site security staff. All employees must check in with the Consultant upon entering and leaving the premises where applicable.
iv) Submittals: Submit all required information and documents for Consultants approval where specified in contract documents and applicable to work of the contract and as requested by the Consultant.
v) Safety Precautions:

(1) Contractor shall supply and ensure that all workers use appropriate personal protective equipment as required by Alberta’s Occupational Health and Safety Act, Regulations and Code.
(2) Contractor shall provide training and ensure all workers practice appropriate safety measures and safe use of tools and equipment by WHMIS (Workplace Hazardous Materials Information System).
(3) Owner reserves the right to have the Contractor remove any employee from the site if not wearing personal protective equipment or if not practising safe work procedures.

vi) Regulatory Requirements: Perform work in accordance with all applicable laws, codes and regulations required by authorities having jurisdiction over such work and provide all permits required by local authorities.

f) DELIVERY, STORAGE, AND HANDLING

i) Harvest, deliver, store, and handle sod in accordance with TPI Section IV, “Specifications for Turfgrass Sod Materials”.
ii) Use all means necessary to protect all materials before, during and after installation, and to protect the installed work and materials of other contractors.

iii) Packaged materials shall be delivered in sealed containers clearly marked with contents, weight, analysis and name of the manufacturer.
iv) Schedule deliveries to keep storage at the site to a minimum without causing delays.
v) Protect sod during transportation with tarpaulin from drying out. Unload and store sod on pallets. Keep sod moist and cool until installed.
vi) Deliver sod to the site within 24 hours of being harvested. Install all sod within 36 hours of being harvested.
vii) Dried out, damaged, deteriorated and unhealthy sod is not acceptable. Broken or irregular pieces of sod are not acceptable. Promptly remove all unacceptable sod from the site.

g) SCHEDULING

i) Proceed with planting only when existing and forecast weather conditions permit.

h) MAINTENANCE PERIOD

i) Maintain all sodded areas between May 1 to October 31 (landscape growing season) for a minimum of two (2) years (24 months), commencing from Landscape Construction Completion Certification for the Work in Contract. See Section 32 99 00 – Exterior Landscape Maintenance for all maintenance requirements and details.
ii) Landscape maintenance shall not terminate at the end of the landscape growing season if additional months of maintenance are still in contract. Any incomplete weeks or months of maintenance shall be carried over to the following landscape growing season.
iii) The Owner reserves the right to extend maintenance period and/or reduce monthly progress payments for maintenance services any time Contractor fails or neglects to provide proper and adequate maintenance services in accordance with contract specifications as determined by the Consultant.

i) WARRANTY

i) Satisfactory Sodded Lawn: At the end of the maintenance period, a healthy, well-rooted, even-coloured, viable lawn has been established, free of weeds, open joints, bare areas, and surface irregularities.
ii) Warranty work on turf between May 1 to October 31 (landscape growing season) for a minimum of two (2) years (24 months), commencing from Landscape Construction Completion Certification for the Work in Contract. See 32 99 00 – Landscape Establishment Maintenance for all maintenance requirements and details.
iii) During the warranty period, Contractor shall immediately remove and replace all sod which is dead or unhealthy or in an unsatisfactory growing condition. Install replacement sod in accordance with contract specifications.
iv) The Town may accept work at the end of Warranty period provided:

(1) Sod is properly anchored into underlying topsoil, well established, vigorously growing and healthy.
(2) Sod is green, even coloured, free of weeds and other pests.
(3) Sod is free of bare and dead spots, visible joints, ruts, undulations and settlement.
(4) Sod areas have been recently mowed and thoroughly watered.
(5) Sod areas are clean and free of all debris.
(6) Sod areas have received all required applications of turf fertilisation.

3.11.2 Products

a) TURFGRASS SOD

i) Sod: cut and supply sod in accordance with TPI Section IV, “Specifications for Turfgrass Sod Materials”.
ii) Sod shall comply with standards outlined in the current edition of “Canadian Standards for Nursery Stock - (Nursery Sod)”, published by the Canadian Nursery Landscape Association.
iii) The seed for sod: certified Canada No. 1, free of disease, weed seeds or other foreign materials, meeting the requirements of the Seeds Act, using cultivars rated in the top 25th percentile of the National Turfgrass Evaluation Plots (NTEP) located in Alberta.
iv) Sod: TPI Certified Number 1 Quality/Premium, Manderley Less Water Turfgrass or approved alternative grown from seed sown with the following composition or approved alternative:

(1) Kentucky Bluegrass “Ridgeline”, 35%
(2) Kentucky Bluegrass “Wildhorse”, 30%
(3) Kentucky Bluegrass “Mallard”, 15%
(4) Kentucky Bluegrass “Monte Carlo”, 10%
(5) 7 Seas Chewings Fescue: 10%

v) Grown on fertile topsoil, by a sod producer specialising in sod production and harvesting. Sod shall be 18 to 24 months in age before harvesting. Submit sod certification for grass species and location of the source.
vi) Permeated with a strong fibrous root system; be freshly cut and in good healthy condition with no decay or bare spots; be uniform in texture and free from weeds, undesirable native grasses and foreign debris; and contain adequate moisture to maintain its vitality during transportation and placement.
vii) Broken, dry, deteriorated, damaged and discoloured sod shall be rejected.
viii) The thickness of the soil portion of nursery sod shall be 15 mm.

b) FERTILISER

i) Commercial Fertiliser: Commercial grade complete fertiliser of neutral character, consisting of fast and slow release nitrogen, 50% derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in amounts recommended by the Agrologist responsible for interpreting soil test results required for topsoil.

c) WATER

i) Water: clean, fresh, and free of substances or matter that would inhibit the vigorous and healthy growth of grass.
ii) Contractor shall supply clean water, equipment, methods of transportation, water tanker, hoses, attachments, and other accessories as necessary to adequately apply water to all sodded areas and for other work in the contract.
iii) Contractor shall bear all costs for the supply of water incurred during the contract period.

3.11.3 Execution

a) EXAMINATION

i) Examine areas to receive lawns and grass for compliance with requirements and other conditions affecting performance.
ii) Proceed with installation only after unsatisfactory conditions have been corrected.
iii) Commencement of work shall imply acceptance of existing surfaces and conditions and no claims for damages or extras resulting from such conditions or defects will be accepted later, except where such conditions could not have been known before commencing work.

b) PREPARATION

i) Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
ii) Remove weeds and debris.
iii) The work shall be done in calm weather, during the normal planting season for the type of seed mixture supplied.

c) FINAL SOIL PREPARATION

i) Do final soil preparation in accordance with TPI Section III, “Specifications for Fertiliser, pH Correction Materials and Final Soil Preparation”, except where sod is laid over grass paving structures.
ii) Till the top 100 mm of natural topsoil incorporating the amendments recommended by the Agrologist based on soil test results as specified in Section 32 91 21 — Topsoil and Finish Grading.
iii) Firm sod bed by rolling before laying sod as necessary. Lightly moisten and rake soil before laying sod.

d) FERTILISING

i) Apply fertiliser before sodding, after a final grade is approved by Owner.
ii) Apply 12-51-0 or other similar granular starter fertiliser evenly at 3 kg/100 m^2 using a calibrated mechanical distributor.
iii) Lightly rake and incorporate fertiliser into topsoil.

e) LAYING SOD

i) Install sod in accordance with TPI Section V, “Specifications for Turfgrass Sod Transplanting and Installation.”
ii) Do not lay sod if dormant.
iii) Do not perform work during hot and dry conditions, or when the ground is frozen, muddy or covered in snow or during times of unfavourable weather.
iv) Lay sod smooth and even; butt sod pieces close and tight with no open joints visible. Stagger end joints 300 mm minimum between adjacent rows to avoid continuous seams. Do not stretch or overlap sod pieces.
v) Finish sod edges at walks, curbs, planting, mulch edges, manholes, and other vertical surfaces by cutting neatly and fitting tightly to edge and line.
vi) Lay sod smooth and flush with adjoining grass areas, curbs, walk and pavement. Where new sod abuts existing turf, cut edge of existing grass with a sharp tool to form a straight line. Level subgrade and butt new sod tight and flush with existing grass. Adjacent to hard surfaces, finish grade of new sod installation shall match finish grade of existing hard surface.

vii) Protect subgrade and sod from damage during installation.
viii) Where big rolls of sod are placed, remove reinforcement netting used to assist in harvesting and/or placement of sod roll before final sod placement.
ix) Cut and remove all irregular, unhealthy and thin sections of sod with a sharp knife and install new replacement sod.
x) Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
xi) After sod and soil have dried from initial watering, roll newly laid sod using a mechanical roller having sufficient weight. Roll sod to ensure good contact with topsoil, to eliminate air pockets, remove minor depressions and irregularities, and to form a smooth even surface. Heavy rolling to correct irregularities in grade is not acceptable. Sod adjacent to existing fixtures shall be thoroughly tamped.
xii) Saturate sod with fine water spray within two hours of planting, until sod and soil in contact with the bottom of sod are thoroughly wet.
xiii) During the first week, water daily or more frequently as necessary to maintain constantly adequate moisture in the soil to a minimum depth of 100 mm (4") below the sod.

f) LAYING SOD ON SLOPES

i) On sloped areas 5:1 and steeper, lay sod perpendicular to the slope and secure with wooden pegs. Place 4 to 6 wooden pegs/m^2, to prevent shifting of sod. Drive pegs flush with sod surface. Initiate sod installation from the bottom of the slope.
ii) Before placing sod on steep slopes where erosion may occur, place geotextile fabric netting over graded topsoil for reinforcement. Install and securely anchor sod in place over fabric with metal staples in accordance with the manufacturer's instructions.

g) CLEANUP AND PROTECTION

i) Promptly remove soil and debris created by lawn work from paved areas; clean wheels of vehicles before leaving the site to avoid tracking soil onto roads, walks, or other paved areas. Clear soil and rubble from catch basins, manholes, valves and other hard surface features.
ii) Collect all litter and other debris from the site during work of the contract.
iii) Remove and dispose of excess materials, soil, litter, debris, and grass clippings at an approved disposal site. Contractor shall be responsible for all disposal costs.
iv) Erect barricades and warning signs as required to protect newly planted areas from traffic; maintain barricades throughout the maintenance period and remove after the lawn is established.
v) Damaged sod resulting from inadequate protection shall be repaired with topsoil, fertiliser and new sod at Contractor's expense. All damages shall be repaired before final acceptance.

3.12 Plant Material (Trees, Shrubs and Perennials)

3.12.1 General

a) RELATED REQUIREMENTS

i) Section 3.8 - Topsoil and Finish Grading
ii) Section 3.12 - Landscape Establishment Maintenance

b) REFERENCES

i) American National Standards Institute (ANSI): ANSI Z60.1-1996, Nursery Stock
ii) Canadian Nursery Landscape Association (CNLA): Certified Horticultural Technician Program
iii) Landscape Alberta Nursery Trades Association (LANTA):
iv) Canadian Standards for Nursery Stock, 7th Edition
v) An Illustrated Guide to Pruning

c) DEFINITIONS

i) Balled and Burlapped Stock: Exterior plants dug with firm, natural balls of earth in which they are grown, with ball size not less than sizes indicated on Drawings; wrapped, tied, rigidly supported, and drum laced as recommended by ANSI Z60.1.
ii) Balled and Container Grown Stock: Exterior plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Container size is not less than the sizes indicated on Drawings.
iii) Planting Soil or Soil: Approved topsoil and soil mix as specified under Section 32 91 21 - Topsoil and Finish Grading and as indicated on Drawings.

d) SUBMITTALS

i) Provide submittals before starting any work.
ii) Submit product data for each type of product indicated, including the source location of all plant material.
iii) Submit planting schedule indicating anticipated planting dates for each type of planting.
iv) Submit maintenance instructions indicating recommended procedures to be established by the Owner for maintenance of plantings after the Contractor's required maintenance period.
v) Submit samples of proposed shredded wood mulch, rock mulch, and other products without specific manufacturers information.

e) QUALITY ASSURANCE

i) Site Supervisor: competent, experienced and knowledgeable to direct and supervise all staff and maintenance work of the contract. The supervisor shall possess a Landscape Journeyman Gardner certification or other similar qualification acceptable to the Consultant. Submit the supervisor's credentials for the Consultant's approval before commencement of work.
ii) Weekly Site Visits: provide adequate site visits each week with enough staff to ensure that all required maintenance services are performed and completed on schedule in accordance with specifications.
iii) Site Security: Contractor's personnel shall carry personal identification at all times while on site. Identification shall be presented when requested by The Town or other site security staff.
iv) Submittals: Submit all required information and documents for The Town's approval where specified in contract documents and applicable to work of the contract and as requested by The Town.
v) Safety Precautions:

(1) Contractor shall supply and ensure that all workers use appropriate personal protective equipment as required by Alberta's Occupational Health and Safety Act, Regulations and Code.

(2) Contractor shall provide training and ensure all workers practice appropriate safety measures and safe use of tools and equipment by WHMIS (Workplace Hazardous Materials Information System).
(3) Owner reserves the right to have the Contractor remove any employee from the site if not wearing personal protective equipment or if not practising safe work procedures.

vi) Regulatory Requirements: Perform work in accordance with all applicable laws, codes and regulations required by authorities having jurisdiction over such work and provide all permits required by local authorities.
vii) Provide quality, size, genus, species, and variety of exterior plants indicated, using ANSI Z60.1 terminology and methods of measurement.
viii) Contractor shall provide the The Town with the source of all plant material and photographs of plant material for this project. The Consultant and Owners representative reserve the right to select and tag plant material at the nursery before they are prepared for transplanting. If the plant material is unacceptable, the Contractor must source alternative plant material at no additional cost to the contract.
ix) Tree and Shrub Measurements: Measure according to ANSI Z60.1 with branches and trunks or canes in their normal position:

(1) Take calliper measurements 150 mm above ground for trees up to 100 mm calliper size, and 305 mm above ground for larger sizes.
(2) Measure the main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.

x) Do not prune to obtain the required sizes.
xi) Observation: The Town will observe trees and shrubs for compliance with requirements for the genus, species, variety, size, and quality as follows:
xii) The Town retains right to review trees and shrubs further for size and condition of balls and root systems, insects, disease, injuries, and latent defects and to reject unsatisfactory or defective material at any time during the progress of work.

(1) Remove rejected trees or shrubs immediately from Project site.
(2) Notify The Town of sources of planting materials fourteen (14) days in advance of delivery to site.

xiii) The Town reserves the right to review trees and shrubs at the following stages to verify conformance with specified requirements:
xiv) Trees and shrubs at source within 50 km of the site; the supplier shall provide transportation where distance exceeds 50 km.

(1) Installed trees and shrubs before the commencement of maintenance period.
(2) At the end of the maintenance period.
(3) If The Town does not review the trees and shrubs at the supplier's site, the Contractor is still responsible for supplying plant material that meets or exceeds the specifications and/or the municipal standards. The Contractor will be responsible for all replacement and installation costs associated with plant material rejected at the supplier site or delivered to the project site.

xv) Preinstallation Conference: Conduct conference at Project site to address the quality of materials, inspection schedule and samples including, but not limited to, the following:
xvi) Materials, mulch, landscape edging, and root barriers.

(1) Proposed landscape maintenance schedule.
(2) Arrangements for nursery visits.

f) SUBSTITUTIONS

i) Substitute plants only with prior approval of The Town.
ii) Submit proof that plant species and sizes specified are unobtainable before making substitution requests.
iii) Substitutions shall be of nearest similar species and size specified.
iv) Substitution of plants larger than specified shall be permitted with no increase in Contract Price.

(1) Balled and burlapped field dug plants may be substituted for container grown plants provided rootball sizes and plant sizes meet the requirements of the Canadian Standards for Nursery Stock, and provided that the proportion and density requirements of this standard are met.
(2) Container grown stock that meets the specified size and requirements of this standard may be substituted for balled and burlapped field dug plants, with prior approved by the Consultant or Owner's representative.

g) DELIVERY STORAGE AND HANDLING

i) Deliver exterior plants freshly dug.
ii) Apply anti-desiccant to trees and shrubs using power spray to provide an adequate film over trunks, branches, stems, twigs, and foliage to protect during digging, handling, and transportation; spray with anti-desiccant at the nursery before moving and again two weeks after planting if deciduous trees or shrubs are moved in full leaf.
iii) Do not prune trees and shrubs before delivery, except as accepted by The Town.
iv) Handle plants with care and skill to prevent injuries to trunk, branches, roots, rootballs and containers. Trees with damaged, broken or abraded trunks or branches may be rejected.
v) Do not bend or bind tie trees or shrubs in such a manner as to destroy their natural shape.
vi) Handle planting stock by the root ball.
vii) Protect plants during shipment with a windscreen or other suitable covering. Carefully tie in all branches before transporting. Take all precautions to prevent excessive drying from sun and wind and breakage from wind and equipment during transport. All points or contact between plant and equipment shall be protected with pads.
viii) Do not transport trees in open trucks when the temperature is more than 25 0C, or at speeds more than 60 km/hr.
ix) Do not drop exterior plants during delivery.
x) Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not install plants whose soil balls have been cracked or broken or when burlap ropes used in connection with transplanting have been removed. Do not use plants damaged during contact with equipment, or plants that are wilted, windburned or stressed.
xi) Replace damaged or rejected plants at no cost to Owner.
xii) Deliver exterior plants after preparations for planting have been completed and install immediately; set exterior plants trees in the shade, protect from weather and mechanical damage and keep roots moist if planting is delayed more than six (6) hours after delivery, and as follows:

(1) Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material balled and burlapped trees.
(2) Do not remove container grown stock from containers before the time of planting.
(3) Water root systems of exterior plants stored on-site with a fine mist spray.
(4) Water as often as necessary to maintain root systems in a moist condition.

h) COORDINATION

i) Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit.
ii) Coordination with Lawns: Plant trees and shrubs after finish grades are established and before planting lawns, unless otherwise acceptable to Consultant.

i) METRIC AND IMPERIAL EQUIVALENTS

i) All measurements should be specified in metric. Where necessary, the following conversion table (Metric/Imperial Equivalents) shall be used to establish equivalency between metric and Imperial sizes.
ii) Reference CNLA Canadian Standards for Nursery Stock C.2.2.2

Metric/Imperial Equivalents

Plants sized by Height or Spread		**Plants sized by Caliper**	
Imperial	**Metric**	**Imperial**	**Metric**
8in.	20.0cm	1in.	25mm
10in.	25.0cm	1.25in.	30mm
12in.	30.0cm	1.5in.	40mm
15in.	40.0cm	1.75in.	45mm
20in.	50.0cm	2in.	50mm
2ft.	60.0cm	2.5in.	60mm
2.5ft.	80.0cm	3in.	80mm
3ft.	90.0cm	3.5in.	90mm
3.28ft.	100cm	4in.	100mm
4ft.	125cm	4.5in.	110mm
5ft.	150cm	4.75in.	120mm
6ft.	175cm	5in.	130mm
6.56ft.	200cm	5.5in.	140mm
7ft.	225cm	6in.	150mm
8ft.	250cm	7in.	180mm

j) MAINTENANCE PERIOD

i) Maintain exterior landscape work between May 1 to October 31 (landscape growing season) for a minimum of two (2) years (24 months), commencing from Landscape Construction Completion Certification for the Work in Contract. See 32 99 00 – LANDSCAPE ESTABLISHMENT MAINTENANCE for all maintenance requirements and details.
ii) Landscape maintenance shall not terminate at the end of the landscape growing season if additional months of maintenance are still in contract. Any incomplete weeks

or months of maintenance shall be carried over to the following landscape growing season.

iii) The Town reserves the right to extend maintenance period if the Contractor fails or neglects to provide proper and adequate maintenance services in accordance with contract specifications as determined by the Consultant.

k) WARRANTY

i) Except for defects resulting from abuse by third-parties, Contractor shall warranty the exterior plants and ornamentals against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by Owner, or incidents that are beyond Trade Contractor's control:

(1) Warranty Period for Trees and Shrubs: Minimum two (2) years (24 months) from the date of Landscape Construction Completion Certification.
(2) Warranty Period for Ground Cover and Plants: Minimum two (2) years (24 months) from the date of Landscape Construction Completion Certification.

ii) Plant material warranty shall not terminate at the end of the landscape growing season if additional months of warranty are still in contract. Any incomplete weeks or months of warranty shall be carried over to the following landscape growing season.
iii) Remove dead plants immediately; replace immediately unless required to plant in the succeeding planting season.
iv) Replace exterior plants that are up to 25% dead or in an unhealthy condition at the end of the warranty period.
v) If the work has not been approved by the municipality as a result of deficiencies within the Contractor's scope, and landscape securities have not been released, the Contractor shall continue to be responsible for warranty, maintenance, and replacements until the Work is approved and securities released.
vi) The Owner may accept work at the end of the Warranty period provided:
vii) Plants meet the requirements of the specifications.

(1) Plants are properly and adequately established.
(2) Plants are alive, healthy and free of all pest infestations.
(3) Plants are properly planted, staked and pruned.
(4) Plants are recently and thoroughly watered.
(5) Plant pits and beds are cultivated and free of weeds, grass and debris.
(6) Planting accessories are properly installed and in good condition.

viii) Contractor shall use specified materials to correct plant installations that do not comply with the requirements for acceptance and continue with specified maintenance/establishment until deemed acceptable by The Town.

3.12.2 Products

a) TREES AND WOODY PLANTS

i) Furnish nursery grown plants with healthy root systems developed by transplanting or root pruning, grown in nurseries in the same agricultural climate zone as the site.
ii) Provide well shaped, fully branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sunscald, injuries, abrasions, and disfigurement.
iii) Provide plants of sizes complying with ANSI Z60.1 for types required; plants of a larger size may be used if acceptable to Consultant, with a proportionate increase in the size of roots or balls.

iv) Label at least one plant of each variety and calliper with a securely attached, waterproof tag bearing the legible designation of the botanical and common name.
v) Select stock for uniform height and spread, and number label to assure symmetry in planting.
vi) Minimum ball sizes for nursery grown trees:

Minimum Rootball Diameters (Deciduous Trees)	
Calliper	**Rootball Diameter (Minimum)**
4cm (1.5in.)	50cm (20in.)
4.5cm (1.8in.)	55cm (22in.)
5cm (2.0in.)	60cm (24in.)
6cm (2.3in.)	70cm (28in.)
7cm (2.8in.)	75cm (30in.)
8cm (3in.)	80cm (32in.)
9cm (3.5in.)	95cm (38in.)
10cm (4in.)	105cm (42in.)
12.5cm (5in.)	125cm (50in.)
15cm (6in.)	150cm (60in.)
17.5cm (7in.)	170cm (67in.)
20cm (8in.)	200cm (79in.)

Minimum Rootball Diameters (Coniferous Trees)	
Height	**Rootball Diameter (Minimum)**
30cm (12in.)	E
40cm (15in.)	E
50cm (20in.)	25cm (10in.)
60cm (24in.)	30cm (12in.)
80cm (32in.)	35cm (14in.)
1.0m (3ft.)	40cm (15in.)
1.25m (4ft.)	45cm (18in.)
1.50m (5ft.)	50cm (20in.)
1.75m (6ft.)	55cm (22in.)
2.0m (6.5ft.)	60cm (24in.)

Minimum Rootball Diameters (Coniferous Trees)	
Height	**Rootball Diameter (Minimum)**
2.5m (8ft.)	70cm (28in.)
3.0m (10ft.)	85cm (34in.)
* For conifers 2.0m (6.5ft.) and taller, calliper shall override height using the same calliper to rootball diameter as for deciduous trees.	

vii) Minimum ball sizes for transplanted trees: Size of root ball shall be 12 times the tree calliper measured at 305 mm above grade. For all trees to be transplanted that is greater than 100 mm calliper, the measurement shall be taken at 1530 mm above finish grade.
viii) Adjust ball size according to growing habits of trees.
ix) All ball sizes shall be sufficiently large to contain at least 75% of the fibrous root system with a ball depth not less than 50% of ball diameter.
x) Move trees with large solid soil ball wrapped in burlap in accordance with Landscape Alberta Guidelines.

b) CONTAINER GROWN PLANS

i) Plants shall have a well-established root system, reaching the sides of the container to maintain a firm ball when removed from the container, but shall not be root bound.
ii) Plants in containers shall not be grown in the same class container for longer than 2 growing seasons, unless species allows otherwise, and providing that the root system does not become root bound, does not develop girdling roots, or other characteristics detrimental to normal plant development.
iii) At the time of potting, all containers shall be filled to within 2.5cm (1in.) of the top of the container.
iv) Decomposition and settling may reduce the depth of growing medium while the plant is in the container. However, once potted no growing medium should be added or be removed from the container.

c) SHADE AND FLOWERING TREES

i) Shade Trees: Single stem trees with a straight trunk, well-balanced crown, and intact leader, of height and calliper indicated, complying with ANSI Z60.1 for the type of trees required, and as follows:

(1) Provide balled and burlapped trees.
(2) Branching Height: One-third to one-half of tree height.

ii) Small Spreading Trees: Branched or pruned naturally according to species and type, with the relationship of the calliper, height, and branching according to ANSI Z60.1; stem form as follows:

(1) Stem Form: Single Stem.
(2) Provide balled and burlapped trees.

iii) Multi-stem Trees: Branched or pruned naturally according to species and type, with the relationship of the caliper, height, and branching according to ANSI Z60.1; stem form as follows:

(1) Stem Form: Clump.
(2) Provide balled and burlapped trees.

d) DECIDUOUS SHRUBS

i) Form and Size: Deciduous shrubs with not less than the minimum number of canes required by and measured according to ANSI Z60.1 for type, shape, and height of the shrub.
ii) Provide potted shrubs. Pot sizes as indicated on drawings.

e) CONIFERS

i) Form and Size: Specimen quality, exceptionally heavy, tightly knit, symmetrically shaped coniferous evergreens:

(1) Provide trees balled and burlapped.
(2) Provide balled and burlapped or potted shrubs.

f) VINES

i) Provide vines of species indicated, established and well rooted in pots or similar containers, and complying with ANSI Z60.1 and the following requirements:

(1) Pot Size: #1 container minimum.
(2) Age: Two-year plant, well-branched tops, with a vigorous well-developed root system.

g) PERENNIALS AND ORNAMENTAL GRASSES

i) Provide perennials, and ornamental grasses of species indicated, established and well rooted in pots or similar containers, and comply with ANSI Z60.1 and the following requirements:

(1) Pot Size: 210mm or 150 mm (6”) pot size, as identified on drawings.
(2) Age: Two-year plant, well-branched tops, with a vigorous well-developed root system.
(3) Grown Condition: Perennials and grasses grown in pots or other containers of adequate size and acclimated to outside conditions will be acceptable.

h) WATER

i) Water: clean, fresh, and free of substances or matter that would inhibit vigorous and healthy plant growth.
ii) Contractor shall supply clean water, equipment, methods of transportation, water tanker, hoses, attachments, and other accessories as necessary to adequately apply water to all plant material and for other work in the contract.

i) PLANT PROTECTION MATERIALS

i) Rodent, Animal and Sun Protection:

(1) Woven wire mesh: galvanised woven wire strands, 1.2 mm wire diameter or suitable alternative with an opening of 12.5 mm x 12.5 mm, c/w fasteners.
(2) Plastic: perforated spiralled strip for horticultural use.
(3) Burlap: clean, minimum 2.5 kg/m mass and 150 mm wide, and twine fastener.

(4) Materials to protect plants from rodent, animal and sun damages. Install galvanized wire mesh with fasteners; plastic perforated spiralled horticultural strips; burlap plant wrap with fasteners; or other approved materials in accordance with manufacturer's instructions. Proposed methods to be reviewed and approved by Consultant prior to installation.

j) PEST CONTROL

i) Chemical Pest Control: supply and apply required chemical pesticides including herbicides, insecticides and fungicides, when Integrated Pest Management Principles (IPM) are considered ineffective in controlling or suppressing pest populations on site.
ii) Submit the following information for Consultant's review and approval before applying any pesticide:

(1) Identification of specific pest(s) on the site that requires control.
(2) Trade name of chemical pesticide and manufacturer's instructions for use.
(3) Manufacturer's material safety data sheets for each chemical pesticide.
(4) Name and credentials of licensed pesticide applicator(s).

iii) Pesticide Application Records: pesticide application record books shall be completed by the certified, licensed applicator in accordance with the Alberta Environmental Protection and Enhancement Act. Submit record books at the completion of each pesticide application on site Provide information regarding target weed, insect or other pest, mode, type, and rates of application and results, including date, time, weather conditions and the name of the applicator.

k) SOIL

i) Materials: Approved Topsoil and Soil Mix as specified under Section 32 91 21 - Topsoil and Finish Grading.
ii) Amendments as recommended in the approved soil analysis.
iii) Installed to the depths shown on Drawings

l) MULCHES

i) **Premium Wood Mulch**: (Foothills Premium Mulch or approved alternative) Premium screened bark and wood mulch derived from processing Spruce, Pine and Fir logs, with 30% by mass of material passing a 10mm screen. Shredded wood mulch shall be approximately 50 mm or less in size and have consistent colour and ageing throughout. Mulch shall be aged and free of recycled wood, live seeds, non-organic materials, wood preservatives, diseased wood, moulds, fungi, and insect infestations.
ii) **Fine Garden Mulch**: Premium screened bark and wood derived from processing Spruce, Pine and Fir logs screened and partially composted, (Montane Garden Mulch or approved alternative) 99% passing a 10 mm screen and have consistent colour and ageing throughout. Mulch shall be aged and free of recycled wood, live seeds, non-organic materials, wood preservatives, diseased wood, moulds, fungi, and insect infestations.

m) STAKES AND GUYS

i) Guy Posts: Steel T-bar stakes, 2.1 m long, scaled and painted.

(1) Paint Finish: one coat, zinc rich paint to CGSB 1-GP-1816. Colour: Green.

ii) Guy and Tie Wire: in accordance with ASTM A641, Class 1, galvanised steel wire

(1) Small sized trees: single strand 2 mm in diameter
(2) Tall or large sized trees: 5 strand cable 5 mm diameter, galvanised steel cable, with zinc coated turnbuckles, a minimum of 76 mm long, with two 10 mm galvanised eyebolts.

iii) Hose Chafing Guard: Reinforced rubber or plastic hose at least 13 mm in diameter, black, cut to lengths required to protect tree trunks from damage.
iv) Flags: Standard surveyor's plastic flagging tape, white, pink, or orange, 150 mm long.

n) MISCELLANEOUS PRODUCTS

i) Anti-desiccant: Water insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs.
ii) Deliver in original, sealed, and fully labelled containers and mix according to manufacturer's written instructions.

3.12.3 Execution

a) EXAMINATION

i) Examine areas to receive exterior plants for compliance with requirements and conditions affecting installation and performance. Proceed with installation only after unsatisfactory conditions have been corrected.

b) PREPARATION

i) Protect structures, utilities, sidewalks, pavements, and other facilities, and lawns and existing exterior plants from damage caused by planting operations.
ii) Provide erosion control measures to prevent erosion or displacement of soils and discharge of soil bearing water runoff or airborne dust to adjacent properties and walkways.
iii) Lay out individual tree and shrub locations and areas for multiple exterior plantings; stake locations, outline areas, adjust locations when requested, and obtain Consultant's acceptance of layout before planting; make minor adjustments as required.

c) UTILITIES

i) The Contractor shall be responsible for coordinating the location and staking of all subsurface utility lines and underground irrigation lines, where applicable. The cost of coordination and staking shall be the Contractors responsibility.
ii) Locate all overhead power and overhead structures. Maintain safe working distances. Ensure all workers are aware of the risks and work accordingly.
iii) Where a conflict exists between underground services and proposed plantings, promptly notify the Owner for instruction. Adjustments to plant locations require the Owner's approval.
iv) Maintain offset distances when locating trees near underground services, adjacent to walkways, property lines, curbs, intersections, entrances, light standards, site signage and buildings or as directed by Owner. Do not locate any tree within a minimum of 1.5 m of a ditch line.

d) EXCAVATION

i) Pits and Trenches:

(1) Excavate circular pits with sides sloped inward.
(2) Trim base leaving center area raised slightly to support root ball and assist in drainage.
(3) Do not further disturb the base.
(4) Scarify sides of plant pit and trenches.
(5) Excavate approximately three times as wide as ball diameter for balled and burlapped or balled and potted stock.
(6) If drain tile is shown or required under planted areas, excavate to the top of porous backfill over the tile.

ii) Subsoil removed from excavations may be used as backfill if found acceptable for use, otherwise, remove from the site and replace with suitable material.
iii) Obstructions: Notify Consultant if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
iv) Drainage: Notify Consultant if subsoil conditions evidence unexpected water seepage or retention in tree or shrub pits.

e) PLANTING BED ESTABLISHMENT

i) Loosen bottom of planting beds to a minimum depth of 150 mm.
ii) Remove stones larger than 25 mm in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property at no additional cost to the contract.
iii) Spread approved topsoil or soil mix as specified on planting details to a depth, after settlement, of 300 mm minimum or to the depth specified on details, whichever is greater, but not less than required to meet finish grades after natural settlement.
iv) Do not spread topsoil or soil mix if planting soil or subgrade is frozen, muddy, or excessively wet.
v) For topsoil amended on site, thoroughly blend and spread topsoil, apply soil amendments and fertiliser on the surface, and thoroughly blend planting soil.
vi) Delay mixing fertiliser with planting soil if planting will not proceed within a few days.
vii) Finish Grading: Grade planting beds to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges and fill depressions to meet finish grades.
viii) Ensure all beds have positive drainage at the soil surface.
ix) Restore planting beds if eroded or otherwise disturbed after finish grading and before planting.

f) PLANTING

i) Set balled and burlapped stock plumb and in the center of pit or trench with the top of root ball flush with adjacent finish grades, sidewalk, curbs, or as directed by Owners Representative, and as follows:

(1) Remove burlap and wire baskets from top 1/3 of root balls and partially from sides, but do not remove from under root balls; remove pallets, if any, before setting; do not use planting stock if the root ball is cracked or broken before or during the planting operation.
(2) Place specified planting soil around the root ball in layers, tamping to settle mix and eliminate voids and air pockets; when the pit is approximately one half backfilled, water thoroughly before placing the remainder of backfill; repeat watering until no more water is absorbed; water again after placing and tamping final layer of planting soil.

ii) Set balled and potted stock plumb and in the center of pit or trench with the top of root ball flush with adjacent finish grades, sidewalk, curbs, or as directed by Owners Representative, and as follows:

(1) Carefully remove the root ball from the container without damaging the root ball or plant.
(2) Place specified planting soil around root ball in layers, tamping to settle mix and eliminate voids and air pockets; when the pit is approximately one half backfilled, water thoroughly before placing the remainder of backfill; repeat watering until no more water is absorbed; water again after placing and tamping final layer of planting soil mix.

iii) Slope planting: place top of root crown at or slightly above finish grade at the centre of plant pit. Form a saucer on the downhill side to catch and retain water and to control erosion.
iv) Do not install any trees closer than 1000 mm to edge of walkways, driveways or building foundations unless directed by the Owners Representative.
v) Face plants for best appearance and relationship to adjacent structures.
vi) Wood Mulching: Apply 100 mm average thickness of the specified premium wood mulch extending a minimum of 300 mm beyond the edge of planting pit or trench or to the limits of the bed as defined on the drawings. Taper mulch to ground level near trunk; do not place mulch within 75 mm of trunks or stems.
vii) At the edge of the beds, topsoil or soil mix should be 50 mm below finished grade. Taper wood mulch from the edge of the bed (50 mm depth) and crown to 100 mm depth through the balance of the bed. The mulch should taper from the 50 mm depth where the bed abut hard surface areas, manholes, catchbasins, curbs, or other at grade structures.
viii) Wrap trees with approved materials to protect plants from rodent, animal and sun damages. Install galvanized wire mesh with fasteners, or plastic perforated spiralled horticultural strips, or burlap plant wrap with fasteners; or other approved materials in accordance with manufacturer's instructions. Obtain Consultants approval for the final trunk protection approach.

g) PRUNING

i) Prune, thin, and shape trees and shrubs in accordance with proper practices and standards (ANSI-A300) of the International Society of Arboriculture and ISA Third Edition: Best Management Practices – Tree Pruning. Pruning to be performed by a certified arborist unless approved otherwise by the Town.
ii) Prune trees to retain the required height and spread; do not cut tree leaders; remove only injured or dead branches.
iii) Prune shrubs and vines to retain natural character; sizes indicated are sizes after pruning.

h) GUYING AND STAKING

i) Upright Staking and Tying:

(1) Stake trees of 50 mm and greater calliper.
(2) Stake trees of less than 50 mm calliper only as required to prevent wind tip out.
(3) Tree staking or guying shall not be required for trees located within metal tree grates.

ii) Use a minimum of 2 stakes of the length required to penetrate at least 450 mm below the bottom of the backfilled excavation and to extend at least 1830 mm above grade.

iii) Set vertical stakes and space to avoid penetrating root balls or root masses.
iv) Support trees with two strands of tie wire encased in hose sections at contact points with tree trunk at approximately 60% of tree height. Allow enough slack to avoid rigid restraint of the tree.

i) CLEANUP AND PROTECTION

i) During work of the contract, keep all hard surfaces clean and tidy. Sweep and wash all walkways and other pavement surfaces to maintain clean appearances. Clear soil and rubble from catch basins, manholes, valves and other hard surface features.
ii) Collect all litter and other debris from the site as necessary during the work of the contract.
iii) Remove all plant name tags, plant labels, cargo seal tags and flagging tape before final inspection or as directed by Owner.
iv) Protect exterior plants from damage due to landscape operations, operations by other Contractors and trades, and others. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged exterior planting.
v) Install rodent, animal and sun protection measures as reviewed and approved by Consultant

j) DISPOSAL

i) Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

3.13 Maintenance (Establishment Maintenance)

3.13.1 General

a) RELATED REQUIREMENTS

i) Section 3.8 - Topsoil and Finish Grading
ii) Section 3.9 - Seeding
iii) Section 3.10 - Sodding
iv) Section 3.11 - Trees, Shrubs, and Ornamentals

b) REFERENCE DOCUMENTS, STANDARDS AND LEGISLATION

i) Pruning in Alberta published by Alberta Agriculture and Rural Development Agdex 270/24-1.
ii) Alberta Yards & Gardens, What to Grow published by Alberta Agriculture and Rural Development, Agdex 200/32-1.
iii) Backyard Pest Management published by Alberta Agriculture and Rural Development, Agdex 605-2.
iv) Pruning methods: "Tree Pruning Guidelines" from the International Society of Arboriculture and in accordance with ANSI A-300 Pruning Standards.
v) Alberta Horticultural Guide: Alberta Agriculture Agdex 200/01.
vi) Alberta Native Plant Council (ANPC), "Rogue's Gallery of Invasive Non-Native Plants", available at http://www.anpc.ab.ca/downloads.htm.
vii) Municipal and local authorities' legislation and requirements: all work shall be done in accordance with local legislation and requirements, which may restrict or prohibit certain activities such as the application of pesticides, herbicides, and insecticides.

c) HOURS OF WORK

i) Perform maintenance work during regular working hours of 07:00 to 18:00, unless directed otherwise.
ii) Obtain Owner's approval to perform maintenance outside of regular working hours.

d) MAINTENANCE PERIOD

i) Commence landscape maintenance following these specifications immediately following installation of plant material.
ii) Formal exterior maintenance period shall begin from the date of Construction Completion Certificate by The Town
iii) Landscape maintenance will be performed between May 1 through October 30 of actual maintenance services over a total of (24) months. The paid maintenance period shall start from the date of Construction Completion and will cover a minimum of 24 months.
iv) Perform maintenance work during regular working hours of 07:00 to 18:00, Monday to Friday.
v) Final Acceptance shall be granted after a minimum of 24 calendar months of warranty and maintenance. All maintenance and warranty costs related directly to the Contractor's faulty materials and workmanship shall be the Contractor's responsibility until Final Acceptance is issued regardless of length.
vi) Landscape maintenance shall not terminate at the end of the landscape growing season if additional months of maintenance are still in contract. Any incomplete weeks or months of maintenance shall be carried over to the following landscape growing season.

e) QUALITY ASSURANCE

i) Site Supervisor: competent, experienced and knowledgeable to direct and supervise all staff and maintenance work of the contract. The supervisor shall possess a Landscape Journeyman Gardner certification or other similar qualification acceptable to the Consultant. Submit the supervisor's credentials for the Consultant's approval before commencement of work.
ii) Weekly Site Visits: provide adequate site visits each week with sufficient staff to ensure that all required maintenance services are performed and completed on schedule in accordance with specifications.
iii) Site Security: Contractor's personnel shall carry personal identification at all times while on site. Identification shall be presented when requested by Consultant or other site security staff. All employees must check in with the Consultant upon entering and leaving the premises where applicable.
iv) Submittals: Submit all required information and documents for Consultants approval where specified in contract documents and applicable to work of the contract and as requested by the Consultant.
v) Safety Precautions:

(1) Contractor shall supply and ensure that all workers use appropriate personal protective equipment as required by Alberta's Occupational Health and Safety Act, Regulations and Code.
(2) Contractor shall provide training and ensure all workers practice appropriate safety measures and safe use of tools and equipment by WHMIS (Workplace Hazardous Materials Information System).
(3) Owner reserves the right to have the Contractor remove any employee from the site if not wearing personal protective equipment or if not practising safe work procedures.

vi) Regulatory Requirements: Perform work in accordance with all applicable laws, codes and regulations required by authorities having jurisdiction over such work and provide all permits required by local authorities.

f) MAINTENANCE LOG REQUIREMENTS

i) Keep Daily Maintenance Log at the contractor's office throughout the contract period and make available to The Town when requested.
ii) Include in Log: detail activities, areas in which activities were carried out, and approximate time for start-up and completion of each activity.
iii) Test soil moisture and record in Log.
iv) Contractor to record damaged plant material to be replaced by warranty in Log.
v) Contractor to record plant material that has failed to successfully establish during reasonable conditions and time in Log.
vi) Contractor to notify the nursery of planting that will be replaced by the warranty.
vii) Contractor to coordinate with Landscape Architect as to a suitable time to replace failed planting.

g) SOIL ANALYSIS

i) Perform horticultural soil tests as requested by The Town.
ii) Submit an original copy of each requested soil test to The Town.
iii) Soil analysis for horticultural use shall include results for existing major soil nutrients; soil pH value; total soluble salts (electrical conductivity); percentage of organic matter; soil texture and percentage of sand, silt and clay; nutrient recommendations; and recommendations for soil amendments.
iv) Contractor shall amend soil conditions as recommended by soil analysis report and indicate all corrective measures taken, documenting final soil condition results in the maintenance log.

h) DELIVERY, STORAGE AND HANDLING

i) Remove all equipment and materials off-site each day unless on-site storage is approved by The Town.
ii) Store tools, equipment and materials in a secure area when not in use during the period of operation and at the completion of each scheduled task.
iii) Contractor shall be present on site to accept delivery of all equipment and/or material shipments

i) DAMAGES OR DETERIORATION

i) Contractor shall be held directly responsible for all damages to Owner’s property, the personal property of all employees, staff and visitors and the property of adjacent landowners resulting from the actions of the contractor, the contractor’s employees, subcontractors or representatives who provide service under this contract.
ii) Contractor shall immediately report all damages to Consultant or Owner.
iii) Repair, replace or restore all damaged property to its original condition or better as directed by The Town. Damages shall be promptly corrected within seven days of approval unless directed otherwise by The Town.
iv) Damages to property or site elements shall be safely secured until repaired. Ensure the public is protected during the repair process. The area of repair shall be secured to the satisfaction of the The Town.
v) Scalping of turf, mechanical damage or injury to plant material, improper plant pruning, and damages resulting from improper use of chemical pesticides and fertilisers will be considered property damage.

vi) Any dangerous or potentially dangerous situations shall be documented. Notification should be given where necessary to the owner or consultant and/or to the authority having jurisdiction.
vii) Damages or deterioration of any element of the site or unsafe conditions shall be documented and reported to the owner or the authority having jurisdiction.

j) PROTECTION AND SAFETY

i) Protect landscape plantings and turf areas at all times against damage of all kinds for the duration of the maintenance period. Maintenance includes temporary protections, fencing, barriers, and signs as required for protection. If any plant material or turf becomes damaged or injured because of insufficient protection, Contractor shall treat or replace plant material or turf at Contractor's sole expense.
ii) Appropriate measures shall be taken to ensure that no spillage of fuels, fertilisers, toxic materials, or toxic wastes occurs. Where the use of such materials is necessary, ensure that adequate containment facilities and cleanup equipment are available and utilized.
iii) Toxic or waste materials, fuels and fertilisers shall not be dumped into storm drains or watercourses.
iv) Toxic or waste materials, fuels and fertilisers shall not be stored adjacent to a watercourse or in a location where spillage could result in seepage into a storm drain or watercourse.
v) Toxic or waste materials, fuels, fertilisers and other material shall be stored and disposed of in accordance with municipal, provincial and federal regulations, and in a manner acceptable to the owner.
vi) Maintenance procedures shall be carried out in a manner that complies with all applicable laws, bylaws, rules, regulations and lawful orders of any public authority having jurisdiction for the safety of persons or property to protect them from damage, injury or loss.
vii) All safeguards for safety and protection, as required by Canada Occupational Health and Safety Regulations, and other regulatory bodies shall be put in place and maintained while maintenance work is in progress. Appropriate protective clothing and equipment shall be available and worn during the application of chemical and biological controls.
viii) Use of equipment and products shall be as per the manufacturer's recommendations taking into account the need to protect all horticultural and non-horticultural elements of the site.
ix) Chemical and biological controls, where required, shall be applied by a qualified professional using appropriate, well maintained and properly calibrated equipment.
x) Storage, handling and disposal of chemical control products shall follow guidelines as set out by municipal, provincial, or federal rules and regulations.
xi) Treatment areas shall have barricades, safety guards, and warning devices, and shall be maintained whenever necessary for the protection of persons and property as required by the manufacturer, provincial and municipal bylaws.

k) FINAL ACCEPTANCE AND TERMINATION OF MAINTENANCE

i) Work under this section may be accepted by the Consultant at the end of the maintenance period provided all requirements for acceptance have been satisfactorily completed.

3.13.2 Products

i) FERTILISER
ii) Synthetic Turf Fertiliser: Apply a complete premium grade synthetic fertiliser, granular in composition, with over 50% of total nitrogen derived from a slow or controlled release nitrogen source to maintain turf in a healthy, vigorous, and green condition. The fertiliser shall contain all essential macronutrients plus 1%-2% iron and other micronutrients. Submit sample for Consultant's approval.
iii) "Weed and Feed" fertilisers are not allowed.
iv) Plant Fertiliser: Apply controlled or slow release plant fertilisers in accordance with soil analysis where applicable.

b) CHEMICALS

i) Chemicals used during the course of maintenance procedures shall be limited to those that are registered and meet all federal, provincial and regional/municipal regulations and bylaws.
ii) Application and disposal of chemicals shall comply with all applicable legislation and regulations, including, but not limited to, the federal Pest Control Products Act and regulations, Fisheries Act, and Food and Drugs Act; as well as any provincial, municipal or regional district legislation.
iii) The applicator shall wear protective clothing and/or equipment that meets all applicable standards and regulations and is suited to the task being performed.
iv) Health and safety shall be considered in the development of establishment maintenance procedures, particularly with regard to food, potable water, play areas, and play equipment.

c) SOIL

i) Materials: Approved Topsoil and Soil Mix as specified under Section 32 91 21 - Topsoil and Finish Grading.
ii) Amendments as recommended in the approved soil analysis.
iii) Installed to the depths shown on Drawings

d) WATER

i) Supply clean, fresh water, water tanker, equipment, sprinklers, and labour necessary to adequately and efficiently apply water to all turf areas and plant materials.
ii) Record the quantity of water supplied and applied on site in the maintenance log.

e) PLANT PROTECTION MATERIALS

i) Rodent, Animal and Sun Protection:

(1) Woven wire mesh: galvanised woven wire strands, 1.2 mm wire diameter or suitable alternative with an opening of 12.5 mm x 12.5 mm, c/w fasteners.
(2) Plastic: perforated spiralled strip for horticultural use.
(3) Burlap: clean, minimum 2.5 kg/m mass and 150 mm wide, and twine fastener.
(4) Alternatives to be reviewed and approved by Consultant prior to installation.

f) PESTS: WEED, INSECT, AND DISEASE CONTROL

i) Integrated Pest Management (IPM):

(1) Manage and control pests using IPM principles that utilizes regular monitoring to identify pests, considers various control options (biological, physical, cultural, mechanical and chemical) before implementing an effective, economical and environmentally acceptable solution to prevent and suppress pests.
(2) Use IPM principles to reduce or eliminate a reliance on chemical pesticides.
(3) Advise owner's representative on whether IPM practices are practical in managing and controlling any existing pests on site.

ii) Contractor shall be knowledgeable regarding the identification of pests on site, controls to be implemented in management of pests and assessing outcome of treatment actions. Inform owner's representative of all pest concerns on site and controls to be implemented in management of pests. Record all information in maintenance log.

g) MAINTENANCE SCHEDULE

i) Schedule: depending on weather, the minimum maintenance frequencies shall be as outlined below. The contractor shall submit a schedule for consultant approval prior to beginning the maintenance work.

(1) Inspect site: Monthly.
(2) Litter Removal: Each site visit.
(3) Reporting: Monthly.
(4) Soil Testing: To diagnose problems.

ii) Aerate Turf Areas: Not during the first year, If necessary in the second growing season, aeration shall be done when turfgrass is actively growing, in either spring or fall, and when soils are neither too dry nor too wet.

(1) Edge Turf Areas: Annually.
(2) Fertilise Turf Areas: twice a year.
(3) Mow Turf Areas: Every 7-10 days or as required to maintain specified turf heights.
(4) Trim: Each time the lawn is mowed.
(5) Fertilise Plant Material: Spring.
(6) Pest Control: As required to keep the plant healthy.
(7) Prune: As required.
(8) Repair: As required.
(9) Water: As required.
(10) Replacements: Monthly as required.
(11) Weed control: As required to manage appearance.

3.13.3 Execution

a) GENERAL WORKMANSHIP

i) Schedule timing of operations to growth, weather conditions and use of the site. Provide a copy of the schedule for approval by Consultant and Owner.
ii) Do each operation continuously and complete within a reasonable period.
iii) Provide equipment and material necessary for maintenance to acceptable horticultural standards.
iv) Coordinate maintenance practices with Owner. Maintenance schedules may have to be altered to deal with site activities.
v) Collect and dispose of excess material and debris to municipal disposal site after completion of each activity listed in the schedule.
vi) Separate and recycle materials suitable for composting before commencing mowing, aerating, dethatching, or rolling operations.

vii) It is the Contractors responsibility to monitor plant health and replace dead, diseased, or unacceptable plant material. The Consultant will review replacements and may identify additional work to be completed. The Contractor shall make the necessary replacements and/or repairs based on their own assessment of the work based on the Contract Documents. The Contractor shall not wait for the Consultant to provide direction on repairs, maintenance, or replacements for work outlined in the Contract Documents that is their responsibility to maintain and warranty.

b) SPRING CLEAN-UP

i) Complete spring cleanup as soon as working conditions are favourable and by May 30.
ii) Review and assess the plant material and all work completed. Identify dead plants to be replaced, pruning requirements, fertilizing, pest and disease control, mulch depth and condition, bed edging, and damages. Make the necessary corrections as per the Contract Documents.
iii) Remove and dispose of protective coverings and mulch used in winter protection.
iv) Collect and dispose of sand, gravel, salt and debris, accumulated on landscape areas during winter months, to a municipal disposal site.
v) Maintained Turf Grass Lawn Areas:

(1) Rake and remove dead vegetation, leaves and debris.
(2) Rake areas with snow mold.
(3) Roll lightly where grass has lifted due to frost action.

vi) Planting Beds: Clean plant beds and planters of debris and dead plant material. Loosen and lightly cultivate soil without disturbing roots of permanent plantings.
vii) Replace all dead or unacceptable plant material.
viii) The consultant will assess Spring cleanup when reviewing the maintenance progress claim. Additional work may be identified at the time and completed during the next monthly maintenance work.

c) TURF MAINTENANCE

i) Begin maintenance immediately after each area is planted and continue until an acceptable lawn is established, but for not less than the maintenance period specified.
ii) Maintain and establish lawns and seeded grasses by watering, fertilising, weeding, mowing, trimming, replanting, and other operations.
iii) Roll, regrade, and replant bare or eroded areas of sod and rematch to produce a uniformly smooth lawn. Anchor as required to prevent displacement.
iv) Watering:

(1) For areas not serviced by an irrigation system, the Contractor shall supply water and apply to sodded areas and plant material to ensure healthy growth until Final Acceptance.
(2) Schedule watering to prevent wilting, puddling, erosion, and displacement of sod.
(3) Ensure lawns receive water at a minimum rate of 25 mm (1”) per week, adjusting for precipitation, after the first 30 days.
(4) The method of application shall be such that compaction or erosion of the soil or excessive leaching of nutrients does not occur.

v) Turf areas shall be examined for invasive plants, noxious weeds, insect pests, and plant diseases at each mowing.
vi) Mowing:

(1) Mow lawn as soon as sod is firmly established and rooted, and top growth is tall enough to cut.
(2) Remove papers, rocks and other debris or foreign material before cutting.
(3) Maintain turf with sharp mowers at 50 to 75mm grass blade height during the growing season.
(4) Change direction of cut with each mowing where practical.
(5) Repeat mowing to maintain specified height without cutting more than 40% of grass height.
(6) Remove no more than 30% of grass leaf growth in initial or subsequent mowings.
(7) Do not delay mowing until grass blades bend over and become matted.
(8) Do not mow when grass is wet.
(9) Remove clippings from sidewalks, roads, windows or buildings during the same mowing operation.

vii) Fertilizing:

(1) Use only mechanical equipment. Check calibration of the spreader to ensure specified rate is used.
(2) Spread 50% of fertiliser in one direction followed by 50% at right angles to the initial application.
(3) Apply Spring fertiliser mix at the rate recommended by the manufacturer as frost is out of the ground before May 31.
(4) Apply Summer fertiliser mix at the rate recommended by the manufacturer the first 2 weeks of July.
(5) Water immediately following fertilising operations and in accordance with manufacturer's recommendations; obtain moisture penetration of 50 mm minimum.

viii) If required aerate sod areas on site in Spring. Allow one full growing season before aerating.
ix) Trim along hard surfaces and lawn abutments, once monthly during June, July, August and September.
x) Sod Replacement:

(1) Cut out areas of dead or unhealthy sod and replace with new sod equal to the specified composition and quality. Make all repairs square or rectangular unless the repair area abuts curved or angular edges.
(2) Scarify topsoil before new sod replacement.
(3) Butt sod tightly and flush to adjacent existing sod areas.
(4) Water as specified for new sod installation.

d) TREE AND SHRUB MAINTENANCE

i) Plant Beds:
ii) Edge plant beds evenly to a depth of 100 mm in lines of the original layout, annually.
iii) Remove weeds bi-weekly in conjunction with lawn mowing operations including their roots.

(1) Do not damage the roots of other plants.
(2) Collect and dispose of paper, refuse, and dead plants.

iv) Staking: Keep stakes and guy wires taut and plants plumb for the duration of the maintenance period.
v) PRUNING:

(1) Obtain ANSI A-300 Pruning Standards and use as a basis for operations from the start of the maintenance period.
(2) Prune, when required or directed, in accordance with Manual.
(3) All work to comply with ISA Third Edition: Best Management Practices – Tree Pruning

vi) Fertilisation Requirements in Early Spring:

(1) Apply Spring fertiliser at manufacturers recommended rate, at the dripline of trees.
(2) Apply water after fertilising to ensure penetration of fertiliser level.

vii) Watering:

(1) For planted areas not serviced by the irrigation system within the Project limits, provide and maintain temporary piping, hoses, and lawn watering equipment to convey water from sources and to keep plants healthy until Final Acceptance.
(2) Test moisture levels of individual plant species and adjust water supply if necessary.

viii) Mulch: Top up mulch to specified depth with the same mulch material installed during landscape construction.
ix) Straighten all plants that lean or sag during the maintenance period.

e) WEED, INSECT AND DISEASE CONTROL

i) General Considerations:

(1) Ensure proper, identification of infestations and consult with the Owner and Consultant before taking corrective action.
(2) Use equipment and containers free of harmful residues not related to specific control measures applicable to the situation.
(3) Carry out treatment with due regard to climatic conditions' effect on surroundings and occupants of buildings.

ii) Do not use chemical herbicides or pesticides.
iii) Pest Monitoring:

(1) Pest Monitoring: regularly monitor and visually inspect all plants, turf and other landscape areas to identify potential pest problems and determine appropriate pest controls. Pest problems include insect, disease and weed infestations that pose a serious and on-going threat to plant life on site.
(2) Ensure proper, positive identification of infestations. Reference "Backyard Pest Management" for identification and control of pests.
(3) Indicate results of each monitoring inspection in maintenance log. Review all pest concerns with owner's representative. Record all actions taken to control pest problems in log

iv) Chemical Pest Control: supply and apply required chemical pesticides including herbicides, insecticides and fungicides, when Integrated Pest Management Principles (IPM) are considered ineffective in controlling or suppressing pest populations on site.
v) Determine susceptibility of plant species to pesticide damage before requesting chemical pesticides. Request owner representative's approval before use, where chemical pesticides are deemed necessary in the management and control of pest infestations.

vi) Applications of pesticides shall be performed in accordance with Alberta Environment's current legislation. Provide owner's representative with three days advance notification of intent to apply chemical pesticides on site.

vii) Use equipment and containers free of harmful residues not related to specific control measures applicable to situation.

viii) Certified Applicator: when pesticides are deemed necessary to control pests, the application of each pesticide on site shall be performed by a certified pesticide applicator. Personnel assisting the certified applicator on site shall be thoroughly trained and knowledgeable in pesticide applications and use of all equipment in accordance with Alberta Environment's Code of Practice for Pesticides. Applicator shall maintain pesticide application record books and submit at completion of each pesticide application.

ix) Prepare and apply pesticide according to manufacturer's specifications. Minimize drift at all times. Erect signs to notify building occupants and the public regarding pesticide use on site.

x) Timing: pesticides shall be applied at times, which limit any possibility of contamination from climatic and other factors. Monitor weather conditions to avoid making application prior to inclement weather to eliminate potential runoff from treated areas. Confine all applications to outside of regular site operation hours to avoid contamination from drift and its effect on surroundings, occupants of nearby buildings and site users.

xi) Ineffective and improper application of pesticide shall be immediately terminated and corrected by Contractor. Additional application of pesticides shall be completed approximately two weeks after initial application is noted as visibly inadequate or deemed deficient by owner's representative.

xii) Submit the following information for Consultant's review and approval before applying any pesticide:

(1) Identification of specific pest(s) on the site that requires control.
(2) Trade name of chemical pesticide and manufacturer's instructions for use.
(3) Manufacturer's material safety data sheets for each chemical pesticide.
(4) Name and credentials of licensed pesticide applicator(s).

xiii) Pesticide Application Records: pesticide application record books shall be completed by the certified, licensed applicator in accordance with the Alberta Environmental Protection and Enhancement Act. Submit record books at the completion of each pesticide application on site Provide information regarding target weed, insect or other pest, mode, type, and rates of application and results, including date, time, weather conditions and the name of the applicator.

xiv) Weeds:

(1) Provide ongoing weed control and eradication methods during active growth and establishment, by cultivation, physical removal and use of approved chemical pesticides.
(2) Weed Control: eradicate weeds in driveways, along curbs and parking lots, within the Project limits.
(3) Completely eliminate and remove from site all noxious weeds in accordance with government regulations.
(4) Control and elimination of weeds within soft and hard landscaped surfaces on site on an ongoing basis. Ensure weed seed heads are removed before maturity.

xv) Insects and Disease: apply pesticides based on development stage of insects' life cycles to prevent loss or damage to plant material. Monitor turf areas and plants and apply pesticides, if approved, to control pest infestations.

xvi) Monitor effectiveness of each pesticide application and promptly correct any inadequate or deficient application.

xvii) Repair and pay for damage caused by application of herbicides.
xviii) Do not use soil sterilants.
xix) Eliminate rodents using controls and methods approved by owner's representative.

f) PLANT MATERIAL WARRANTY REMOVAL AND REPLACEMENT

i) Contractor shall immediately remove and replace all dead plant material and sod areas at the time of the maintenance visit to the site or when directed by the Owner's Representative, unless weather conditions prohibit, dead plants including trees shall be replaced immediately. Promptly supply and install healthy new replacement plants to ensure original landscape plan is maintained. Replacement plants shall meet specifications and be subject to approval by owner's representative.
ii) For plants that have dead areas of 25% or less of the plant, these plants will be monitored and replaced at the end of the maintenance period, unless they deteriorate beyond 25%, at which time they will be replaced during the maintenance visit.
iii) Replacement plantings shall be performed in a timely manner and as soon as conditions permit. Contractor shall advise owner's representative when availability of any replacement plant will be delayed.
iv) All replacement plants must be fully established before termination of maintenance by Contractor. Contractor shall continue to provide specified maintenance for replacement plants not fully established until deemed acceptable by owner's representative.
v) All replacement plants shall be flagged or tagged by Contractor for identification.
vi) Contractor shall extend warranty on all plants not fully established by end of warranty period. Owner's representative will determine the additional warranty period on replacement plants if deemed necessary.
vii) Replacement costs for warrantied plant material shall be covered by the unit price or stipulated price for plant material or sod. Additional maintenance funds will not be paid to cover warranty costs.

g) AUTUMN PREPARATION

i) Rake leaves as necessary and remove from site until leaves cease to fall.
ii) Deep water trees and shrubs between October 1 to 15.
iii) Cut back foliage of perennial plants within one week after killing frost. Ornamental grass shall remain intact during winter and trimmed back the following spring unless directed otherwise by owner's representative. Stake locations of cut perennials and apply organic mulch around plants for winter protection as necessary. Thoroughly water all perennial plants for winter.
iv) Clean all plant beds, planters, tree wells, mulched areas, and other landscaped areas on site. Remove all collected leaves and other debris to approved waste recycling depot.
v) Protect plants from rodent damage by use of appropriate protection measures.
vi) Protect tree trunks with appropriate trunk protection measures, approved by Consultant
vii) Protect sensitive conifers and plant material with burlap wrap.
viii) Apply anti-desiccant to all coniferous plant material.
ix) Record condition of the site for confirmation of any third party winter damages.
x) Supply and erect snow fencing, as necessary, in protection of new landscape installations and as directed by owner's representative.

3.14 Existing Tree Protection

3.14.1 General

a) RELATED REQUIREMENTS

i) Section 3.8 — Topsoil and Finish Grading

b) DEFINITIONS

i) Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, plus a margin beyond that line by 2.0 meters, unless otherwise indicated.

c) SUBMITTALS

i) Provide photographs or video, sufficiently detailed, of existing conditions of trees and plantings adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing, before starting any work.
ii) Provide record drawings identifying and accurately locating capped utilities and other subsurface structural, electrical, and mechanical conditions.

d) MEASUREMENT AND PAYMENT

i) Monthly progress payments will be made for work satisfactorily completed in accordance with contract specifications. Payment will be subject to the Owner's review and acceptance of the Contractor's workmanship and performance.

e) QUALITY ASSURANCE

i) Employ an independent arborist, licensed in jurisdiction where the Project is located, to review construction schedule and pre-construction planting preparation, to submit details of any proposed repairs, to perform all root and canopy pruning work, and to repair any damage to trees and shrubs and provide maintenance of existing trees and shrubs within the Project limits during the construction period.
ii) The Arborist shall be a member in good standing of the International Society of Arboriculture.
iii) For trees on private property, the project Landscape Architect and/or independent arborist will review the municipality requirements against these specifications. The Owner reserves the right to apply the more stringent requirements based on the project Landscape Architects or Independent arborist recommendations.
iv) All trees and plant material on public land are subject to the municipality guidelines, standards, and details to be applied to the complete satisfaction of the municipality. The contractor will be responsible for all costs and claims arising from failing to satisfy the municipal requirements for tree protection.
v) Preinstallation Conference: Conduct conference at Project site to address quality of materials, construction, inspection and maintenance schedules, and samples and procedures including, but not limited to, the following:

(1) The layout of fencing and identification of trees and planting materials, and permanent fixtures to remain.

(2) Locations of required excavations and root pruning zones within and adjacent to tree protection zones, methods of excavation and schedule for execution of protective measure specified herein.
(3) Canopy pruning extents and schedule.

f) PROTECTION

i) Prevent damage to trees landscaping, natural features, benchmarks, existing buildings, existing pavements, utility lines and site appurtenances which are to remain.
ii) Repair any damaged items to the approval of the Consultant:
iii) Replace any trees designated to remain, if damaged, as directed by Consultant.
iv) Compensation for replacement of damaged trees shall be valued and determined by the City of Edmonton “Guideline for Evaluation of Trees”, Bylaw 7921, Appendix I.

3.14.2 Products

a) SOIL MIX

i) As specified under Section 32 91 21 – Topsoil and Finish Grading.

b) FERTILISER

i) Do not use "weed and feed" fertiliser.
ii) Fertiliser: analysis of 10-52-10, slow release, water soluble, apply as per 3.5 C

c) WATER

i) Potable, supplied by the Contractor.

3.14.3 Execution

a) PREPARATION

i) Protect and maintain benchmarks and survey control points from disturbance during construction.
ii) Locate and clearly flag trees and vegetation to remain or being relocated.
iii) Protect existing site improvements, to remain, from damage during construction.
iv) Restore damaged improvements to their original condition, acceptable to Owner.

b) TREE PROTECTION

i) Erect chain link fencing or approved alternate at tree protection zones as indicated on the drawings before starting site clearing, demolition and excavation.

(1) Tree protection fencing shall meet the following requirements;

- Minimum 1.8 metres height unless otherwise indicated on the drawings.
- Posts or supports shall be firmly secured on or below grade to provide an immovable fence alignment for the duration specified.
- Panels shall be rigid or taut when secured to their posts or supports and be fabricated from steel or wood.

ii) Remove and restore tree protection only as required to complete work immediately adjacent to the tree protection areas.

iii) Remove fences when construction is complete.
iv) Do not store construction materials, debris, or excavated material nor permit vehicles, equipment, or foot traffic within fenced tree protection enclosures or within 1.5m of the fenceline.
v) Maintain fenced areas free of weeds and trash in conformance with City of Edmonton Bylaw 14600.
vi) Carefully remove limbs using approved horticultural methods where limbs or portions of trees are removed to accommodate construction work. Prune in accordance with Section 32 93 45.
vii) Contact Consultant before proceeding to alter any tree.
viii) Maintain fencing in place for the duration of the Contract.
ix) Contractor shall be responsible for all costs in maintaining and removing such fencing and for regular watering and maintenance of trees while so enclosed. All repair or reconstruction and tree repair and replacement shall be the Contractor's expense.
x) Protective fence and areas within shall be maintained in clean and safe condition to the satisfaction of Owner and Consultant. Contractor shall also be responsible for the maintenance of the lawns within protected areas.
xi) Do not excavate within tree protection zones, unless otherwise indicated.

c) EXCAVATIONS ADJOINING TREES

i) Where excavation for new construction is within tree protection zones, hand clear and excavate to minimise damage to root systems using narrow tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.
ii) When excavation is within 5.0 metres of the trunk of a tree, root prune 3 months in advance of adjacent excavation by cutting a narrow trench, 300 mm wide and 500 mm or more in-depth at locations indicated on the drawings.

(1) Review such situations with the Arborist and Consultant minimum 3 months before Project excavation work.
(2) Unless otherwise approved by the Consultant and Arborist, perform root pruning work before April 30th or after October 15th.
(3) All roots shall be cut clean with a root pruner, a sharp saw and/or hand pruners.
(4) No more than one-third of a tree's root system shall be removed, with no more than 25 per cent from one side without the approval of the Consultant.
(5) Roots must not be removed from more than one side of the tree in any given year.
(6) Backfill root pruned zones with soil mix as specified under Section 32 93 10 and fertiliser immediately following completion of root pruning work.
(7) Guy root-pruned trees as if new trees of the same size, and prune the crowns in advance of root pruning work.
(8) All trees that have been root pruned shall receive deadwood removal in the year after the root pruning occurred.

iii) Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
iv) Immediately cover exposed roots adjacent to excavated zones with burlap and water regularly. Burlap shall be consistently moist. Do not allow exposed roots zones to dry.
v) Coat cut faces of roots more than 38 mm in diameter with an emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
vi) Backfill excavated areas with soil mix as specified under Section 32 93 10 and fertiliser immediately following completion of work adjacent to adjoining trees.

d) RESTORATION

i) Repair or replace trees and vegetation indicated to remain that are damaged by construction work, in a manner acceptable to Consultant, and as follows:
ii) Replace trees that cannot be repaired and restored to full growth status, as determined by Consultant.
iii) Should the destroyed tree be of such size or shape that it cannot be feasibly replaced the Contractor shall employ an independent arborist, licensed in the jurisdiction where the Project is located, to submit an assessment of the value of the tree. The value of the assessment shall be compensated to the Owner.
iv) The cost of the independent arborist shall be the responsibility of the Contractor.

e) FERTILIZING EXISTING TREES

i) Apply fertiliser at the rate specified by the manufacturer.
ii) Take calliper measurement 300 mm above grade.
iii) Apply once early in the growing season.

f) WATERING

i) Provide and maintain temporary piping, hoses, and watering equipment to convey water from sources.
ii) During the growing season, apply water at each tree within the project limits. Test moisture levels of individual plant species and adjust water supply.
iii) At each watering, saturate the top 500 mm of soil within the drip line of the tree and all root pruned trenches.

g) AERATION

i) Aerate area around the drip line of all trees where compaction has occurred by drilling vent holes measuring 40 mm diameter, 200 mm depth and 600 mm apart.

3.15 Chain Link Fencing

3.15.1 General

a) REFERENCE DOCUMENTS

i) American Society for Testing and Materials (ASTM):

(1) ASTM A53/A53M-07 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.

ii) Canadian General Standards Board (CGSB):

(1) CAN/CGSB 138.1 96 Fabric for Chain Link Fence.
(2) CAN/CGSB 138.2 96 Steel Framework for Steel Fence.
(3) CAN/CGSB 138.3 96 Installation for Chain Link Fence.

b) DELIVERY, STORAGE AND HANDLING

i) Separate waste materials for recycling in accordance with Section 01 74 19 – Waste Management and Disposal.

3.15.2 Products

a) STANDARDS

i) Steel Pipe to ASTM A53.
ii) Chain Link Fabric to CAN2-138.1.
iii) Fence, Chain Link, Frame Work, Zinc-Coated, Steel to CAN2-138.2.
iv) Fence, Chain Link Installation to CAN2-138.3.

b) MATERIALS

i) Pipe: Steel butt weld, Schedule 40, hot dip galvanized to 550 g/m^2 coating.
ii) Mesh Wire: Galvanized steel wire hot-dipped galvanized to 490 g/m^2, 3.5mm diameter (9 gauge).
iii) Concrete: Normal Portland cement, 20 MPa @ 28 days, 50 mm to 80 mm slump, 20 mm aggregate, 6% air entrainment.

c) COMPONENTS

i) Line Posts: 60 mm O.D., 5.43 kg/m.
ii) Corner, Terminal and Straining posts: 89 mm O.D., 11.28 kg/m.
iii) Gate Posts: 168 mm O.D., 28.23 kg/m.
iv) Top and Brace Rail: 43 mm O.D., 3.38 kg/m plain end, sleeve coupled.
v) Gate Frame: 43 mm O.D., 3.38 kg/m. Gate leaves to have horizontal and vertical intermediate brace on gate leaves 3.0 m wide and over.
vi) Post Caps: Cast aluminum, sized to post diameter, set screw retained.
vii) Extension Arms: Cast aluminum to accommodate 3 strands of barbed wire, sloped 45° towards the outside of the property, top strand 300 mm from fence fabric.
viii) Line Post Eye tops: Cast aluminum.
ix) Rail Ends: Cast aluminum.
x) Fittings: Sleeves, bands, clips, tension bars, fasteners and fittings galvanized steel.
xi) Fabric: 50 mm diamond mesh, interwoven 3.5 mm wire, top selvage twisted tight, bottom selvage knuckle end closed.
xii) Bottom tension Wire: 5.0 mm (6 gauge) steel single strand hot-dipped galvanized to 490 g/m^2
xiii) Barbed Wire: 2.5 mm wire, three strands, four point barbs at 150 mm on centre, zinc coated steel.
xiv) Gate Frames: to conform with CGSB CAN2-138.2M with a minimum 42.2mm outside diameter; shall be electrically welded at all joints and hot dip galvanize after welding; if braces are used, use truss rod and turn buckle adequate for gate size
xv) Single Gate Hardware: 2 piece lift latch and latch catch. Gate hinge 180° male and female. Hardware provision for a padlock, chain hold open.
xvi) Double Gate Hardware: Gate centre rest, 2 piece lift latch, 3 piece drop latch and latch catch with drop bolt. Gate hinge 180° male and female. Hardware provision for a padlock. chain hold open, gate keeper post and ground latch stop.

3.15.3 Execution

a) INSTALLATION

i) Install to alignment specified, line posts, corner posts, gate posts and top rails to provide rigid structure for 2.4 m high fabric and gates.
ii) Maximum spacing of posts: 3.0 m on centre
iii) Install line and corner posts plumb.

iv) Set posts in cylindrical cast-in-place concrete footings sized as follows:

Location	Depth	Diameter
Fence height of 2.4m:		
Line posts	1200 mm	300 mm
Gate and corner posts	1500 mm	400 mm

v) Set posts to within 150 mm from bottom of concrete footing.
vi) Set top of concrete footing 50 mm above finished grade. Slope top of footing to ensure water run off.
vii) Position bottom of fabric 50 mm above finished grade with tension wire stretched taut between posts.
viii) Align top of posts to ensure that top rail varies gradually with changes in ground elevations.
ix) Pass top rail through line post tops to form continuous bracing. Install 150 mm long couplings mid-span at pipe ends.
x) Brace each gate and corner post back to adjacent line post with horizontal centre brace rail. Install brace rail, one bay from corner and gate posts.
xi) .11 Install 10 mm steel truss rod and truss tightener diagonally from top of gate post back to adjacent line post for gate leaves that are 3.0 m wide and over or for gate leaves for 1.8 m high and over fence.
xii) Fasten fabric to top rail, line posts, braces and bottom tension wire with 3.5 mm wire ties maximum 500 mm centres.
xiii) Attach fabric to corner and gate posts with tension bars and tension bar clips. Stretch fabric between posts at intervals of 30.0 m maximum.
xiv) Install straining post at 90 m approximately.
xv) Install 3 strands of barbed wire on arms, tensioned and secured. Slope extension arms for barb wire outward.
xvi) Install gates of sizes shown using fabric and vertical extension arms to match fence. Install 3 hinges per leaf and hardware specified. Gates to have maximum clearance below gate bottom rail of 100 mm.
xvii) Provide concrete centre rest and drop bolt retainers at centre of double gate openings.
xviii) Install sway brace units on gate posts where gate leaves are 4.0 m and over in width.

3.16 Rock Mulch & Boulders

3.16.1 General

a) PROTECTION

i) Protect trees, shrubs, other vegetation, buildings and pavements indicated to remain in place, against unnecessary cutting, breaking and any other damage.
ii) Provide approved hoarding and protection to any buildings or completed surface works to protect against damage. All protection shall remain in place until completion of all installations specified under this section.

b) QUALITY ASSURANCE

i) Work shall be performed by those experienced in rock mulch and boulder placement.
ii) Boulders

(1) Provide boulders from recognized stone industry supplier that is experienced in supplying, lifting, palletizing, shipping and unloading landscape boulders of the sizes, and weights for this Project.

3.16.2 Products

a) ROCK MULCH

i) Limestone Rock Mulch: clean rock (nominally) 50mm dia to min. 100mm depth.

b) LIME STONE BOULDERS

i) Dimensions & size as shown in Landscape Drawings &
ii) Height specified is above ground height with 1/3 of boulder buried.
iii) Visible fracture lines are not acceptable
iv) All boulders to be free of sharp edges, hand dress as required.

c) WEED CONTROL BARRIERS

i) Non-woven Fabric: Polypropylene or polyester fabric, 339 g/m2 (10 oz/yd2) minimum, black.

d) EDGERS

i) 3.17mm (1/8”) thick x 200mm depth steel flat bar with 10M reinforcement bar stakes spaced at 400mm centres welded to one side of the plate; galvanized finish.

3.16.3 Execution

a) VERIFICATION OF EXISTING WORK

i) Verify that site is ready to receive work of this Section.

b) PROTECTION OF EXISTING WORK

i) Prevent damage to fencing, trees, landscaping, natural features, benchmarks, existing buildings, existing pavement and utility lines which are to remain. Make good any damage.

c) DELIVERY AND STORAGE

i) Boulders shall be loaded on individual pallets at stone supplier’s yard and pallets shall be used to lift and move boulders, avoiding contact with boulder faces at all times during loading, shipping and unloading.

d) PREPARATION OF SUBGRADE

i) Locate utility lines before commencement of work and protect from damage.
ii) Remove foreign material, undesirable plants, roots, stones in excess of 25 mm diameter, debris and soil contaminated with oil or gasoline, from site. Do not bury foreign material beneath areas to be landscaped.
iii) Grade subgrade to eliminate uneven areas, low spots and ensure positive drainage. Finish subgrades to depth shown on drawings.
iv) Compact subgrades to minimum 95% Standard Proctor Density.

e) GEOTEXTILE FILTER FABRIC UNDER ROCK MULCH

i) Where geotextile filter fabric is specified, the slope shall be graded to provide a smooth, uniform surface. All stumps, large rock, 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 or unstable soils shall be replaced.
ii) The non-woven geotextile filter fabric shall meet the specifications and physical properties as listed above.
iii) The fabric shall be laid parallel to the slope direction. It shall be placed in a loose fashion, however folds and wrinkles shall be avoided. Adjacent strips of fabric shall be overlapped a minimum of 300 mm, except where placed underwater, the minimum lap width shall be 1 m. Overlaps shall be pinned using 6 mm diameter steel pins fitted with washers and spaced at 1 m intervals along the overlaps.
iv) The top edge of the filter fabric shall be anchored by digging a 300 mm deep trench, inserting the top edge of the fabric and backfilling with compacted soil. Where adjacent to concrete walks, filter fabric shall be placed between the lower edge of the concrete and rock mulch so no fabric is visible.
v) Install filter cloth on prepared subgrade to approval of the Consultant.
vi) Care shall be taken to prevent puncturing or tearing the geotextile. Any damage shall be repaired by use of patches that extend at least 1 m beyond the perimeter of the tear or puncture.
vii) The fabric shall be covered by rock mulch within sufficient time so that ultraviolet damage does not occur; in no case shall this time exceed 7 days for ultraviolet material and 14 days for ultraviolet protected and low ultraviolet susceptible polymer geotextiles.
viii) Trim any exposed fabric a minimum 25-50mm below surface of rock materials.

f) BOULDER PLACEMENT

i) Compact minimum 150mm depth granular base to minimum 95% Standard Proctor Density.
ii) Contractor shall rough position boulders at excavated locations shown on the Drawings for review by the Landscape Architect prior to final installation. Adjust positioning as directed.
iii) Orient boulder placements with the longest length horizontal to the ground plane with the largest width running parallel to the ground. Bury the base of the boulder with the surrounding surface material so that the bottom edge of the boulder is not visible or as identified in the detail drawings.
iv) Place boulders to expose weathered surfaces where feasible.

g) CLEANING

i) Remove all soil, mortar, concrete splatter, etc. from exposed stone faces as work progresses. Any cleaners used shall be non-toxic to adjoining creek and biodegradable. Submit product literature for approval prior to cleaning.
ii) Remove all excess material and debris, including excavated material, from site.
iii) Restore existing landscaped areas disturbed by boulder and rock installation in a manner acceptable to the Town.

3.17 Construction Completion Certificate

Town of Calmar
P.O. Box 750
4901 – 50 Avenue
Calmar, Alberta
T0C 0V0
Fax: (780) 985-3039

CONSTRUCTION COMPLETION CERTIFICATE

DEVELOPMENT AREA: _____

DEVELOPER: _____

SERVICING AGREEMENT DATED: _____ AGREEMENT NO.: _____

CONTRACTOR: _____

MUNICIPAL IMPROVEMENT: _____

BOUNDARIES OF DEVELOPMENT AREA: AS PER ATTACHED PLAN

DATE OF APPLICATION: _____

PURSUANT TO THE SERVICING AGREEMENT NO. _____ DATED _____

I, _____ OF THE FIRM _____

("CONSULTING ENGINEERS") HEREBY CERTIFY THAT THE MUNICIPAL IMPROVEMENT WORK NOTED HEREIN MEETS ALL REQUIREMENTS FOR A CONSTRUCTION COMPLETION CERTIFICATE AS SPECIFIED IN THE SAID SERVICING AGREEMENT MENTIONED ABOVE, AND CONSTRUCTED AS FAR AS CAN BE PRACTICALLY ASCERTAINED ACCORDING TO THE TOWN OF CALMAR DESIGN STANDARDS IN COMPLIANCE WITH THE REQUIREMENTS OF THE SAID SERVICING AGREEMENT, I, HEREBY, RECOMMEND APPROVAL OF THIS CONSTRUCTION COMPLETION CERTIFICATE BY THE TOWN OF CALMAR.

_____ Date _____
Project Engineer (Consulting Engineering Firm)

_____ Date _____
Signing Officer (Consulting Engineering Firm)

_____ Date _____
Authorized Town Representative

Seal

Approved on _____ 20 _____ _____
Town of Calmar

Rejected on _____ 20 _____ _____
Town of Calmar

Cause(s) for Rejection: (See attached report) _____

_____

I hereby certify that the items listed as reasons for rejection have been corrected.

_____ Date _____
Project Engineer (Consulting Engineering Firm)

Approved: _____ Date _____
Town of Calmar

Date Maintenance Period to Start: _____

Date Maintenance Period to End: _____

3.18 Final Acceptance Certificate

Town of Calmar
P.O. Box 750
4901 – 50 Avenue
Calmar, Alberta
T0C 0V0
Fax: (780) 985-3039

FINAL ACCEPTANCE CERTIFICATE

DEVELOPMENT AREA: _____

DEVELOPER: _____

SERVICING AGREEMENT DATED: _____ AGREEMENT NO.: _____

CONTRACTOR: _____

MUNICIPAL IMPROVEMENT: _____

BOUNDARIES OF DEVELOPMENT AREA: AS PER ATTACHED PLAN

DATE OF APPLICATION: _____

PURSUANT TO THE TOWN OF CALMAR SERVICING AGREEMENT NO. _____ DATED _____

I, _____ OF THE FIRM _____

("CONSULTING ENGINEERS") HEREBY CERTIFY THAT AS OF THE ABOVE DATE, THE SAID MUNICIPAL IMPROVEMENT MEETS ALL THE REQUIREMENTS FOR FINAL ACCEPTANCE AS SPECIFIED BY THE SAID SERVICING AGREEMENT, AND I HEREBY RECOMMEND THIS MUNICIPAL IMPROVEMENT FOR FINAL ACCEPTANCE BY THE TOWN OF CALMAR.

_____ Date _____
Project Engineer (Consulting Engineering Firm)

_____ Date _____
Signing Officer (Consulting Engineering Firm)

_____ Date _____
Authorized Town Representative

Seal

Approved on _____ 20 _____ _____
Town of Calmar

Rejected on _____ 20 _____ _____
Town of Calmar

Cause(s) for Rejection: (See attached report) _____

_____

I hereby certify that the items listed as reasons for rejection have been corrected.

_____ Date _____
Project Engineer (Consulting Engineering Firm)

Approved: _____ Date _____
Town of Calmar

Date Maintenance Period to End: _____

4.0 STANDARD DETAILS

4.1 Roadways

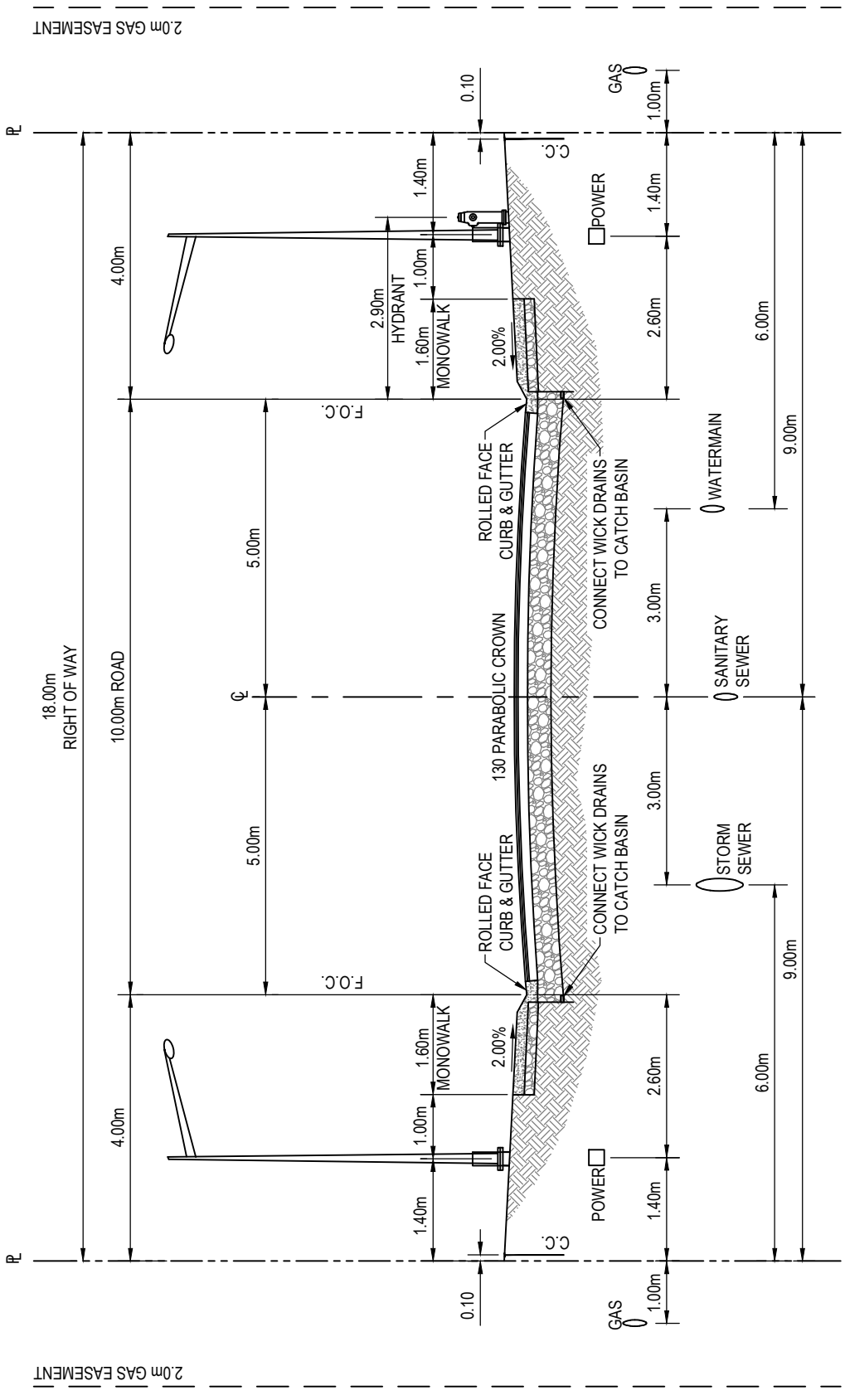
Detail	Drawing Number
Local Urban Residential Road	T01
Residential Urban Collector	T02
Undivided Arterial	T03
Local Industrial (Rural)	T04
Industrial Collector (Rural)	T05
Commercial Crossing – Boulevard	T06
Commercial Crossing - Monowalk	T07
Concrete Swale	T08
Pedestrian Ramp	T09
Rolled Curb & Gutter	T10
Straight Face Curb & Gutter	T11
Rolled Monolithic Curb & Gutter	T12
Separate Sidewalk	T13
Straight Face Monolithic Curb & Gutter	T14

4.2 Utilities

Detail	Drawing Number
Standard 1200mm Manhole	U01
Standard 1200mm Catchbasin Manhole	U02
Standard 1200mm Perched Manhole	U03
Standard 600mm Catchbasin	U04
Standard 900mm Catchbasin	U05
Hydrant Connection	U06
Valve with Cathodic Protection	U07
Trench Backfill	U08
Thrust Block Details	U09
Standard Water Service Connection	U10
Standard Sanitary Service Connection	U11
Lot Grading Types	U12

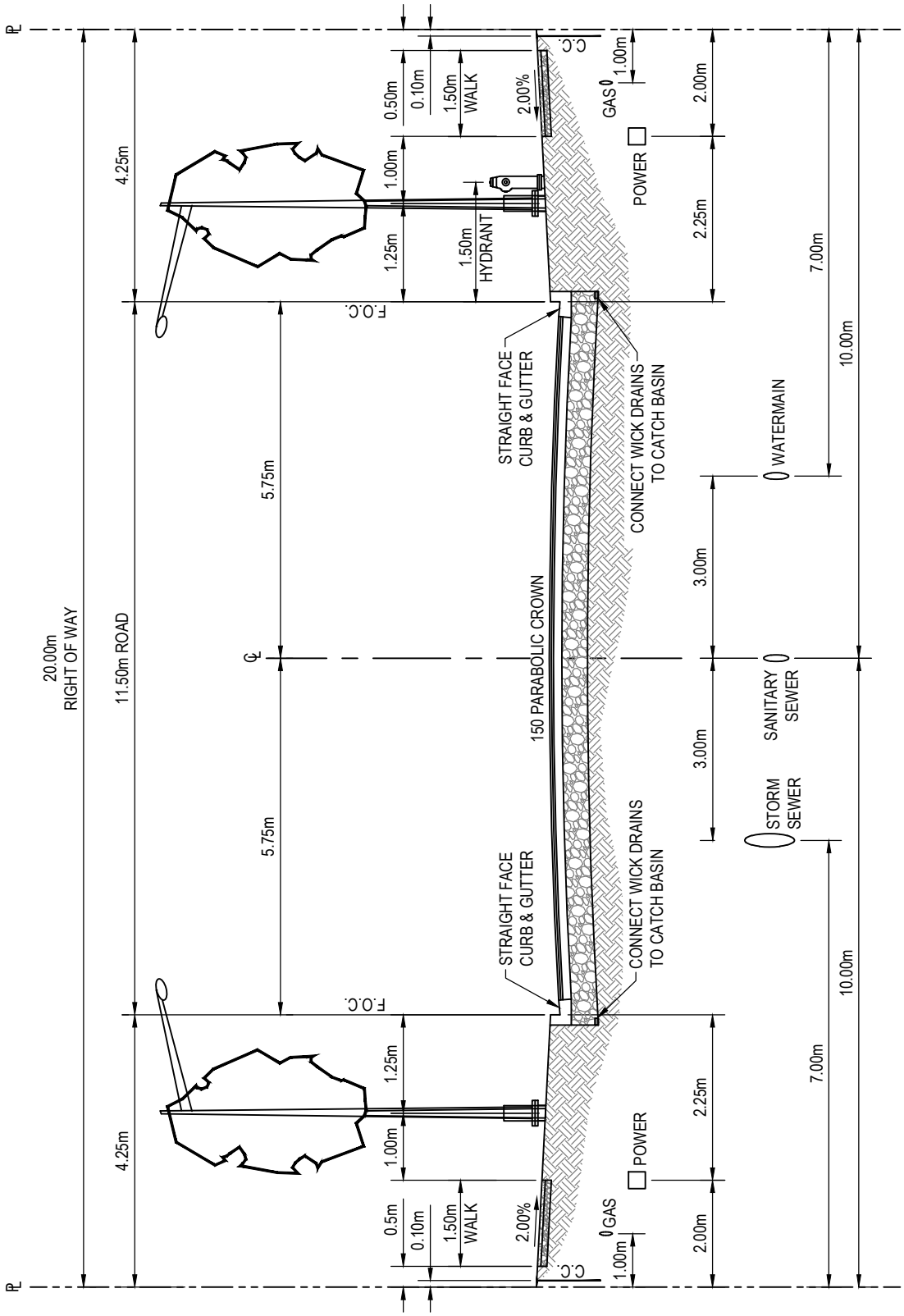
4.3 Landscaping

Detail	Drawing Number
Tree Protection Zone	LA01
Typical Tree Planting	LA02
Typical Tree Planting on Slopes	LA03
Typical Transplanted Tree	LA04
Typical Tree in Grate	LA05
Typical Shrub Bed Planting	LA06
Typical Shrub Bed Planting on Slope	LA07
Sod installation	LA08
Asphalt Trail	LA09
Granular Trail	LA10
Permanent Wood Rail Fence	LA11
Temporary Wood Rail Fence	LA12
Chain Link Fence	LA13
Wood Fence	LA14
Wood Fence Stepdown Detail	LA15
Sound Attenuation Fence	LA16
Typical Bench Detail	LA17
Boulder Installation	LA18
Wood Bumper Post	LA19
Concrete Playground Edger	LA20



NOTE: A MODIFIED RESIDENTIAL ROAD CROSS SECTION IS PERMITTED WITH A WALK ON ONE SIDE.

REVISIONS			TITLE			
DATE	DESCRIPTION	BY	18.0m LOCAL RESIDENTIAL ROAD			
APR 2020	DETAIL UPDATE	JH				
-	-	-	APPROVED: DH			
-	-	-	CHECKED: DH			DWG NO.
-	-	-	DATE: APR 2020	SCALE: NTS	DRAWN: AS	T01



REVISIONS			TITLE			
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APR 2020	DETAIL UPDATE	JH				
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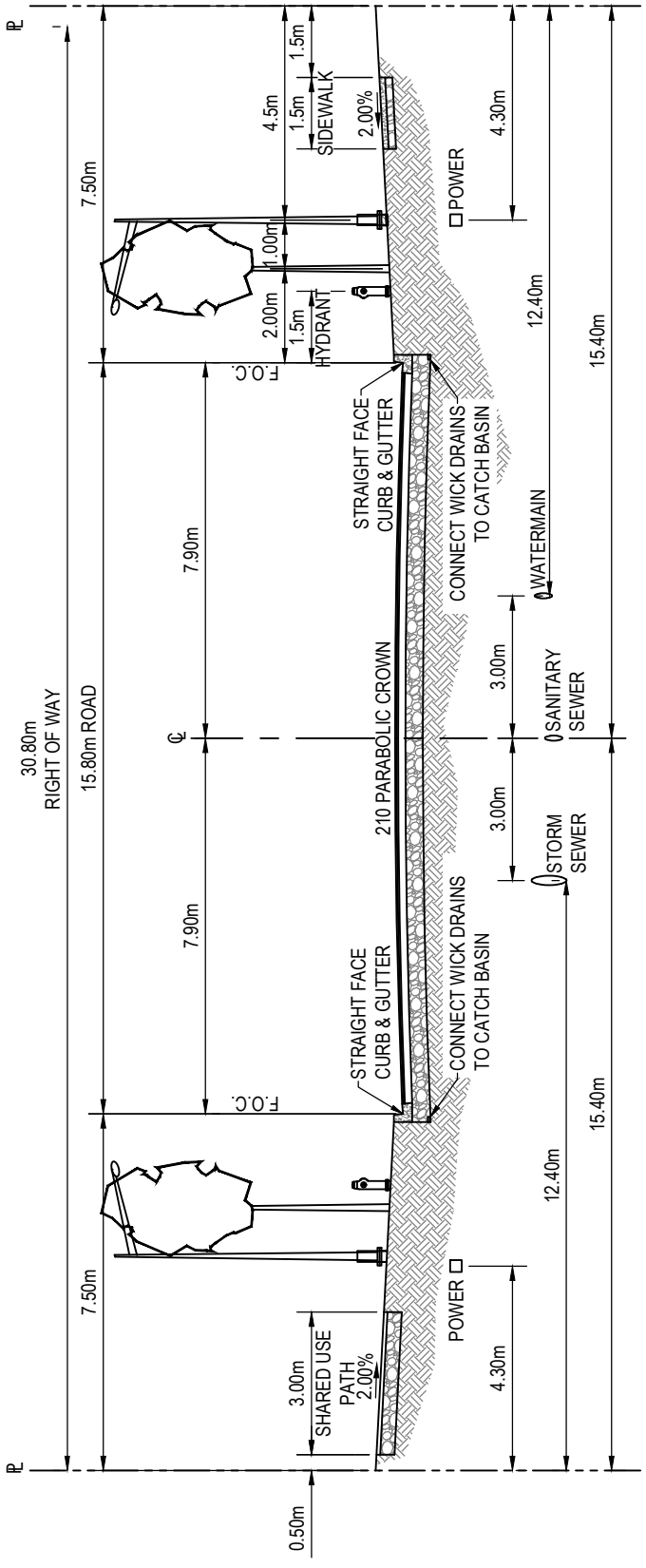
-	-	-	CHECKED: DH			DWG NO.
-	-	-	DATE: APR 2020	SCALE: NTS	DRAWN: AS	T02



REVISIONS			TITLE			
DATE	DESCRIPTION	BY	30.8m UNDIVIDED URBAN ARTERIAL			
APR 2020	DETAIL UPDATE	JH				
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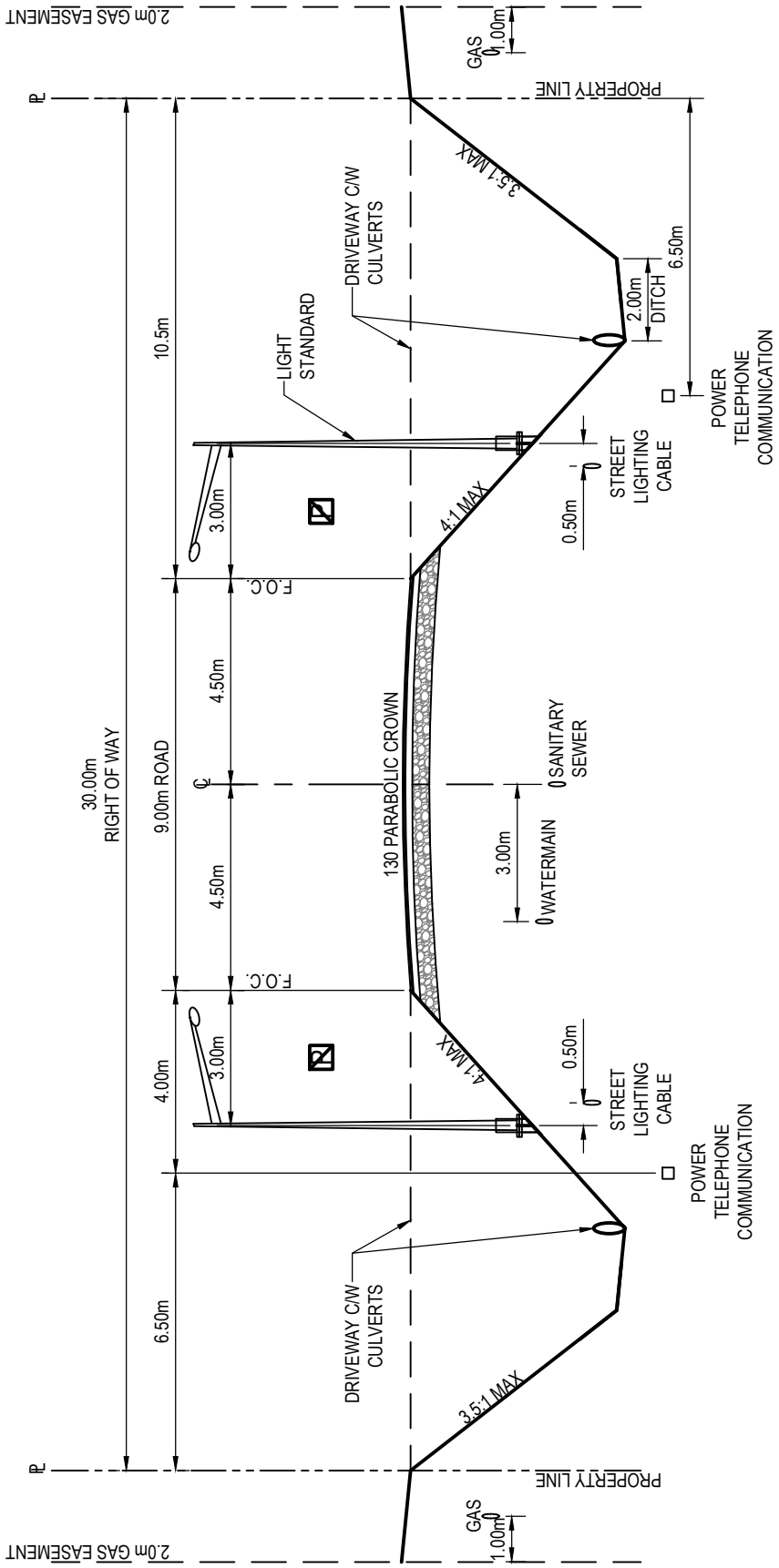
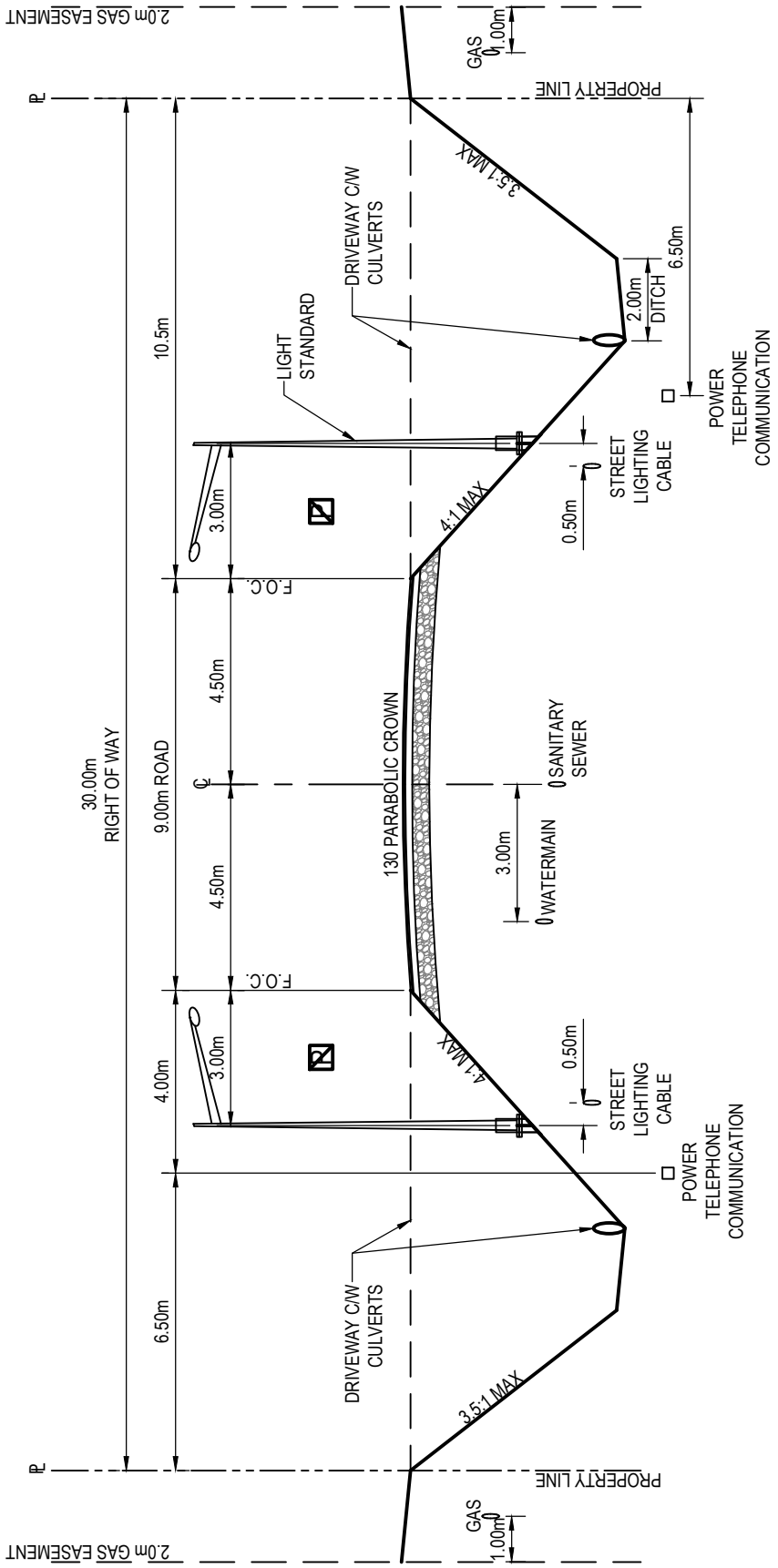
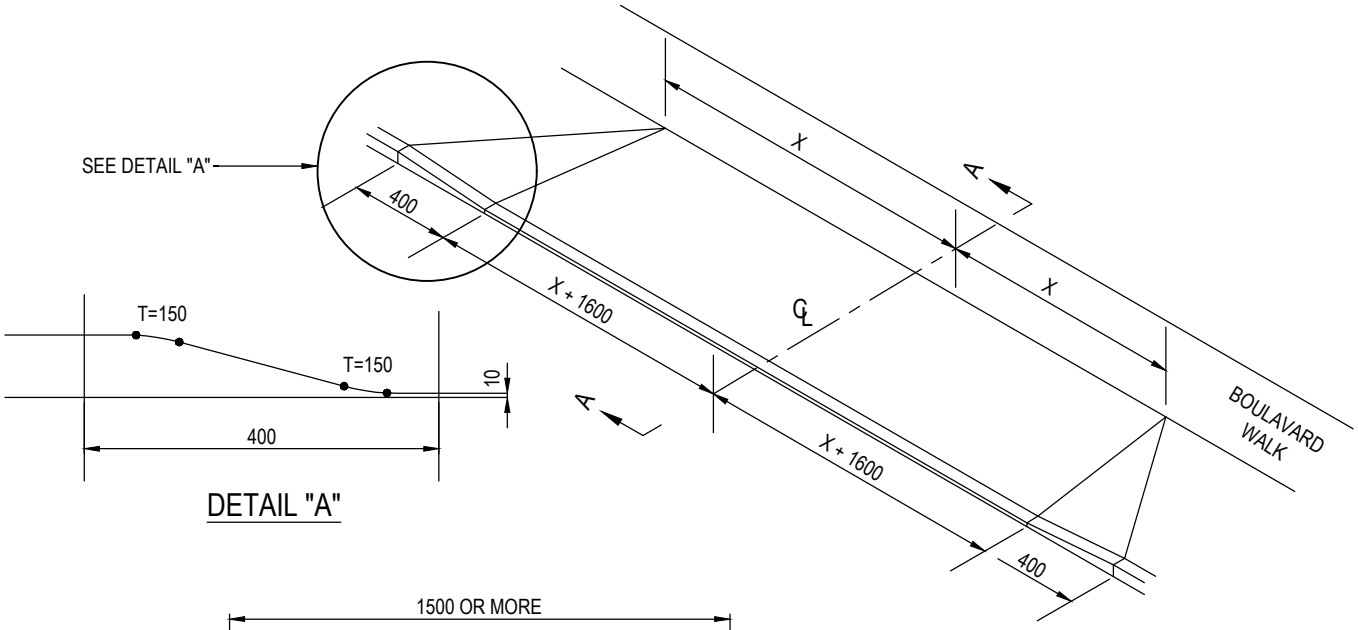
-	-	-	CHECKED: DH			DWG NO.
-	-	-	DATE: APR 2020	SCALE: NTS	DRAWN: AS	T03



REVISIONS			TITLE			
DATE	DESCRIPTION	BY	30.0m RURAL INDUSTRIAL LOCAL			
APR 2020	DETAIL UPDATE	JH				
-	-	-	APPROVED: DH			
-	-	-	CHECKED: DH			DWG NO.
-	-	-	DATE: APR 2020	SCALE: NTS	DRAWN: AS	T04



REVISIONS			TITLE			
DATE	DESCRIPTION	BY	30.0m RURAL INDUSTRIAL COLLECTOR			
APR 2020	DETAIL UPDATE	JH				
-	-	-	APPROVED: DH			
-	-	-	CHECKED: DH			DWG NO.
-	-	-	DATE: APR 2020	SCALE: NTS	DRAWN: AS	T05



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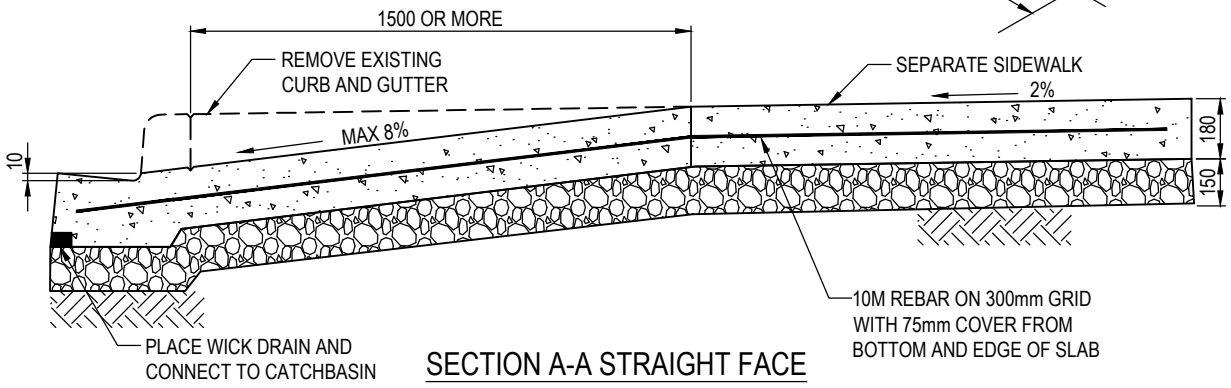
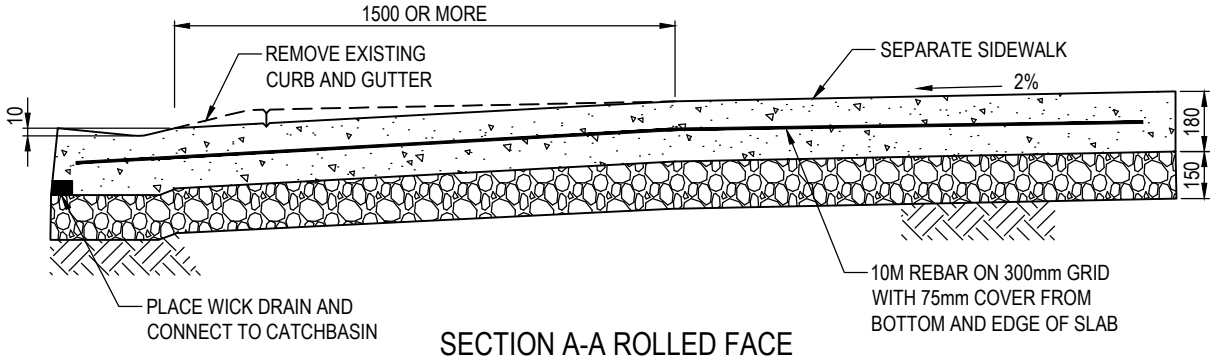


SECTION A-A STRAIGHT FACE



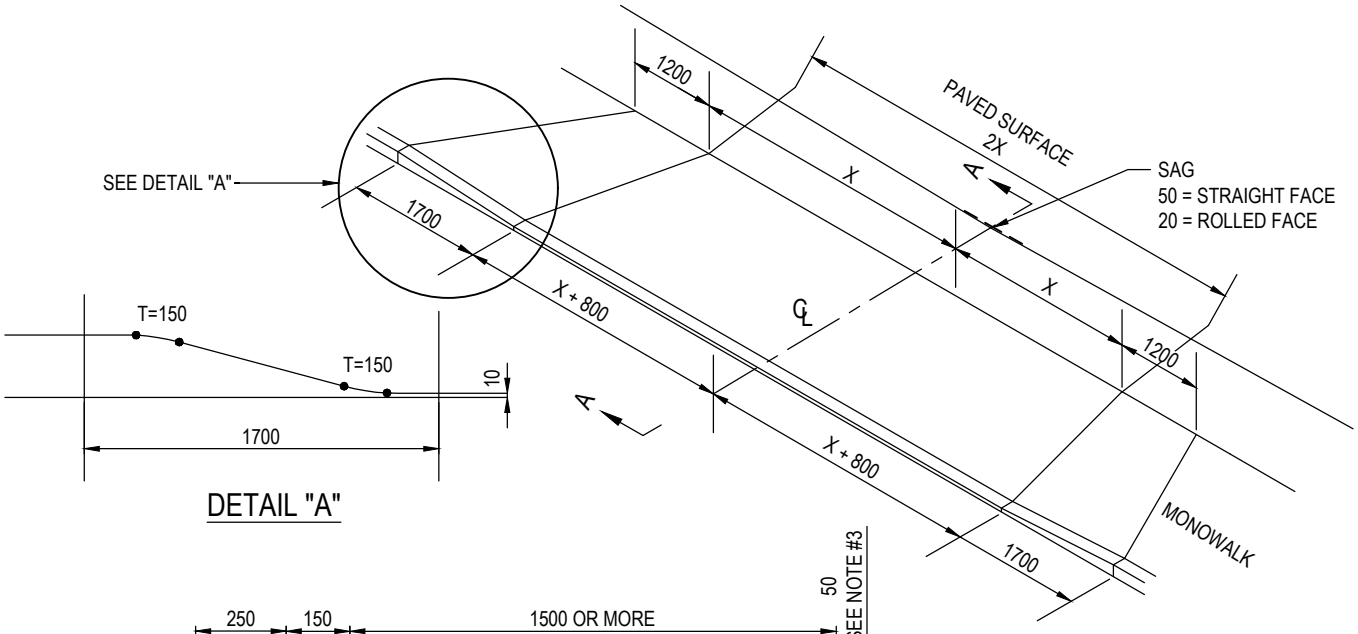
SECTION A-A ROLLED FACE

NOTES:

1. MAXIMUM CROSSFALL SLOPE TO BE 8.00% AT CROSSING UNLESS APPROVED BY ENGINEER.
2. CROSSING MUST BE POURED MONOLITHICALLY WITH CURB AND GUTTER.

ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED

REVISIONS			TITLE			
DATE	DESCRIPTION	BY	COMMERCIAL CROSSING BOULEVARD WALK			
APR 2020	DETAIL UPDATE	JH				
-	-	-	APPROVED: DH			
-	-	-	CHECKED: DH			DWG NO.
-	-	-	DATE: APR 2020	SCALE: NTS	DRAWN: JH	T06



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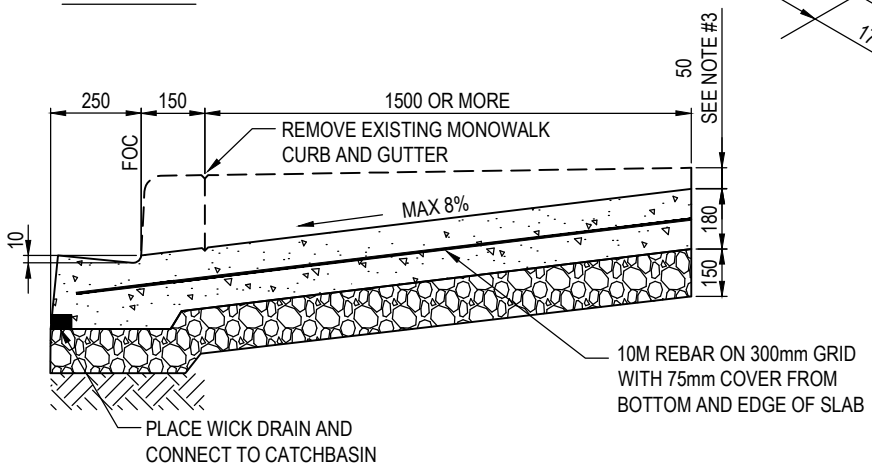
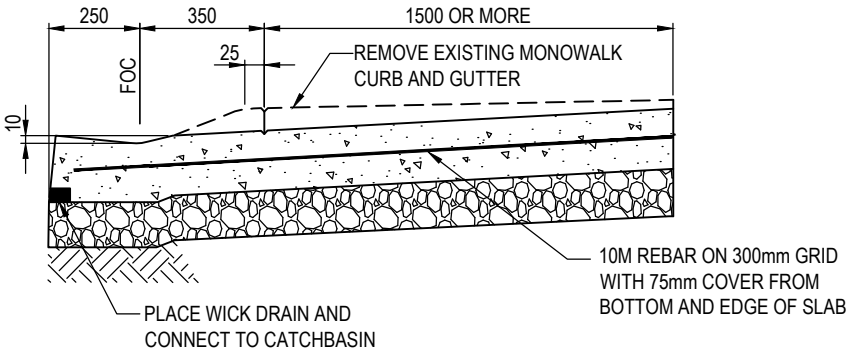


SECTION A-A STRAIGHT FACE



SECTION A-A ROLLED FACE

NOTES:

1. MAXIMUM CROSSFALL SLOPE TO BE 8.00% UNLESS OTHERWISE APPROVED BY ENGINEER.
2. CROSSING MUST BE POURED MONOLITHICALLY WITH CURB AND GUTTER.
3. BACK OF CROSSING DROP FOR EXISTING 200mm CURB FACE TO BE 50mm.

ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED

REVISIONS		
DATE	DESCRIPTION	BY
APR 2020	DETAIL UPDATE	JH
-	-	-
-	-	-
-	-	-

TITLE

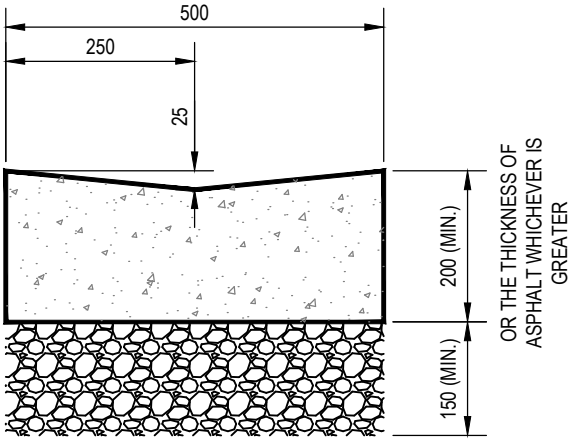
COMMERCIAL CROSSING
MONOWALK

APPROVED: DH

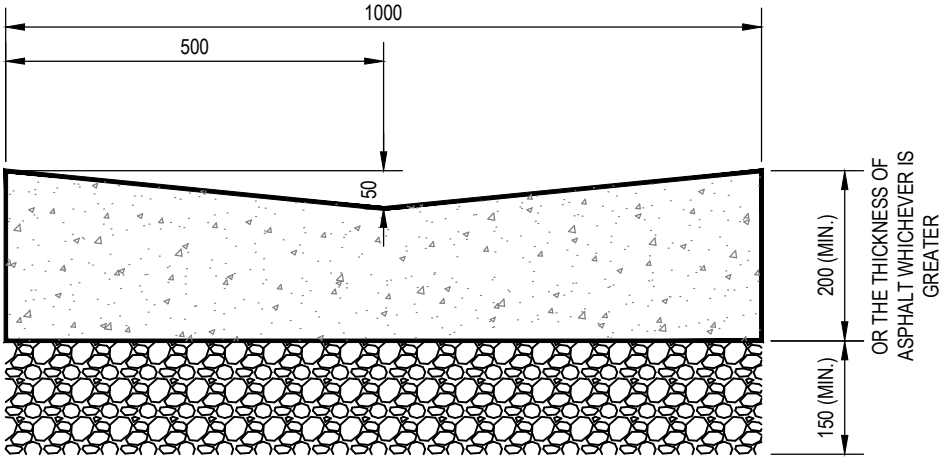
CHECKED: DH

DATE: APR 2020 | SCALE: NTS | DRAWN: JH

DWG NO.
T07



500mm CONCRETE SWALE



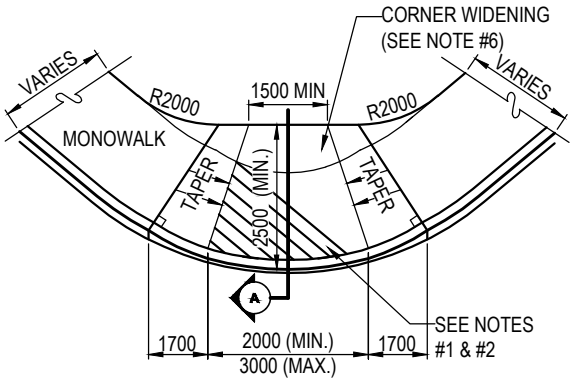
1000mm CONCRETE SWALE

NOTES:

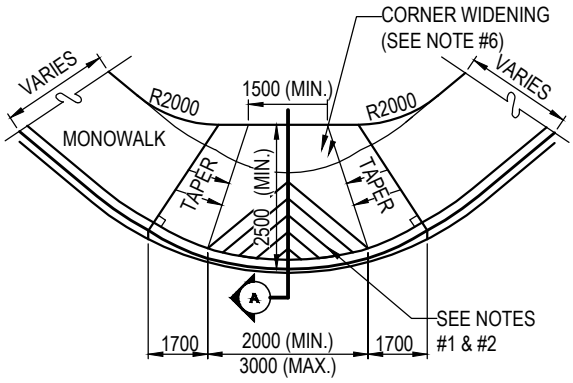
1. MINIMUM 150mm GRANULAR MATERIAL TO BE PLACED AND PREPARED AS PER TOWN OF CALMAR SPECIFICATIONS.
2. SUB-GRADE TO BE PREPARED AS PER TOWN OF CALMAR SPECIFICATIONS.

ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED

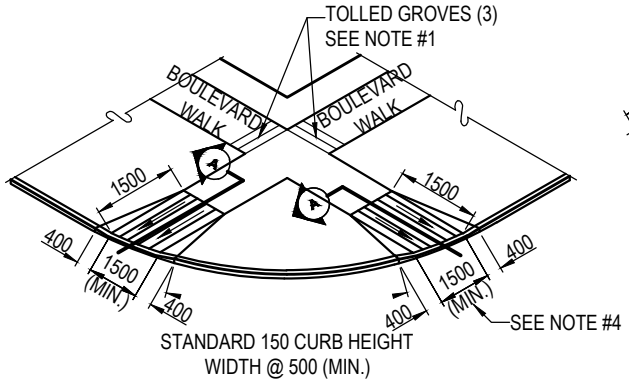
REVISIONS			TITLE			
DATE	DESCRIPTION	BY	500mm / 1000mm CONCRETE SWALE			
APR 2020	DETAIL UPDATE	JH				
-	-	-	APPROVED: DH			
-	-	-	CHECKED: DH			DWG NO.
-	-	-	DATE: APR 2020	SCALE: NTS	DRAWN: AS	T08



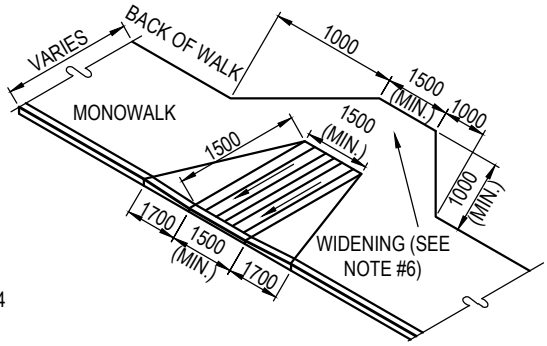
TYPE A1 (ONE DIRECTION)



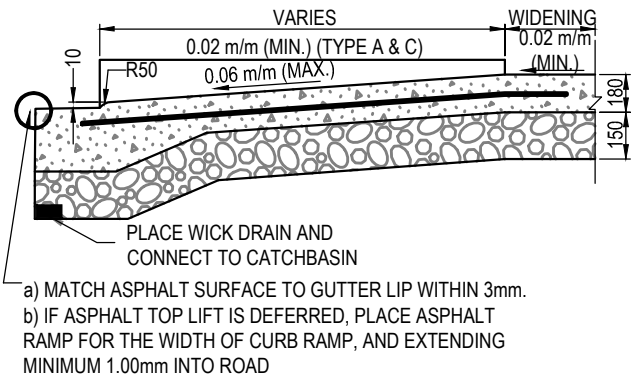
TYPE A2 (TWO DIRECTIONS)



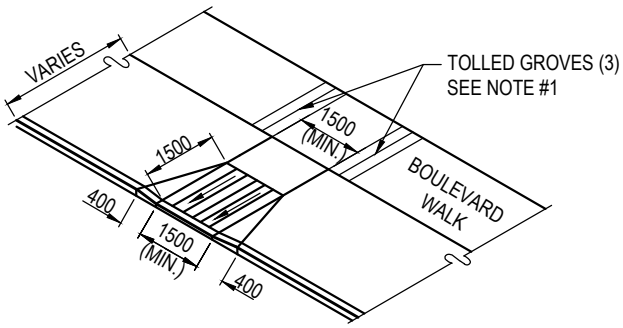
TYPE B



TYPE C



TYPICAL CROSS SECTION A-A



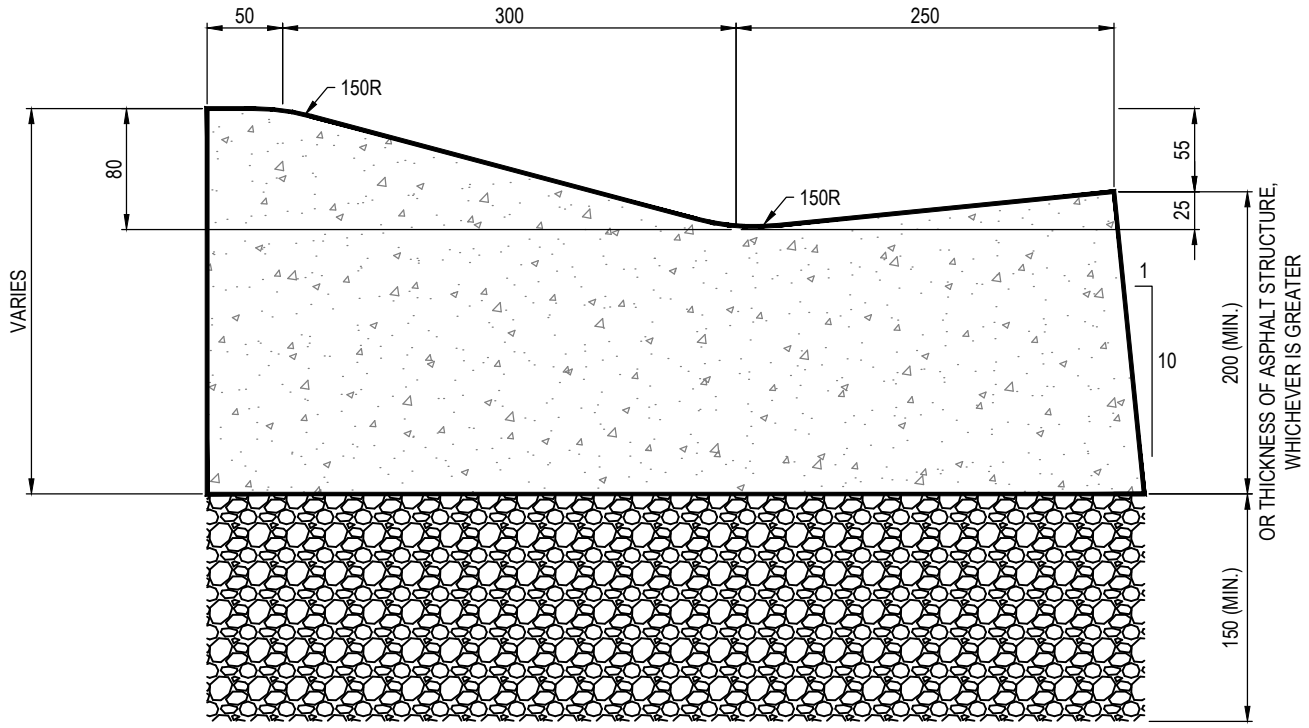
TYPE D

NOTES:

1. TOOLED GROOVES 5mm WIDE X 10mm DEEP, BROOM FINISH, GROOVE SPACING 150mm O.C. ADJACENT TO CURB.
2. GROOVES TO BE IN DIRECTION OF TRAVEL.
3. WHEN REQUIRED, TRANSITION FROM STRAIGHT FACE CURB TO ROLLED FACE CURB AT CURB RAMP.
4. CURBS AND RAMPS TO BE POURED MONOLITHICALLY.
5. WIDTH OF RAMP MUST EQUAL WIDTH OF WALK (MIN. 1.5m, MAX 3.0m) EXCEPT TYPE A.
6. PROVIDE 1.0m WIDENING (AT 2.0% X-FALL) FROM BACK OF CURB RAMPS (TYPES A & C) WHERE ROAD RIGHT OF WAY ALLOWS.

ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED

REVISIONS			TITLE			
DATE	DESCRIPTION	BY	CURB RAMP			
APR 2020	DETAIL UPDATE	JH				
-	-	-	APPROVED: DH			
-	-	-	CHECKED: DH			DWG NO.
-	-	-	DATE: APR 2020	SCALE: NTS	DRAWN: JH	T09

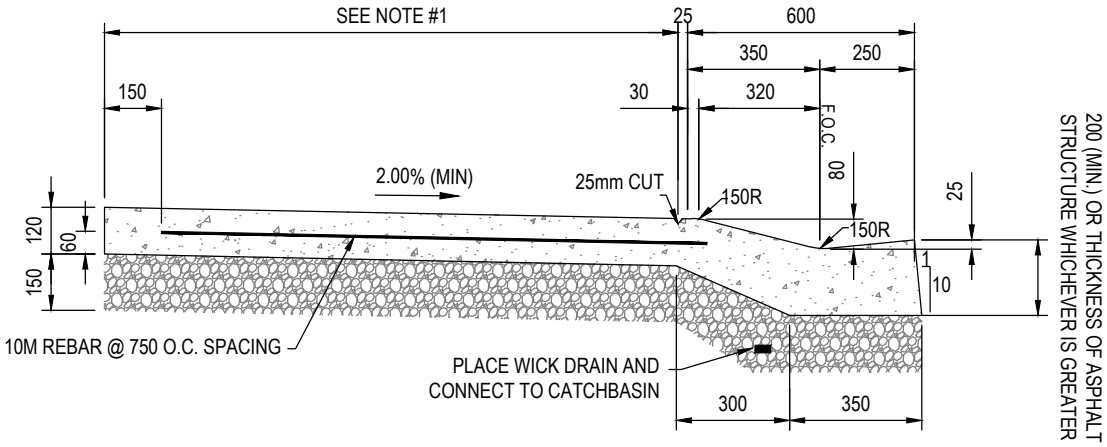


NOTES:

1. MINIMUM 150mm GRANULAR MATERIAL TO BE PLACED AND PREPARED AS PER TOWN OF CALMAR SPECIFICATIONS.
2. SUB-GRADE TO BE PREPARED AS PER TOWN OF CALMAR SPECIFICATIONS.

ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED

REVISIONS			TITLE			
DATE	DESCRIPTION	BY	ROLLED FACE CURB & 250 GUTTER			
APR 2020	DETAIL UPDATE	JH				
-	-	-	APPROVED: DH			
-	-	-	CHECKED: DH			DWG NO.
-	-	-	DATE: APR 2020	SCALE: NTS	DRAWN: JH	T10



NOTES:

1. MINIMUM WIDTH OF MONOWALK ON URBAN LOCAL ROADWAYS TO BE 1.60m.

ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED

REVISIONS		
DATE	DESCRIPTION	BY
APR 2020	DETAIL UPDATE	JH
-	-	-
-	-	-
-	-	-

TITLE

ROLLED FACE MONOLITHIC WALK AND GUTTER

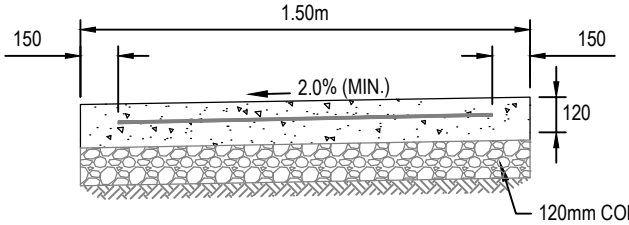
APPROVED: DH

CHECKED: DH

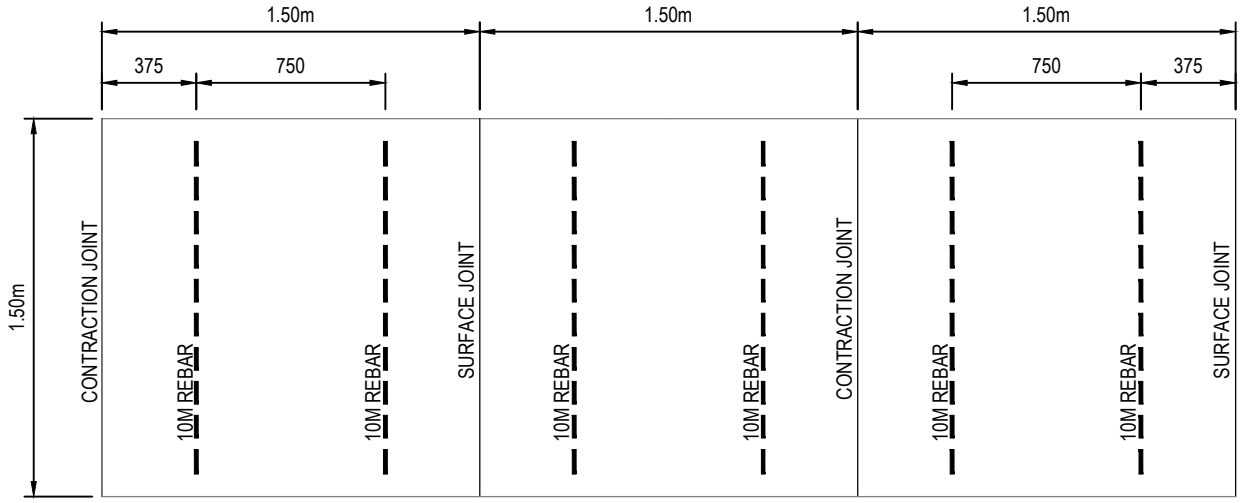
DATE: APR 2020 | SCALE: NTS | DRAWN: JH

DWG NO.

T12



TYPICAL SECTION



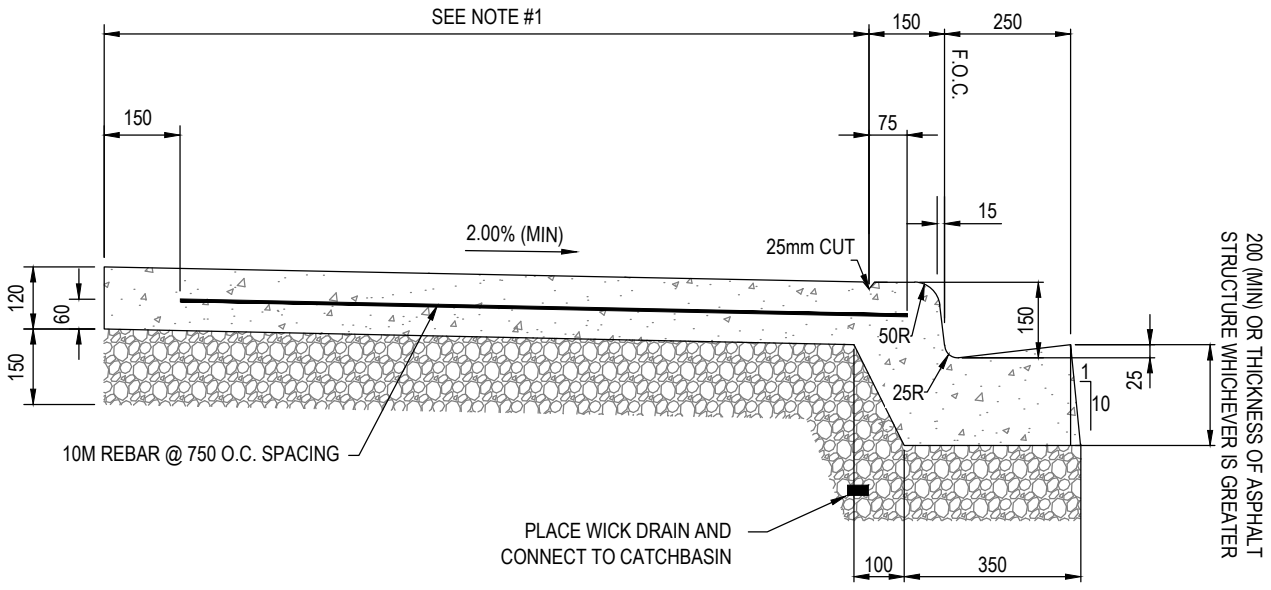
NOTE: ALTERNATE CONTRACTION JOINT AND SURFACE JOINT

TYPICAL PLAN VIEW

NOTES:

1. SURFACE JOINTS TO BE CENTERED BETWEEN CONTRACTION JOINTS ACROSS WALK.
2. IN MONOLITHIC CONSTRUCTION, PLACE SURFACE JOINTS ACROSS THE WALK AND CONTRACTION JOINTS ON THE CURB AND GUTTER, BOTH JOINTS BEING ON SAME LINE.
3. WHERE REQUIRED, PLACE A LONGITUDINAL SURFACE JOINT ON WALK AND SLABS CONTINUING ON THROUGH ALLEY CROSSING AND DRIVEWAYS.

REVISIONS			TITLE			
DATE	DESCRIPTION	BY	SEPARATE SIDEWALK			
APR 2020	DETAIL UPDATE	JH				
-	-	-	APPROVED: DH			
-	-	-	CHECKED: DH			DWG NO.
-	-	-	DATE: APR 2020	SCALE: NTS	DRAWN: AS	T13



NOTES:

1. MINIMUM WIDTH OF MONOWALK ON URBAN LOCAL ROADWAYS TO BE 1.60m.

ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED

REVISIONS		
DATE	DESCRIPTION	BY
APR 2020	DETAIL UPDATE	JH
-	-	-
-	-	-
-	-	-

TITLE

MONOLITHIC WALK WITH 150mm CURB AND 250mm GUTTER

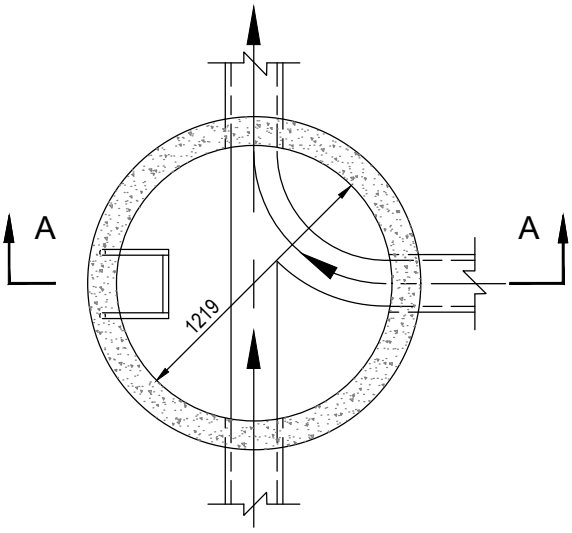
APPROVED: DH

CHECKED: DH

DATE: APR 2020 | SCALE: NTS | DRAWN: JH

DWG NO.

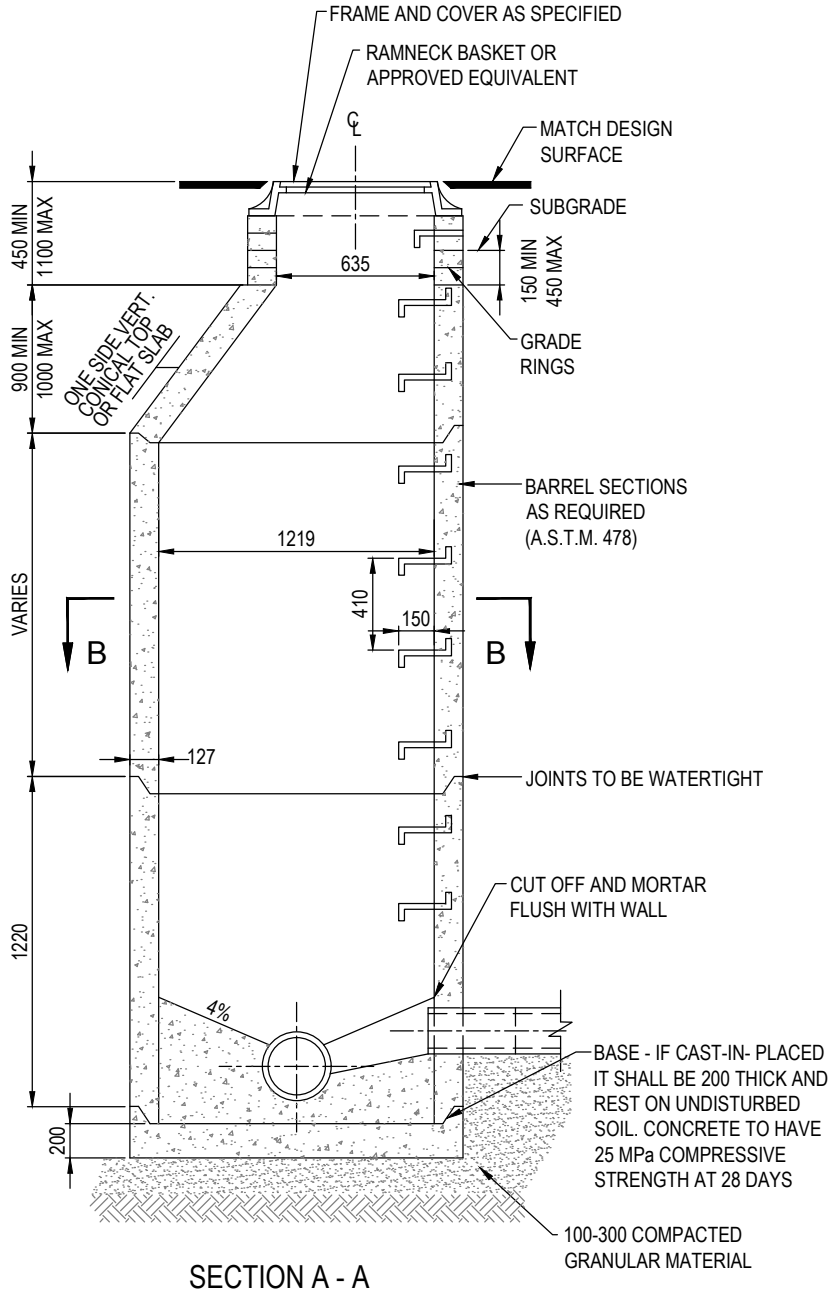
T14



SECTION B - B

NOTES:

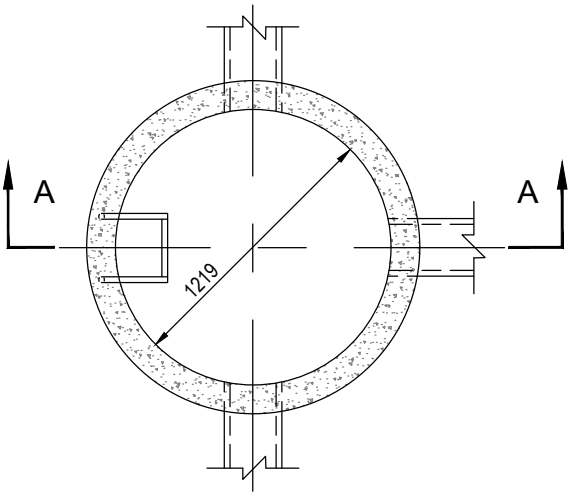
1. CAST-IN-PLACE CONCRETE BASE MAY BE USED. CAST-IN-PLACE CONCRETE TO BE TYPE 50 25MPa IN 28 DAYS. CAST-IN-PLACE CONCRETE BASE TO BE MIN. 200mm THICK AND CONSTRUCTED ON UNDISTURBED SOIL. FOR MH OVER 5.0m IN DEPTH, BASE TO BE REINFORCED WITH 10M BARS AT 250mm EACH WAY.
2. PRECAST RINGS, CONES AND BARRELS TO MEET CURRENT A.S.T.M. C478 STANDARDS.
3. JOINTS TO BE SEALED WITH CEMENT MORTAR, CONFINED O-RING GASKET, ASTM 445, OR BOTH TO MAKE JOINTS WATERTIGHT.
4. CONNECTION OF CONCRETE PIPES TO MH TO BE SEALED WITH CEMENT MORTAR.
5. INLET AND OUTLET PIPES TO BE GROUTED FLUSH WITH WALL.
6. CHANNELING AND BENCHING TO BE FINISHED TO TROWEL SMOOTHNESS.
7. SAFETY STEP SPACING TO BE EQUALLY SPACED AT A MAX. OF 410mm APART TO WITHIN 300mm BELOW COVER AND TO WITHIN 600mm OF THE BASE OR BENCHING.
8. COMPACT BACKFILL AROUND MH TO A MIN. OF 95% STANDARD PROCTOR DENSITY.
9. COMPACT TOP 1.5m OF BACKFILL AROUND MANHOLE TO A MIN. OF 98% STANDARD PROCTOR DENSITY FOR MANHOLE WITHIN ROAD RIGHT OF WAY.
10. PRECAST INLINE TEE MH's ARE ACCEPTABLE FOR SEWERS 900mmØ AND LARGER.
11. FOR PVC PIPE CONNECTIONS USE PRE-INSTALLED SEALED ALOK CONNECTIONS or APPROVED EQUIVALENT.
12. A TEMPORARY POLYETHYLENE DIRT BARRIER SHALL BE PLACED BETWEEN THE FRAME AND COVER AND THE CONCRETE SECTION WHEN MANHOLES ARE NOT IMMEDIATELY ADJUSTED TO GRADE.



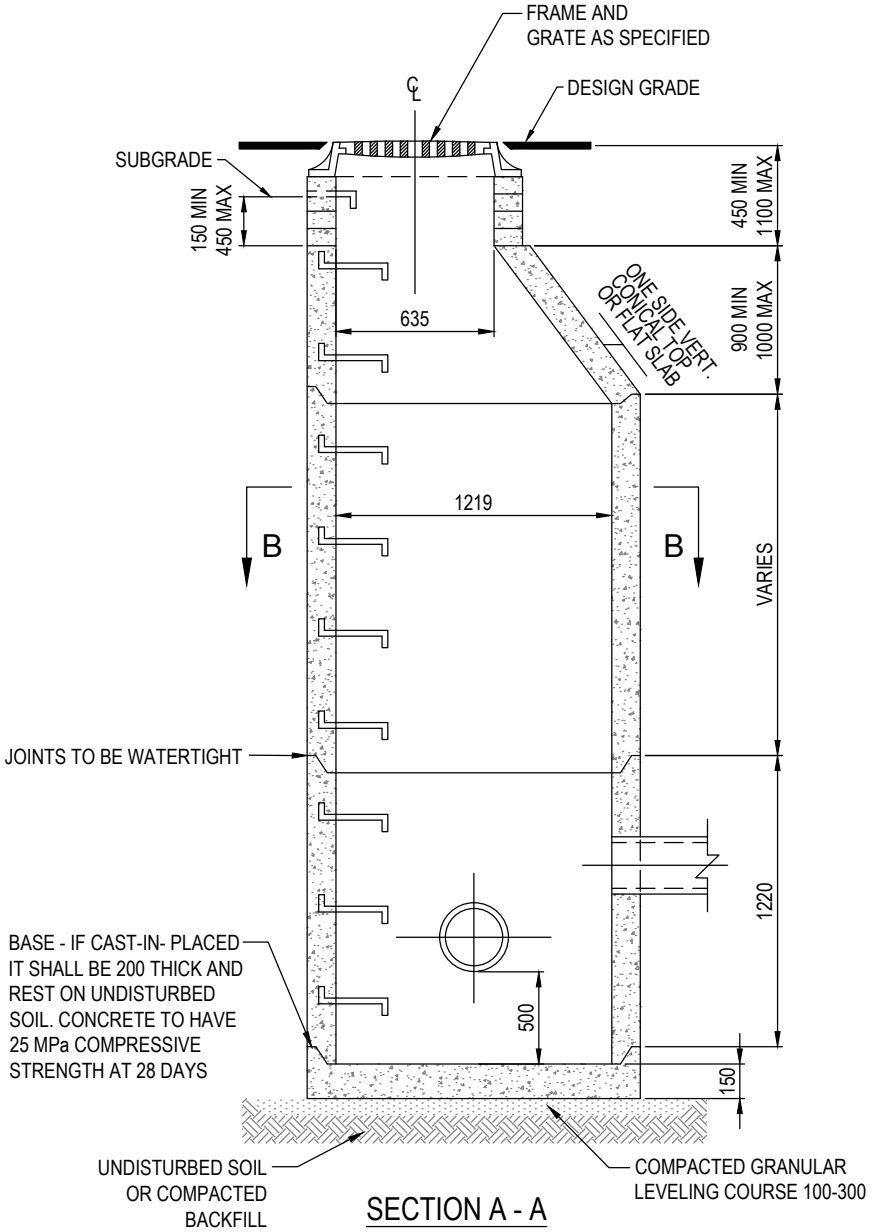
SECTION A - A

ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED

REVISIONS			TITLE			
DATE	DESCRIPTION	BY	STANDARD 1200mm MANHOLE			
APR 2020	DETAIL UPDATE	JH				
-	-	-	APPROVED: DH			
-	-	-	CHECKED: DH			DWG NO.
-	-	-	DATE: APR 2020	SCALE: NTS	DRAWN: JH	U01



SECTION B-B



SECTION A - A

NOTES:

1. CAST-IN-PLACE CONCRETE BASE MAY BE USED. CAST-IN-PLACE CONCRETE TO BE TYPE 50 25MPa IN 28 DAYS. CAST-IN-PLACE CONCRETE BASE TO BE MIN. 150mm THICK AND CONSTRUCTED ON UNDISTURBED SOIL. FOR MH OVER 5.0m IN DEPTH, BASE TO BE REINFORCED WITH 10M BARS AT 250mm EACH WAY.
2. PRECAST RINGS, CONES AND BARRELS TO MEET CURRENT ASTM C478 STANDARDS.
3. STORM MH JOINTS TO BE SEALED WITH CEMENT MORTAR, OR CONFINED O-RING GASKET.
4. CONNECTION OF CONCRETE PIPES TO MH TO BE SEALED WITH CEMENT MORTAR.
5. INLET AND OUTLET PIPES TO BE GROUTED FLUSH WITH WALL.
6. SAFETY STEP SPACING TO BE EQUALLY SPACED AT A MAX. OF 410mm APART TO WITHIN 300mm BELOW COVER AND TO WITHIN 600mm OF THE BASE OR BENCHING.
7. COMPACT BACKFILL AROUND MH TO A MIN. OF 98% STANDARD PROCTOR DENSITY.
8. COMPACT TOP 1.5m OF BACKFILL AROUND MANHOLE TO A MIN. OF 98% STANDARD PROCTOR DENSITY FOR MANHOLE WITHIN ROAD RIGHT OF WAY.
9. FOR PVC PIPE CONNECTIONS USE PRE-INSTALLED SEALED ALOK CONNECTIONS or APPROVED EQUIVALENT

ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED

REVISIONS		
DATE	DESCRIPTION	BY
APR 2020	DETAIL UPDATE	JH
-	-	-
-	-	-
-	-	-

TITLE

STANDARD 1200mm CATCHBASIN MANHOLE

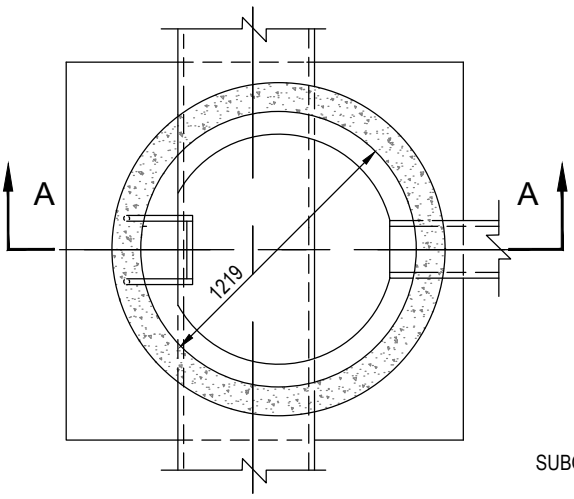
APPROVED: DH

CHECKED: DH

DATE: APR 2020 | SCALE: NTS | DRAWN: JH

DWG NO.

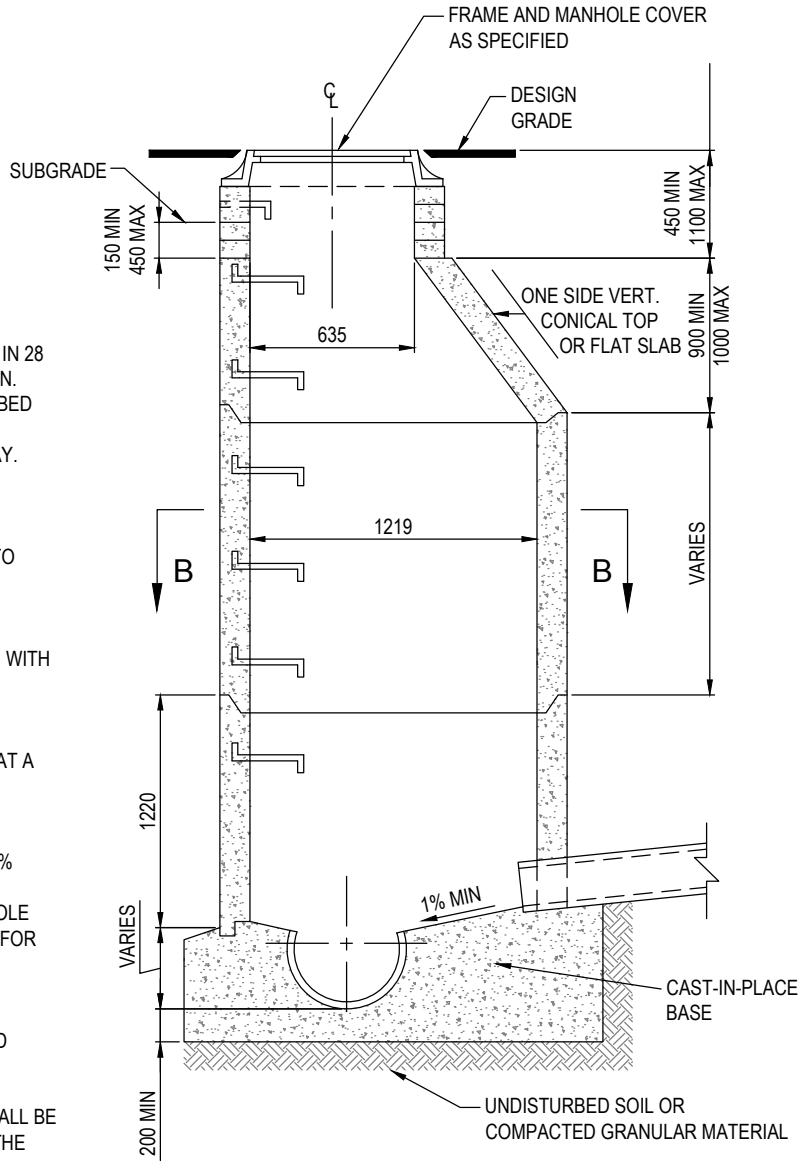
U02



SECTION B-B

NOTES:

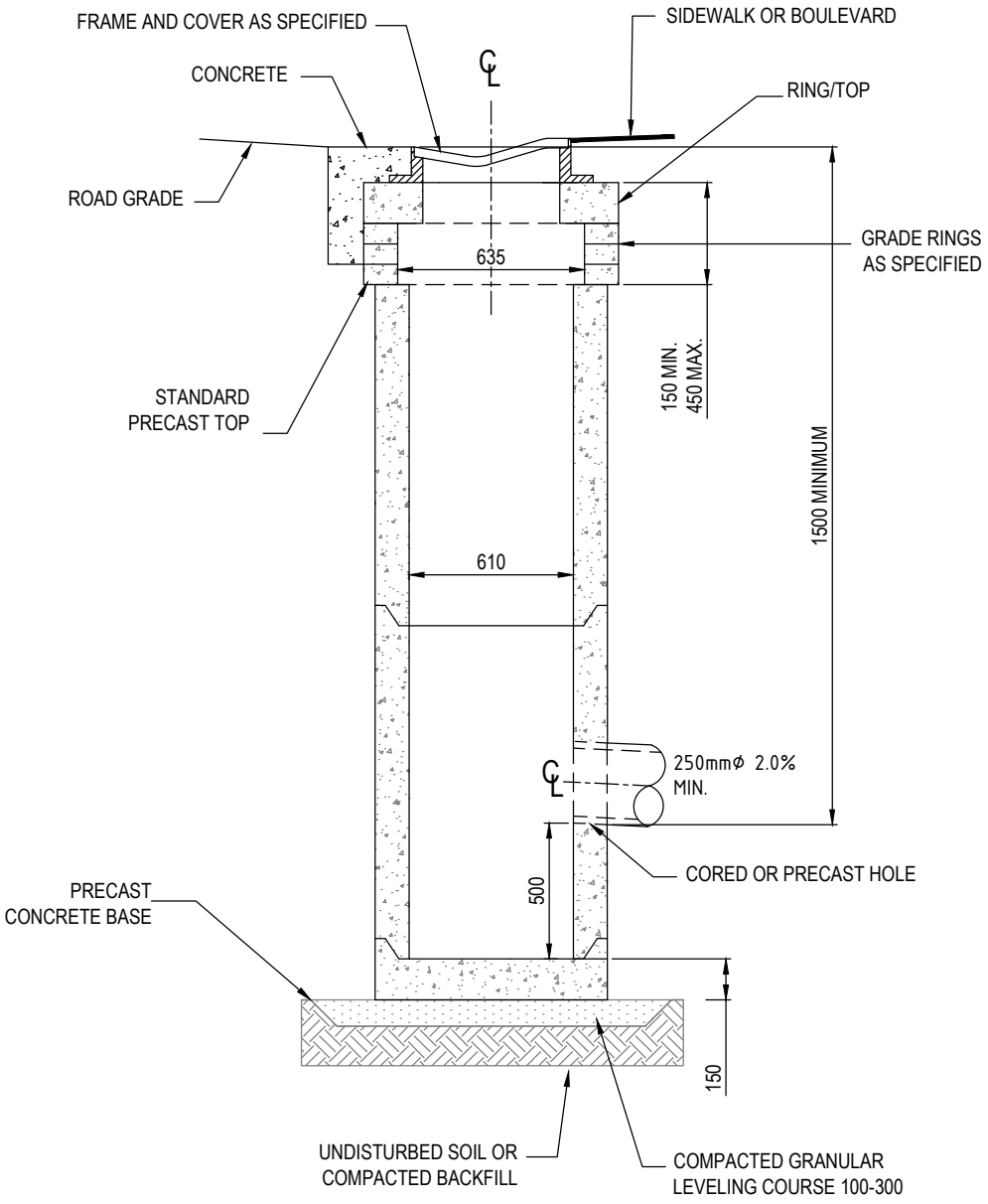
1. CAST-IN-PLACE CONCRETE BASE MAY BE USED. CAST-IN-PLACE CONCRETE TO BE TYPE 50 25MPa IN 28 DAYS. CAST-IN-PLACE CONCRETE BASE TO BE MIN. 200mm THICK AND CONSTRUCTED ON UNDISTURBED SOIL. FOR MH OVER 5.0m IN DEPTH, BASE TO BE REINFORCED WITH 10M BARS AT 250mm EACH WAY.
2. PRECAST RINGS, CONES AND BARRELS TO MEET CURRENT A.S.T.M. C478 STANDARDS.
3. JOINTS TO BE SEALED WITH CEMENT MORTAR, CONFINED O-RING GASKET, ASTM 445, OR BOTH TO MAKE JOINTS WATERTIGHT.
4. CONNECTION OF CONCRETE PIPES TO MH TO BE SEALED WITH CEMENT MORTAR.
5. INLET AND OUTLET PIPES TO BE GROUTED FLUSH WITH WALL.
6. CHANNELING AND BENCHING TO BE FINISHED TO TROWEL SMOOTHNESS.
7. SAFETY STEP SPACING TO BE EQUALLY SPACED AT A MAX. OF 410mm APART TO WITHIN 300mm BELOW COVER AND TO WITHIN 600mm OF THE BASE OR BENCHING.
8. COMPACT BACKFILL AROUND MH TO A MIN. OF 95% STANDARD PROCTOR DENSITY.
9. COMPACT TOP 1.5m OF BACKFILL AROUND MANHOLE TO A MIN. OF 98% STANDARD PROCTOR DENSITY FOR MANHOLE WITHIN ROAD RIGHT OF WAY.
10. PRECAST INLINE TEE MH's ARE ACCEPTABLE FOR SEWERS 900mmØ AND LARGER.
11. FOR PVC PIPE CONNECTIONS USE PRE-INSTALLED SEALED ALOK CONNECTIONS or APPROVED EQUIVALENT.
12. A TEMPORARY POLYETHYLENE DIRT BARRIER SHALL BE PLACED BETWEEN THE FRAME AND COVER AND THE CONCRETE SECTION WHEN MANHOLES ARE NOT IMMEDIATELY ADJUSTED TO GRADE.



SECTION A - A

ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED

REVISIONS			TITLE			
DATE	DESCRIPTION	BY	STANDARD 1200mm PERCHED MANHOLE			
APR 2020	DETAIL UPDATE	JH				
-	-	-	APPROVED: DH			
-	-	-	CHECKED: DH			DWG NO.
-	-	-	DATE: APR 2020	SCALE: NTS	DRAWN: JH	U03



NOTES:

1. CAST-IN-PLACE CONCRETE BASE MAY BE USED. CAST-IN-PLACE CONCRETE TO BE TYPE 50 25MPa IN 28 DAYS. CAST-IN-PLACE CONCRETE BASE TO BE MIN. 150mm THICK AND CONSTRUCTED ON UNDISTURBED SOIL.
2. PRECAST RINGS, CONES AND BARRELS TO MEET CURRENT ASTM C478 STANDARDS.
3. JOINTS TO BE SEALED WITH CEMENT MORTAR, CONFINED O-RING GASKET ASTM C445, OR BOTH TO MAKE JOINTS WATERTIGHT.
4. CONNECTION OF CONCRETE PIPES TO CB TO BE SEALED WITH CEMENT MORTAR.
5. INLET AND OUTLET PIPES TO BE GROUTED FLUSH WITH WALL.
6. COMPACT BACKFILL AROUND CB TO A MIN. OF 95% STANDARD PROCTOR DENSITY.
7. COMPACT TOP 1.5m OF BACKFILL AROUND CB TO A MIN. OF 98% STANDARD PROCTOR DENSITY FOR CB WITHIN ROAD RIGHT OF WAY.
8. FOR PVC PIPE CONNECTIONS USE PRE-INSTALLED SEALED ALOK CONNECTIONS OR APPROVED EQUIVALENT.

ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED

REVISIONS		
DATE	DESCRIPTION	BY
APR 2020	DETAIL UPDATE	JH
-	-	-
-	-	-
-	-	-

TITLE

STANDARD 600mm CATCHBASIN

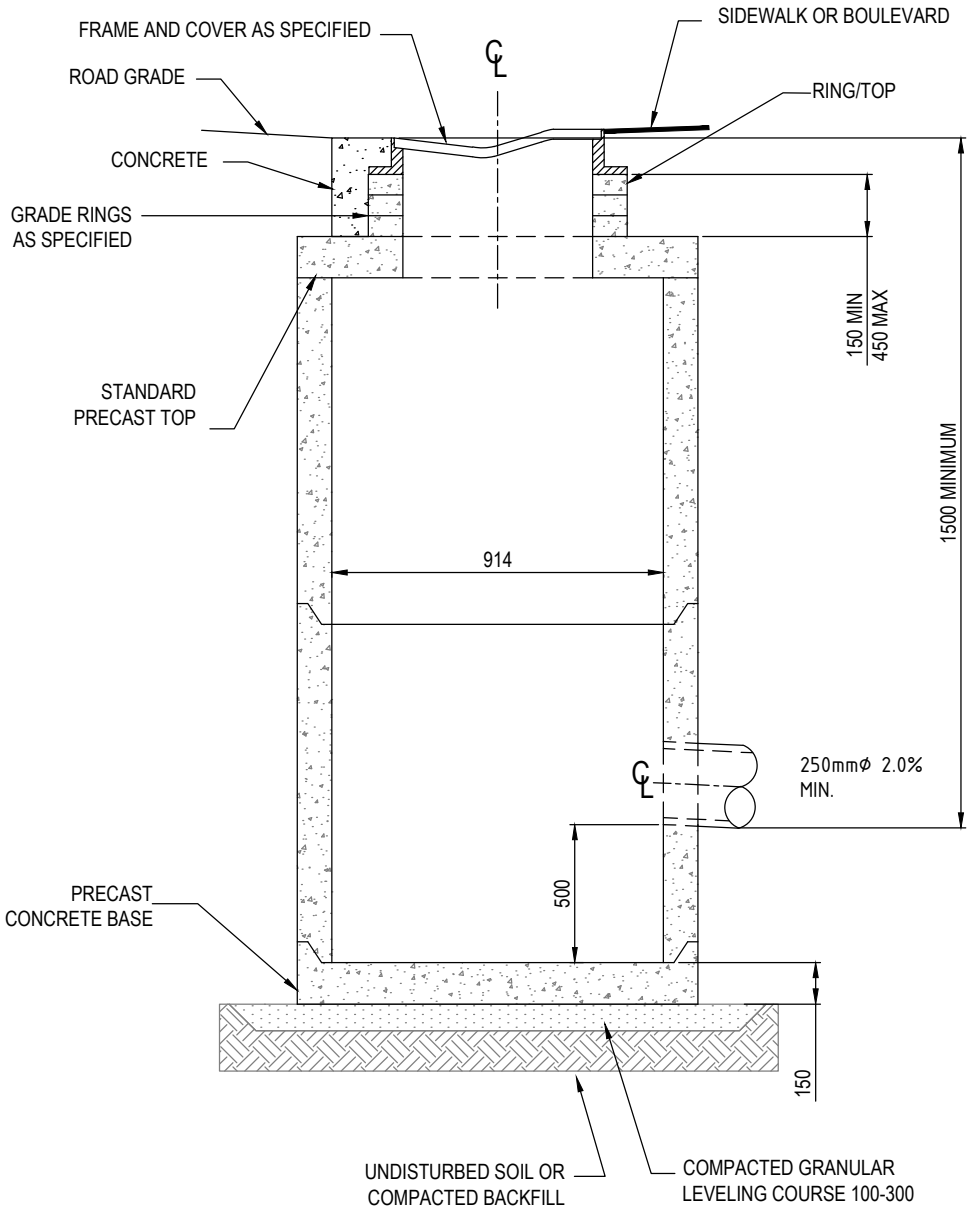
APPROVED: DH

CHECKED: DH

DATE: APR 2020 | SCALE: NTS | DRAWN: JH

DWG NO.

U04

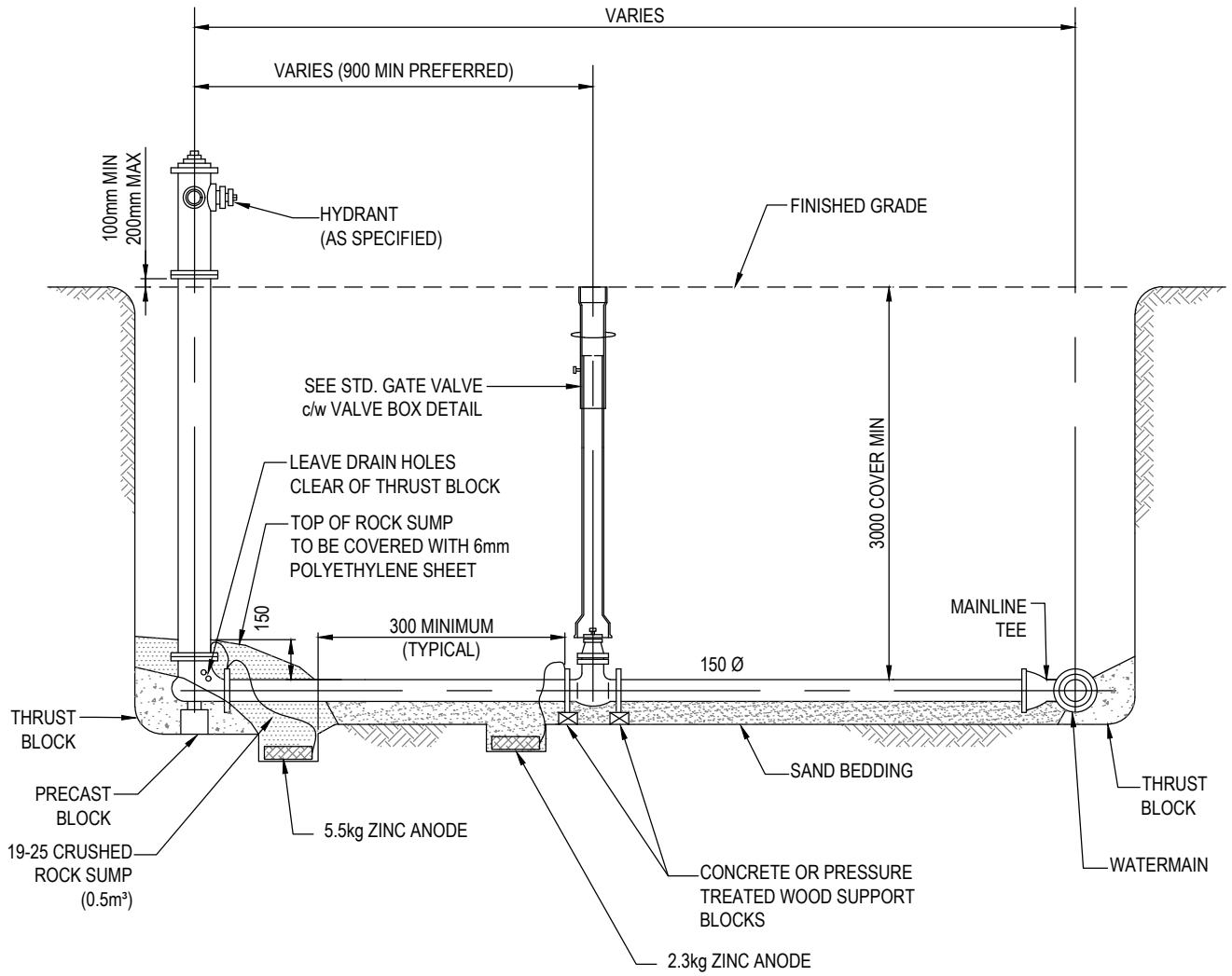


NOTES:

1. CAST-IN-PLACE CONCRETE BASE MAY BE USED. CAST-IN-PLACE CONCRETE TO BE TYPE 50 25MPa IN 28 DAYS. CAST-IN-PLACE CONCRETE BASE TO BE MIN. 150mm THICK AND CONSTRUCTED ON UNDISTURBED SOIL.
2. PRECAST RINGS, CONES AND BARRELS TO MEET CURRENT ASTM C478 STANDARDS.
3. JOINTS TO BE SEALED WITH CEMENT MORTAR, CONFINED O-RING GASKET ASTM C445, OR BOTH TO MAKE JOINTS WATERTIGHT.
4. CONNECTION OF CONCRETE PIPES TO CB TO BE SEALED WITH CEMENT MORTAR.
5. INLET AND OUTLET PIPES TO BE GROUTED FLUSH WITH WALL.
6. COMPACT BACKFILL AROUND CB TO A MIN. OF 95% STANDARD PROCTOR DENSITY.
7. COMPACT TOP 1.5m OF BACKFILL AROUND CB TO A MIN. OF 98% STANDARD PROCTOR DENSITY FOR CB WITHIN ROAD RIGHT OF WAY.
8. FOR PVC PIPE CONNECTIONS USE PRE-INSTALLED SEALED ALOK CONNECTIONS OR APPROVED EQUIVALENT.

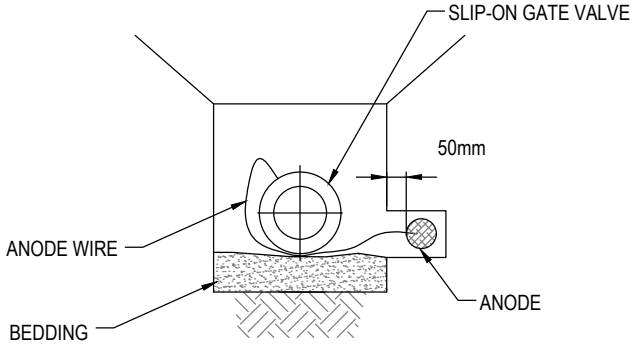
ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED

REVISIONS			TITLE			
DATE	DESCRIPTION	BY	STANDARD 900mm CATCHBASIN			
APR 2020	DETAIL UPDATE	JH				
-	-	-	APPROVED: DH			
-	-	-	CHECKED: DH			DWG NO.
-	-	-	DATE: APR 2020	SCALE: NTS	DRAWN: JH	U05



NOTES:

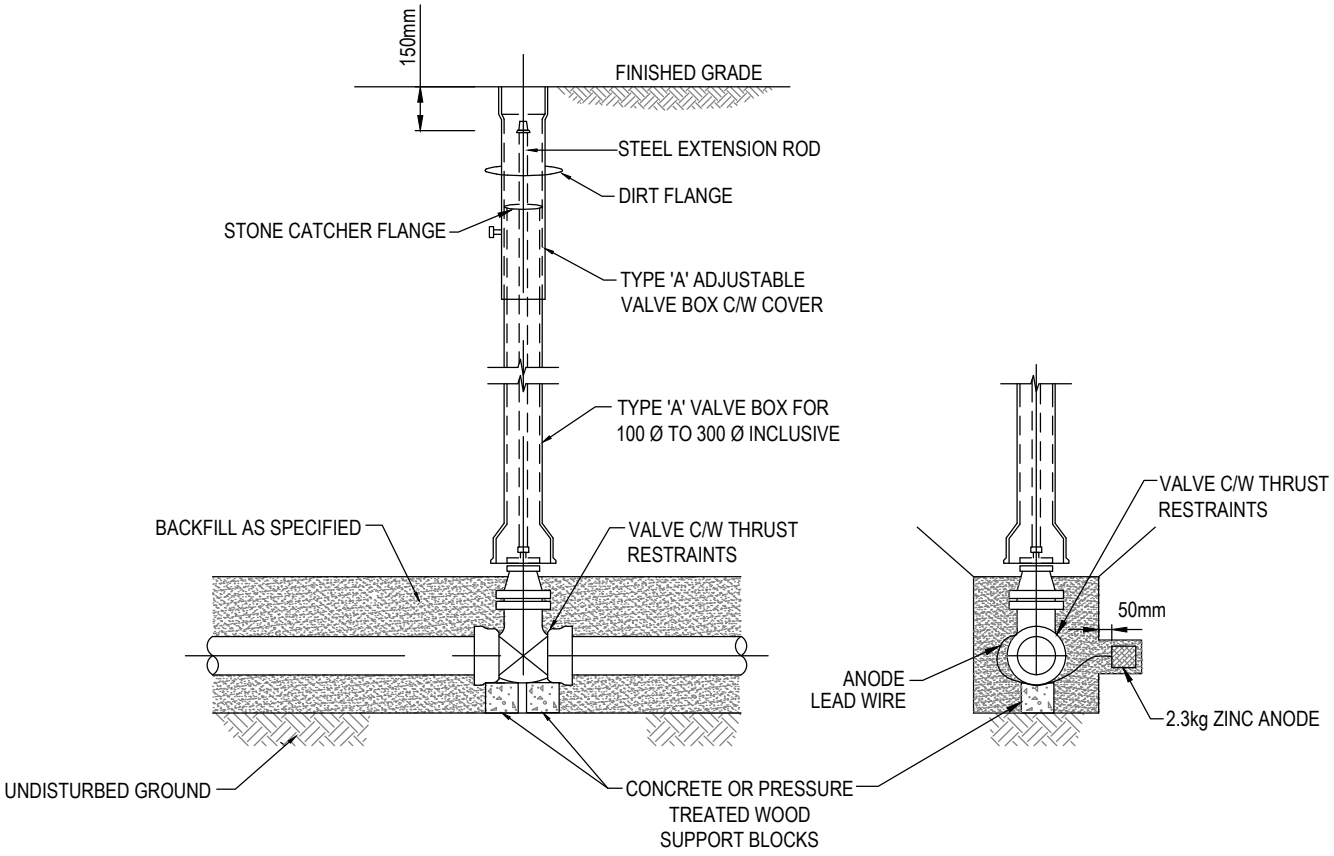
1. HYDRANT AND VALVE TO BE CATHODICALLY PROTECTED WITH A 11KG ZINC ANODE.
2. VALVE TO BE LOCATED IN BOULEVARD WHERE POSSIBLE.
3. HYDRANT TO BE CHROME YELLOW WITH TOPS AND CAPS COLORED IN ACCORDANCE WITH NFPA GUIDELINES.
4. ALL NUTS AND BOLTS TO BE STAINLESS STEEL.
5. HYDRANT MUST NOT RESTRICT SIDEWALK
   - MINIMUM 0.5m CLEARANCE TO FACE OF CURB.
   - MAXIMUM DISTANCE FROM CENTER LINE OF HYDRANT TO BACK OF CURB IS 3.0m.
6. OPERATOR AND CAPS TO HAVE PENTAGONAL NUTS.
7. HYDRANT SHOULD BE LOCATED SO STEAMER PORT FACES THE ROAD OR MOST ACCESSIBLE SPOT FOR A FIRE TRUCK TO CONNECT.



ANODE INSTALLATION AT HYDRANT

ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED

REVISIONS			TITLE			
DATE	DESCRIPTION	BY	HYDRANT CONNECTION			
APR 2020	DETAIL UPDATE	JH				
-	-	-	APPROVED: DH			
-	-	-	CHECKED: DH			DWG NO.
-	-	-	DATE: APR 2020	SCALE: NTS	DRAWN: JH	U06

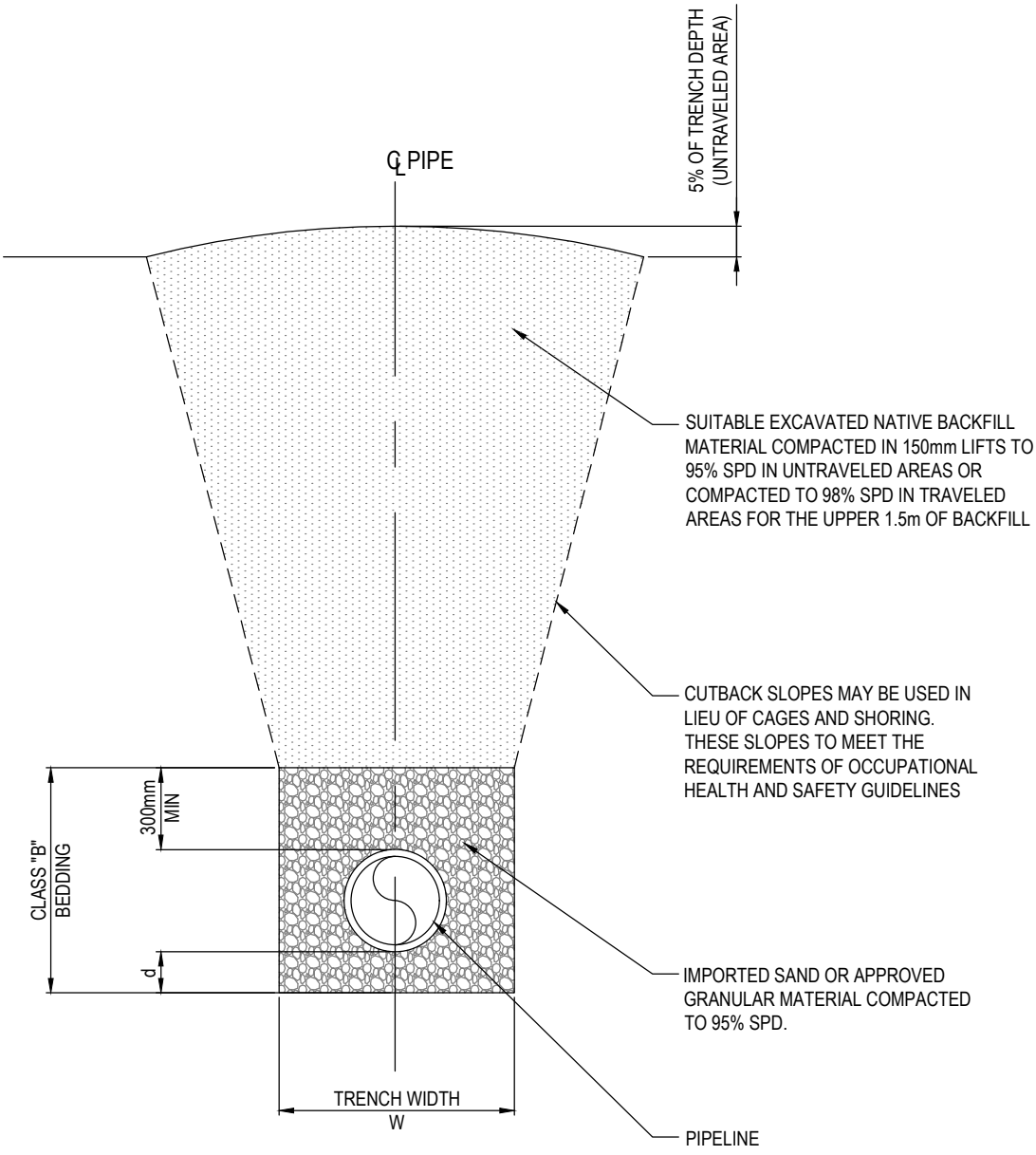


NOTES:

1. VALVE BOX TOPS TO BE SET FLUSH WITH SURFACE IN BOULEVARDS, GREEN SPACES AND CONCRETE SIDEWALKS.
2. VALVE BOXES SHALL BE BITUMINOUS COATED TO PREVENT CORROSION.
3. TYPE "B" VALVE TO BE USED FOR WATER LINES GREATER THAN 350mmØ.
4. VALVE TO BE EPOXY COATED WITH STAINLESS STEEL NUTS AND BOLTS.
5. VALVE TO BE RESILIENT SEATED WEDGE TYPE.

ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED

REVISIONS			TITLE			
DATE	DESCRIPTION	BY	VALVE WITH CATHODIC PROTECTION			
APR 2020	DETAIL UPDATE	JH				
-	-	-	APPROVED: DH			
-	-	-	CHECKED: DH			DWG NO.
-	-	-	DATE: APR 2020	SCALE: NTS	DRAWN: JH	U07



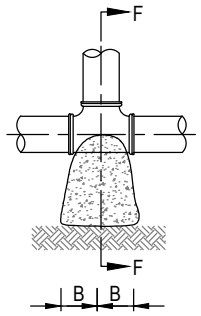
W = TRENCH WIDTH = O.D. + 450mm
O.D. = OUTSIDE PIPE DIAMETER
I.D. = INSIDE PIPE DIAMETER

d = DEPTH OF BEDDING BELOW PIPE

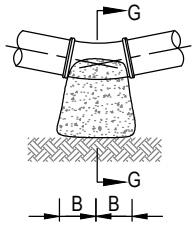
I.D. </= 675m : d MINIMUM = 75mm
I.D. 750mm to 1500mm: d MINIMUM = 100mm
I.D. >/= 1650mm : d MINIMUM = 150mm

ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED

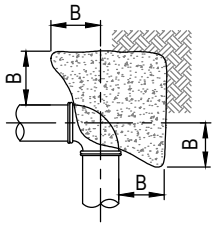
REVISIONS			TITLE			
DATE	DESCRIPTION	BY	TRENCH BACKFILL			
APR 2020	DETAIL UPDATE	JH				
-	-	-	APPROVED: DH			
-	-	-	CHECKED: DH			DWG NO.
-	-	-	DATE: APR 2020	SCALE: NTS	DRAWN: JH	U08



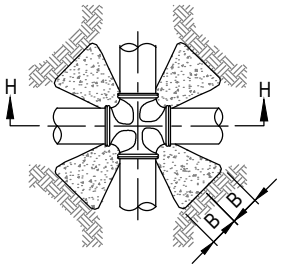
TEE & DEAD END CONNECTION



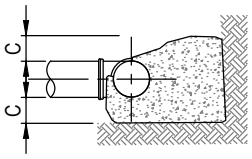
22 1/2° & 11 1/4° BENDS



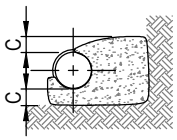
90° BEND



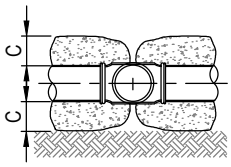
CROSS CONNECTION



SECTION F-F



SECTION G-G



SECTION H-H

NOTES:

1. CONCRETE TO BE 25 Mpa @ 28 DAYS
2. CONCRETE TO BE TYPE 50 SULFATE RESISTANT
3. CONCRETE TO BE CLEAR OF BELLS & PIPE
4. MINIMUM 75mm CONCRETE UNDER ALL FITTINGS
5. THRUST BLOCK DESIGNED ON
   - 100 Kpa ALLOWABLE SOIL BEARING PRESSURE
   - 1.5 FACTOR OF SAFETY
   - 1035 Kpa PIPE WATER PRESSURE
   - LARGER REACTION AREAS ARE REQUIRED IN POOR SOIL CONDITIONS

MINIMUM CONCRETE THRUST BLOCK DIMENSIONS

1035 KPa WATER PRESSURE & 95.76 KPa ALLOWABLE SOIL PRESSURE									
FITTINGS		11 1/4° BEND	22 1/2° BEND	45° BEND	60° BEND	67 1/2° BEND	75° BEND	90° BEND	CROSS-TEE & PLUG
RAR		0.198 A	0.390 A	0.765 A	A	1.112 A	1.218 A	1.414 A	A
RAR = 2B x (2C + DIA.) & 2B ≥ (2C + DIA.)					RAR = REACTION AREA REQUIRED A = AREA CONSTANT				
DIA. = 150 A = 0.197	RAR	0.039	0.77	0.151	0.197	0.219	0.240	0.279	0.197
	B	100	150	220	250	250	275	310	250
	C	50 (MIN.)	50 (MIN.)	100	125	150	150	150	125
DIA. = 200 A = 350	RAR	0.069	0.137	0.268	0.350	0.389	0.426	0.495	0.350
	B	125	175	275	300	325	360	360	300
	C	75	100	150	200	200	200	250	200
DIA. = 250 A = 0.547	RAR	0.108	0.213	0.418	0.547	0.608	0.666	0.773	0.547
	B	150	250	380	420	420	450	460	420
	C	75	100	150	200	250	250	300	200
DIA. = 300 A = 0.788	RAR	0.156	0.307	0.603	0.788	0.876	0.960	1.114	0.788
	B	200	310	430	440	440	440	500	440
	C	75	100	200	300	350	400	400	300
DIA. = 350 A = 1.073	RAR	0.212	0.418	0.821	1.073	1.193	1.307	1.517	1.073
	B	200	380	430	510	520	570	570	510
	C	100	100	300	350	400	400	500	350
DIA. = 400 A = 1.401	RAR	0.277	0.545	1.072	1.401	1.558	1.706	1.981	1.401
	B	230	455	540	580	600	610	710	580
	C	100	100	300	400	450	500	500	400
DIA. = 450 A = 1.773	RAR	0.351	0.692	1.356	1.773	1.972	2.160	2.507	1.773
	B	260	510	610	650	675	700	800	650
	C	100	100	400	450	500	600	600	450

ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED

REVISIONS		
DATE	DESCRIPTION	BY
APR 2020	DETAIL UPDATE	JH
-	-	-
-	-	-
-	-	-

TITLE

THRUST BLOCK

APPROVED: DH

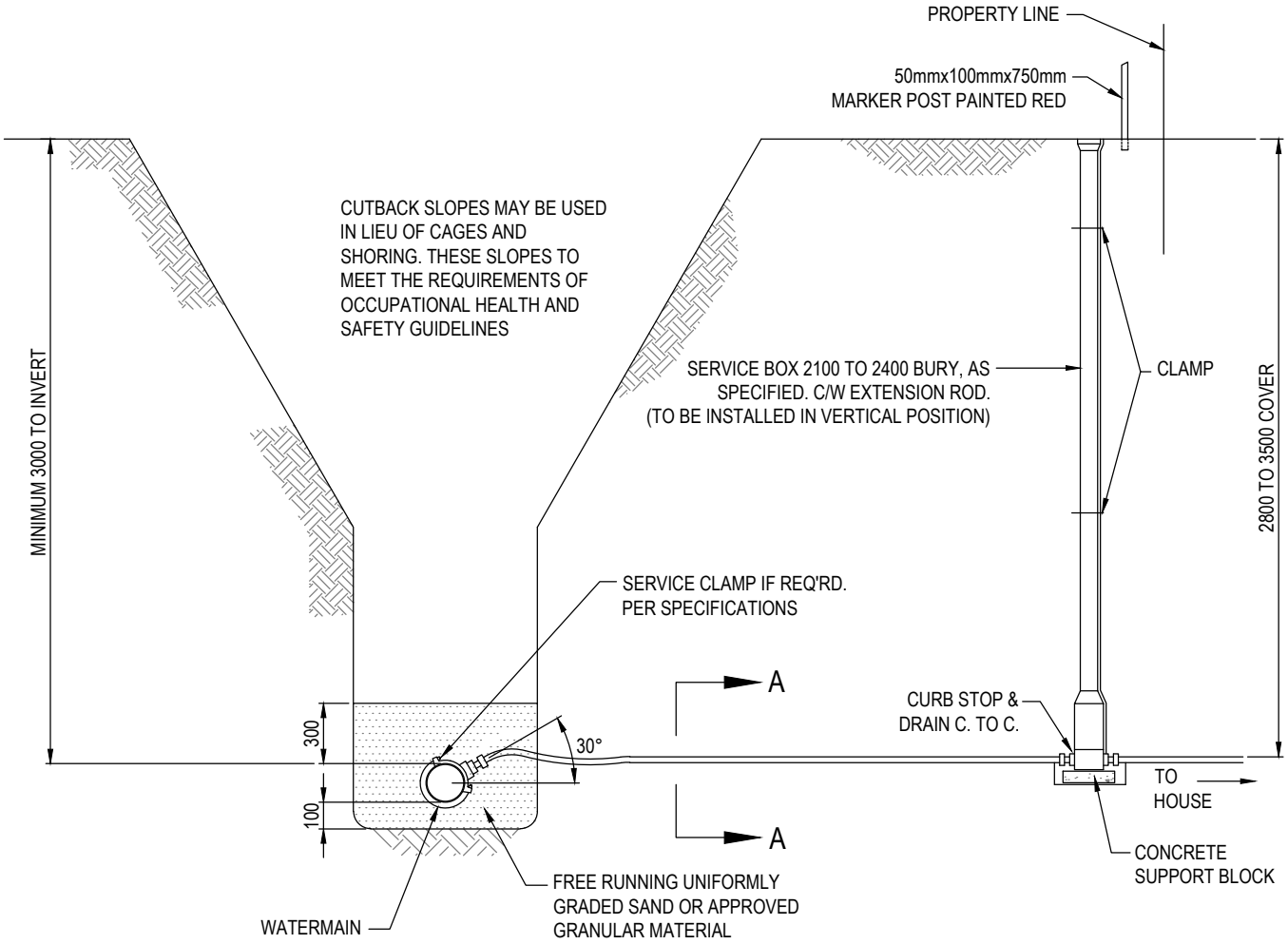
CHECKED: DH

DATE: APR 2020 | SCALE: NTS | DRAWN: JH

the TOWN of Calmar

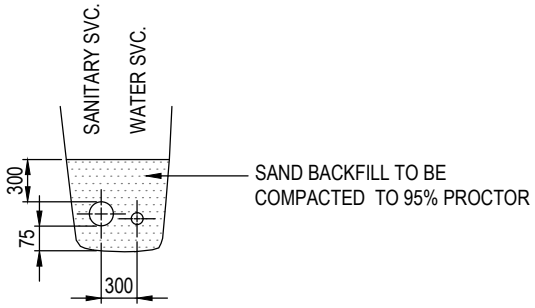
DWG NO.

U09



NOTE:

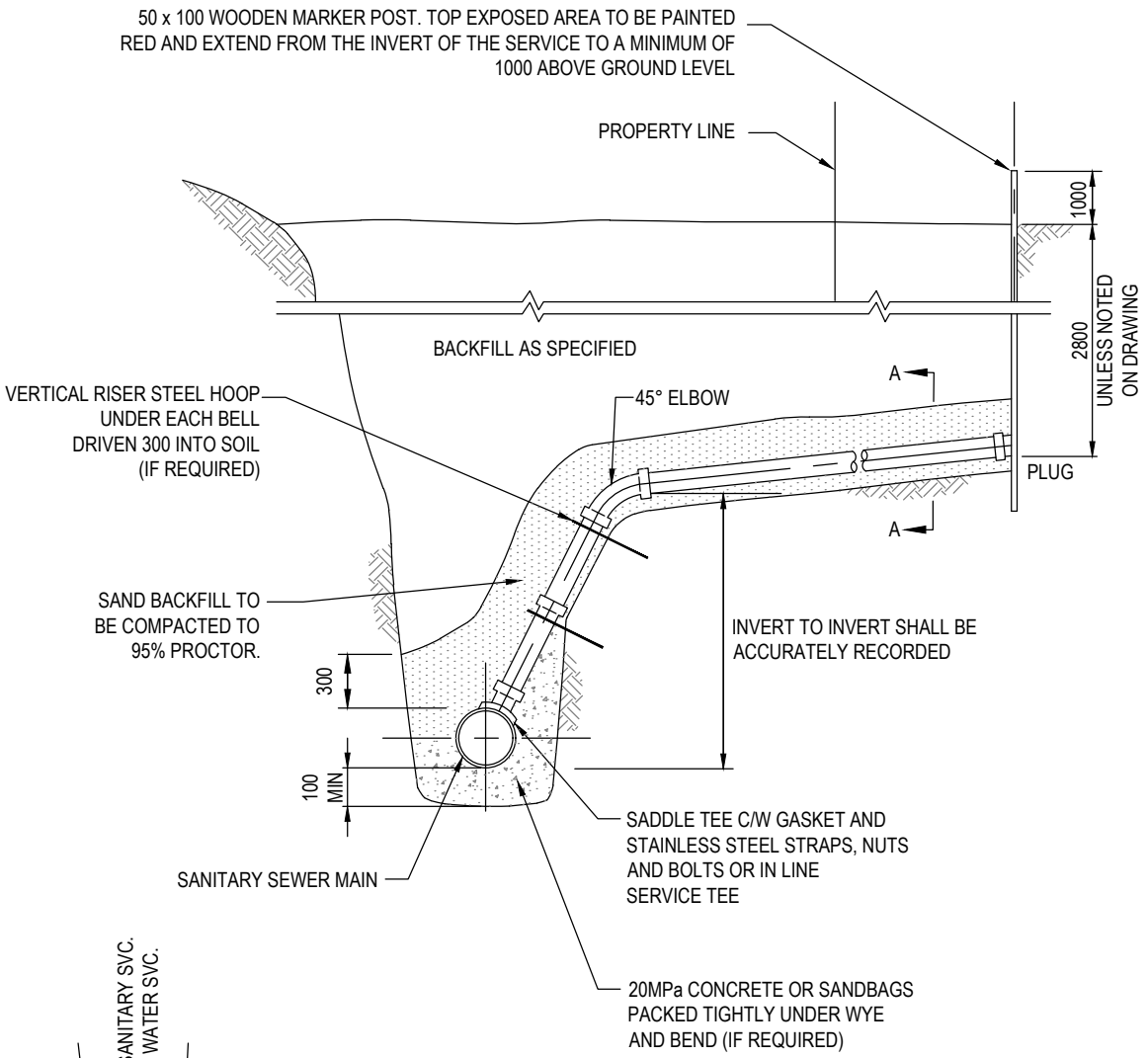
1. WATER SERVICE TO BE TAPPED AT THE 2 TO 3 O'CLOCK POSITION.
2. WATER SERVICE TO BE TYPE K COPPER.
3. WATER SERVICE TO BE SNAKED IN THE TRENCH.
4. WATER SERVICE IS NOT TO BE GOOSNECKED AT THE CORPORATION STOP.
5. CORPORATION STOP AND CURB STOP TO BE CATHODICALLY PROTECTED WITH 5KG ZINC ANODES.
6. ALL FITTINGS TO BE PACKER NUT TYPE, NOT GRIPPER NUT.



SECTION A - A

ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED

REVISIONS			TITLE			
DATE	DESCRIPTION	BY	STANDARD WATER SERVICE CONNECTION			
APR 2020	DETAIL UPDATE	JH				
-	-	-	APPROVED: DH			
-	-	-	CHECKED: DH			DWG NO. U10
-	-	-	DATE: APR 2020	SCALE: NTS	DRAWN: JH	



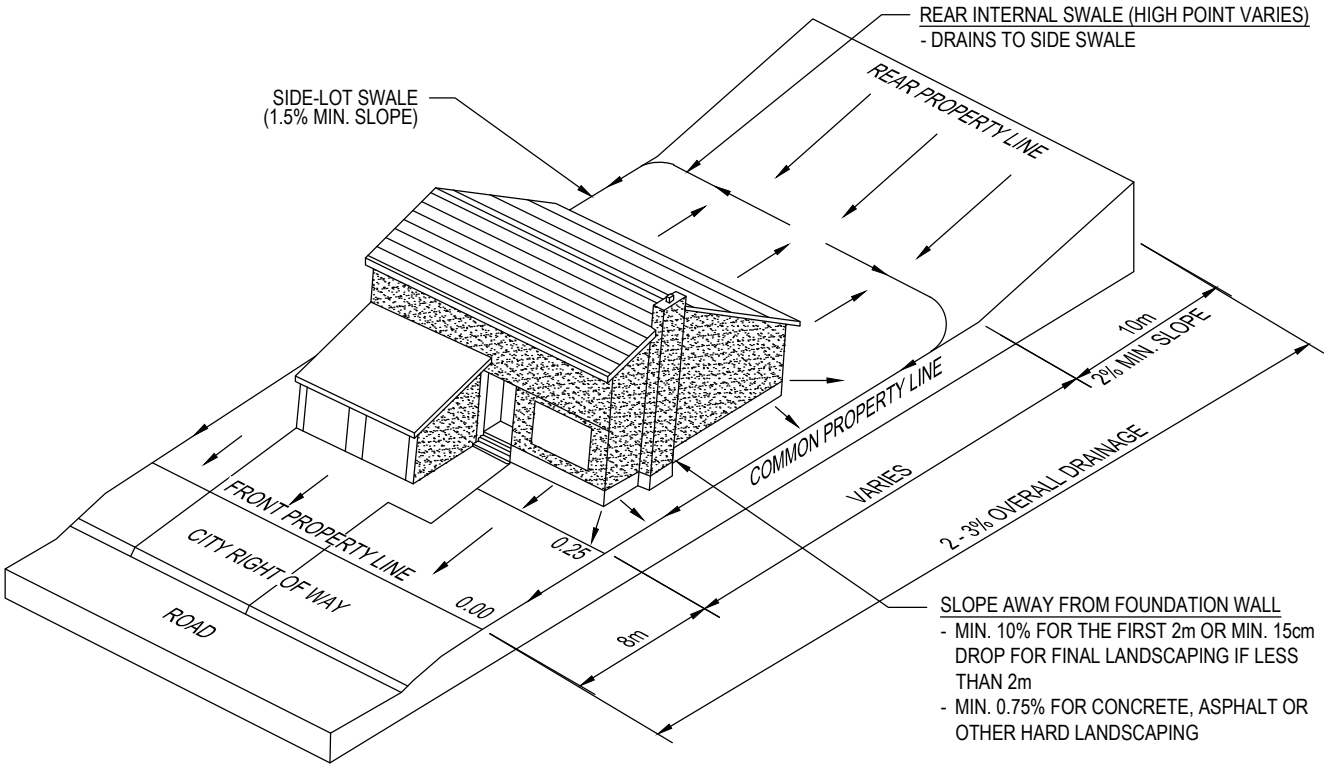
SECTION A-A

NOTE:

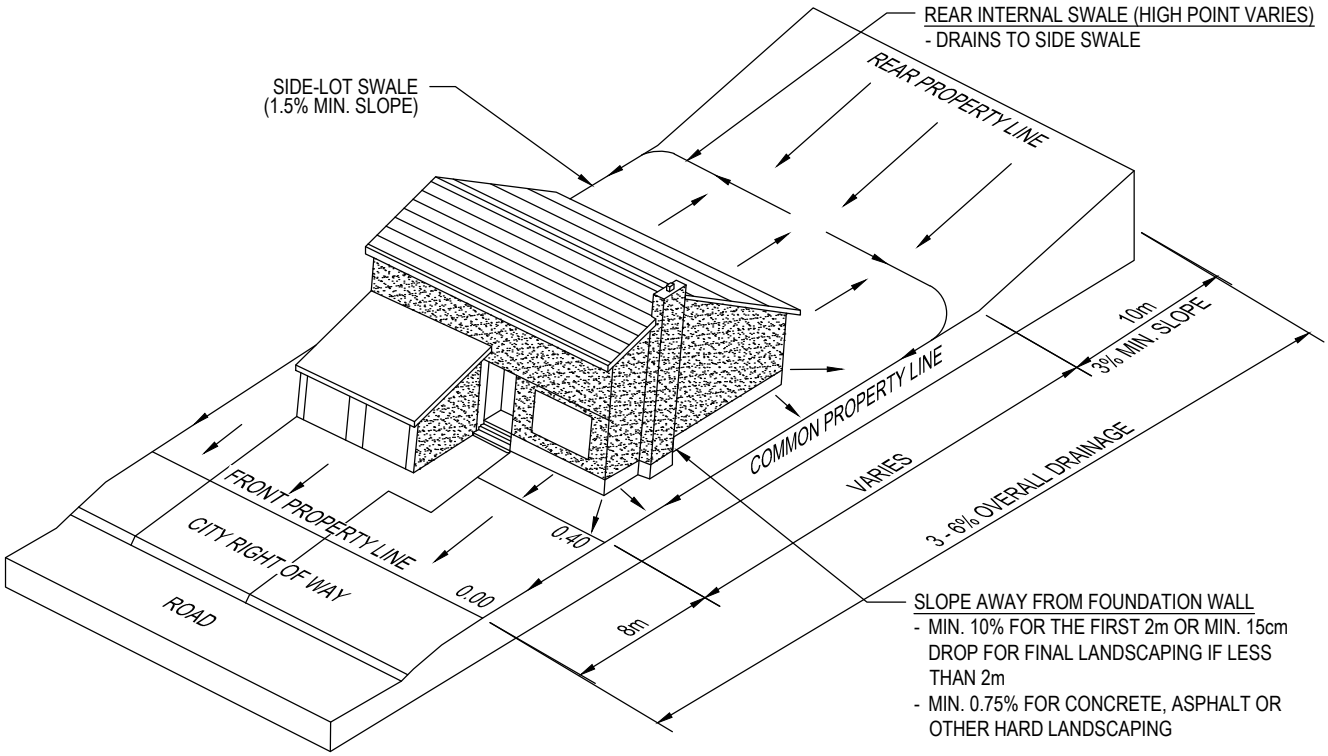
1. MINIMUM SLOPE FOR 100mm & 150mm DIA. PIPE IS 2%
2. RESIDENTIAL SERVICE CONNECTIONS SHALL BE 100mm UNLESS SPECIFICALLY APPROVED OTHERWISE.

ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE NOTED

REVISIONS			TITLE			
DATE	DESCRIPTION	BY	STANDARD SANITARY SERVICE CONNECTION			
APR 2020	DETAIL UPDATE	JH				
-	-	-	APPROVED: DH			
-	-	-	CHECKED: DH			DWG NO.
-	-	-	DATE: APR 2020	SCALE: NTS	DRAWN: JH	U11



TYPE A [A]
2 - 3 % OVERALL
BACK TO FRONT DRAINAGE



TYPE B [B]
3 - 6 % OVERALL
BACK TO FRONT DRAINAGE

REVISIONS		
DATE	DESCRIPTION	BY
APR 2020	DETAIL UPDATE	JH
-	-	-
-	-	-
-	-	-

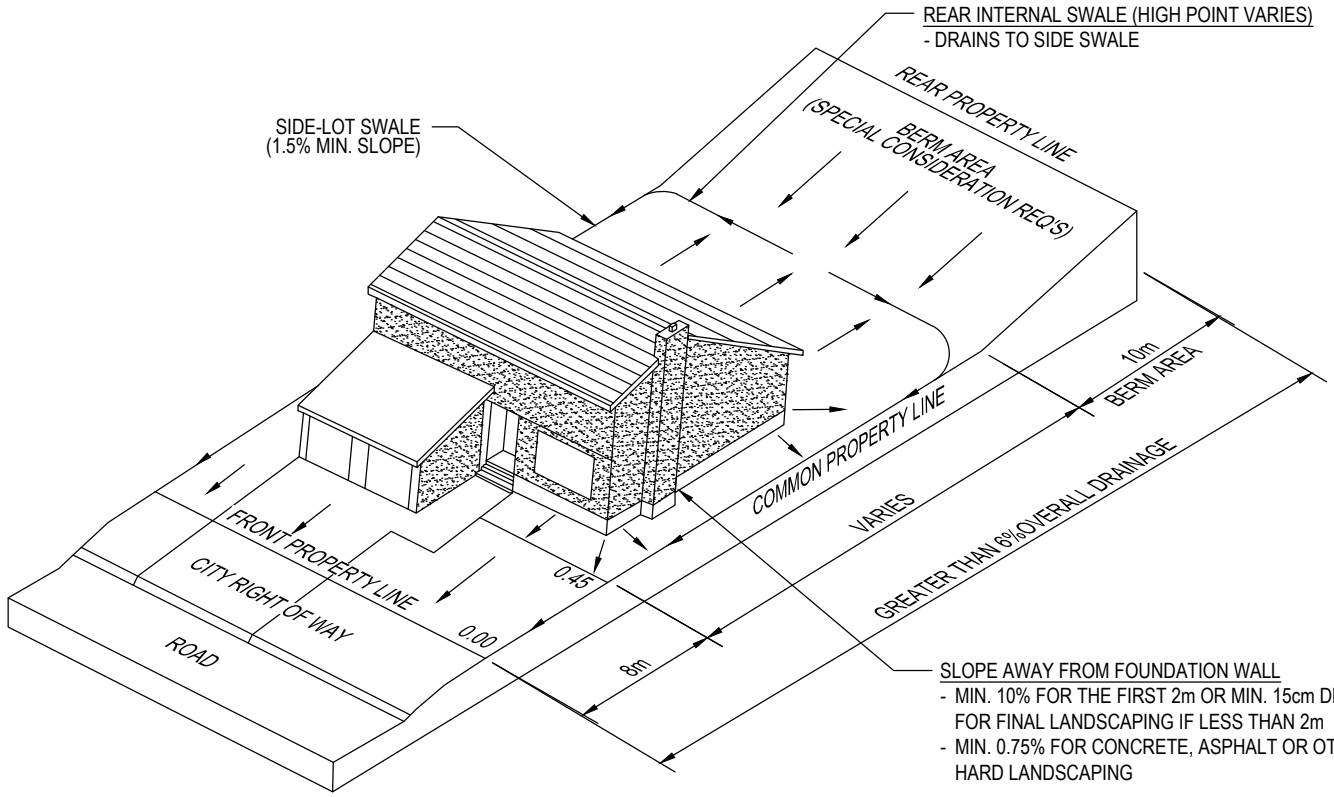
TITLE
LOT GRADING DETAILS

APPROVED: DH

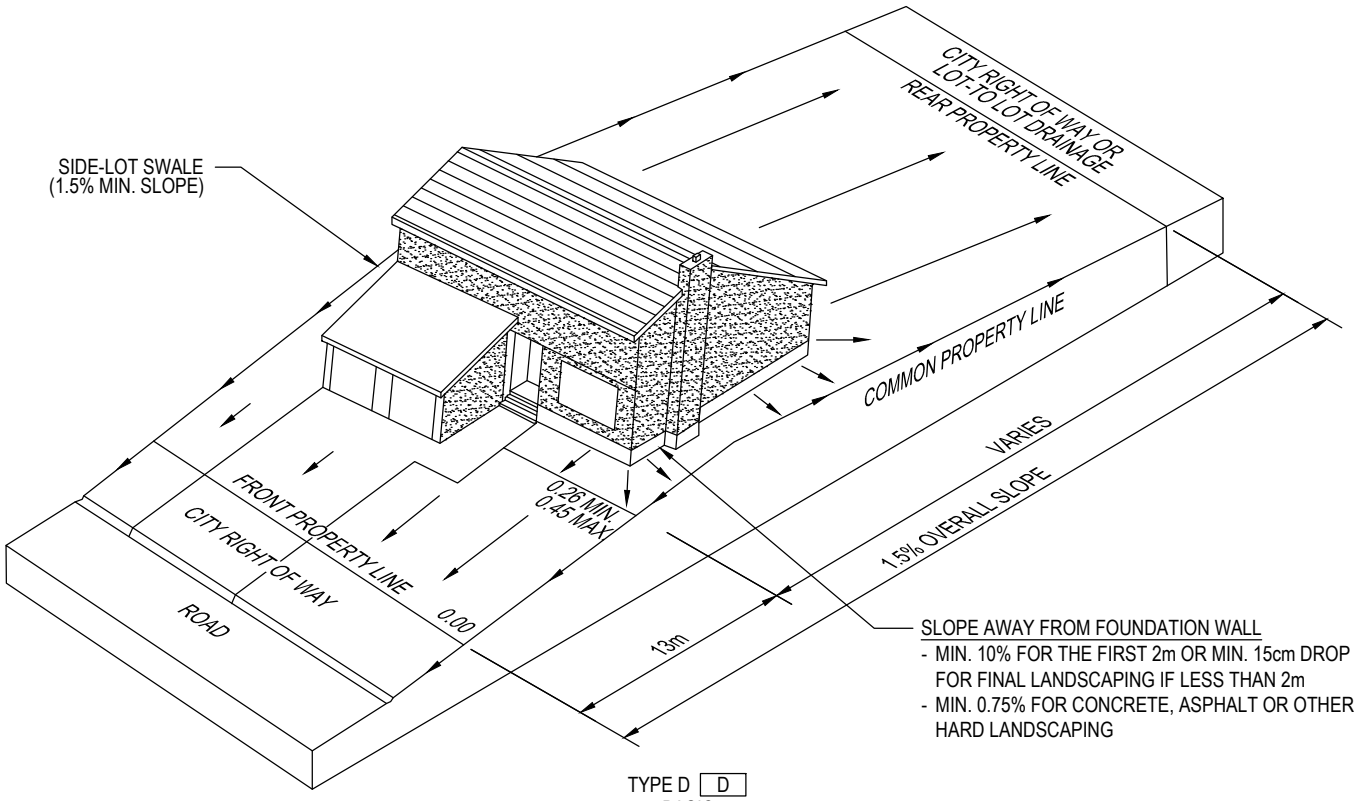
CHECKED: DH

DATE: APR 2020 | SCALE: NTS | DRAWN: JH

DWG NO.
U12



TYPE C [C]
6 - 10 % MAX. OVERALL
BACK TO FRONT DRAINAGE



TYPE D [D]
BASIC
SPLIT DRAINAGE

REVISIONS		
DATE	DESCRIPTION	BY
APR 2020	DETAIL UPDATE	JH
-	-	-
-	-	-
-	-	-

TITLE

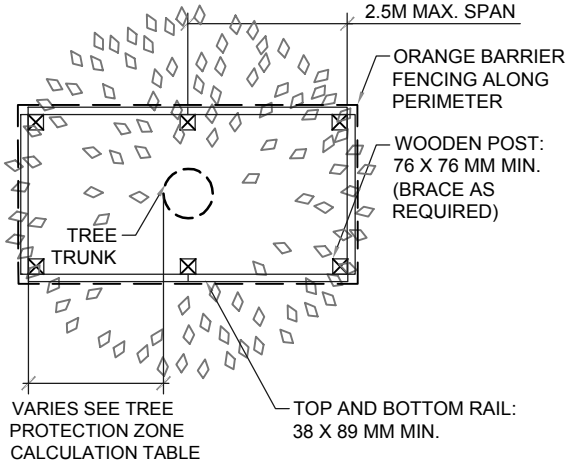
LOT GRADING DETAILS
TYPE C & TYPE D

APPROVED: DH

CHECKED: DH

DATE: APR 2020 | SCALE: NTS | DRAWN: JH

DWG NO.
U13

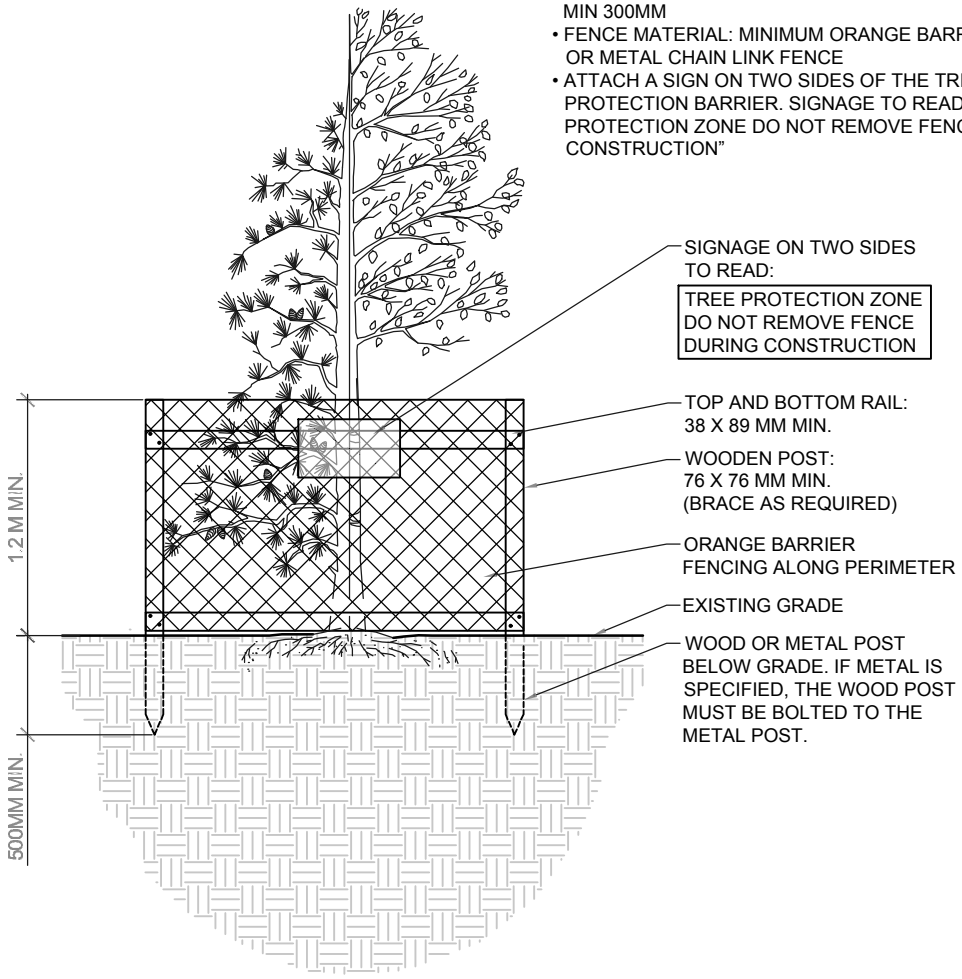


PLAN VIEW

TREE PROTECTION ZONE CALCULATION TABLE	
TRUNK DIAMETER (DBH)	MINIMUM PROTECTION DISTANCE REQUIRED (MEASURE FROM THE OUTSIDE EDGE OF TREE TRUNK)
10 CM & UNDER	1.2 METERS
11 - 30 CM	1.8 METERS
31 - 40 CM	2.4 METERS
41 - 50 CM	3.0 METERS
51 - 60 CM	3.6 METERS
61 - 70 CM	4.2 METERS
71 - 80 CM	4.8 METERS
>80 CM	5.0 METERS

NOTES:

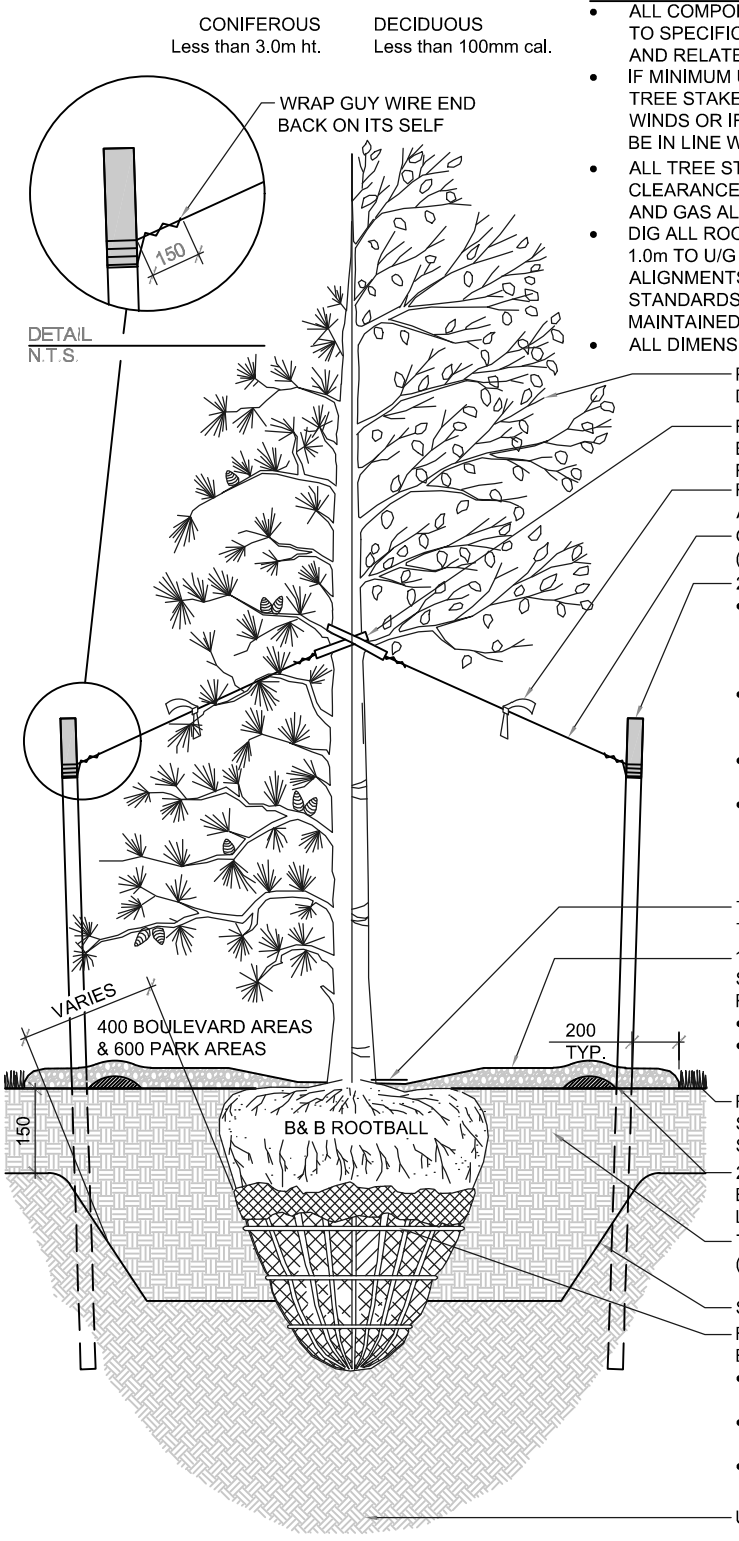
- WOOD POST: (MIN. 76MM WIDTH) INSTALLED TO A DEPTH OF 500MM (ALBERTA FIRST CALL REQUIRED)
- TOP AND BOTTOM RAIL: (MIN. 38 X 89MM CONSTRUCTION, MAX. SPAN 2.5M), CROSS BRACING AS REQUIRED.
- HEIGHT OF THE FENCE: MIN.1.2 METERS
- NO GROUND DISTURBANCE WITHIN 1.2 METER OF THE TREE TRUNK (I.E. POST INSTALLATION)
- POSTS SET BACK FROM SIDEWALK AND CURB: MIN 300MM
- FENCE MATERIAL: MINIMUM ORANGE BARRIER FENCE OR METAL CHAIN LINK FENCE
- ATTACH A SIGN ON TWO SIDES OF THE TREE PROTECTION BARRIER. SIGNAGE TO READ “TREE PROTECTION ZONE DO NOT REMOVE FENCE DURING CONSTRUCTION”



REVISIONS			TITLE			
DATE	DESCRIPTION	BY	TREE PROTECTION ZONE			
-	-	-				
-	-	-	APPROVED:			
-	-	-	CHECKED: JS			DWG NO. LA01
-	-	-	DATE: JULY 2020	SCALE: NTS	DRAWN: DF	

NOTES:

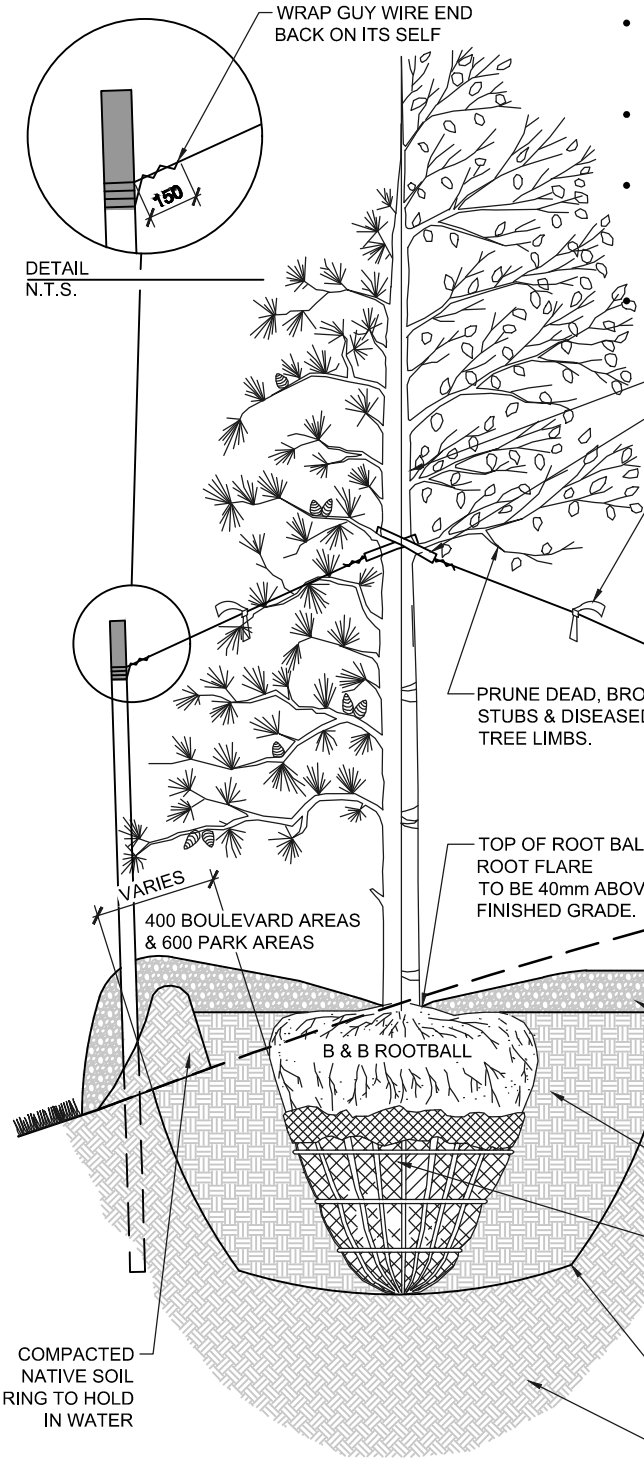
- ALL COMPONENTS AND WORKMANSHIP TO CONFORM TO SPECIFICATION SECTION 3.11 PLANT MATERIAL AND RELATED SECTIONS.
- IF MINIMUM UTILITY SETBACKS PERMIT POSITION TREE STAKES INTO DIRECTION OF PREVAILING WINDS OR IF IN THE BOULEVARD STAKES SHOULD BE IN LINE WITH THE DIRECTION OF TRAFFIC.
- ALL TREE STAKES TO MAINTAIN MINIMUM 1.0m CLEARANCE FROM ALL U/G POWER, TELEPHONE AND GAS ALIGNMENTS.
- DIG ALL ROOT HOLES BY HAND WHEN CLOSER THAN 1.0m TO U/G POWER, TELEPHONE AND GAS ALIGNMENTS (REFER TO UTILITY SETBACKS IN STANDARDS WHEN CLEARANCE CANNOT BE MAINTAINED FOR EXCAVATIONS.
- ALL DIMENSIONS IN MILLIMETERS.



REVISIONS			TITLE			
DATE	DESCRIPTION	BY	TYPICAL TREE PLANTING			
-	-	-				
-	-	-	APPROVED:			
-	-	-	CHECKED: JS			DWG NO. LA02
-	-	-	DATE: JULY 2020	SCALE: NTS	DRAWN: DF	

CONIFEROUS
Less than 3.0m ht.

DECIDUOUS
Less than 100mm cal.



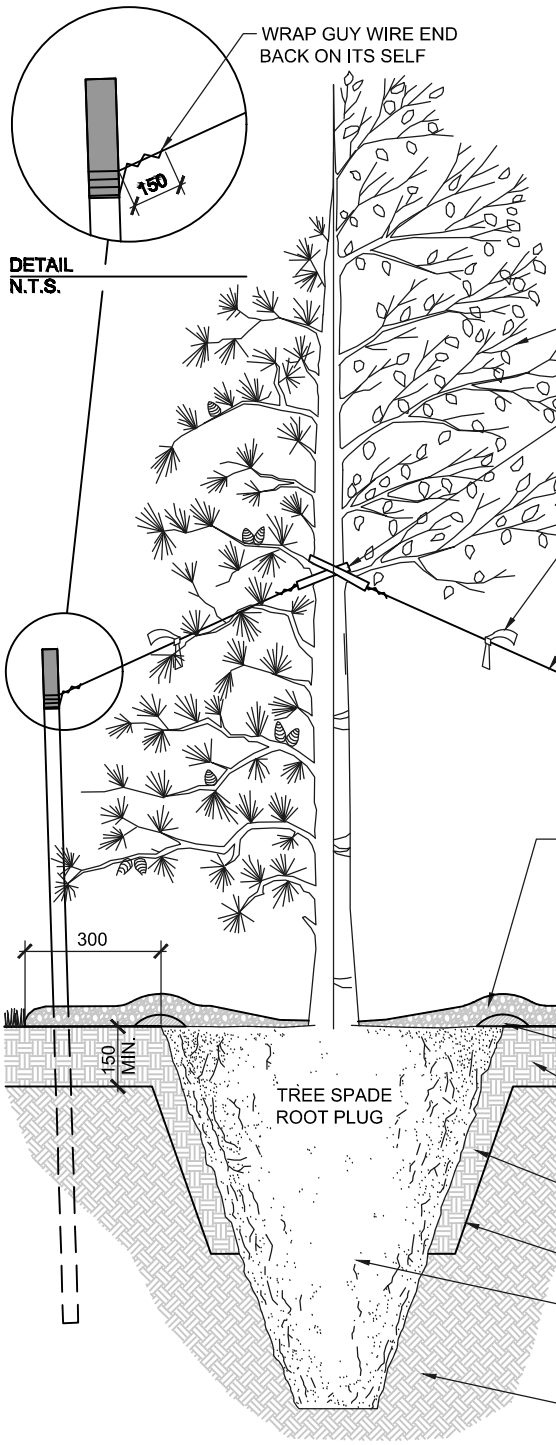
NOTES:

- ALL COMPONENTS AND WORKMANSHIP TO CONFORM TO SPECIFICATION SECTION 3.11 PLANT MATERIAL AND RELATED SECTIONS.
- IF MINIMUM UTILITY SETBACKS PERMIT POSITION TREE STAKES INTO DIRECTION OF PREVAILING WINDS OR IF IN THE BOULEVARD STAKES SHOULD BE IN LINE WITH THE DIRECTION OF TRAFFIC.
- ALL TREE STAKES TO MAINTAIN MINIMUM 1.0m CLEARANCE FROM ALL U/G POWER, TELEPHONE AND GAS ALIGNMENTS.
- DIG ALL ROOT HOLES BY HAND WHEN CLOSER THAN 1.0m TO U/G POWER, TELEPHONE AND GAS ALIGNMENTS (REFER TO UTILITY SETBACKS IN STANDARDS WHEN CLEARANCE CANNOT BE MAINTAINED FOR EXCAVATIONS.
- ALL DIMENSIONS IN MILLIMETERS.

REVISIONS			TITLE			
DATE	DESCRIPTION	BY	TYPICAL TREE PLANTING ON SLOPES			
-	-	-				
-	-	-	APPROVED:			
-	-	-	CHECKED: JS			DWG NO. LA03
-	-	-	DATE: JULY 2020	SCALE: NTS	DRAWN: DF	

CONIFEROUS
Less than 3.0m ht.

DECIDUOUS
Less than 200mm cal.



NOTES:

- ALL COMPONENTS AND WORKMANSHIP TO CONFORM TO SPECIFICATION SECTION 3.11 PLANT MATERIAL AND RELATED SECTIONS.
- IF MINIMUM UTILITY SETBACKS PERMIT POSITION TREE STAKES INTO DIRECTION OF PREVAILING WINDS OR IF IN THE BOULEVARD STAKES SHOULD BE IN LINE WITH THE DIRECTION OF TRAFFIC.
- ALL TREE STAKES TO MAINTAIN MINIMUM 1.0m CLEARANCE FROM ALL U/G POWER, TELEPHONE AND GAS ALIGNMENTS.
- DIG ALL ROOT HOLES BY HAND WHEN CLOSER THAN 1.0m TO U/G POWER, TELEPHONE AND GAS ALIGNMENTS (REFER TO UTILITY SETBACKS IN STANDARDS WHEN CLEARANCE CANNOT BE MAINTAINED FOR EXCAVATIONS.
- ALL DIMENSIONS IN MILLIMETERS.

PRUNE DEAD, BROKEN, STUBS & DISEASED TREE LIMBS.

RUBBER HOSE - 12mm OR APPROVED EQUAL. POSITION AT APPROX. 3/5 HT. FOR ALL TREES.

FLUORESCENT ORANGE FLAGGING ON ALL GUY WIRES.

GALVANIZED GUY WIRE No. 12 (MIN. SIZE)

2 VERTICAL STAKES PER TREE:

- TREE STAKES MIN. 2.0m LENGTH PLAIN T-POSTS (1.33LB/FT) C/W 7 PUNCHED HOLES (1-1/2" X 1-3/8" X 7") OR TEETH / NOTCHES
- ALL EXPOSED PORTIONS OF TREE STAKES FREE OF RUST, SCALED, PRIMED, & PAINTED.
- TREE STAKES SET MIN. 600mm INTO UNDISTURBED SOIL.
- LARGE TREES TO HAVE 3-4 STAKES.

100mm MIN. WOOD MULCH, SEE SPEC SECTION 32 93 10 TREES SHRUBS ORNAMENTALS, OVER ROOT BALL.

- TAPER MULCH TO BASE OF TREE.
- MULCH TO EXTEND TO 150mm BEYOND EDGE OF WELL BUMP.

RE-ESTABLISH ANY DAMAGED SEED/SOD TO TOWN OF CALMAR STANDARDS.

254mm WIDE X 51mm HIGH TOPSOIL BUMP TO HOLD IN WATER (CENTRE LINE OF BUMP ON EDGE OF WELL).

TOPSOIL, MODERATELY COMPACTED (ENSURE STABILITY OF ROOT BALL).

ENSURE ANY VOIDS ARE FILLED WITH TOPSOIL.

SCARIFY WALL OF TREE WELL.

ROOT PLUG (MINIMUM SIZE AS PER SPECIFICATIONS) - FOR EVERY 25mm OF D.B.H. OVER MIN. SIZE ADD 300mm TO SPADE WIDTH.

UNDISTURBED NATIVE SOIL.

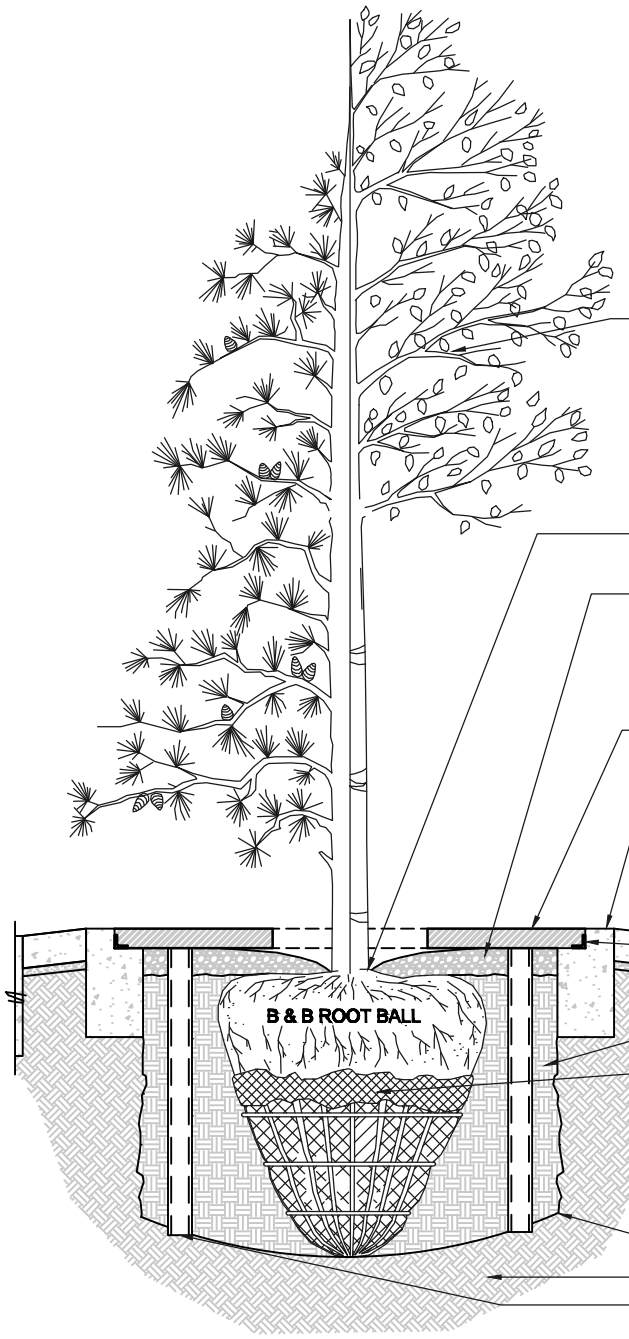
REVISIONS			TITLE			
DATE	DESCRIPTION	BY	TYPICAL TRANSPLANTED TREE			
-	-	-				
-	-	-	APPROVED:			
-	-	-	CHECKED: JS			DWG NO. LA04
-	-	-	DATE: JULY 2020	SCALE: NTS	DRAWN: DF	

CONIFEROUS
Less than 3.0m ht.

DECIDUOUS
Less than 100mm cal.

NOTES:

- ALL COMPONENTS AND WORKMANSHIP TO CONFORM TO SPECIFICATION SECTION 3.11 PLANT MATERIAL AND RELATED SECTIONS.
- DIG ALL ROOT HOLES BY HAND WHEN CLOSER THAN 1.0m TO U/G POWER, TELEPHONE AND GAS ALIGNMENTS (REFER TO UTILITY SETBACKS IN STANDARDS WHEN CLEARANCE CANNOT BE MAINTAINED FOR EXCAVATIONS.



PRUNE DEAD, BROKEN, STUBS & DISEASED TREE LIMBS.

TOP OF ROOT BALL & ROOT FLARE TO BE 40mm ABOVE FINISHED GRADE.

100mm MIN. WOOD MULCH, SEE SPEC SECTION 3.11 PLANT MATERIAL, OVER ROOT BALL.
- TAPER MULCH TO BASE OF TREE.

APPROVED TREE GRATE.

CONCRETE TREE GRATE SURROUND.

CONCRETE VERGE TO SATISFACTION OF THE CITY ENGINEER.

CONCRETE CURBING.

ANGLE IRON TREE GRATE FRAME.

TOPSOIL MODERATELY COMPACTED TO ENSURE STABILITY OF ROOT BALL.

FOLD 1/3 (OR REMOVE) WIRE BASKET & BURLAP FROM TOP OF ROOT FLARE.
- POSITION TOP OF ROOT BALL 40mm ABOVE FINISHED GRADE.
- BURLAP TO BE TREATED NATURAL FIBRE.
- ROOT BALL MIN. SIZE AS PER CSLA STANDARDS FOR NURSERY STOCK.

SCARIFY WALL OF TREE WELL.

UNDISTURBED NATIVE SOIL.

100mm PLASTIC PERFORATED PIPE.
- TWO PIPES PER TREE @ 1.0m LONG.
- ONE PIPE FILLED COMPLETELY WITH 19mm WASHED ROCK.
- ONE PIPE HALF FILLED ONLY WITH 19mm WASHED ROCK.

REVISIONS		
DATE	DESCRIPTION	BY
-	-	-
-	-	-
-	-	-
-	-	-

TITLE

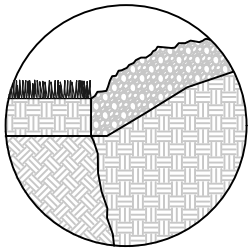
TYPICAL TREE IN GRATE

APPROVED:

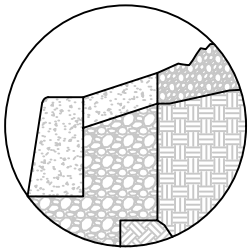
CHECKED: JS

DATE: JULY 2020 | SCALE: NTS | DRAWN: DF

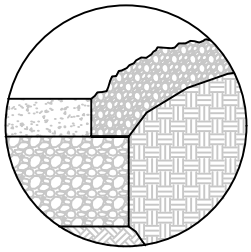
DWG NO.
LA05



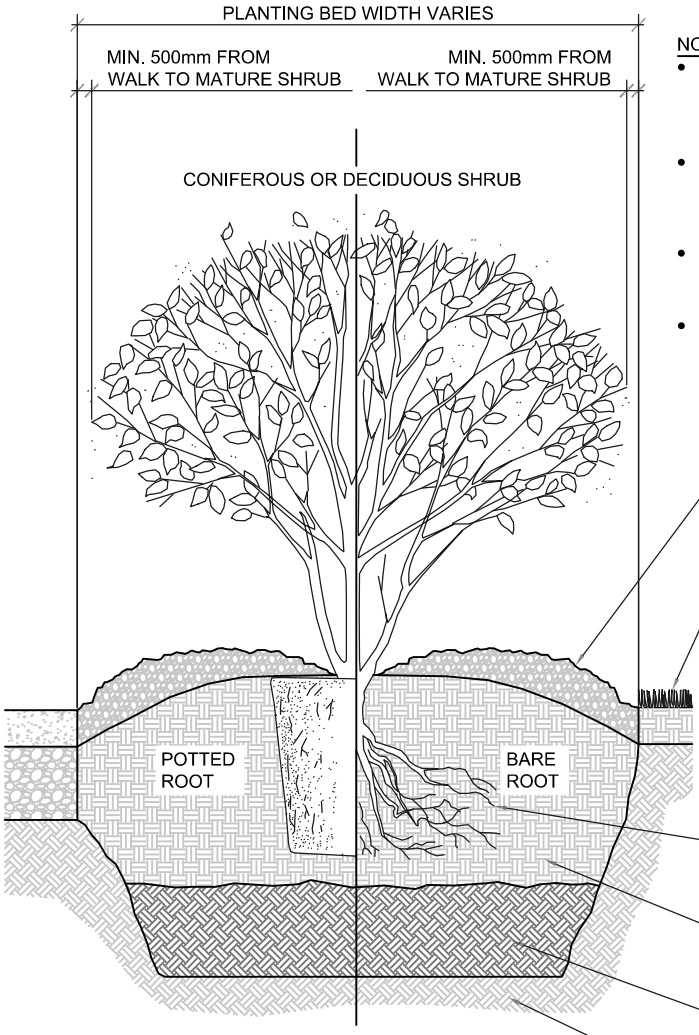
OPTION 'A'
EDGING DETAIL
N.T.S.



OPTION 'B'
CONCRETE CURB DETAIL
N.T.S.



OPTION 'C'
CONCRETE WALK DETAIL
N.T.S.



NOTES:

- ALL COMPONENTS AND WORKMANSHIP TO CONFORM TO SPECIFICATION SECTION 3.11 PLANT MATERIAL AND RELATED SECTIONS.
- PRUNE ONLY DEAD, BROKEN, OR DISEASED BRANCHES TO MAINTAIN PROPER SHRUB FORM (DECIDUOUS ONLY).
- DO NOT ROTOTILL WITHIN 1.0m OF U/G POWER, TELEPHONE, AND GAS ALIGNMENTS.
- DIG ALL ROOT HOLES BY HAND WHEN CLOSER THAN 1.0m TO U/G PWER, TELEPHONE, AND GAS ALIGNMENTS.

100mm MIN. WOOD MULCH, SEE SPEC SECTION 3.11 PLANT MATERIAL.
- TAPER MULCH TO BASE OF SHRUB.

RE-ESTABLISH ANY DAMAGED SEED/SOD TO TOWN OF CALMAR STANDARDS

SPREAD ROOTS EVENLY THROUGHOUT SOIL. PRUNE ALL DAMAGED ROOTS.

300mm MIN. DEPTH SOIL MIX MODERATELY COMPACTED.

ROTOTILL 150mm NATIVE SOIL. ADD SOIL MIX.

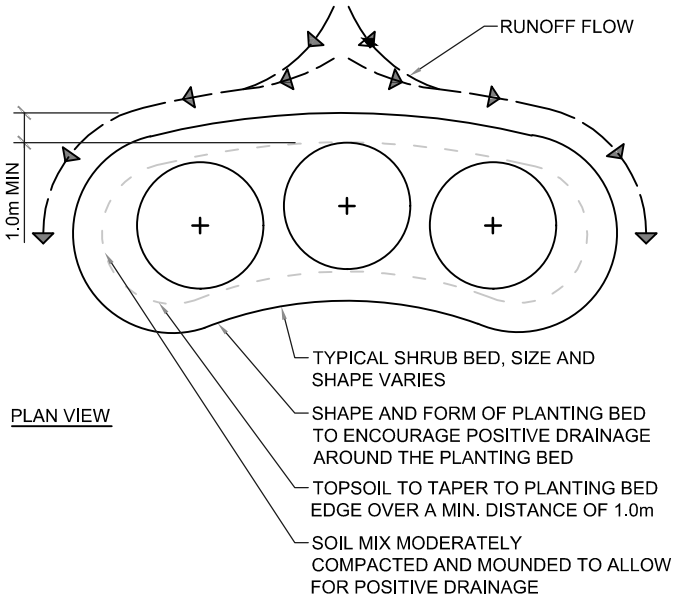
UNDISTURBED NATIVE SUBSOIL.

OPTIONS:
A: EDGING DETAIL
B: CONCRETE CURB W/ VERGE DETAIL
C: CONCRETE/ASPHALT WALK DETAIL

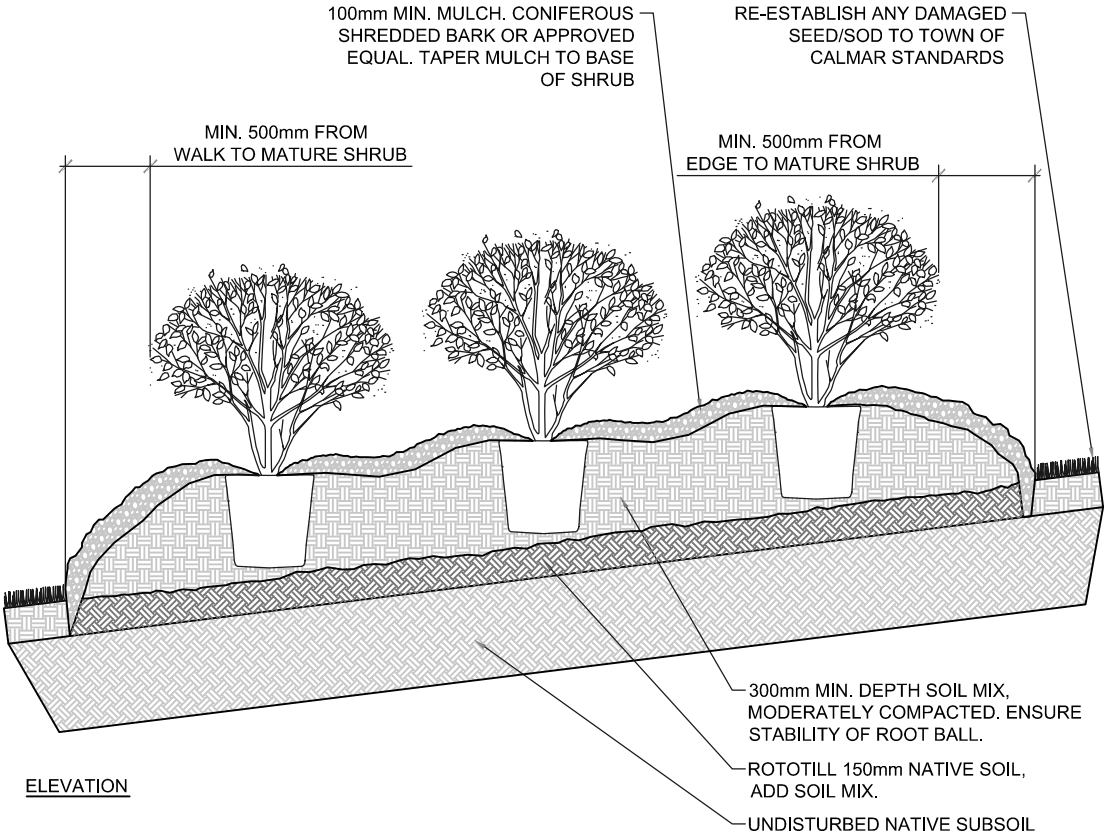
REVISIONS			TITLE			
DATE	DESCRIPTION	BY	TYPICAL SHRUB BED PLANTING			
-	-	-				
-	-	-	APPROVED:			
-	-	-	CHECKED: JS			DWG NO. LA06
-	-	-	DATE: JULY 2020	SCALE: NTS	DRAWN: DF	

NOTES:

- ALL COMPONENTS AND WORKMANSHIP TO CONFORM TO SPECIFICATION SECTION 3.11 PLANT MATERIAL AND RELATED SECTIONS.
- PRUNE ONLY DEAD, BROKEN, OR DISEASED BRANCHES TO MAINTAIN PROPER SHRUB FORM (DECIDUOUS ONLY).
- DO NOT ROTOTILL WITHIN 1.0m OF U/G POWER, TELEPHONE, AND GAS ALIGNMENTS.
- DIG ALL ROOT HOLES BY HAND WHEN CLOSER THAN 1.0m TO U/G PWER, TELEPHONE, AND GAS ALIGNMENTS.

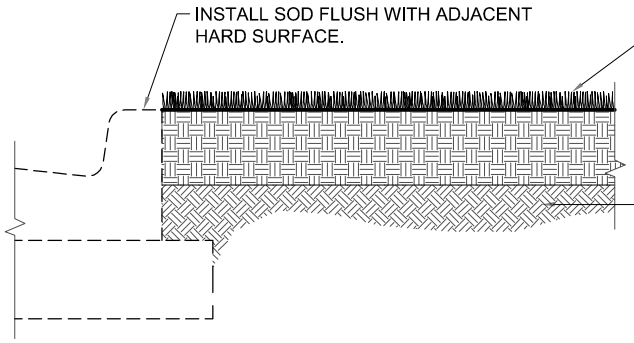


PLAN VIEW

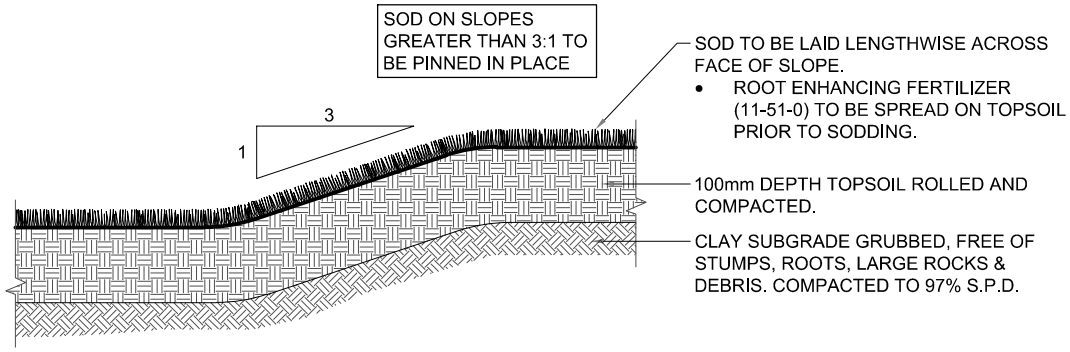


ELEVATION

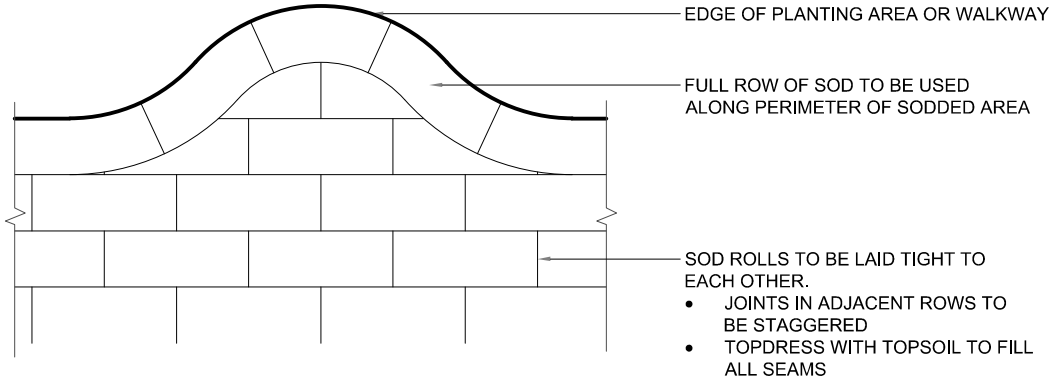
REVISIONS			TITLE			
DATE	DESCRIPTION	BY	TYPICAL SHRUB BED PLANTING ON SLOPE			
-	-	-				
-	-	-	APPROVED:			
-	-	-	CHECKED: JS			DWG NO. LA07
-	-	-	DATE: JULY 2020	SCALE: NTS	DRAWN: DF	



CROSS SECTION



CROSS SECTION THROUGH SLOPE

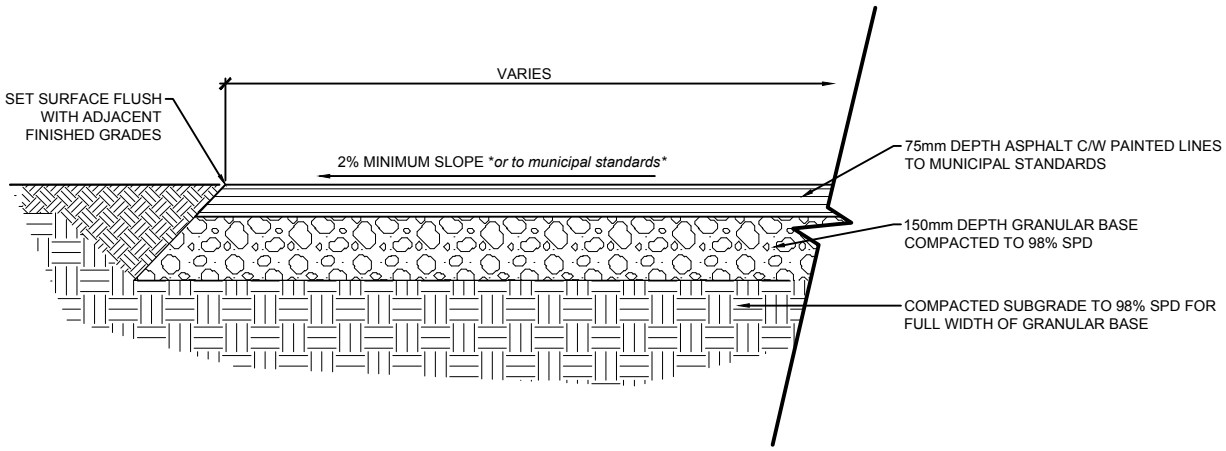


PLAN VIEW

NOTES:

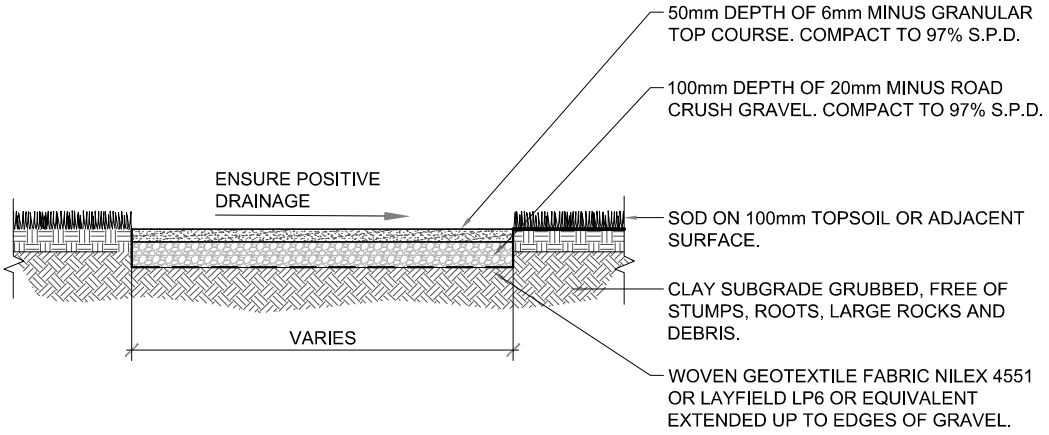
- ALL COMPONENTS AND WORKMANSHIP TO CONFORM TO SPECIFICATION SECTION 3.10 SODDING AND RELATED SECTIONS.

REVISIONS			TITLE			
DATE	DESCRIPTION	BY	SOD INSTALLATION			
-	-	-				
-	-	-	APPROVED:			
-	-	-	CHECKED: JS			DWG NO. LA08
-	-	-	DATE: JULY 2020	SCALE: NTS	DRAWN: DF	

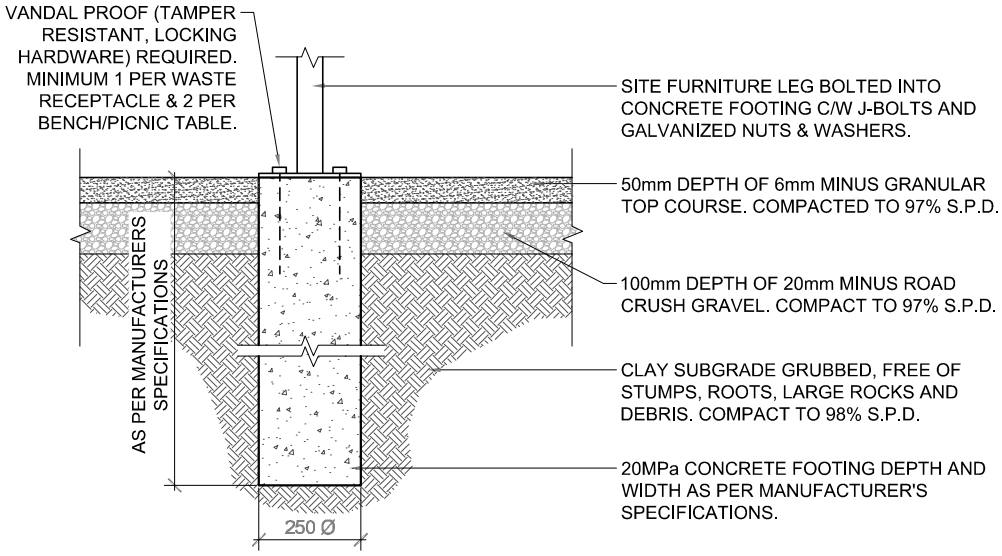


NOTES:
- SET ASPHALT SURFACE FLUSH WITH ADJACENT GRADES
- ***Line painting to municipal standards***

REVISIONS			TITLE			
DATE	DESCRIPTION	BY	ASPHALT TRAIL			
-	-	-				
-	-	-	APPROVED:			
-	-	-	CHECKED: JS			DWG NO.
-	-	-	DATE: JULY 2020	SCALE: NTS	DRAWN: DF	LA09



GRANULAR CROSS SECTION (TYP.)

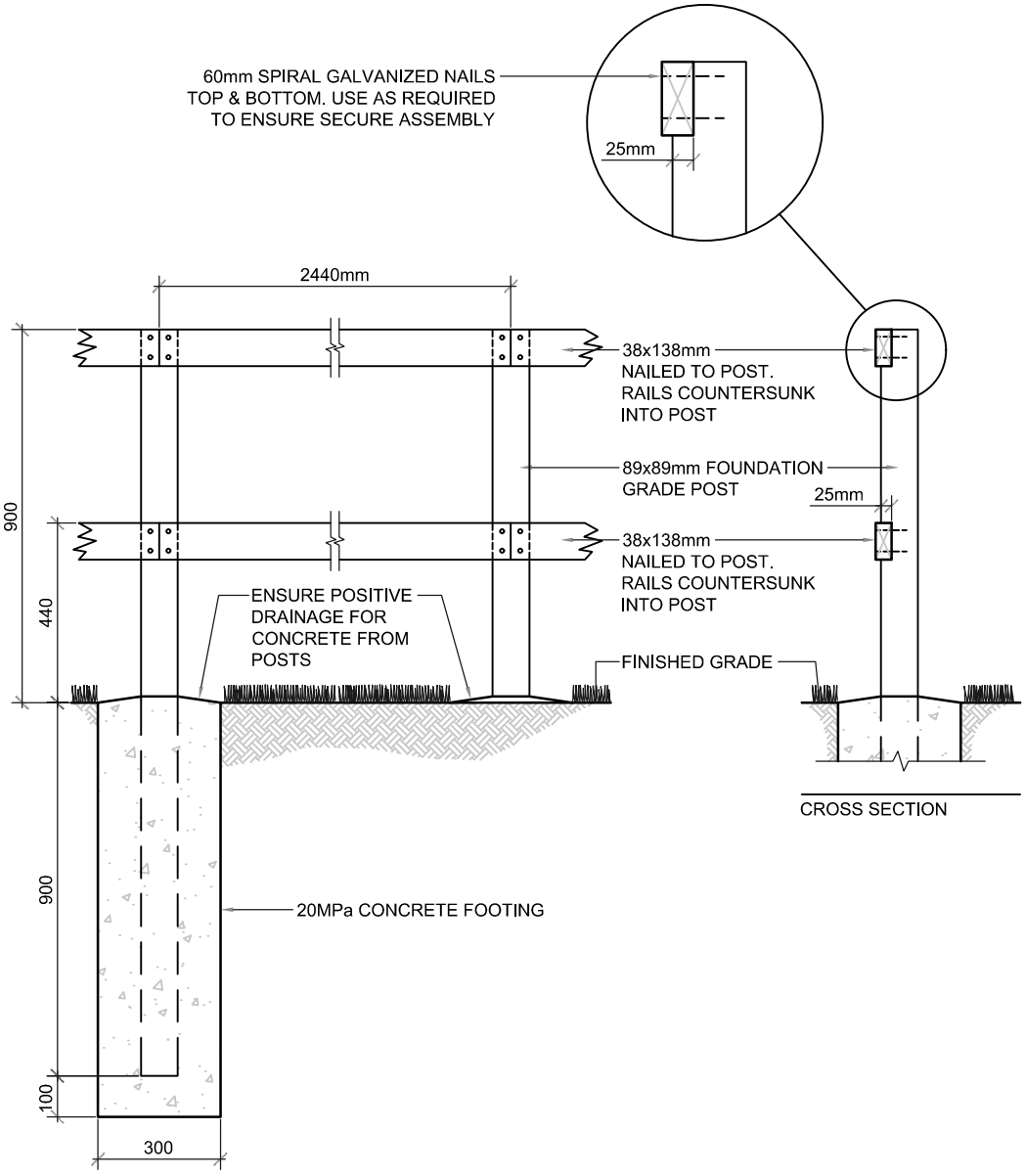


SITE FURNITURE FOOTING WITHIN GRANULAR AREA

NOTES:

- DIMENSIONS OF GRANULAR WALKWAY OR PLAZA AS PER LANDSCAPE DRAWINGS.
- SET GRANULAR SURFACE FLUSH WITH ADJACENT GRADES.
- ENSURE DRAINAGE OFF GRANULAR AT ALL LOCATIONS & IN COMPLIANCE WITH THE OVERALL SITE DRAINAGE PLAN.
- 20mm MINUS GRANULAR, COMPACT TO 97% S.P.D.

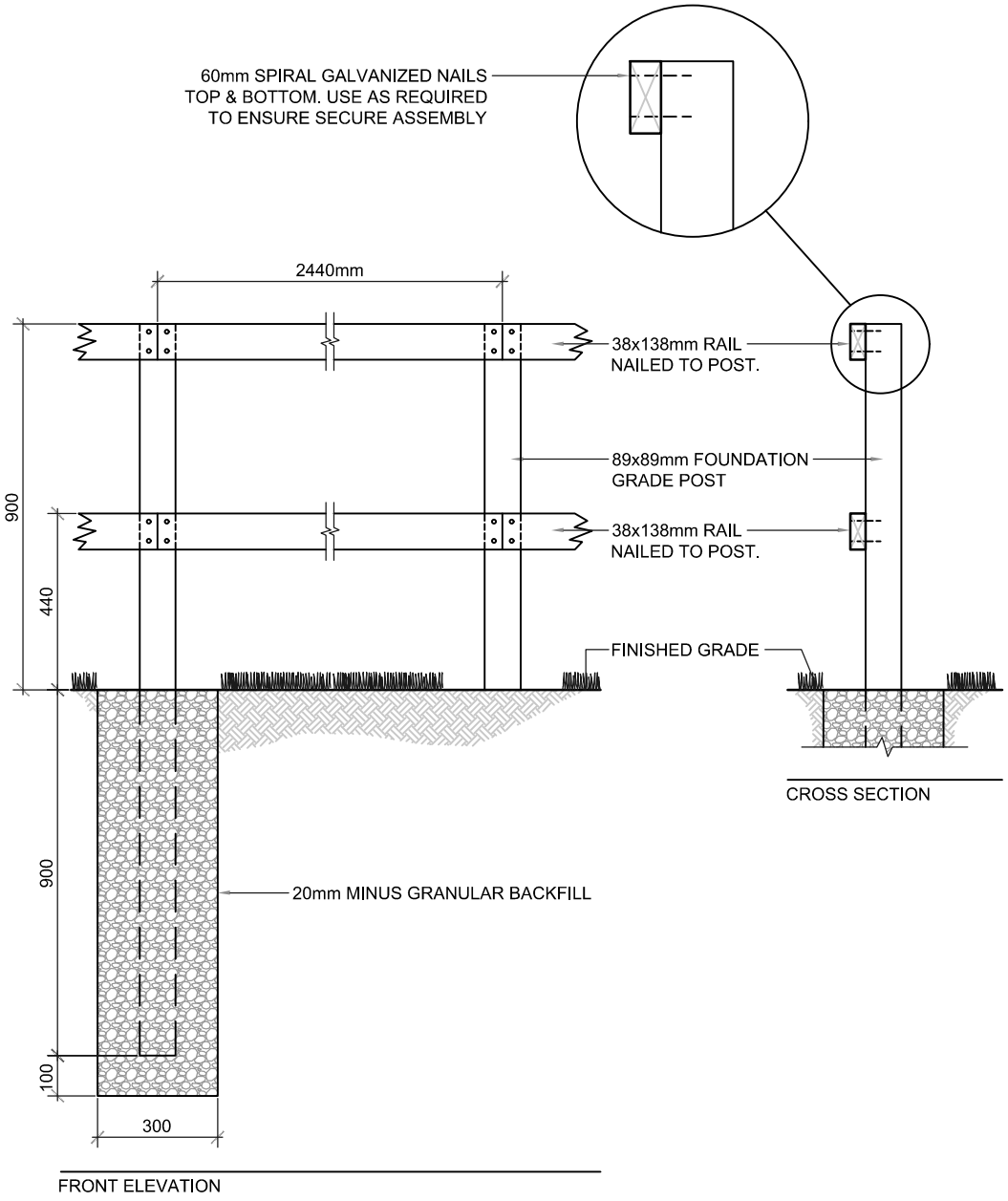
REVISIONS			TITLE			
DATE	DESCRIPTION	BY	GRANULAR TRAIL			
-	-	-				
-	-	-	APPROVED:			
-	-	-	CHECKED: JS			DWG NO. LA10
-	-	-	DATE: JULY 2020	SCALE: NTS	DRAWN: DF	



NOTES:

- ALL POSTS TO BE PRESSURE TREATED ACQ.
- ALL NAILS TO BE 60mm LENGTH SPIRAL GALVANIZED. USE AS REQUIRED TO ENSURE SECURE ASSEMBLY.
- WOOD USED MAY BE LODGEPOLE PINE, FIRE, HEMLOCK OR SPRUCE, DEPENDANT ON AVAILABILITY AT TIME OF CONSTRUCTION.
- ALL WOOD CUTS TO BE COATED WITH TWO COATS OF APPROVED WOOD PRESERVATIVE.
- ALL DIMENSIONS IN MILLIMETERS.

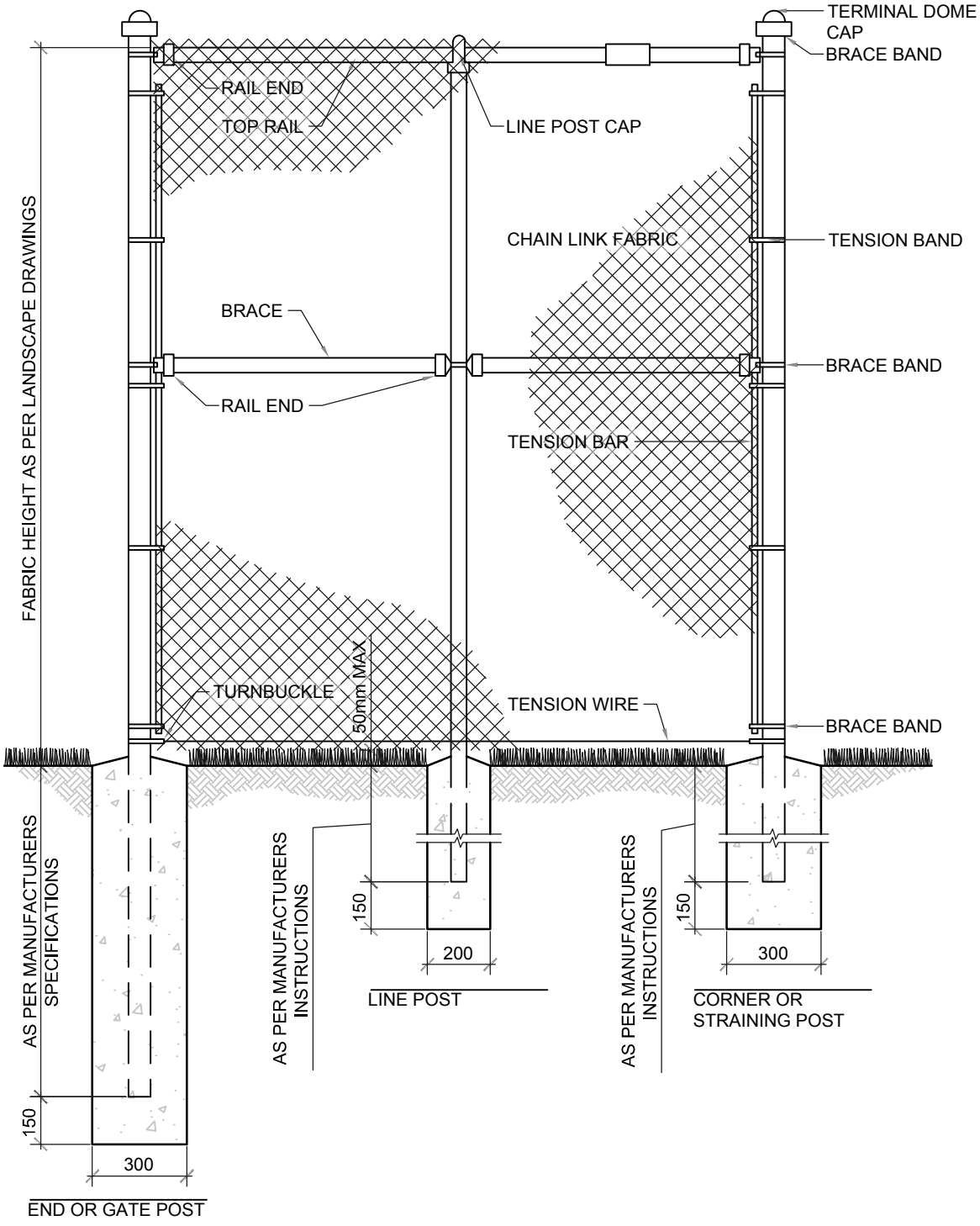
REVISIONS			TITLE			
DATE	DESCRIPTION	BY	PERMANENT WOOD RAIL FENCE			
-	-	-				
-	-	-	APPROVED:			
-	-	-	CHECKED: JS			DWG NO. LA11
-	-	-	DATE: JULY 2020	SCALE: NTS	DRAWN: DF	



NOTES:

- ALL NAILS TO BE 60mm SPIRAL GALVANIZED. USE AS REQUIRED TO ENSURE SECURE ASSEMBLY.
- WOOD USED MAY BE LODGEPOLE PINE, FIRE, HEMLOCK OR SPRUCE, DEPENDANT ON AVAILABILITY AT TIME OF CONSTRUCTION.
- 20mm MINUS GRANULAR, COMPACT FIRMLY.
- ALL DIMENSIONS IN MILLIMETERS.

REVISIONS			TITLE			
DATE	DESCRIPTION	BY	TEMPORARY WOOD RAIL FENCE			
-	-	-				
-	-	-	APPROVED:			
-	-	-	CHECKED: JS			DWG NO. LA12
-	-	-	DATE: JULY 2020	SCALE: NTS	DRAWN: DF	

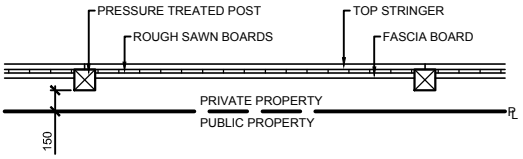


NOTES:

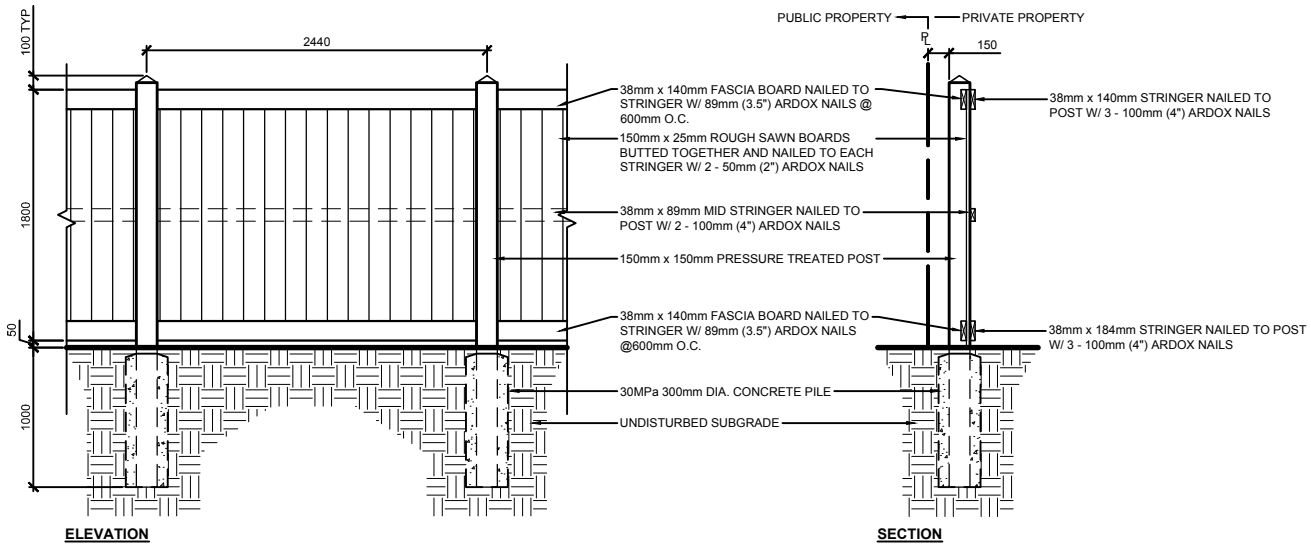
- ALL COMPONENTS AND WORKMANSHIP TO CONFORM TO SPECIFICATION SECTION 3.14 CHAIN LINK FENCE AS WELL AS THE RELATED SECTIONS.
- ALL DIMENSIONS IN MILLIMETERS.

REVISIONS			TITLE			
DATE	DESCRIPTION	BY	CHAIN LINK FENCE			
-	-	-				
-	-	-	APPROVED:			
-	-	-	CHECKED: JS			DWG NO. LA13
-	-	-	DATE: JULY 2020	SCALE: NTS	DRAWN: DF	

NOTES:
- ALL WOOD TO BE PRESSURE TREATED ACQ SPF.
- ALL WOOD MEMBERS ABOVE GROUND TO BE NON-INCISED.
- ALL WOOD TO BE STAINED (COLOUR TO BE ACCEPTED BY TOWN). APPLY 2 COATS PER MANUFACTURER'S SPECIFICATIONS. STAIN BOARDS ALL FOUR SIDES PRIOR TO CONSTRUCTION.
- PRESSURE TREATED POSTS TO BE TREATED WITH A SOLUTION OF PENTACHLOROPHENOL AND PETROLEUM TO CSA-080.
- NO GAP BETWEEN FINISHED GRADE AND BOTTOM FASCIA/STRINGER BOARDS
- MID STRINGER NAILS TO BE INSTALLED IN A STRAIGHT AND NEAT MANNER.

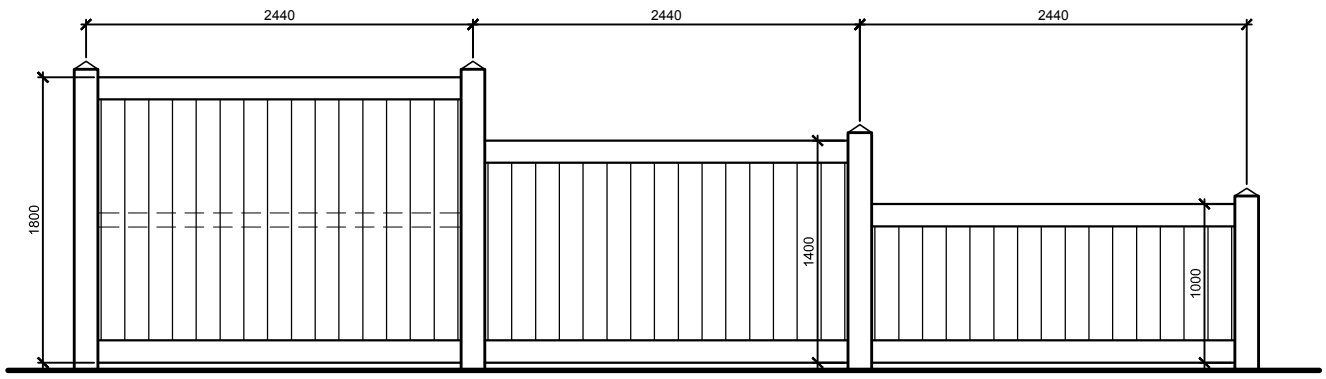


PLAN



ELEVATION **SECTION**

REVISIONS			TITLE			
DATE	DESCRIPTION	BY	WOOD FENCE			
-	-	-				
-	-	-	APPROVED:			
-	-	-	CHECKED: JS			DWG NO. LA14
-	-	-	DATE: JULY 2020	SCALE: NTS	DRAWN: DF	



NOTES:
- REFER TO DETAIL **LA14** FOR 1.8m HEIGHT WOOD SCREEN FENCE DETAIL.

REVISIONS		
DATE	DESCRIPTION	BY
-	-	-
-	-	-
-	-	-
-	-	-

TITLE

WOOD FENCE STEPDOWN DETAIL

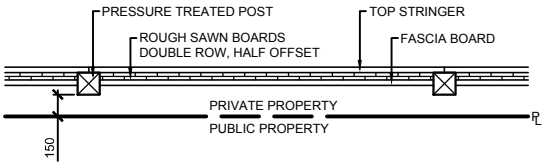
APPROVED:

CHECKED: JS

DATE: JULY 2020 | SCALE: NTS | DRAWN: DF

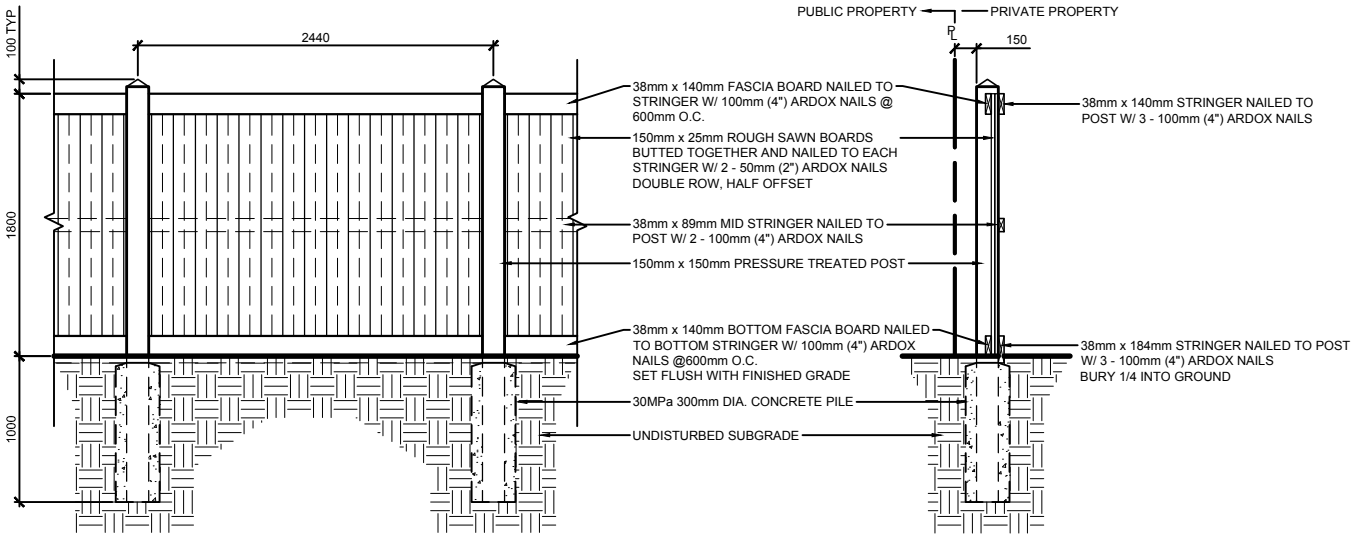
DWG NO.

LA15



PLAN

NOTES:
- ALL WOOD TO BE PRESSURE TREATED ACQ SPF.
- ALL WOOD MEMBERS ABOVE GROUND TO BE NON-INCISED.
- ALL WOOD TO BE STAINED (COLOUR TO BE ACCEPTED BY TOWN). APPLY 2 COATS PER MANUFACTURER'S SPECIFICATIONS. STAIN BOARDS ALL FOUR SIDES PRIOR TO CONSTRUCTION.
- PRESSURE TREATED POSTS TO BE TREATED WITH A SOLUTION OF PENTACHLOROPHENOL AND PETROLEUM TO CSA-080.
- NO GAP BETWEEN FINISHED GRADE AND BOTTOM FASCIA/STRINGER BOARDS
- MID STRINGER NAILS TO BE INSTALLED IN A STRAIGHT AND NEAT MANNER.



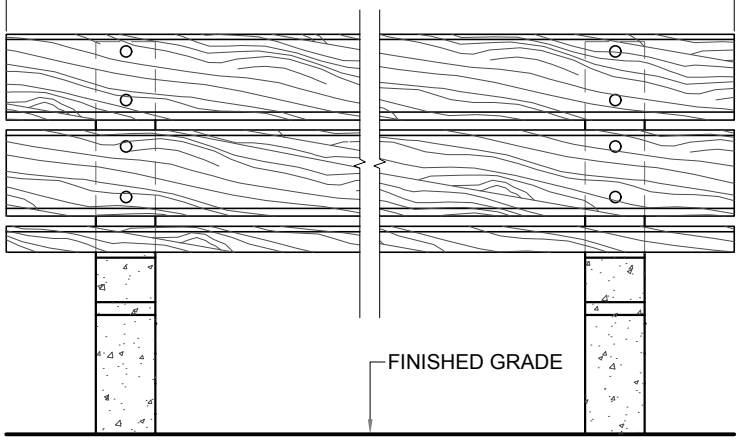
ELEVATION

SECTION

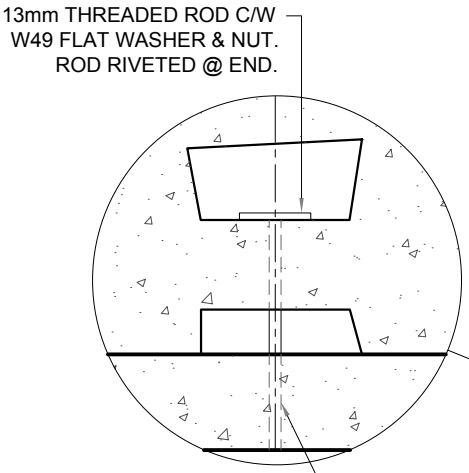
REVISIONS			TITLE			
DATE	DESCRIPTION	BY	SOUND ATTENUATION FENCE			
-	-	-				
-	-	-	APPROVED:			
-	-	-	CHECKED: JS			DWG NO. LA16
-	-	-	DATE: JULY 2020	SCALE: NTS	DRAWN: DF	

WOOD BENCH SCHEDULE

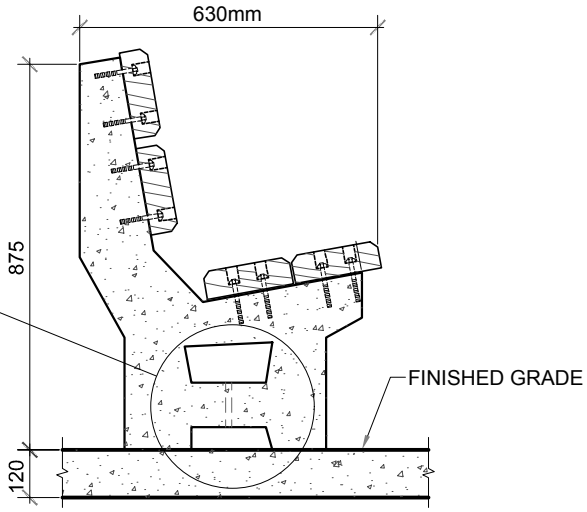
TYPE	LENGTH	WIDTH	THICKNESS
A	1219	193	70
B	1829	193	70
C	2438	193	70
D	3048	790	70
E	3658	193	70



FRONT ELEVATION



SIDE ELEVATION

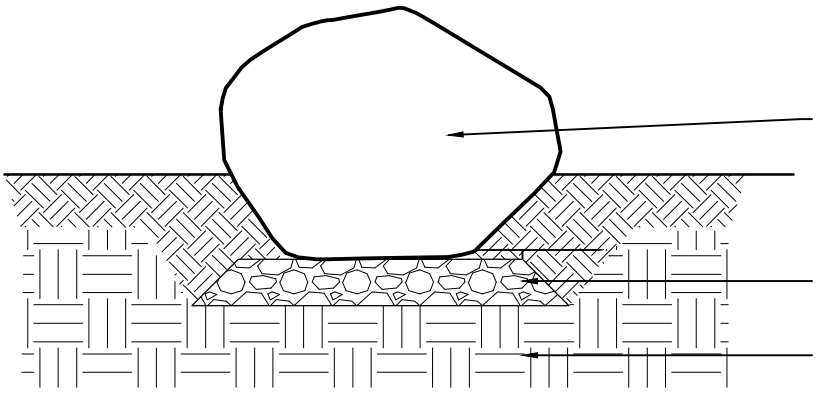


SIDE ELEVATION

NOTES:

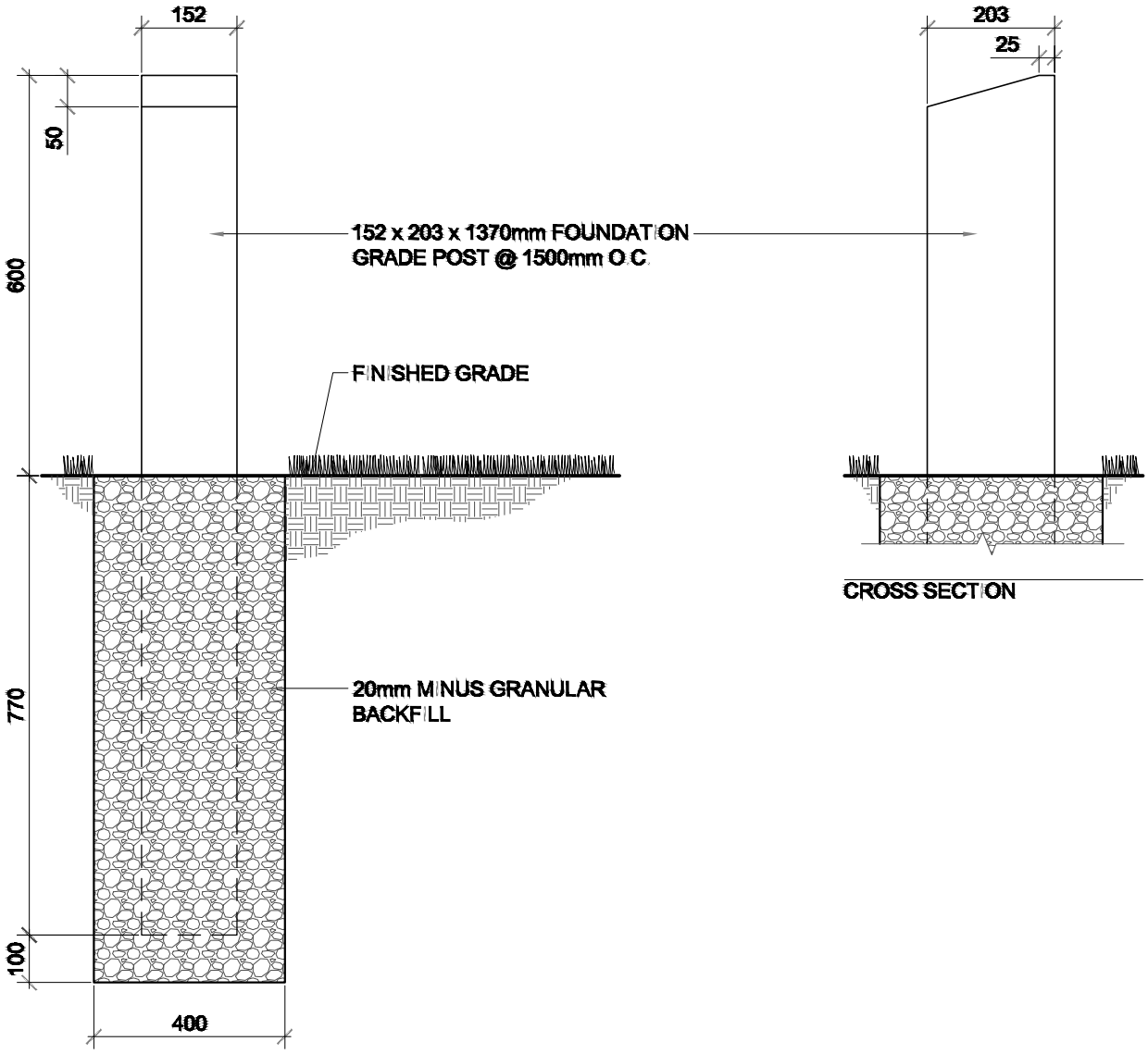
- TWO VANDAL PROOF LOCKING HARDWARE PER BENCH
- COAT WITH WATER BASED AND UV RESISTANT TOWN APPROVED STAIN AND TOP COAT
- ALL WOOD ELEMENTS TO BE NO. 1 WOOD AS DEFINED BY THE ALBERTA FOREST PRODUCTS ASSOCIATION
- ALL WOOD ELEMENTS TO BE SANDED SMOOTH AND ALL EDGES SANDED ROUND WITH NO SHARP CORNERS

REVISIONS			TITLE			
DATE	DESCRIPTION	BY	TYPICAL BENCH DETAIL			
-	-	-				
-	-	-	APPROVED:			
-	-	-	CHECKED: JS			DWG NO. LA17
-	-	-	DATE: JULY 2020	SCALE: NTS	DRAWN: DF	



NOTES:
- BOULDERS TO BE BURIED MINIMUM ⅓ OF THEIR TOTAL HEIGHT
- BOULDER LAYOUT TO BE REVIEWED BY THE LANDSCAPE ARCHITECT OR OWNER'S REPRESENTATIVE PRIOR TO PLACEMENT

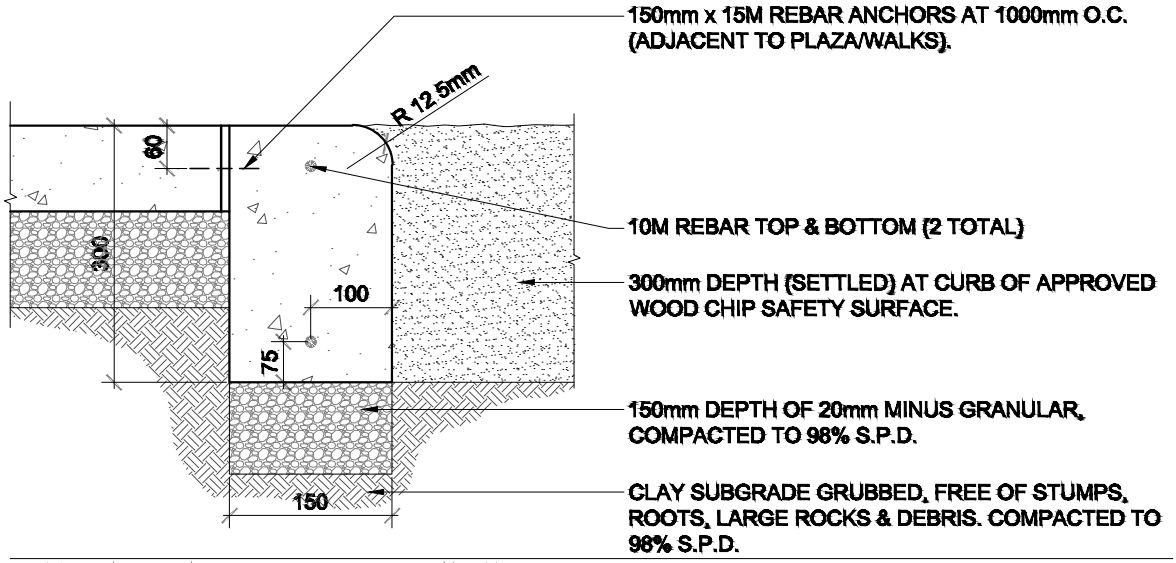
REVISIONS			TITLE			
DATE	DESCRIPTION	BY	BOULDER INSTALLATION			
-	-	-				
-	-	-	APPROVED:			
-	-	-	CHECKED: JS			DWG NO. LA18
-	-	-	DATE: JULY 2020	SCALE: NTS	DRAWN: DF	



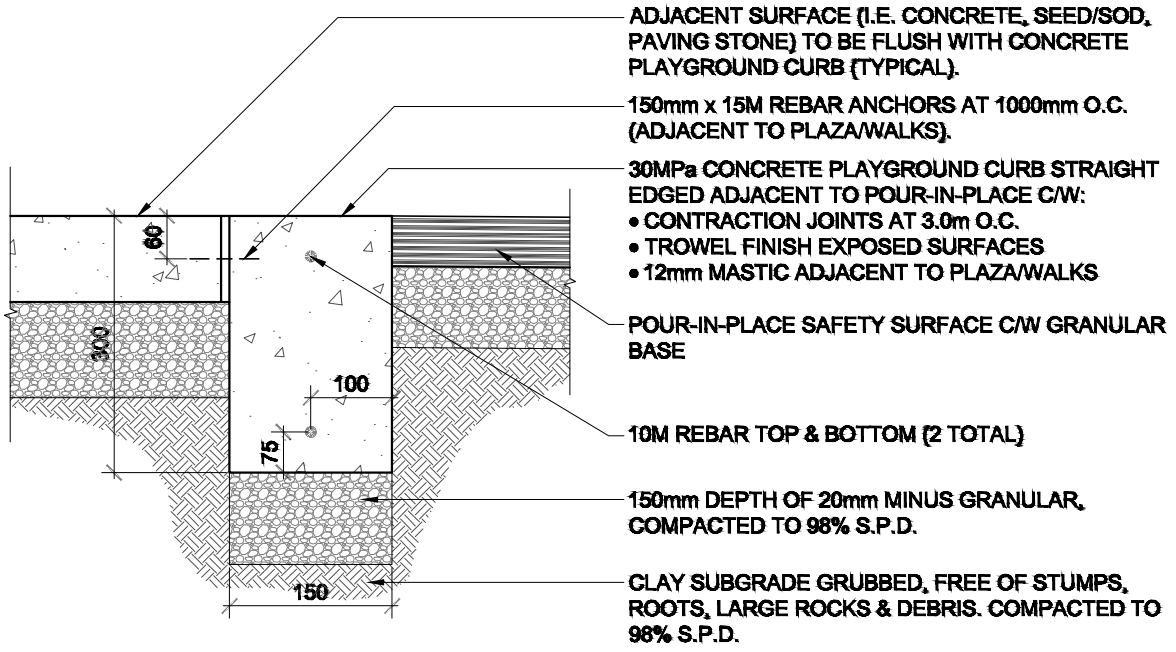
NOTES:

- ALL WOOD TO BE PRESSURE TREATED ACQ.
- WOOD USED MAY BE LODGEPOLE PINE, FIR, HEMLOCK OR SPRUCE, DEPENDANT ON AVAILABILITY AT TIME OF CONSTRUCTION.
- ALL WOOD CUTS TO BE COATED WITH TWO COATS OF APPROVED WOOD PRESERVATIVE.
- 20 MINUS GRANULAR, COMPACT FIRMLY.

REVISIONS			TITLE			
DATE	DESCRIPTION	BY	WOOD BUMPER POST			
-	-	-				
-	-	-	APPROVED:			
-	-	-	CHECKED: JS			DWG NO. LA19
-	-	-	DATE: JULY 2020	SCALE: NTS	DRAWN: DF	



PLAYGROUND CURB ADJACENT WOOD MULCH



PLAYGROUND CURB ADJACENT POUR-IN-PLACE SURFACE

NOTES:

- SPECIFICATIONS: ALL COMPONENTS AND WORKMANSHIP CONFORM TO SPECIFICATION 3.1.7 CONCRETE CURBS, CURBS AND GUTTERS, SIDEWALKS, MEDIANS, DRIVEWAYS, AND SWALES AS WELL AS RELATED SECTIONS
- **PLAYGROUND SAFETY SURFACE THAT ARE COMBINATIONS OF WOOD MULCH AND POUR-IN-PLACE RUBBER REQUIRE A 25mm RADIUS ON CURB ADJACENT TO WOOD MULCH SURFACE AND CURB ADJACENT TO POUR-IN-PLACE RUBBER SURFACE IS TO BE SQUARE AND FLUSH.**
  - **20mm MINUS GRANULAR, COMPACT TO 98% S.P.D.**
  - **DEPTH OF GRANULAR LEVELING COURSE MAY BE ALTERED AT THE DISCRETION OF THE LANDSCAPE ARCHITECT ONLY.**

REVISIONS			TITLE			
DATE	DESCRIPTION	BY	CONCRETE PLAYGROUND EDGER			
-	-	-				
-	-	-	APPROVED:			
-	-	-	CHECKED: JS			DWG NO. LA20
-	-	-	DATE: JULY 2020	SCALE: NTS	DRAWN: DF	