City of Prince Albert Master Specifications

Construction of Site Grading, Underground Utilities, Streets, Curbs and Sidewalks

Approved April 27, 2020

City of Prince Albert

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1.0 DESCRIPTION OF WORK

.1 The work shall include:

.1 Furnishing of all materials, plant, equipment, tools, supplies, temporary lighting and heating, transportation, labour and superintendence necessary for the construction of the work as herein specified and as shown on the drawings.

.2 Provide and maintain construction signing, barricades, temporary detours, and traffic accommodation during construction.

.3 Relocation of existing excavated material stockpiles.

.4 Excavation and embankment of roadways and residential lots.

.5 Stockpiling of excess excavation material.

.6 Water and sewer main construction including excavating, pipe laying, bedding, backfilling, compaction, and roadway subgrade and granular base course construction.

.7 Street construction including excavating to subgrade, subgrade preparation, geotextile filter fabric and granular base course placement, and hot mix asphalt placement.

.8 Curb and sidewalk construction including additional granular base course placement where required and concrete curb, gutter and sidewalk installation.

.9 Removal and Disposal of existing asphalt and concrete where required for underground utility installation.

.10 Removal and Disposal of existing asphalt where required for existing street connections.

.11 Removal and Disposal of existing concrete where required for existing curb and sidewalk connections.

.12 Install manholes, valves, catch basins, hydrants, service connections and related appurtenances, to match finished pavement grades.

.13 Adjust manholes and valves to match finished pavement grades.

.14 Adjust catch basins to match finished concrete grades.

.15 Testing all materials for approval for incorporation into the work. Compaction testing will be conducted and paid for by the Owner.

.16 Cleaning up of the site.

.17 Repair of all defects for one year after completion of the work.

2.0 DOCUMENTS REQUIRED

.1 Maintain at job site, one copy of each of the following:

.1 Contract Documents

.2 Specifications and Plans

.3 Addenda

.4 Reviewed Shop Drawings

.5 Change Orders

.6 Other Modifications to Contract

.7 Field Test Reports

3.0 WORK SCHEDULE

.1 Provide within ten (10) working days after the contract award, in form acceptable to Engineer, schedule showing anticipated progress stages and final completion of work within time period required by contract documents.

.2 Interim reviews of work progress based on schedule submitted by Contractor will be conducted as directed by Engineer and schedule updated by Contractor in conjunction and with approval of Engineer.

4.0 MEASUREMENT AND PAYMENT

.1 Notify the Engineer sufficiently in advance of operations to permit required measurements for payment.

5.0 CONTRACTOR'S USE OF SITE

.1 Coordinate work and provide access for other contractors working in the area.

.2 Do not unreasonably encumber site with materials or equipment.

.3 Move stored products or equipment, which interfere with operations of Engineer or other contractors.

.4 Obtain and pay for use of additional storage or work areas for operations.

6.0 CODES AND STANDARDS

.1 Perform work in accordance with National Building Code of Canada (NBC), latest Edition, unless otherwise specified.

7.0 PROJECT MEETINGS

.1 Engineer will arrange project meetings and assume responsibility for setting times and recording and distributing minutes.

8.0 CUTTING, FITTING AND PATCHING

.1 Execute cutting (including excavation), fitting and patching required to make work fit properly together.

.2 Where new work connects with existing and where existing work is altered, cut, patch and make good to match existing work.

.3 Obtain Engineer's approval before cutting, boring or sleeving load-bearing members.

.4 Make cuts with clean, smooth edges. Make patches inconspicuous in final assembly.

9.0 PROTECTION OF SURVEY MONUMENTS

.1 Prior to commencement of construction operations, the Contractor shall acquaint himself with the survey monuments on the site and thus be aware of their location.

.2 Contractor shall place 38 x 89 mm markers at property pins, bench marks and control points, and paint fluorescent orange prior to construction start.

.3 Upon completion of construction operations, an inspection shall be carried out to determine if any of the survey monuments have been removed or damaged. The Contractor shall reimburse the Owner for the costs involved in replacement by Registered Saskatchewan Land Surveyor of any monuments which have been removed or damaged.

10.0 SITE RESTORATION

.1 All roadways disturbed by construction shall be reconstructed as per drawings and specifications.

.2 Damaged culverts and lot accesses shall be repaired or replaced at the Contractors expense.

11.0 ARCHAELOGICAL INTERESTS

.1 Immediate notice shall be given to the Engineer if evidence of archaeological finds are encountered during construction.

.2 Items of historical, cultural or archaeological interest such as cornerstones, headstones, commemorative plaques, inscribed tablets and similar objects

found on site shall be left in place until specific instruction from the Engineer or Owner is given.

12.0 HOURS OF WORK

.1 Subject to sub-clause .2, the Contractor's hours of work shall comply with all Local, Provincial, and Federal regulations. At all times, operational noise shall be kept to a practicable minimum for construction operations. Hours of work shall not exceed beyond 7:00 A.M., to 9:00 P.M., Monday to Friday without prior authorization by the Engineer. Hours of work shall be established by the Contractor and the Project Engineer prior to construction start-up. Hours of work shall become part of the work schedule to be provided by the Contractor as per Article 10 of the General Conditions.

.2 The Engineer's representative is to be informed not less than forty-eight (48) hours in advance if work is to be carried out beyond the normal hours of work established in Schedule.

.3 If the Project Construction is behind schedule, the Contractor shall take the necessary steps as set out in Article 10 of the General Conditions.

.4 Weekend work will only be allowed if written permission is given beforehand by the Engineer.

.5 Permission of the Engineer does not relieve the Contractor of the responsibility for attaining necessary permission from local governing agencies.

END OF SECTION

1.0 CONSTRUCTION SCHEDULE

.1 The Contractor shall submit a proposed construction schedule to complete the works to the Engineer.

.2 The Contractor shall meet with the Engineer for his approval after he has had sufficient time to review the schedule.

2.0 MILESTONE INSPECTION PROCEDURES

.1 Contractor's Inspection: The Contractor and his Sub- Contractors shall conduct an inspection of the work and correct all deficiencies.

.2 Resident Engineer's Inspection: The Contractor shall notify the Engineer, in writing of satisfactory completion of the "Contractor's Inspection", and request a "Resident Engineer's Inspection". The Resident Engineer's Inspection shall consist of the Engineering Team and Contractor.

.3 Deficiencies: During the "Resident Engineer's Inspection" a list of all deficiencies shall be drawn up and signed by the Resident Engineer. The Contractor shall correct all deficiencies in a satisfactory manner.

.4 Substantial Completion Inspection: When the Contractor is satisfied that all identified deficiencies have been corrected, the Contractor shall request, in writing a "Substantial Completion Inspection". The Inspection team shall consist of the Engineering Team and the Contractor.

.5 Total Completion Inspection: When the Contractor is satisfied that all deficiencies have been corrected at or during the Performance Testing, the Contractor shall request in writing, a "Total Completion Inspection". The Inspection team shall consist of the Engineering Team and the Contractor.

END OF SECTION

1.0 CONTRACTOR'S OPTION

.1 For products specified only by reference standards, select any product meeting standards.

.2 For products specified by naming several products or manufacturers, select any product and manufacturer named.

.3 For products specified by naming one or more products, but indicating the option of selecting equivalent products by stating "or equal" after specified product, submit a request for approval of any product not specifically named.

.4 For products specified by naming only one product and manufacturer, there is no option and substitution will not be allowed.

2.0 SUBSTITUTIONS

.1 The City of Prince Albert may consider requests for substitutions providing that requests are submitted in time to allow for adequate review and describe such substitutions in full detail, the type of material, equipment or method and reasons for substitutions. Requests may be made for substitutions as an equal or as an alternate. In the case of an alternate, submit any increase or decrease in price for the substitution.

.2 In making request for substitution, ensure that:

.1 The proposed product and method has been investigated and it is equal or superior in all respects to that specified.

.2 At least the same guarantee is given for the substitution as for the product and method originally specified.

.3 The installation of the accepted substitution is coordinated into the work, and make such changes as may be required for the work to be complete in all respects.

.3 Do not substitute materials, equipment or methods into the work unless such substitutions have been specifically approved by the Engineer.

.4 Substitutions will not be considered if:

.1 They are indicated or implied on shop drawings or project data without formal request submitted in accordance with these specifications.

.2 Acceptance will require substantial revision of the Contract Documents.

.3 They are not submitted in accordance with these specifications.

END OF SECTION

1.0 GENERAL

.1 The Contractor shall be responsible for the following:

.1 Review of all submittals prior to submission.

.2 Verify field measurements, field construction criteria, catalogue numbers and similar data.

.3 Coordinate each submittal with requirements of the work and the Contract Documents.

.4 Responsibility for errors and omissions in submittals is not relieved by the Engineer's review of submittals.

.5 Notify the Engineer in writing at time of submission, of any deviation in submittals from requirements of the Contract Documents.

.2 Submit well in advance of schedule dates for fabrication, manufacture, erection, and installation to provide adequate time for reviews, securing necessary approvals, possible revisions and re-submittals, placing orders, securing delivery and to avoid construction delays.

.3 Accompany each submittal with a letter of transmittal containing all pertinent information required for identification and checking of submittals.

.4 When submittals are resubmitted for any reason, transmit under a new letter of transmittal.

.5 Do not carry out work which requires submittals until submittals have been reviewed by the Engineer.

2.0 SHOP DRAWINGS, TEMPLATES AND MANUALS

.1 Prepare shop drawings which the Engineer considers necessary to show details of the work to be provided in relation to adjacent work of other contracts. Clearly identify shop drawings by title and Contract, name and reference to applicable Engineer's drawings. Notify the Engineer in writing of changes made from the Contract Documents.

.2 Submit in accordance with the Contract Schedule not less than Four (4) copies of shop drawings to the Engineer for his review, Two (2) of the copies will be returned by the Engineer, stamped to indicate that the shop drawings have been reviewed, and with comments added where applicable. If shop drawings are illegible, obscure or incomplete, they may be returned by the Engineer marked "not reviewed", and such shop drawings are to be properly redrawn and resubmitted.

.3 Make changes in shop drawings which the Engineer may require consistent with the Contract, and resubmit as before. Ensure work and units supplied conform to final shop drawings.

.4 The Engineer's review of shop drawings does not relieve the Contractor of his responsibility for detail design inherent in shop drawings, correctness of dimensions and details and conformity to the Contract Documents.

.5 Supply drawings, models, templates and special instructions or manuals called for in the Specifications, or required for the proper installation of the parts shown and conform to the intent of the Contract Documents.

3.0 INTENT

.1 Before delivery of materials to the site, submit samples of materials as required by sections of the specifications or if so requested by the Engineer for his approval.

.2 Samples must represent physical examples to illustrate materials, equipment or workmanship and to establish standards by which completed work is judged.

.3 After approval, samples may be used in construction of the project.

.4 Locate field samples on the project site at locations acceptable to the Engineer.

.5 Construct each sample or mock-up complete, including work of all trades required in finished work.

4.0 SCHEDULES

.1 Submit proposed construction schedules in accordance with the requirements specified in Article 10 of the General Conditions, and Section 01005.

5.0 MANUFACTURER'S INSTRUCTIONS

.1 Submit manufacturer's instructions when required to supplement the specifications, for the assembly and installation of specific materials or equipment. Obtain the approval of the Engineer before commencing such work.

.2 Provide copies of such approved instructions to each crew working on the items affected.

.3 Manufacturer's instructions only apply to particular requirements relative to the manufacturer's products and are in addition to the specifications. Do not interpret or apply such instructions to limit the work or responsibilities, the Contract Documents take precedence in all cases.

6.0 CERTIFICATION OF TRADESMEN

.1 Provide certificates, at the request of the Engineer, to establish qualifications of personnel employed on the work where such certification is required by authorities having jurisdiction, by the Owner or by the Contract Documents.

7.0 WARRANTIES

.1 Submit warranties as requested in sections of Specifications and in accordance with the General Conditions.

END OF SECTION

1.0 INSPECTION AND TESTING OF WORK

1.1 Laboratories/Agencies

.1 Independent Inspection/Testing Agencies may be engaged by the Owner for the purpose of inspecting and/or testing portions of Work for the purposes of determining whether the work completed is satisfactory for Progress Payment.

.2 Costs of the above services will be paid by the Owner.

.3 All equipment required for carrying out the above inspection and testing will be provided by the respective Agencies.

1.2 Contractor Responsibility

.1 It is the Contractor's responsibility to perform mix designs and carry out preliminary testing on aggregates to be incorporated into the work and whatever testing he feels is required to ensure that the work is in conformance with the Contract Documents.

.2 The Contractor cannot rely on the testing that will be carried out by the Independent Testing Agency for Quality Control by the Engineer; the intention of this Testing is for determination by the Engineer of satisfactory completed work for Progress Payment.

.3 All costs, beyond the testing by Independent Testing retained by the Owner, deemed required to ensure Quality Control shall be borne by the Contractor.

1.3 Access to Work and Plant

.1 Allow the Inspection/Testing Agencies access to all portions of Work on site and manufacturing and fabrication plants, as may be necessary to carry out their work. Cooperate to provide reasonable facilities for such access.

1.4 Procedures for Tests

.1 Notify the Engineer well in advance of the requirements for tests, in order that necessary arrangements can be made by the Engineer with the respective Agencies.

.2 Submit necessary samples and/or materials required for testing, as specifically requested in the Specifications. Submit with reasonable promptness and in an orderly sequence, so as to cause no delay in Work.

.3 Provide workers and facilities to obtain and handle samples and/or materials on-site. Provide sufficient space to facilitate the storage and curing of test samples.

.4 If defects are revealed during inspection and/or testing, the Engineer may request additional inspection and/or testing to ascertain full degree of defects.

.5 The Contractor shall correct defects and irregularities and pay all costs for all additional testing.

1.5 Rejected Work

.1 Defective work whether the result of poor workmanship, use of defective products, or damage through carelessness or other act of omission of the Contractor, and whether incorporated in the Work or not, which has been rejected by the Engineer as failing to conform to the Contract Documents shall be removed promptly from the Work and replaced or re-executed by the Contractor in accordance with the Contract Documents at the Contractor's expense.

.2 Other work destroyed or damaged by such removals, replacements or re-execution shall be made good promptly at the Contractor's expense.

2.0 TESTS AND DESIGNS

.1 Furnish to the Engineer test results and mix designs as specifically requested in the Specifications.

.2 The cost of test results and mix design shall be borne by the Contractor.

3.0 REFERENCE STANDARDS

.1 Within the text of the Specifications, reference may be made to the following standards:

ACI	-	American Concrete Institute
AISC	-	American Institute of Steel Construction
ANSI	-	American National Standards Institute
ASTM	-	American Society of Testing and Materials
AWWA-		American Water Works Association
CANI	-	National Standard of Canada
CEC	-	Canadian Electric Code (published by CSA)
CGA	-	Canadian Gas Association
CGSB	-	Canadian Government Specification Board
CISC	-	Canadian Institute of Steel Construction
CMB	-	Construction Materials Board
CSA	-	Canadian Standards Association
EIB	-	Electrical Inspection Branch
IEEE	-	Institute of Electrical and Electronic Engineers
IPCEA	-	Insulated Power Cable Engineers Association
NACE	-	National Association of Corrosion Engineers
NBC	-	National Building Code
NEMA	-	National Electrical Manufacturers Association

NFPA - National Fire Protection Association
ULC - Underwriters Laboratories of Canada

.2 Conform to the latest version of such standards available at the time of tendering, in whole or in part, as specified.

.3 If there are questions as to whether any product or system is in conformance with applicable standards, the Engineer reserves the right to have such products or systems tested to prove or disprove conformance with Contract Documents, or by the Contractor in the event of non-conformance.

END OF SECTION

1.0 ACCESS

.1 Provide and maintain adequate access to project site.

.2 Build and maintain temporary roads and provide traffic accommodation during period of work.

.3 If authorized to use existing roads for access to project site, maintain such roads for duration of contract and make good damage resulting from Contractor's use of roads.

2.0 STORAGE SHEDS

.1 Provide adequate weathertight sheds with raised floors for storage of materials, tools and equipment which are subject to damage by weather.

3.0 SANITARY FACILITIES

.1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.

.2 Post notices and take such precautions as required by local health authorities. Keep area and premises in sanitary condition.

.3 Design enclosure to withstand wind pressure.

4.0 POWER

.1 When required, arrange, pay for and maintain temporary electrical power supply in accordance with governing regulations and ordinances.

.2 Install temporary facilities for power such as pole, underground cables, etc., to approval of local power supply authority.

5.0 WATER SUPPLY

.1 When required, arrange, pay for and maintain temporary water supply in accordance with governing regulations and ordinances.

.2 Upon approval of the Owner, City water supply system may be used for construction requirements. Reimburse Owner at water rates agreed upon and make good any damage.

6.0 HEATING AND VENTILATION

.1 Pay for costs of temporary heat and ventilation used during construction, including costs of installation, fuel, operation, maintenance and removal of equipment. Use of direct-fired heaters discharging waste products into work areas will not be permitted unless prior approval is given by Engineer.

.2 Furnish and install temporary heat and ventilation in enclosed areas as required to:

.1 Facilitate progress of work.

.2 Protect work and products against dampness and cold.

.3 Prevent moisture condensation on surfaces.

.4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.

.5 Provide adequate ventilation to meet health regulations for safe working environment.

.3 Maintain minimum temperature of 10 ^{O}C or higher where specified as soon as finishing work is commenced and maintain until acceptance of structure by Engineer.

.1 Maintain ambient temperature and humidity levels as required for comfort of office personnel.

.4 Ventilating:

.1 Prevent hazardous accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.

.2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.

.3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.

.4 Ventilate storage spaces containing hazardous or volatile materials.

.5 Ventilate temporary sanitary facilities.

.6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful elements.

.5 Maintain strict supervision of operation of temporary heating and ventilating equipment.

.1 Enforce conformance with applicable codes and standards.

.2 Enforce safe practices.

.3 Prevent abuse of services.

.4 Prevent damage to finishes.

.5 Vent direct-fired combustion units to outside.

7.0 REMOVAL OF TEMPORARY FACILITIES

.1 Remove temporary facilities from site when directed by Engineer.

8.0 SITE SIGNS AND NOTICES

.1 Only Project Identification sign boards and notices for safety or instruction are permitted on site.

.2 Format, location and quantity of site signs and notices to be approved by the Engineer.

.3 Signs and notices for safety or instruction to be in English language, or commonly understood graphic symbols.

.4 Maintain sign boards for duration of project. Remove and dispose of signs off site on completion of project.

END OF SECTION

1.0 FIRES

.1 Fires and burning of rubbish on site will not be permitted.

2.0 DISPOSAL OF WASTES

.1 Burying of rubbish and waste materials on site is not permitted.

.2 Disposal of waste or volatile materials, such as mineral spirits, oil or paint thinner into waterways, storm or sanitary sewers, is prohibited.

3.0 DRAINAGE

.1 Provide temporary drainage and pumping as necessary to keep excavations and site free from water.

.2 Pumping of water containing silt in suspension into waterways, sewer and drainage systems prohibited.

4.0 SITE CLEARING AND PLANT PROTECTION

.1 Protect trees and plants on site and adjacent properties where indicated.

.2 Protect roots to drip line during excavation and site grading to prevent disturbance or damage. Avoid unnecessary traffic, dumping and storage of materials over root zones of protected trees.

.3 Minimize stripping of topsoil and vegetation.

.4 Restrict tree removal to those designated by Engineer.

5.0 WORK ADJACENT TO WATERWAYS

.1 The Contractor's operation of construction equipment in waterways shall meet all Provincial and Federal Regulations. It shall be the Contractor's responsibility to secure all approvals.

.2 Do not use waterway beds for borrow material.

.3 Do not dump excavated fill, waste material or debris into waterways.

END OF SECTION

1.0 RELATED INSTRUCTIONS

.1 Check field conditions and characteristics prior to bidding.

.2 Report any irregularities or changed surface conditions.

.3 Contractors are expected to make such additional examination of the site and soil as they may feel necessary in order to satisfy themselves as to the conditions to be encountered.

.4 Contractor shall not carry out additional testing without notifying Engineer and the Owner.

END OF SECTION

1.0 GENERAL

1.1 Related Work

.1 Coordinate the requirements of this section with all other sections, including but not limited to:

.1 Section 02212 Topsoil

1.2 Quality Control

.1 **City of Prince Albert, Public Works** to approve rough grading and sub grade preparation for all Work.

.1 Notification is required when unsuitable or waste material is encountered during rough grading operations.

1.3 Measurement and Payment

.1 The Lump Sum and Unit prices submitted are for supply of all labour and equipment and materials as specified or required to complete the Work as intended.

.2 The prices submitted to be full compensation for supplying (if applicable), hauling, installing, cleaning and placing in service the Work as specified and detailed, together with all incidental Work.

.3 Measurement for Payments to be calculated on the basis of a percentage of completion of the Lump Sum and Unit prices for the applicable item of Work or at Unit rates of Force Account Rates as entered on the Tender Form.

.4 Rough Grading includes all associated costs for excavation, grading to design sub grade elevations, disposal of material, aeration, adding water and compaction for all applicable surface treatments.

.1 Quantities refer to material after compaction.

.5 Imported Fill (cu. m.) includes all associated costs for sub grade preparation of areas to be rough graded.

1.4 Inspections

.1 Notify **Consultant** for inspection of:

.1 Rough grading, prior to placement of topsoil or soil mixes for:

.1 Berms, swales, and all turf areas.

1.5 TESTING

.1 Rough grading and sub grade preparation for all surface treatments excluding asphalt may be subject to compaction tests by an approved testing laboratory service.

2.0 PRODUCTS

2.1 Materials

.1 Existing On Site Fill Material: clean subsoil material for rough grading, **containing no organic matter, waste material or other unsuitable material** deemed to be detrimental to construction of rough grade.

.1 Topsoil is acceptable fill material within soft landscape areas.

.2 Imported Fill Material: clean subsoil material, as approved for rough grading, **containing no organic matter, waste material or other unsuitable material** deemed to be detrimental to construction of rough grade.

.3 Waste materials found on site which are deemed to be unsuitable for fill, grading or landscaping. Waste material includes:

.1 Soil containing spongy or yielding material, organic material, frozen materials, wet or saturated materials, toxic materials, alkaline material, and other unsuitable materials.

3.0 EXECUTION

3.1 Preparation

.1 Remove weeds, stones, debris, and other foreign material in excess of 50mm diameter prior to start of Work.

3.2 Layout

.1 Establish and maintain line and grade controls using appropriate survey personnel and equipment.

.1 Contractor is responsible for layout accuracy.

.2 Check surface grades constantly as Work proceeds.

.3 Normal tolerance will be +/- 25 mm, except where greater accuracy is specified.

3.3 Rough Grading

.1 Scarify surface of existing ground to depth of 150 mm prior to start of rough grading operations.

.2 Rough grade to sub grade elevations. Ensure some moisture content between existing ground and graded material to facilitate bonding.

.1 Burying of waste material or unsuitable material is prohibited.

.3 Rough grade to designed sub grades per drawings, allowing for the depths required for hard and soft landscape surface treatments.

.4 Backfill areas over excavated below design sub grade with selected material or granular backfill.

.5 Compact the sub grade to Standard Proctor, ASTM D-698.

.1 If soil is too moist, dry top 300mm by aeration to optimum moisture content.

.2 If the soil is too dry, add water uniformly with a pressure water sprayer to achieve optimum moisture content.

.3 Use sheeps foot type roller or other equipment to achieve compaction.

.4 Do not over compact the sub grade for the use intended.

.6 Compact sub grade to the following densities:

.1	Turf areas	85%
.2	Unit Paving, Concrete and Asphalt areas	97%

.7 Eliminate uneven or low areas, ensuring positive drainage.

.1 Re-grade areas damaged during construction of other Work.

3.4 Clean-Up

.1 Remove and dispose of excess material, waste material and surface debris.

.2 Clean adjacent walks and road surfaces at the end of each working day.

END OF SECTION

1.0 GENERAL

1.1 Related Work

.1 Coordinate the requirements of this section with all other sections, including but not limited to:

.1 Section 02210 Park Grading

.2 Section 02933 Seeding

.3 Section02950 Plant Material

1.2 Quality Control

.1 **City of Prince Albert, Public Works** to approve all topsoil, planting soil mix and soil mix amendments.

.1 for all topsoil material delivered to the site:

.1 A one (1) litre sample of topsoil (type A and B), planting soil mix and any soil mix amendments (imported topsoil, manure, and type A sand used for the Work.

.2 **City of Prince Albert, Public Works** to review topsoil requirements for the Work before final placement.

1.3 Inspection

.1 **Consultant** to inspect:

.1 Initial application of topsoil, before placement of manure.

.2 Placement of manure, before cultivation.

.3 Placement of sand in planting beds, before cultivation and planting.

1.4 Testing

.1 Topsoil and planting soil mix is subject to tests by the City of Prince Albert, Public Works and analyses by ALS Laboratory Group, Saskatoon or other approved testing laboratory service. Testing requirements;

.1 PSA-2 (Particle size analysis),

.2 C-TOT-ORG (organic carbon),

.3 SAL-DETAIL+TGR (detailed salinity), and

.4 Soil Analysis Package 1 (for NPKS - with recommendations).

.2 All soil mix amendments are subject to further analyses by an approved testing laboratory service.

1.5 Measurement and Payment

.1 The Unit prices submitted shall include the supply of all labour and equipment and materials as specified or required to complete the Work as intended.

.2 The prices submitted to be full compensation for supplying (if applicable), hauling, installing, cleaning and placing in service the Work as specified and detailed, together with all incidental Work.

.3 Measurement for payments to be calculated on the basis of the Unit prices for the applicable item of Work as entered on the Tender Form. Topsoil (sq. m.) for turf areas and shrub planting beds includes all associated costs for placement and spreading.

.4 Planting soil mix for all individual trees and trees/shrubs in shrub planting beds is considered incidental to cost of all plant material and will not be measured for payment.

2.0 PRODUCTS

2.1 Topsoil

.1 Topsoil A: Existing on site, stockpiled and approved for use.

2.2 Planting Soil Mix

.1 Planting soil mix is not required for tree or shrub plantings within shrub planting beds.

.1 See Soil Mix 3.3.1.

2.3 Soil Mix Amendments

.1 Imported Topsoil (if required)

.1 Neither heavy clay nor of light sandy nature.

.2 35% Sand, 35% Silt, 30% Clay

.3 Containing a minimum of 5% organic matter to maximum of 20% by weight.

.4 Acidity range (pH) of 6.0 to 7.5.

.5 Free from subsoil, toxic materials, stones and foreign objects.

.2 Manure requirements; to be well decomposed cattle excrement, rich in organic matter and humus containing balanced proportions of nitrogen, phosphorus and potash.

.1 Reasonably free of living vegetation, weed seeds, and couch grass or brome grass rhizomes.

.2 In a pulverised, friable condition, not containing fresh, or "green" manure, clay, silt, gravel or other foreign material.

.3 Sand - Type A: Homogeneous, sharp-grained.

3.0 EXECUTION

3.1 Preparation

.1 Re-grade areas damaged during construction of other Work before Topsoil placement.

.2 Approval of sub grade before topsoil and soil mix placement is required.

.1 Excavate and remove excess sub grade material to depths required.

.2 Remove weeds, stones, debris, and other foreign material in excess of 50mm diameter.

.3 Scarify entire area to receive topsoil.

.3 Ensure the moisture content of the Topsoil allows for ease of placement. Placement of grading of saturated topsoil's unacceptable.

3.2 Topsoil - Turf Areas

.1 Place 75mm (minimum) of Topsoil A at all Irrigation Mix areas.

.1 Place 50mm manure.

.2 Cultivate to blend.

.3 Final depth of topsoil and manure combined to be min. 125 mm.

3.3 Finish Grading

.1 See Section 02933 – Seeding

3.4 Protection

.1 Vehicular traffic, trenching or other activities compromising the topsoil layer is not permitted.

3.5 Clean-Up

.1 Clean adjacent walks and road surfaces at the end of each working day.

END OF SECTION

1.0 GENERAL

1.1 Description

.1 This Section specifies requirement for excavating trenches and backfilling for installation of pipelines and appurtenances.

1.2 Related Work Specified Elsewhere

.1	Water Distribution	Section 02510
.2	Manholes	Section 02536
.3	Sanitary Sewers	Section 02537
.4	Building Services	Section 02539
.5	Catch Basins, Grates and Frames	Section 02631
.6	Storm Drainage, Pipes and Fittings	Section 02635

1.3 Definitions

.1 Common excavation is defined as the excavation of all materials including rock, and shall include over-burden, hard pan, quicksand, frozen earth and boulders.

.2 Boulder excavation is defined as boulders, pieces of concrete or masonry, in excess of 0.2 cubic metres and having an average diameter less than 600 mm, which can be removed with a power operated excavator.

1.4 Safety Requirements

.1 Adhere to municipal and provincial requirements relating to safety of trenching work.

1.5 Protection

.1 Existing Buried Utilities:

.1 Prior to commencing any excavation work, notify applicable utility authorities, establish location and state of use of buried services. Clearly mark such locations to prevent disturbance during work.

.2 Maintain and protect from damage, water, sewer, electric and other utilities encountered.

.3 Obtain direction of owner of utility and Engineer before moving or otherwise disturbing utility.

.2 Existing Surface Features:

.1 Protect existing buildings, culverts, trees and other plants, lawns, fencing, service poles, wires located within right-of-way or adjoining properties from damage while work is in progress and repair damage.

.3 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 to be registered in province or territory in which work is to be carried out.

.2 When requested by Engineer, submit for review, drawings and calculations signed and stamped by 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.

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

.5 Protect open excavation against flooding and damage from surface water run-off.

1.6 Site Conditions

.1 The Bidder must examine the site of the Work before submitting his Bid, either personally or through a representative and satisfy himself as to the nature and location of the Work, local conditions, soils structure and topography at the site of the Work, the nature and quality of the materials to be used, the equipment and facilities needed preliminary to, and during, the prosecution of the Work, the means of access to the site, on-site accommodation, all necessary information as to risks, contingencies and circumstances as may affect his Bid, and all other matters which can, in any way, affect the Work under the Contract. The Tenderer is fully responsible for obtaining all information required for the preparation of his Bid and for the execution of the Work.

.2 The Bidder is not entitled to rely on any data or information included in the Bid Documents as to site or sub-surface conditions or test results indicating the suitability or quantity or otherwise off-site or subsurface materials for backfilling or other uses in carrying out the construction of the Work. If the Bidder requires additional time to conduct his own investigations or is of the opinion either that the site or subsurface conditions or that site or subsurface materials differ materially from that indicated by data or information included in the Bid Documents, he shall promptly request such additional time or notify the Engineer in writing of this opinion before the time of Bid submission. The Engineer will either request the Owner to extend the time for submission of Bids or enable Bidders to carry out further investigation or issue an addendum modifying the Bid Documents or both as the circumstances may permit.

1.7 Protection of Existing Curb and Gutter and Sidewalks

.1 The Contractor shall protect the existing curb and gutter from damage caused by his operations. Any curb and gutter damaged by the Contractor's operations shall be replaced at his own expense. This applies when the curb is not proposed to be replaced.

1.8 Measurement and Payment

.1 Work performed to this section will be in conjunction with work involved in other sections with the exception of the following:

.1 Common Excavation:

Payment for common excavation will be included in the unit price tendered per metre of pipe(s) being installed. The cost shall include excavation, hauling, dewatering, backfilling, placing and compaction of bedding material, disposal of excess excavation material, restoration of roadways and ditches to previous cross-sections, grade and condition that existing prior to construction, regravelling of roadways and driveways disturbed by construction, disposal of all rocks not allowed as backfill and replacement with suitable backfill, and all other work required for which separate payment is not indicated in the tender form.

.2 Boulder Excavation: Shall be measured in cubic metres.

Boulder to be measured for payment shall be set at the side of the trench for measurement by Engineer. The boulders shall be individually measured in 3-point dimensions. Upon completion of measurement, the Engineer shall mark the boulders so they can be disposed of at a site approved by the Engineer and secured by the Contractor. The cost of this disposal and replacement with approved backfill shall be included in the unit price for boulder excavation.

.3 Unstable Subgrade:

Where the subgrade of the trench is unstable or will not properly support the pipe, or where it contains material harmful to the pipe such as ashes, cinders, refuse, vegetable or organic material, the Contractor shall excavate such material to the width, depth and length, authorized in writing by the Engineer, and dispose of the material at a suitable disposal location. The subgrade shall then be made by backfilling with granular backfill or bedding stone and compacting in 150 mm layers. The finished subgrade surface shall be shaped to provide a uniform and continuous support for the pipe. Unstable or otherwise unsuitable ground excavated from the bottom of the trench, will be measured in cubic metres calculated from the length, width and depth authorized for removal. Payment will be at the Unit Price tendered including excavation and hauling, backfilling with bedding stone, and compaction of all bedding material used.

.4 Bedding Stone: Shall be measured in cubic metres.

Bedding stone where required by the Engineer shall be used for bedding below the pipe.

The bedding stone quantity shall be calculated using a trench width of 1.1 m, times the length of trench and depth of bedding stone as requested by the Engineer. Any cost of bedding stone beyond the above widths or depths shall be borne by the Contractor.

The cost of any bedding stone required to correct any unauthorized over-excavation and disposal of over-excavation shall be borne by the Contractor.

.5 Imported Granular Backfill:

Where designated by the Engineer, imported granular backfill required for replacement of unsuitable material in the subgrade shall be paid for at the unit price bid per cubic metre in place based on the actual length, width and depth of the area filled, and shall include supplying, hauling, placing and compacting the material.

.6 Pavement Saw Cutting:

Saw cutting roadway asphalt materials will be measured and paid for at the contract unit price as listed in the Bid Form regardless of depth of asphalt.

.7 Removal and Disposal of Asphalt:

Removal of existing asphalt will be paid for at the unit price bid per square metre. The unit price shall include loading and hauling to an approved disposal area.

2.0 PRODUCTS

2.1 Materials

.1 Imported Granular Backfill:

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

ASTM Sieve Designation	Per Cent Passing
50.0 mm	100
31.5 mm	60 - 100
16.0 mm	40 - 90
4.75 mm	25 - 60
2.00 mm	20 - 50
0.425 mm	10 - 25
0.075 mm	0 - 10

.2 Common Backfill:

.1 Approved material selected from trench excavation or other source to be used in the Final Backfill zone, unfrozen and free from cinders, ashes, sods, refuse or other deleterious materials.

.2 The maximum size of boulders permitted in backfill will be 0.02 m^3 or 300 mm average diameter.

.3 Pipe Embedment Materials:

.1 The pipe embedment zone shall be broken down into foundation, bedding, haunching, and initial backfill as identified in Figure 1 of ASTM Standard Practice D2321.

.2 Materials for use as foundation, embedment, and backfill for all pipe material types are as classified in Table 1 of ASTM Standard Practice D2321. They include natural, manufactured, and processed aggregates and the soil types classified according to ASTM Test Method D 2487.

.3 Class I, Class II, and Class III pipe embedment materials are suitable for use as foundation material and in the embedment zone subject to the limitations noted herein and in Table 2 of ASTM Standard Practice D2321.

.4 Class IV-A materials should only be used in the embedment zone in special design cases, as they would not normally be construed as a desirable embedment material for flexible pipe.

.5 Class IV-B, Class V Soils, and Frozen Materials are not recommended for embedment, and should be excluded from the final backfill except where specifically allowed by project specifications.

.6 For ease of compactability and to facilitate proper placement of material in the haunch area of the pipe, a suggested gradation for sand within the pipe embedment zone are the following limits:

ASTM Sieve Size		**Per Cent Passing**		
9.50	mm		100	
4.75	mm	50	-	100
2.00	mm	30	-	90
0.425	mm	10	-	50
0.075	mm	0	-	12

The above material is classified as an ASTM D2321 Class II embedment material.

.7 Fillcrete: Non-shrinking fill made up of a mixture of portland cement, sand, water and admixtures conforming to the following:

.1 Minimum 28 day compressive strength 0.60 to 2.00 MPa

.2 Slump 100 mm ±25 mm

.3 Portland Cement Type 10

.4 Air Entrainment 5% ±1%

.4 Bedding Stone (for use in the Foundation Zone):

A suggested material for bedding stone to be used as foundation material includes screened gravel, crushed stone or crushed gravel to following gradation requirements:

ASTM Sieve Size		**Per Cent Passing**		
63.0	mm		100	
37.5	mm	85	-	100
25.0	mm	75	-	95
19.0	mm	50	-	75
16.0	mm	25	-	50
9.50	mm	0	-	10

.5 Concrete:

Concrete required for cradles, Class A bedding, encasement, supports, reaction blocking to CAN A23.1-M90 and shall be 25 MPa CSA A3001 Type HS cement.

.6 Pit Locations:

The Contractor shall be responsible for locating, organizing approvals for haul roads, screening or crushing to meet specified gradations, loading, hauling and all other associated work for the specific trenching, backfilling and compaction material requirements.

3.0 EXECUTION

3.1 Site Preparation

.1 Remove trees, shrubs, vegetation, fences and other obstructions, ice and snow, from surfaces to be excavated within limits indicated.

.2 Strip topsoil and other surface materials from within limits of excavation and stockpile or dispose as specified.

.3 The Contractor is responsible for maintaining sewage flows by pumping when replacing sewer mains. This will be considered a subsidiary obligation of the Contract and no extra payment will be made for this item. By-passed sewage shall only be discharged to a legal disposal location.

3.2 Dewatering

.1 Trenches must be maintained in a dry condition for pipe laying. Method and execution of dewatering are the responsibility of the Contractor and should be designed such there is no detrimental impact on adjacent utilities and/or structures.

.2 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.

3.3 Excavation

.1 Excavations shall be in accordance with the Saskatchewan Occupational Health Safety Act and Occupational Health and Safety Regulations.

.2 Minimum trench width shall conform to the drawing details. Where trench walls are stable, trench widths shall be of sufficient width, but no greater than necessary, to ensure working room to properly and safely place and compact haunching and other pipe embedment zone materials. The space between the pipe and the trench wall must be wider than the compaction equipment used to construct the pipe embedment zone.

.3 In addition to safety considerations, the trench width in unsupported, unstable soils may compromise the structural design parameters of the pipe. Notify the Engineer when unsupported, unstable soils are encountered so that actual structural support conditions are considered.

.4 Excavate to lines, grades, elevations and dimensions indicated on drawings.

.5 Remove and salvage or dispose replaced piping and manholes to an approved location as directed by the Engineer.

.6 The foundation soil shall be moderately firm to hard in-situ soil, stabilized soil, or compacted fill material. Ledge rock, boulders and large stones should be removed, where present, to provide a minimum clearance of 150 mm below pipe invert.

.7 Notify Engineer when soil at proposed elevation of trench bottom appears unsuitable for foundation of installation.

.8 Remove unsuitable material from trench bottom to extent and depth necessary to stabilize foundation and replace with approved material. The cost of any granular backfill or bedding stone required to correct any unauthorized over-excavation shall be borne by the Contractor.

.9 Where groundwater and soil characteristics may contribute to the migration of soil fines into or out of the foundation, embedment soils, sidefill, and/or backfill materials, methods to prevent migration of fines shall be provided by the Contractor.

.10 The finished subgrade surface shall be shaped to provide a uniform and continuous support for the pipe bedding.

.11 Unless otherwise authorized by Engineer in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 10 m of trench at end of day's operation.

.12 Stockpile suitable excavated materials required for trench backfill in approved location. Where excavated material cannot be piled along the trench, stockpile at locations approved by the Owner.

.13 Dispose of surplus and unsuitable excavated material in an approved disposal site location.

.14 Do not obstruct flow of surface drainage or natural water courses.

.15 Sufficient clear space must be left on one side of the trench to accommodate the construction survey stakes.

3.4 Pipe Embedment Zone Construction

.1 Construction in the pipe embedment zone (i.e. bedding, haunching and initial backfill) shall conform to the requirements of Section 02510, 02537 and 02635.

3.5 Final Backfilling

.1 Do not proceed with final trench backfilling operations until Engineer has inspected installations.

.2 The Contractor shall not push final backfill directly onto the pipe until there is at least 300 mm of carefully placed initial backfill over the pipe to avoid damage to the pipe.

.3 After the initial backfill is completed and meets specific requirements; the common backfill material shall be pushed down a ramp or slope of existing backfill and not directly onto the new bedded pipe. A crawler tractor or front-end loader working in the trench and parallel with it shall compact the trench to the required Class II or Class III backfill as outlined herein.

.4 Notwithstanding the above, under no circumstances shall equipment that exceeds the structural capacity of the pipe be allowed direct access over the pipe until sufficient cover has been obtained. The Contractor shall be solely responsible for ensuring the equipment used during final backfilling operations is carefully selected and staged such that the pipe is not damaged during final backfilling operations.

.5 Class II Backfill:

Class II Backfill shall be used under all street and road right of ways or as indicated on the drawings. Approved excavated material shall be placed in 300 mm lifts over the whole width of the trench. Each lift shall be compacted to at least 98% of standard proctor maximum dry density as determined by the ASTM D698 test procedures, using mechanical compaction equipment.

.6 Class III Final Backfill:

Class III Backfill shall be used where trenches are located in parks, green space or as indicated on the drawings. Approved excavated material shall be placed in 600 mm lifts over the whole width of the trench. Each lift shall be compacted to at least 95% of standard proctor maximum dry density as determined by the ASTM D698 test procedures, using mechanical compaction equipment.

.7 Use common or granular backfill material as indicated or as required by the Engineer.

.8 Backfilling around installations:

.1 Do not backfill around or over cast-in-place concrete within 24 hours after placing.

.2 Place layers simultaneously on sides of installed work to equalize loading.

.3 Place material by hand under, around and over installations until 300 mm of pipe embedment above pipe crown is provided. Dumping material directly on installations will not be permitted.

.4 Boulders in excess of 0.02 m^3 or 300 mm average diameter will not be allowed in any of the backfill.

.9 Do not place frozen material in the embedment zone. During freezing weather conditions, heat the embedment material as necessary to provide enough free moisture to facilitate compaction as specified.

Placing frozen material during final backfilling operations will result in considerable consolidation of the final backfill material. Obtain the necessary approvals prior to utilizing frozen material as final backfill material and repair as subsequent damage due to excessive consolidation of the material.

.10 Shoring, sheeting and bracing:

.1 Unless otherwise shown on drawings remove sheeting and shoring from trench during backfilling operations in a manner that does not disrupt the pipe embedment zone.

.2 Do not remove bracing until backfilling has reached level of bracing.

3.6 Trench Subsidence

.1 The Contractor shall be responsible to ensure that trench settlement is maintained at a maximum of 50 mm for a period of one year from time of substantial completion.

.2 Contractor shall bear the costs for repairs of subsidence beyond 50 mm by filling with asphalt, and levelling to meet the technical requirements of the approving authority.

3.7 Access to Properties and Street Maintenance

.1 Until the date of substantial completion, the Contractor, at his costs, shall be responsible for street maintenance and access to properties.

.2 Such maintenance and access to properties shall include providing proper drainage, temporary gravel streets, street levelling with use of motor patrol, and providing towing services when required.

3.8 Construction Easements and Repair

.1 The Contractor shall be responsible for obtaining any construction easements beyond the easement limits as set out on the drawings.

.2 All costs for restoration within the construction easements indicated on the drawings and beyond to a condition equal to or better than their condition prior to construction, shall be borne by the Contractor.

3.9 Cleanup

.1 The Contractor shall be required to restore all roadways and areas affected by his operation to conditions prior to construction start or to design elevations and cross-sections within this contract.

.2 The Contractor shall restore drainage after construction of the storm sewer mains are complete. The Contractor shall replace all existing sidewalks, curbs and other appurtenances damaged from construction activities at his cost.

END OF SECTION

1.0 GENERAL

1.1 Related Work Specified Elsewhere

.1 Trenching, Backfilling and Compaction for Utilities Section 02315

1.2 Site Conditions

.1 Subsurface investigation is the responsibility of the Contractor.

.2 Underground and surface utility lines and buried objects are known to exist within the area. The Contractor shall contact applicable utility companies for staking and more precise information prior to commencement of work.

1.3 Protection

.1 Prevent damage to fencing, trees, landscaping, natural features, bench marks, existing buildings, existing pavement, surface or underground utility lines which are to remain. Make good any damage.

1.4 Scope

.1 Items of work covered by this Specification are those pertaining to excavation, filling, hauling, compaction, stockpiling and other associated work required to construct roadway subgrades and easements to the required cross-sections and grades. Lot grading in some areas will also be required.

1.5 Definitions

.1 Common excavation is defined as the excavation of all material other than rock, and shall include over-burden over rock, hard pan, quicksand, frozen earth and boulders up to a size of 0.2 m^3 or boulders having an average diameter less than 600 mm.

.2 Ditch is defined as V-shaped earthen drainage channel of varying depth with 3:1 sideslopes.

.3 Swale is defined as broad V-shaped earthen drainage channel of shallow depth with 8:1 or flatter sideslopes.

1.6 Measurement and Payment

.1 Common Excavation to Embankment: Shall be measured in cubic metres.

Excavated materials for roadway and lot embankment to be measured for payment in cubic metres in their original position. Measurements will be computed from elevations taken before excavation for water and sewer construction and before site excavation commences and after subgrade construction has been completed. Elevations will be taken by the Engineer

and computations for quantities will be made using the end area method. Embankment quantities calculated using 25% shrinkage factor.

Payment for roadway and site common excavation to embankment shall be considered full payment for excavation, hauling, excavation of unsuitable subgrade, watering and dewatering, placing and compaction to specified density, regravelling of adjacent structures disturbed by construction, disposal of all boulders not allowed as backfill and all other work required for which separate payment is not indicated in the tender form.

.2 Common Excavation to Stockpile: Shall be measured in cubic metres.

Excavated materials for stockpile placement to be measured for payment in cubic metres in their original position. Measurements will be computed from elevations taken before excavation for water and sewer construction and before site excavation commences and after subgrade has been completed. Elevations will be taken by the Engineer and computations for quantities will be made using the end area method.

Payment for common excavation to stockpile shall be considered full payment for: excavation and trimming to the lines, grades, slopes and elevations shown on the drawings, hauling and placing and trimming within the stockpile limits. Stockpile location to be determined by Owner.

.3 Existing Stockpile Relocation: Shall be measured in cubic metres.

Stockpile relocation to be measured for payment in cubic metres in their original position. Elevations will be taken by the Engineer and computations for quantities will be made using the end area method.

Payment for stockpile relocation shall be considered full payment for: loading, hauling, placing and trimming with the stockpile limits. Stockpile location to be determined by Owner.

.4 Drainage Swales and Ditches

Drainage swale and ditch excavation shall be paid for as common excavation.

.5 Boulder Excavation: Shall be measured in cubic metres.

Boulders to be measured for payment shall be set at the side of the trench for measurement by Engineer. The boulders shall be individually measured in 3-point dimensions. Upon completion of measurement, the Engineer shall mark the boulders so they can be disposed of at a site approved by the Engineer and secured by the Contractor. The cost of this disposal and replacement with approved backfill shall be included in the unit price for boulder excavation.

2.0 PRODUCTS

2.1 Materials

.1 Excavated or graded material to be approved by Engineer before use as fill for grading work.

3.0 EXECUTION

3.1 Construction of Embankments

.1 Suitable excavated material shall be used in the formation of embankment fills or for other backfill. Excavation used as fill in the road shall be placed and compacted in lifts not exceeding 150 mm. The material shall be bladed, shaped and compacted with appropriate compaction equipment to 98% of Standard Proctor Density and to conform to the required gradelines and cross-sections. Sufficient compaction equipment shall be employed to keep pace with the rate of placement of embankment fill. If required, the material shall be wetted or dried during placing to ensure the proper moisture contents as determined by the Standard Proctor Density Test.

.2 The Contractor shall be responsible for the supply of any water necessary for the work. Compaction water may be available from the City water mains upon approval of the Owner. The Contractor shall limit use of hydrants to one hydrant and shall notify the City well in advance which one he wishes to use. No separate payment shall be made for this work. Payment will be made on the basis of excavated volumes and no extra payment will be made for earth placed in fills or embankments.

3.2 Grading

.1 Rough grade to levels, profiles, contours and typical cross-sections shown on the drawings or as staked by the Engineer.

.2 The finished subgrade shall conform to the grade lines and cross-sections within a tolerance of $\pm$ 30 mm in all areas.

.3 Compaction of sub-grade and fill material shall be at or near optimum moisture content to a minimum of 98/% of the maximum dry density as determined by ASTM Test Designated D698.

.4 If the soil contains moisture in excess of the optimum it shall be aerated until the moisture content has been reduced to optimum. Water shall be added if required for proper compaction.

3.3 Overhaul

.1 There shall be no additional payment for overhaul for common excavation for embankments.

.2 Contractor to determine these costs and include in the unit price bid for roadway and lot excavation.

3.4 Settlement

.1 Immediately before the commencement of maintenance period, bring all fills that have settled up to grade with suitable site material. It will be the responsibility of the Contractor to restore to design grade only locations in which the settlement exceeds 50 mm during the maintenance period.

3.5 Granular Base Course Placement

.1 After completion of road grading, underground utility installations, subgrade preparation, and geotextile filter fabric installation haul granular base course and place as shown on the drawings.

3.6 Testing

.1 Inspection and testing of soil compaction will be carried out by testing laboratory designated by Engineer.

.2 Costs for compaction testing will be borne by the Owner. Refer to Section 01450.

3.7 Surplus Material

.1 Dispose of surplus material not required for grading to the designated stockpile.

END OF SECTION

1.0 GENERAL

1.1 Description

.1 This section specifies requirements for replacing and constructing water mains, and appurtenances, to lines, grades and dimensions as directed.

1.2 Related Work Specified Elsewhere

.1	Trenching, Backfilling and Compaction for Utilities	Section 02315
.2	Building Services	Section 02539

1.3 Record Drawings

.1 Provide data to produce Record Drawings, including details of pipe material.

1.4 Scheduling of Work

.1 Schedule work to minimize interruptions to existing services.

1.5 Measurement and Payment

.1 Water Main Construction – Separate Trench: The payment for water supply line and water mains installed in separate trench will be at the rate tendered per metre which shall include excavation, bedding, supply and installation of pipe, initial backfilling, general backfilling and all other work required to install, swab and test the mains as specified. Measurement will be along the main with no deductions for valves, fittings or hydrants. The payment shall include placement of sand bedding and selected backfill.

.2 Water Main Construction and Replacement - Separate Trench: The payment for water supply line and water mains installed in separate trench will be at the rate tendered per metre which shall include excavation, removal and disposal of existing pipe, bedding, supply and installation of pipe, initial backfilling, general backfilling and all other work required to install, swab and test the mains as specified. Measurement will be along the main with no deductions for valves, fittings or hydrants. The payment shall include placement of sand bedding and selected backfill.

.3 Connection to Existing Water Mains: Connection to existing water mains will be paid for at the lump sum bid and shall include all labour, equipment and materials required to make the connection.

.4 Boring Under Proposed Sidewalk for Fire Hydrant Leads: Boring under proposed sidewalk for fire hydrant leads will be paid for at the unit price tendered for each completed boring. The tendered price shall include all costs for labour, equipment and materials required to complete the boring.

.5 Fittings, valves including boxes, hydrants shall be measured as each item installed and shall include the cost of excavation, backfilling and concrete thrust blocking.

.6 Sand bedding material and placement to be included in water main and water supply main unit prices bid.

.7 Unstable subgrade, imported granular backfill, and bedding stone where authorized by the Engineer, will be measured and paid for as outlined in Section 02315.

2.0 PRODUCTS

2.1 Water Mains

.1 PVC Pipe

Pipe shall be DR18, PR 235 to cast iron OD dimensions Polyvinyl Chloride conforming to AWWA Specification C900-07. Joints shall be rubber gaskets.

2.2 Valves

.1 Valves and boxes with lengths to suit for water mains and water supply line shall be Resilient Seat gate valves to suit pipe ends to AWWA Specification AWWA C509-01. Valves shall be fitted with stainless steel nuts and bolts on the bonnet.

.2 Valve casings shall be adjustable cast iron casing to accommodate a 3 metre cover over the hood, top section with lid and stone disc in accordance with the Standard Drawing. The casing must rest on the bonnet of the valve and not on the stuffing box. The extension stem shall be made of 25 mm square mild steel with a bottom socket to fit a 50 mm square valve operating nut and shall extend to within 0.3 metres of the top of the casing when assembled.

2.3 Fittings for 300 mm and Smaller Pipe

.1 Fittings shall be PVC fittings for AWWA C900 pipe manufactured in one piece of injection molded PVC compound conforming to AWWA C-905-97.

2.4 Flanges, Bolts, Nuts and Washers

.1 Flanges shall comply with ANSI bolt circle. Securing bolts, nuts and washers shall be stainless steel, conforming to ASTM: A320/A320 M-93, Type B8M, Class 2. Hexagon heads shall be used.

2.5 Hydrants

.1 Hydrants shall be Mueller Canada Valve three-way hydrant dry barrel. No alternates.

.2 Hydrants shall be compression type shut off with cast iron body bronze mounted, 150 mm barrel diameter, O-Ring stem seals, for "on line" construction, and shall open with a counter-clockwise rotation conforming to AWWA Specification C502-05. The barrel shall be flanged at ground line and the barrel length shall be suitable for cover as indicated on drawings from flange at ground surface to crown of inlet pipe.

.3 Hydrants shall have one 100 mm pumper nozzle and 2-65 mm hose connections conforming to AWWA C502-05 and threads shall conform to Sask. Mutual Aid Standards.

.4 All hydrants are to be certified by Underwriters' Laboratory of Canada (ULC).

.5 The operating nut shall be Pentagonal shaped. Hydrants shall be flanged at ground line. The colour of the hydrant above the ground shall be red.

.6 Joints between hydrant and water main shall conform to the type of pipe supplied.

.7 All nuts and bolts below grade shall be stainless steel. Hydrant barrels and tees shall be coated with Denso paste and tape.

2.6 Pipe Foundation and Embedment Materials

.1	Granular Material for Final Backfill:	As per Section 02315
.2	Common Backfill:	As per Section 02315
.3	Pipe Embedment Zone Materials	As per Section 02315
.4	Bedding Stone for Foundation Material:	As per Section 02315
.5	Concrete:	As per Section 02315

2.7 Chlorine

.1 Sodium hypochlorite to AWWA B300-04 to disinfect water mains.

3.0 EXECUTION

3.1 Preparation

.1 Clean pipes, fittings, valves, and appurtenances of accumulated debris and water before installation. Carefully inspect materials for defects. Remove defective materials from site.

3.2 Trenching and Backfill

.1 Do PVC C900 water main trenching and backfill work in accordance with ASTM D2321-04 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications except as modified in Section 02315 - Trenching, Backfilling and Compaction for Utilities, and herein.

.2 Trench depth to provide minimum cover over pipe of 3.0 m below finished grade for water distribution mains and water supply line or to grades where deeper as indicated on drawings.

.3 Do not allow contents of any sewer or sewer service connection to flow into trench.

.4 Confirm trench line, grade and depth meet design requirements prior to placing bedding material and pipe.

.5 Do not backfill trenches until pipe grade and alignment have been reviewed by the Engineer.

3.3 Construction in the Pipe Embedment Zone

.1 Construct embedment zone for PVC water main in accordance with ASTM D2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications except as noted herein.

.2 If required and approved by the Engineer, replace unsuitable material in the foundation zone with granular backfill or bedding stone according to Section 02315.

.3 Place granular bedding, haunch and initial backfill materials to details indicated in Section 02315 and as indicated on the drawings.

.4 Shape bed true to grade to provide continuous uniform bearing surface for pipe exterior. Do not use blocks in bedding pipe.

.5 Shape transverse depressions as required to make joints.

.6 Compact the bedding to at least 90% standard proctor maximum dry density with the exception of the middle 1/3 of pipe diameter. Do not compact middle 1/3 of pipe diameter.

.7 Place haunch and initial backfill to 300 millimetres above the crown of the pipe. Compact in maximum 150 millimetre lifts and compact to 90% standard proctor maximum dry density.

.8 Exercise caution and place and compact material for haunch and initial backfill area in such a manner that adverse vertical and horizontal deflection does not occur.

.9 Place bedding stone in lieu of sand bedding material when requested.

3.4 Pipe Installation for PVC Pressure Pipe

.1 Lay and join pipes in accordance with manufacturer's recommendations.

.2 Handle pipe with approved equipment. Do not use chains or cables passed through pipe bore so that weight of pipe bears upon pipe ends.

.3 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.

.4 Commence laying and proceed in upstream direction with socket ends of pipe facing upgrade.

.5 Do not exceed permissible deflection at joints recommended by pipe manufacturer.

.6 Do not allow water to flow through pipe during construction, except as may be permitted by Engineer.

.7 Whenever work is suspended, install a removable watertight bulkhead at open ends of last pipe laid to prevent entry of foreign materials.

.8 Position and join pipes with approved equipment. Do not use excavating equipment to force pipe sections together.

.9 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 or 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 Apply sufficient pressure in making joints to assure that joint is complete as outlined in manufacturer's recommendations.

.9 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipe or as otherwise approved by Engineer.

.10 Block pipes when any stoppage of work occurs in such a manner as required by Engineer to prevent creep during down time.

.11 Cut pipes as required for special inserts, 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.

.12 Upon completion of pipe laying place specified granular material to dimensions indicated or directed.

.13 Hand place granular material in uniform layers of 150 mm thick or less. Dumping of material directly on top of pipe is not permitted.

.14 Place layers uniformly and simultaneously on each side of pipe to prevent lateral displacement of pipe.

3.5 Concrete Reaction Blocking

.1 Do concrete work to CSA A23.1-M90.

.2 Place concrete reaction blocking between changes in pipe diameter, and fittings and solid ground as shown on drawings or as directed by Engineer.

.3 Do not backfill over concrete for 24 hours after placing.

3.6 Hydrostatic Leakage Testing for PVC Piping

.1 Test Procedure

After backfilling is completed, a pressure test shall be carried out in the presence of the Engineer on all lines at the maximum rated operating pressure for the class of pipe installed. Hydrostatic leakage testing, cleaning and flushing of pressure mains shall not be conducted when the ambient air temperature is less than + 10^{o} C.

The pressure shall be maintained for not less than one hour by pumping additional water into the test section from a measuring tank. The test section will not be accepted if the leakage in litres per hour measured by the above method exceeds the quantity determined by the following table.

Allowable Leakage in Litre/Hr. Per 100 Couplings Based on AWWA C605-05 Test Pressure (kPa)							
Pipe Diameter	**350**	**500**	**700**	**850**	**1000**	**1400**	**1550**
150 mm	2.2	2.6	3.0	3.4	3.6	4.3	4.5
200 mm	2.9	3.4	4.1	4.5	4.9	5.7	6.0
250 mm	3.6	4.3	5.1	5.6	6.1	7.2	7.6
300 mm	4.3	5.1	6.1	6.7	7.3	8.6	9.1
350 mm	5.0	6.0	7.1	7.8	8.5	10.0	10.6
400 mm	5.7	6.9	8.1	8.9	9.7	11.5	12.1

If the leakage exceeds the allowable, the Contractor shall locate and repair leaks and defects and repeat the test until the leakage does not exceed the allowable.

The Contractor shall provide all necessary labour, materials and equipment for the test including a suitable pump and measuring tank, pressure hoses and connection plugs, caps, gauges and all other apparatus necessary for filling the main, pumping to the required test pressure and recording the pressure and leakage losses. The Contractor shall provide evidence that the gauges used are accurate.

The test section of the pipeline shall be filled with water at a velocity not exceeding 0.3 metres per second, taking care to expel all air from the high points. If air valves, service connections, or other means of venting are not provided, the Contractor shall at his own expense drill and tap small holes for the purpose at high points. He shall also provide a suitable cock to vent air during tests. The hole shall be sealed by means of a tight fitting plug at the conclusion of the test.

3.7 Flushing

.1 Flushing operations to be under direct control of Engineer. Notify Engineer at least 4 days in advance of proposed date when flushing and disinfection operations are to commence.

.2 Flush water mains with a sufficient flow to produce a velocity of 0.9 m per second, for three volume changes in the flush section, or until foreign materials have been removed and flushed water is clear. Ensure flushed water drains to a suitable location at an appropriate flow and appropriate measures are employed to prevent erosion and flooding.

.3 Flushing flows to be as follows:

		Flow (L/s)	
Pipe Size (mm)	=	**Minimum**	**Maximum**
200		30	40
250		45	60
300		65	75

.4 Provide all connections and pumps as required. Employ backflow prevention measures as required.

3.8 Swabbing

.1 After the hydrostatic leakage testing and flushing and before disinfection has been completed, the pipe shall be swabbed with swabs as supplied by Full Kote Systems.

3.9 Disinfection

.1 Disinfect all water mains, tie-ins and connections according to AWWA C651-05 except as specified herein.

.2 If the tablet method of chlorination is utilized, the Engineer shall be informed and approve at least 15 days in advance of any leakage testing, flushing and swabbing.

.3 When flushing, swabbing and pressure testing have been completed to satisfaction of Engineer, introduce a solution of chlorine into the water main utilizing the continuous feed method. Ensure the chlorine is distributed evenly throughout the entire test section.

.4 Protect the remaining distribution system that is in use for potable water distribution or existing potable water systems from backflow from pipes undergoing disinfection.

.5 Chlorine application to be within 3 m of filling water main and occur at same time. When application is complete, the free chlorine concentration shall be not less than 25 mg/L throughout the test section. The Contractor shall arrange for field testing and report test results, time of sample and test locations.

.6 Chlorinated water shall be retained in the line for at least 24 hours. All appurtenances shall be operated during this time to ensure disinfection.

.7 At the end of 24 hour period, the water shall be tested to ensure a free chlorine concentration of not less than 10 mg/L throughout the test section. The Contractor shall arrange for field testing and report test results including test sample locations and sample time.

.8 Repeat disinfection processes until tests are satisfactory to the Engineer.

.9 Flush pipes and appurtenances of chlorine solution after satisfactory disinfection. Flushing is complete when the total chlorine concentration is suitable for potable water use. Apply a neutralizing chemical to the chlorinated water being disposed to neutralize the chlorine to a level suitable to governing regulatory agencies.

.10 Take water samples at end of test section and submit to an accredited lab to test for chlorine concentration and the presence of bacteria. Submit two copies of the test results to the Engineer.

3.10 Delivery and Stockpiling Materials

.1 The Contractor shall be responsible for arranging, stockpiling, and protecting the materials from damage and theft.

.2 The Contractor shall be responsible for the delivery of material and the Owner will not pay for materials ordered by the Contractor and not used in the work, nor pay for shipping charges on the return of such material to the supplier.

END OF SECTION

1.0 GENERAL

1.1 Description

.1 This section specifies requirements for constructing new and adjusting manholes as indicated or as directed.

1.2 Related Work Specified Elsewhere

.1	Trenching, Backfilling, and Compaction for Utilities	Section 02315
.2	Sanitary Sewers	Section 02537
.3	Storm Drainage Pipe and Fittings	Section 02635
.4	Perforated Subdrain Pipes	Section 02636

1.3 Measurement and Payment

.1 Type I manholes to be measured from top of frame and cover to lowest pipe invert as follows:

.1 in vertical metres

.2 to the nearest 5 mm

.2 Type IA and Type II manholes to be measured from top of frame and cover to top of cast-in-place manhole base as follow:

.1 in vertical metres

.2 to the nearest 5 mm

.3 Cast-in-place Type IA and Type II manhole bases shall be paid at the lump sum price bid on an individual basis and shall include all equipment materials and all other work required to excavate, construct and backfill the manhole base as detailed and specified.

.4 Where manholes include a drop section, drop inlets will be paid for at the unit price tendered per vertical metre, which shall be payment for supply and installation of the Y or T branch, elbow, pipe and concrete and all other work necessary to install the drop inlet in the manhole. Measurement will be in metres from the invert of the incoming sewer to the invert of the drop section.

.5 Sewer stub pipes to lengths and depths and in locations indicated on drawings shall be included in the price per vertical metre of manhole.

.6 Manhole unit prices shall include supply/installation of granular base.

2.0 PRODUCTS

2.1 Materials

.1 Concrete to CSA A23.1-M90.

.2 Precast manhole sections: shall be 1050 mm or 1200 mm diameter as indicated on the drawings to ASTM C478-75, circular. Top section eccentric cone with opening offset and vertical ladder installation.

.1 1050mm sections shall be supplied by Expocrete.

.2 1200mm sections shall be supplied as designated by the Engineer.

.3 Joints: to be made watertight using rubber rings, bituminous compound, epoxy resin cement or cement mortar.

.4 Bituminous caulking compound: to CGBS-4a.

.5 Mortar:

.1 Aggregate: to CSA A82.56-1950.

.2 Cement: to CSA A8-1970.

.6 Ladder rungs: to be as detailed on the drawings.

.7 Adjusting rings: to ASTM C478-75.

.8 Brick: to CSA A82.1-1965 Type 1, Class B.

.9 Drop manhole pipe: to be same as sewer.

.10 Standard manhole frame and cover to be Titan Foundry Type TF-105 Herzog with no alternates.

.11 Sewer stub pipes to the lengths and locations indicated on the drawings.

3.0 EXECUTION

3.1 Excavation and Backfill

.1 Excavate and backfill to Section 02315.

.2 Excavation requires approval prior to installing manholes.

3.2 Concrete Work

.1 Do concrete work to CSA A23.1-M90.

3.3 Installation

.1 Construct units to details indicated, plumb and true to alignment and grade.

.2 Complete manholes as pipe laying progresses. Maximum of three manholes behind point of pipe laying will be allowed.

.3 Pump manhole excavations dry and remove soft and foreign material before placing concrete base.

.4 Cast bottom slabs directly on undisturbed ground or when permitted by Engineer, set precast concrete slab on 150 mm minimum of well compacted granular material.

.5 For Precast Units:

.1 Set bottom section of precast unit in bed of mortar and bond to concrete slab. Make each successive joint watertight with approved rubber ring gaskets, mastic joint filler, cement mortar, or combination thereof.

.2 Clean surplus mortar and joint compounds from interior surface unit as work progresses.

.3 Plug lifting holes with precast concrete plugs set in cement mortar or mastic compound.

.6 For Sanitary 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 diameter of sewer. Adjacent floor to be sloped at 1 in 10. Channels to be curved smoothly. Slope invert to establish sewer grade. For pipes smaller than 250 mm use standard pipe, breaking out upper half of pipe upon completion of manhole.

.7 Set frame and cover to required elevation using adjusting rings. Final adjustment to be at finished pavement.

.8 Clean units of debris and foreign materials; remove fins or sharp protuberances.

.9 Pre-benched manholes shall be watertight connections between pipe and manhole with pipe manufacturers rubber gaskets.

.10 Manholes to be made watertight from the outside prior to backfilling.

.11 1200 mm ∅ precast manholes shall have sanitary sewer pipe stubs cast into base during fabrication. Precast base shall be set on a bed of 150 mm well compacted crushed rock. Crushed rock shall be placed on undisturbed soil. If sewer pipe stubs are not cast into the precast base, coring a hole will be accepted using an approved coring machine. Using hammer's or any other method of providing a hole in the precast base will not be accepted.

3.4 Delivery and Stockpiling Materials

.1 The Contractor shall be responsible for arranging, stockpiling, and protecting the materials from damage and theft.

.2 The Contractor shall be responsible for the delivery of material and the Owner will not pay for materials ordered by the Contractor and not used in the work, nor pay for shipping charges on the return of such material to the supplier.

3.5 Engineer's Access to the Work

.1 The Engineer shall be allowed to inspect the work at anytime.

END OF SECTION

1.0 GENERAL

1.1 Description

.1 This section specified requirements for constructing gravity sanitary sewer and pipe embedment to lines, grades and dimensions indicated or directed.

1.2 Related Work Specified Elsewhere

.1	Trenching, Backfilling, and Compaction for Utilities	Section 02315
.2	Water Distribution	Section 02510
.3	Manholes	Section 02536
.4	T.V. Camera Sewer Main Inspections	Section 02800

1.3 Schedule of Work

.1 Schedule work to minimize interruptions to existing services.

1.4 Method of Measure

.1 Sanitary Sewer Main Construction:

Measurements will be made in lineal metres from centre to centre of manholes and the depths of excavation will be those determined at the time the grade stakes are set. The elevations of ground opposite the stake and on the centre line of the proposed trench will be recorded, and the final estimate will be considered as the average of the excavation depths in vertical metres taken every 15 lineal metres between every pair of manholes.

The unit price tendered shall cover the cost of supplying, hauling, laying and jointing all pipe, together with the necessary excavation, pipe embedment, common backfilling as specified, disposal of surplus material, all acceptance testing including CCTV camera and infiltration/exfiltration testing and all other work required to install the sewer mains as specified.

.2 Connection to Existing Sanitary Sewer:

Connection to the existing sanitary sewer main will be paid for at the lump sum bid and shall include all labour, equipment and materials required to make the connection. This shall include manhole, pipe connections and include related measures required to keep sewer service uninterrupted during the connection.

2.0 PRODUCTS

2.1 Sanitary Sewer Pipe

.1 Type PSM PVC Sewer Pipe and Fittings for Non-Insulated Sections

.1 Pipe shall be Type PSM PVC sewer pipe

.2 Pipe shall conform to CSA B182.2

.3 Standard Dimension Ratio SDR 35

.4 Factory installed locked-in gasket and integral bell system conforming to ASTM F477.

.5 Materials used for pipe shall come from a single compound manufacturer and shall have a cell classification of 12454-B, 12454-C, or 12364-C as defined in ASTM Standard D1784. Materials used for moulded fittings shall come from a single compound manufacturer and shall have a cell classification of 12454-B, 12454-C, or 13343-C as defined in ASTM Standard D1784.

.2 Type PSM PVC Sewer Pipe and Fittings for Insulated Sections

.1 Pipe shall be Type PSM PVC sewer pipe

.2 Pipe shall conform to CSA B182.2

.3 Standard Dimension Ratio SDR 35

.4 Factory installed locked-in gasket and integral bell system conforming to ASTM F477.

.5 Materials used for pipe shall come from a single compound manufacturer and shall have a cell classification of 12454-B, 12454-C, or 12364-C as defined in ASTM Standard D1784. Materials used for moulded fittings shall come from a single compound manufacturer and shall have a cell classification of 12454-B, 12454-C, or 13343-C as defined in ASTM Standard D1784.

.6 The sewer mains shall be insulated with 50 mm polyurethane insulation with a density of 55 kg/m^3 with a compressive strength of 275-310 kPa and in locations shown on drawings or as directed by the Engineer where the ground cover is less than 2.5 metres above crown of the pipe.

.7 The insulation shall be covered with a minimum 1 mm thick HDPE outer jacket.

.8 The insulation shall extend to the ends of the bell. Where the bell and spigot ends meet the insulation, shall be covered with mastic to ensure a waterproof joint exists.

2.2 Cement Mortar

.1 Portland Cement to conform to CAN A3001 Type HS.

.2 Mortar to be one part by volume of cement to two parts of clean, sharp sand mixed dry. Add only sufficient amount of water after mixing to give optimum consistency for placement. Do not use additives.

2.3 Pipe Foundation, Embedment and Backfill Materials

.1	Granular Material for Final Backfill:	As per Section 02315.
.2	Common Backfill:	As per Section 02315.
.3	Pipe Embedment Zone Materials:	As per Section 02315.
.4	Bedding Stone:	As per Section 02315.
.5	Concrete:	As per Section 02315.

3.0 EXECUTION

3.1 Delivery and Stockpiling Materials

.1 Contractor shall be responsible for arranging, stockpiling, and protecting the materials from damage and theft.

.2 The Contractor shall be responsible for the delivery of material and the Owner will not pay for materials ordered by the Contractor and not used in the work, nor pay for shipping charges on the return of such material to the supplier.

3.2 Preparation

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

3.3 Trenching and Backfill

.1 Do Type PSM PVC sewer trenching and backfill work in accordance with ASTM D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications except as modified in Section 02223 - Trenching, Backfilling and Compaction for Utilities.

.2 Do not allow contents of any sewer or sewer connection to flow into trench.

.3 Do not perform pipe embedment until the foundation, pipe grade and alignment meet the design requirements.

.4 Do not backfill trenches until pipe grade and alignment have been reviewed by the Engineer.

3.4 Pipe Embedment Zone Construction

.1 Construct in pipe embedment zone to conform to ASTM D2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications except as noted herein.

.2 Pipe Embedment Zone Construction:

.1 Place granular bedding, haunch and initial backfill materials to details indicated in Section 02315 and drawing details.

.2 Shape bed true to grade and to provide continuous, uniform bearing surface for barrel of pipe. Do not use blocks when bedding pipe.

.3 Shape transverse depressions as required to receive bell if bell and spigot pipe is used.

.4 Install PVC and reinforced concrete pipe as a Type 2 installation as per the detail drawings. As noted on the detail drawing, do not compact bedding material under the middle 1/3 of pipe diameter of the pipe.

.5 Place haunch and initial backfill to 300 millimetres above the crown of the pipe. Compact in maximum 150 millimetre lifts to the specified density for a Type 2 installation.

.6 For flexible pipe, exercise caution and place and compact material for haunch and initial backfill area in such a manner that adverse vertical and horizontal deflection does not occur.

.3 Concrete Bedding:

.1 Pipe may be positioned on concrete blocks to facilitate placement of concrete. When necessary, sufficiently anchor or weight pipe, to prevent floatation and resultant compromised line and grade, while concrete is placed and sufficiently cured.

.2 Do not backfill over concrete within 24 hours after placing.

3.5 Pipe Installation

.1 Lay and join pipes in accordance with ASTM D2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications and manufacturer's recommendations except as noted herein.

.2 Handle pipe with approved equipment. Do not use chains or cables passed through pipe bore so that weight of pipe bears upon pipe ends.

.3 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.

.4 Commence laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.

.5 Do not exceed permissible deflection at joints recommended by pipe manufacturer unless directed in writing.

.6 Do not allow water to flow through pipe during construction that adversely affect the installation.

.7 Whenever work is suspended, install a removable watertight bulkhead at open ends of last pipe laid to prevent entry of foreign materials.

.8 Position and join pipes with approved equipment. Do not use excavation equipment to force pipe sections together.

.9 Pipe Jointing:

.1 Install pipe joints 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 pipes are properly joined.

.3 Align pipes carefully before joining.

.4 Maintain pipe joints free from mud, silt, gravel or 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 a pipe joint not more than 1.2 m from side of structure.

.9 Apply sufficient pressure in making joints to assure that joint is complete as outlined in manufacturer's recommendations.

.10 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by Engineer.

.11 Block pipes when any stoppage of work occurs in such a manner as required by Engineer to prevent creep during down time.

.12 Cut pipes as required for special inserts, 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.

.13 Make watertight connections to manholes with manufacturer's factory installed rubber gaskets.

.14 Upon completion of pipe laying, and after Engineer has inspected pipe joints, place specified granular material to dimensions indicated or directed.

.15 Hand place granular material in uniform layers of 150 mm thick or less. Dumping of material directly on top of pipe is not permitted.

.16 Place layers uniformly and simultaneously on each side of pipe to prevent lateral displacement of pipe.

3.6 Delivery and Stockpiling Materials

.1 The Contractor shall be responsible for arranging, stockpiling, and protecting the materials from damage and theft.

.2 The Contractor shall be responsible for the delivery of material and the Owner will not pay for materials ordered by the Contractor and not used in the work, nor pay for shipping charges on the return of such material to the supplier.

4.0 ACCEPTANCE TESTING

.1 Sewer inspection by televising:

.1 Storm sewers less than 1350 mm diameter shall be inspected by camera after backfilling of the trench to finished grade.

.2 The inspection shall be made by employing television scanning equipment which shall be provided by the Contractor. The Contractor shall employ a qualified closed circuit television Contractor acceptable to the Engineer to carry out the inspection.

.3 The closed circuit television Contractor shall provide all equipment and materials necessary to conduct the inspection as specified in Section 02800.

.4 All television inspection shall be carried out in the presence of the Engineer who shall be given at least 48 hours advance notice of any testing to be carried out. Television inspection shall be performed by the Contractor on all sewers unless otherwise directed by the Engineer.

.2 Infiltration test:

.1 The Contractor shall conduct an infiltration test on the gravity sewer mains including manholes.

.2 Conduct infiltration test where static groundwater level is 300 mm or more above top of pipe measured at highest point in the test section.

.3 Do not interpolate a head greater than 750 mm above the pipe to obtain an increase in allowable infiltration rate.

.4 Install a watertight plug at upstream end of pipeline test section.

.5 Discontinue pumping operations for at least 72 hours before test measurements are to commence, and during this time keep thoroughly wet at least one third of pipe invert perimeter.

.6 Prevent damage to pipe and bedding material due to flotation and erosion.

.7 Place a 90° V-notch weir, or other measuring device approved by Engineer to measure infiltration.

.8 Measure rate of flow over a minimum of 1 hour, with recorded flow for each 5 minute interval.

.3 Exfiltration Testing:

.1 If required by the Engineer, the Contractor shall conduct an exfiltration test.

.2 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.

.3 Immediately prior to test period add water to pipeline until there is a head of 0.3 m over interior crown of pipe measured at highest point of test section or water in manhole is 1.0 m above static groundwater level, whichever is greater.

.4 Duration of exfiltration test shall be two hours.

.5 Water loss at end of test period shall not exceed maximum allowable exfiltration over any test section.

.4 Allowable Infiltration/Exfiltration:

.1 Infiltration/Exfiltration shall not exceed following 40 litres per hour per 100 metres of pipe, including manholes.

END OF SECTION

1.0 GENERAL

1.1 Description

.1 This section specifies requirements for constructing building services and appurtenances, to lines, grades and dimensions as directed.

1.2 Related Work Specified Elsewhere

.1 Trenching, Backfilling and Compaction for Utilities Section 02315

.2 Water Distribution Section 02510

.3 Sanitary Sewers Section 02537

1.3 Record Drawings

.1 Provide data for record drawings including details of pipe material as well as maintenance and operating instructions.

1.4 Scheduling of Work

.1 Schedule work to minimize interruption of service.

1.5 Measurement and Payment

.1 Machine excavation for building services will be measured in lineal metres for service trenches excavated and backfilled but shall not include installing the pipe.

The unit price for machine excavation shall include the costs for excavation, backfilling and sand bedding.

.2 Sewer service pipe will be measured in lineal metres installed for the various pipe sizes.

The unit price tendered shall include the cost of supplying, hauling, laying and jointing all pipe and all other work required to install non-insulated sewer service pipe.

Insulated pipe unit price to include the insulated pipe and all the other requirements of non-insulated pipe noted above.

.3 Sewer pipe fittings shall be measured as each item installed including insulation specified.

.4 Water service pipe will be measured in lineal metres installed for the various pipe sizes and where applicable include the removal and disposal of the existing water service pipe.

The unit price tendered shall include the cost of supplying, hauling, laying and jointing all pipe and all other work required to install non-insulated water service pipe.

The unit price tendered shall include the cost of supplying, hauling, laying and jointing all pipe, and the pre-insulated duct system and all other work required to install the insulated water service pipe.

.5 Water service pipe fittings shall be measured as each item installed.

.6 There will be no separate payment for locating mains for service tie-ins.

.7 Risers for building services shall be measured in vertical metres from the sewer main invert to the top of the constructed riser, installed as per drawing.

.8 Boring under future sidewalk and curb locations will be paid for at the unit price tendered for each completed boring required. The tendered price shall include all costs for labour, materials, and equipment required to complete the boring.

2.0 PRODUCTS

2.1 Sewage Pipe and Fittings

.1 Polyvinyl Chloride Pipe: PVC pipe shall be SDR 28 conforming to ASTM D3034. Joints to be rubber ring type. Fittings to be of similar manufacture to the pipe.

.2 Sewer Pipe Insulation: Insulated sewer service pipe as required by the Engineer or when the cover over the service line is less than 2.0 metres, shall be insulated with expanded polystyrene insulation as follows:

.1 The insulation shall have a density of 24 kg/m^3 and the thickness shall be an actual minimum thickness of 50 mm with a compressive strength of 110 kPa;

.2 The insulation on pipe and fittings shall be covered with a minimum 1 mm thick HDPE outer jacket.

.3 The insulation shall extend to the ends of the bell. Where the bell and spigot ends meet the insulation, it shall be covered with mastic to ensure a waterproof joint exists.

2.2 Water Pipe and Fittings

.1 Water Pipe: Pipe for building services shall be High Density Polyethylene Pipe (HDPE), SDR9, Series 200 conforming to AWWA C901. The pipe shall be manufactured in accordance with ASTM D2737-74 and all current revision, using materials designated PE2306, PE3306 or 3406. Joints shall be standard compression type with stainless steel inserts with no alternates.

.2 Corporation Stops: Shall be standard brass with Mueller tapping thread suitable for compression type connection to piping.

.3 Curb Stops: Curb stops shall be standard brass with drain and compression type joints, Mueller Mark II Oriseal valve with drain. The valve casing shall be John East #3063 curb box.

.4 Thaw Wire: Thaw wire shall be No. 4 AWG bare stranded copper wire.

.5 Filler Grease: Shall be Grade O Zunicon Light, Food Grade.

2.3 Pipe Bedding and Backfill Materials

.1 Granular Bedding: As per Section 02315

.2 Common Backfill: As per Section 02315

.3 Bedding Sand: As per Section 02315

.4 Bedding Stone: As per Section 02315

.5 Concrete: As per Section 02315

3.0 EXECUTION

3.1 Preparation

.1 Clean pipes, fittings, valves, and appurtenances of accumulated debris and water before installation. Carefully inspect materials for defects. Remove defective materials from site.

3.2 Trenching and Backfill

.1 Do trenching and backfill work to Section 02315.

.2 Trench depth to provide minimum cover over sewer pipe to 2.7 m and 3.0 m for water from finished grade.

3.3 Bedding

.1 Bedding shall be Sand Bedding as detailed on drawings and extend to 300 mm above the crown of the pipe.

.2 Shape bed true to grade to provide continuous uniform bearing surface for pipe exterior. Do not use blocks when bedding pipe.

.3 Shape transverse depressions as required to make joints.

.4 Compact full width of bed to at least 95% of maximum dry density.

.5 Place bedding stone in lieu of sand bedding material when required by the Engineer.

.6 Fill any excavation below level of specified bedding with bedding stone.

3.4 Sewer Pipe Installation

.1 Lay pipe to manufacturer's standard instructions and specifications. Do not use blocks.

.2 Join pipes to manufacturer's recommendations.

.3 Handle pipe by approved methods.

.4 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.

.5 The pipe shall be installed in full sections without damage to bell. The pipe shall be terminated outside the right-of-way a distance of 1.0 to 4.0 metres from the property line.

.6 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.

.7 Protect installed pipes from ingress or dirt and water or other foreign materials. Whenever work is suspended, install a removable watertight bulkhead at open end of the last pipe laid to prevent entry of foreign materials.

.8 Position and join pipes with approved equipment. Do not use excavating equipment to force pipe sections together.

.9 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.

.10 Align pipes carefully before jointing.

.11 Maintain pipe joints clean and free from foreign materials.

.12 Avoid displacing gasket or contaminating with dirt or other foreign material. Gaskets so disturbed to be removed, cleaned, lubricated and replaced before jointing is attempted.

.13 Complete each joint before laying next length of pipe.

.14 Minimize deflection after joint has been made to avoid damage.

.15 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.

.16 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by Engineer.

.17 Do not lay pipe on frozen bedding.

.18 Upon completion of pipe laying surround and cover pipes with approved granular material placed to dimensions indicated or requested.

.19 Hand place granular material in uniform layers not exceeding 150 mm thick. Dumping of material directly on top of pipe is not permitted.

.20 Place layers uniformly and simultaneously on each side of pipe to prevent lateral displacement of pipe.

.21 Compact each layer to at least 95% of maximum dry density.

3.5 Water Pipe Installation

.1 Construct service connections at right angles to water main unless otherwise directed. Locate curb stops 300 mm inside right-of-way.

.2 Employ only competent workmen equipped with suitable tools to carry out tapping of mains, cutting and flaring of pipes.

.3 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 manufacture, or 1 m, whichever is greater.

.4 Leave corporation stop valves fully open.

.5 In order to relieve strain on connections, install service pipe in "Goose Neck" form.

.6 Install curb stop with corporation box on services 50 mm or less in diameter. Set box plumb over stop and adjust top flush with final grade elevation. Leave curb stop valves fully closed.

.7 Place temporary location markers at ends of plugged or capped disconnected water lines. Each marker to consist of a 38 x 89 mm stake extending from pipe end at pipe level to 600 mm above grade. Paint exposed portion of stake red with designated 'WATER SERVICE LINE' in black.

.8 Water pipe shall terminate at the same point as the sewer service pipe unless directed otherwise by the Engineer.

3.6 Building Service Connections

.1 The Contractor shall install a water and sewer connection to each of the lots staked by the Engineer.

.2 The building water and sewer services shall be installed in accordance with drawings and as directed by the Engineer.

.3 Where building services are laid across recently excavated trenches, particular care shall be given to supporting the pipes. If necessary, backfill material below the pipes shall be re-excavated and backfilled with compaction to ensure that the pipes will not settle.

.4 All lots shall be serviced with the piping extending from the main to a point 300 mm outside the property line or as requested by the Engineer.

3.7 Delivery and Stockpiling Materials

.1 The Contractor shall be responsible for arranging, stockpiling, and protecting the materials from damage and theft.

.2 The Contractor shall be responsible for the delivery of material and the Owner will not pay for materials ordered by the Contractor and not used in the work, nor pay for shipping charges on the return of such material to the supplier.

3.8 Engineer's Access to the Work

.1 The Engineer shall be allowed to inspect the work at any time.

END OF SECTION

1.0 GENERAL

1.1 Description

.1 This section specifies requirements for constructing new and adjusting catch basins as indicated or as directed.

1.2 Related Work Specified Elsewhere

.1	Trenching, Backfilling, and Compaction for Utilities	Section 02315
.2	Storm Drainage Pipe and Fittings	Section 02635

1.3 Measurement and Payment

.1 Catch Basins

Payment shall be paid at the contract unit price and shall include all equipment, materials and work required to construct the catch basin unit complete including base, barrel, adjusting rings, frame and cover and adjustment to final grade, and backfill.

.2 Catch Basin Frames and Covers

Payment shall be included in the contract unit price paid for catch basin installation.

.3 Connect to Existing Catch Basin

Connection to existing catch basin shall be paid for at the lump sum bid on an individual basis and shall include all labour, equipment and materials required to make the connection.

2.0 PRODUCTS

2.1 Catch Basin Materials

.1 Materials used for Catch Basins shall be in accordance with current ASTM Specification C-478 and as per Standard Drawings B3. The precast barrel and base shall be constructed as a single unit.

2.2 Frame and Covers Materials

.1 Frames and Covers to be installed in vertical faced curbs shall be the barrier curb and gutter inlet Type TF-106 as manufactured by Titan Foundry.

.2 Rolled frames and covers shall be Type TF-33 COS as manufactured by Titan Foundry.

.3 Flat top frames and covers shall be Type TF-104 Herzog as manufactured by Titan Foundry, or approved equal.

.4 Grade rings shall be constructed of 30 MPa concrete with a minimum thickness of 100 mm and a maximum thickness of 200 mm. Final adjustment grade rings shall be INFRA-RISER composite rubber grade rings with a minimum thickness of 25mm and a maximum thickness of 50 mm.

3.0 EXECUTION

3.1 Excavation and Backfill

.1 Excavate and backfill to Section 02315.

.2 Excavation requires approval prior to installing catch basins.

3.2 Concrete Work

.1 Do concrete work to CSA A23.1-M90.

3.3 Installation

.1 Construct units to details indicated, plumb and true to alignment and grade.

.2 Complete catch basins as pipe laying progresses.

.3 Pump excavations dry and remove soft and foreign material before placing concrete base.

.4 Cast bottom slabs directly on undisturbed ground or when permitted by Engineer, set precast concrete slab on 150 mm minimum of well compacted granular material.

.5 For Precast Units:

.1 Set bottom section of precast unit in bed of mortar and bond to concrete slab. Make each successive joint watertight with approved rubber ring gaskets, mastic joint filler, cement mortar, or combination thereof.

.2 Clean surplus mortar and joint compounds from interior surface unit as work progresses.

.3 Plug lifting holes with precast concrete plugs set in cement mortar or mastic compound.

.4 Place stub outlets and bulkheads at elevations and in positions indicated.

.6 Set frame and cover to required elevation using adjusting rings. The topmost adjustment grade ring for all manholes and catch basins shall be rubber.

.7 Clean units of debris and foreign materials; remove fins or sharp protuberances.

.8 Pre-benched catch basins shall be watertight connections between pipe and units with pipe manufacturers rubber gaskets.

.9 Catch basins to be made watertight from the outside prior to backfilling.

3.4 Delivery and Stockpiling Materials

.1 The Contractor shall be responsible for arranging, stockpiling, and protecting the materials from damage and theft.

.2 The Contractor shall be responsible for the delivery of material and the Owner will not pay for materials ordered by the Contractor and not used in the work, nor pay for shipping charges on the return of such material to the supplier.

3.5 Engineer's Access to the Work

.1 The Engineer shall be allowed to inspect the work at any time.

END OF SECTION

1.0 GENERAL

1.1 Description

.1 This section specifies requirements for constructing gravity storm sewer with bedding material to lines, grades and dimensions indicated or directed.

1.2 Related Work Specified Elsewhere

.1	Trenching, Backfilling, and Compaction	Section 02315
.2	Manholes	Section 02536
.3	Catch Basins, Grates and Frames	Section 02631
.4	Building Services	Section 02539
.5	Perforated Subdrain Pipe	Section 02636
.6	T.V. Camera Sewer Main Inspections	Section 02800

1.3 Schedule of Work

.1 Schedule work to minimize interruptions to existing services.

1.4 Measurement and Payment

.1 Storm Sewers: Measurements will be made in lineal metres from centre to centre of manholes and the depths of excavation will be those determined at the time the grade stakes are set. The elevations of ground opposite the stake and on the centre line of the proposed trench will be recorded, and the final estimate will be considered as the average of the depths in vertical metres taken every 15 lineal metres between every pair of manholes.

The unit price tendered shall cover the cost of supplying, hauling, laying and jointing all pipe, together with the necessary excavation, bedding, backfilling, connection to existing storm sewer mains, and all other work required to install the storm sewer mains as specified.

.2 Storm Sewer Main Construction and Replacement: Measurements will be made in lineal metres from centre to centre of manholes and the depths of excavation will be those determined at the time the grade stakes are set. The elevations of ground opposite the stake and on the centre line of the proposed trench will be recorded, and the final estimate will be considered as the average of the depths in vertical metres taken every 15 lineal metres between every pair of manholes.

The unit price tendered shall include excavation, removal and salvage of existing pipe, excavation, bedding, supply and installation of new pipe, initial backfilling, general backfilling and all other work required to install the storm sewer as specified.

.3 Existing Manhole Removal: Payment shall be paid at the lump sum price bid on an individual basis and shall include excavation, removal and salvage of the existing manhole.

The lump sum bid price shall include all labour, equipment and materials required to complete the removal.

.4 Remove / Salvage Existing Storm Sewer: Payment shall be paid by the lineal metre for the length of pipe removed and salvaged in an undamaged condition. The payment shall include all labour, equipment and materials required to remove and salvage the existing pipe in an undamaged condition.

Backfill of the salvaged pipe trench after pipe removal to Class III final backfill is also included in the payment.

.5 Catch Basin Leads: Measurements will be made in lineal metres from center of manhole to center of catch basin along the pipe alignment.

The unit price tendered shall cover the cost of supplying, hauling, laying and jointing all pipe, together with the necessary excavation, bedding, backfilling, connection to existing manholes or mains, and all other work required to install the catch basin leads as specified.

.6 Weeping Tile: Refer to section 02636 Perforated Subdrain Pipes.

2.0 PRODUCTS

2.1 Storm Sewer Pipe

.1 Reinforced Concrete Pipe for Direct Bury

.1 Storm sewers larger than 900 mm diameter (unless otherwise specified) shall be reinforced concrete pipe.

.2 Conform to ASTM C76-08, ASTM C655 and CSA A257.2.

.3 Pipe sections shall conform to ASTM C76-08 Standard pipe classifications as indicated on drawings

.4 Flexible rubber gaskets conforming to CAN A257.3 and ASTM C443-05a.

.5 Portland Cement: CSA A3001 Type HS.

.2 Profile Wall PVC Sewer Pipe and Fittings

.1 Pipe shall conform to CSA B182.4.

.2 Minimum Pipe Stiffness: 320 kPa as per ASTM D2412-02

.3 Factory installed locked-in gasket and integral bell system conforming to ASTM F477-07.

.4 IPEX Ultra-Rib (300 to 600 mm diameter), IPEX Ultra X2 (750 to 900 mm diameter) or approved equal.

.3 Type PSM PVC Sewer Pipe and Fittings

.1 Pipe shall conform to CSA B182.2.

.2 Standard Dimension Ratio SDR 35

.3 Factory installed locked-in gasket and integral bell system conforming to ASTM F477-07.

.4 IPEX Ring-Tite or approved equal.

2.2 Catch Basin Leads

.1 Catch basin leads shall be 250 mm diameter SDR 35 PVC pipe complete with rubber gaskets. Tandem catch basin installations shall be 250 mm diameter between catch basins and 300 mm diameter SDR 35 PVC pipe from catch basin to manhole or mains. Connection directly to storm sewer mains shall only be as directed by the Engineer and the diameter of the main must be twice that of the catch basin lead. IPEX-ULTRA-RIB may be used as an alternate.

2.3 Weeping Tile

.1 Refer to section 02636 Perforated Subdrain Pipes.

2.4 Cement Mortar

.1 Portland Cement: to CSA A5-171, CSA A5-1977, Sulphate Resistant Type 50.

.2 Mortar to be one part by volume of cement to two parts of clean, sharp sand mixed dry. Add only sufficient amount of water after mixing to give optimum consistency for placement. Do not use additives.

2.5 Pipe Foundation and Embedment Materials

.1	Granular Material for Final Backfill:	As per Section 02315
.2	Common Backfill:	As per Section 02315
.3	Pipe Embedment Zone Materials	As per Section 02315 with the exception that the initial backfill material for reinforced concrete pipe can be Common Backfill material.

.4	Bedding Stone for Foundation Material:	As per Section 02315
.5	Concrete:	As per Section 02315

3.0 EXECUTION

3.1 Delivery and Stockpiling Materials

.1 The Contractor shall be responsible for arranging, stockpiling, and protecting the materials from damage and theft.

.2 The Contractor shall be responsible for the delivery of material and the Owner will not pay for materials ordered by the Contractor and not used in the work, nor pay for shipping charges on the return of such material to the supplier.

3.2 Preparation

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

3.3 Trenching and Backfill

.1 Do Type PSM PVC and Profile Wall PVC storm sewer trenching and backfill work in accordance with ASTM D2321-04 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications except as modified in Section 02315 - Trenching, Backfilling and Compaction for Utilities, and herein.

.2 Do reinforced concrete pipe storm sewer trenching and backfill work in accordance with ASCE Type 2 Standard Installation except as modified in Section 02315 - Trenching, Backfilling and Compaction for Utilities, and herein.

.3 Do not allow contents of any sewer or sewer connection to flow into trench.

.4 Confirm trench line, grade and depth meet design requirements prior to placing bedding material and pipe.

.5 Do not backfill trenches until pipe grade and alignment have been reviewed by the Engineer.

3.4 Construction in Pipe Embedment Zone

.1 Construct pipe embedment zone for PVC storm sewer in accordance with ASTM D2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications except as noted herein.

.2 Construct embedment zone for reinforced concrete pipe storm sewer pipe in accordance with ASCE Standard Practice 15 – Standard Practice for Direct Design of Buried Precast Concrete Pipe Using Standard Installations except as modified herein.

.3 Pipe Embedment Zone Construction:

.1 Place granular bedding, haunch and initial backfill materials to details indicated in Section 02315 and drawing details.

.2 Shape bed true to grade and to provide continuous, uniform bearing surface for barrel of pipe. Do not use blocks when bedding pipe.

.3 Shape transverse depressions as required to receive bell if bell and spigot pipe is used.

.4 Install PVC and reinforced concrete pipe as a Type 2 installation as per the detail drawings. As noted on the detail drawing, do not compact bedding material under the middle 1/3 of pipe diameter of the pipe.

.5 Place haunch and initial backfill to 300 millimeteres above the crown of the pipe. Compact in maximum 150 millimetre lifts to the specified density for a Type 2 installation.

.6 For flexible pipe, exercise caution and place and compact material for haunch and initial backfill area in such a manner that adverse vertical and horizontal deflection does not occur.

.4 Concrete Bedding:

.1 Pipe may be positioned on concrete blocks to facilitate placement of concrete. When necessary, sufficiently anchor or weight pipe, to prevent floatation and resultant compromised line and grade, while concrete is placed and sufficiently cured.

.2 Do not backfill over concrete within 24 hours after placing.

3.5 Pipe Installation in Open Trench Construction

.1 The horizontal alignment of the centreline of the pipe shall not be more than 75 mm off the given line.

.2 The vertical grade of the sewer main shall not deviate from the given grade by an amount greater than 20 mm.

.3 Handle pipe by approved methods. Do not use chains or cables passed through pipe bore so that weight of pipe bears upon pipe ends. Do not exceed maximum joint deflection recommended by pipe manufacturer. Install PVC pipe and fittings in accordance with CSA B181.12.

.4 Lay and join pipes in accordance with specified Standard Practices and manufacturer's requirements. Lay pipes on prepared bedding, 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 providing uniform support throughout its full length. Commence laying at the lowest point of the length being laid and proceed in upstream direction with bell socket ends of pipe facing upgrade.

.5 Do not allow water to flow through pipe during construction.

.6 Whenever work is suspended, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.

.7 Pipe Jointing:

.1 Install flexible rubber 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. Maintain pipe joints free from mud, silt, gravel and other foreign material.

.4 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. Only the lubricant recommended by the rubbing ring manufacturer shall be applied to the rubber ring or ends of the pipe.

.5 Complete each joint before laying next length of pipe. Minimize joint deflection after joint has been made to avoid joint damage. Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.

.6 At rigid structures, install pipe joints not more than 1.2 m from side of structure.

.7 Plug lifting holes with approved prefabricated plugs set in non-shrink grout.

.8 Cut pipes as required for special inserts, 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.

.9 Make watertight connections to manholes. Use non-shrink grout when suitable gaskets are not available.

.10 Upon completion of pipe laying, and after Engineer has inspected pipe joints, place specified granular material to dimensions indicated or directed.

.11 Hand place granular material in uniform layers of 150 mm thick or less. Dumping of material directly on top of pipe is not permitted.

.12 Place layers uniformly and simultaneously on each side of pipe to prevent lateral displacement of pipe.

3.6 Appurtenances

.1 Install all manholes, drop inlets, junctions, risers, catch basins and other appurtenances at the locations shown on the construction drawings and/or as directed by the Engineer. Installation shall be in accordance with the drawings for each appurtenance.

.2 Maximum allowable tolerances for installed manhole and catch basins are:

.1 Horizontal: 10 mm horizontal in 1.5 m vertical.

.2 Vertical: ± 10 mm for any elevation shown.

.3 A minimum of 2 grade rings are required immediately beneath the manhole cover.

.4 Confined rubber gasket joints conforming to ASTM C443-05a shall be used between all joints and between manhole barrel joints. All joints shall be finished smoothly with cement mortar.

.5 The channelled floor of the manholes shall be smooth and true to line and grade and shall be constructed of concrete shaped to provide a smooth, unobstructed flow. The benching shall be trowelled to a smooth finish. Branch lines entering the manhole shall be channelled to join the main line at an acute angle.

.6 Sewer pipe into existing manholes must be grouted in. Since concrete will not bond to PVC pipes, it will be necessary to coat the PVC pipe with an approved cementing agent to which sand has been added to form a suitable surface to which the concrete will bond. All PVC pipe shall be connected in accordance with the ASTM Standard.

.7 Break into existing manholes, catch basins or sewers as shown on the construction drawings. This work shall be performed in a workmanlike manner according to the dictates of good practice. Existing manhole floors shall be rechannelled and properly benched, the junction area shall be grouted to form a smooth joint, all debris including concrete and excavated material shall be removed and the vicinity of the connection shall be left in a tidy condition acceptable to the Engineer.

3.7 Weeping Tile Installation

.1 Refer to section 02636 Perforated Subdrain Pipes.

3.8 Acceptance Testing

.1 Sewer inspection by televising:

.1 Storm sewers less than 1350 mm diameter shall be inspected by camera after backfilling of the trench to finished grade.

.2 The inspection shall be made by employing television scanning equipment which shall be provided by the Contractor. The Contractor shall employ a qualified closed circuit television Contractor acceptable to the Engineer to carry out the inspection.

.3 The closed circuit television Contractor shall provide all equipment and materials necessary to conduct the inspection as specified in Section 02800.

.4 All television inspection shall be carried out in the presence of the Engineer who shall be given at least 48 hours advance notice of any testing to be carried out. Television inspection shall be performed by the Contractor on all sewers unless otherwise directed by the Engineer.

.2 Exfiltration Testing:

.1 If required by the Engineer, the Contractor shall conduct an exfiltration test.

.2 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.

.3 Immediately prior to test period add water to pipeline until there is a head of 1.0 m over interior crown of pipe measured at highest point of test section or water in manhole is 1.0 m above static groundwater level, whichever is greater.

.4 Duration of exfiltration test shall be two hours.

.5 Water loss at end of test period shall not exceed maximum allowable exfiltration over any section of pipe between manholes.

.3 Infiltration test:

.1 Storm sewer pipe 1350 mm diameter and larger and manholes, shall be examined visually for infiltration ensuring required provincial safety measures are employed to conduct such an examination. Where required by the Engineer, the Contractor shall conduct an infiltration test, as specified herein.

.2 Conduct infiltration test in lieu of exfiltration test where static groundwater level is 300 mm or more above top of pipe measured at highest point in the test section.

.3 Do not interpolate a head greater than 750 mm to obtain an increase in allowable infiltration rate.

.4 Install a watertight plug at upstream end of pipeline test section.

.5 Discontinue pumping operations for at least 72 hours before test measurements are to commence, and during this time keep thoroughly wet at least one third of pipe invert perimeter.

.6 Prevent damage to pipe and bedding material due to flotation and erosion.

.7 Place a 90° V-notch weir, or other measuring device approved by Engineer, in invert of sewer at each manhole.

.8 Measure rate of flow over a minimum of 1 hour, with recorded flow for each 5 minute interval.

.4 Allowable Infiltration/Exfiltration:

.1 Infiltration and exfiltration shall not exceed following 0.2 litres per millimetre of pipe diameter per hour per 100 metres of pipe.

3.9 Acceptance

.1 The location of all deficient work will be recorded and the Contractor will be required to repair, relay, restore or otherwise make good, to the satisfaction of the Engineer any deficient work including the repair of alignment problems, cracked or broken pipe, deformed pipe, leaks or any other faults not conforming with these specifications or the pipe manufacturers which the television inspection revealed.

.2 After the deficiencies are repaired and corrected and before final acceptance, the Owner reserves the right to have the faulty areas re-inspected at the Contractor's expense.

END OF SECTION

1.0 GENERAL

1.1 Description

.1 This section specifies requirements for constructing perforated subdrain pipe with filtration/separation geotextile, bedding material to lines, grades and dimensions indicated or directed.

1.2 Related Work Specified Elsewhere

.1	Trenching, Backfilling, and Compaction	Section 02315
.2	Storm Drainage Pipe and Fittings	Section 02635
.3	Manholes	Section 02536
.4	Catch Basins, Grates and Frames	Section 02631
.5	Building Services	Section 02539
.6	Subgrade Construction	Section 02705
.7	Geosynthetics for Roadways	Section 02706

1.3 Schedule of Work

.1 Schedule work to minimize interruptions to existing services.

1.4 Measurement and Payment

.1 Measurements will be made in lineal metres.

.2 The unit price tendered shall cover the cost of trenching, supply and install of filtration/separation geotextile, supplying, hauling, laying and jointing all pipe, together with the necessary crushed rock bedding, backfilling, and all other work required to install the weeping tile.

.3 Connections to manholes or catch basins shall be paid for at the unit price tendered and shall cover the cost of coring, capping, and all other work required to connect the weeping tile to the manhole or catch basin as specified.

1.5 References

.1 AASHTO M252-18 Standard Specification for Corrugated Polyethylene Drainage Pipe

.2 ASTM D2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

.3 AASHTO M288-17 Geosynthetic Specification for Highway Applications

.4 FHWA Geosynthetic Design and Construction Guidelines, FHWA NHI-07-092 Chapter 2 Subsurface Drainage

2.0 PRODUCTS

2.1 Perforated Subdrain Pipe

.1 The Contractor will supply 150 mm diameter HDPE perforated subdrain pipe which shall meet AASHTO M252, Type C.

.2 Minimum pipe stiffness shall be 210 kPa at 5% deflection when tested in accordance to ASTM D2412.

2.2 Filtration/Separation Geotextile

.1 The Contractor will supply a geotextile for wrapping the granular drainage media and perforated pipe. The geotextile is to be nonwoven composed of polypropylene fibres which are needle-punched into a stable network such that they retain their relative position. The geotextile shall be inert to biological degradation and resist naturally encountered chemicals, alkalis, and acids.

.2 Geotextile filtration properties are a function of the in-situ soil gradation, plasticity, and hydraulic conditions. The Engineer may specify alternative geotextile properties based on site specific analyses.

.3 The default nonwoven geotextile shall meet the requirements of AASHTO M288-17 Class 3 for subsurface drainage applications. The strength and filtration properties shall meet the following Minimum Average Roll Properties (MARV):

Properties	ASTM Test Method	Marv Requirements
PHYSICAL		
Grab Tensile Strength	D4632	500 N
Grab Tensile Elongation	D4632	≥ 50%
Trapezoidal Tear	D4533	180 N
CBR Puncture	D6241	990 N
UV Resistance	D4355	50% after 500 hours exposure

Hydraulic		
Apparent Opening Size (Max. Average Roll Value)	D4751	0.3 mm
Permittivity	D4491	0.1 sec^{-1}

2.3 Drainage Aggregate

.1 The Contractor shall supply drainage aggregate composed of hard, durable mineral particles free from organics, clay, silt, and other deleterious materials and meeting the following gradation requirements:

Sieve Designation	Percent by Weight Passing
50 mm	100
19 mm	0-80
12.5 mm	0-18
5 mm	0-12
71 µm	0-5

3.0 EXECUTION

3.1 Delivery and Stockpiling Materials

.1 The Contractor shall be responsible for arranging, stockpiling, and protecting the materials from damage and theft.

.2 The Contractor shall be responsible for the delivery of material and the Owner will not pay for materials ordered by the Contractor and not used in the work, nor pay for shipping charges on the return of such material to the supplier.

3.2 Trench Excavation

.1 Confirm trench line, grade and depth meet design requirements prior to placing geotextile, drainage gravel, and pipe.

.2 Do not backfill trenches until pipe grade and alignment have been reviewed by the Engineer.

.3 In all instances, excavation shall be done in such a way so as to prevent large voids from occurring in the sides and bottom of the trench.

.4 The minimum width of the trench shall be the inside diameter of the pipe plus 0.2m.

.5 The bottom of the trench shall be stable to afford a firm and uniform bearing throughout the entire length of perforated subdrain pipe.

3.3 Filtration/Separation Geotextile Installation

.1 The geotextile shall be placed loosely with no wrinkles or folds, and with no void spaces between the geotextile and the ground surface. Successive sheets of geotextile shall be overlapped a minimum of 300mm with the upstream sheet overlapping the downstream sheet.

.2 In trenches equal to or greater than 300mm in width, after placing the drainage aggregate, the geotextile shall be folded over the top of the backfill material in a manner to produce a minimum overlap of 300mm. In trenches less than 300mm but greater than 100mm wide, the overlap shall be equal to the width of the trench

.3 Should the geotextile be damaged during installation or drainage aggregate placement, a geotextile patch shall be placed over the damaged area, extending beyond the damaged area a distance of 300mm.

.4 Placement of drainage aggregate and subdrain pipe should proceed immediately following the placement of the geotextile.

3.4 Perforated Subdrain Pipe Installation

.1 Installation shall be to manufacturer's specifications and comply with ASTM D2321-18.

.2 Perforated pipe shall be installed to the depth and grade as shown on the drawings or as directed by the Engineer. Perforations shall be oriented in directions as indicated by the Engineer, in accordance with the requirements for either collecting or carrying of water.

.3 The pipe shall normally be joined with external snap or split couplers. Couplers shall be of sufficient width to cover at least two outside crest corrugations on each end of the pipe to be joined.

.4 Perforated pipe shall be grouted into outfall locations such as manholes and catch basins.

.5 Perforated subdrain pipe connections to the storm sewer system shall be capped as required by the Engineer to prevent rapid flow back into the weeping tile during system surcharging. The cap shall be fastened to the end

of the pipe and have a 32 mm hole drilled at the invert to allow drainage to pass.

.6 At no time shall the perforated subdrain pipe be connected to the sanitary sewer system.

.7 The perforated subdrain pipe shall be bedded within crushed rock. 200 mm lift of crushed rock should be placed and compacted with maximum allowable tolerance of 35 mm from vertical grade. The weeping tile will be placed with a maximum allowable tolerance of 100 mm from horizontal alignment. The perforated subdrain pipe shall be covered with 200 mm of crushed rock.

.8 For new street construction without storm sewer or which the Engineer deems it necessary, perforated subdrain pipe shall be installed within the compacted subgrade.

.1 The perforated subdrain pipe shall be installed below and centered beneath the curb and gutter. There shall be a minimum of 200 mm between the top of the perforated subdrain pipe and the bottom of the curb and gutter compacted sand cushion.

.2 The perforated subdrain pipe shall be bedded with sub-drainage rock.

.3 Perforated subdrain pipe shall be installed prior to placement of granular base material.

.9 For existing street construction which the Engineer deems it necessary, there shall be perforated subdrain pipe installed within the compacted subgrade.

.1 Pipe shall be installed adjacent to the curb line at a distance that will not undermine and cause concrete curb and gutter instability. Any sections of curb and gutter which are damaged or settle from original grade during perforated subdrain pipe installation shall be replaced at the Contractor’s expense.

.2 Invert of perforated subdrain pipe shall be 350 mm below bottom of concrete gutter elevation. Where concrete gutter does not exist the perforated subdrain pipe invert shall be a minimum of 600 mm below the finished asphalt grade.

.3 The perforated subdrain pipe shall be bedded with sub-drainage rock

.4 Perforated subdrain pipe shall be installed prior to placement of granular base material.

3.5 Acceptance

.1 The location of all deficient work will be recorded and the Contractor will be required to repair, relay, restore or otherwise make good, to the satisfaction of the Engineer any deficient work including the repair of alignment problems, cracked or broken pipe, deformed pipe, leaks or any other faults not conforming with these specifications or the pipe manufacturers which the television inspection revealed.

.2 After the deficiencies are repaired and corrected and before final acceptance, the Owner reserves the right to have the faulty areas re-inspected at the Contractor's expense.

END OF SECTION

1.0 GENERAL

1.1 Related Work Specified Elsewhere

.1	Perforated Subdrains Pipes	Section 02636
.2	Geosynthetics for Roadways	Section 02706
.3	Granular Base Course	Section 02721
.4	Adjustment of Appurtenances	Section 02840

1.2 Site Conditions

.1 Subsurface investigation is the responsibility of the Contractor.

.2 Underground and surface utility lines and buried objects are known to exist on the job site. The Contractor shall contact applicable utility companies for more precise information prior to commencement of work.

1.3 Protection

.1 Prevent damage to fencing, trees, landscaping, natural features, bench marks, existing buildings, existing pavement, surface or underground utility lines which are to remain. Make good any damage.

1.4 Scope

.1 Items of work covered by this Specification are those pertaining to excavation, filling, hauling, compaction and other associated work required to construct the subgrade to the required cross sections and grades.

1.5 Definitions

.1 Roadway common excavation is defined as the excavation of all material including rock and shall include over-burden, hard pan, quicksand, frozen earth and boulders.

.2 Topsoil is defined as organic material and is to be removed and placed on the designated topsoil disposal stockpile.

1.6 Measurement and Payment

.1 Common excavation will be paid for at the unit bid price per cubic metre which shall be full payment for excavation of all material except rock. Payment for common excavation shall be considered full payment for excavation, hauling, stockpiling topsoil, excavation of unsuitable subgrade, watering and dewatering, embankment placement, and compaction to specified density, disposal of excess material to waste, regravelling of adjacent structures disturbed by construction, disposal of all boulders not

allowed as backfill, maintaining the subgrade to specification until completion of the work and all other work required for which separate payment is not indicated in the bid form. The quantity shall be the volume measured in its original place determined by cross-sections taken before and after excavation and computed by the Average End Area Method. Excavation beyond the limits established by the Engineer or required on the drawings will not be paid for. Payment will be made on the basis of excavated volumes and no extra payment will be made for earth placed in fills or embankment.

.2 Subgrade preparation will be measured for payment by the square metre of the finished subgrade, completed to the dimensions indicated on the typical road cross-section details and to a depth of 150 mm. Payment shall be full compensation for shaping, scarifying, mixing, windrowing, watering, aerating/drying and compaction to 98% Standard Proctor Density.

.3 Imported granular material when ordered by the Engineer, will be measured in cubic metres of material in place after compaction. Payment shall be full compensation for supply, hauling, watering, aerating/drying, placing and compacting the material to 98% Standard Proctor Density.

.4 Refer to section 02706 for Geosynthetics for Roadways.

.5 Refer to section 02636 for Perorated Subdrain Pipes.

2.0 PRODUCTS

2.1 Imported Granular Fill (Pit-Run)

.1 Material for the imported granular material shall consist of sound, hard, durable, uniformly graded crushed gravel and shall not contain organic or soft materials, materials that break up when alternately frozen and thawed or wetted and dried, or other deleterious materials.

.2 Imported granular fill shall be placed in 150 mm lifts. Each lift shall be compacted to 98% of Standard Proctor Density, using mechanical compaction equipment.

2.2 Road Geotextile Filter Fabric

.1 Refer to section 02706 Geosynthetics for Roadways.

2.3 Weeping Tile

.1 Refer to section 02636 Perforated Subdrain Pipes.

3.0 EXECUTION

3.1 Unstable Subgrade

.1 Where the subgrade is unstable, or where it contains materials such as ashes, cinders, refuse, vegetable or organic material, the Contractor shall excavate such material to the width, depth and length designated by the Engineer and dispose of the material as required. The subgrade shall then be made by backfilling with approved native material or imported granular material as required by the Engineer. Material shall be placed in successive layers not exceeding 150 mm in depth and compacted to a minimum of 98% Standard Proctor Density.

3.2 Subgrade Preparation

.1 The subgrade shall be scarified and compacted to a minimum of 98% Standard Proctor Density at optimum moisture content, over the full width of the cross-section. The material shall be worked to ensure as much uniformity as possible in material.

.2 All topsoil encountered during this operation shall be removed and replaced with suitable clay material excavated elsewhere on the project. The subgrade moisture content shall be maintained to the required specifications until completion of the project.

Light blading of the subgrade will be required during the compaction process to assure that any distortion of the roadway is corrected.

Soft spots or areas of subgrade failure due to unsuitable material which appear during the rolling shall be excavated as required by the Engineer and backfilled with suitable native material or imported granular fill when directed by the Engineer. Backfill material shall be compacted into place. It shall be the Contractor's responsibility to co-ordinate the overall excavation and subgrade preparation, so that suitable native material can be placed in the subcut areas directly from cuts elsewhere on the project. Payment for removal of unsuitable material will be made as common excavation. Payment for replacement and compaction of native material used to replace unstable subgrade will be paid for at the Unit Price tendered for common excavation.

.3 Water shall be added or the material shall be aerated to bring the moisture content to optimum value. The supply of water shall be the responsibility of the Contractor.

.4 Upon completion of subgrade preparation, the Contractor shall protect it against all damage.

3.3 Geotextile Installation

.1 Refer to section 02706 Geosynthetics for Roadways.

3.4 Weeping Tile Installation

.1 Refer to section 02636 Perforated Subdrain Pipes.

3.5 Compaction

.1 The top 150 mm of the subgrade shall be scarified and compacted to a minimum of 98% Standard Proctor Density at optimum moisture content, over the full width of the roadway cross-section. The material shall be worked to ensure as much uniformity as possible in material.

.2 Field tests for density and moisture content shall be taken by the Engineer or his representative. The cost of this testing shall be as per Section 01450, Clause 1.1.1. Non-conformity with the specified density or moisture content shall constitute sufficient grounds for rejection of the work.

.3 Final compaction of the subgrade surface shall be done with pneumatic tire rollers. Rolling shall be continued until all loose soil is properly compacted true to design elevations but not uniformly high or low.

.4 Trench backfill encountered in the preparation of the subgrade which has not been compacted sufficiently, shall be excavated and recompacted. The cost of this item shall be included in the unit price tendered for subgrade preparation.

.5 The Contractor shall be responsible for any repair required to roadworks arising from the subsidence of trenches after the completion of the maintenance period of the underground services contractor(s).

.6 Inaccessible areas by large compaction equipment shall be compacted by mechanical hand tampers.

3.6 Testing Compaction

.1 Compaction results shall be based on a minimum of one density test per 500 square metres of road. Additional tests may be called for by the Engineer as deemed necessary.

.2 Field density tests shall conform to ASTM D1556, ASTM D2167, or ASTM D2922 for comparison with a maximum density determined according to ASTM D698 Method A.

3.7 Tolerances

.1 The finished surface of the subgrade shall conform to grades approved by the Engineer, and shall show no depression more than 15 mm under a straightedge 3.0 m long when placed parallel to the centreline. Subgrade higher than the approved grades shall be cut to the required grades.

.2 The tolerance for ditches, boulevards, etc., shall be $\pm$ 30 mm.

3.8 Inspection

.1 Before acceptance by the Engineer and prior to application of the subsequent layer of roadway materials, the subgrade surface shall be true to cross-section and grade, and shall conform to the density and bearing ratio requirements specified.

.2 The Contractor shall supply a truck loaded to 8,200 kilograms axle load (4.5 kilograms per millimeter of tread width) for subgrade axle test. This test will be undertaken when compaction of the subgrade has been completed, and shall be carried out under the direction and in the presence of the Engineer. It will be used as a supplement to density tests for determining performance of the Contract. No separate payment shall be made for this work.

.3 Any rutting or deflection points noted during the axle test shall be repaired by the Contractor and at the Contractor's expense. Following repairs, the axle test shall be repeated.

3.9 Protection of New and Existing Curb, Gutter and Sidewalks and Asphalt

.1 The Contractor shall protect the new and existing curb, gutter and sidewalks and asphalt from damage caused by his operations. Any damage by the Contractor's operations shall be replaced at his own expense.

END OF SECTION

1.0 GENERAL

1.1 Related Sections

.1	Submittals	Section 01330
.2	Quality Control	Section 01450
.3	Trenching, Backfilling and Compaction for Utilities	Section 02315
.4	Site Excavation, Embankment and Compaction	Section 02335
.5	Perforated Subdrain Pipe	Section 02706
.6	Subgrade Construction	Section 02705
.7	Granular Base Course	Section 02721

1.2 Scope

.1 Items of work covered by this specification are those pertaining to the supply and installation of nonwoven, woven geotextile, and multiaxial (biaxial or triaxial) geogrids for roadway applications.

1.3 References

.1 ASTM D 4439 Geosynthetic Terminology

.2 ASTM D 4354 Sampling of Geosynthetics

.3 AASHTO M288-17 Standard Specification for Geosynthetic Specification for Highway Applications

.4 AASHTO R 50-09 Geosynthetic Reinforcement of the Aggregate Base Course of Flexible Pavement Structures.

.5 GMA White Paper II Geosynthetic Reinforcement of the Aggregate Base/Subbase Courses of Pavement Structures

.6 FHWA Geosynthetic Design and Construction Guidelines, FHWA NHI-07-092 Chapter 5 Roadway Reinforcement

1.4 Definitions

.1 Nonwoven Geotextile: A planar geosynthetic made of randomly orientated yarns produced by bonding fibres, or interlocking fibres, or both bonding and interlocking fibres by mechanical, chemical, or thermal means.

.2 Slit-Tape / Slit-Film Woven Geotextile: A planar geosynthetic made from flat, tape-like yarns that are produced by slitting and extruded film. Unsuitable for

subgrades in which high groundwater, moderate to high moisture contents, seasonal moisture fluctuations, or thaw weakening are present.

.3 Enhanced Woven Geotextile: A planar woven geotextile made from high-tenacity long-chain synthetic polymers composed of at least 95 percent by weight of polyolefins. They shall form a stable network such that the filaments or yarns retain their dimensional stability relative to each other, including selvages.

.4 Multiaxial Geogrid: A geosynthetic formed by a regular network of integrally connected polymer tensile elements with square, rectangular, or triangular apertures of sufficient size to allow strike-through of surrounding soil, rock or other geotechnical materials.

.5 Minimum Average Roll Value (MARV): Property value calculated as typical minus two standard deviations. It shall yield a 97.7 percent degree of confidence that any sample taken during quality assurance testing will exceed value reported.

.6 Separation: A geosynthetic function in which a geosynthetic is used to prevent intermixing of two dissimilar geotechnical materials to maintain their engineering properties such as a subgrade soil and an aggregate cover (base/subbase/select embankment).

.7 Filtration: A geosynthetic function in which a geotextile is placed between two dissimilar soils to allow for long-term passage of water while preventing the uncontrolled passage of soil particles.

.8 Reinforcement: A geosynthetic function in which a geosynthetic acts as a tensile member in the surface structure of a pavement.

.9 Confinement: A geosynthetic function in which a geosynthetic prevents the lateral movement of aggregate.

.10 Stabilization: The use of an enhanced woven geosynthetic on weak to very weak subgrade conditions (CBR ≤ 3.0%) to provide the coincident functions of separation, filtration, reinforcement, and confinement. Alternatively, a combination of geogrid and geotextile providing the same functions may also be utilized.

1.5 Measurement and Payment

.1 Geosynthetic will be measured in square metres in place. Payment shall be full compensation for supply, placing, overlapping or sewing.

1.6 Sampling, Testing, and Acceptance

.1 All geosynthetics may be subject to additional sampling and testing by the Engineer to verify conformance with this specification.

.2 Sampling shall be in accordance with the most current ASTM D4354, using the section titled “Procedure for Sampling for Purchaser’s Specification Conformance Testing”.

.3 Testing shall be performed in accordance with the methods referenced in this specification for the indicated application. The number of specimens to test per sample is specified by each test method. Geosynthetic product acceptance shall be based on ASTM D4759.

1.7 Materials Certification

.1 The manufacturer is responsible for establishing and maintaining a quality control program to assure compliance with the requirements of the specification. Documentation describing the quality control program shall be made available upon request. The manufacturer shall have a quality control program that includes an on-site laboratory accredited by the Geosynthetic Accreditation Institute Laboratory Accreditation Program (GAI-LAP) to perform the required test methods.

.2 The manufacturer’s certificate shall state that the furnished geosynthetic meets MARV requirements, except as otherwise specified, of the specification as evaluated under the manufacturer’s quality control program. A person having the legal authority to bind the manufacturer shall attest to the certificate.

.3 The manufacturer must participate in the AASHTO National Transportation Product Evaluation Program’s Audit Program for Geotextiles (GTX). Upon request, the manufacturer will provide:

.1 Public status data in NTPEP’s DataMine website.

.2 Current publicly released NTPEP Reports on Laboratory Results of Evaluations showing the physical properties of the geosynthetic product or product line is in compliance with the specifications.

.4 Products without proper identification or labelling, mislabeling, or misrepresentation of materials shall be reason to reject those geosynthetic materials. Identification includes an NTPEP stamp at every 5 meters along a length of a roll.

1.8 Submissions

.1 The contractor shall provide the Engineer a Manufacturer’s Certificate stating the name of the manufacturer, product name, style number, chemical composition of the filaments or yarns, and other pertinent information to fully describe the geotextile for review and approval before being used.

.2 Certificates with distributor or private label letterhead will not be accepted. Technical or Material Data Sheets will not be accepted.

.3 The contractor shall provide the Engineer the Manufacturer's valid GAI-LAP laboratory accreditation certificate.

.4 Preliminary review of the material as represented by the test results shall not constitute general acceptance of all the material or source of supply.

.5 Rejected material will not be paid for. The Engineer has the right to request roll test data or additional testing if there are any concerns with the proposed geosynthetic.

1.9 Delivery and Storage

.1 Each geotextile roll shall be wrapped with a material that will protect the geosynthetic, including the ends of the roll from damage due to shipment, water, sunlight, and contaminants. The protective wrapping shall be maintained during periods of shipment and storage. Each geotextile roll shall include an inner core made from a different material that shall protect, ensure ease of handling, and prevent damage from forklifts or other equipment used to transfer or move the geosynthetic roll.

.2 During delivery and storage, the geotextile shall be elevated off the ground and adequately covered to protect them from the following: site construction damage, precipitation, extended ultra violet radiation, chemicals that are strong acids or strong bases, flames and sparks, temperatures in excess of 71° Celsius, and any other environmental condition that may damage the physical property values of the product.

2.0 PRODUCTS

2.1 Separation and Filtration Applications

.1 This specification is applicable to the use of a geotextile to prevent mixing of a subgrade soil and an aggregate cover material (subbase, base, select embankment). The secondary function is allowing moisture to travel through the plane of the geotextile while preventing the migration of fine soil particles.

.2 The separation and filtration applications are appropriate for pavement structures constructed over soils with a California Bearing Ratio greater than or equal to 3 (CBR ≥ 3) or a shear strength greater than 90 kPa. It is appropriate for unsaturated subgrade soils.

.3 The geotextile shall be an AASHTO M288-17 Class 2 nonwoven meeting the requirements of the following table. All numerical values in the table except AOS represent MARV in the weakest principal direction. Values for AOS represent maximum average roll value.

Specifications and Physical Properties		
	ASTM Test Method	AASHTO Class 2 Nonwoven
Grab Strength	D 4632	700 N
Elongation	D 4632	≥50%
CBR Puncture Strength	D 6241	1375 N
Trapezoidal Tear	D 4533	250 N
Apparent Opening Size (AOS)	D 4751	0.22 mm
Permittivity	D 4491	1.5

.4 The severity of installation conditions for the application generally dictate the required geotextile class. The Engineer shall specify Class 1 nonwoven geotextile properties for more severe or harsh installation conditions. See AASHTO M288-17 Table 4 for survivability guidance.

2.2 Stabilization Applications

.1 This specification is applicable to the use of a geotextile for pavement structures constructed over soils with a California Bearing Ratio between 2% and 3% or a shear strength between 60 kPa and 90 kPa. It is appropriate for wet conditions to provide the coincident functions of separation, filtration, reinforcement, and confinement.

.2 The stabilization application is appropriate for subgrade soils that are saturated due to a high groundwater table, soils susceptible to thaw-weakening, or due to prolonged periods of wet weather.

.3 The geotextile shall meet the requirements of the following table. All numerical values in the table except AOS represent MARV in the weakest principal direction. Values for AOS represent maximum average roll value.

Enhanced Woven Geotextile Specifications and Physical Properties		
	ASTM Test Method	Class 3A MARV
Tensile Strength (at ultimate)	D 4595	35.9 kN/m
Tensile Strength (at 5% strain)	D 4595	18.6 kN/m
Flow Rate	D 4491	1630 l/min/m^2
Permittivity	D 4491	0.6 sec^{-1}
Apparent Opening Size (AOS)	D 4751	0.6 mm

.4 Alternatively, a separation/filtration nonwoven geotextile meeting section 2.1 combined with a multiaxial geogrid meeting the requirements of the following

table can be used. All numerical values in the table represent MARV in the weakest principal direction.

Geogrid Specifications and Physical Properties		
	ASTM Test Method	FHWA Class 1 Geogrid
Tensile Strength (at ultimate)	D 6637	18.0 kN/m
Tensile Strength (at 2% strain)	D 6637	6.0 kN/m
Tensile Strength (at 5% strain)	D 6637	11.0 kN/m
Junction Strength	D 7737	17.9 kN/m
UV Stability (after 500 hr)	D 4355	50%

2.3 Enhancement Applications

.1 This specification is applicable to the use of a geotextile for pavement structures constructed over soils with a California Bearing Ratio below 2.0% or below a shear strength of 60 kPa. This specification is applicable to the use of a geotextile in wet, saturated conditions to provide the coincident functions of separation, filtration, reinforcement, and confinement.

.2 The enhancement application is appropriate for subgrade soils that are saturated due to a high groundwater table, soils susceptible to thaw-weakening, or due to prolonged periods of wet weather.

.3 The geotextile shall meet the requirements of the following table. All numerical values in the table except AOS represent MARV in the weakest principal direction. Values for AOS represent maximum average roll value.

Enhanced Woven Geotextile Specifications and Physical Properties		
	ASTM Test Method	Class 1A MARV (CBR < 2.0)
Tensile Strength (at ultimate)	D 4595	70 kN/m
Tensile Strength (at 5% strain)	D 4595	35 kN/m
Flow Rate	D 4491	1222 l/min/m^2
Permittivity	D 4491	0.5 sec^{-1}
Apparent Opening Size (AOS)	D 4751	0.60 mm

2.4 Proprietary Geosynthetic Products

.1 Proprietary geosynthetic products can be included in the roadway surface structure by the design engineer provided:

.1 The proposed roadway structure meets or exceeds the performance of the City of Prince Albert standard roadway pavement structure as laid out in Section 6.6 “Minimum Requirements for Roadway Pavement” of the City of Prince Albert Design standards.

.2 The use of a proprietary geosynthetic product is in the best interest of the City of Prince Albert. Potential justifications may include reduced construction costs, improved life-cycle costs, reduced excavation requirements avoiding utility conflicts, reduced excavation requirements avoiding high water table, mitigation of special soil conditions such as frost heave or expansive clay soils.

.3 The proprietary geosynthetic product is calibrated for the applicable design method (AASHTO 93, AASHTO ME, or Giroud-Han).

.2 Alternate proprietary products may be submitted by bidders during the tender stage. Alternate products must:

.1 be submitted 10 days prior to tender close to allow for full evaluation.

.2 be stamped by a professional engineer registered in the Province of Saskatchewan.

.3 have full scale performance testing in accordance with AASHTO R50-09 and GMA White Paper II performed by an Independent testing agency.

.4 Documentation of benefit must be by the empirical means of constructing test sections with and without geosynthetic for the project conditions or similar conditions of interest.

.5 Documentation of benefit by analytical or modelling techniques will not be permitted.

.6 Have performance testing that demonstrates equal or greater performance to the specified proprietary product in similar geotechnical and vehicle loading conditions. The benefit must be quantified as a Base Course Reduction (BCR), Traffic Benefit Ratio (TBR), or Layer Coefficient Ratio (LCR) value when possible.

.7 Proprietary geosynthetic product submittals shall include information on five (5) similar projects in size and scope.

.8 Comparison or evaluation of proprietary products based on mechanical or physical properties is not permitted.

.3 The Engineer shall specify the Proprietary Product by trade name and include contact information for local distributor(s).

3.0 EXECUTION

3.1 Geosynthetic Installation

.1 These installation instructions are intended for use in conjunction with the material specification for geosynthetics. The specification details material properties for geosynthetics used in separation, subsurface drainage, permanent erosion control, and stabilization applications. The material properties are only one factor in a successful installation involving geosynthetics. Proper material handling, construction, and installation techniques are essential in order to ensure that the intended function of the geosynthetic is fulfilled.

.2 Atmospheric exposure of the geosynthetics to the elements following laydown shall be a maximum of 14 days to minimize damage potential.

.3 The installation site shall be prepared by clearing, grubbing, and excavating or filling the area to the design grade. This includes the removal of topsoil and vegetation.

.4 Soft spots and unsuitable areas will be identified during site preparation or subsequent proof rolling. These areas shall be excavated and backfilled with select material and compacted using normal procedures.

.5 The geosynthetic shall be laid smooth without wrinkles or folds on the prepared subgrade in the direction of construction traffic. Adjacent geosynthetic panels shall be overlapped or sewn as required in the plans. S

Geosynthetic Overlap Requirement	
CBR ≥ 3%	300 - 450 mm overlap
1% ≤ CBR < 3%	600 - 900 mm overlap
0.5% ≤ CBR < 1%	900 mm overlap or sewn
CBR < 0.5%	sewn

.6 When using a multiaxial geogrid for subgrade stabilization, the separation/filtration nonwoven geotextile will be placed directly upon the subgrade and the multiaxial geogrid will be placed directly on top of the separation/filtration nonwoven geotextile.

.7 New roadway construction will include geosynthetic installed throughout road cross-section from back of sidewalk to back of sidewalk unless directed otherwise by the Engineer.

.8 Existing roadway reconstruction or repair work shall include geosynthetic installation from gutter to gutter or as directed by the Engineer.

.9 On curves, the geotextile may be cut to conform to the curves. The overlap shall be in the direction of construction and held in place by piles of Granular Base Course or Granular Subbase Course.

.10 Prior to covering, the geotextile shall be inspected to ensure that it has not been damaged during installation. The inspection shall be done by the engineer or the engineer's designated representative. Damaged geotextiles, as identified by the engineer, shall be repaired immediately. Cover the damaged area with a geotextile patch that extends an amount equal to the required overlap beyond the damaged area.

.11 Place and compact soil layers in accordance with Section 02705 - Subgrade Construction, 02721 – Granular Base Course.

.12 The subbase shall be placed by end dumping onto the geotextile from the edge of the geotextile or from previously placed subbase aggregate. Construction vehicles shall not be allowed directly on the geotextile. The subbase shall be placed such that at least the minimum specified lift thickness shall always be between the geotextile and equipment tires or tracks. Turning of vehicles shall not be permitted on the first lift above the geotextile.

.13 On subgrades having a CBR value of less than 1.0%, the subbase aggregate should be spread in its full thickness as soon as possible after dumping to minimize potential of localized subgrade failure due to overloading of the subgrade.

.14 Any ruts occurring during construction shall be filled with additional subbase material and compacted to the specified density.

.15 In stabilization applications, the use of vibratory compaction equipment is not recommended with the initial lift of the subbase material. The use of static rollers is encouraged for the initial lift.

END OF SECTION

1.0 GENERAL

1.1 Samples

.1 At least 2 weeks prior to commencing work, inform Engineer of proposed source of granular materials.

.2 The Contractor shall provide a sieve analysis of the material for the Engineer's review.

1.2 Submissions

.1 Granular base course sieve test results shall be submitted to the Engineer before material is used.

.2 Preliminary review of the material as represented in the test results shall not constitute general acceptance of all material in the deposit or source of supply. Materials may be considered unsuitable even though particle sizes are within the limits of the gradation sizes required, if particle shapes are thin or elongated or any other characteristic precludes satisfactory compaction or if the material fails to provide a roadway suitable for traffic. Rejected material will not be paid for. The Engineer has the right to request additional testing if there are any concerns with the proposed aggregate.

.3 The Contractor shall provide weigh scale receipts for each load to the Engineer at the time of load delivery. The Contractor shall quote using his own certified scale only with the approval of the Engineer or where indicated within the tendering documents.

1.3 Measurement for Payment

.1 Granular base course will be measured for payment in tonnes in place based on the area and thickness specified. Payment shall be full compensation for supplying, loading, hauling, placing, remixing if segregation has occurred, compacting, moisture conditioning, shaping the material and provision of a sieve analysis.

2.0 PRODUCTS

2.1 Granular Base Course

.1 Material for the granular base course shall consist of sound, hard, durable crushed rock or crushed gravel and shall not contain organic or soft, thin elongated, or laminated materials, materials that break up when alternately frozen and thawed or wetted and dried, or other deleterious materials. When compacted near the optimum moisture content to not less than 100% of the maximum dry density corrected for the stone content as determined by ASTM D698, the material shall have a minimum CBR value of 65 and a maximum particle size of 18 mm.

.2 Granular base course shall meet the following gradation when tested to ASTM C136 and ASTM C117, and give a smoother curve without sharp breaks when plotted on a semi-log grading chart:

BASE COURSE		
Sieve Designations (mm)	**Percent by Weight Passing**	
	Lower Limit	**Upper Limit**
19.0	100	100
12.5	75	100
5.0	50	75
2.0	32	52
0.900	20	35
0.400	15	25
0.160	8	15
0.071	6	11
Plasticity Index	0	6
% Fractured Face	60 Minimum	
% Light Weight Pieces	5 Maximum	

3.0 EXECUTION

3.1 Placing

.1 The base material shall not be placed until the underlying subgrade has been accepted by the Engineer. The granular material shall be placed in uniform layers not exceeding 150 mm in thickness before compaction. The material shall be placed by mechanical spreaders or deposited in windrows and leveled with suitable equipment. Material shall be handled in a manner such that segregation of the coarser and finer fractions will not occur.

3.2 Compaction

.1 All granular base course layers shall be compacted near the optimum moisture content to not less than 100% of the maximum dry density corrected for the stone content as determined by ASTM D698 Method A for the material used.

The thickness of any compacted base course lift shall not be less than seventy-five millimeters (75 mm) and not greater than one hundred and fifty millimeters (150 mm).

Oversize material shall not be incorporated into the base coruse.

.2 During compaction, the moisture content shall be maintained at the optimum moisture content as determined by ASTM D698. If the moisture content exceeds the optimum moisture content the material shall be aerated by mechanical means until the material has dried sufficiently to reach the optimum moisture content. Water shall be added if the moisture

content is below optimum. Watering and compacting shall be controlled to prevent pumping of fines to the surface or washing fines away.

The Contractor shall supply a truck loaded to 8,200 Kilograms per axle load for a base course axle test. This test will be undertaken when compaction of the base course has been completed and shall be carried out under the direction and in the presence of the Engineer. It will be used as a supplement to density tests for determining performance of the Contract. No separate payment shall be made for this work.

Failures in the subgrade or base course, which develop on a section of roadway upon which base course has been deposited, shall be repaired at the expense of the Contractor.

3.3 Testing Compaction

.1 Compaction results shall be based on a minimum of one density test per 1000 square metres of road. Additional tests may be called for by the Engineer as deemed necessary.

.2 Field density tests shall conform to ASTM D1556, ASTM D2167, or ASTM D2922 for comparison with a maximum density determined according to ASTM D698 Method A.

.3 The following tests will be performed as directed by the Engineer.

.1 Wash Sieve Analysis

.2 Plastic Index

.3 CBR Value

.4 Standard Proctor Compaction Tests.

3.4 Shaping and Finishing

.1 The finished surface of the granular base course shall conform to grades approved by the Engineer, and shall show no depression more than 5 mm under a straight edge 3.0 m long placed parallel to the road centerline. Granular base course higher than the approved grades shall be cut to the required grades.

Prior to hot mix applications a prime coat shall be placed on the finished final lift of base course in accordance with the requirements of Bituminous Prime and Fog Coat.

Streets, roads, and lanes used for hauling material, that are damaged, shall be repaired by the Contractor at the Contractor’s expense.

3.5 Inspection

.1 Before acceptance by the Engineer and prior to the application of the subsequent layer of roadway materials, the granular base course surface shall be true to cross-section and grade, shall conform to the density and bearing ration requirements specified. The granular base course surface shall show no visible subsidence or weave under the wheels of a roller having a weight of 4.5 kilograms per millimeter width of tread (8,200 kilograms per axle load).

.2 Field density and moisture content tests will be made by the Engineer or his representative to ensure that the material is satisfactory. Material not meeting the specification requirements will not be approved.

END OF SECTION

1.0 GENERAL

.1 The Contractor shall read and be governed by the General Provisions, Special Provisions, General Requirements, Instructions to Bidders, Addenda, Bid Form, Agreement, and the complete Specification for this project.

.2 The complete work under this trade shall be governed by the dictates of good practice in all details of materials and methods even if not minutely specified. The work shall be properly coordinated with the requirements of other units of work specified in other sections.

1.2 Work Included

.1 The work to be done under this item of the specification includes the supply and placing of hot mix asphalt concrete.

1.3 Submissions

.1 The Contractor shall provide weigh scale receipts for each load to the Engineer at the time of load delivery. The Contractor shall quote using his own certified scale only with the approval of the Engineer or where indicated within the tendering documents.

1.4 Measurement for Payment

.1 Hot mix Bituminous Surface Course pavement will be paid for at the unit price bid per tonnes for the thickness specified which shall be compensation in full for the furnishing, mixing, transporting, placing and rolling, and for all other labour and materials required to complete the work in accordance with these specifications. Tonnage will be verified by measurement made of the finished top width and length, and calculated on a unit area basis for the designated thickness specified and subject to adjustment as outlined in Clause 3.13 of this section.

A manhole or catch basin handwork is defined as the addition work for placement of asphalt adjacent to manhole and catch basins and shall be paid by the unit count in addition to the payment for asphalt surface.

2.0 PRODUCTS

2.1 Approvals

.1 The Contractor shall submit asphalt concrete mix design based on the Marshall Method and trial mix test results to the Engineer for review at least two (2) weeks prior to commencing work and before any asphalt is used in the work. The Contractor shall provide a sieve analysis of the aggregate material for the Engineer’s review. The Contractor shall pay for all costs of performing these tests.

.2 The Contractor shall supply a five point, 50 blow, Marshall method mix design on the approved aggregate for the asphaltic mix to meet the following characteristics.

.1	Marshall Stability at 60°	not less than 8,000 N
.2	Marshall Flow Index	2.0 mm to 4.0 mm
.3	Percentage Voids of Total Mix	3.5% to 5.5%
.4	Percentage Aggregate Voids Filled with Asphalt	75% to 90%
.5	Voids in Mineral Aggregate (VMA)	14.0% minimum
.6	Permissible Variation of Asphalt Cement from Job Mix	0.25%
.7	Asphalt Film Thickness (µm)	7.5 minimum
.8	The Asphalt Cement Content	5.7% minimum
.9	Anti-Stripping Agent or Lime	Stripping Potential <5%

The Marshall Stability value and Flow Index shall be tested by ASTM Designation D-1559 for Resistance to Plastic Flow of Bituminous Mixtures.

The Percentage Voids and Percentage Aggregate Voids filled with Asphalt shall be determined according to the Marshall Method of Mix Design for Hot Mix Asphalt Paving.

2.2 Gradation for Asphalt Mix

.1 Aggregate shall consist of hard, durable, uniformly graded crushed gravel and shall not contain organic or soft materials that break up when alternately frozen and thawed or wetted and dried, nor other deleterious materials.

.2 Aggregate shall meet the following gradation when tested to ASTM C136 and ASTM C117, and give a smooth curve without sharp breaks when plotted on semi-log grading chart.

ASPHALT AGGREGATE		
Sieve Designations (mm)	**Per Cent by Dry Mass Residential Class II**	
	Lower Limit	**Upper Limit**
16.0	100	100
12.5	78	97
9.0	66	90
5.0	50	72
2.0	32	51
0.900	21	37
0.400	16	27
0.160	7	15
0.071	4	10
Sand Equivalent	50 minimum	
% Fractured Face	60.0 minimum	
% Light Weight Pieces	1.5 maximum	

.1 The Liquid Limit shall not exceed 25 and the Plasticity Index shall not exceed 6 for the portion of material passing the 400 sieve.

.2 Los Angeles Abrasion: Maximum % loss by weight: 40%

.3 Crushed Fragments: At least 60% of fragments within following size ranges to have at least 2 freshly fractured faces:

Passing	**Retained On**
20.0 mm	to 5.0 mm

.4 Maximum of 3.0% total deleterious matter by total mass of combined aggregate.

.3 Should the grading of the mineral aggregates supplied to the plant not meet the gradation above, mineral filler shall be added in the weight hopper of the asphalt plant in such quantities as will be required to meet the specifications.

2.3 Mineral Filler

.1 Mineral filler shall consist of Portland Cement, Pozzolan, commercially ground stone dust or other mineral dust approved by the Engineer. Mineral filler shall have a Plasticity Index of Zero and, when tested by means of laboratory sieves, it shall meet the following gradation.

Sieve Size (mm)	Percent Passing (by weight)
0.400	100
0.160	not less than 90
0.063	not less than 70
0.045	not less than 62

.2 Mineral filler to be dry and free flowing when added to aggregate.

2.4 Asphaltic Binder

.1 The asphaltic binder shall be uniform in character, shall not foam when heated to 175° C, and shall meet the following requirements:

.1	Designation	A/C 150/200
.2	Penetration (ASTM D5) under 100 g for 5 sec. at 25° C	170 to 240
.3	Flash Point (ASTM D92) filled or unfilled greater than	232° C
.4	Ductility (ASTM D113) strain rate of cm/sec. at	25° C greater than 100(+) cm
.5	Solubility in $CC1_4$ (unfilled)	99.0(+)%
.6	Kinematic Viscosity in Centistokes at 135° C	150(+)

.7	Thin Film Oven Test Penetration under 100 g for 5 sec. at 25° C	45(+)%

2.5 Storage of Materials

.1 The aggregate shall be stockpiled at the mixing plant. Stockpiles shall be constructed by placing the aggregate in uniform layers over a pre-determined stockpile area in such a manner that no segregation of the various particle sizes results. The asphalt binder shall be stored in suitable tanks at a temperature not exceeding 150^0C.

2.6 Mixing Plant

.1 The mixing plant and auxiliary equipment shall be such as to combine, dry, and heat the mineral aggregate, heat the asphalt and accurately proportion the asphalt and aggregate to produce a uniform mixture. The mixing plant shall meet the requirements of A.S.T.M. Designation D995 for Bituminous Mixing Plant Requirements.

3.0 EXECUTION

3.1 Preparation of Site

.1 Patch and correct depressions and other irregularities to approval of the Engineer before beginning paving operations. Prior to laying mix, clean surfaces of loose and foreign material and apply prime coat or tack coat in accordance with Section 02745.

3.2 Preparation of Mixture

.1 The mineral aggregate, and mineral filler when required, shall be combined by means of hoppers and conveyors at the cold feed plant. The aggregate shall be dried and delivered at a temperature of 120^0C to 160^0C to the mixer. The temperature between these limits shall be regulated according to the penetration grade of the asphalt, temperature of the atmosphere and workability of the mixture. The aggregate shall be dry mixed in the mixer for not less than 15 seconds.

.2 The asphalt cement shall be brought to temperature of 120^0 to 160^0C before mixing with aggregate. The temperature between these limits shall be regulated to the penetration grade of the asphalt used.

.3 The aggregate and asphalt cement shall then be mixed in the proportions as determined by the design mix. The temperature of both the aggregate and asphalt cement shall be maintained between 120^0C and 150^0C until mixing is completed. The time of mixing shall be not less than 30 seconds, and shall be such that a homogenous mixture is produced in which all particles of the aggregate are uniformly coated with asphalt.

.4 The bituminous mix temperature at mixer discharge shall be controlled between low temperature of 130°C and a maximum high temperature of 150°C.

.5 Mix Tolerances

.1 All mixture furnished shall conform to the job mix formula within the range of tolerance specified.

Aggregate Material Passing	Percent by Weight
5.0 mm Sieve	± 5
0.90 mm Sieve	± 3
0.071 mm Sieve	± 1.5

.2 The amount of bituminous material designated for the job mix shall be maintained within the tolerance of 0.25 percentage points.

.3 The temperature for mixing asphaltic mixtures shall not vary from those specified in the job mix formula by more than 5° C.

3.3 Transportation of Mix

.1 The mixture shall be transported from the mixing plant to the work in vehicles with tight metal boxes previously cleaned of all foreign materials. The vehicles shall be suitably insulated and each load shall be covered with canvas or other suitable material of sufficient size to protect it from weather conditions. The inside surface of all vehicles may be lightly lubricated with a thin oil or soap solution prior to loading, but excess lubricating will not be permitted.

.2 Any accumulation of asphaltic material which was collected in the box shall be thoroughly cleaned before loading with hot mix.

.3 Trucks shall be maintained perfectly clean of mud or any substance which could contaminate the working area.

3.4 Paver

.1 The mixture shall be laid with a mechanical self-powered spreader capable of spreading the mixture true to line, grade and crown as required. The paver shall be equipped with hopper and distributing screw of the reversing type to place the mixture evenly in front of adjustable screeds.

.2 Mechanical self-powered pavers shall be equipped with electronic screed control system capable of automatically maintaining screed elevations on each side of the paver through any combination of stringline, 9.1 m long ski-type device or joint matching shoe.

3.5 Placing

.1 The Contractor shall remove all loose and foreign material and water prior to placing the asphaltic concrete mixture. The mixture shall be delivered at a minimum temperature of 130°C or maximum temperature of 150°C and laid in dry conditions and only when the ambient air temperature is 2°C and rising.

.2 The mixture shall be laid and rolled to the widths and thickness shown on the drawings. The finished surface shall have the minimum number of longitudinal and horizontal joints as practicable.

.3 The asphalt pavement shall be laid in two lifts, the second lift shall not be placed over the bottom layer within 24 hours. Before rolling is started, the surface shall be checked, inequalities in depth adjusted and fat spots or sandy accumulations replaced and irregularities in alignment or grade along the outside edge shall be corrected.

.4 The maximum thickness of any lift shall not exceed 50 mm compacted thickness.

.5 The Contractor will only be allowed to place bituminous mix during daylight hours. Daylight hours are from sunrise to one-half hour before sunset.

.6 When temperature of surface on which material is to be placed falls below 10° C, provide extra rollers as necessary to obtain required compaction before cooling.

.7 Do not place hot mix asphalt when pools of standing water exist on surface to be paved, during rain, or when surface is damp.

.8 In small areas where the use of mechanical finishing equipment is not practical, the mix may be spread and finished by hand, if so directed by the Engineer. The material shall be distributed uniformly to avoid segregation of coarse and fine aggregates. Broadcasting of material shall not be permitted. During the spreading operation, all material shall be thoroughly loosened and uniformly distributed by lutes or rakes. Material that has formed into lumps and does not break down readily shall be rejected.

3.6 Joints

.1 A continuous well-sealed bond is required between old and new surfaces. The contract surface of all longitudinal joints shall be painted with a thin and uniform coat of hot asphalt primer before placing the new mix, and the same treatment shall be given to contact joints with curbs, gutters, manholes and other appurtenances.

.2 When the work is resumed after a lapse of several hours, one end shall be cut back approximately 150 mm to a new and clean surface before paving is started and heat shall be used as necessary to ensure a proper bond.

.3 Where the asphaltic concrete material is placed in two layers; longitudinal joints in the two layers shall be staggered by a minimum of 150 mm.

.4 Where the proposed pavement meets the existing pavement, the Contractor shall cut to a neat square edge to ensure a good seam. The cost of this cutting shall be included in the unit price bid for hot mix asphaltic concrete.

3.7 Rollers

.1 The rollers used for compaction shall be self-propelled steel-wheeled and rubber tired rollers, weighing at least 3.6 kilograms per millimeter width of tread.

.2 The rollers shall be in good condition without backlash when reversed and shall be operated by competent rollerman.

.3 The wheels shall be kept properly moistened, but excess water or lubricant will not be permitted.

.4 The rollers must be kept in continuous operation as nearly as practicable and all parts of the pavement shall receive substantially the same compaction.

.5 The number of rollers used on the project shall be compatible with the rate the asphalt is being laid.

3.8 Rolling and Compaction

.1 Before rolling is started, the surface shall be checked, inequalities in depth adjusted and fat spots or sandy accumulations replaced, and irregularities in alignment or grades along the outside edge shall be corrected.

.2 At least one steel wheeled and one rubber tire roller shall be used for every 40 tonnes of asphaltic concrete laid per hour.

.3 Rolling shall start as soon as the pavement will bear the roller without checking or undue displacement, working from the lower part or edge to the high part or edge continuously until no roller marks are left in the finished surface and no further compaction is possible.

.4 The rollers must be kept in continuous operation as nearly as practicable and all parts of the pavement shall receive substantially the same compaction. Rolling shall be done at a maximum speed of 5 km per hour.

.5 At all curbs, manholes and other appurtenances, and at all locations not accessible to the roller, hand tampers shall be used to produce the same density as provided by the roller.

.6 The completed pavement shall not have a density of less than 98% of the laboratory compacted density as determined by methods described in ASTM D1559, using a compaction of 50 blows for each face.

3.9 Finish

.1 The finished pavement shall be true to the required profile and cross-section. The allowable tolerance for finished pavement shall be ±5 mm, and the surface shall show no depressions or bumps exceeding 3 mm under a straight-edge 3 m long placed parallel to the road centreline.

.2 Finished surface shall have a tightly knit texture free of visible signs of poor workmanship such as, but no limited to:

.1 Segregation

.2 Areas exhibiting excess or insufficient asphalt

.3 Improper matching of longitudinal and transverse joints

.4 Roller marks, cracking, or tearing

.3 If surface and grade tolerances are exceeded, or if surface texture is not met, repair defective areas as required by the Engineer.

3.10 Defective Work

.1 Correct irregularities which develop before completion of rolling by loosening surface mix and removing or adding material as required. If irregularities or defects remain after final compaction, remove surface course promptly and lay new material to form a true and even surface and compact immediately to specified density.

.2 Repair areas showing checking or hairline cracking.

3.11 Testing and Inspection

.1 Bituminous Mixture Samples:

Samples of the bituminous mixture shall be taken from the spreader or haul truck and forwarded to an approved laboratory for testing. One such sample shall be obtained per 2,000 square metres of area surfaced except during the initial period of construction when a greater number of samples will be necessary.

.2 The following tests shall be performed on all samples of the bituminous mixture submitted to the laboratory.

.1 Bitumen Content

.2 Aggregate Gradation

.3 On the first four samples submitted and on every third sample thereafter, the following additional tests shall be performed.

.1 VMA
.2 Per Cent Air Voids
.3 Marshall Stability
.4 Flow
.5 Density

.4 One core sample shall be obtained for each one hundred lineal metres of street paved. Core sample locations should correspond to the same locations as samples gathered for Lab testing. All core samples shall be tested for bitumen content and density and measured for thickness. Every third specimen shall also be tested for aggregate gradation.

.5 The Contractor shall repair all test holes with fresh, hot mix asphaltic concrete mixture, and thoroughly compact it to the required density with no additional compensation.

3.12 Traffic

.1 No traffic shall be allowed on the finished surface until it has cooled to atmospheric temperature.

3.13 Failure to Meet Compaction Density and Thickness Requirement

.1 The Owner reserves the right to reject any Hot Mix Bituminous Surface Course whatsoever which does not meet all the specified requirements for the Hot Mix Bituminous Surface Course.

.2 The Owner may, however, at the discretion of the Engineer, accept Hot Mix Bituminous Surface Course which does not meet the specified density and thickness requirements and, in such case, payment shall be made on the basis of a percentage scale for the Hot Mix Bituminous Surface Course product by each test as follows:

.1 Density Specified to 98% of Marshall

Compacted Density % of Marshall	Payment
98 to 100	100%
97.6 to 97.9	98%
97.0 to 97.5	96%
96.6 to 96.9	93%
96.0 to 96.5	90%
94.0 to 95.9	75%
92.0 to 93.9	50%
Less than 92%	Replace pavement – no payment for removal or replacement

.2 Thickness

"T" – the over thickness limit, which is the greater of:

- (Design thickness) x 10%; or
- 5 mm

Thickness (X = actual thickness / design thickness)

Variation in Thickness From Design Thickness	Payment
more than specified thickness – 5 mm thin	100%
6 mm thin – 15 mm thin	X^2 (100%)
more than 15 mm thin	No Payment

.3 Where more than one lift of asphalt is placed, the thickness tolerances will apply to the total asphalt layer and not to the thickness of each lift.

When asphalt concrete is measured in square meters, excess thickness will be accepted with no claim for extra payment. When asphalt concrete is measured in tonnes, asphalt concrete in excess of over thickness limit "T" will be paid at 35% of tendered unit price for that item.

.4 If any Hot Mix Bituminous Surface Course tested in accordance with this Specification fails to meet the specified density, the Contractor may request coring of the Hot Mix Bituminous Surface Course in question. When such coring is approved by the Engineer, arrangements shall be made by the Contractor, through the Engineer, to employ an independent, qualified testing service, all at the expense of the Contractor. The cores shall be taken and tested within three days of the testing of the cores representing the Hot Mix Bituminous Surface Course in question. One core shall be taken for each strength test previously taken and there shall be no doubt that the cores taken represents the area in question. Cores shall be tested in accordance with the requirements of A.S.T.M. Designation D1559 and reported by the independent testing service shall constitute a test. When more than one core strength is taken, in one area the average of all the core strength tests shall represent the strength of the Hot Mix Bituminous Surface Course in question.

3.14 Acceptance

.1 Locations shall be cleared of all excess material resulting from the paving operation and any damage caused by the Contractor shall be repaired to the Engineer's satisfaction within 3 days of the date of completion of the street or lane. Failure to cleanup or repair damage may result in other crews undertaking this work without notice to the Contractor and deducting the costs from money due to the Contractor.

END OF SECTION

1.0 GENERAL

1.1 Definitions

.1 Prime Coat:

.1 Prime coat shall be the application of bituminous material to granular base course, preparatory to placing bituminous surfacing materials or asphaltic concrete base course.

.2 Tack Coat:

.1 Tack coat shall be the application of bituminous material to a previously constructed paved surface of any type in preparation of placing bituminous surfacing materials.

.3 Fog Coat:

.1 Fog Coat shall be the application of bituminous materials to seal small cracks and surface voids on asphalt surface materials or a curing seal for Cement Stabilized Base Course.

1.2 Measurement for Payment

.1 Measurement for prime coat will be in litres of material applied. Payment shall include the supply of materials, preparation of the surface, brooming or sweeping the surface, application, sand blotting, including supply of sand, maintaining the treated surface and the supply of all tools and incidentals to complete the work.

.2 Payment for tack and fog coats shall be in litres of material applied. The Engineer will decide if fog coat is required on finished paved surfaces.

2.0 PRODUCTS

2.1 Prime Coat

.1 The bituminous material for priming the base course shall be liquid asphalt. Asphalt types may vary from medium curing (MC) type MC-30 to MC-250; from emulsified asphalt Types SS-1 to SS-1H or a special emulsified asphalt primer S.E.P. 1 or S.E.P. 2 depending on conditions to suit the base and time of season. The type of asphalt suitable for this application shall be a 50:50 mixture of water and SS-1 applied at a rate of 1.5 L/m^2 providing the hot mix asphalt pavement is placed immediately after curing is complete.

2.2 Tack Coat

.1 The bituminous material for tacking the existing asphalt surface shall be liquid asphalt. The asphalt types may vary from rapid curing (RC) type RC-30 to RC-250; from emulsified asphalt types SS-1 to SS-1H, depending on conditions to suit the base and time of season.

.2 In addition to 2.2.1 Tack Coat above, the tack coat shall be applied in accordance with the application rates outlined in the following table:

Application Rate (L/m²)			
Surface Type	Residual	Undiluted	Diluted (one part water to one part emulsified asphalt)
Milled Asphalt Concrete	0.27 – 0.36	0.45 – 0.60	0.90 – 1.20
New Asphalt Concrete	0.14 – 0.18	0.23 – 0.32	0.45 – 0.60

2.3 Fog Coat

.1 The bituminous material for sealing the surface course if specified shall be liquid asphalt. The asphalt types may be emulsified asphalt type SS-1 or medium curing (MC) type MC-30, depending on the surface material to be sealed and time of season. The type of asphalt suitable for this application shall be a 50:50 mixture of water and SS-1 applied at a maximum rate of 0.5 L/m^2.

2.4 Sand Blotter

.1 The materials for sand cover shall consist of clean granular mineral material, all of which shall pass a 5.0 mm sieve.

3.0 EXECUTION

3.1 Equipment

.1 Cleaning equipment shall consist of power brooms, flushers, and whatever hand scrapers may be necessary to remove all foreign material.

.2 The pressure distributor used for applying asphaltic material shall be equipped with pneumatic tires and shall be so designed and operated as to distribute the asphaltic material in a uniform spray without atomization, in the amount and between the limits of temperature specified. It shall be

equipped with a fifth wheel speed tachometer registering metres per second and so located as to be visible to the truck driver to maintain the constant speed required for uniform application at the specified rate.

.3 The pump shall be operated by a separate power unit, or by the truck power unit. It shall be equipped with a metre registering litres per minute passing through the nozzles and located to be readily visible to the operator.

.4 Suitable means for accurately measuring the temperature of the asphaltic material shall be provided.

The thermometer well shall be so placed as not to be in contact with a heating tube. The distributor shall be so designed that the normal width of application shall be not less than 2 m, with provision for the application of lesser width when necessary.

.5 If provided with heating attachments the distributor shall be so equipped and operated that the asphaltic material shall be circulated or agitated throughout the entire heating process.

3.2 Preparation

.1 Immediately prior to applying the asphaltic primer, tack or fog coat, the surface shall be brought to uniform cross-section by patching all depressions and defective areas using an approved patching material and by removing all bumps and irregularities.

.2 All loose and foreign material shall be removed by light sweeping.

3.3 Application

.1 Obtain Engineer's approval of existing surface before applying asphalt prime, tack or fog coats. Clean surface as required.

.2 Upon the prepared surface the asphalt shall be applied uniformly at a rate of from 1.0 to 1.50 litres/square metre (L/m^2) for asphalt primer, and at a rate of from 0.25 to 0.90 L/m^2 for tack coat and a rate not exceeding 0.5 L/m^2 for fog coat. The asphalt primer, tack or fog coat shall be applied only when the surface is dry or slightly damp, unless otherwise allowed by the Engineer in writing, or only when the air temperature in the shade is above 10°C. Hand apply asphaltic primer in areas not accessible with the distributor.

.3 The application temperature of the asphalt primer, tack or fog coat shall be as follows:

.1 Rapid Curing Asphalt:

RC-30	51 – 68°C

RC-70	74 – 88°C
RC-250	100 – 110°C

.2 Medium Curing Asphalt:

MC-30	51 – 68°C
MC-70	74 – 88°C
MC-250	100 – 110°C

.3 Emulsified Asphalt:

SS-1	24 – 54°C
SS-1H	24 – 54°C

.4 Emulsified Asphalt Primer: 15 – 50°C

.4 Coat contact surfaces of curbs, gutters, headers, manholes and like structures with a thin uniform coat of asphalt material. Do not prime or tack surfaces that will be visible when paving is complete. Work adjacent to the roadway shall be completely protected from the application operation by a suitable covering. Any unnecessary splashing of the concrete shall be cleaned.

.5 Do not apply asphalt coat when air temperature is less than 5°C and/or when rain is forecast within 8 hours. Do not apply prime or tack coat if surface temperature is less than 2°C. Do not apply fog coat if surface temperature is less than 10°C.

.6 The Contractor shall maintain the primed surface until the surface course has been placed. Maintenance shall include spreading any additional sand and patching any breaks in the primed surface with additional asphaltic material.

.7 The asphalt primer should preferably be entirely absorbed by the base course and therefore require no sand cover. If, however, the asphalt has not been completely absorbed 24 hours after application, just sufficient sand shall be spread over the surface to blot up excess asphalt and prevent it from being picked up by any traffic.

.8 Traffic shall not be permitted to travel on tack or fog coat until cured. The Contractor shall use flagmen, if required; provide and maintain signs, barricades, and keep all animals and pedestrians off newly primed surfaces until cured.

.9 Traffic shall not be permitted to travel on prime coat until 6 hours after application or until completely cured. After this period of time, excess asphalt material remaining on the surface shall be blotted by sand before traffic is permitted to travel on the surface.

.10 Allow prime coat to properly cure before paving.

END OF SECTION

1.0 GENERAL

.1 The complete work under this trade shall be governed by the dictates of good practice in all details of materials and methods even if not minutely specified. The work shall be properly coordinated with the requirements of other units of work specified in other sections.

.2 All concrete work shall be constructed in accordance with the Standard Drawings in locations noted on the plans. The dimensions shall be as specified on the drawings and in the Bid Form.

.3 The Contractor shall notify the City of Prince Albert prior to the removal of any existing street and traffic signs. The Contractor will notify the City of Prince Albert upon construction completion to ensure that signs are replaced.

1.1 Related Work Specified Elsewhere

.1	Adjustment of Appurtenances	Section 02840
.2	Subgrade Construction	Section 02705
.3	Granular Base Course	Section 02721

1.2 Existing Structures

.1 Temporary support, adequate protection and maintenance of all underground and surface structures and utilities and other obstructions encountered in the progress of the work shall be furnished by the Contractor at his own expense and under the direction of the Engineer. The structures and utilities which may have been disturbed or damaged shall be restored to their original or new condition at such a time as deemed necessary or upon completion of the work.

1.3 Measurement for Payment

.1 Payment for new and replacement concrete pavement shall be full compensation for excavation, preparing the subgrade and compaction to 98% Standard Proctor density, supply and placing granular bedding where required, forming, supplying and placing concrete, jointing, jointing materials, finishing, curing, stripping forms, and backfilling. Measurement for new and replacement concrete pavement shall be as follows:

.1 The subgrade area for the new concrete pavement shall be excavated in conjunction with the adjacent roadways excavation and be filled with compacted granular base course material and geotextile filter fabric as indicated on the plans. Common excavation, subgrade preparation and geotextile filter fabric quantities and payments are included in the roadways pay items.

.2 Concrete pavement shall be measured by the square metre. Payment for concrete pavement shall be at the unit price bid per square metre and shall include all preparation work required to prepare the site and all reinforcement steel.

.3 Removal of existing concrete pavement will be paid for at the unit price per square metre regardless of the depth. The unit price shall include disposing of the concrete removed at a location designated by the Engineer.

.4 Compacted granular base where required shall be paid for at the unit price bid per cubic metre for compacted granular base course under concrete pavement.

.2 Payment for concrete pavement shall be subject to the penalties outlined in Section 3.13 for deficient concrete.

2.0 PRODUCTS

2.1 Granular Base Course

.1 Material for the granular base course shall consist of sound, hard, durable crushed rock or crushed gravel and shall not contain organic or soft, thin elongated, or laminated materials, materials that break up when alternately frozen and thawed or wetted and dried, or other deleterious materials. When compacted near the optimum moisture content to not less than 100% of the maximum dry density corrected for the stone content as determined by ASTM D698, the material shall have a minimum CBR value of 65 and a maximum particle size of 18 mm.

.2 Granular base course shall meet the following gradation when tested to ASTM C136 and ASTM C117, and give a smoother curve without sharp breaks when plotted on a semi-log grading chart:

BASE COURSE		
Sieve Designations (mm)	**Percent by Weight Passing**	
	Lower Limit	**Upper Limit**
19.0	100	100
12.5	75	100
5.0	50	75
2.0	32	52
0.900	20	35
0.400	15	25
0.160	8	15
0.071	6	11
Plasticity Index	0	6
% Fractured Face	60 Minimum	
% Light Weight Pieces	5 Maximum	

2.2 Cement

.1 All cement used shall be Normal Portland Cement and shall conform to CSA standard CAN3-A5 Type 10 or Type 50.

2.3 Aggregates

.1 Samples: Before any aggregates are used in the work, the Contractor shall obtain and ship to a testing laboratory designated by the Engineer for preliminary approval, representative samples containing not less than 25 kg of aggregate. Sampling shall be done in accordance with CSA Test Method A23.2 – 1A. The Contractor shall pay for all costs of obtaining and shipping samples and for all Laboratory Tests.

.2 Materials: Fine and coarse aggregate shall conform to the requirements of CSA CAN3-A23.1-M77 with the following gradation limits:

.1 Coarse Aggregate: Shall conform to the following gradation limits:

Sieve Opening	Percent Passing
28 mm	100%
19 mm	90 - 100
9.5 mm	25 - 60
5 mm	0 - 10
2.5 mm	0 - 5
80 um	0 - 1

Coarse aggregate shall consist of crushed stone or gravel or combination thereof, having hard, strong, durable particles, free from elongated particles, dust, shale, earth, vegetable matter or other injurious substances.

.2 Fine Aggregates: Shall conform to the following gradation limits:

Sieve Opening	Percent Passing
10 mm	100%
5 mm	95 - 100
2.5 mm	80 - 100
1.25 mm	50 - 90
630 um	25 - 65
315 um	10 - 35
160 um	2 - 10
80 um	0 - 3

Fine aggregate shall consist of sand, stone screenings or there inert materials with similar characteristics or a combination thereof having clean, hard, strong, durable uncoated grains and free from an injurious amount of dust, lumps, shale, alkali, organic matter, loam or other deleterious substances.

.3 Approval: Preliminary approval of the aggregate as represented in the samples and test results shall not constitute general acceptance of all material in the deposit or source of supply, and acceptance

shall be subject to field tests taken at the discretion of the Engineer. Materials may be considered unsuitable, even though particle sizes are as required, if particle shapes are thin or elongated or if the material fails to provide a suitable concrete. Rejected material will not be paid for. The acceptability of the final material will be determined by the Engineer.

.4 Storage: The aggregates shall be stockpiled in such a manner as to minimize segregation. Stockpiles should be built up in layers of uniform thickness.

2.4 Concrete Strength

.1 All concrete shall be proportioned and mixed to produce a concrete having a minimum compressive strength of 32 MPa at 28 days.

2.5 Water

.1 The water used in mixing or curing concrete shall be clean and free from salt, oil, acids, alkalies, and organic or other deleterious substances.

2.6 Air Entraining Admixture

.1 An air entrainment admixture conforming to the requirements of CSA Standard A266.1 shall be used to produce an air entrained concrete containing not less than 5% and not more then 8% entrained air, as determined by the standard test described in CSA Standard CAN3-A23.2-4C.

2.7 Reinforcing Steel

.1 Reinforcing steel shall conform to the following requirements:

.1 Welded steel wire fabric shall conform to CSA standard G30.5.
.2 Billet steel bars shall conform to CSA standard G30.12-M.

2.8 Expansion Joint Filler

.1 Expansion joint filler shall be a 19 mm thick non-extruding bituminous type and shall conform to ASTM D1751 for preformed expansion joint filler.

2.9 Expansion Joint Sealer

.1 Joint sealer shall conform to CGSB standard specification for polyurethane sealing compound 19-GP-15 or ASTM standard specification for hot poured joint sealer D-1190.

2.10 Membrane Curing Compound

.1 Curing compound shall be impervious resin base, conforming to ASTM standard specification C309 Type, 1D-Type B. The membrane curing compound shall be applied in accordance with the manufacturer's instructions.

2.11 Concrete

.1 Design Mix

The Contractor shall submit to the Engineer three copies of a proposed design mix showing the proportions of the material to be used. From concrete mixed according to this design, the Contractor shall have three cylinders taken and tested according to CSA Standard CAN3.A23.2-9C and shall forward three copies of the test results to the Engineer. The costs of the design mix and concrete samples and test shall be borne by the Contractor. No concrete shall be used in the work before a mix design from a recognized testing laboratory has been submitted to the Engineer.

The concrete mix shall be designed as follows:

.1	Minimum 28 day compressive strength	32 Mpa
.2	Slump	30 mm ± 10 mm
.3	Maximum aggregate size	20 mm
.4	Air entrainment	5.0 % to 8.0 %

.2 Concrete Mixing

.1 On Site: Concrete shall only be made on the site with the approval of the Engineer.

.2 Ready-Mixed: Ready-mixed concrete shall be mixed and transported in accordance with CSA Standard CAN3-A23.1-M77.

3.0 EXECUTION

3.1 Grade Preparation

.1 The prepared bed for the concrete pavement shall be excavated in conjunction with adjacent roadways excavation and shall be filled with compacted granular base course material and geotextile filter fabric to the lines, grades and cross sections as indicated on the plans. The Contractor shall coordinate and schedule with other contractor as required. The Owner shall not be responsible for delays caused by other contractors.

.2 The subgrade shall be scarified and compacted to a minimum of 98% Standard Proctor Density at optimum moisture content, over the full width of the cross-section. The material shall be worked to ensure as much uniformity as possible in material.

.3 Granular base course shall be installed as specified as a foundation material under concrete pavement. The base on which the concrete will rest shall be thoroughly wetted immediately prior to placing the concrete and must not be frozen, muddy or have areas of water pondage.

.4 All granular base course layers shall be compacted near the optimum moisture content to not less than 100% of the maximum dry density corrected for the stone content as determined by ASTM D698 Method A for the material used.

3.2 Forms

.1 Forms shall be of steel or wood of sufficient strength to resist the pressure of wet concrete, and the supply shall be sufficient to permit their remaining in place not less than 12 hours after concrete has been placed, or longer if the Engineer considers it necessary. The use of bent, twisted, battered or worn-out forms will not be permitted. Forms shall be held securely by approved methods to prevent movement and bulging when the concrete is placed. Forms will be checked for alignment and elevation by the Engineer before concrete is poured, and shall be cleaned and oiled before each use.

3.3 Reinforcement

.1 Where required, reinforcement shall be secured in the location shown on the Standard Drawings or as directed by the Engineer and shall be free from mill scale, grease and rust immediately prior to placing concrete. Reinforcement shall be drilled and dowelled into existing concrete at all joints.

3.4 Equipment

.1 Slipform paver suitable to the work shall be used and equipped with adequate internal vibrators to consolidate concrete to full depth and width of slab; adjustable crown and crossfall; subject to the approval of the Engineer. Slipform paver shall be capable to uniformly spreading, shaping, and consolidating fresh concrete to produce a dense homogeneous mass with surfaces requiring a minimum of hand finishing.

3.5 Slipforming

.1 Set and maintain grade line by establishing taut string line or wire, based on the lines and grades in the Drawings and as set by the Engineer.

.2 Provide stable support of the travelling slipform machine. Protect adjacent work and repair if damaged.

.3 Remove excess mortar that may accumulate on a slipformed vertical edge.

.4 If slab edge sags, repair immediately by hand forming; do not use concrete mortar to top off the sag. If edge sagging persists, suspend operations and perform corrective measures.

3.6 Hand Forming

.1 Hand forming and placing concrete without extruding machine shall only be used on areas impractical for slipforming and with the approval of the Engineer.

.2 The concrete shall be thoroughly consolidated against and along the faces of the forms. Hand spreading shall be done with shovels, not with rakes, in order that the concrete will not be segregated. Precautions should be taken to prevent overworking of the concrete.

3.7 Placement

.1 The concrete shall be placed as soon as possible after mixing, but not later than one hour after mixing has begun. Retempered concrete shall not be used. The concrete shall be transported, by methods which will prevent segregation, and deposited on the subgrade so that as little handling as possible is required.

.2 Concrete thickness shall be those shown on Standard Drawings.

.3 Concrete shall be placed continuously until the scheduled pour is complete. Arrange the rate of concrete delivery to ensure that the discharge interval between successive loads does not exceed 30 minutes. If the discharge interval is exceeded, place a construction joint.

3.8 Appurtenances

.1 Appurtenances shall be located, examined for deficiencies and staked by the Contractor prior to work beginning on a particular section and any deficiencies noted must be reported to the Engineer immediately. Upon completion of a block of work, the Contractor shall relocate these structures and inspect them with the Engineer. Any damage which may have occurred during the concreting operations, and deficiencies not previously reported to the Engineer, shall be repaired at the Contractor's expense. The Contractor shall schedule his work in such a manner as to not have more than seven days or 1000 m, whichever is greater, of work in progress at one time. This includes the entire process of preparing the subgrade for the concrete, to the final backfilling and cleaning up. All costs involved in using an extruding machine shall be included in the contract unit prices tendered for concrete pavement.

3.9 Finishing

.1 Surfaces shall be struck off and screeded to the slope, cross-section and elevation shown on the drawings and staked by the Engineer. The surface shall be consolidated and smoothed using a wood float. Light steel trowelling shall be used followed by a uniform burlap finish. Drag multiple ply burlap equal in length equal to the width of the slab and having at least a 1.0 m strip in contact with the plastic concrete surface. Drag carefully in the direction of concrete placement to produce a finished surface simulating a sandy texture with no disfiguring marks. No patching will be allowed.

3.10 Joints

.1 Construct joints as required in each type of construction to the following standards as applicable.

.2 Expansion and Contractor Control Joints

.1 Intended to control the location of shrinkage cracks in hardening concrete. Construct joints to the indicated dimensions, depth, spacing, and pattern, with a maximum spacing of 6.0 m by any of the following methods:

.1 Formed Joint: Form the groove by inserting a metal or fibre strip, or polyethylene film into the plastic concrete. Finish the edges to a 6 mm radius. Remove the insert immediately after initial set of the concrete. Seal the joint with a specified sealant.

.2 Tooled Joint: Hand form the groove using a jointing tool with a thin metal blade to impress a plane of weakness into the plastic concrete. Finish the edges to a 6 mm radius. Seal the joint with a specified sealant.

.3 Sawed Joint: Cut the groove with a concrete saw as soon as the concrete surface has hardened sufficiently to resist raveling as the cut is made, but before shrinkage cracks form in the concrete. The Contractor is responsible for the proper timing of the saw cut. Immediately flush the saw cut clean with water. Once the joint surfaces are dry, seal the joint with a specified sealant.

.2 Isolation Joint: required where concrete is placed adjacent to an immovable structure or where indicated on the Standard Drawings. Construct the joint by sawing or forming to create a clean break though the full cross-section of the concrete member. Make the joint wide enough to permit a snug fit for the pre-formed joint filler.

Alternatively, place the pre-formed joint filler against the structure and pour the concrete against the pre-formed joint filler.

.3 Construction Joint: required between concrete pours or for joing new concrete to existing work. Construct the joint with dowels as detailed on the Standard Drawings or as directed by the Engineer. Finish edges to a 6 mm radius. Vertically trim the existing concrete by sawing at least 50 mm deep and breaking. Leave the joint form in place until the concrete has set, then remove the joint form without damaging the concrete.

3.11 Curing

.1 All concrete shall receive two applications of membrane curing compound. The first application is to be applied after the disappearance of the water sheen and the final finishing of the concrete. During hot, dry, windy days, the first application shall be applied immediately after final finishing and before all free water on the surface has evaporated. The second applications shall be made immediately at right angles to the first so that complete coverage on the surface is attained. Immediately after removal of the forms all exposed surfaces shall be thoroughly wetted with water and then sprayed with membrane curing compound. The membrane curing compound shall be applied in accordance with the manufacturer's instructions.

3.12 Cold Weather Requirements

.1 When the temperature of the surrounding atmosphere is at, or below 4°C, the aggregate and the mixing water shall be heated. The aggregate and mixing water shall have a temperature of not less than 4°C and be entirely free of frozen materials. The aggregate shall not be heated to more than 60°C, and the concrete when deposited in the forms shall have a temperature of not less than 10°C and not more than 38°C. The concrete shall be maintained at a minimum temperature of 10°C for not less than four days after placing.

3.13 Tolerances

.1 The finished surfaces of all concrete work shall be true to the required cross-section with a tolerance of ± 3 mm from the required elevation and dimensions. Surface of concrete pavement shall not show any depressions or bumps under a straight edge 3 m long exceeding 3 mm parallel to the street direction of travel. Depressions shall not exceed 6 mm in transverse to the direction of travel and at intersections and ramps. Concrete not meeting the requirements specified shall be removed to the nearest joint and replaced at the Contractor's expense.

3.14 Field Tests

.1 Tests shall be made of the concrete to ensure that it meets these specifications. Testing shall be done to conform to the following standard specifications:

Test	Current Issue of ASTM
Sampling of Fresh Concrete	C172
Test for Slump of Concrete	C143
Compression and Flexure Test	C31
Compressive Strength of Molded Concrete Cylinders	C39
Measurement of Air Content	C173 or C231

.2 Concrete: The services of an independent, qualified, materials testing laboratory shall be retained to perform the field and laboratory concrete tests. The Contractor shall be responsible for arranging for an paying the full cost of all control testing including sampling, transporting the samples for compression tests of the cylinders taken to the designated testing labs. The cost required for sampling and shipping of samples to the laboratory shall be included in the unit prices tendered for concrete work.

The cost of compression testing of concrete specimens in the laboratory will be paid for by the Owner.

The Owner shall appoint the laboratory to be used for concrete testing.

Copies of all test results shall be promptly forwarded to the Contractor, the Concrete Supplier and the Engineer.

.3 Sub-Grade Density: The Owner shall pay the cost of the sub-grade density control testing required to ensure performance of the Contract. Only tests that indicate that the density is at or above that specified will be paid for. The costs of any test which indicate the density does not meet or exceed the minimum specified will be deducted from the Contractor's Progress Certificate.

The Owner will appoint the laboratory to be used for quality control testing.

.4 Three concrete cylinders shall constitute one test and shall be made from the same batch or load. They shall be stored undisturbed on site for 24 hours, covered with a plastic sheet to prevent loss of moisture. They shall then be delivered to an approved testing laboratory for curing with one cylinder tested at seven days and the other two at twenty-eight days. A set of three cylinders shall be taken for every 100 m^3 of concrete poured or for each side of each block or portion thereof placed in one day, or as directed by the Engineer.

.5 When construction begins, the Engineer may take additional cylinders in order to establish a concrete strength pattern in the early stages of the project.

.6 At the City's request, the quality assurance laboratory will take one or more sets of cores from suspect concrete pavement, east set comprising of 3 cores whose average thickness represents not more than 500 m^2 of concrete pavement.

3.15 Failure to Meet Strength Requirements

.1 The Owner reserves the right to reject any concrete whatsoever which does not meet all the specified requirements for the concrete.

.2 The Owner may, however, at the discretion of the Engineer, accept concrete which does not meet the specified strength requirements and, in such case, payment shall be made on the basis of a percentage scale for the concrete product represented by each test as follows:

<u>32.0 MPa Concrete:</u>

32.0 MPa and over	100% of the unit bid price
29.2 MPa to 32.0 MPa	90% of the unit bid price
26.5 MPa to 29.1 MPa	70% of the unit bid price

All concrete below 26.5 MPa will be rejected.

.3 Furthermore, the Owner reserves the right to reject any particular portion of a pour if there exists manifest evidence that this particular portion of the pour has a strength that is below the minimum acceptable strength required under this Section.

.4 If any concrete tested in accordance with this Specification fails to meet the specified strength, the Contractor may request coring of the concrete in question. When such coring is approved by the Engineer, arrangements shall be made by the Contractor, through the Engineer, to employ an independent, qualified testing service, all at the expense of the Contractor. The cores shall be taken and tested within seven days of the testing of the twenty-eight day cylinders representing the concrete in question. Three cores shall be taken for each strength test previously taken and there shall be no doubt that the cores taken and the cylinders under consideration represent the same batch of concrete. Cores shall be tested in accordance with the requirements of CSA A23.2-14C and the average strength of the cores as reported by the independent testing service shall constitute a test. When more than one core strength test is taken, the average of all the core strength tests shall represent the strength of the concrete in question.

.5 The foregoing procedure may be altered if the concrete in question was placed during weather conditions not suitable, in the opinion of the Contractor, to permit satisfactory curing. When 7 day test results indicate that the concrete is likely to be sub-standard or rejected, the Contractor will

be notified and can either request to arrange coring at that time or can continue to provide curing for the remainder of the 28 day period. In the event that the Contractor chooses to take cores after 7 days, they shall be taken as described in the foregoing paragraph, transported to an approved laboratory, and cured for a period of time such that the total curing time in place in the structure, plus the curing time in the laboratory is equal to 28 days. The cores shall then be tested and reported as described in the foregoing paragraph.

.6 In cases where the concrete strength, as indicated by the cores, is higher than the strength based on the concrete cylinder results, the core results shall be used as the basis of acceptance and payment of the concrete. If the core strengths are lower than the strength from the concrete cylinder tests, the cylinder tests shall govern.

3.16 Failure to Meet Thickness Requirements

.1 The Owner reserves the right to reject any concrete whatsoever which does not meet all the specified requirements for the concrete.

.2 The Owner may, however, at the discretion of the Engineer, accept concrete which does not meet the specified thickness requirements and, in such case, payment shall be made on the basis of a percentage scale for the concrete product represented by the average core thickness test as follows:

$$\text{Thickness } (X = \frac{\text{actual thickness}}{\text{design thickness}})$$

Variation in Thickness From Design Thickness	Pavement
more than specified thickness – 3 mm thin	100%
3 mm thin – 10 mm thin	X^2 (100%)
10 mm thin – 15 mm thin	X^5 (100%)
more than 15 mm thin	No Payment

.3 Concrete pavement with excess thickness may be accepted if surface and grade tolerances are met, but no claim for additional payment will be accepted.

3.17 Construction Record Imprints

.1 Each block of street constructed shall be marked at each end with a suitable tool showing legibly the name of the Contractor and year of construction.

3.18 Protection

.1 Keep all animals and pedestrians off the newly constructed concrete. The Contractor shall also be responsible for keeping all vehicles off the work

until cylinder testing has confirmed that the concrete has attained 75% of the specified strength or as directed by the City.

3.19 Backfilling

.1 Backfill areas between alley pavement, parking lots, or driveways with specified granular material compacted to a minimum density of 97% Standard Proctor Density.

.2 Backfill other areas along alley edges with 150 mm of lightly tamped topsoil shaped to match adjacent landscaped areas.

3.20 Final Cleanup

.1 As the work progresses, the Contractor shall clean up the site and all areas in which work has been done shall be left in a neat and presentable condition. All gutters and street drainage ditches which have been blocked as result of the Contractor's trenching operation shall be restored or repaired at the Contractor's expense.

.2 The Contractor shall, at his own expense, dispose of all surplus excavated material, organic soil, rock boulders and pieces of concrete and masonry, including those less than 0.1 m^3 in volume at an approved off-site disposal area.

3.21 Concrete Deterioration

.1 Concrete that shows surface scaling, deterioration or loss of cement or aggregate during the maintenance period will be rejected and require removal and replacement by the Contractor at no cost to the Owner.

END OF SECTION

1.0 GENERAL

.1 The complete work under this trade shall be governed by the dictates of good practice in all details of materials and methods even if not minutely specified. The work shall be properly coordinated with the requirements of other units of work specified in other sections.

.2 All concrete work shall be constructed in accordance with the Standard Drawings.

.3 The Contractor shall notify the City of Prince Albert prior to the removal of any existing street and traffic signs. The Contractor will notify the City of Prince Albert upon construction completion to ensure that signs are replaced.

1.2 Existing Structures

.1 Temporary support, adequate protection and maintenance of all underground and surface structures and utilities and other obstructions encountered in the progress of the work shall be furnished by the Contractor at his own expense and under the direction of the Engineer. The structures and utilities which may have been disturbed or damaged shall be restored to their original or new condition at such a time as deemed necessary or upon completion of the work.

1.3 Sidewalks, Curb and Gutter

.1 In locations noted on the plans, new sidewalk, monolithic sidewalk curb and gutter, or curb and gutter shall be constructed. The dimensions shall be as specified on the drawings and in the Bid Form.

1.4 Measurement for Payment

.1 Payment for new and replacement curbs, gutters and sidewalks shall be full compensation for excavation, preparing the subgrade and compaction to 98% Standard Proctor density, supply and placing granular bedding where required, forming, supplying and placing concrete, jointing, jointing materials, finishing, curing, stripping forms, backfilling to within 50 mm at back of walk and curb valve adjustments. Measurement for new and replacement concrete curbs, gutter and sidewalks shall be as follows:

.1 The subgrade area for the new sidewalks, curbs and gutters has been excavated in conjunction with the roadways excavation and has been filled with compacted granular base course material and geotextile filter fabric as indicated on the plans. Common excavation, subgrade preparation and geotextile filter fabric quantities and payments are included in the roadways pay items.

.2 Sidewalks not poured monolithically with curbs will be measured by the square metre.

.3 Sidewalks poured monolithically with curbs or curbs and gutters will be measured by the lineal metre measured along the line of the back of the curb.

.4 Curbs or curbs and gutters not poured monolithically will be measured by the lineal metre.

.5 Concrete sidewalk ramps will be paid at the unit price bid per square metre for the type of ramp constructed and will include saw cuts, gutter, drop curb and tapered curb and transition sections and any reinforcing steel required.

.6 Payment for concrete pavement shall be at the unit price bid per square metre and shall include all preparation work required to prepare the site and all reinforcement steel.

.7 Payment for sidewalk lane crossings shall be at the unit price bid per square metre and shall include all preparation work required to prepare the site and all reinforcement steel.

.8 Payment for curb or curb and gutter, lane, driveway and commercial crossings shall be at the unit price bid per lineal meter of crossing including the 1.5 metre transition wings.

.9 Rebar for new trench crossing will be paid for at the unit price bid per lineal metre of rebar installed. Rebar will be installed as detailed and in crossing locations of new underground piping installations.

.10 Removal of existing curbs, curbs and gutters, and curb crossings will be paid for at the unit price per linear metre regardless of the size of the curbs. The unit price shall include disposing of the concrete removed at a location designated by the Engineer.

.11 Removal and disposal of existing combined concrete curb and walk or separate sidewalk shall be at the unit price bid per square metre regardless of depth.

.12 Compacted granular base where required shall be paid for at the unit price bid per cubic metre for compacted granular base course under sidewalk and curb and gutter.

.13 Curb stops shall be adjusted to match the adjacent back-of-walk elevation. No separate payment will be made for this item, should be included in the unit prices for concrete construction.

.2 Payment for concrete curbs, gutters and sidewalks shall be subject to the penalties outlined in Section 3.13 for deficient concrete.

2.0 PRODUCTS

2.1 Granular Base Course

.1 Material for the granular base course shall consist of sound, hard, durable crushed rock or crushed gravel and shall not contain organic or soft, thin elongated, or laminated materials, materials that break up when alternately frozen and thawed or wetted and dried, or other deleterious materials. When compacted near the optimum moisture content to not less than 100% of the maximum dry density corrected for the stone content as determined by ASTM D698, the material shall have a minimum CBR value of 65 and a maximum particle size of 18 mm.

.2 Granular base course shall meet the following gradation when tested to ASTM C136 and ASTM C117, and give a smoother curve without sharp breaks when plotted on a semi-log grading chart:

BASE COURSE		
Sieve Designations (mm)	**Percent by Weight Passing**	
	Lower Limit	**Upper Limit**
19.0	100	100
12.5	81	100
5.0	50	80
2.0	32	52
0.900	20	35
0.400	15	25
0.160	8	15
0.071	6	10
Plasticity Index	0	6
% Fractured Face	60 Minimum	
% Light Weight Pieces	5 Maximum	

2.2 Cement

.1 All cement used shall be Normal Portland Cement and shall conform to CSA standard CAN3-A5 Type 10 or Type 50.

2.3 Aggregates

.1 Samples: Before any aggregates are used in the work, the Contractor shall obtain and ship to a testing laboratory designated by the Engineer for preliminary approval, representative samples containing not less than 25 kg of aggregate. Sampling shall be done in accordance with CSA Test Method A23.2 – 1A. The Contractor shall pay for all costs of obtaining and shipping samples and for all Laboratory Tests.

.2 Materials: Fine and coarse aggregate shall conform to the requirements of CSA CAN3-A23.1-M77 with the following gradation limits:

.1 Coarse Aggregate: Shall conform to the following gradation limits:

Sieve Opening	Percent Passing
28 mm	100%
19 mm	90 - 100
9.5 mm	25 - 60
5 mm	0 - 10
2.5 mm	0 - 5
80 um	0 - 1

Coarse aggregate shall consist of crushed stone or gravel or combination thereof, having hard, strong, durable particles, free from elongated particles, dust, shale, earth, vegetable matter or other injurious substances.

.2 Fine Aggregates: Shall conform to the following gradation limits:

Sieve Opening	Percent Passing
10 mm	100%
5 mm	95 - 100
2.5 mm	80 - 100
1.25 mm	50 - 90
630 um	25 - 65
315 um	10 - 35
160 um	2 - 10
80 um	0 - 3

Fine aggregate shall consist of sand, stone screenings or there inert materials with similar characteristics or a combination thereof having clean, hard, strong, durable uncoated grains and free from an injurious amount of dust, lumps, shale, alkali, organic matter, loam or other deleterious substances.

.3 Approval: Preliminary approval of the aggregate as represented in the samples and test results shall not constitute general acceptance of all material in the deposit or source of supply, and acceptance shall be subject to field tests taken at the discretion of the Engineer. Materials may be considered unsuitable, even though particle sizes are as required, if particle shapes are thin or elongated or if the material fails to provide a suitable concrete. Rejected material will not be paid for. The acceptability of the final material will be determined by the Engineer.

.4 Storage: The aggregates shall be stockpiled in such a manner as to minimize segregation. Stockpiles should be built up in layers of uniform thickness.

2.4 Concrete Strength

.1 All concrete shall be proportioned and mixed to produce a concrete having a minimum compressive strength of 32 MPa at 28 days.

2.5 Water

.1 The water used in mixing or curing concrete shall be clean and free from salt, oil, acids, alkalies, and organic or other deleterious substances.

2.6 Air Entraining Admixture

.1 An air entrainment admixture conforming to the requirements of CSA Standard A266.1 shall be used to produce an air entrained concrete containing not less than 5% and not more then 8% entrained air, as determined by the standard test described in CSA Standard CAN3-A23.2-4C.

2.7 Reinforcing Steel

.1 Reinforcing steel shall conform to the following requirements:

.1 Welded steel wire fabric shall conform to CSA standard G30.5.
.2 Billet steel bars shall conform to CSA standard G30.12-M.

2.8 Expansion Joint Filler

.1 Expansion joint filler shall be a19 mm thick non-extruding bituminous type and shall conform to ASTM D1751 for preformed expansion joint filler.

2.9 Expansion Joint Sealer

.1 Joint sealer shall conform to CGSB standard specification for polyurethane sealing compound 19-GP-15 or ASTM standard specification for hot poured joint sealer D-1190.

2.10 Membrane Curing Compound

.1 Curing compound shall be impervious resin base, conforming to ASTM standard specification C309 Type, 1D-Type B. The membrane curing compound shall be applied in accordance with the manufacturer's instructions.

2.11 Concrete

.1 Design Mix

The Contractor shall submit to the Engineer three copies of a proposed design mix showing the proportions of the material to be used. From concrete mixed according to this design, the Contractor shall have three

cylinders taken and tested according to CSA Standard CAN3.A23.2-9C and shall forward three copies of the test results to the Engineer. The costs of the design mix and concrete samples and test shall be borne by the Contractor. No concrete shall be used in the work before a mix design from a recognized testing laboratory has been submitted to the Engineer.

The concrete mix shall be designed as follows:

.1	Minimum 28 day compressive strength	32 Mpa
.2	Slump not exceeding	75 mm
.3	Maximum aggregate size	20 mm
.4	Air entrainment	5.0 % to 8.0 %

.2 Concrete Mixing

.1 On Site: Concrete shall only be made on the site with the approval of the Engineer.

.2 Ready-Mixed: Ready-mixed concrete shall be mixed and transported in accordance with CSA Standard CAN3-A23.1-M77.

2.12 Levelling Course

.1 Levelling course for fills of less than 50 mm shall be medium to coarse graded sand meeting the following gradation when tested to ASTM C136 and ASTM C117, and give a smooth curve without sharp breaks when plotted on semi-log grading chart:

Sieve Size (mm)	Percent Passing (by weight)
25.0	100
5.0	95 – 100
1.25	53 – 85
0.200	10 – 30
0.063	0 - 10

.2 The liquid limit shall not exceed 25 and the plasticity index shall not exceed 6 for the portion of material passing 0.400 mm sieve.

.3 The leveling course for fills of more than 50 mm shall consist of base aggregate meeting the requirements of this Specification.

.4 The leveling course shall be compacted to not less than 98% of the Standard Proctor Density for the material.

3.0 EXECUTION

3.1 Grade Preparation

.1 The prepared bed for the new sidewalks, curbs and gutters has been excavated in conjunction with the roadways excavation and has been filled with compacted granular base course material and geotextile filter fabric to the lines, grades and cross sections as indicated on the plans. The Contractor shall coordinate and schedule with the roadways contractor required. The Owner shall not be responsible for delays caused by the preparation of the bed of the new sidewalks, curbs and gutters.

.2 A layer of compacted clean leveling base course shall be used where required as a foundation material under concrete sidewalks, curbs and driveway crossings. The base on which the concrete will rest shall be thoroughly wetted immediately prior to placing the concrete and must not be frozen, muddy or have areas of water pondage.

.3 The subgrade elevation shall be finished to tolerances requiring 50 mm of leveling course materials on the subgrade when not extruded. The material shall be compacted to 98% Standard Proctor Density.

3.2 Forms

.1 Forms shall be of steel or wood of sufficient strength to resist the pressure of wet concrete, and the supply shall be sufficient to permit their remaining in place not less than 12 hours after concrete has been placed, or longer if the Engineer considers it necessary. The use of bent, twisted, battered or worn-out forms will not be permitted. Forms shall be held securely by approved methods to prevent movement and bulging when the concrete is placed. Forms will be checked for alignment and elevation by the Engineer before concrete is poured, and shall be cleaned and oiled before each use.

3.3 Reinforcement

.1 Where required, reinforcement shall be secured in the location shown on the drawings or as directed by the Engineer and shall be free from mill scale, grease and rust immediately prior to placing concrete. Reinforcement shall be drilled and dowelled into existing concrete at all joints.

3.4 Placement

.1 The concrete shall be placed as soon as possible after mixing, but not later than one hour after mixing has begun. Retempered concrete shall not be used. The concrete shall be transported by methods, which will prevent segregation and deposited on the subgrade so that as little handling as possible is required.

Concrete thickness shall be those shown on Standard Drawings. No payment will be made for concrete placed at thickness less than specified.

.2 Concrete shall be placed continuously until a complete section between expansion joints has been poured.

.3 The concrete shall be thoroughly consolidated against and along the faces of the forms. Hand spreading shall be done with shovels, not with rakes, in order that the concrete will not be segregated. Precautions should be taken to prevent overworking of the concrete.

.4 Mechanical Extruding Machines.

.1 If an extruding machine is used in constructing curbs, curb and gutter, sidewalk or combined curb and sidewalk, the material excavated to accommodate the machine shall be either stockpiled at a specified location or windrowed to the centre of the street with a minimal disruption to the traffic. After the installation of the concrete works the excavated material shall be replaced to the original street grade or the elevations designated by the Engineer and compacted to not less than 98% Standard Proctor Density. Backfill material required behind curbs or sidewalks shall be hauled in from surplus stockpiles or a location designated by the Engineer. Granular material which may have existed shall be replaced.

3.5 Appurtenances

.1 Appurtenances shall be located, examined for deficiencies and staked by the Contractor prior to work beginning on a particular section and any deficiencies noted must be reported to the Engineer immediately. Upon completion of a block of work, the Contractor shall relocate these structures and inspect them with the Engineer. Any damage, which may have occurred during, the concreting operations and deficiencies not previously reported to the Engineer, shall be repaired at the Contractor's expense. The Contractor shall schedule his work in such a manner as to not have more than seven days or 1500 m, whichever is greater, of work in progress at one time. This includes the entire process of preparing the subgrade for the concrete, to the final backfilling and cleaning up. All costs involved in using an extruding machine shall be included in the contract unit prices tendered for curb, curb and gutter, sidewalk and combined curb and sidewalk.

3.6 Finishing

.1 Surfaces shall be struck off and screeded to the slope, cross-section and elevation shown on the drawings and staked by the Engineer. The surface shall be consolidated and smoothed using a wood float. Light steel trowelling shall be used followed by a uniform brush finish. After brushing and before the concrete has taken its initial set, surfaces shall be edged at

all joints to prevent chipping of the concrete and where required edges rounded to the required radius. No patching will be allowed.

.2 Access crossing to lanes and private property shall be struck off and screeded to the required slope and cross-section.

3.7 Expansion and Contraction Joints

.1 The sidewalk shall be divided into 1.5 m sections by the use of tooled joints as detailed on the Standard Drawing. All curbing shall have a 25 mm deep tooled joint at 1.5 m intervals to coincide with joints placed in monolithic or combined sidewalks. Refer to the Standard Drawing. At the beginning and end of curb radii, an expansion joint shall be constructed.

3.8 Curing

.1 All concrete shall receive two applications of membrane curing compound. The first application is to be applied after the disappearance of the water sheen and the final finishing of the concrete. During hot, dry, windy days, the first application shall be applied immediately after final finishing and before all free water on the surface has evaporated. The second applications shall be made immediately at right angles to the first so that complete coverage on the surface is attained. Immediately after removal of the forms all exposed surfaces shall be thoroughly wetted with water and then sprayed with membrane curing compound. The membrane curing compound shall be applied in accordance with the manufacturer's instructions.

3.9 Cold Weather Requirements

.1 When the temperature of the surrounding atmosphere is at, or below 4°C, the aggregate and the mixing water shall be heated. The aggregate and mixing water shall have a temperature of not less than 4°C and be entirely free of frozen materials. The aggregate shall not be heated to more than 60°C, and the concrete when deposited in the forms shall have a temperature of not less than 10°C and not more than 38°C. The concrete shall be maintained at a minimum temperature of 10°C for not less than four days after placing.

3.10 Tolerances

.1 The finished surfaces of all concrete work shall be true to the required cross-section with a tolerance of plus or minus 3 mm from the required elevation and dimensions. Surface of curbs, gutters or sidewalks shall not show any depressions or bumps exceeding 3 mm under a straight edge 3 m long placed parallel to the curb or sidewalk. Concrete not meeting the requirements specified shall be removed to the nearest joint and replaced at the Contractor's expense.

3.11 Field Tests

.1 Tests shall be made of the concrete to ensure that it meets these specifications. Testing shall be done to conform to the following standard specifications:

Test	Current Issue of ASTM
Sampling of Fresh Concrete	C172
Test for Slump of Concrete	C143
Compression and Flexure Test	C31
Compressive Strength of Molded Concrete Cylinders	C39
Measurement of Air Content	C173 or C231

.2 Concrete: The services of an independent, qualified, materials testing laboratory shall be retained to perform the field and laboratory concrete tests. The Contractor shall be responsible for arranging for an paying the full cost of all control testing including sampling, transporting the samples for compression tests of the cylinders taken to the designated testing labs. The cost required for sampling and shipping of samples to the laboratory shall be included in the unit prices tendered for concrete work.

The cost of compression testing of concrete specimens in the laboratory will be paid for by the Owner.

The Owner shall appoint the laboratory to be used for concrete testing.

Copies of all test results shall be promptly forwarded to the Contractor, the Concrete Supplier and the Engineer.

.3 Sub-Grade Density: The Owner shall pay the cost of the sub-grade density control testing required to ensure performance of the Contract. Only tests that indicate that the density is at or above that specified will be paid for. The costs of any test which indicate the density does not meet or exceed the minimum specified will be deducted from the Contractor's Progress Certificate.

The Owner will appoint the laboratory to be used for quality control testing.

.4 Three concrete cylinders shall constitute one test and shall be made from the same batch or load. They shall be stored undisturbed on site for 24 hours, covered with a plastic sheet to prevent loss of moisture. They shall then be delivered to an approved testing laboratory for curing with one cylinder tested at seven days and the other two at twenty-eight days. A set of three cylinders shall be taken for every 100 m^3 of concrete poured or for each side of each block or portion thereof placed in one day, or as directed by the Engineer.

.5 When construction begins, the Engineer may take additional cylinders in order to establish a concrete strength pattern in the early stages of the project.

3.12 Sidewalk Ramps

.1 Sidewalk ramps shall be constructed as shown on the Standard Drawings at locations shown on the drawings or designated by the Engineer.

.2 The Contractor shall shape the subgrade to maintain specified concrete thickness and shall pour the ramps at the time of the sidewalk and curb construction.

3.13 Failure to Meet Strength Requirements

.1 The Owner reserves the right to reject any concrete whatsoever which does not meet all the specified requirements for the concrete.

.2 The Owner may, however, at the discretion of the Engineer, accept concrete which does not meet the specified strength requirements and, in such case, payment shall be made on the basis of a percentage scale for the concrete product represented by each test as follows:

<u>32.0 MPa Concrete:</u>

32.0 MPa and over	100% of the unit bid price
29.2 MPa to 32.0 MPa	90% of the unit bid price
26.5 MPa to 29.1 MPa	70% of the unit bid price

All concrete below 26.5 MPa will be rejected.

.3 Furthermore, the Owner reserves the right to reject any particular portion of a pour if there exists manifest evidence that this particular portion of the pour has a strength that is below the minimum acceptable strength required under this Section.

.4 If any concrete tested in accordance with this Specification fails to meet the specified strength, the Contractor may request coring of the concrete in question. When such coring is approved by the Engineer, arrangements shall be made by the Contractor, through the Engineer, to employ an independent, qualified testing service, all at the expense of the Contractor. The cores shall be taken and tested within seven days of the testing of the twenty-eight day cylinders representing the concrete in question. Three cores shall be taken for each strength test previously taken and there shall be no doubt that the cores taken and the cylinders under consideration represent the same batch of concrete. Cores shall be tested in accordance with the requirements of CSA A23.2-14C and the average strength of the cores as reported by the independent testing service shall constitute a test. When more than one core strength test is taken, the average of all the core strength tests shall represent the strength of the concrete in question.

.5 The foregoing procedure may be altered if the concrete in question was placed during weather conditions not suitable, in the opinion of the Contractor, to permit satisfactory curing. When 7 day test results indicate that the concrete is likely to be sub-standard or rejected, the Contractor will be notified and can either request to arrange coring at that time or can continue to provide curing for the remainder of the 28 day period. In the event that the Contractor chooses to take cores after 7 days, they shall be taken as described in the foregoing paragraph, transported to an approved laboratory, and cured for a period of time such that the total curing time in place in the structure, plus the curing time in the laboratory is equal to 28 days. The cores shall then be tested and reported as described in the foregoing paragraph.

.6 In cases where the concrete strength, as indicated by the cores, is higher than the strength based on the concrete cylinder results, the core results shall be used as the basis of acceptance and payment of the concrete. If the core strengths are lower than the strength from the concrete cylinder tests, the cylinder tests shall govern.

3.14 Construction Record Imprints

.1 Each block of sidewalk constructed shall be marked at each end with a suitable tool showing legibly the name of the Contractor and year of construction.

.2 Curb box locations are to be marked at right angles along the back of sidewalk. Imprint is to be 150 mm from the back of sidewalk and have initials C.C. Imprints shall be legible and supplied by the Contractor at his cost.

3.15 Protection

.1 Keep all animals and pedestrians off the newly constructed sidewalks or curb until completely set. The Contractor shall also be responsible for keeping all vehicles off the work for a period of 5 days after the concrete has been finished.

3.16 Backfilling

.1 Backfill along the backs of walks or curbs, to 50 mm below top of the concrete, within seven days of the placing of the concrete. The backfill shall be mechanically tamped in maximum lifts of 150 mm to a minimum density of 95% Standard Proctor Density, to a distance 300 mm from the back of the walk or curb. Granular material which may have existed shall be replaced.

3.17 Final Cleanup

.1 As the work progresses, the Contractor shall clean up the site and all areas in which work has been done shall be left in a neat and presentable

condition. All gutters and street drainage ditches which have been blocked as result of the Contractor's trenching operation shall be restored or repaired at the Contractor's expense.

.2 The Contractor shall, at his own expense, dispose of all surplus excavated material, organic soil, rock boulders and pieces of concrete and masonry, including those less than 0.1 m^3 in volume at an approved off-site disposal area.

3.18 Concrete Deterioration

.1 Concrete that shows surface scaling, deterioration or loss of cement or aggregate during the maintenance period will be rejected and require removal and replacement by the Contractor at no cost to the Owner.

END OF SECTION

1.0 GENERAL

1.1 Description

.1 The complete work under this trade shall be governed by the dictates of good practice in all details of materials and methods even if not minutely specified. The work shall be properly coordinated with the requirements of other units of work specified in other sections.

.2 This section specifies the requirements for T.V. inspection of sewer mains which shall consist of cleaning the mains, pulling a closed circuit T.V. (CCTV) camera through the mains and recording the condition of the inside periphery, providing traffic control around the work area and submission of recordings and reports. The work shall be completed within the limits of the contract documents.

.3 The Contractor shall obtain a current Contractor's License prior to commencement of the Contract.

1.2 Related Work

.1	Sanitary Sewers	Section 02537
.2	Storm Drainage Pipe and Fittings	Section 02635

1.3 Quality Control

.1 Provide a minimum one operator on site at all times with each inspection unit who holds a valid certificate from the National Association of Sewer Service Companies (NASSCO) in the Pipeline Assessment and Certification Program (PACP). Ensure each operator is fully trained in all aspects of sewer inspection and capable of making accurate observations and recording all conditions that may be encountered in the sewers.

.1 Perform inspection work only when PACP certified operators are on site.

.2 Submit a valid copy of the PACP Certificate for each operator to the Engineer at least 5 working days before starting the inspection work.

.2 The Work shall be comply with the standards of the National Association of Sewer Servicing Companies (NASSCO) and the Pipeline Assessment Certification Program (PACP).

.3 The Contractor shall be responsible for all works performed by the subcontractor, for traffic control and any other related work incidental to the completion of television inspection.

2.0 EQUIPMENT

2.1 General

.1 All tools, machinery, and equipment used in handling materials and executing any part of the work shall be subject to the approval of the Engineer. All such equipment shall be maintained in efficient working order and where any of the machinery or equipment is found to be unsatisfactory, it shall be improved or replaced by the Contractor to the satisfaction of the Engineer.

2.2 Inspection Unit

.1 Sewer and manhole inspection unit is to consist of a self-contained vehicle with separate areas for viewing and storage complete with the following equipment as a minimum.

.1 Cellular telephone and suitable communication system linking all crew members.

.2 Fans and blowers capable of removing fog that may be present in sewers at the time of the inspection.

.3 Video cameras, lighting, cables and power source.

.4 Video monitor, videocassette recorder and digital video recorder.

.5 Computer system with video capture card or dedicated unit and other related equipment.

2.3 CCTV Video Inspection Equipment

.1 Video inspection is to consist of the following.

.1 Video camera capable of panning 360° and tilting 270° with optimum picture quality provided by focus and iris adjustment. Focal range to be adjustable from 100 millimetres to infinity.

.2 Adjustable light source to allow an even distribution of light around the sewer or manhole perimeter without loss of contrast, flare out of picture, or shadowing. Ensure lighting illuminates the sewer or manhole ahead of the camera to be able to determine general condition, features and upcoming defects.

.3 Video overlay equipment capable of superimposing a minimum of 15 lines with up to 30 characters per line of alphanumeric information onto the video recording.

2.4 High Velocity Cleaning Equipment

.1 High velocity cleaning equipment is to be capable of producing a minimum flow rate of 4.1 litres per second at 13,800 kPa of pressure complete with the following.

.1 Selection of nozzles capable of effectively scouring and removing sediment from the sewer pipe wall and transporting debris in all sizes of the sewers to be cleaned.

.2 Water tank.

.3 Auxiliary engines.

.4 Pumps.

.5 Hydraulically driven hose reel with a wash down gun for cleaning manholes.

.6 Approved backflow prevention device for filling water tank from a hydrant.

.2 The equipment shall be of sufficient size, capacity, and condition to endure continuous operation in 150 mm through 1,200 mm diameter pipe.

2.5 Hazard Lights

.1 The mobile van, sewer flusher and service vehicles shall be equipped with rotating amber lights of sufficient number and height for the amber lights to be visible from all directions of approach.

2.6 Heating System

.1 A heating system or suitable alternative is required to prevent fogging of the lines during cold weather inspection.

2.7 Distance Meter

.1 The meter shall record distance travelled by the camera to 0.1 metres with an accuracy of plus or minus 0.2 percent.

.2 It must be connected to the video equipment in such a manner that the distance is automatically imprinted onto the video.

3.0 EXECUTION

3.1 General

.1 The Contractor shall inform the Public Works Department one week prior to the commencement of the Contract.

.2 The Public Works Department shall expose all manholes, which the Contractor has been unable to locate.

.3 The Public Works Department shall provide any bypass pumping, if required, at no cost to the Contractor.

.4 The Engineer may require that work on busy streets be done at off peak hours.

.5 The Contractor shall schedule the work so that the flows in the storm sewer trunks are at a minimum to maximize the information obtained by CCTV inspection.

3.2 Cleaning

.1 A high pressure sewer flusher and vacuum shall be used to clean the sewer. Cleaning shall be sufficient to produce recordings which are unobstructed by material in the sewer main.

.2 Start the cleaning operation with the upstream sewers in the system and proceed downstream with the direction of flow. Clean all contributing upstream sewers before proceeding with cleaning downstream sewers.

.3 Clean sewers and manholes completely of debris including sludge, dirt, sand, gravel, rocks, bricks and other solid and semi-solid materials.

.4 Advise the Engineer immediately when pipe material or backfill material is observed during the cleaning of a sewer. The Engineer will direct one of the following operations be performed.

.1 Complete or attempt to complete cleaning of the sewer.

.2 Suspend cleaning operations and inspect the sewer.

.3 Simultaneously clean and inspect the sewer.

.5 Continuously remove debris from the downstream manhole during sewer cleaning. Do not allow debris to be passed into the downstream sewer unless approved by the Engineer.

.6 The waste material dislodged during flushing shall be intercepted, decanted, and delivered to the City of Prince Albert Waste Water Treatment Plant sewage receiving station. The solids are to be disposed of at the at the City of Prince Albert Landfill.

.7 Take necessary precautions to ensure that no flooding of public or private property occurs during sewer and manhole cleaning. Reduce pressure of cleaning equipment as directed by the Engineer.

3.3 Access to Hydrants

.1 The Public Works Department shall designate a hydrant from which the Contractor can obtain water as required for sewer cleaning. The Public Works Department shall check the condition of the hydrant before commencement of the Contract and upon completion of the Contract. The hydrant shall only be operated by workers familiar with hydrant operation. Any damage to the hydrant or water mains due to the improper operation shall be repaired by City Forces. The cost of such repairs shall be deducted from payment for other work completed by the Contractor.

3.4 Pulling Camera

.1 Camera inspection is to be performed on one sewer section at a time, pulling the camera through the pipe in the direction of flow. Pulling against the flow will be permitted where an obstruction requires a reverse set up. The distance meter is to be zeroed at the beginning of each section of main televised. A sewer section is defined as the length of pipe between adjacent manholes.

.1 A sewer flusher may be required for pulling the camera. It is mandatory that a flusher be used for pulling where there are; high flows, dips and flat grades that may accumulate material that will obscure the camera lens and where there is light debris in the line. The flusher shall be used to lower flow levels and to move minor deposits of sludge and debris and clean the camera lens to ensure total viewing of the inside periphery of the pipe.

.2 Where the condition of the pipe permits, the method of pulling is optional and may be accomplished by directly pulling with a flusher or by prestringing the mains with a flusher and using a winch to pull the camera. The Engineer shall be advised of all mains which are prestrung, the string lines shall be taut and tied to manhole steps.

.3 Communication between the person pulling the camera and the person monitoring its progress must be adequate to quickly stop the camera if necessary to prevent jamming of the camera or damage to the sewer.

.4 Camera travelling speeds in the pipelines shall be as follows:

.1 0.10 m/s for diameters less than 200 mm

.2 0.15 m/s for diameters 200 mm to 310 mm

.3 0.20 m/s for diameters exceeding 310 mm

.5 The view of the camera is to be transmitted to a suitably sized monitor located in the mobile van, allowing continuous monitoring and recording of the progress of the colour T.V. camera. During recording a log is to be kept identifying the location of all defects and lateral connections. Still recordings shall be made of defects in the sewer.

3.5 Recording Defects in the Sewer

.1 The camera shall be stopped for 10 to 15 seconds to record defects. Defects shall include open and/or offset joints, cracked pipe, deflected or collapsed pipe, missing pipe segments, root infiltration, groundwater infiltration, pipe misalignment, corrosion and erosion.

.2 A separate log shall be kept of service connections with comments of condition.

.3 Photographs shall be taken as directed by the Engineer or at the discretion of the television scanning operator. A minimum of one photo per manhole reach is required plus one of every deficiency.

.4 Manhole identity shall be noted clearly as indicated on the drawings.

3.6 Recording Resolution

.1 Provide a minimum of 250 lines of resolution around the periphery of the picture for digital MPEG video playback.

.2 Confirm recording resolution if requested by the Engineer by recording a RETMA type resolution chart as follows.

.1 Set up camera and accessories for the recording to simulate an actual inspection i.e. video signal routed through the cable reel, video overlay system, etc.

.2 Record camera being introduced and reaching its final position for the test.

.3 Resolution chart is to fill the monitor screen;

.4 Resolution chart is to be illuminated evenly and uniformly without reflection and illumination source is to accurately simulate the lighting used in the sewer inspections.

.5 Record test for a minimum of 30 seconds.

.6 Identify the camera on the recording;

.7 Perform the test at the start of a tape or digital recording.

3.7 Screen Information on Video Recordings

.1 Clearly display in legible letters for 30 seconds on the monitor and video recording at the start of each inspection a video overlay system containing the following alpha-numeric information. Enter this information before beginning the inspection utilizing City GIS identifiers:

line 1:	Contract ID	e.g. 10-0061
line 2:	Street Name	e.g. MARQUIS RD
line 3:	Start MH to Finish MH ID	e.g. 2712 to 2711
line 4:	Pipe ID	e.g. 112967
line 4:	Sewer Size (diameter)	e.g. 2100 mm
line 8:	Contractor Name	e.g. XYZ LTD
line 9:	Date and Time of Inspection	e.g. 03/17/2014-14:15
line 10:	Direction of Inspection	e.g. WITH FLOW
line 11:	Start MH to Finish MH Steel Tape Measured Distance	e.g. 119.5 m
line 12:	Cable Calibration Distance	e.g. 1.5 m

.2 Clearly display in legible letters on the periphery of the monitor and video recording the following information during the inspection. Arrange the information to minimize interference with the inspection image:

bottom centre:	automatic update of the camera's distance from the centre of the start manhole	e.g. 15.3 m
top centre:	Street Name	e.g. MARQUIS RD

.3 Use the following naming convention when entering street and place names in sewer and manhole inspection records.

Term	Naming Convention	Term	Naming Convention
Street	ST	First	1ST
Avenue	AV	Second	2ND
Boulevard	BV	Third	3RD
Road	RD	Fourth	4TH
Bay	BY	Fifth	5TH
Crescent	CR	Sixth	6TH
Lane	LN	North of	N OF
Drive	DR	South of	S OF
Place	PL	East of	E OF
Way	WY	West of	W OF
Cove	CV	North Property Line	NPL
Highway	HW	South Property Line	SPL
		East Property Line	EPL
		West Property Line	WPL
		Centre Line	CL

.4 Use uppercase lettering for all street/place naming and location descriptions. Reference street locations relative to the direction of flow where possible. Reference sewer location using street name and start/end manhole locations as follows:

.1 Street/Place

Enter the street name, followed by a Naming Convention, if required, in brackets noting its location within the right of way, e.g. CENTRAL AV (N OF CL).

.2 Location/Description

Enter manhole number followed by “TO”, followed by manhole number, e.g. 2712 TO 2711.

3.8 Analog Format Video Recordings

.1 Analog format video recordings on VHS tape will not be acceptable.

3.9 Digital Format Video Recordings

.1 Capture the inspections in digital format in colour from the live video source on digital versatile discs, DVD-R format to the following minimum requirements. Adjust requirements as required to achieve 250 lines of resolution specified in clause 3.9 of this specification.

.1 XSVD MPEG2 format.
.2 Picture Size: NTSC 352 x 240 @ 29.97 frames per second.
.3 Data/Bit Rate: MPEG-2 @ 3.0 M-bits/sec.

.2 Obtain digital video inspections from first generation recordings using video capture equipment capable of capture with no frame loss.

.3 Digital video inspections can to be saved to a hard-drive and later transferred to recordable digital versatile disc, DVD-R media for submission.

.4 Provide file names containing up to a maximum of 64 characters for each digital video file in accordance with the following.

.1 STREET NAME-START MH TO END MH-DATE.MPG

Eg. CENTRAL AV –2712 TO 2711-17-Mar-14.MPG

.5 Submit digital files of the original video inspections to the Engineer on recordable digital versatile discs, DVD-R format in 5.2 millimetre slim-line clear “jewel cases” capable of displaying a summary sheet containing the information listed in this specification.

.6 Submit one complete single digital file for each inspection. Ensure the entire inspection of a particular sewer or manhole is contained on the same DVD-R disc. Record reverse set-up inspections of a sewer immediately after the original inspection where possible.

3.10 Reverse Set - Up Inspection

.1 Perform a reverse set-up inspection when a blockage in the sewer prevents completion of the inspection from the upstream manhole. Move the equipment to the downstream manhole and attempt to complete the inspection of the entire sewer to the upstream manhole.

3.11 Excavation to Remove Camera

.1 Advise the Engineer immediately if equipment becomes stuck in a sewer.

.2 The City of Prince Albert Public Works Department shall excavate, if required to free lodged camera equipment at no cost to the contractor. The Contractor shall bare any costs which arise for the Contractor due to delays

incurred while the equipment is retrieved. Camera equipment repairs caused by lodging of camera shall be borne by the Contractor.

.3 Repeat cleaning of the sewer to remove sediment and debris that may have entered the sewer during removal of the equipment.

4.0 REPORTING

4.1 General

.1 A final typewritten report with corresponding photograph secured properly and referenced to the text along with a copy of the video tape shall be submitted within two weeks after completion of inspection.

.2 Acceptance of the sewer video inspection shall be based on the City's review of all submitted reports and materials.

.3 The Contractor shall inform the Public Works Department of any sewers that could not be televised and shall state the reasons why they could not be televised.

4.2 Deliverables

.1 The Contractor shall submit a formal Multi-Sensor Inspection Report, in paper and digital (PDF) formats, that summarizes all inspection activities and includes all inspection data in their raw format, along with any software required to view or utilize the raw data.

.2 The Multi-Sensor Inspection Report shall include the following information:

.1 CCTV Video inspection:

a) Inspection video with standard video and audio overlays in XSVD MPEG-2 format.

b) Still images captured from the inspection video in JPEG or BMP format.

.3 The location, nature and extent of all defects in the sewer shall be recorded in the inspection report.

5.0 MEASUREMENT AND PAYMENT

5.1 General Requirements

.1 General requirements will be paid as a percentage of the lump sum bid in accordance with the overall completion of the work as it is accepted. This item includes mobilization, demobilization and any other contract requirements.

5.2 CCTV Video Inspections

.1 In-Line inspections will be measured on a length basis for each size and type of sewer and paid for at the Contract Unit Price with no distinction made between technologies employed. The length to be paid for will be the total length of sewer inspected by CCTV including traffic control, cleaning, inspection, coding and submission of deliverables in accordance with this specification as accepted, measured and reviewed by the Engineer.

.2 75% of the in-line inspection payment will be made upon satisfactory completion of the cleaning and CCTV work. The remaining 25% of the payment will be made upon final acceptance of the cleaning, in-line inspection work and upon acceptance of the project deliverables as determined by the review of the corresponding inspection and deliverables by the Engineer.

.3 Measurement will be made horizontally at grade above the centreline of the sewer from centre to centre of manholes or from center of the start manhole to the point of abandoned inspection as confirmed by tape measurement.

.4 Full payment will not be made until the required report submissions are accepted by the Engineer.

.5 Payment will not be made for inspections re-performed where the Engineer has determined the requirements of the specification have not been satisfied.

5.3 Inspection Coding, Reports and Deliverables

.1 Payment for inspection coding, reports and deliverables shall be included with the CCTV Video Inspection.

.2 Correction and re-submission of non-compliant submissions will be at Contractor’s expense.

5.4 Reverse Set Up-Inspection

.1 There will be no separate payment made for reverse set-up inspections.

5.5 Removal of Equipment that Becomes Stuck in a Sewer

.1 No payment extra payment or extra time will be given for equipment retrieval.

5.6 New Construction

.1 Cost of capturing camera recordings for new pipe installations shall be included in the unit price per the Contract as specified.

END OF SECTION

1.0 GENERAL

1.1 Related Work

.1 Coordinate the requirements of this section with all other sections, including but not limited to:

.1 Section 02212 Topsoil

.2 Section 02933 Seeding

.3 Section02950 Plant Material

.4 Section 02998 Landscape Maintenance

1.2 Quality Control

.1 **City of Prince Albert, Public Works** to approve irrigation materials and construction for Work.

.1 Submit the following:

.1 Proof of Irrigation Experience (Min. 3 years).

.2 Butt Fusion and Backflow Technician Certificates.

.3 Shop Drawings (3 sets).

.4 Copy of Plumbing Permit.

.5 Copy of Electrical Permit.

.6 As-Built / Project Record Drawing (Mark-up Print), and

.7 Operation and Maintenance Manuals (1 set).

.2 Irrigation Contractor / Sub-contractor must have three years experience in installing irrigation systems in commercial or industrial (50mm pipe or larger) applications.

.3 Backflow preventer testing if required, performed by qualified backflow technicians with valid registered certificate. Butt fusion Work if required, performed by qualified butt fusion technicians with valid registered certificate.

.4 120 Volt electrical and water service box installed by qualified journeyman.

1.3 Measurement and Payment

.1 The Lump Sum and Unit prices submitted are for supply of all labour and equipment and materials as specified or required to complete the Work as intended.

.2 The prices submitted to be full compensation for supplying (if applicable), hauling, installing, cleaning and placing in service the Work as specified and detailed, together with all incidental Work.

.3 Measurement for Payments to be calculated on the basis of a percentage of completion of the Lump Sum and Unit prices for the applicable item of Work or at Unit rates of Force Account Rates as entered on the Tender Form.

.4 Specified items of irrigation Work (lump sum / each / lin. m.) includes all associated costs for that item.

.5 Excavation or trenching of materials which cannot be excavated by normal mechanical excavation means will be an addition to the Contract, as agreed.

1.4 Inspections

.1 Notify City of Prince Albert, Public Works for inspection of:

- Main Service Connection
- Layout of Components
- Main Line low points
- Main line Butt fusion's
- Trenching Depth Laterals
- Swing Joints
- Lateral Lines Flush (Zone)
- Main Line Final Test (Hydrostatic to 90psi)
- Service Connection Flush Trenching depth Mainline
- Main Line Flush
- Main line Primary Test (City Pressure)
- Details (Number/Sheet)
- Saddle Hole Cuts
- Wire tags
- Winterization (Blow-out)
- Spring Start Up

1.5 Testing

.1 Primary Test: After flushing, test main line with main line components installed at City water pressure prior to covering main line. Some joints may be covered to anchor main line.

.1 Testing consists of main line services connection from street curb box - service box components and all fused joints and mechanical connections inclusive of main line installation.

.2 Test duration is one hour after closure of main curb box supply.

.2 Final Test: Upon completion of irrigation system, hydrostatically test main line system to 620 kPa (90 psi) with all components installed for a duration of one hour.

.1 Check all related components for proper operation.

1.6 Shop Drawings

.1 Before fabrication and installation of any materials or equipment submit three (3) sets of shop drawings and data sheets covering all items of equipment furnished and intended for installation.

.2 Insert shop drawings in duo tang cover with tab inserts for each item and include all information necessary to indicate the following:

.1 Dimensional data for roughing-in and installation.

.2 Technical data to ensure that equipment meets requirements of drawings and specifications.

.3 Wiring, piping and service connection data for all trades.

.4 Electric valves complete with voltage and ampere ratings.

.5 Job name, irrigation contractor, supplier or agent, manufacturer, consultant.

.3 Shop drawings are required for the following irrigation components:

- Backflow preventer
- Clamps
- Controller
- Gauges
- Irrigation heads
- Pump
- Saddles
- Wire
- Polyethylene & PVC pipe
- Rain Sensor
- Pressure reducing valves
- Valve electrical and mechanical
- Pressure switch
- Water service valve & box
- Strainer
- Valve boxes

.4 Consultant review and acceptance of shop, data and layout shop, data and layout shop drawings does not relieve the Contractor of full responsibility for performance of the work as specified and detailed.

1.7 As-Built Drawings

.1 Keep one set of drawings, one set of shop drawings and specifications on job site for the sole purpose of recording any changes to Work.

.1 Update drawing set daily as Work progresses.

.2 Mark up print with changes done to the project as a “Project Record Copy”.

.2 Submit irrigation “Project Record Copy” to **City of Prince Albert, Public Works** for revision to “As-Built” status to reflect total irrigation system installed. Minimum requirements for acceptable submission include but are not limited to the following:

.1 Legend to be revised to indicate head type, flow rate, nozzle size, controller type, electric valve type and any other changes.

.2 Revise wiring schematic to reflect actual installation.

.3 Water service connection:

- Show location of service box
- Add dimensions from service box to curb box valve and main drain.

.4 Main line:

- Add sufficient dimensions to identify its location.
- Dimension tie points connections for main branch lines.
- Dimension location of isolation valves.
- Dimension starts and ends of major bends.

.5 Dimension location of electric valves.

.6 Dimension location of drain valves.

.7 Dimension location of electric splices.

.8 Dimension location of buried wires (i.e. to controller, electrical power supply).

.9 Revise lateral lines and heads to show installed locations.

.10 Delete from drawing any symbols, lines, or contract limit that has been abandoned during construction.

.11 Any existing operational lines on drawings are to remain as part of mark-up print.

.12 Indicate colours of all wires.

.13 Incorporate changes made to the contract by addendum and by change order.

.14 Submit ‘As built’ drawings prior to CCC site inspection.

1.8 Operating and Maintenance Manuals

.1 Submit one (1) set of irrigation operation and maintenance manuals for each piece of equipment and system that are supplied and installed.

.2 Place documents in black hard cover three-ring binder with clear plastic pocket on outer spine inscribed with:

.1 Operating and Maintenance Manual -Project Name and Year

.3 Content for each binder arranged according to following index system.

.1 Page One: Title page with binder title, project name and location, project date, Owner, Contractor and Designers, in clear plastic cover.

.2 Page Two: Operating and Maintenance Manual index in clear plastic cover.

.3 Tab 1: Main line and back flow test reports. Letter of Warranty

.4 Tab 2: Include list of suppliers addresses and phone numbers.

.5 Tab 3: Controller information: Manufacturer Data to describe its operation, performance, maintenance requirements, parts list and trouble shooting data.

.6 Tab 4: Irrigation Heads: Manufacturer Data to describe its operation, performance, maintenance requirements and part list.

.7 Tab 5: Electric valves: Manufacturer data to describe its operation, performance, maintenance requirements and parts list.

.8 Tab 6: Backflow preventer valve: Manufacturer data describing field test procedure, installation instructions, and trouble shooting guide.

.9 Tab 7: Remainder of components used for project.

.10 Tab 8: Clear plastic cover (for final As-Built Drawing).

1.9 Winterization

.1 Winterization of irrigation system as follows:

.1 Turn off main curb stop.

.2 Open main drain next to the curb stop.

.3 Open water meter drain.

.4 Open Backflow preventer.

.5 Open and activate quick coupler at end of main line.

.6 To blow out main line manually activate electric valve furthest downstream on the main or valves in low area. Leave zone open until mainline is blown dry.

.7 Hook up an air compressor (a minimum size of 375 CFM) to 50 mm ball valve downstream of all service box components. Set compressor pressure regulator at 585 kPa (85 psi). Minimum 50mm hose from compressor.

.8 Install pressure gauge downstream on main line quick coupler.

.9 Blow out system, with minimum of 206 kPa (30 psi) and maximum of 520 kPa (75 psi).

.10 Visually inspect quick coupler activated in step 5. Remove key from quick coupler when discharge water begins misting . Activate zones manually in sequence, working back to main source. Deactivate when all water is discharged. Continue operation until zones have been blown dry. Insure all quick coupler lines have been blown dry.

.11 Run system through timer to complete final blow-out.

.12 Leave drain open.

.13 Check drains at low points on main line. Leave in closed position.

.14 Close street side main gate valve in service box. Secure this valve. Tag and date blow-out. Lock service box.

1.10 Spring Start-Up

.1 Spring start-up of irrigation system as follows:

.1 Connect blow off hose to ball valve or quick coupler, street side of main shut off valve in service box.

.2 Close drain cocks on backflow preventer assembly and water meter.

.3 Close furthest gate valve down stream on backflow preventer assembly in service box.

.4 Check to make sure all drains along main line are closed.

.5 Open and activate quick coupler at end of main line.

.6 Manually activate electric valve furthest down stream on main line.

.7 Manually activate electric valve in vicinity of service box.

.8 Close main drain on service supply to service box.

.9 Open curb stop valve very slowly to charge line between street service and service box.

.10 Remove blow off hose in sequence .

.1 Check main drain with stethoscope to confirm its holdings.

.11 Open gate valves and throttle to maintain and not exceed a flow of 5.0 l/s (80 G.P.M.) until main line is fully charged.

.12 Close valves in sequence .5, .6, .7.

.1 Check with stethoscope in valve box to confirm main line is holding. Alternately, check dial on meter.

.2 Open valves in service box fully if main line is holding.

.13 Operate each electric valve manually and adjust all equipment for a smooth trouble free operation of system.

.14 Check controller operation. Leave in off position.

.15 Close main gate valve in service Box, the one closest to street side. Secure this valve Tag and date - check out "Lock Service Box ".

1.11 Existing Water Distribution System

.1 Notify **City of Prince Albert, Public Works** irrigation maintenance 24 hours prior to shutting down an existing irrigation system.

.2 Existing water distribution system on irrigation site can be turned off when working on new main line.

.1 Identify in service box with a tag attached to valve that system was locked and closed, provide contact name and phone number.

.2 Close isolation valve and install lock and chain.

.3 Integrate new installation with existing system to function as one installation.

1.12 Repairs (During Warranty)

.1 Contractor to correct soil depressions and defects or misalignment of any part of the Work caused by settlement of bedding or backfill material within warranty period.

.2 Repairs of an emergency nature may be required to protect property or permit operation of the Work with Contractor notified by phone and follow up letter.

.1 Make repairs within twenty-four (24) hours otherwise repairs arranged by **City of Prince Albert, Public Works**, are at Contractors expense.

.2 Notification of required non-critical repairs in writing only.

2.0 PRODUCTS

2.1 Pipe & Fittings

.1 Lateral lines: 50 mm in diameter and smaller use low density polyethylene pipe conforming to CSA B137.1 Series 75. Use schedule 40 PVC Type 1 elbows, tees, coupling, bushings, plugs and unions conforming to ASTM D-2464.

.2 Main lines: 75 mm diameter and larger or pipe over 70 psi, use SDR17 high density polyethylene pipe conforming to ASTM F714-85 for 690 kPa rated pipe. Require manufacturer pre-fused socket weld fittings.

.3 Polyvinyl chloride (PVC) nipples are Schedule 80 Type I to ASTM D-2609.

.4 Steel or galvanized steel pipe and fittings are not allowed where these pipes are buried.

2.2 Clamps

.1 Global Fasteners or approved equal stainless steel pipe clamps with stainless steel screws. Welded backing on screw housing. Crimp clamps not acceptable.

2.3 Sleeves

.1 Use PVC pipe of any grade two nominal pipe sizes larger than pipe required for that portion of system.

.2 Sleeve for power feed at the controller is 50mm (2") PVC sceptre conduit c/w 50 mm (2") PVC sceptre conduit 900 bends (6 times the pipe diameter).

2.4 Wiring

.1 Identify control wires individually with heat shrink and acid pen method in all valve and splice boxes.

.2 All wires are direct burial CSA approved TWU 40 wire of a different colour than 115 volt service to controller.

.1 All wires (tracer, common, spare and control) are #12 wire.

.3 Colours:

.1 Tracer wire is Green. Common wire is white. Spare wire is blue.

.2 Control wires can be any colour except green, white or blue.

.3 Wires to be one continual colour.

.4 Wire each valve individually back to controller. Use DBR connectors for #12 wire. Manual valves shall be supplied with control wire to allow for future upgrade.

2.5 Manual Valves

.1 Ball valves:

- 50 mm and smaller use bronze body, screwed ends, full port, 1380 kPa
- W.O.G. with chromium plated bronze ball and teflon seat. Use Newman Hatterly
- 1969F Kitz #58, Crane #9322 or TOYO 5044A..2.

.2 Gate valves:

- 50 mm and smaller use bronze, screwed ends, internal seats, 1380 kPa
- W.O.G. Gate valve with solid wedge disc and non-rising stem. Use Newman Hatterly
- 150's,Kitz #40, Crane #438 or Red and white #206.

.3 Gate valve:

- 75 mm and larger use iron body, flanged ends, 1380 kPa
- W.O.G. gate valve with bronze trim and non-rising stem. Use Newman Hatterly
- 150's, Kitz #75, Crane #461 or Red and white #415A.

2.6 Valve Boxes

.1 Prefabricated Carson #1220-12, 1419-12 and 910 heavy duty plastic valve boxes green in colour or approved equal and complete with locking cover.

.1 Install 316 stainless steel hex head bolt (3/8" x 2.5") through lid into manufacturer's pre-tapped box body.

.2 Identify valve box lids as follows:

.1 Manual valve Controller # - Zone # (i.e. MV-4)

.2 Quick coupler QC-# (i.e. QC-5)

.3 Drain valve DV-#

.4 Blow out valve BV-#

.5 Splice box SB-#

.6 Isolation valve IV-#

2.7 Service Boxes

.1 Prefabricated Carson #2436 heavy duty plastic valve boxes green in colour or approved equal and complete with locking cover.

.1 Install 316 stainless steel hex head bolt (3/8" x 2.5") through lid into manufacturer's pre-tapped box body.

2.8 Crushed Rock

.1 Use approved 25 mm nominal size washed crushed drainage rock at valve boxes and meter pit. **City of Prince Albert, Public Works** to provide name of supplier.

2.9 Saddles

.1 Cal-AM series 4400 saddles for main line pipe 75mm and larger or approved equal.

.1 Install 4x2 Rowbar or Ford brass saddle in service boxes. 45 lbs maximum torque on bolts.

.2 Use heavy brass for lateral pipe saddles. Size as required. Do not use saddles on pipe size 25mm and smaller.

2.10 Irrigation Heads - Rotors

.1 Institutional quality pop-up grey water sprinkler heads gear driven, low angle and standard angle nozzles, part circle forty degrees to three hundred and sixty degrees arc, heavy duty retracting spring, matched precipitation, 100 mm pop-up, compatible with different nozzles and fully adjustable to allow for field adjustment.

.1 Use Hunter I-20 Ultra and Hunter I-25 Heaps

.2 Sprinkler head equipped with built in check valve, rubber cover, and filter screen and grey water compatible.

.3 Sprinkler head body and riser constructed of non-corrosive heavy duty ABS plastic.

.4 Rotors require a five (5) year unconditional non-prorated manufacturer warranty.

2.11 Irrigation Heads – Sprays and Bubblers

.1 Institutional quality pop-up spray heads, 100 mm pop up, pressure regulating, check valve and stainless steel spring.

.1 Hunter Institutional series.

.2 Spray heads require a five (5) year unconditional non-prorated manufacturer warranty.

2.12 Pressure Gauge

.1 65 mm diameter glycerine gauge (pressure rated to 850 kPa minimum), filled in nylon case, bronze internal components, geared brass movement, extruded brass socket 3% full scale accuracy.

.1 Use brass ball valve on pressure gauge taps meeting or exceeding valve pressure rating specified for the system.

2.13 Back Flow Preventer

.1 Wilkens Zurn Model 350 for 100mm size. Wilkens 950xl for 25 - 50mm sizes.

.2 Conbraco Model DC for 100mm size. Conbraco 40-100 series for 25-50mm sizes.

.3 Watts 709-NRS for 100mm size. Watts 007M2-QT for 50mm size.

.4 Back flow preventer valves are cast iron, internally epoxy coated, cast iron bonnet, spring

.1 Loaded poppet type check, with reversible seat discs and bronze fitted non-rising stem and nut. Valve assembly rated to 1203 kPa (175 PSI) water working pressure and water temperature from 00C (320F) to 460C (1400F). Meet requirements of ASSE Standard 1015, AWWA Standard C506-78, and USC for cross connection control and hydraulic research latest edition.

.5 Back flow preventer valves supplied with ball type drain valves mounted at the base of each check valve.

3.0 EXECUTION

3.1 Laying Out Work

.1 Establish and maintain line and grade controls using appropriate survey personnel and equipment.

.1 Layout of all Work and its accuracy is Contractor's responsibility.

.2 Changes to the irrigation layout or design must be approved before changes are implemented.

.2 Stake locations of sprinkler heads and notify **Consultant** of any deficiencies that may affect performance of the irrigation system so that adjustments may be made.

3.2 Flushing (Main Line and Lateral Lines)

.1 Flush main line between City of Prince Albert water main and service box water meter before water meter is installed.

.2 Flush main line prior to activating system.

.3 Flush lateral lines prior to installing end head on line. Retain full line size with pipe extended above ground level.

.1 Removing end head is not acceptable.

.4 **City of Prince Albert, Public Works** to observe flushing and requires 24 hours' notice.

3.3 Excavation

.1 Notify utility and other underground service companies prior to undertaking Work.

.1 Notify **Consultant** of underground utilities and services including power, gas, telephones cable, traffic lights and others and have locations staked prior to commencing excavations.

.2 Trench 120 volt service for controller and park lights, pipes and control wiring. Excavation is unclassified and includes materials encountered except which cannot be excavated by normal mechanical excavation means.

.3 Minimum and maximum depth of cover over lateral lines and main lines:

.1 Main Lines pipe sizes 450mm to 550mm.

.2 Lateral Lines pipe sizes 400mm to 500mm.

.4 Backfill and tamp over excavated trenches to provide compacted bearing for pipe.

.5 Remove from backfill material rocks, stones and other unsuitable substances that could damage pipe or create unusual settling problems. Backfill in 150mm layers and tamp each layer to prevent excessive settling with mechanical device.

.6 Equip chain trenchers with a crumber, or manually clean trenches of loose material before laying pipe.

.7 Backfill mainline trench within 72 hours of excavation.

.8 Repair all concrete and asphalt damaged in the course of this contract.

.9 Backfill trenches containing pipe when pipe is cool avoiding excessive stress and heaving of pipe due to expansion. All trenches must be tamped with a mechanical tamper.

.10 Install PVC sleeves where electrical wires and main line pass under roads or concrete walks. Sleeves two nominal pipe sizes larger than water pipe. No sleeve smaller than 100mm (4") nominal. Extend sleeve a minimum 300mm beyond edge of surfaces. Install 50 mm sleeve for wire only where it passes under asphalt walks. No butt fusions on main line where it passes under asphalt walk.

.11 Minimum width of trenches for main pipes to be 150mm (6") wider than nominal size of the pipe in the trench (i.e. 100 mm (4") pipe requires 200 mm (10") trench width etc.)

.12 Where trenches cross areas that are to be re-seeded or sodded the backfill trench must be re-compacted and re-seeded using a seed mixture that matches existing. After trench has been backfilled and re-compacted, remove trenching debris from grass on each side of the trench by hand raking or other suitable means. Water trench area until turf is established and accepted to specification standard. Repair any trench settling during warranty period. Do not trench across pathways for lateral lines.

.13 Backfill pits for valve boxes, quick couplers, curb valves and isolation valves with 25 mm crushed rock from undisturbed soil to required elevation.

3.4 Water Service Connection and Service Box

.1 Install water service connection in accordance with Section 02315 – Trenching, Backfilling and Compaction for Utilities, Section 02510 – Water Distribution and Section 02539 Building Services.

.2 Backfill around water service box evenly with 150 mm lifts.

.3 Install Irrigation Service Box Marking Post.

3.5 Backflow Preventer

.1 Install and field test the back flow preventer to manufacturer's recommendation and submit test result to **City of Prince Albert, Public Works**. Installation to be done with approved, qualified personnel only.

3.6 Installation of Pipes

.1 Install pipes and fittings in accordance with manufacturer's instructions and proceed from point of supply connection. Install concrete thrust blocks at directional changes in pipelines in accordance with pipe manufacturer's instructions.

.2 Connect sprinkler heads to polyethylene pipe with brass saddles and insert tee.

.3 Install lateral lines by pulling in pipe.

.1 Use a vibrator type pipe plough for pull-in method with a Mole or Bullet 25mm larger in diameter than outside diameter of the pipe.

.2 Eliminate ridge created by the vibrator plough by mechanical tamping so soil over pipe is returned to final grade.

.4 Lay 75mm and larger main water pipe in trench. Saw cut saddle holes on High Density Polyethylene (HDPE) main line pipe. Do not burn hole in HDPE pipe.

.1 Leave pipe uncovered at this stage for inspection.

.2 Do not backfill until approved.

.5 Slope main lines to provide gravity drainage to local low points in the pipe.

.1 Run a survey of the main line to establish exact low points.

.2 See 3.13 of this specification.

.6 Double clamp insert fittings.

.7 Follow pipe manufacturer butt-fusion procedure for pipe and fittings.

3.7 Wiring

.1 Install wires in a neat and orderly fashion in pipe trenches. Bundle wires together and tape every 2m.Test the wires for continuity prior to burying the wires.

.2 Assemble splices in services boxes or valve boxes when required. Loop 610 mm (24") of electrical wire in splice box.

.1 Apply brass tag with zone number on each side of splice having wire run through tag hole.

.2 One splice allowed per leg of wire. Go to nearest valve box with wire if more required.

.3 T-splice a 150mm tail on common and attach valve wire to common tail.

.4 Install electrical wiring in accordance with existing Canadian Electrical codes.

.1 Loop 600mm (24") of spare, common, and applicable control wire in each valve box.

.2 Loop at 90 degree changes in direction along main line.

.5 115-volt wiring installed and connected by Contractor **Electrician**.

.6 Install tracer wire in all main line trenches from service box to end of main lines.

.1 Attach tracer wire to 18mm x 600mm copper clad ground rod with 18mm brass ground clamp inside each last box on the main line.

.7 Install spare wire in main line trench with wire bundle from controller to last control valve.

3.8 Valves

.1 Install valves according to manufacturer's instructions. No pipe dope or oil base lubrication on threads.

.1 Install valve in a valve box set plumb and flush with grade.

.2 Align valve boxes perpendicular to main line.

.3 Do not install valve boxes in bottom of swales.

.4 Tamp the ground around each valve box to its original grade.

.2 Min. 50mm and maximum 100mm clearance from top of valve to bottom of lid.

.3 Valve box is supported by 300mm of crushed rock and compacted soil so that it can support the weight of turf maintenance machinery without sinking.

.4 Tag zone valves with brass tags and correspond number with controller station number.

.1 Correspond valve cover identification with valve tag marking.

3.9 Sprinkler Heads

.1 Follow manufacturers directions for installation. Use four elbow swing joint.

.1 Connect swing joints on top or side of lateral pipe.

.2 Tamp the excavated ground around each head to its original grade.

.2 Do not use saddles on pipes 25mm and smaller. Use insert tee fitting with double clamps.

.3 Burn or drill with a hole saw for saddle. Do not use ordinary steel bit.

3.10 Drains

.1 Install drains along main line in locations as approved.

.1 Install drain valve box with 25mm ball valve at low points.

.2 Install where depressions occur and water is likely to collect in pipe.

.3 Do not install drains in bottom of swales or below existing water table.

3.11 Balancing and Adjustments

.1 Balance and adjust various components of sprinkler system so overall operation and coverage meets the design specifications prior to final inspection.

3.12 End of Season

.1 If irrigation system has not had a final inspection in the current year, then blow-out irrigation water lines prior to October 8 and activate system in spring of the following year.

.1 Cease irrigation installation prior to October 15, unless otherwise approved.

3.13 Clean-Up

.1 Clean adjacent walks and road surfaces at the end of each working day.

END OF SECTION

1.0 GENERAL

1.1 Scope

.1 The items of work governed by this Section of the Specifications are those required to adjust the surface elevations of existing valve boxes, curb boxes, catch basin covers, and manhole covers to the required finished elevations.

1.2 Measurement for Payment

.1 Adjustment of appurtenances will be measured for payment for the number of units adjusted, and shall include all labour and material necessary except replacement parts supplied by the Owner for boxes, frames or covers broken before the Contractor started work on the site.

A manhole or catch basin adjustment is defined as the addition or removal of at least one grade ring or course of brickwork, resetting disturbed grouting and change of rim elevations. An adjustment does not include the removal or addition of manhole blocks or precast manhole rings.

.2 Manholes which cannot be adequately adjusted shall be reconstructed. Measurement and payment for manhole reconstruction will be by the vertical metre from the elevation of the undisturbed portion of the manhole to the revised rim elevation. Payment shall include all labour and material necessary for the work indicated.

2.0 PRODUCTS

2.1 Valve Box Extensions

.1 Valve box extensions shall be 150 mm cast iron and are to be completely coated with an asphaltic type varnish to prevent corrosion.

2.2 Manhole Grade Rings and Blocks

.1 Precast grade rings and blocks for manhole grade adjustment shall conform to ASTM C478 and C139 respectively.

.2 Final adjustment riser/ring shall be composite rubber INFRA-RISER as Manufactured by East Jordan Iron Works or approved equal.

2.3 Mortar

.1 Mortar shall be Sulphate Resistant ASTM Type 50.

3.0 EXECUTION

3.1 Inspection of Existing Appurtenances

.1 Prior to the start of construction on any street or block, the Contractor shall locate and inspect all manholes, catch basins, and valves in order to satisfy himself that they are all in proper working condition. Any damaged materials shall be brought to the immediate attention of the Engineer, who will make arrangements with the Owner for replacement parts. Damaged materials, which are not brought to the immediate attention of the Engineer, will be the sole responsibility of the Contractor and shall be repaired by the Contractor at his own expense.

3.2 Valve and Cub Boxes

.1 Adjustment of valve box tops and curb box tops shall include the repair of any broken boxes. The Owner will supply necessary replacement parts except those parts broken by the Contractor. The Contractor shall shorten or lengthen the boxes and stems as required and block the boxes to prevent any settlement. The adjustments shall be so made that the valves operate as effectively as before the adjustment.

3.3 Manhole and Catch Basins

.1 Manhole and catch basin covers shall be adjusted so that the cover conforms to the required finished elevation. All adjustments are to be made with mortar and brick or grade rings firmly set in position and grouted.

.2 Final adjustment shall include a minimum of 25 mm composite rubber grade ring below frame and cover. Maximum height of stacked composite rubber adjustment risers should not exceed 75 mm.

.3 Steel extensions for frame and cover shall not be used unless accepted in writing by the Engineer.

.4 The Contractor shall notify the Engineer if existing manholes or catch basins have less than 150 mm of grade rings, more than 300 mm of grade rings, existing grade rings are damaged, or existing cone appears to be damaged prior to or during construction.

3.4 Manhole Reconstruction

.1 Manholes may be reconstructed or lowered using precast rings or blocks where an adjustment is not possible. The blocks shall meet the requirements of A.S.T.M. Specification C139.

3.5 Backfill

.1 Should any backfill be required around the valve box, manhole or catch basin cover below the elevation of the road subbase surface, Granular backfill shall be used and properly compacted in place.

.2 Granular Backfill

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

ASTM Sieve Designation	Per Cent Passing
50.0 mm	100
31.5 mm	60 - 100
16.0 mm	40 - 75
4.75 mm	25 - 60
2.0 mm	20 - 45
0.425 mm	10 - 25
0.075 mm	0 - 10

END OF SECTION

1.0 GENERAL

1.1 Related Work

.1 Coordinate the requirements of this section with all other sections, including but not limited to:

.1 Section 02212 Topsoil

.2 Section 02998 Landscape Maintenance

1.2 Quality Control

.1 Approved seed mixes for use.

.1 Submit “original” seed bag labels for each type of seed mix used.

.2 Notify City of Prince Albert prior to seeding.

.1 Failure to obtain inspection and approval of seeding operations will affect date of Construction Completion Certificate (CCC) for the Work.

1.3 Measurement and Payment

.1 The Unit prices submitted shall include the supply of all labour and equipment and materials as specified or required to complete the Work as intended.

.2 The prices submitted to be full compensation for supplying (if applicable), hauling, installing, cleaning and placing in service the Work as specified and detailed, together with all incidental Work.

.3 Measurement for payments to be calculated on the basis of the Unit prices for the applicable item of Work as entered on the Tender Form. Seeding (sq. m.) of turf areas for each type of seed mix includes all associated costs for seed mix, fertilizer, and fine grading of topsoil areas.

.1 Failure to obtain inspection of seeding operations will result in Contractor providing all landscape maintenance required until satisfactory germination of seed for turf areas or a 50% deficiency holdback in the amount paid as determined by Consultant.

1.4 Inspection

.1 Notify Project Manager and City of Prince Albert for inspection of:

.1 Fertilizer application and seed bed preparation, before seeding.

.2 Seeding.

2.0 PRODUCTS

2.1 Grass Seed and Seed Mixes

.1 Grass seed to be Canada No. 1 Grade Seed, from a recognized seed firm, free of disease, minimum germination of 75%, minimum purity of 97% and conforming to the following seed mixes.

.2 Seed mixes for turf:

.1 Irrigation Mix.

.1 40% Creeping Red Fescue “Boreal” (acceptable alternative “Jasper II”)

.2 37%. Perennial Rye “Fiesta 3” (acceptable alternative “Playmate” or “Citation III”)

.3 15%. Kentucky Blue “Able I” (acceptable alternative “Quantum Leap”)

.4 8% kg. Kentucky Blue “Midnight” (acceptable alternative “Awesome” or “Rugby II”)

.2 Non Irrigation Mix.

.1 35% Aberdeen Creeping Red Fescue

.2 25% Shadow III Chewings Fescue

.3 20% Sheep Fescue

.4 20% Hard Fescue

2.2 Other Materials

.1 Fertilizer: Complete synthetic, slow release with maximum 35% water soluble nitrogen.

.1 11-52-0, or as recommended in soil test analysis results.

.2 Water: Free of impurities inhibiting germination and growth.

.3 Tackifier/Binder; As approved.

2.3 Equipment

.1 Manual seeding; "Cyclone" type manually operated seeder and flexible “drag mat”.

.2 Mechanical seeding; "Brillion" type mechanical landscape seeder which accurately places seed at specified depth and rate and rolls in single operation.

.3 Rollers; Suitable for type of Work and seeded area.

3.0 EXECUTION

3.1 Preparation

.1 Re-grade areas damaged during construction of other Work and remove weeds, stones, debris, and other foreign material in excess of 50mm diameter before seeding.

3.2 Fertilizer

.1 Apply approved fertilizer to topsoil areas at rate of 100 kg per hectare, or as recommended in soil test analysis results.

3.3 Seed Bed Preparation

.1 Requirements:

.1 Fine grade and loosen topsoil to achieve loose friable bed.

.2 Eliminate rough spots and low areas to ensure positive drainage.

.3 Consolidate topsoil in seeded areas leaving surface smooth, uniform, firm against deep foot printing, and with a fine loose texture.

3.4 Seeding Operations

.1 Do not perform work under adverse site conditions; frozen ground, saturated ground, or ground covered with snow, ice or standing water.

.1 Obtain approval to proceed with seeding.

.2 Calculate number of seed bags used for each seed mix type.

.3 Seed using same method as intended for other seeding operations.

.2 Authorization is required before applying seed mixes.

.1 Seed half of required seed amount in one direction and remainder at right angles.

.2 Seed uniformly for each type of seed mix at rate of 220kg per hectare.

.3 Ensure seed does not spread to non-turf areas (e.g. shrub beds)

.4 Blend applications into adjacent turf areas achieve uniform surfaces.

.3 Ensure seed is embedded into soil to depth of 5 mm within 1 hour of seeding.

3.5 Protection

.1 Protect seeded areas against damage using materials and method as approved and remove protection after turf areas have been accepted.

3.6 Establishment and Maintenance

.1 See Specification Section 02998 Landscape Maintenance

3.7 Clean-Up

.1 Clean adjacent walks and road surfaces at the end of each working day.

END OF SECTION

1.0 GENERAL

1.1 Related Work

.1 Coordinate the requirements of this section with all other sections

.1	Section 02210	Park Grading (If Required)
.2	Section 02212	Topsoil
.3	Section 02998	Landscape Maintenance

1.2 Quality Control

.1 Approval from City of Prince Albert, Public Works required for proposed plant material specifications and sizes.

.1 Name of source and supplier of plant material, species and quantity must be submitted prior to delivery

.1 Imported plant material must accompany necessary permits and import licenses, conforming to federal and provincial regulations.

.2 All plant material must be rated **Zone 3A** or hardier as per Canada Plant Hardiness Zone

.1 Map and comply with the current edition of the Canadian Nursery Landscape Association (C.N.L.A.) Canadian Standards for Nursery Stock requirements for:

.1 Botanical nomenclature

.2 Required labels clearly specifying:

- Species
- Mature height and spread
- Calliper
- Root ball size and condition
- Container size and condition

.2 Tree and shrub requirements; strong fibrous root systems, structurally sound, free of disease, insects, insect eggs, sunscald, frost cracks, rodent damage, defects, injuries and damage.

.3 Planting Season:

.1 Plant all deciduous plant material between April 15 and October 15.

.2 Dig all coniferous plant material during Spring dormancy only and plant prior to August 15.

.4 Mulch:

.1 Submit for all mulch material delivered to the site:

.1 A one (1) litre sample of mulch.

1.3 Substitutions

.1 Species and / or size substitutions to plant material as per planting plan prohibited unless written approval is obtained from the Consultant before tender close. Plant substitutions must be of similar species and of equal size as those originally specified.

1.4 Inspection

.1 Notify the **City of Prince Albert, Public Works,** for inspection and approval of nursery plant material at source before delivery of any plant material to site.

.2 Notify the **City of Prince Albert, Public Works,** for inspection of layout before to planting of:

.1 Trees and planting beds.

.3 Notify the **City of Prince Albert, Public Works,** for inspection of plant material and planting installation before to planting of:

.1 Trees and shrubs.

.4 Inspection of plant material includes:

- Species
- Size
- Health
- General form and leaf development
- Location
- Proper installation
- Ensure invasive plant species have not been imported to the site.

Inspection before installation does not prevent rejection after planting.

1.5 Delivery and Storage

.1 Coordinate shipping of plants and site preparation to ensure minimum time lapse between transport and planting.

.2 During shipment, protect plant material from frost, excessive heat, sun and wind with tarpaulin covering all the plants, to prevent loss of moisture.

.1 Protect plants from damage during shipping.

.2 Damaged root balls, trunks, branches and leaders are unacceptable. Damaged plant material will be rejected.

.3 Pack plants in damp peat moss, place in bales or boxes, and keep damp during transportation and storage until planted.

.3 If plant material cannot be planted within 4 hours of arrival on site, provide protection necessary to keep plants at optimum health:

.1 Keep roots moist and protected from sun, wind and mechanical damage.

.2 Protect root balls against sudden temperature changes and exposure to heavy rainfall.

.3 Dropping of root balls at any time during handling is not acceptable.

.4 If plants cannot be planted on same day of arrival to site, heel in plant material in shaded areas and water well. Provide extra protection from construction, sun and wind. Ensure close monitoring of plants watering needs.

1.6 Measurement and Payment

.1 The Lump Sum and Unit prices submitted are for supply of all labour and equipment and materials as specified or required to complete the Work as intended.

.2 The prices submitted to be full compensation for supplying (if applicable), hauling, installing, cleaning and placing in service the Work as specified and detailed, together with all incidental Work.

.3 Measurement for Payments to be calculated on the basis of a percentage of completion of the Lump Sum and Unit prices for the applicable item of Work or at Unit rates of Force Account Rates as entered on the Tender Form.

.4 Plant materials (each) for specified species of tree or shrub and includes all associated costs for excavation, planting soil, tree staking, wood mulch and maintenance.

.5 Plant material that has been rejected after installation and prior to Construction Completion Certificate (CCC) will not be paid for.

1. Prior payment for this material will be reversed.

.6 Undersized plant material to have their payment reduced as follows:

.1 Caliper specified trees - Unit rate is reduced by 2% for every one mm caliper size under specified size.

.2 Height trees - Unit rate is reduced by 2.5% for every 5cm increment below specified size.

.7 Wood mulch for individual trees is incidental to cost of individual trees and will not be measured for payment.

1.7 Warranty

.1 The Contractor hereby warrants plant material will remain healthy for one full year following date of Construction Completion.

.2 The Consultant reserves the right to extend Contractor's warranty responsibilities for an additional one year if, at end of initial warranty period, leaf development and growth is questionable or the plant shows signs of stress.

.3 The Contractor warrants invasive or unwanted plant species will not be imported into the site with the plant material.

1.8 Replacements

.1 During Construction period, the project site is **not to contain** dead or diseased plant material at any time. Remove and replace plant material as required.

2.0 PRODUCTS

2.1 Plant Materials

.1 Plant material, sizes, conditions and quantities must conform to drawings and plant lists. Sizes noted on drawings are plant lists are minimum.

.2 Plants not listed on the below approved plant list shall not be planted without written approval from the City of Prince Albert, Park Branch.

City of Prince Albert | Preferred Tree Species

Botanic Name	Common Name	Zone	Height	Spread	Columnar	Upright Spreading	Flowering	Fruiting	Winter Interest	Drought Tolernt	Water Tolerant	Salt Tolerant
All-Purpose Trees for All Applications												
Acer ginnala *Acer tataricum subsp. Ginnala*	Tree-form Amur Maple	2	6m (18')	5m (15')		X						
Acer saccharinum 'Silver Cloud'	Silver Maple	3	18m (60')	9m (30')		X				X	X	X
Acer tataricum 'GarAnn'	Hot Wings Tatarian Maple	2	7m (20')	6m (18')		X				X		X
Fraxinus mandshurica 'Mancana'	Mancana Manchurian Ash	2	12m (40')	7m (20')		X				X	X	X
Fraxinus x 'Northern Gem'	Northern Gem Hybrid Ash	2	15m (50')	12m (40')		X				X		
Fraxinus pennsylvanica 'Patmore'	Patmore Green Ash	2	18m (60')	11m (35')		X				X		X
Fraxinus pennsylvanica 'Rugby'	Prairie Spire Green Ash	2	18m (60')	9m (30')		X				X		X
Quercus macrocarpa	Bur Oak	2	24m (80')	18m (60')		X				X		X
Tilia americana	American Linden	2	18m (60')	12m (40')		X	X					
Tilia cordata 'Greenspire'	Greenspire Littleleaf Linden	3	12m (40')	10m (30')		X						
Tilia cordata 'Ronald'	Norlin Littleleaf Linden	3	15m (50')	9m (30')		X						
Tilia mongolica 'Harvest Gold'	Harvest Gold Mongolian Linden	2	12m (40')	8m (25')		X						
Tilia x flavescens 'Dropmore'	Dropmore Hybrid Linden	2	15m (50')	9m (30')		X						
*Ulmus americana**	American Elm	2	20m (60')	12m (40')		X						
Ornamental Trees Located Away from Pavement | Street Trees between Property Boundary and Combined Curb-Sidewalk												
Betula platyphylla 'Fargo'	Dakota Pinnacle Asian White Birch	2	12m (40')	9m (30')	X				X			
Celtis occidentalis	Hackberry	2	15m (50')	12m (40')		X	X	X		X	X	
Crataegus x mordenensis 'Snowbird'	Snowbird Hawthorn	3	5m (15')	5m (15')		X	X	X				
Elaeagnus angustifolia	Russian Olive	2	6m (18')	6m (18')		X	X	X		X		X
Malus x adstringens 'Jefgreen'	Emerald Spire Crabapple	3	5m (15')	2m (6')	X		X					
Malus x adstringens 'Jefspire'	Purple Spire Crabapple	3	5m (15')	2m (6')	X		X					
Malus x adstringens 'Thunderchild'	Thunderchild Crabapple	2	6m (18')	5m (15')		X	X	X				
Malus 'Royalty'	Royalty Crabapple	2	5m (15')	5m (15')		X	X	X				
Prunus maackii	Amur Cherry	2	10m (30')	8m (25')		X	X	X	X			
Syringia reticulata	Japanese Tree Lilac	3	6m (20')	5m (15')		X	X		X			X
Upright Conifer Trees for Winter Interest Located where Space Allows												
Picea glauca	White Spruce	2	13m (43')	6m (18')		X			X			
Picea pungens	Colorado Spruce Blue Spruce	2	19m (62')	8m (25')		X			X			X
Pinus contorta var. latifolia	Lodgepole Pine	1	25m (80')	8m (25')		X			X			
Pinus sylvestris	Scotch Pine	2	18m (60')	8m (25')		X			X	X		
Park and Nature Trees Located Away from Infrastructure												
Acer negundo	Boxelder Maple	2	15m (50')	10m (30')		X				X	X	
Larix laricina	Tamarack		12m (40')	6m (18')	X						X	
Larix siberica	Siberian Larch	2	25m (80')	5m (15')		X						
Prunus virginiana 'Schubert'	Schubert Chokecherry	2	8m (25')	6m (18')		X	X	X				
Salix alba 'Siberica'	White Willow	2	25m (80')	10m (30')		X					X	
Salix pentandra	Laurel Leaf Willow	2	18m (60')	9m (30')		X					X	
Sorbus aucuparia 'Rossica'	Russian Mountain Ash	2	8m (25')	6m (18')		X		X				
Sorbus decora	Showy Mountain Ash	2	8m (25')	6m (18')		X		X				

Please note that the Preferred Species are tried-and-true suggestions. Other species and substitutions may be permitted on City property with permission from the City of Prince Albert Parks Division

*Elms are permitted in limited numbers in high visibility locations where they can be easily monitored for DED

.1 Approval of plant material substitutions in required from **City of Prince Albert, Park Branch, Project Manager.**

.2 Requested plant material substitutions must be of similar species and of same size as originally specified.

.3 If plant material is not commercially available at the minimum size specified, smaller sizes of the same species may be approved by Project Manager.

.3 Plant material must have well developed branches and foliage, stable and strong fibrous root systems, structurally sound, free of disease, insects, insect eggs, sunscald, frost cracks, rodent damage, defects, injuries and damage.

.1 Trees with sparse foliage or over-elongated branches are unacceptable.

.2 Plant material with dieback or tip kill that adversely affecting the structure of a tree is unacceptable (e.g., damaged leader or severe tip kill to lateral branches).

.3 Plant material with stumps or weeds included in the root ball is unacceptable.

.4 If larger plants than specified are used, increase the root ball in proportion to the size of the plant to conform to C.N.L.A. specifications.

.5 Trees with excessive pruning, shearing or pruning that adversely affecting trees mature form is unacceptable.

.4 Plants dug from native stands, woodlots, Christmas tree lots, orchards or neglected nurseries, and have not received proper maintenance as per C.N.L.A., are designated as “collected” plants.

.1 “Collected” plants are unacceptable unless inspected and approved.

2.2 Wood Mulch

.1 Approved clean untreated shredded wood chips produced from pulp mills in Northern Saskatchewan or other approved product.

.2 Ensure wood mulch is well shredded. Large wood chunks are not acceptable.

2.3 Other Materials

.1 Water:

.1 Potable and free of minerals detrimental to plant growth.

.2 Non potable water:

.1 Location and source of water is required.

.2 Water test is required and test results submitted to City of Prince Albert, Public Works for approval prior to use.

.3 Park Trees: Metal T-Bar stake, supplied by Contractor.

.4 1524-1828mm long, heavyweight.

.2 Accessories: Use 14 gauge galvanized wire inserted into 2 ply reinforced 12mm diameter rubber hose.

3.0 EXECUTION

3.1 Layout

.1 Establish and maintain line and grade controls using appropriate survey personnel and equipment.

.1 Contractor is responsible for layout accuracy.

.2 Stake locations of trees and obtain approval before planting.

.3 Spray-paint edge of planting bed and obtain approval before installation of sand and start of planting operations.

3.2 Utilities and Setbacks

.1 All underground utilities and irrigation mainline must be located and clearly flagged or marked within 5 metres of proposed planting sites.

.1 Identify all discrepancies in existing conditions, including the locations of underground utilities affecting proposed plant material locations.

.2 Trees require a set back of minimum distance, measured from centre of tree trunk, from utilities and other objects:

.1 0.6m: 120 - 240 voltage lines (e.g., streetlight power lines), traffic control lines

.2 1.0m: sidewalks, pathways

.3 1.5m: local road curb face, driveways and private walks

.4 2.0m: buried high voltage power lines, overhead power lines (small species of trees only allowed), SaskTel/AT&T/telephone lines, Sask Energy/gas distribution lines, Shaw/telecable lines, utility pedestals, curb

face of arterial or collector roadways, roadway signs except from the front of stop and yield signs

.5 3.0m: fibre optic lines, water and sewer lines, electrical transformers, street lights, fire hydrants, structures (e.g., houses, garages), side and back of bus stop signs, front of bus stop signs where tree is more than 3.0m from curb face

.6 7.0m: street corners, front of stop and yield signs

.7 10.0m: Trans gas/gas transmission lines

3.3 Tree Spacing

.1 Minimum distances between / from existing trees measured from centre of tree trunks:

.1 5.0m: small tree species less than 6.0m spread at maturity.

.2 6.0m: trees species 6.0 - 7.5m spread at maturity.

.3 7.0m: coniferous trees.

.4 9.0m: tree species with greater than 7.5m spread at maturity.

3.4 Excavation – Tree and Shrubs

.1 Excavate planting hole for each type of plant:

.1 Large trees (over 3.0m height):

.1 Depth: Equal height of container or root ball of tree.

.2 Diameter: 600 mm greater than diameter of container or root ball of tree.

.2 Small trees (up to 3.0 m height):

.1 Depth: Equal height of container or root ball of tree.

.2 Diameter: 600 mm greater than container or root ball of tree.

.3 Shrubs:

.1 Excavate at least 300 mm wider than container of shrub.

.2 Scarify wall of planting holes before installing any planting stock material.

.2 Remove excess soil and all water from planting hole before placing tree.

3.5 Tree and Shrub Planting

.1 Install plant material in centre of planting hole, plumb, per drawings and planted at the same grade level as originally grown in nursery.

.1 Consider existing sub grade soil conditions and further settlement of newly planted material at this stage of planting.

.2 Water each plant immediately after planting.

.2 Coniferous plant material must be Spring dug (See 1.2.4).

.3 Balled and burlapped plant material:

.1 Place top of the root ball at the same level as in the nursery (allowable tolerance: +/- 50mm), allowing for future settlement.

.1 If tree location is in heavy clay soil, install top of the root ball 50mm above the nursery level (+/- 50mm).

.2 Install root ball on undisturbed/compacted sub grade. Place topsoil at edges of excavation to support root ball.

.1 Damaged to the root balls are unacceptable.

.3 Place planting soil around root system in layers of 150 mm, eliminating air voids.

.1 When planting soil is installed up to half the root ball height, ties are required remove the top 1/3 of the burlap and / or wire basket ensure 2 lacing loops are left intact and folded down.

.2 When 2/3 of planting soil has been placed, fill hole with water. Do not complete backfill until water has completely penetrated into soil. Cover root ball with soil

.4 Build soil ring around perimeter of the root ball to assist with maintenance watering.

.5 Apply 140 litres (30 gal) of water slowly per tree immediately after planting

.4 Container stock plant material:

.1 Remove container without disturbing root ball.

.1 If roots have grown to the edge of the container, cut 3 (three) vertical slices around the root ball.

.2 Install small trees and shrubs per drawings.

.3 Position top of root ball flush with proposed finished grade.

.4 Place planting soil and compact firmly around plant.

.5 Apply 90 litres (20 gal) of water slowly per small tree immediately after planting

.5 Remove remaining shipping materials, wire, burlap and protective coverings from plant material and beds.

3.6 Tree Support

.1 Install tree support for trees in parks right after planting, see details. Ensure tree support does not disturb root ball.

.2 Ensure tree support is placed as per setback identified above in 3.2.2

3.7 Pruning

.1 Prune dead, injured, damaged branches or branches that rub against bark.

.1 Remove projecting stubs back to branch collar.

.2 Postpone pruning of trees until in full leaf to prevent heavy bleeding.

3.8 Wood Mulch

.1 Wood mulch is required for all planting beds and individual trees and shrubs.

.2 Minimum mulch depth including uniform compaction:

.1 Irrigated areas 50 mm.

.3 Install mulch immediately following planting.

.1 Do not install mulch within 100 mm of tree trunks.

.2 Taper mulch layer at base of shrubs to provide a 100mm diameter saucer centred on shrub, with no mulch directly at the base of stem(s).

.4 Compact mulch by spraying with water.

3.9 Clean-Up

.1 Clean adjacent areas, walks and road surfaces at the end of each working day.

.2 Remove all remaining shipping and construction debris from planting.

END OF SECTION

1.0 GENERAL

1.1 Related Work

.1 Coordinate the requirements of this section with all other sections.

.1 Section 02212 Topsoil

.2 Section 02810 Irrigation

.3 Section 02933 Seeding

.4 Section02950 Plant Material

1.2 Quality Control

.1 Approval from **City of Prince Albert, Public Works** is required for labour, materials and equipment necessary to maintain new landscape components.

.1 Submit the following to City of Prince Albert, Public Works, Project Manager, at time of CCC:

.1 Contact name of Contractors maintenance supervisor.

.2 Copy of current pesticide applicators license (Sask.) for applicable personnel.

.3 Landscape Maintenance Schedule.

.4 List of Maintenance Equipment.

.2 Initiate and Maintain a Maintenance Log for the Project, indicating all maintenance Work performed in a chronological order. Include notes on labour, equipment, and products used and the work performed.

.3 Submit maintenance log to the City of Prince Albert, Public Works, at the completion of the maintenance period.

1.3 Measurement and Payment

.1 The Lump Sum and Unit prices submitted are for supply of all labour and equipment and materials as specified or required to complete the Work as intended.

.2 The prices submitted to be full compensation for supplying (if applicable), hauling, installing, cleaning and placing in service the Work as specified and detailed, together with all incidental Work.

.3 Measurement for Payments to be calculated on the basis of a percentage of completion of the Lump Sum and Unit prices for the applicable item of Work or at Unit rates of Force Account Rates as entered on the Tender Form.

.4 Landscape Maintenance prior to Construction Completion Certificate (CCC) (lump sum) is for the period between April 15 to October 15 and will be paid at the time of Construction Completion.

.5 Landscape Maintenance after Construction Completion (month) is for the maintenance period only - April 15 to October 15 (6 months) within one calendar year from the date of Construction Completion Certificate (CCC).

1.4 Inspections

.1 Notify City of Prince Albert, Public Works for inspection of:

.1 Spring Start-up.

.2 Winterization.

.3 Plant material removed or replaced before or during Warranty Period.

.4 End of Maintenance.

.2 City of Prince Albert, Public Works will inspect the project site regularly to review maintenance, including a review of the Maintenance Log.

1.5 Vandalism

.1 Contractor is not responsible for repair or replacement of items damaged or altered as a result of vandalism or other acts that are outside the control of the Contractor.

2.0 PRODUCTS

2.1 Equipment and Tools

.1 Maintenance equipment and tools requirements; suitable for Work performed, in good working order and approved, including but not limited to:

.1 Portable irrigation systems, tank trucks, hoses etc.

.2 Mowers and other landscape maintenance equipment.

.3 Weed and pest control equipment.

2.2 Materials

.1 Products and materials must be suitable for the Work performed, including but not limited to:

.1 Products or Materials as specified in relevant sections.

.2 Weed and pest control products.

3.0 EXECUTION

3.1 Ongoing Maintenance and Establishment

.1 Provide labour, materials and equipment necessary to maintain all existing and new landscape components within the project site.

.2 Provide labour, materials and equipment necessary to establish all new turf and plant material.

.3 Irrigation:

.1 Winterize and energize as required.

.2 Adjust grades around components to maintain designed elevations.

.3 Repairs or adjust as required to maintain a functional system.

.4 Balance and adjust irrigation system to meet design specifications of overall operation and coverage.

.5 Follow designated water window restrictions see drawings.

.4 Turf areas (seeded):

.1 Maintain design grades and layout. Topdress and overseed as needed.

.2 Maintain drainage patterns. Re-grade and overseed to eliminate ponding water and erosion.

.3 Remove contaminants from the surface.

.4 Remove garbage and debris.

.5 Provided weed control as required.

.6 Provide rodent, and pest control as required.

.7 Established turf areas are fully germinated, mature stands of turf without bare patches, with a grass composition reflective of the seed mix used.

.5 Plant material:

.1 Remove weeds and vegetation including rocks in mulch areas. Do not damage Plan Material roots.

.2 Maintain grades and layout. Add mulch if required to maintain specified depths.

.3 Maintain clean edge on planting beds. Naturalized beds do not require edging.

.4 Correct settlement and erosion damage.

.5 Remove contaminants from the surface.

.6 Remove all garbage and debris.

.7 Maintain plant material staking and supports.

.8 Remove and replace plant material as directed.

.9 Provide rodent, pest and weed control as required.

3.2 Spring Start Up

.1 Obtain approval for start of seasonal maintenance requirements.

.1 Perform spring start-up of irrigation system as per Section 02810.

.2 Remove and dispose of weeds, branches, stones, refuse and other debris within project area.

.3 Inspect the site and record all damages to site.

.4 Remove blockages in the storm sewer system. Dewater the site if necessary.

3.3 Winterization

.1 Obtain approval for end of seasonal maintenance requirements.

.1 Perform winterization of irrigation system as per Section 02810.

.2 Remove and dispose of weeds, branches, stones, refuse and other debris within project area.

.3 Ensure all turf areas and plant materials have received final watering and all other maintenance requirements for the season.

.1 One watering cycle must be completed in October after temperatures fall below freezing to ensure adequate moisture in root zone at freeze-up.

3.4 Watering

.1 Water all areas for establishment using new irrigation system, temporary irrigation system as provided by the Contractor, or other method ensuring that compaction is not caused during watering procedures.

.2 Monitor watering to ensure:

.1 Over watering is not acceptable. Saturated soils do not promote healthy establishment and growth.

.2 Areas are not eroded, and materials do not contaminate adjacent areas or properties due to erosion.

.3 Adjacent properties are not otherwise adversely impacted by irrigation operations.

.3 Seeded areas:

.1 From time of seeding to 90% germination:

.1 Apply light, frequent watering to supplement rainfall to guarantee continuous 19 mm moisture penetration.

.2 From 90% germination to establishment:

.1 Apply water to supplement rainfall to guarantee 25 mm of water per week.

3.5 Turf Mowing

.1 Mowing of turf areas is not approved until the turf is well established and approaching mowing height tolerances as follows:

.1 Irrigated turf areas 100 mm (4.0") high.

.1 Mow to height of 63 mm (2.5").

.2 Mow all turf areas using equipment suitable for the work.

.1 Cut no more than 30% of grass blade in one mowing.

.2 Do each operation continuously and complete within a reasonable time period.

.3 Remove clippings that smother turf within 24 hours of mowing.

.4 Trim turf around all vertical objects (e.g. light posts).

.3 If height of turf is greater than acceptable heights identified in 3.5.1, the City of Prince Albert, Public Works to request that the Contractor mow turf areas within two (2) days.

.1 If Contractor fails to meet this request, the City of Prince Albert, Public Works to mow the turf at Contractor expense.

3.6 Turf Fertilization

.1 Once per season, apply approved fertilizer to all turf areas, at rate of 100kg per hectare, or as per recommendations of soils test analysis results. Apply within the period from mid May to late June.

3.7 Turf Topdressing / Re-Seeding

.1 Top-dress and re-seed turf areas not growing vigorously:

.1 Mow turf adjacent to areas to be re-seeded to a height as per 3.5.1.

.2 Rake thoroughly, removing loose and dead turf, stones and debris.

.3 Spread clean topsoil to a depth of 12 mm, filling in low areas and bare spots.

.4 Mix topsoil and seed thoroughly.

.5 Water to ensure contact between seed and soil.

3.8 Plant Material Watering

.1 Water all plant materials using new irrigation system or temporary / portable irrigation system (provided by the Contractor), preventing erosion and compaction during watering. Repair all damage.

.1 Ensure adequate moisture in root zone at freeze-up.

.2 Watering requirements of all plant materials depend on plant species, soil type, sun, temperature, winds, rainfall, and plant location.

.3 Water shrubs weekly to maintain top 200-300mm depth of soil moist at all times.

.4 Water trees every seven to fourteen days depending on the moisture level of the soil and environmental conditions.

.1 Water slowly to ensure water does not create run off from root zone and ensure saturation of top 300mm of in the tree well.

.2 Water trees a minimum of eight times during the growing season with the following amounts of water as per tree caliper:

.1 30 - 50mm: 90 litres (20 gallons)/tree

.2 51 - 75mm: 120 litres (30 gallons)/tree

.3 76 - 85mm: 190 litres (50 gallons)/tree

3.9 Plant Material Pruning

.1 Perform pruning requirements in accordance with Section 02950 Plant Material for trees and shrubs.

.1 Extent of pruning:

.1 Remove tree branches overhanging pathways and sidewalks to a minimum 3.0 metres from the ground.

.2 Remove tree branches overhanging play areas and roads to a minimum 4.5 metres from the ground.

.3 Remove tree branches within 2.0 metres of all structures.

3.10 Use of Pesticides

.1 All pesticides must be applied by a licensed Pesticide Applicator.

.2 Submit requests for use of pesticides to the City of Prince Albert, Public Works or Consultant for review and approval prior to use.

.3 Protect plant material within or adjacent to the application area(s).

3.11 Plant Material Removal and Replacements

.1 During warranty period, the project site is not to contain dead or diseased plant material at any time. Remove and replace dead or diseases plant material as required within a reasonable time. All replacements are required noted in a maintenance log.

.2 Remove and replace seed that shows growth failure, deterioration or is dead.

3.12 End of Landscape Maintenance

.1 Request End of Landscape Maintenance inspection in writing and:

.1 Mow all turf areas, edge all planting areas and water all plant materials as required within 48 hours prior to the confirmed date of inspection.

.2 Remove tree supports, ties and guy wires.

.2 Fill post holes and repair adjacent surfaces.

END OF SECTION

1.0 GENERAL

1.1 Requirements

.1 Cooperate and coordinate with the requirements of other units of work specified in other sections.

1.2 Work Included

.1 This section specifies requirements for supply installation and removal of concrete formwork for structures.

.2 Cooperate and coordinate with the requirements of other units of work specified in other sections.

1.3 Reference Standards

.1 Do concrete formwork to CSA A23.1, except as otherwise specified herein.

1.4 Responsibility

.1 The design of formwork and its supporting framing shall be the responsibility of the Contractor.

2.0 PRODUCTS

2.1 Materials

.1 Formwork Materials: to CSA A23.1.

.2 Form Ties: snap-off metal ties, free of devices that will leave hole larger than 25 mm diameter, in concrete surface.

.3 Form Release Agent: colourless mineral oil, free of kerosene or other incompatible material or fluids, compatible with applied finish.

3.0 EXECUTION

3.1 Workmanship

.1 Verify lines, levels and column centres before proceeding with formwork. Ensure that dimensions agree with drawings.

.2 Obtain Engineer's permission before framing openings in Structural joists, beams or columns.

.3 Obtain Engineer's approval of use of earth forms, hand trim sides and bottoms of earth forms and remove loose dirt prior to placing of concrete.

.4 Align form joints and make watertight without affecting appearance of concrete. Keep form joints to minimum.

.5 Use 20 mm chamfer strips on external corners of beams, joists, columns, curbs, machine bases.

.6 Form chases, slots, openings, drops and recesses as detailed or required.

.7 Set screed with top edge level to proper elevation.

3.2 Tolerance and Measurement

.1 Construct formwork to maintain the following tolerances:

.1 Deviation from vertical line - 5 mm in 3,000 mm, 10 mm in 6,000 mm and 20 mm in 12,000 mm or more.

.2 Deviation from flat surface, for walls and floors 5 mm in 3,000 mm.

.3 Deviation from horizontal line - 5 mm in 3,000 mm, 20 mm in 12,000 m or more.

.4 Deviation of linear building lines from design drawings and position of columns, walls and partitions 6 mm.

.5 Deviation in cross-sectional dimensions of columns beams, or in thickness of slabs and walls - plus or minus 6 mm.

.2 Camber slabs and beams 6 mm per 3000 mm of span unless shown otherwise. Maintain beam depth and slab thickness from cambered surface.

3.3 Inserts

.1 Set sleeves, ties, anchor bolts, pipe hangers and other inserts, in concrete work as required by other trades.

.2 No sleeves, ducts, pipes or other openings shall pass through joists, beams, or columns, except where detailed on the drawings.

.3 Confirm location of all sleeves and openings, shown on structural drawings and check against architectural, mechanical and electrical drawings.

.4 Install continuous preformed flashing reglets to form where flashings occur at concrete surfaces.

.5 Install formed construction joints to floor pattern pouring sequence, set vertical, top screed to required elevations, sufficiently secure to resist movement of wet concrete. Drive stake cleanly through vapour barrier.

3.4 Form Removal

.1 Leave formwork in place for the following minimum periods of time after pouring concrete:

.1 Two days for walls and sides of beams.

.2 Seven days for columns.

.3 Fourteen days for beams soffits, slabs and other structural members, or after in-situ concrete has achieved the specified 28 day strength. Responsibility for ascertaining in-situ concrete strength lies with the Contractor.

END OF SECTION

1.0 GENERAL

1.1 Requirements

.1 Cooperate and coordinate with the requirements of other units of work specified in other sections.

1.2 Work Included

.1 This section specifies requirements for supplying and placing reinforcing steel for concrete structures.

1.3 Related Work Specified Elsewhere

.1	Concrete Formwork	Section 03100
.2	Cast-in-Place Concrete	Section 03300

1.4 Reference Standards

.1 CSA A23.1.

1.5 Delivery and Storage

.1 To CSA A23.1.

.2 Store materials on raised supports in a manner to prevent material from coming in contact with the ground.

1.6 Shop Drawings

.1 Submit for approval for Engineer 5 copies of shop drawings within 2 weeks of award of contract and 1 week prior to concrete pour.

.2 Regardless of approval of shop drawings by Engineer, be responsible for fit, conformity or performance in accordance with drawings and specifications.

2.0 PRODUCTS

2.1 Materials

.1 Reinforcing Steel: to CSA G30.12 Billet Steel Grade 400 deformed bars. Furnish bars in full lengths shown.

.2 Wire Ties: Plain, cold drawn annealed steel wire.

.3 Supports: Supply approved supports and chairs of strong, durable, non-corrodible materials which fasten or tie securely to reinforcing steel. Galvanized metal or plastic chairs, concrete blocks or other devices may be

used provided they satisfy requirements of this section and are approved by Engineer.

3.0 EXECUTION

3.1 Field Bending

.1 Do not field bend reinforcement except where indicated or authorized by Engineer.

.2 When authorized, bend without heat, applying a slow and steady pressure.

.3 Replace bars which develop cracks or splits.

3.2 Placing

.1 Accurately place reinforcing steel in positions indicated and hold firmly during placing, compacting and setting of concrete.

.2 Tie reinforcement where spacing in each direction is:

.1 Less than 300 mm: tie at alternate intersections
.2 300 mm or more: tie at each intersection

3.3 Splicing

.1 Make no splices of reinforcement other than those indicated or authorized by Engineer.

.2 Splice reinforcing bars and mesh to CAN3-S6.

3.4 Welding

.1 Welding reinforcing steel not acceptable.

.2 When authorized, weld to CSA W186. Use only welders qualified under provisions of CSA W47.1.

.3 Do not weld stirrups to main tension reinforcement.

3.5 Cleaning

.1 To CSA A23.1-94.

3.6 Inspection

.1 Do not place concrete until Engineer has inspected reinforcement work in place.

END OF SECTION

1.0 GENERAL

1.1 Requirements

.1 Cooperate and coordinate with the requirements of other units of work specified in other sections.

1.2 Description

.1 This Section specifies requirements for Portland cement concrete used in construction of cast-in-place manhole bases.

1.3 Related Work Specified Elsewhere

.1	Concrete Formwork	Section 03100
.2	Concrete Reinforcement	Section 03200

1.4 Reference Standards

.1 CSA A23.1, Concrete Materials and Methods of Concrete Construction and CSA A23.2, Methods of Test for Concrete.

1.5 Ready Mix Concrete Qualifications

.1 Minimum 3 weeks prior to starting concrete work furnish Engineer with copies of manufacturer's test data and certification that cement admixtures and reinforcing steel delivered to job site meet requirements of this Section.

.2 Engineer to approve ready mix concrete.

.3 Provide with each load of concrete delivered to site, duplicate delivery slips containing following:

.1 Name of ready mix batch plant.

.2 Serial number of ticket.

.3 Date and truck number.

.4 Name or number of project.

.5 Class of concrete or mix.

.6 Amount of concrete in cubic metres.

.7 Time of loading or first mixing of aggregate, cement and water.

1.6 Submittals

.1 At least 3 weeks prior to commencing work, inform Engineer of proposed source of aggregates.

.2 The Contractor shall retain the service of an approved testing laboratory for aggregate sampling and testing.

.3 At least 1 week prior to commencing work, submit to Engineer for his review the test results from the approved testing laboratory.

1.7 Measurement and Payment

.1 Sanitary manhole chamber base shall be paid for at the lump sum bid which shall include all excavating, concrete work, reinforcing steel, backfilling and all other work required.

2.0 PRODUCTS

2.1 Materials

.1 Cement: to CSA A5-M90, CAN A3001 Type HS.

.2 Aggregates: to CSA 23.1.

.3 Form Stripping Agent: colourless mineral oil, free of kerosene, with viscosity between 70 and 110 seconds Saybolt Universal 15 to 24 square millimetres per second at 40° C, flashpoint minimum 150° C, open cup.

.4 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.

.5 Concrete reinforcement to Section 03200.

2.2 Concrete Mixes

.1 Submit all proposed mix designs to Engineer a minimum of 5 days prior to placing concrete.

.2 Except where indicated or specified otherwise, provide concrete mix for inlet and outlet structures as follows:

Minimum Compressive Strength - 28 days	32 MPa
Aggregate Size - Maximum	20 mm
Air Entrainment	7% $\pm$ 1%
Slump	75 mm $\pm$ 25 mm

.3 Where 7 day strength is less than 70 per cent of specified 28 day strength, provide additional curing and make changes to mix proportions as required by Engineer.

3.0 EXECUTION

3.1 Workmanship

.1 Ensure that reinforcement and inserts are securely fastened and will not be disturbed during concrete placement.

.2 All concrete shall be watertight.

.3 Provide dampproofing on all exterior walls, in contact with soil. Dampproofing shall be Bakelite Flintguard 710-11, with Bakelite Primer 910-11 or approved equal. Dampproofing shall be applied to manufacturer's instructions.

.4 Place concrete in accordance with CSA-A23.1.

3.2 Inserts

.1 Set sleeves, ties, anchor bolts and other inserts, openings and sleeves, specified in other sections.

3.3 Finishes

.1 General and Schedule

.1 Remove fins and projections, repair damaged areas.

.2 The holes left by withdrawal of rods or the holes left by removal of ends of ties shall be filled solid with mortar after first being thoroughly wetted. For holes passing entirely through the wall, a plunger-type pressure gun or other device shall be used to force the mortar through the wall starting at the back face. A piece of burlap or canvas shall be held over the hole on the outside and when the hole is completely filled, the excess mortar shall be struck off with the cloth flush with the surface. Holes not passing entirely through the wall shall be filled with a small tool that will permit packing the hole solid with mortar. Any excess mortar at the wall shall be struck off flush with the surface.

.3 Provide Smooth-Form finish on all surfaces.

.4 Leave all voids filled without a visible grout film on the surface.

.5 Provide 25 mm chamfer on all exposed edges of concrete walls and floor slabs.

3.4 Control Joints

.1 Saw cut control joints where shown on Drawings within 24 hours after finishing. Vacuum clean saw cut prior to installation of sealant.

3.5 Curing

.1 Cure and protect concrete to CSA A23.1 unless otherwise required.

3.6 Defective Work

.1 Concrete is defective when:

.1 Concrete contains excessive honeycombing or embedded debris.

.2 28 day strength in any defined area is less than 95% of specified strength.

3.7 Repair

.1 Repair defective areas while concrete is still plastic, otherwise wait until curing is completed. Repair defective areas as follows:

.1 Chip down edges perpendicular to surface;

.2 Wet area and brush on 1:1 sand-cement grout;

.3 Patch with 1:2 sand-cement mortar with 10% hydrated lime added.

.2 Where directed, remove defective work and replace with new concrete.

.3 Where directed, grind off high surface irregularities.

.4 Where, as a result of alterations, previously exterior faces become interior, water blast, clean, patch, grind, etc., the surfaces to match adjacent interior surfaces.

3.8 Patching

.1 Patch imperfections in green concrete as follows:

.1 Chip down edges perpendicular to surface.

.2 Wet the area and brush on 1:1 cement-sand grout.

.3 Patch with latex modified cement mortar in accordance with manufacturer's printed instructions.

.2 Patching existing concrete.

.1 Clean and roughen existing concrete to sound substrate. Remove all loose, disintegrated, unsound or contaminated concrete.

.2 Thoroughly soak substrate prior to application but eliminate standing water.

.3 Patch with latex modified cement mortar in accordance with manufacturer's printed instructions.

3.9 Frost Protection

.1 After curing process is completed, provide continuous protection for slabs on grade to prevent subgrade below from freezing during cold weather. Provide heated enclosures, insulation, etc., as required.

.2 All concrete work in below freezing conditions to be placed in a proper hoarded and heated enclosure.

3.10 Rough-In and Blockouts

.1 The Contractor shall provide the required blockouts and chases for the installation of pipes and for any other type of equipment.

3.11 Testing

.1 All concrete testing shall be carried out as per CSA A23.2, Methods of Test for Concrete.

.2 Three concrete cylinders for each 100 cubic metres of concrete poured or a minimum of one set of test cylinders per day shall be taken.

.3 The Contractor shall be responsible for the concrete cylinders upon completion of casting. The Contractor shall ensure that the cylinders are not damaged and the cylinders shall be shipped as soon as possible in crates acceptable to the testing laboratory designated by the Engineer.

.4 All costs of crating, shipping, etc., shall be borne by the Contractor.

.5 The cost of cylinder breaking shall be reimbursed from the Material Testing Prime Sum. Provide Engineer with copy of invoice from testing laboratory.

END OF SECTION

1.0 GENERAL

1.1 Requirements

.1 Cooperate and coordinate with the requirements of other units of work specified in other sections.

1.2 Related Work Specified Elsewhere

.1 Cast-in-Place Concrete Section 03300

1.3 Referenced Standards

.1 Conform to CAN3-S16.1 for Steel and CSA S157 for aluminum.

.2 Welding, fabrications and erection for steel to conform to CSA W59 and CSA W47.1 (Qualification Code).

.3 Welding aluminum: use inert-gas-arc processes and use appropriate filler rod, CSA W47.2 - Aluminum Welding Qualification Code.

1.4 Shop Drawings

.1 Submit shop drawings in accordance with Section 01300.

.2 Clearly indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details and accessories.

2.0 PRODUCTS

2.1 Materials

.1 Steel sections and plates: to CSA G40.21, Type 300W.

.2 Aluminum sections and plates: Alloy 6061-T6.

.3 Galvanizing: hot dipped galvanizing with minimum zinc coating of 600 g/m^2 (3.4 mils) to CSA G164.

.4 Shop coat primer: to refer to Section 09900 for surface preparation.

.5 Galvanized primer: zinc rich, ready mix to CAN/CGSB-1.181.

.6 Anchor Bolts: Stainless Steel Anchors, to AISI 303/304.

2.2 Fabrication

.1 Build work square, true, straight and accurate to required size, with joints closely fitted and properly secured.

.2 Fabricate items from steel unless otherwise noted.

.3 Use self-tapping shake-proof countersunk flat headed screws on items required to be assembled by screws or as indicated.

.4 Where possible, work to be fitted and shop assembled, ready for erection.

.5 Exposed welds to be continuous for length of each joint. File or grind exposed welds smooth and flush.

2.3 Shop Painting

.1 Apply one shop coat of primer to metal items, with exception of those to be galvanized or encased in concrete.

.2 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, and grease. Do not paint when temperature is lower than 7^{o} C.

.3 Protect primed surfaces and re-apply prime coats, which have been damaged.

.4 Clean surfaces to be field welded; do not paint.

.5 Aluminum surfaces in contact with concrete to be coated with bituminous paint.

3.0 EXECUTION

3.1 Erection

.1 Erect metal work square, plumb, straight, and true, accurately fitted, with tight joints and intersections.

.2 Provide suitable and acceptable means of anchorage, such as dowels, anchor clips, bar anchors, expansion bolts and shields, toggles.

.3 Make field connections with high tensile stainless steel bolts, or weld to CSA S16-1969 and S16S1-1975.

.4 Touch up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection.

.5 Touch up galvanized surfaces with zinc primer where burned by field welding.

3.2 Miscellaneous Metal Work Items

.1 Examine drawings and specifications and furnish miscellaneous metalwork items required for proper execution of this project.

END OF SECTION

1.0 GENERAL

1.1 Description

.1 This section specifies the requirements for an External Corporation or Contractor (hereafter called "Company") to conduct a cut in City of Prince Albert surface infrastructure for the purpose of installing, maintaining or exposing a shallow buried utility, and the requirements to restore the surface infrastructure there after (hereafter called the "Work").

1.2 Request to Cut City Surface Infrastructure

.1 Seventy-two (72) hours prior to cuts being made in the City of Prince Albert Right of Way, 00-04-20 "Contractor Utility Locate/Cut Request" Form must be submitted either by email or by City Website at:

publicworks@citypa.com or

https://forms.citypa.ca/Public-Works/Contractor-Utility-Locate-or-Cut-Request

.2 Information that is required includes, but limited to:

.1 City Locate Request

.2 Traffic Closure Request

.3 Construction Drawing Permit Number

.4 Requested Start Date

.5 Locations of Requested Utility Cuts

.6 Surface Type and Cut Surface Area

.7 Contact Information of the Owner of the Utility or Infrastructure

.8 Contact Information of the Contractor Conducting the Work

1.3 Restoration Completion Notice

.1 Companies are required to give notice to the City of Prince Albert upon completing the restoration of a cut. Notices will be given as per 00-04-20 "Contractor Utility/Cut Request" form, submitted at:

publicworks@citypa.com or

https://forms.citypa.ca/Public-Works/Contractor-Utility-Locate-or-Cut-Request

.2 Information that is required includes, but limited to:

.1 Actual Start Date of the Cut

.2 Restoration Completion Date

.3 Mark-up Drawing of the Utility Cuts Repaired

1.4 City Inspection

.1 Upon notice of restoration completion from the Company, the City of Prince Albert will inspect the utility cut restoration for compliance with section 6100, and will either:

.1 Provide receipt of the City's acceptance of the restoration, or

.2 Provide the Company with a deficiency list that are required to be repaired prior to acceptance.

1.5 Cost for Work Performed by City Forces

.1 Traffic Devices and Barricading

If the Company requires lane closure or traffic accommodation, indicate the request for services on the "Contractor Utility Locate/Cut Request" Form. The City may provide a cost estimate to complete the work if able.

.2 Encroachment Permit

If the Company will be encroaching within the legal right of way an Encroachment Permit must be applied for. Permits forms can be found at:

https://forms.citypa.ca/Public-Works/Contractor-Utility-Locate-or-Cut-Request

or by contacting Public Works (contact 306-953-4900).

.3 Restoration

The Company may request that City complete the restoration work. The City may elect to restore the work at its sole discretion. The cost to Company for the city to complete the work will be at the City's charge out rates plus 15%.

1.6 Work Performed by the Company

.1 All costs to complete the Work and remediate the infrastructure is solely the responsibility of the Company unless otherwise explicitly stated.

.2 The Company is solely responsible and liable for the site used for purpose of completing the Work including, but limited to:

.1 Any interim maintenance of utility cuts.

.2 Any interim maintenance of the restorations not yet accepted by the City.

.3 Any conflicts or claims from the general public arising from the Work.

.4 Damages to City or Private Infrastructure.

1.7 Failure to Complete the Work

.1 Should the Company fail to maintain the Work as defined in section 1.6, the City may elect to restore the site at the cost of the Company, charging at the City's charge out rates plus 15%.

1.8 Warranty

.1 Once a Company receives restoration acceptance as per 1.5.3, the Company's responsibility under 1.6 is ceded. Any Damages to City Infrastructure will remain the responsibility of the Company to repair.

.2 Subject to 1.8.1, the company will warrant latent defects for 1 year that result from the Work including:

.1 Premature failure of the restoration that have been determined to not comply with 2.0.

.2 Claims from the public or private that result from the Work.

1.9 Asphalt Degradation Fees

.1 For utility cuts performed in asphalt roads and pathways, the Company will pay an asphalt degradation fee to City based on the area of each utility cut, the age of the asphalt pavement and classification of the roadway, as calculated as follows:

Asphalt Degradation Fees = [Area] x [Road Designation Charge + Asphalt Surface Age Charge]

Area [m2] = (cut width + 2) [m] x (cut length + 2) [m]

Road Designation	Cut Charge
Arterial	$ 50 per m2
Collector	$ 45 per m2
Local/Lane/Path	$ 40 per m2

Asphalt Surface Age	Cut Charge
Less than 5 years	$ 50 per m2
5 to 10 years	$ 25 per m2
10 years and older	$ 0 per m2

.2 Asphalt Area will be determined by the City upon receiving notice of restoration completion from the Company and completing the inspection.

.3 Road Age will be determined based on the last surface treatment to the section of roadway as determined by the City.

2.0 EXECUTION

.1 Specifications for Summer Work Conditions will be followed by the Company between and including April 15 to November 15.

.2 Specifications for Winter Work Conditions will be followed by the Company outside of Summer Work Conditions.

.3 The City may extend or alter the dates of when Summer/Winter Work can be performed based on the weather.

.4 The Company will perform utility cuts and restorations to meet the City's Master Specifications and the Standard Detail Drawings:

<table>
<tr><th rowspan="2">Utility Cut Width (mm)</th><th colspan="5">Surface Infrastructure Type / Drawing Number</th></tr>
<tr><th>Asphalt Pavement</th><th>Concrete Pavement</th><th>Gravel</th><th>Curb/Walk</th><th>Boulevard</th></tr>
<tr><td>Less than 300</td><td>00-04-15</td><td rowspan="3">PW*</td><td rowspan="2">00-04-18</td><td rowspan="3">00-04-19</td><td rowspan="3">00-04-21</td></tr>
<tr><td>300 to 1200</td><td>00-04-16
00-04-17</td></tr>
<tr><td>over 1200</td><td>PW*</td><td>PW*</td></tr>
</table>

.5 *PW – The Company will obtain a repair procedure from Public Works for Utility Cuts in, but limited to;

.1 Asphalt pavement with cut width greater than 1200mm.

.2 Concrete Pavement.

.3 Gravel Lanes or Roads with cut width greater than 1200mm or cut length greater than 20 meters.

END OF SECTION