PART 1 - GENERAL

1.1 DESCRIPTION

.1 This section specifies requirements for the supply, fabrication and placing of reinforcing steel, including necessary supports, spacers, and related accessories.

1.2 RELATED WORK

.1 Concrete Paving and Curbs - Section 32 16 13

1.3 REFERENCE STANDARDS

.1 Concrete Materials and Methods of Concrete Construction CSA-A23.1.

.2 Billet-Steel Bars for Concrete Reinforcement - CSA-G30.18.

.3 Welded Steel Wire Fabric for Concrete Reinforcement - CSA-G30.5.

.4 ACI Detailing Manual - ACI 315.80.

.5 CRSI Manual of Standard Practice.

1.4 SUBMITTALS

.1 Submit bending schedules and placing drawings.

.2 Show bar size, spacing, location and quantities to permit correct placement without reference to structural drawings.

.3 Provide details to show placement of reinforcing where special conditions occur.

.4 Details shall be in accordance with ACI 315.

.5 Submit certificates and mill tests for the material supplied as requested by the Consultant.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

.1 Ship bar reinforcement in standard bundles, easily identifiable and marked in accordance with the bar lists.

.2 Store reinforcement to prevent deterioration or contamination by dirt, detrimental rust, loose scale, paint, oil or other foreign substances that will destroy or reduce bond.

.3 Do not straighten or rebend reinforcement in any manner.

.4 Do not use bars kinked or bent by improper handling or storage.

PART 2 - PRODUCTS

2.1 REINFORCING STEEL

.1 Reinforcing steel to meet CSA-G30.12 as shown on drawings:

.1 All bars shall be 400 MPa grade

.2 Welded steel wire fabric to CSA-G30.5, provide in flat sheets only.

2.2 CHAIRS, BOLSTERS, BAR SUPPORTS, SPACERS

.1 Provide adequate support of reinforcement (according to CRSI Manual of Standard Practice).

.2 For exposed or architectural concrete surfaces use accessories which are plastic coated, stainless steel or as indicated on the drawings.

.3 Precast concrete block supports must be equal in strength and quality to the concrete in the structure.

.4 Chairs, bolster bar supports and spacers shall have sufficient strength to support the reinforcing under normal construction conditions. Brick shall not be used for bar supports.

2.3 FABRICATION

.1 Fabricate reinforcing steel from bar sizes and grades indicated within the following tolerances:

.1 Sheared length: plus or minus 25 mm.

.2 Depth of truss bar: plus or minus 13 mm.

.3 Stirrups, ties and spirals: plus or minus 13 mm.

.4 Location of bends: plus or minus 25 mm.

.2 Unless otherwise indicated, fabricate in accordance with CSA-A23.1.

PART 3 - EXECUTION

3.1 INSPECTION

.1 Notify Consultant to permit inspection after placement is completed. Reinforcing for all concrete pours shall be inspected after placing and prior to concreting.

.2 Provide adequate notice of scheduled pours to facilitate inspection of reinforcement (minimum of 24 hours).

3.2 PLACING OF REINFORCEMENT

.1 Place reinforcement as shown on the reviewed shop drawings and in accordance with CSA-A23.1.

.2 Support reinforcement in position as follows:

.1 Beams, walls, and columns - laterally support reinforcement with supports in pairs on opposite faces.

.2 Do not use supports which will be forced into the supporting formwork or soil by the weight of the reinforcement or other construction loads.

.3 Separate layers of bars by precast mortar blocks, bars or equally suitable devices. Do not use pebbles, pieces of broken stone or brick, metal pipe or wooden blocks.

.4 Do not place bars on layers of fresh concrete as the work progresses or install bars during placing of concrete.

.3 Provide concrete cover as follows unless detailed otherwise on drawings:

.1	Cast against and permanently exposed to earth	75 mm
.2	Exposed to earth, weather or water:	
	No. 20 through No. 55 bars	50 mm
	No. 15 bars, 16 mm wire and smaller	40 mm
.3	Not exposed to weather or not in contact with the ground:	
.1	Slabs, walls and joists:	
	No. 45 and No. 55 bars	40 mm
	No. 35 bars and smaller	20 mm
.2	Beams, girders, and columns: Principal reinforcement, ties, stirrups and spirals	40 mm
.3	Shells and folded plate members:	
	No. 20 bars and larger	20 mm
	No. 15 bars, 16 mm wire, and smaller	15 mm
.4	Slabs on grade (top surface)	40 mm

3.3 WELDING OF REINFORCEMENT

.1 Welding of reinforcing bars is not permitted.

3.4 SPLICING OF REINFORCEMENT

.1 Splice bars only as shown on the drawings or approved by the Consultant.

.2 Bar splices shall conform to CSA3-A23.3, Type B, unless noted.

.3 Lap adjacent sheets of wire fabric to provide an overlap of at least one cross wire spacing plus 50 mm, measured between outermost cross wires of each sheet.

3.5 DETAILS

.1 Corner Bars: Install corners bars in walls and beams to match the larger size of normal reinforcement unless otherwise noted on the drawings.

.2 Openings in slabs or walls: Unless otherwise noted, install 2 additional 15 M bars on all sides of every opening, one near each concrete face or the number of bars intercepted, divided equally between the two sides, whichever is greater. Bars to extend one lap length past each side of the opening.

END OF SECTION

PART 1 - GENERAL

1.1 DESCRIPTION

.1 This section specifies requirements for stripping of topsoil. organic material and gravel from the site.

.2 The work includes:

- Stripping and hauling to disposal.

- Stripping and stockpiling for re-use.

1.2 RELATED WORK

.1 Grading - Section 31 22 16.

1.3 REGULATIONS

.1 Abide by provincial and municipal regulations with regard to stream crossings, diversions or alterations to drainage patterns.

1.4 LIMITS

.1 Stripping width shall be to limits shown on the drawings.

.2 Stripping width for pipelines shall be the full width of the trench, plus the width of area to be used for spoil piles and the width of working areas.

.3 The Consultant may order specific areas to be stripped; and the width of stripping for pipeline construction shall be acceptable to the Engineer.

.4 The Consultant may waive stripping of wet land areas, at his discretion.

.5 If the topsoil is frozen strip the area over the trench and only other areas designated by the Consultant.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.1 NOTIFICATION

.1 The Contractor shall notify the Consultant in writing, a minimum of 3 working days prior to commencement of stripping.

.2 The Consultant and the Contractor shall inspect the area to be stripped to establish specific requirements and to review procedures, which shall be confirmed in writing by the Contractor.

3.2 STRIPPING AND STOCKPILING

.1 Load, haul and place in stockpiles in the designated areas.

.2 Stockpile in a manner that will not endanger persons, the work or adjacent property.

.3 Keep topsoil stockpiles separate and do not mix with common excavation.

.4 Maintain a minimum of 1 m separation between topsoil and common excavation material when piling.

.5 Leave openings in stockpiles so that fields are accessible to Owners.

3.3 STRIPPING AND DISPOSAL

.1 Strip organic material that will not be re-used.

.2 Strip unsuitable material.

.3 Load, haul and dispose of stripped material.

3.4 DISPOSAL AREAS

.1 Disposal areas shall be as shown on the drawings or as marked in the field by the Engineer.

.2 Grade the disposal areas to provide adequate drainage.

3.5 STRIPPING FROZEN TOPSOIL

.1 Frozen topsoil may be stripped by ripping provided a minimum of 2 passes are made, the first of which shall not exceed 50% of the topsoil depth.

3.6 MIXING

.1 If the topsoil and subsoil are mixed and the topsoil is adversely affected, the Contractor shall, at his own expense, engage a soils specialist to determine the necessary remedial work, and shall perform the required work.

END OF SECTION

PART 1 - GENERAL

1.1 DESCRIPTION

.1 This section specifies requirements for grading for roads, parking lots, easements and general site grading.

.2 NOTE: The property has gas lines and other easements. The Contractor is responsible for executing the ATCO Crossing Agreement and obtaining all approvals and inspections as required by ATCO

.3 The work includes:

- Grading, in accordance with contours, cross sections, grades and elevations shown on the drawings and as staked by the Contractor.
- Excavation of organic materials and stockpiling or placing in fill areas on site, or hauling to disposal.
- Excavation of common excavation materials from areas on the site that are to be cut, and hauling and placing in fill areas on the site or hauling to disposal.
- Supplying and placing common borrow material.
- Supplying and placing pit run gravel fill.
- Supplying and placing sand or granular fill.
- Excavation and hauling stockpiled and excess material to disposal areas.
- Excavation and hauling rock to disposal areas.
- Subgrade preparation.

1.2 RELATED WORK

.1 Stripping - Section 31 14 13

1.3 QUALITY ASSURANCE

.1 Submit to the Consultant a list of sources of materials including sand, gravel, and borrow materials.

.2 Provide samples, test results, sieve analyses and reports for preliminary approval of materials.

.3 Preliminary approval of material does not constitute general acceptance. Acceptance depends upon satisfactory field test results and performance in place.

1.4 QUALITY CONTROL TESTING

.1 Moisture density curves to ASTM D698-78.

.2 Sieve analyses to ASTM C136-84a.

.3 Field densities to ASTM D2167-84 or to ASTM D2922-81.

.4 Minimum quality control test frequencies specified as follows are the minimum number required. The Contractor shall perform as many tests as are necessary to ensure that the Work conforms to the requirements of the Contract regardless of the minimum number required.

.5 Provide moisture/density curves for each type of material from each source of material to be compacted to a specified density.

.6 Field densities:

- Pit run gravel - one for each 2000 m^2 of compacted layers.
- Crushed gravel - one for each 2000 m^2 of compacted layers.
- Common borrow - one for each 2000 m^2 of compacted layers.
- Embankments (from excavated material) - one for each 4000 m^2 of compacted layers.

1.5 REGULATIONS

.1 Abide by provincial and municipal regulations with respect to stream crossings, diversions or alterations to drainage patterns.

.2 Conform with blasting requirements of the Canadian Construction Safety Code and all local and provincial codes.

.3 Obtain the approval of the Consultant and the Owner and employ a licensed explosive expert to supervise blasting.

1.6 BORROW AREAS

.1 Strip overburden from borrow areas, and restore borrow areas after use, leaving the borrow sites in a neat and uniform condition.

.2 The Contractor is responsible for all borrow pit royalties.

PART 2 - PRODUCTS

2.1 ORGANIC MATERIAL

.1 Organic material is peat moss, or other organic soil underlying the topsoil, or topsoil that has not previously been stripped.

2.2 UNSUITABLE MATERIALS

.1 Unsuitable materials are materials other than organic material that are in the opinion of the Consultant not suitable for use in subgrade of roads or in embankments, or fills.

2.3 COMMON EXCAVATION MATERIALS

.1 Common excavation materials shall be materials excavated from the site, consisting of sand, clay or silty material, other than rock, organic materials or unsuitable material which can be removed and placed in fill areas, embankments or stock piles for re-use, or otherwise disposed of. Compaction shall be included at 98% of the Soils Standard Proctor Density. Moisture content shall be between 0 and 2% above the soils optimum moisture content.

2.4 COMMON BORROW MATERIALS

.1 Common borrow material is obtained from areas off the site.

.2 Common borrow materials shall be sandy or silty clay materials of medium plasticity or sand or pit run gravel from borrow pits. Common borrow materials shall be free from topsoil, organic material, or debris. Borrow or import shall also include compaction and moisture contents as referenced in 2.3.1 above.

2.5 PIT-RUN GRAVEL

.1 Pit run gravel shall be maximum size 75 mm complying with the following gradation.

Sieve Size	Percent Passing
200 mm	100
150 mm	96 - 80
75 mm	60 - 80
25 mm	70 - 100 ⎫ material passing
4.75 mm	25 - 63 ⎭ the 75 mm sieve
1.18 mm	14 - 41
600 um	7 - 30
150 um	3 - 18
75 um	2 - 9

2.6 SAND

.1 Sand shall be maximum size 9.5 mm complying with the following gradation.

Sieve Size	Percent Passing
9.5 mm	100
4.75 mm	95 - 100
2.36 mm	80 - 100
1.18 mm	50 - 85
600 um	26 - 60
300 um	10 - 30
150 um	2 - 10

2.7 CRUSHED GRAVEL

.1 Crushed gravel shall be maximum size 20 mm complying with the following gradation.

Sieve Size	Percent Passing
20.0 mm	100
10.0 mm	60 - 80
4.75 mm	40 - 60
2.36 mm	28 - 48
600 um	13 - 29
300 um	9 - 21
150 um	6 - 15
75 um	4 - 10

2.8 COARSE GRAVEL

.1 Coarse gravel for bedding and drainage shall conform to the following grading:

Nominal Gravel Size (Square Openings)	50 mm	40 mm
SIEVE SIZES	PERCENT PASSING BY WEIGHT	
50 mm	100	---
40 mm	90 - 100	100
25 mm	---	95 - 100
20 mm	35 - 70	---
15 mm	---	25 - 60
10 mm	10 - 30	---
4.75 mm	0 - 5	0 - 10
2.36 mm	---	0 - 5

2.9 ROCK

.1 Rock is either single boulders, pieces of concrete or masonry with a volume in excess of 0.73 m^3 or any material that cannot be removed by a tracked machine having a bucket capacity of 0.95 to 1.15 m^3, and which requires for its removal, drilling and blasting or breaking up with a power operated hand tool.

.2 No soft or disintegrated rock which can be removed with a hand pick; no material which can be ripped with a crawler tractor having a rated horsepower of 200 to 249; no loose or previously blasted rock or broken stone and no rock exterior to the minimum limits for measurement allowed, will be measured or allowed.

.3 Frozen material is not classified as rock.

PART 3 - EXECUTION

3.1 PREPARATION OF SITE

.1 Complete site clearing and stripping before beginning grading.

.2 Maintain slopes and adequate drainage during grading.

3.2 INSPECTION OF MATERIALS ON SITE

.1 Obtain Consultant's approval prior to using material on site.

3.3 GRADING PROCEDURES

.1 Excavate to the required subgrade elevation and to cross sections shown on the drawings, or as designated by the Consultant.

.2 Excavate rock and haul to disposal areas.

.3 Excavate organic material and stockpile or place in fills, if approved by the Engineer.

.4 Excavate unsuitable material and haul to disposal areas.

.5 Do not mix organic materials, unsuitable materials or rock with other excavated materials.

.6 Over excavate as required to remove organic and unsuitable material.

.7 Over excavate to remove organic and unsuitable material, such that there is a 5:1 slope between the in situ material and the material replaced with gravel.

3.4 EMBANKMENTS AND FILLS

.1 Uniformly grade areas to be filled before placing material.

.2 Place common excavated materials in embankments and fills; and in over excavated areas if approved by the Consultant.

.3 Construct embankments by depositing, shaping and rolling materials in layers not exceeding 150 mm thickness.

.4 Where compaction of embankments and fills is required place the material in 150 mm lifts and compact to the following minimum percentages of the maximum density as determined by the Standard Proctor Compaction Test.

- Outside of the road right-of-way 98%

- Within the road right-of-way 98%

.5 In the event that the material is too wet to obtain the specified density thoroughly work the material by blading or other acceptable means, until the optimum moisture content is reached. If the material is too dry add water as necessary. Moisture content of the material being placed in fills and embankments shall be controlled to within 0 plus 2% of the optimum condition.

.6 Schedule work to use the common excavated materials completely. Borrowing of materials will be authorized only after all suitable common excavated materials have been utilized.

.7 If common excavated materials are not available in sufficient quantity to complete the work, or if borrow materials are required, supply and place either common borrow, sand, crushed gravel or pit-run gravel as specified and compact as specified above.

3.5 FINISHING

.1 Final surfaces shall be reasonably smooth and uniform, free from lumps, loose earth, stones and debris.

.2 Grades shall be within 15 mm of design grades.

3.6 UTILITIES AND APPURTENANCES

.1 Locate, protect and mark all utilities and appurtenances, including manholes, catch basins, valves and hydrants.

.2 Adjust utility structures and appurtenances to final grades and elevations.

3.7 SUBGRADE COMPACTION

.1 Scarify, shape and compact the subgrade to a minimum of 98% of the maximum density as determined by the Standard Proctor Compaction Test.

.2 Total compacted thickness shall be 200 mm.

3.8 SUBGRADE ELEVATION

.1 Final surfaces shall be within 15 mm of design grades.

3.9 PROOF ROLLING

.1 If ordered by the Consultant, supply and operate a loaded test vehicle of 8200 kg axle load to test the roadway subgrade.

END OF SECTION

PART 1 - GENERAL

1.1 DESCRIPTION

.1 This section specifies the requirements for granular sub-base and base course for roadways and parking areas.

.2 The work includes:

.1 Supply of granular materials.

.2 Placing and compacting sub-base: 200 mm Designation 6, Class 80 (Aggregates: Refer to Standard Specification for Highway Construction, Alberta Transportation, Table 3.2.3.1)

.3 Placing and compacting base course: 100 mm Designation 2, Class 25 (Aggregates: Refer to Standard Specification for Highway Construction, Alberta Transportation, Table 3.2.3.1)

1.2 RELATED WORK

.1 Section 31 22 16 Grading

.2 Section 32 12 16 Asphalt Paving

1.3 MAINTENANCE OF TRAFFIC

.1 Perform work in a manner that will cause the least disruption to traffic.

.2 Closing of streets, detouring of traffic, posting of traffic signs and provision of flagmen shall be the Contractor's responsibility.

.3 Maintain detour roads.

1.4 PERMITS

.1 Obtain all permits required for this section of the work and abide by the stipulations of the permits.

1.5 QUALITY ASSURANCE

.1 Submit to the Consultant a list of sources of materials including sand, pit-run gravel, and crushed gravel.

.2 Provide samples, test results, sieve analyses and reports for preliminary approval of materials.

1.6 QUALITY CONTROL TESTING

.1 Moisture density curves to ASTM D698-78.

.2 Sieve analyses to ASTM C136-84a.

.3 Field densities to ASTM D2167-84 or to ASTM D2922-81.

.4 Minimum quality control test frequencies specified as follows are the minimum number required. The Contractor shall perform as many tests as are necessary to ensure that the Work conforms to the requirements of the Contract regardless of the minimum number required.

.5 Provide moisture/density curves for each type of material from each source of material to be compacted to a specified density.

.6 Field densities:

.1 Road base - one for each 1200 m^2

PART 2 - PRODUCTS

2.1 GRANULAR SUB-BASE

.1 Consists of sound, hard, durable, uniformly graded pit run or crushed gravel or sand as specified.

2.2 GRANULAR BASE

.1 Consists of sound, hard, durable particles of gravel, stone, sand and fine soil particles crushed to a uniform gradation, and to the maximum size designated.

2.3 GRANULAR SUB-BASE AND GRANULAR BASE

.1 Shall not contain sod, roots, plants or other organic materials, neither shall they contain soft fragments such as shale or flaky particles in excess of fifteen (15%) percent by weight. The materials shall be well graded from course to fine within the gradation limits, and shall not be subject to extreme variation between the lower and upper limits of the gradation band specified.

.2 On the prepared materials that portion of fine aggregate, including supplementary material, if any, which passes the 425 micro-m sieve shall have a Liquid Limit of not more than 25 and a Plasticity Index of not more than 6.

2.4 GRADATION DESIGNATIONS

.1 When tested on Standard Laboratory screens the materials shall meet one or more of the following gradations.

Designation 1 - Sand

Sieve Size	Percent Passing
9.5 mm	100
4.75 mm	90 - 100
150 micro-m	20 max.

Designation 2 - Pit Run Gravel - Max, Size 75 mm

Sieve Size	Percent Passing
75 mm	100
25 mm	60 - 85
4.75 mm	30 - 60
75 micro-m	2 - 10

Designation 3 - Crushed Gravel - Max. Size 20 mm

Sieve Size	Percent Passing
20.0 mm	100
12.5 mm	60-96
5.0 mm	37-76
2.0 mm	26-60
400 mm	11-41
160 micro m	6-21
63 micro m	2-10

For crushed gravel not less than 60 percent of the material retained on the 4.75 mm sieve shall be crushed particles. The ratio of the percentage passing the 75 micro-m sieve shall not exceed two-thirds and preferably not less than one-half.

PART 3 - EXECUTION

3.1 SUB-GRADE

.1 The sub-grade shall be shaped to the cross-section shown on the plans prior to placing the sub-base course thereon. The Contractor shall maintain the sub-grade to the specified compaction and section, free from ruts, waves, and undulations, by whatever means are necessary.

.2 The sub-grade or sub-base course shall be in a firm dry condition before any material is placed thereon and the Engineer's consent must be obtained before placing any granular material.

3.2 PLACING OF SUB-BASE AND BASE COURSE

.1 Unless otherwise specified, 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 levelled with a suitable motor grader.

3.3 COMPACTION OF SUB-BASE AND BASE COURSE

.1 The granular sub-base and base course material shall be compacted by rolling with a pneumatic tired roller, vibratory roller or other approved type. Each layer shall be compacted at the optimum moisture content, to 100 percent of the maximum dry density as determined by the Standard Proctor Compaction Test for the material used.

.2 During compaction, water shall be added by an applicator, in such quantities that the moisture content will be maintained at the optimum level as determined by the Standard Proctor test. If the moisture content exceeds the optimum moisture content, the material shall be aerated by mechanical means or work shall cease temporarily until the material has dried sufficiently to reach the optimum moisture content.

3.4 SHAPING OF SUB-BASE AND BASE COURSE

.1 A blade grader shall be used in conjunction with the compaction equipment to keep the finished surface of each layer even and uniform. The finished surfaces of the granular base course and sub-base course shall conform to the required cross-section and grades as shown on the drawings and as staked by the Contractor and approved by the Consultant, within a tolerance of plus or minus 15 mm. The finished sub-base course surface shall show no depression more than 13 mm under a straight edge of 3 m long placed parallel to the road centre line. The finished base course surface shall show no depression more than 6 mm under a straight edge 3 m long placed parallel to the road centre line.

3.5 PROOF ROLLING

.1 If ordered by the Consultant, the Contractor shall supply and operate a loaded test vehicle of 8 200 kg axle load to test the sub-base and base for rutting and weaving.

.2 Where proof rolling indicates areas that are defective, remove and replace according to this specification at the Contractor's expense.

END OF SECTION 32 11 00

PART 1 - GENERAL

1.1 DESCRIPTION

.1 This section specifies requirements for asphaltic plant mix base course and surface course.

.2 The work includes supply of aggregates, and asphalt; preparation and placing and the supply and placing of prime and tack coats.

1.2 RELATED WORK

.1 Section 31 22 16 Grading

.2 Section 32 11 00 Granular Road Base.

1.3 MAINTENANCE OF TRAFFIC

.1 Perform work in a manner that will cause the least disruption to traffic.

.2 Closing of streets, detouring of traffic, posting of traffic signs and provision of flagmen shall be the Contractor's responsibility.

.3 Maintain detour roads.

1.4 PERMITS

.1 Obtain all permits required for this section of the work and abide by the stipulations of the permits.

.2 Notify the Consultant as to intended sources of supply of aggregates.

1.5 QUALITY ASSURANCE

.1 The Contractor is totally responsible for the quality of materials and products which he provides for the Work.

.2 Materials supplied by the Contractor shall be tested for compliance with the specifications by the Contractor.

.3 The Contractor shall submit copies of test data to the Consultant within 24 hours of receiving results.

1.6 MINIMUM QUALITY CONTROL TEST FREQUENCIES

.1 The following frequencies of testing are the minimum required. The Contractor shall perform as many tests as are necessary to ensure that the work conforms to the requirements of the Contract regardless of the minimum number specified.

.2 Submit a certified laboratory analysis to the Consultant for each shipment of asphalt cement.

.3 Provide test data re the temperature viscosity relationship.

.4 Submit one copy of results of each of the following control tests for each class of aggregate to be used:

.1 Los Angeles Abrasion Test - ASTM C131-81

.2 Crushed Fragments

.3 Specified Gravity and Absorption ASTM C127-84 and ASTM C128-84

.4 Material passing 75 micro-m sieve - ASTM C117-87

.4 Combined aggregate tests shall be taken prior to the aggregate being combined with asphalt.

.1 Sieve analysis (ASTM C136-84A) will be taken daily.

.2 Moisture contents of dried aggregates will be taken daily.

.5 The testing agency shall sample asphalt mixtures daily, and in accordance with ASTM D1559-82 method subject the samples to a density and air voids analysis and an asphalt content determination.

.6 A stability value shall be established at least once in each five days of mixing.

.7 Density determination and air void contents shall be taken by the Testing Agency at a rate of one test for each 1,600 m^2 of each layer; and at least one each day during placing operations.

.8 Nuclear density determinations, if required by the Consultant, will be in accordance with ASTM D2950-71 and will be at a rate of 5 tests per 1,600 m^2 of each layer.

.9 Final curing and analysis tests will be taken at the rate of one test each 4,000 m^2 of pavement.

.10 Cores will be measured and tested to provide the following information.

.1 Thickness

.2 Asphalt content

.3 Density

.4 Sieve analysis

.5 Percentage voids (ASTM D3203-83)

1.7 QUALITY CONTROL TESTING BY THE OWNER

.1 The Owner may employ a testing agency to do on-site materials testing in addition to the Contractor's Quality Control Testing as the work progresses.

.2 The Engineer and the Owner's testing agency shall have access at all times to all parts of the operation for testing, for verification of weights, temperatures, proportion and character of materials.

.3 The Contractor shall provide the means at the asphalt mixing plant for the Owner's testing agency to obtain representative samples for testing of combined aggregates.

1.8 SUBMITTALS - MIX DESIGN

.1 The Contractor shall pay for and submit duplicate copies of a design mix as recommended by a testing agency employed by the Contractor.

.2 The Contractor shall submit to the Consultant a mix design for each required asphalt concrete mix type at least 10 days before start of production and for each subsequent change in supplier or source of materials. No hot-mix production can proceed until the applicable mix design and job-mix formula are approved by the Engineer.

.3 Mix types: Mixes are designed according to use as follows:

.1 Surface (ACS) - (Mix B - Calgary) surface course for freeways, arterials, industrial/ commercial and collectors.

.2 Base (ACB) - (Mix A - Calgary) base course for freeways, arterials, industrial/ commercial and collectors.

.3 Residential (ACR) - for paving residential streets only.

.4 Residential (Type III) - for paving residential streets only - base course

.4 The mix design shall be performed by a qualified laboratory possessing a permit to practice under the Engineering, Geological and Geophysical Professions Act of Alberta, following the Marshall Method of Mix Design as set out in the latest edition of the Asphalt Institute Manual Series No. 2 (MS-2) to the following criteria:

MIX TYPE	ACS	ACB	ACR	TYPE III
Max size of aggregate, mm	20	25	12.5	20
No. of blows	75	75	50	75
Minimum stability, kN	6.7	6.7	4.5	6.5
Min retained stability, %	75	75	75	75
Flow value, 0.254 mm unit	6-12	6-12	8-16	6-12
Air voids, % of total mix	4.0 ± 0.2	4.0 ± 0.4	3.0 ± 1.0	3.0 ± 1.0
Voids filled, %	70-75	70-75	75-85	70-75
Minimum film thickness, mm	6.5	6.0	7.0	6.0

1.9 JOB MIX FORMULA

.1 Submit with the mix design the proportions of materials and plant settings to include the following:

.1 For Batch Plant:

.1 Sieve analysis of the combined aggregate in the mix.

.2 Sieve analysis of aggregate in each bin separation to be used.

.3 Mass of material from each bin for each batch of mix.

.4 Mass of asphalt in each batch.

.5 Mixing temperature of the asphalt as determined from its temperature viscosity relationship.

.2 For Continuous or Drum-Mix Plant:

.1 Sieve analysis of combined aggregate in the mix.

.2 Mass of asphalt by tonne of mix.

.3 Mixing temperature of asphalt determined from its temperature-viscosity curve.

.4 Settings of aggregate and asphalt feed systems.

.3 The quality assurance laboratory will test a trial batch of job-mix formula to verify the mix design. The mix design and job-mix formula will not be approved until successful results are obtained. If the initial trial batch fails, submit results of further trial batch tests performed by a quality control laboratory.

.4 Do not make changes to approved job-mix formula without written approval from the Consultant.

.5 Display approved job-mix formula in clear sight of plant operator. Failure to display the currently approved job-mix formula will result in a plant shutdown order by the Engineer.

.6 Production rate: Produce hot-mix at a rate compatible with the rate of placement and compaction of the job.

.7 Recommended quality control plan: Before commencing hot-mix production, submit for the Engineer's review a quality control plan including the following recommended tests and frequency for each mix type produced. Make test results available weekly to the Consultant for review.

.1 Tests: Three Marshall specimens per test

- Asphalt content

- Air voids
- Stability and flow
- Film thickness
- Moisture content in mix
- Gradation in mix
- Plant discharge temperature
- Asphalt storage temperature

.2 Frequency: a minimum of two tests per day in full production

.8 Tolerances and Quality Assurance:

.1 Mixing Temperature Tolerance: Allowable variation from design mixing temperature shall be ± 9° C.

.2 Asphalt Cement: Samples of asphalt cement used will be taken weekly from each source and tested for penetration and kinematic viscosity.

.3 Production Mix Analysis: Samples will be taken for each 1000 t minimum of hot-mix, or each day's production, whichever is less, and subjected to complete Marshall testing.

.1 Asphalt Content Tolerance: Allowable variation from approved design asphalt content shall be ± 0.3% by mass of mix.

.2 Tolerance in Extracted Aggregate from Approved Job-Mix Gradation:

	% Passing by Mass	
Sieve Size (mm)	Individual Sample	Average of Last 10 Samples
5.0	± 5.0	± 3.0
1.25	± 4.0	± 2.5
.63	± 3.0	± 2.0
.315	± 3.0	± 2.0
.15	± 2.0	± 1.5
.80	± 1.5	± 1.0

.4 Crushed-Face Count: For each mix type, the minimum percentage, by mass retained down to the 5 mm sieve, having at least two crushed-faces shall be as follows, provided there is a minimum 50% crushed-face counts in each individual sieve size greater than 5 mm:

Mix Type:	ACS	ACB	ACR	Type III

	Crushed-Face Count	75%	70%	70%	60%

.5 Tolerance for Air Voids in Mix:

Mix Type:	ACS	ACB	ACR	Type III
Air Voids, %	4.0 ± 1.0	4.0 ± 1.0	3.0 ± 1.0	3.0 ± 1.0

.9 Nonconforming Mix Production: If one or more of the preceding mix production tolerances are exceeded, the Consultant will order suspension of mix production until the Contractor has demonstrated to the Engineer's satisfaction that corrective measures have been taken to produce a mix that meets requirements.

1.10 PRODUCT DELIVERY, STORAGE, HANDLING

.1 Handle all aggregate in a manner that will prevent segregation, and intrusion of foreign materials.

1.11 SITE EXAMINATION

.1 Examine all existing structures and protect them from damage during laying operations.

.2 Ascertain that the base course is properly compacted and prepared for placement of the surface course.

PART 2 - PRODUCTS

2.1 PRIME COAT

.1 Bituminous primer MC-0 or MC-1 (MC-30 or MC-70) or as approved by the Consultant.

2.2 ASPHALT CEMENT

.1 Asphalt shall be prepared by the refining of petroleum.

.2 Asphalt shall be uniform in character and shall not foam when heated to 177°C.

.3 Delivery temperature shall be between 135°C and 177°C.

.4 One of the following grades will be selected by the Consultant, on the basis of the laboratory analysis results.

	ASTM	Grades	
Characteristics	Test Method	AC5 Min.	AC2.5 Min.
Viscosity at 60°C, in poises	D2171-85	500	250

Penetration at 25°C,			
100 gm., 5 sec.	D5-86	150	250
Thin Film Oven Test,	D1754-83		
Penetration after test			
25°C, 100 gm., 5 sec.			
% of original	D5-86	45	45

2.3 TACK COAT

.1 R.C. 30 asphalt or as approved by the Consultant.

2.4 SAND

.1 100% passing 4.75 mm sieve - clean granular sand.

2.5 MINERAL AGGREGATE

.1 Coarse fractions shall consist of hard, clean, durable crushed stone, crushed slag, crushed gravel or a combination thereof or of material naturally occurring in a fractured condition.

.2 Coarse aggregates shall meet the quality requirements of ASTM D692-85.

.3 Fine aggregates shall consist of natural sand and/or manufactured material derived from crushing stone, slag or gravel. All particles shall be clean, tough, durable, moderately sharp and free from coatings of clay silt or other deleterious materials and shall contain no organic matter.

.4 When tested by means of laboratory sieves, the combined aggregates in the mix shall meet the following requirements for the various mix types:

Mix Type:	ACS	ACB	ACR	Type III
Designation 1 Class	20	25	12.5	20
Sieve Size (mm):	Total Passing Sieve Percent by Mass			
25	--	100	--	--
20	100	80-95		100
12.5	80-95	--	100	--
5	45-65	40-60	60-80	40-65
0.8	--	--	--	20-36
.16	9-14	9-14	9-14	--
.08	4-8	4-8	4-8	--
.063	--	--	--	2-10

.1 Coarse Aggregate is that fraction of the total aggregate retained on the 5 mm sieve.

.2 Fine Aggregate is that fraction of the total aggregate passing the 5 mm sieve.

.1 Fine aggregate shall contain manufactured or crushed fines at a percentage by mass of fine aggregate as follows:

Mix Type:		Surface	Base
Manufactured Fines:	Minimum	70%	60%
	Maximum	85%	

.2 Pit-run material shall be pre-screened to remove natural sand and subsequently crushed and screened to obtain manufactured fines.

.3 Aggregate in Stockpile:

.4 Stockpile aggregate in horizontal lifts. Stacking conveyors are not allowed for stockpiling. Draw aggregate from stockpile in a manner that mixes the full depth of stockpile face.

.5 When it is necessary to blend aggregates from one or more sources to produce the combined gradation, stockpile each source or size of aggregate individually. Do not blend aggregates in stockpile; feed through separate bins to the cold elevator feeders.

.5 Aggregate Quality Control:

.1 Engage a quality control laboratory to conduct aggregate sampling, sieve analysis to ASTM C136, crushed face count, abrasion and soundness tests. Submit abrasion and soundness test results for each aggregate source. Submit results of sieve analysis and crushed face count to the following frequencies:

.1 For Existing Stockpile at Time of Contract Award: a minimum of one sieve test and one crushed face count per 1000 t. Submit also the average gradation of entire stockpile when submitting a mix design using it.

.2 For Aggregate Stockpiled During Contract: a minimum of one sieve test and one crushed face count per 1500 t, or each day's production, whichever is less. Submit results within 24 hr of testing.

.2 Do not use aggregate until test results have been reviewed and accepted by the Engineer.

.3 Notify the Consultant when production of the manufactured fines is scheduled, so that he has the opportunity to inspect the manufacturing process. Failure to notify the Engineer will result in non-approval of the fines for use in asphalt concrete.

2.6 MINERAL FILLER

.1 Portland cement, fly ash or ground limestone may be used if necessary to meet grading specifications and if permitted by the Consultant. Submit mill tests and gradation prior to hot-mix production and as requested by the Consultant. Mineral filler shall have zero plasticity index and shall meet the following gradation:

Sieve Size (mm)	% Passing, by Mass
.40	100
.16	90 minimum
.08	70 minimum
.045	62 minimum

PART 3 - EXECUTION

3.1 INSPECTION

.1 No priming or paving shall be carried out until the surfaces to be paved have been inspected and approved by the Consultant.

.2 If ordered by the Consultant the Contractor shall supply and operate a loaded test vehicle of 8 200 kg axle load to test the subbase and base for excessive rutting.

.3 The load test will be directed by the Consultant and the Contractor shall pay for the test vehicle and for any repairs required to the road base.

.4 Remove ruts, waves and undulations by mechanical means.

.5 Clean and check the base course to ensure that the surface of the base course is within 6 mm of the design grade.

3.2 GENERAL

.1 Construction traffic on pavements under construction shall be suitable in relation to the thickness of the courses it traverses so that damage is not caused to the sub-grade or material already compacted.

.2 The wheels or tracks of equipment moving over the various pavement courses shall be kept free from deleterious materials.

.3 Base course shall be kept clean and uncontaminated for so long as it remains uncovered by a wearing course or surface treatment. The only traffic permitted access to base course material shall be that engaged in laying and compacting the wearing or surface course or, where the base course is to be blinded or surface dressed that engaged on such a surface treatment. Should the base course become contaminated, the Contractor shall make good by cleaning it to the satisfaction of the Consultant and if this proves impracticable, by removing the layer and replacing it to specification.

.4 Any piece of machinery causing the spillage of fuel oil, lubricating oil or hydraulic oil onto the surface prior to laying or onto the finished surface shall be removed from the work. Any areas of base or surface course affected by the spillage will be cut out and replaced as the Consultant shall direct and at the Contractors own expense.

.5 Any final surface found to be defective either in finished quality or as a result of subsequent laboratory testing, will be cut out and replaced at the Contractors expense. The area cut out of any final pavement surface will be not less than 15 m longitudinally by the full width of the section laid down.

.6 If it is necessary to use aggregates from more than one source, the material shall be introduced into the dryer through a divided system of cold feed. The material shall be fed in such a manner that no segregation to the various sources takes place.

.7 The net weight of asphaltic binder added to the mix shall be controlled to within 2 percent of the specified weight in kg required. Plants using the fluidometer method must be equipped with a bypass and scale in order that the actual weight of the bitumen used in kg may be quickly checked.

3.3 APPLICATION OF PRIME COAT

.1 All surfaces including the surface of the base and edges of existing buildings or curbs and gutters shall be completely dry and free of loose material before the prime coat is applied. No primer shall be applied when the ambient temperature is lower than 10°C. No priming shall be carried out until the surfaces to be primed have been inspected and approved by the Engineer.

.2 Application shall be made uniformly by means of an approved pressure distributor at a rate of 1.08 to 2.17 Litres per m^2 at an application temperature of 21° to 50°C or as directed by the Engineer. Sufficient primer shall be applied to completely cover the surface and to be absorbed and set within a period of 24 hours.

.3 Blot up excess primer with sand and keep traffic off the primed area until the primer has been absorbed.

.4 Priming includes priming the edges of existing curbs, gutters and pavement.

3.4 EQUIPMENT

.1 Plant - General

.1 Use a batch mixing type plant or other type approved by the Consultant which is capable of combining, drying and heating the mineral aggregate, heating the asphalt and accurately proportioning all materials to produce an asphaltic hot mix possessing the foregoing characteristics within designated tolerances. It shall be complete with a drier equipped with a dust collector, a gradation control unit to reject over-size material and to separate and store the dried aggregate into at least three hot material bins, a positive displacement asphalt pump, a twin shaft pugmill, a weight box or hopper equipped for accurately weighing the aggregates, and proper thermometric equipment.

.2 The Consultant or his authorized representative shall have access at any time to all parts of the paving plant.

.3 The plant used shall be of a type which is approved by the Consultant and which shall be so designed, coordinated and operated to provide a mixture conforming to the job mix requirements.

.2 Equipment for Preparation of Bituminous Materials

.1 Tanks for storage of bituminous materials shall be equipped for heating the material, under effective and positive control at all times, to the temperature required in the paving mixture specifications. Heating shall be done by steam or oil coils, electricity, or other means such that no flame shall contact the heating tank.

.2 A circulation system for the bituminous material shall be of adequate capacity to provide proper and continuous circulation between storage tank and proportioning units during the entire operating period.

.3 All pipe lines and fittings shall be steam or oil jacketed or otherwise properly insulated to prevent heat loss.

.4 The discharge end of the bituminous binder circulating pipe shall be kept below the surface of the bituminous material in the storage tank to prevent discharging the hot bituminous material into the open air.

.5 Storage tank capacity shall suffice for at least one day's run.

.6 The Contractor shall provide a sampling outlet in the bituminous material feed lines connecting the plant storage tanks to the bituminous material weighing system. The outlet shall consist of a valve installed in such a manner that samples may be withdrawn from the line slowly at any time during the plant operation. The sampling outlet shall be installed between the pump and the return line discharge in a location that is readily accessible and free from obstruction. A drainage receptacle shall be provided for flushing the outlet prior to sampling.

.3 Feeder for Dryer

,1 The plant shall be provided with mechanical means for uniformly feeding the aggregate into the dryer so that uniform production and temperature may be assured. When aggregates must be blended from two or more sources at the cold feed to meet the requirements of the job mix formula a synchronized proportioning method shall be provided.

.4 Dryer

.1 A dryer of satisfactory design shall be provided. The dryer shall be capable of drying and heating the aggregate to the moisture and temperature requirements set forth in the paving mixture specifications, without leaving any visible unburned oil or carbon residue on the aggregate discharged from the dryer.

.5 Screens

.1 Plant screens shall have adequate capacity and size range to properly separate all of the aggregate into the sizes required for proportioning so that they may be recombined consistently within the specification limits.

.2 6 mm and 3 mm screens shall be provided in the plant to ensure proper control of the uniformity of mix.

.3 Over-run shall be limited to having not more than twenty (20) percent in any one bin.

.4 Screens shall be checked daily and cleaned when necessary.

.6 Bins

.1 The Plant shall have a hot bin storage of sufficient capacity to ensure uniform and continuous operation. Bins shall be divided into the specified number of compartments arranged to ensure separate and adequate storage of appropriate fractions of the aggregate.

.2 Each compartment shall be provided with an overflow pipe of such size and at such location to prevent any backing up of material into other bins or into contact with the screen.

.3 Adequate additional dry storage shall be provided for mineral filler, when required, and provisions shall be made for accurate proportioning.

.4 Bins shall be equipped with "telltale" devices to indicate the position of the aggregate in the bins at the lower quarter points. An automatic plant shut off shall be provided to operate when any aggregates bin becomes empty.

.5 Adequate and convenient facilities shall be provided for obtaining aggregate samples from each bin.

.7 Weight Box or Hopper

.1 The equipment shall include a means for accurately weighing each bin size of aggregates into a weight box or hopper, suspended on scales and ample in size to hold a full batch without running over.

.2 The weight box or hopper shall be supported on fulcrums and knife edges that will not easily be thrown out of alignment or adjustment.

.3 Gates, both on the bins and the hopper shall be constructed to prevent leakage when closed.

.8 Aggregate Scales

.1 Scales for any weigh box or hopper may be of either beam or springless dial type and shall be of standard make and design having tolerances on over registration not exceeding 0.1 percent of the indicated weight when tested for accuracy.

.2 All weighing equipment shall be tested and sealed as often as the Engineer may deem necessary to ensure accuracy.

.3 Bituminous Control Unit

.1 Satisfactory means, either by weighing or metering, shall be provided to obtain the proper amount of bituminous material. Metering devices shall prove accurate to within 2 percent variation, above or below the actual weight in kg required.

.2 Adding the bituminous material shall not take more than 10 seconds. Where the quantity of bitumen is metered, provision shall be made to check the delivery of the meter by actual weight.

.3 Suitable means shall be provided either by steam or oil jacketing or other insulation for maintaining specific temperatures of the bitumen in the pipe lines, meters, weigh buckets, spray bars, and other containers or flow lines.

.4 Thermometric Equipment

.1 An armored recording thermometer of suitable range shall be fixed in the bituminous material feed line at a suitable location near the discharge at the mixer unit.

.2 The plant shall be equipped with approved automatic recording thermometers, pryometers, or other approved recording thermometric instruments at the discharge chute of the dryer and in the hot fines bin to register and record automatically the temperatures of the heated aggregate.

.5 Mixer Unit for Batch Method

.1 The plant shall include a batch mixer of an approved twin pugmill type capable of producing a uniform mixture within the permissible job mix tolerances.

.2 It shall have a batch capacity of not less than 0.9 t.

.3 The mixer shall be designed to provide means of adjusting the clearance between the mixer blades and liner plates to ensure proper and efficient mixing.

.4 The mixer shall be of the enclosed type.

.5 The mixer shall be constructed to prevent leakage of the contents.

.6 Mixer discharge shall not cause appreciable segregation.

.7 The mixer shall have an accurate time lock to control the operation of a complete mixing cycle by locking the weigh box gate after the charging of the mixer until closing of the mixer gates at the completion of the cycle; it shall lock the bituminous material control unit throughout the dry and wet mixing period.

.8 The dry mixing period is defined as the interval of time between the opening of the weigh box gate and the application of the bitumen. The wet mixing period is the interval of time between the start of application of the bituminous material and opening of the mixer gate.

.9 The timing control shall be flexible and capable of being set at intervals of not more than 5 seconds throughout cycles up to 3 minutes.

.6 Dust Collectors

.1 When plants are located where dust may be objectionable or where dust interferes with the efficient operation of the plant, proper housing, mixer covers, or duct collective systems shall be installed. Provisions shall be made to waste the material collected or to return it uniformly to the mixture as the Engineer may direct.

.7 Safety Requirements

.1 Adequate and safe stairways to mixer platforms shall be provided and guarded ladders to other plant units shall be located where required.

.2 All gears, pulleys, chain, sprockets and other dangerous moving parts shall be thoroughly protected.

.3 Ample unobstructed space shall be provided on the mixing platform.

.4 An unobstructed passage shall be maintained at all times in and around the truck loading space. This space shall be kept free of drippings from the mixing platform. A ladder or platform shall be located at the truck loading space to permit easy and safe inspection of the mixture as it is delivered into the trucks. Overhead protection shall be provided where required.

.8 Continuous Mixing Plants

.1 Continuous plants will not be accepted unless prior approval is received from the Consultant.

.2 Approval will depend on uniformity of source of aggregates, type of plant and location.

.3 In addition to the above, continuous plants must meet the requirements as laid down by the Asphalt Institute, with regard to Special Requirement for Continuous Plants.

3.5 PREPARATION OF HOT MIX MATERIAL

.1 Preparation of Mineral Aggregate

.1 The mineral aggregates shall be dried to maximum moisture content of 1/2 of 1 percent, and heated so that when delivered to the mixing unit, they shall be at as low a temperature as is consistent with proper mixing and laying and in no case to exceed 163°C. The mineral aggregate may be fed simultaneously into the same dryer, but in all cases immediately after heating, they shall be screened into bins, with separation on the 6 mm, 3 mm, and such other coarser sieves specified as the number of bins permit.

.2 Preparation of Binder

.1 The asphaltic binder shall be carefully heated to a specified temperature between 118°C and 150°C depending on the temperature viscosity relationship, by approved means designed to secure uniform heating of the entire contents of the storage tank. The temperature differential between aggregates and binder shall at no time be more than 4°C.

.3 Composition of Mixture

.1 The mineral aggregate and asphaltic binder shall be mixed in a manner to produce a homogeneous mixture in which all particles of the mineral aggregate are uniformly coated and in such proportions as to produce a mixture having an asphaltic binder content as indicated by the approved job mix formula. When the mixture is prepared in a twin pugmixer, the volume of mineral aggregate and

asphalt cement shall not be so great as to extend above the tips of the mixer blades when those blades are in a vertical position.

.2 After the hot aggregate and mineral filler have been charged into the mixer, and thoroughly mixed for a period of not less than 15 seconds, as directed by the Engineer, the asphaltic binder shall be added and the mixing continued for a period of at least 20 seconds, and not more than 45 seconds.

3.6 HAULING OF ASPHALTIC PLANT MIX MATERIAL

.1 Truck boxes must be clean and lightly lubricated with thin oil, and loads shall be covered when, in the opinion of the Consultant, weather conditions require it.

.2 Trucks must be driven in a manner such that damage will not occur to surfaces and slopes of the roadway.

.3 Deliver hot mix material at a temperature within 10°C of the temperature specified by the Consultant.

.4 Do not haul over previously placed asphalt until it is compacted and cooled.

3.7 PREPARATION OF BASE

.1 Clean the prepared base free of loose or foreign material.

.2 Where old asphalt surfaces are to be overlaid, apply an approved emulsion or cut back asphalt to the surface at the rate of 0.50 to 1.50 L/m^2.

.3 Base surfaces shall be dry when hot mix asphalt is placed.

3.8 SPREADING THE MIXTURE

.1 General

.1 Hot mix asphalt shall be placed with time remaining so that compaction can be completed during daylight hours, when the air temperature is 2°C, and rising and the road surface is dry.

.2 The mixture shall not be placed when in the opinion of the Consultant, the road and weather conditions are unfavorable.

.3 The mixtures shall be laid when temperatures, as measured in the truck boxes are not lower than 124°C, or more than 150°C. Trucks shall have an accessible 6 mm diameter hole, drilled into the driver's side of the box at a distance of 0.3 m from the box bottom for purposes of checking asphalt mixture temperatures.

.2 Mechanical Spreading

.1 Spread the mixture by means of a mechanical self-powered paver, capable of spreading the mix, within the specified tolerances, true to line, grade and crown set by the Consultant. The paving machine shall be operated so that material does not accumulate and remain along the sides of the receiving hopper. Pavers shall be equipped with a quick and efficient steering device and shall be capable

of traveling both forward and in reverse. They shall be equipped with hoppers and distributing screws which place the mix evenly in front of adjustable screed.

.2 The screed shall include strike-off devices operated by cutting, crowding or other action which is effective on mixes at workable temperatures without tearing, shoving or gouging them, and which produces a finished surface of an even and uniform texture. The screed shall be adjustable as to height and crown and shall be equipped with a controlled heating device for use when required. The screed shall strike off the mix to the depth and cross-section specified.

.3 Pavers shall operate when laying mixtures at such a speed between 2.4 m and 6.0 m per minute, or as may be decided by the Consultant.

.4 Equipment which leaves tracks or indented areas which cannot be corrected in normal operations, or which produces flushing or other permanent blemishes or fails to produce a satisfactory surface, shall not be used.

.5 Pavers shall be capable of spreading mixes without segregation or tearing. They shall also be capable of placing courses in thickness from 13 mm to at least 150 mm. Extensions and cut off shoes shall permit changes in widths by increments of 150 mm or smaller. They shall be equipped with blending or joint leveling devices for smoothing and adjusting all longitudinal joints between adjacent strips of courses of the same thickness.

.6 Each paving machine shall carry an approved 3 m straight-edge for checking finished surfaces.

.7 Transverse joints in succeeding courses shall be offset at least 1.2 m.

.8 Immediately after any course is screeded and before roller compaction is started, the surface shall be checked, any inequalities adjusted, all accumulation from the screed removed by rake or hoe, and all fat spots in any course removed and replaced with satisfactory material.

.9 Irregularities in alignment and grade shall be corrected before rolling. Before the addition of material to any mat, the surface must be broken with the tynes of a rake to ensure proper blending.

.10 Edges against which additional pavement is to be placed shall be straight and approximately vertical. A lute or rake shall be used immediately behind the paver, when required to obtain a true line and vertical face.

.11 The Contractor shall provide a competent workman who is capable of performing the work incidental to the correction of all pavement irregularities. Special attention shall be given by him to the straight edging of each course following the initial rolling.

.3 Hand Spreading

.1 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 Consultant.

.2 Placing by hand shall be performed carefully; the material shall be distributed uniformly to avoid segregation of the coarse and fine aggregates. Broadcasting

of material shall not be permitted during the spreading operations, but 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 Following placing and before rolling, the surface shall be checked with templates and straightedges and all irregularities corrected.

.4 Heating equipment used for keeping hand tools free from asphalt shall be provided. Caution shall be exercised to prevent high heating temperatures which may burn the material. The temperature of the tools when used shall not be greater than the temperature of the mix being placed. Heat only will be employed to clean hand tools; petroleum oil or solvents will not be permitted.

3.9 COMPACTION

.1 Breakdown Rolling

.1 The breakdown roller shall be an approved type of pneumatic tired roller whose tire pressures can be varied while the vehicle is moving.

.2 The Contractor shall furnish to the Consultant charts and tabulations showing the contact areas and contact pressures for the full range of the inflation pressures and for the full range of tire loadings to each type and size compactor tire furnished.

.3 The rollers shall be equipped with pneumatic tires of equal size and diameter which are capable of exerting average contact pressures varying from 275 kPa to 690 kPa by adjusting tire inflation pressure while in motion. The wheels of the roller shall be so spaced that one pass will accomplish one complete coverage equal to the rolling width of the machine. There shall be a minimum of 6 mm overlap of the tracking wheels. The wheels shall oscillate but not wobble. The roller shall be so constructed that the contact pressure shall be uniform for all wheels.

.4 Steel wheeled rollers shall immediately follow the pneumatic tired breakdown roller. Steel wheeled rollers may be of three types; three wheeled rollers, two axle tandem rollers and three axle tandem rollers. These rollers shall be equipped with power units of not less than four cylinders and working under conditions shall develop contact pressures under the compression rolls of 113 to 159 Kg per 25 mm of width.

.5 Rollers shall be equipped with a reversing clutch adjustable scraper to keep the wheel surfaces clean and with means of keeping them moist to prevent mixes from sticking. These surfaces shall have no flat areas, openings or projections which will mar the surface of the pavement.

.6 The three axle tandem rollers shall be so constructed that, when locked in position for all treads to be in one plane, the roller wheels are held with such rigidity that, if either front or centre wheel is unsupported, the other two wheels will not vary from the plane more than 6 mm.

.7 The use of vibratory packers will be permitted in conjunction with rubber tired packers. They shall be of a type designed for rolling asphalt which allows adjustment to the frequency of vibration. The resonant frequency for the

equipment and material shall be determined by the Contractor and approved by the Consultant.

.2 Rolling

.1 The rollers shall move at a slow but uniform speed with the drive roll or wheel nearest the paver. The speed shall not exceed 4.8 km/h for steel wheeled rollers or 8 km/h for pneumatic tired rollers.

.2 The line of rolling shall not be changed suddenly or direction of rolling reversed suddenly. If rolling causes displacement of material, the affected areas shall be loosened at once with lutes, rakes or shovels and restored to the original grade of the loose material before being rerolled. Heavy equipment or rollers shall not be permitted to stand on the finished surface before it has been compacted and thoroughly cooled.

.3 During rolling, the roller wheel shall be kept moist with only sufficient water to avoid picking up the material.

.3 Joints

.1 The mixture shall be laid so that all longitudinal joints are made while the first mat is still hot.

.2 A narrow strip along the edge of a mat which is to be joined with another asphalt mat shall be left without rolling until the adjoining mat has been placed against it. The joint which is formed shall be rolled immediately after the adjacent mat has been placed to ensure a bonding of the material while the asphalt is still hot.

.3 Transverse joints shall be carefully constructed and thoroughly compacted to provide a smooth riding surface. Joints must be straight edged or string lined to ensure smoothness and true alignment.

.4 Where previously laid asphalt or existing asphalt is encountered it shall be cut back, at the Contractor's expense, to a point where approximately 50 mm of asphalt is exposed. When spreading is resumed, the exposed edge of the joint will be painted with an approved bituminous material and the freshly laid mixture raked against the joint, tamped with hot tampers and rolled.

.4 Existing Structures

.1 All concrete or metal structures such as curbs and manholes, shall be painted with a thin coat of approved bituminous material on the surface that will be covered by plant mix material.

.2 Where mechanical placing methods will not produce the proper bond at joints, gutters, curbs or other structures, hand methods will be required for placing, spreading, raking and tamping the mix, in order that satisfactory results may be obtained.

3.10 DENSITY

.1 Required Density: Each mat of hot-mix placed shall be compacted to the following minimum density (% of Marshall density) for the type of paving, or as indicated in the Supplementary Conditions or drawings.

Minimum Density	Type of Paving
98%	New and staged paving of road base and surface
96%	Second stage residential mat 40 mm thick or less
97%	Lane paving
97%	Overlay more than 40 mm thick
96%	Overlay 40 mm thick or less.

.2 Sampling and Testing: The quality assurance laboratory will:

.1 Determine the density of laboratory compacted Marshall specimens at a minimum frequency of one Marshall density for every 1000 tonnes of hot-mix, or a day's production, whichever is less.

.2 Drill cores from compacted mat placed from same load of hot-mix from which Marshall specimens were taken, or from suspect compacted mat, and test for density.

.3 Basis of Acceptance: Pavement compaction will be accepted on the basis of the ratio (in percent) of the core density to the density of Marshall specimen. If cores were drilled from mat where no Marshall specimen was taken, acceptance will be based on ratio of core density to the average density of all Marshall specimens to date.

.4 Representative Cores: A single core is initially taken representing quantity of hot-mix in not more than 1000 m^2 of mat, with a minimum of one core taken from a day's production. If the core density is below specified, three more cores will be taken from the same area and the average density of the three new cores represents that area.

.5 Deficient Density: If the average core density is below specified, the represented area of mat may be accepted subject to a pay factor according to the following table to be applied to the price of the quantity of hot-mix in that mat area.

ASPHALT DENSITY PAY FACTORS

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

Actual Density = % of Marshall Density
Pay Factor = % of Contract Price

3.11 SURFACE TOLERANCES

.1 Smoothness:

.1 Maximum variation under 3 m straightedge as follows:

.2 Longitudinal in direction of travel: 3 mm

.3 Transverse to direction of travel: 6 mm

.4 (Straight crossfall)

.2 Grade:

.1 +6 mm maximum variation from designated grade elevations.

.3 .3 Texture:

.1 Finished surface shall have a tightly knit texture free of visible signs of poor workmanship such as, but not limited to:

.2 Segregation

.3 Areas exhibiting excess or insufficient asphalt

.4 Improper matching of longitudinal and transverse joints

.5 Roller marks, cracking or tearing

.4 Defective Surface: If surface and grade tolerances are exceeded, or if surface texture is not met, grind down and resurface defective areas as directed by the Consultant.

3.12 THICKNESS TOLERANCE

.1 The quality assurance laboratory will take three cores from each 1000 m^2 of asphalt pavement suspected to be deficient of the specified total thickness. The average thickness of the three cores represents that area.

.1 If average core thickness is deficient, that area of asphalt pavement will be assessed a pay factor according to the following table to be applied to the price of the top 50 mm of asphalt surface.

ASPHALT THICKNESS PAY FACTORS

THICKNESS DEFICIENCY (mm)	PAY FACTOR (% of Price of Top 50 mm)
6	100.0
7	97.0
8	93.0
9	90.0
10	85.5
11	80.5
12	75.0
13	68.0
14	60.0
15	50.0
Over 15	Grind and resurface

.2 Asphalt pavement with excess thickness may be accepted if surface and grade tolerances and texture are met, but no additional payment is due.

3.13 METHOD OF PENALTY PAYMENT

.1 The penalty for deficient asphalt as calculated per Sections 3.10 to 3.12 will be deducted from payment to the Contractor. Final computation of the penalty may not be completed until the end of the maintenance period. The penalty may therefore take the form of an interim hold back from progress payments to the Contractor.

END OF SECTION 32 12 16

PART 1 - GENERAL

1.1 DESCRIPTION

.1 This section specifies the requirements for surface gravel for roads and parking areas that will not be paved.

.2 Base Course: 100 mm Designation 2, Class 25 (Aggregates: Refer to Standard Specification for Highway Construction, Alberta Transportation, Table 3.2.3.1)

.3 Sub-base: 200 mm Designation 6, Class 80 (Aggregates: Refer to Standard Specification for Highway Construction, Alberta Transportation, Table 3.2.3.1)

1.2 RELATED WORK

.1 Refer to Section 31 22 13 - Grading.

1.3 REGULATIONS

.1 Abide by the bylaws and regulations of the Province, Territory or Municipality in which the work is located.

.2 Obtain permission from the Local or Highway Authority for haul routes and abide by the regulations with respect to their maintenance.

.3 Aggregates: Refer to Standard Specification for Highway Construction, Alberta Transportation, Table 3.2.3.1

PART 2 - PRODUCTS

2.1 25 MM MAXIMUM CRUSH

Sieve Size	Percent Passing
25 mm	100
19 mm	95 - 100
9.5 mm	60 - 80
4.75 mm	40 - 60
2.00 mm	25 - 45
425 micro-m	10 - 25
75 micro-m	2 - 10

For crushed aggregate not less than 60 percent of the material retained on the 4.75 mm sieve shall be crushed particles. The ratio of the percentage passing the 4.75 mm sieve to the ratio passing the 425 micro-m sieve shall not exceed two-thirds and preferably not less than one half.

2.2 MINIMUM QUALITY CONTROL TEST FREQUENCIES

.1 The following frequencies of testing are the minimum required. The Contractor shall perform as many tests as are necessary to ensure that the Work conforms to the requirements of the Contract regardless of the minimum number specified.

.2 Crushed Gravel

.1 One sieve analysis for every 500 m^3 of crushed gravel.

.2 One field density for every 2000 m^2 of compacted layers.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Excavate and dispose of topsoil and objectionable surface materials.

.2 Excavate and remove unsuitable materials in the subgrade and replace with approved embankment material.

3.2 COMPACTION

.1 The Contractor shall compact the gravel to 98% of the maximum density as determined by the Standard Proctor Compaction Test, with approved compaction equipment.

3.3 UTILITIES

.1 Utility appurtenances shall be adjusted to 6 mm - 13 mm below finished surface elevation and protected during the duration of the work.

END OF SECTION 32 15 23

PART 1 - GENERAL

1.1 DESCRIPTION

.1 This section specifies requirements for cast-in-place concrete sidewalks, curbs, and other flatwork.

.2 The work includes:

.1 Preparation of subgrade

.2 Supply and placing of fills and cushion materials

.3 Supply of materials and casting in place separate sidewalks, monolithic sidewalks, and curbs.

.4 Finishing, curing, and backfilling.

1.2 QUALITY ASSURANCE

.1 Submit to the Consultant a list of sources of materials including sand, gravel, borrow materials and concrete aggregates.

.2 Provide samples, test results, sieve analyses and reports for preliminary approval of materials.

.3 Submit to the Consultant for review:

.1 Concrete mix design

1.3 QUALITY CONTROL TESTING

.1 Moisture density curves: to ASTM D698-78.

.2 Sieve analyses: to ASTM C136-84a.

.3 Field densities: to ASTM D2167-84 or to ASTM D2922-81.

.4 Concrete testing: to CSA CAN3-A23.3 M77.

.5 Minimum quality control test frequencies specified as follows are the minimum number required. The Contractor shall perform as many tests as are necessary to ensure that the Work conforms to the requirements of the Contract regardless of the minimum number required.

.6 Cast 3 concrete test cylinders for each compressive strength test, one cylinder for the 7 day test and 2 for the 28 day test.

.7 Curbs

.1 One test each section 0 - 200 linear m of curb.

.8 Separate sidewalk

.1 One test for each section 0 - 200 linear m of sidewalk.

.9 Monolithic sidewalk

.10 One test for each section 0 - 150 linear m of 1200 mm monolithic sidewalk, curb and gutter.

.11 Air content tests - one test per load or batch of concrete.

.12 Make slump tests at the discretion of the Consultant.

1.4 MAINTENANCE OF TRAFFIC

.1 Perform work in a manner that will cause the least disruption of traffic.

.2 Closing of streets, detouring of traffic, maintaining detour roads, posting of traffic signs, barriers and flagmen shall be the Contractor's responsibility.

1.5 ALTERNATIVES

.1 The Consultant will consider alternative materials and methods of construction such as extruded curb and gutter.

.2 Submit complete details and specifications to the Consultant, including materials, method of construction, method of control and equipment details.

1.6 DISPOSAL

.1 All materials on site whether stockpiled, stored or excavated are the property of the Owner, and the Owner reserves the right to keep any part or all of the material.

.2 The Contractor shall dispose of debris, waste, unsuitable materials, rejected work, broken concrete or excess material in accordance with the specifications.

.3 The Contractor shall dispose of all materials at sites to be located by the Contractor.

PART 2 - PRODUCTS

2.1 SAND CUSHION

.1 Cushion material shall consist of sand, crusher screenings or other approved material meeting the following requirements:

Sieve Size	Percent Passing
19 mm	100
425 micro-m	20 - 60
75 micro-m	10 - 20

2.2 CONCRETE

.1 To CAN3-A23.1 M77.

.2 Concrete mix shall be in accordance with the following:

	Minimum 28 Day Strength	Designated Size of Aggregate	Slump	Air Entrainment	Water Cement Ratio	Class
All Areas	25 MPa	Max. 25 mm to 76 mm	25 mm	6 - 8% maximum	0.50	B

.3 Cement

.1 Type 10 - Normal Portland Cement,

.2 Type 50 - Sulphate Resistant Portland Cement.

2.3 EXPANSION JOINTS

.1 Premoulded expansion joint filler minimum thickness 13 mm, cut to the same shape as the component into which it is installed.

2.4 REINFORCEMENT

.1 Wire mesh - P35 x P35 - 150/150 - welded wire fabric.

.2 Reinforcing bars - 10 M deformed bars to meet CSA-G30.12 M77. Where bars overlap, they are to be tied with wire.

.3 Fiber reinforced concrete is an acceptable alternative to reinforcing bars in concrete drainage swales.

2.5 FILL MATERIALS

.1 Pit run gravel - shall be maximum size 75 mm complying with the following gradation:

Sieve Size	Percent Passing
75 mm	100
25 mm	80 max.
4.75 mm	60 max.
75 micro-m	10 max.

2.6 CURING COMPOUND

.1 Curing compound to ASTM C309 TYPE 1-D Class B.

2.7 SEALING SOLUTION

.1 Mixture of 50% boiled linseed oil and 50% kerosene or varsol.

PART 3 - EXECUTION

3.1 REMOVAL OF EXISTING STRUCTURES

.1 Remove existing curbs, sidewalks and other structures shown on the drawings to be removed.

.2 Cut existing concrete neatly, and load and haul debris to designated disposal areas.

3.2 EXCAVATION

.1 Excavate materials to the required grade, elevations, and cross-sections as shown on the drawings.

.2 Remove all deleterious substances encountered at the subgrade level and replace with approved fill material, compacted to 98% of maximum density as determined by the Standard Proctor Compaction Test, to provide a uniform bearing over the area of the structure.

.3 If the subgrade is excavated in error, below the specified grade, replace with approved fill material compacted to 98% of maximum density as determined by the Standard Proctor Compaction Test, at the Contractor's expense.

.4 Load, haul and dispose of excavated material that is unsuitable for use as fill, or surplus excavated material. Refer to Paragraph 1.5 Disposal.

3.3 FILL

.1 Areas to be filled shall be stripped of topsoil and graded uniformly before fill is placed.

.2 Fill material shall be approved fill material, either pit run gravel or common fill.

.3 Spread fill material in 150 mm layers and compact to 98% of maximum density as determined by the Standard Proctor Compaction Test.

3.4 SUBGRADE COMPACTION

.1 Scarify, shape and compact the subgrade to a minimum of 98% of maximum density as determined by the Standard Proctor Compaction Test.

.2 Total Compacted Thickness - 150 mm.

3.5 CUSHION

.1 The Consultant shall inspect the condition of the subgrade before cushion material is placed.

.2 Place the cushion material with a maximum of 50 mm compacted thickness.

.3 Compact cushion to 98% of maximum density as determined by the Standard Proctor Compaction Test.

3.6 FORMING

.1 Use straight, smooth and clean metal or timber forms oiled with Parvelube #30 or approved alternative.

.2 Place forms to line and grade; and brace and stake firmly in place.

.3 Use wooden forms or other approved equal for curved surfaces with radii less than 46 m.

3.7 ADJUSTMENT

.1 Adjust elevations of manholes, valves, catch basins and other structures to suit final grades, and wrap metal surfaces to be cast in concrete with a layer of plastic.

.2 All valves located in sidewalks shall be screw type, encased within a protective PVC pipe sleeve, suitable in size to allow for future adjustment of the valve.

3.8 INSPECTION

.1 Inspect the subgrade and cushion to ensure that the base has not been softened by moisture, and to ensure that the base is not too dry for placing concrete.

.2 Delay placing concrete as required to dry the base if the base is too wet or add moisture as necessary to prevent absorption of water from concrete if the base is too dry.

.3 The Consultant shall inspect the base before concrete is placed.

3.9 COLD WEATHER REQUIREMENTS

.1 Do not place concrete when air temperature is below 4°C, unless the following requirements are met.

.2 Preheat water and aggregates as well as reinforcing, forms and the ground.

.3 When temperature in the shade is 2°C and indications are that the temperature will fall, cover the concrete and maintain an adequate air cushion at 10°C, and if forced air heating is used add moisture. Keep the air cushion heated for 72 hours and keep the protection for 96 hours.

.4 Do not use calcium chloride, except with the written permission of the Engineer and then only with normal portland cement and in quantities less than 2% by weight. Close control of calcium chloride quantities and careful mixing are required.

3.10 POURING AND VIBRATING

.1 Place concrete in forms and consolidate in the forms using mechanical vibrators.

.2 Vibrate sidewalks and rolled face monolithic sidewalks with a vibrating screed, approved by the Consultant.

.3 Vibrate curb and gutter sections with a poker type vibrator not exceeding 50 mm in diameter.

3.11 EXPANSION JOINTS

.1 Place expansion joint material at each expansion joint, construction joint and at the following locations.

.1 Transversely at the beginning and end of curve where the radius is less than 15 m.

.2 Around all structures such as poles, valve boxes, hydrants, and existing concrete.

.3 Adjacent to any existing building or structure.

3.12 CONTRACTION JOINTS AND SURFACE JOINTS

.1 Form 6 mm wide and 50 mm deep contraction joints and 13 mm deep surface joints in sidewalks every other 1.5 m as detailed on the drawings.

.2 Provide 3 mm wide contraction joints in curb and gutter every 3 m by placing a steel plate in the forms and withdrawing the plate after concrete has attained its initial set.

.3 Provide 3 mm wide surface joints longitudinally between sidewalk and curb.

3.13 FINISHING

.1 Work the concrete surface with a wood float and brush with a stiff brush or broom to provide an even surface.

.2 Avoid excessive trowelling.

.3 If there is excessive water, delay finishing until excess water has evaporated.

.4 Remove surplus water from brushes before brushing.

.5 Tool all edges 50 mm wide with rounded edges.

3.14 PRIVATE AND LANE CROSSINGS

.1 Construct private crossings at all existing private driveways and where required by the Consultant.

.2 Construct lane crossings at all lanes, commercial buildings, service stations, and where required by the Consultant.

.3 Construct paraplegic ramps at locations shown on the drawings. Paraplegic ramps shall be constructed monolithically or securely dowelled to the curb.

.4 Dimensions, reinforcing and joints shall be as detailed on the drawings.

3.15 PROTECTION

.1 Supply and place tarpaulins and other materials necessary to protect the work from weather.

.2 Supply and sprinkle water as necessary to control dust.

.3 Barricade the work as necessary to prevent damage to the work, and leave in place for at least 7 days.

3.16 STRIPPING FORMS

.1 Remove forms carefully after initial set, and repair damaged surfaces immediately.

3.17 CURING

.1 Apply curing compound immediately after forms are removed.

.2 Apply curing compound uniformly with an approved pressurized spray.

3.18 SEALING

.1 Apply sealing solution if ordered by the Consultant.

.2 Concrete surfaces must be clean and dry.

.3 Make the first application of sealing compound between 3 to 7 days after the time that the concrete is poured.

.4 Apply the second coat immediately after the first coat has been absorbed and appears dry.

.5 Coverage - First coat 8.6 m^2 per litre.

.6 Second coat 12 m^2 per litre.

.7 Apply uniformly with an approved pressurized spray.

3.19 BACKFILLING

.1 Backfill material is common fill.

.2 Commence backfilling within 10 days, but not sooner than 7 days from the day the concrete was finished.

.3 The area between the edge of the concrete work and the surrounding ground shall be backfilled.

.4 If the top of the concrete is below the elevation of the surrounding ground, backfill to the full height of the concrete section and back slope at 1:5 slope, excavating as necessary.

.5 If the top of the concrete is above the elevation of the surrounding ground, backfill to the full height of the concrete and back slope at 1:5 to the level of existing ground.

.6 Where landscaping by other Contractors or the Owner follows the work of this contract, leave backfill 150 mm low to allow for topsoil.

.7 Where this contract includes curb and sidewalks, the Contractor shall grade the area between the curb and gutter and the sidewalk, cutting excess material and filling in where required.

3.20 CLEANUP

.1 Remove all debris and excess materials from the site immediately after completion of the work.

.2 Cleanup operations shall be carried on continuously as the work progresses.

END OF SECTION 32 16 13

1 General

1.1 GENERAL REQUIREMENTS

.1 Refer to Division 1, General Requirements.

.2 All contract documents form an integral part of this section

1.2 DESCRIPTION

.1 This section specifies the supply and placing of sod.

1.3 RELATED WORKS

.1 Section 32 91 19 Spreading of Topsoil

.2 Section 32 93 10 Tree Shrub Groundcover Planting

.3 Section 31 22 16 Grading

1.4 JOB CONDITIONS

.1 Report in writing to Consultant, prior to commencing work, any conditions or defects encountered on the site, upon which the work of this section depends, and which may adversely affect the performance of the work.

.2 Do not commence work until such conditions or defects have been investigated and corrected.

.3 Commencement of work implies acceptance of surfaces and conditions and no claim for damages or resulting extra work will be accepted except where such conditions cannot be determined prior to construction.

1.5 UTILITIES

.1 Before commencing work, establish location and extent of all utility lines in the area of any excavations.

.2 Contractor to stake in field and maintain utility locations until job is completed.

.3 The Contractor is responsible for all damage and subsequent repair to underground utilities resulting from his operations.

1.6 SOURCE QUALITY CONTROL

.1 Obtain review of sod by Consultant prior to installation.

.2 When proposed source of sod is reviewed, use no other source without written authorization.

1.7 SAMPLES

.1 Submit one (1) square metre of sample sod to Consultant for review.

1.8 DELIVERY AND STORAGE

.1 Schedule deliveries in order to eliminate storage at job site.

.2 Deliver and unload sod on pallets.

.3 Deliver sod to site within twenty-four (24) hours of being lifted.

.4 Do not deliver small, irregular or broken pieces of sod.

.5 Dry or discoloured pieces will be rejected.

.6 During wet weather allow sod to dry sufficiently to prevent tearing during lifting and handling.

.7 Protect sod from sun and drying winds. Water sod as necessary to ensure its vitality and prevent dropping of soil in handling. Dry sod will be rejected.

.8 Protect sod during transportation to prevent drying out. Sod to arrive at site in fresh and healthy condition.

.9 Lay all sod within twenty four (24) hours of delivery to the site.

1.9 **DRAINAGE CONTROL**

.1 Provide for proper water management and drainage of site during construction. Include silt traps, erosion control measures, temporary water collection ditches, as well as their adequate maintenance during construction period.

1.10 **WARRANTY**

.1 The Contractor hereby warrants that the work of this section will remain free of defects for a period of one (1) year after SubstantialPerformance of landscape works on project.

.2 End of Warranty inspection will be conducted by the consultant to identify deficiencies to be corrected by contractor in accordance with this specification.

2 **Products**

2.1 **MATERIALS**

.1 Nursery sod: Quality and source to comply with standards outlined in Guide Specification for Nursery Stock, published by Canadian Landscape Trades Association.

.1 Drought Resistant Kentucky Blue Grass Mix

.2 Sod will not contain any Poa annua.

.3 Sod to be cut by machines designed for that purpose, and by accepted methods, and rolled for shipment.

.4 Soil portion of sod not to exceed 25mm (1”) or be less than 12 mm (1/2”).

.2 Water: potable, free of impurities that would inhibit lawn growth. Contractor to ensure adequate water is available to maintain sod in its original healthy state.

.3 Fertilizer: complete synthetic slow release fertilizer. Type and application shall be as required by the soil analysis report.

.4 Wooden Pegs: lath pegs of sufficient length to ensure satisfactory anchorage of sod.

3 Execution

3.1 PREPARATION OF SURFACES

.1 Cultivate areas to be sodded to 100 mm depth. Fine grade, free of humps and hollows and free of deleterious and refuse material. All sticks and stones over 50 mm (2") in any direction shall be removed from the cultivated soil.

.2 All areas to be sodded which are misshapen or eroded shall be restored to specified condition, grade and slope as directed just prior to sodding. Minor adjustment and refinement of finish grade to be made as recommended by the Consultant.

.3 Crown or slope for surface drainage and eliminate all low spots or depressions.

.4 Consultant to review finish grading and growing medium depth prior to placement of sod.

3.2 LAYING OF SOD

.1 Lay sod during growing season. Sodding during hot, dry summer periods, at freezing temperatures, or over frozen soil is not acceptable.

.2 Lay sod in rows, perpendicular to slope, smooth and even with adjoining areas, and with joints staggered. Butt sections closely without overlapping or leaving gaps between sections. Cut out irregular or thin sections with a sharp knife.

.3 Lay sod smooth and flush with adjoining grass areas , paving and top surfaces of curbs unless shown otherwise on plans.

.4 On slopes exceeding 3:1, lay sod length wise up slope and peg every row with wooden pegs at intervals of not more that eighteen inches. Drive pegs flush with sod.

.5 Provide close contact between sod and soil by means of light roller. Heavy rolling to correct irregularities in grade is not permitted.

.6 Water immediately after sod laying to obtain moisture penetration through sod into top 100 mm of growing medium.

.7 Protect new sod from heavy foot traffic during laying. Place planks if necessary to prevent damage. Replace any sod damaged by construction or construction traffic.

3.4 MAINTENANCE

.1 Maintenance of plants shall begin immediately after planting operation and shall continue until all deficiencies noted in the Substantial Performance review have been rectified to the satisfaction of the Consultant. The Contractor is to notify the Consultant in writing forty eight hours (48) prior to stopping maintenance operations.

.2 All maintenance equipment and practices are to conform to the CLTA standards.

.3 Water sodded areas in sufficient quantities and at required frequency to maintain growing medium immediately under sod continuously moist for depth of 75 mm (3").

.4 First grass cutting to occur at 65 mm (2 1/2")height. Grass to be cut to a height of 38 mm (11/2"). Remove clippings. Continue regular weekly cutting until acceptance.

.5 Sodded areas are to be kept pests, disease, and noxious weeds and grasses.

.6 Fertilize sodded areas as per recommendations of growing medium analysis. Application of fertilizer shall follow manufacturers recommendations. Sod placed after October 1 shall not be fertilized until April 15th of the following spring.

3.5 **CLEAN UP**

.1 Clean up immediately any growing medium or debris spilled onto pavement.

.2 Remove all materials and other debris resulting from sodding operations from job site.

3.6 **FINAL ACCEPTANCE**

.1 Conditions for final acceptance of sod:

.1 Sodded areas have been maintained for a minimum period of (90) days after Substantial Performance.

.2 Sodded areas exhibit fully established root systems.

.3 Sod is free of bare and dead spots and without weeds.

.4 No surface growing medium is visible when grass has been cut to height of 68 mm (2 3/4”).

.5 Sodded areas have been cut a minimum of two, (2) times, a minimum seven (7) days apart.

.6 Sodded areas are a uniform green colour.

.7 Sodded areas exhibit a thick, dense, uniform and healthy appearance.

.2 Lawns sodded after November 1st will not be accepted until April 30th of the following growing season. All acceptance conditions must be fulfilled at that time.

END OF SECTION 32 29 38

Part 1 General

1.1 SECTION INCLUDES

.1 Fence framework, fabric, and accessories.

.2 Excavation for post bases; [concrete foundation for posts] [centre drop for gates].

.3 Manual gates and related hardware.

1.2 REFERENCES

.1 ASTM A123/A123M-15 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.2 ASTM A153/A153M-09 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

.3 [ASTM A428/A428M-10 - Standard Test Method for Weight (Mass) of Coating on Aluminum-Coated Iron or Steel Articles.]

.4 [ASTM A1011/A1011M-13 - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.]

.5 ASTM C94/C94M-15a - Standard Specification for Ready-Mixed Concrete.

.6 ASTM F567-11a - Standard Practice for Installation of Chain-Link Fence.]

.7 ASTM F668-11 - Standard Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric.

.8 ASTM F1083-13 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.

.9 CAN/CGSB 138.1-96 - Fabric for Chain Link Fence.

.10 CAN/CGSB 138.2-96 - Steel Framework for Chain Link Fence.

.11 CAN/CGSB 138.3-96 - Installation of Chain Link Fence.

.12 CAN/CGSB 138.4-96 - Gates for Chain Link Fence.

.13 CSA-A23.1-09/A23.2-09 - Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.

.14 CLFMI (Chain Link Fence Manufacturers Institute) - Product Manual.

1.3 SYSTEM DESCRIPTION

.1 Fence Height: As indicated on Drawings

.2 Line Post Spacing: At intervals not exceeding 3 metre

.3 Fence Post and Rail Strength: Conform to ASTM F1043, Light Industrial Fence quality.

1.4 QUALITY ASSURANCE

.1 Products of This Section: Manufactured to ISO 9000 certification requirements.

.2 Perform Work in accordance with CAN/CGSB 138.3.

.3 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years experience.

.4 Installer Qualifications: Company specializing in performing the work of this section with minimum three (3) years documented experience and approved by the manufacturer.

Part 2 Products

2.1 MATERIALS AND COMPONENTS

.1 Materials and Components: Conform to CLFMI Manual.

.2 Fabric Size: Light Industrial service.

.3 Intermediate Posts: Type I round

.4 Terminal, Corner, Rail, Brace, and Gate Posts: Type I round.

2.2 MATERIALS

.1 Framing (Steel): CAN/CGSB 138.2 Schedule 40 galvanized steel pipe, welded construction, minimum yield strength of 25 ksi; ASTM F668-11 - Standard Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric.

.2 Framing (Steel): ASTM A653/A653M hot rolled steel strip, cold formed to pipe configuration, longitudinally welded construction, minimum yield strength of 50 ksi; coating conforming to ASTM F1043 Type B on pipe exterior and interior.

.3 Fabric Wire (Steel): ASTM F668 PVC coated galvanized wire

.4 Concrete: CSA-A23.1/A23.2 Sulfate Resisting Portland Cement, 17 MPa strength at 28 days, 75 mm slump; nominal sized coarse aggregate.

2.3 COMPONENTS

.1 Line Posts: 60 mm diameter.

.2 Corner and Terminal Posts: 73 mm diameter

.3 Gate Posts: 89 mm diameter.

.4 Top and Brace Rail: 42 mm diameter, plain end, sleeve coupled.

.5 Fabric: 51 mm diamond mesh interwoven wire, 4 mm thick, top salvage knuckle end closed bottom selvage knuckle end closed

.6 Tension Wire: 5 mm thick steel, single strand.

.7 Tie Wire: Aluminum alloy steel wire.

.8 Gates: CAN/CGSB 138.4.

.1 Gate Frame: 42 mm diameter for fittings and truss rod fabrication.

2.4 ACCESSORIES

.1 Caps: Cast steel galvanized and PVC coated; sized to post diameter, set screw retainer.

.2 Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; steel.

.3 Gate Hardware: Man gate: Fork latch with gravity drop. Vehicle gate: Mechanical keepers; [wo (2), 180 degree gate hinges per leaf and hardware for padlock.

2.5 FINISHES

.1 Components and Fabric: Galvanized to ASTM A123/A123M, coating thickness appropriate grade for type and size of steel material indicated.

.2 Components and Fabric: Vinyl coating, colour black.

.3 Vinyl Components: Colour black

.4 Hardware: Galvanized to ASTM A153/A153M, 550 g/sq m coating.

.5 Accessories: Same finish as fabric.

Part 3 Execution

3.1 INSTALLATION

.1 Install framework, fabric, accessories and gates in accordance with ASTM F567.

.2 Place fabric on outside of posts and rails.

.3 Set posts plumb, in concrete footings with top of footing 150 mm below finish grade. Slope top of concrete for water runoff.

.4 Line Post Footing Depth Below Finish Grade: ASTM F567 1.0 m.

.5 Corner, Gate and Terminal Post Footing Depth Below Finish Grade: ASTM F567, 1.2 m

.6 Brace each gate and corner post to adjacent line post with horizontal centre brace rail Install brace rail one bay from end and gate posts.

.7 Provide top rail through line post tops and splice with 150 mm long rail sleeves.

.8 Install centrebrace rail on corner gate leaves.

.9 Do not stretch fabric until concrete foundation has cured twenty-eight (28) days.

.10 Stretch fabric between terminal posts or at intervals of 30 m maximum, whichever is less.

.11 Position bottom of fabric 50 mm above finished grade.

.12 Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 380 mmon centres.

.13 Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.

.14 Install bottom tension wire stretched taut between terminal posts.

3.2 ERECTION TOLERANCES

.1 Maximum Variation From Plumb: 6 mm.

.2 Maximum Offset From True Position: 25 mm.

.3 Components shall not infringe adjacent property lines.

END OF SECTION

PART 1 GENERAL

1.1 DOCUMENTS

.1 This section of the Specifications forms a part of the Contract Documents, and is to be read, interpreted and coordinated with all other parts.

1.2 SUMMARY

.1 This section specifies requirements for the supply and installation of site irrigation.

1.3 RELATED WORK

Section 32 91 19 Spreading of Topsoil.

Section 32 93 10 Trees, Shrubs and Groundcover Planting.

1.4 QUALITY ASSURANCE

.1 The system shall be installed by a firm regularly engaged in this type of work with experienced, qualified personnel under the direction and supervision of a foreman with a least 5 years of experience.

.2 Install the system in accordance with the drawings, specifications and the recommendations of the Manufacturer. Alternatives must be approved by the Consultant prior to bid submission.

.3 Shall conform to industry standards for institutional projects in general and the project documents, specifically unless prior written consent is obtained from the Consultant.

1.5 DRAWINGS

.1 Be aware that the irrigation system as shown on drawings is approximate and schematic and may require field adjustment. Confirm that layout is within project boundaries and property lines. Heads shall be spaced to ensure head to head coverage. Where deviation from the design drawing is anticipated, submit in writing, as required, change requests to The Consultant for approval.

.2 Verify all conditions on the site and immediately report all discrepancies and variation from the drawing to the Consultant.

.3 Provide the Consultant with preliminary ‘as-built’ drawing and two (2) copies for submission to the Client.

.4 No claim for final payment shall be honored until “as-built” drawings are approved by the Consultant.

.5 As-built drawings shall conform to the following:

.1 Submit a reproducible electronic drawing file which has been drafted in a

professional manner and is to scale on legal base plan, which shows the exact “as-built” location of the system relative to property line, including the locations of all lines, sprinkler heads, valves (drain and zone control), boxes, double check valves, parks water service, curb stops, underground pipe fitting not adjacent to surface fixtures (tee, elbows, etc.) saddles for poly pigtails and other irrigation materials prior to the issuance of final acceptance by the Consultant. All of the above items must be tied in at two points each from site property lines or other permanent on-site features.

.2 Requirements for acceptable submission of ‘as-built’ drawings will include, but not be limited to, the following:

- Sheet size to be consistent with the approved construction drawings. Title block to be supplied digitally by the Consultant.
- Labeled as “As-built Irrigation System”.
- Key plan showing location of site.
- Labeling to be a minimum of a 12 pt. Font.
- Plan of site showing property lines, bearings, surrounding site uses, north location, on-site structures, utilities, fences, buildings, walkways, etc., all to a suitable metric scale.
- Municipal address and legal description of said property including a registered plan number; if more than one address, refer to location of parks water service.
- Largest scale 1:200 with a minimum letter size of 12 pt. Font.
- Legend: Do not include Detail Sheets in as-built drawings; instead, refer to approved shop drawings. Clarify type of irrigation system (gravity drain, blow out or main line gravity drain with lateral line that has to be blown out).
- Number all irrigation zones starting from DCVA and turning to the right at a mainline junction, return to last turn and continue as before until all zones are numbered.
- Name, address and 24 hour phone number of installer as well as owner/developer and consultant, where applicable.
- Revised Irrigation Schedule Chart if as-built system varies from the design

1.6 COORDINATION WITH PRIVATE OWNERS

.1 Parts of the irrigation system may be on private property and will be operated by private owners. Coordinate the installation and operation of the irrigation system in these areas with other construction work and owners.

.2 Make arrangements with private owners to explain the system and ensure that they are familiar with the operation of the system

1.7 OPERATIONS AND MAINTENANCE DATA

.1 Provide three (3) copies, in binders, of instructions for operation and maintenance of systems and controls, seasonal activation/deactivation, and manufacturer’s parts catalog.

.2 If establishment or maintenance irrigation schedule deviates from the drawings, provide a schedule indicating length of time each valve is required to be open to provide a determined amount of water.

1.8 QUALIFICATIONS

.1 Install by experienced, qualified personnel under the direction and supervision of a foreman with a least 5 years of experience.

1.9 WARRANTY

.1 Warranty all workmanship, materials and operation of the irrigation system to the date of the issuance of final acceptance

PART 2 - PRODUCTS

2.1 SYSTEM DESIGN

.1 The site irrigation system is intended to provide irrigation for landscaped areas specified.

.2 Coordinate work of this section with work of other trades to prevent conflicts and disruption or damage to system

2.2 MATERIALS

.1 Materials shall be new and without flaw or defects of any type.

.2 Store all materials off the ground and under protection until ready to use. Support, as required, to prevent excessive strain on piping.

.3 Remove off site all materials that are damaged or rejected.

.4 Substitution of material to be approved by Consultant 72 hours prior to scheduled installation

2.3 PIPING AND FITTINGS

.1 Mainline piping to be Series 160 P.V.C. with schedule 40 fittings and schedule 80 nipples, or Type 3 Series 160 high density polyethylene pipe using butt fusion according to manufacturer's specifications.

.2 Lateral piping to be series 160 P.V.C. or Series 100 CSA poly pipe, with Schedule 40 fittings.

.3 For P.V.C. pipe with a diameter greater than 75 mm, gasketed type pipe and fittings with rubber gaskets shall be used. Solvent weld P.V.C. joints will be permitted on piping up to, but not including 75 mm diameter.

.4 Mainline connection to be double-clamped, as appropriate.

2.4 EMISSION DEVISES

.1 Rotors

.1 Shall conform to the drawings, but the following rotors may be considered; Hunter MPR 1000/3000, or approved equivalent.

.2 Sprayhead

.1 Shall conform to the drawings, but the following spray heads may be considered; Hunter SRS or approved equivalent.

.3 Quick Coupler Valves
.1 Hunter HQ or approved equivalent

2.5 HARDWARE

.1 Controller

.1 Automatic controller shall be C.S.A. certified as Class II power limiting circuit and of a commercial make and model, with dual programming capability, compatible with the designed system capable of handling the zones as noted on drawings.

.2 Zone control valves shall be C.S.A. certified as Class II power limiting circuit low voltage (i.e. 24 volts) operated only.

.2 Electric Valves

.1 Hunter ICV Series electric valve or an approved equal shall be used.

.3 Gate Valves

.1 Valves ¼" to 3": Red and White gate valves or an approval equal shall be used.

.4 Double Check Valve Assembly

.1 The term "double check valve assembly" (D.C.V.A.) shall mean an assembly composed of two independently acting, approved check valves, including tightly closing shut-off valves with resilient seats located at each end of the assembly and fitted with properly located test cocks as per C.S.A. B64 series-1976.

.5 Brass Saddles, Tees or Crosses

- Cambridge or A.Y. MacDonald.
- Rainbow saddles, tees and crosses or approved equals must be used.
- ¾" to 4" pipe size.
- ½" to 1" female threaded outlet (F.I.P.T.).
- Casting of saddle must be: 85% copper, 5% zinc, 5% tin, 5% lead.
- Bolts are of 18-8 non-corrosive stainless steel.
- To be used on series 160 PVC. Or series 100 polyethylene pipe.

.6 Irrigation Control Valve Boxes

.1 Manufactured irrigation boxes shall be of heavy-duty weight polyethylene and capable of being extended, and shall have a locking capability. Gravel beds in boxes, shall be cleaned, washed 19 mm.

.1 Wire Splices Box

Body	Carson 910-10 or an approved equal
Lid	Carson 910-4 or an approval equal

.2 Drain Boxes

Box	Carson 1419-12 or an approved equal
Lid	Carson 1419-4L or an approved equal
Extension	Carson 1419-6X

.3 Control Valve Box, Meter Valve Box, Gate Valve Box

Box	Carson 1220-12 or an approval equal
Lid	Carson 1220-4L or an approved equal
Extension	Carson 1220-6X

.4 Double-check Valve Assembly

Box	Carson 1730-18 or an approved equal
Lid	Carson 1730-3L or an approved equal

.7 Thrust Blocking

.1 Method of thrust blocking to be approved by Consultant (i.e. concrete, rock rebar or combination).

.2 Block all changes of direction and pipe endings (tee, elbow 45^0 and 90^0, plugs).

.3 All lines 4" and over will require concrete thrust blocks. Concrete will be Class B.

.8 Sleeving

.1 Sleeving shall be PVC SDR 35 bell and spigot pipe.

PART 3 - EXECUTION

3.1 Prior to commencing the installation work under this section, visit the site and meet with the landscape contractor to arrange for the orderly coordination of irrigation and landscape work. Provide the Consultant with Plumbing Permit prior to commencement. Fully coordinate work with other trades, so as not to delay work progress. If the water or electric service exists from a building, coordinate work with the building owner to ensure proper connections to services.

3.2 Stake out the location of all valves, piping and principal fittings. All additions, changes or equipment locations, shall be noted on the "working plans" from which the "as-built" drawings will be prepared. Additions/changes must be confirmed with the Consultant prior to construction.

3.3 Have layout inspected and approved by the Consultant before commencement of work. Due to changes in landscape elements, it may be necessary to adjust the spacing of the sprinklers in the field. Such changes that do not require extra materials or labor shall be done at no extra cost to The Client. If such changes result in extra cost, all such changes shall be approved, in writing, by The Consultant/Client before proceeding with work.

3.4 Install all components as per manufacturer's specifications and pipe shall have a minimum fall of .5% to drain boxes.

3.5 All emission devises are to be adjusted and set flush with final grade.

3.6 VALVES

.1 All valves shall be connected directly to the mainline in a plumb position with sufficient clearance for service and operation.

.2 Where requested by the Consultant/Client install a combination master valve with a water meter.

3.7 CONTROL/COMMON WIRING

.1 Lay wire in the trench with sufficient slack to accommodate backfilling and then backfill with suitable material.

.2 Ensure a 14-gauge tracer wire is installed with lateral lines.

.3 Provide a minimum of 24” coiled loops of wire at all control valves and changes in direction.

3.8 TRENCHING/PIPING

.1 Ensure that the grade has been set and approved by the Consultant before commencing trench operations.

.2 Width of trench shall be a minimum of three times the diameter of the pipe. Main line pipe depth shall be in accordance with the following table to ensure adequate coverage.

.3 Bed with suitable material to the proper depth and compact to meet the approval of The Consultant.

.4 The Contractor shall repair any settlement of the trenches by bringing them to grade with topsoil and sodding.

.5 Place sleeving, as required to enclose piping under paved areas. Depth of sleeving shall match drawings.

.6 Block all changes of direction and pipe endings (tee, elbow 45^0 and 90^0, plugs).

3.9 BACKFILLING

.1 Do not backfill until receiving approved open trench inspection.

.2 Place backfill in 6” lifts, placing and compacting all lifts to 85% S.P.D. until 6” below finished grade.

.3 All irrigation systems shall be flushed out in a satisfactory manner to remove accumulations of dirt and other foreign matter.

.4 Trenches must be backfilled flush with, or slightly above adjacent finished grade.

3.10 CLEANUP AND TESTING

.1 All pressure piping shall be hydrostatically tested.

.2 Pressure test backflow prevention device in accordance with appropriate local By-laws

.3 Submit a preliminary 'as-built' drawing.

.4 Receive in writing from Consultant acceptance and approval of the construction completion inspection and pressure test.

.5 Remove off site, all debris and excess material left over from installation or from any other source, at the end of each working day.

3.11 MAINTENANCE

.1 Prior to commencing the installation work under this section, visit the site and meet with the landscape contractor to arrange for the orderly coordination of irrigation and landscape work. Provide inspector with Plumbing Permit prior to commencement.

.2 Maintenance of the irrigation system shall include:

.1 System Turn On

a. Operational at Construction Completion as determined by contract documents.

b. Includes: Spray painting water services and keeping them clear and exposed from overgrowth, locator markings.

c. Follow all maintenance and repair procedures to ensure a completely functional system with head to head coverage according to original intent of design.

d. Submit and implement a weekly watering schedule for the season, which shall provide moisture to the turf and plant material as site conditions dictate.

.2 Monthly Checks

The following items will be checked on a monthly basis for proper operation: controller (clock), automatic valves, double-check valve (if included), water services, piping, manual valves, sprinkler heads (arcs), boxes and general settling and grading problems.

.3 System Turn Off (for maintenance purposes)

a. Turn off the water supply to the irrigation system. You will have two choices:

- Stop and drain (or seal, ¼ turn clockwise to close.
- Service valve and drain rod – service valve counter-clockwise to close and drain rod is ¼ turn counter-clockwise to open.

b. Open all drain valves on main line of irrigation system and all test cocks and drains on double check valve assembly and allow sufficient time for the water to drain out.

c. Close all drain valves.

d. Connect an air compressor (600cfm) to a quick coupler using a 1" hose or to a 2" gate valve outlet assembly using a 2" hose downstream of the double check valve assembly or water meter.

e. Activate all electric valves from the controller. Ensure that each zone blows "clean" of any water before proceeding to the next. After this procedure is completed, go to each electric valve and manually activate each zone to make sure you have not missed a zone. Repeat the procedure from controller to dispel any remaining water.

f. Turn the air compressor off and drain the main line of air, through the drain valve. Check all drain valves to make sure no water is coming out. Disconnect the air compressor. DO NOT leave drain valves and test cocks open for the winter.

END OF SECTION 32 84 23

1 **General**

1.1 **GENERAL REQUIREMENTS**

.1 Division One, General Requirements, is part of this section and shall apply as if repeated here.

1.2 **DESCRIPTION**

.1 This section specifies the supply and spreading of topsoil.

.2 The term “Consultant” will at times refer to approval or supervision activities performed by the Landscape Architect, Engineer, or Soil Scientist.

1.3 **RELATED SECTIONS**

.1 Section 31 22 16 Grading

.2 Section 32 84 23 Irrigation.

.3 Section 32 93 10 Tree, Shrubs Groundcover Planting.

.4 Section 32 29 38 Sodded Lawns

.5 Section 32 92 19 Seeding

1.4 **QUALITY ASSURANCE (APPROVAL AND INSPECTION)**

.1 Obtain approval of imported topsoil sources (as required) from Consultant.

.2 Test imported topsoil for N.P.K., particle site analysis, soluble salt content, and pH and forward soils report to Consultant. Soils will be mixed thoroughly, containerize and labelled to include:

.1 Origin of material

.2 Intended Use

.3 Name and job number of the project

.3 Use an approved independent inspection and testing agency. Arrange and be responsible for all costs relating to testing.

.4 Should the source of topsoil be exhausted, obtain the approval of Consultant for material from the new source before using.

.5 Consultant shall approve both the rough grade and finished grade at appropriate times before the Contractor proceeds with the next phase of work.

1.5 **PRODUCT DELIVERY, STORAGE AND HANDLING**

.1 No onsite stockpiling of imported topsoil will be allowed.

.2 Do not spread topsoil in frozen or muddy conditions.

1.6 **JOB CONDITIONS**

.1 Report in writing to Consultant prior to commencing work any conditions or defects encountered on site, upon which the work of this section depends, and which may adversely affect the performance of the work.

.2 Do not commence work until such conditions or defects have been investigated and corrected.

.3 Commencement of work implies acceptance of surface conditions and no claims for damages or extra work will be accepted, except where such conditions cannot be determined prior to construction.

1.7 **PROTECTION**

.1 Protect all trees and planting areas to remain in accordance with the General Conditions. Make good all damage at no extra cost.

1.8 **WARRANTY**

.1 Guarantee all work for a period commencing on the date of issue of Substantial Performance to the date of satisfactory Final Acceptance.

.2 Bring back to design grade all areas, which have settled during the warranty period.

2 **Products**

2.1 **TOPSOIL**

.1 Friable, fertile, natural loam, neither heavy clay or of very light sandy nature containing minimum of 4% organic matter of clay loams and not less than 2% organic matter for sandy loams to a maximum of 15%, and capable of sustaining vigorous plant growth, free of rocks of 50 mm in diameter and over, subsoil contamination, roots, weeds, toxic materials, foreign objects and with an acidity range of 7.0 to 8.5.

.2 Topsoil containing non-native plant species or weed seeds will be rejected.

.3 Material subject to analysis by testing laboratory prior to use.

2.2 **PEATMOSS**

.1 Decomposed plant material, fairly elastic and homogeneous; free of decomposed colloidal residue, wood, sulphur and iron containing minimum 60% organic matter by weight and moisture content, not exceeding 15%, Shredded particles may not exceed 6 mm (¼") in size. Minimum pH value of part 4.5 maximum 6. Supply peatmoss in bags unless approved otherwise by Consultant.

2.3 **LIME**

.1 Ground agricultural limestone containing minimum 85% of total carbonates.

2.4 **SULPHUR**

.1 Finely crushed agricultural elemental sulphur, free of impurities-

3 Execution

3.1 PREPARATION

.1 Grade subgrade, eliminating uneven areas and low spots, ensuring positive drainage. Scarify subgrade to depth of 50 mm. Remove debris, roots, branches, stones in excess of 50 mm (2") diameter and other deleterious materials. Remove subsoil that has been contaminated. Dispose of removed materials as directed.

.2 Locate utility lines and appurtenances, including manholes, catch basins, valves, hydrants and boxes before commencement of work and protect from damage.

3.2 SPREADING OF TOPSOIL

.1 Do not spread topsoil until Consultant has inspected and approved the subgrade.

.2 Manually spread the topsoil around trees and plants.

.3 Spread topsoil with adequate moisture in uniform layers during dry weather over approved dry, unfrozen subgrade, where seeding or sodding is indicated.

.4 Place topsoil at finished grade for all seeded and sodded areas.

.5 Place topsoil 50mm below final grade for all planted areas.

.6 Apply topsoil to the following minimum depths:

.1 Full depth for tree box and raised planters

.2 600mm for at grade planting beds.

.7 Remove stones, roots, grass, weeds, construction materials, debris, and foreign non-organic objects from the topsoil.

.8 Apply lime, sulphur or other soil amendments at a rate determined from a soil sample test. Mix soil amendment well into full depth of topsoil by cultivating or rototilling prior to application of the amendment.

.9 Fertilizers shall be used only as specified during the establishment of grasses and planter materials on this site.

.10 Fine grade and loosed topsoil mechanically and manually over entire topsoiled area to contours and elevations as indicated. Eliminate rough spots and low areas to ensure positive drainage.

.11 Do not cover catch basins, valve covers, or inspection pits.

.12 Leave surface smooth, uniform and firm against deep foot printing with a fine loose texture.

.13 Take appropriate measures to reduce dust and control erosion during the spreading of topsoil.

3.3 **CLEAN-UP**

.1 Make good any damage caused by topsoil spreading activities.

.2 Clean all adjacent walks, streets and properties as a result of work done under this section, at the end of each working day.

.3 Dispose of surplus topsoil not required by fine grading and landscaping off site as directed by Consultant.

.4 Remove all temporary stockpile sites within or adjacent to contract limits to a “neat clean condition acceptable to Consultant”.

END OF SECTION 32 91 19

1 General

1.1 DESCRIPTION

.1 This section specifies the supply and placing of grass seed.

1.2 RELATED WORK

a) Section 32 91 19 Spreading of Topsoil.

b) Section 32 84 23 Irrigation

c) Section 32 29 38 Sodded Lawns.

1.3 QUALITY ASSURANCE

.1 The contractor must have experience at performing this type and scale of work and must be willing to provide proof of this experience.

1.4 PRODUCT DELIVERY, STORAGE AND HAULING

.1 Deliver grass seed in original container showing:

.1 Analysis of seed mixture.

.2 Percentage of pure seed.

.3 Year of production.

.4 Net mass.

.5 Date when tagged and location.

.6 Percentage of germination.

.7 Name and address of distributor.

.2 Deliver wood fibre mulch in moisture proof containers indicating manufacturer content and net air-dry mass.

.3 Deliver erosion control agent in moisture proof containers, showing manufacturer, content and net mass.

2. Products

2.1 MATERIALS

.1 Grass seed shall be certified Canada #1 Grade to Government of Canada, free of disease, weed seeds or other foreign materials, meeting the requirements of the Seed Act and having minimum germination of 75% and minimum purity of 97%,

.2 Mulch: Fiber wood or wood cellulose fibre free of germination or growth inhibiting ingredients and forming blotter like groundcover allowing absorption and percolation of water. The following specifications shall apply:

d) moisture content 10%

e) organic matter 99.2%

f) ash content 8%

g) water holding capacity 1000gms/100gms of fibre

h) minimum application rate is 16.0 kg of air dry fibre per 100 m^2Fiber shall not be produced from recycled material.

.3 Tackifier: Acceptable colloidal polysaccharide tackifier that adheres to mulch during manufacturing, non toxic, without growth or germination inhibiting factors. pH value to be between 7 and 8.

.4 Water: Potable, free of impurities that would inhibit germination.

.1 Application rate is 160 L/100 m^2.

.5 Fertilizer: Commercial fertilizers complete commercial fertilizers of approved manufacture, containing not less than 60% urea formaldehyde and the specified percentage of nutrients by weight. Supply and deliver in bags clearly marked with name of manufacturer, contents, weights and analysis. Type and application rate to be determined by a soil test.

3 EXECUTION

3.1 PREPARATION

.1 Cultivate areas to be seeded to a depth of 25 mm (1”). Fine grade free of lumps and hollows and free of deleterious and refuse material.

.2 Obtain Consultant’s approval of topsoil grade and depth before starting seeding.

3.2 INSTALLATION

.1 Seeding time: May 1 until September 30, or otherwise approved by the Consultant, maximum wind velocity 20 km/hr. and when general site condition are approved by the Engineer.

.2 Measure all quantities of material by mass - calibrated volume measurement to satisfaction of the Consultant.

.3 Two means of applying seed are acceptable

.1 hydro-seeding

.2 mechanical or brillion drill seeding.

Hand broadcasting of seed is unacceptable under any conditions except for isolated repair work.

.4 Hydro Seeding

.1 Charge seeder with water, seed, mulch, seed fertilizer and mix thoroughly. Add material into seeder under agitation. Add tackifier into seeder and mix thoroughly to complete seeding slurry.

.2 Notify Consultant 24 hours before loading seeder and allow for an inspection by same at location of loading operation. Failure to notify the Consultant before loading occurs can result in rejection of the seeding operation.

.5 Tackifier

.1 Apply as per labeled manufacturer's specifications for slopes 4:1 and greater or as specified by the Consultant.

.6 Blend applications into existing adjacent grass areas and previous applications to form uniform surfaces.

.7 Rake in seed in all areas not accessible with drill seeder or hydro seeder.

3.3 **MAINTENANCE AND CLEAN-UP**

.1 Contractor to be responsible for protection of seeded areas until grass is properly established. Turf to be free of erosion , dead spots and weeds.

.2 Broom clean pavement and sidewalks, clean soil and rubble from underground or surface storm water lids, shrubs, signage, fences and the like.

.3 Leave site in neat and clean condition. Remove excess material from site.

.4 Apply water in sufficient quantities for grass to flourish.

3.4 **ACCEPTANCE**

.1 Areas will be accepted by Owner provided that:

.1 Satisfactory seed test results have been received from seed testing laboratory.

.2 Seed areas are properly established.

.3 Turf is free of erosion, dead spots and weeds.

.4 Prior to acceptance, top dress, seed and water all bare spots larger than 15 cm. Acceptance will be given upon germination of seeded areas.

END OF SECTION 32 92 19

Part 1 General

1.1 RELATED REQUIREMENTS

.1	Topsoil Placement and Grading	Section 32 91 19
.2	Seeding	Section 32 92 19

1.2 REFERENCES

.1 Definitions:

- .1 Mycorrhiza: association between fungus and roots of plants. This symbiosis, enhances plant establishment in newly landscaped and imported soils.

.2 Reference Standards:

- .1 Agriculture and Agri-Food Canada (AAFC).
  - .1 Plant Hardiness Zones in Canada.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Scheduling: obtain approval from Consultant of schedule seven 7 days in advance of shipment of plant material.

.2 Schedule to include:

- .1 Quantity and type of plant material.
- .2 Shipping dates.
- .3 Arrival dates on site.
- .4 Planting Dates.

1.4 QUALITY ASSURANCE

.1 Qualifications: The work shall be installed by a qualified landscape contractor with a minimum of 5 years of continuous experience

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.1 Protect plant material from frost, excessive heat, wind and sun during delivery.

.2 Protect plant material from damage during transportation:

.1 Delivery distance is less than 30 km and vehicle travels at speeds under 80 km/h, tie tarpaulins around plants or over vehicle box.

.2 Delivery distance exceeds 30 km or vehicle travels at speeds over 80 km/h, use enclosed vehicle where practical.

.3 Protect foliage and root balls using anti-desiccants and tarpaulins, where use of enclosed vehicle is impractical due to size and weight of plant material.

.3 Storage and Handling Requirements:

.1 Immediately store and protect plant material which will not be installed within 1 hour in accordance with supplier's written recommendations and after arrival at site in storage location approved by Concultant

.2 Protect stored plant material from frost, wind and sun and as follows:

.1 For bare root plant material, preserve moisture around roots by heeling-in or burying roots in topsoil and watering to full depth of root zone.

.2 For pots and containers, maintain moisture level in containers.

.3 For balled and burlapped and wire basket root balls, place to protect branches from damage. Maintain moisture level in root zones.

.3 Store and manage hazardous materials in accordance with manufacturer's written instructions.

1.6 WARRANTY

.1 Contractor hereby warrants that plant material as itemized on plant list will remain free of defects until the Final Warranty Inspection.

.2 End-of-warranty inspection will be conducted by Consultant.

.3 The Owner 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 not sufficient to ensure future survival.

Part 2 Products

2.1 PLANT MATERIAL

.1 Type of root preparation, sizing, grading and quality:

.1 Source of plant material: grown in Zone 3a in accordance with Plant Hardiness Zones in Canada.

.2 Plant material must be planted in zone specified as appropriate for its species.

.3 Plant material in location appropriate for its species.

.2 Plant material: free of disease, insects, defects or injuries and structurally sound with strong fibrous root system.

.3 Trees: with straight trunks, well and characteristically branched for species.

.4 Bare root stock: nursery grown, in dormant stage, not balled and burlapped or container grown.

.5 Collected stock: maximum 40 mm in caliper, with well-developed crowns and characteristically branched; no more than 40% of overall height may be free of branches.

.1 During collection, ensure 10% maximum seed crop (or plants) are collected from healthy population of many individuals, and from several plants of same species.

.2 Leave remainder for natural dispersal and as food for dependent organisms.

2.2 WATER

.1 Free of impurities that would inhibit plant growth.

2.3 TRUNK PROTECTION

.1 Wire mesh: galvanized, electrically welded 1.4 mm wire with 25 x 25 mm mesh and fasteners.

2.4 FERTILIZER

.1 Synthetic commercial type and use as recommended by soil test report.

.1 Ensure new root growth is in contact with mycorrhiza.

.2 Use mycorrhiza as recommended by manufacturer's written recommendations.

2.5 SOURCE QUALITY CONTROL

.1 Obtain approval from Consultant of plant material prior to planting.

.2 Imported plant material must be accompanied with necessary permits and import licenses. Conform to Federal, Provincial or Territorial regulations.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrate previously installed under other Sections or Contracts are acceptable for planting installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Consultant

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied Consultant

3.2 PRE-PLANTING PREPARATION

.1 Proceed only after receipt of written acceptability of plant material from Consultant Remove damaged roots and branches from plant material.

.2 Locate and protect utility lines.

.3 Notify and acquire written acknowledgment from utility authorities before beginning excavation of planting pits for trees and shrubs.

3.3 EXCAVATION AND PREPARATION OF PLANTING BEDS

.1 Establishment of sub-grade for planting beds in accordance with Section 31 22 16 Grading.

.2 Preparation of planting beds in accordance with Section 32 91 19 - Topsoil Placement and Grading.

.3 For individual planting holes:

.1 Stake out location and obtain approval Consultant prior to excavating.

.2 Excavate to depth and width as indicated.

.3 Remove subsoil, rocks, roots, debris and toxic material from excavated material that will be used as planting soil for trees and individual shrubs. Dispose of excess material.

.4 Scarify sides of planting hole.

.5 Remove water which enters excavations prior to planting. Notify Consultant if water source is ground water.

3.4 PLANTING

.1 For bare root stock, place 50 mm backfill soil in bottom of hole.

.1 Plant trees and shrubs with roots placed straight out in hole.

.2 For jute burlapped root balls, cut away top one third of wrapping and wire basket without damaging root ball.

.1 Do not pull burlap or rope from under root ball.

.3 For container stock or root balls in non-degradable wrapping, remove entire container or wrapping without damaging root ball.

.4 Plant vertically in locations as indicated.

.1 Orient plant material to give best appearance in relation to structure, roads and walks.

.5 For trees and shrubs:

.1 Backfill soil in 150 mm lifts.

.1 Tamp each lift to eliminate air pockets.

.2 When two thirds of depth of planting pit has been backfilled, fill remaining space with water.

.3 After water has penetrated into soil, backfill to finish grade.

.2 Form watering saucer as indicated.

.6 For ground covers, backfill soil evenly to finish grade and tamp to eliminate air pockets.

.7 Water plant material thoroughly.

.8 After soil settlement has occurred, fill with soil to finish grade.

3.5 TRUNK PROTECTION

.1 Install trunk protection on deciduous trees as indicated.

.1 Install flagging tape to guys as indicated.

3.6 CLEANING

.1 Progress Cleaning:.

.1 Leave Work area clean at end of each day.

.2 Perform cleaning after installation to remove construction and accumulated environmental dirt.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

.2 Dispose of waste materials and debris at an approved facility.

END OF SECTION 32 93 10