

PART 1 - GENERAL

1.1 RELATED WORK

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 REFERENCES

- A. ASTM C 117-90, Test Method for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.
- B. ASTM C 131-89, Test method for Resistance to Degradation of Small-Size Coarse aggregate by Abrasion and Impact in the Los Angeles Machine.
- C. ASTM C 136-92, Method for Sieve Analysis of Fine and Coarse Aggregates.
- D. ASTM D 698-91, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³) (600 kN-m/m).
- E. CAN/CGSB-8.1-88, Sieves Testing, Woven Wire, Inch Series.
- F. CAN/CGSB-8.2-M88, Sieves Testing, Woven Wire, Metric.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Store cement in weather tight bins or silos that provide protection from dampness and easy access for inspection and identification of each.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Coarse aggregates satisfying requirements of applicable section shall be one, or a blend of following:
 - 1. Crushed rock from an approved bedrock source.
 - 2. gravel composed of naturally formed particles of stone from an approved source.
- B. Grey Riverstones: 50 to 100 mm dia. Washed granite riverstones.
- C. Clear Stone: 19mm washed stones, free of sand or filler material.
- D. Granular base material: 19 mm crusher run limestone, or Granular 'A'.
- E. Granular sub-base material: 50 mm crusher run limestone, or Granular 'B'.
- F. Crushed pit-run or screened stone, gravel or sand consisting of hard, durable, angular particles, free from clay lumps, cementation, organic material, frozen material, and other deleterious materials.
- G. Bioretention choking layer, washed 3 to 10 mm diameter clear stone.

- H. Bioretention gravel storage layer washed 50 mm diameter clear stone.

PART 3 - EXECUTION

3.1 SEQUENCE OF OPERATION

- A. Place granular base after finished sub-base surface or subgrade is inspected and approved by Consultant.
- B. Placing
 1. Construct granular base to depth and grade in areas indicated.
 2. Ensure no frozen material is placed.
 3. Place material only on clean unfrozen surface, free from snow and ice.
 4. Place material on geotextile filter. Ensure geotextile filter overlaps minimum 500mm and lap in the direction of flow.
 5. Place material using methods which do not lead to segregation or degradation of aggregate.
 6. Place material to full width in uniform layers not exceeding 150 mm compacted thickness.
 7. River stone shall be placed at 250mm depth. Refer to drawings for extent and location.
 8. Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
 9. Remove and replace that portion of layer in which material becomes segregated during spreading.
- C. Compaction Equipment
 1. Compaction equipment to be capable of obtaining required material densities.
 2. Efficiency of equipment not specified to be proved at least as efficient as specified equipment at no extra cost and written approval must be received from Consultant before use.
 3. Equipped with device that records hours of actual work, not motor running hours.
- D. Compacting in accordance with ASTM D 698 and ASTM D 1557
 1. Compaction of Road Pavement Base: Compact to density of not less than 100% SPMDD.
 2. Compaction of Sidewalks Base: Compact to density of not less than 100% of SPMDD.
 3. Shape and roll alternately to obtain smooth, even, and uniformly compacted base.
 4. Apply water as necessary during compacting to obtain specified density.
 5. In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Consultant.
 6. Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.2 SITE TOLERANCES

- A. Finished base surface to be within plus or minus 10 mm of established grade and cross section but not uniformly high or low.

3.3 PROOF ROLLING

- A. For proof rolling use roller of 45400 kg gross mass with four pneumatic tires each carrying 11350 kg and inflated to 620 kPa. Four tires arranged abreast with center to center spacing of 915 mm maximum.
- B. Consultant may authorize use of other acceptable proof rolling equipment.
- C. Proof roll top of base upon completion of fine grading and compaction.
- D. Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.
- E. Where proof rolling reveals defective areas:
 - 1. Remove base, sub-base and subgrade material to depth and extent directed by Consultant.
 - 2. Backfill excavated subgrade with sub-base material and compact in accordance with this section.
 - 3. Replace sub-base material and compact in accordance with this section.
 - 4. Replace base material and compact in accordance with this Section.

3.4 INSPECTION AND TESTING

- A. Testing of materials and compaction will be carried out by testing laboratory designated by Owner. Frequency of tests will be determined by Consultant.
- B. Owner will pay costs for inspection and testing.

3.5 PROTECTION

- A. Maintain finished base in condition conforming to this section until succeeding material is applied or until acceptance by Consultant.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- A. Notify Construction Manager of proposed date for use of materials. Order and schedule shipments to coincide with construction schedule.

1.2 SUMMARY

- A. Section Includes Concrete Paving. Including the Following:
 - 1. Walks.
- B. Related Requirements:
 - 1. Section 03 30 00 "Cast-in-Place Concrete" for general building applications of concrete.
 - 2. Section 32 13 73 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.

1.3 MEASUREMENT PROCEDURES

- A. Measure Portland cement concrete paving in square metres.
- B. Measure supply of Portland cement in tonnes.
- C. Measure sealing of joints including saw cutting and preparation, in linear metres.

1.4 REFERENCE STANDARDS

- A. ASTM International
 - 1. ASTM A775/A775M-07b, Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
 - 2. ASTM C171-07, Standard Specification for Sheet Materials for Curing Concrete.
 - 3. ASTM C260/C260M-10a, Standard Specification for Air-Entraining Admixtures for Concrete.
 - 4. ASTM C309-11, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - 5. ASTM C494/C494M-13, Standard Specification for Chemical Admixtures for Concrete.
 - 6. ASTM C666/C666M-03(2008), Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.

7. ASTM D1752-04a(2013), Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Bituminous Expansion Joint Fillers for Concrete Paving and Structural Construction.
 8. ASTM D2628-91(2011), Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.
 9. ASTM D3569-95(2000), Standard Specification for Joint Sealant, Hot-Applied, Elastomeric, Jet-Fuel-Resistant Type for Portland Cement Concrete Pavements.
 10. ASTM D5329-09, Standard Test Methods for Sealants and Fillers, Hot-Applied, For Joints and Cracks in Asphaltic and Portland Cement Concrete Pavements.
 11. ASTM D6297-13, Standard Specification for Asphaltic Plug Joints for Bridges.
 12. ASTM D6690 -12, Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
- B. CSA Group
1. CSA A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 2. CSA-A3000-13, Cementitious Materials Compendium.
 3. CSA G30.18-09, Carbon Steel Bars for Concrete Reinforcement.
 4. CSA G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- A. Submit in accordance with Section 01 33 00- Submittal Procedures.
- B. Product Data:
1. Submit manufacturer's instructions, printed product literature and data sheets for concrete paving material and include product characteristics, performance criteria, physical size, finish and limitations.
 2. Submit following sampling and testing data:
 1. Sieve analysis for gradation of bedding and joint material.
 2. Evaluation of sealing and cleaning compound.
- C. Samples:
1. Inform Construction Manager of proposed source of aggregates and provide sampling at least 4 weeks prior to commencing work.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Installer: Company or person specializing Portland cement concrete paving with 5 documented years of experience.

B. Certifications:

1. Submit to Construction Manager manufacturer's test data and certification that following material meets criteria and requirements of this section prior to starting concrete work:
 1. Portland Cement.
 2. Blended Hydraulic Cement.
 3. Supplementary Cementing Material.
 4. Admixtures.
 5. Joint Sealants.
 6. Curing Materials.
 7. Joint Filler.
2. Submit certification that plant, equipment, and materials to be used in concrete comply with requirements of CSA A23.1/A23.2, and that mix design is adjusted to prevent alkali aggregate reactivity problems.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle materials in accordance with manufacturer's written instructions.

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

C. Storage and Handling Requirements:

1. Store materials off ground in a dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 1. Unload cement and store in weathertight bins or silos that protect cement from dampness and contamination and provide easy access for inspection and identification of each shipment.
 2. Stockpile minimum 50% of total required amount of each size of aggregate prior to commencing mixing operation.
2. Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Portland cement: to CSA A3000.
- B. Aggregates: to CSA A23.1/A23.2 and to following requirements:
 - 1. Coarse aggregate:
 - 1. Produce coarse aggregate in at least two separate sizes which, when combined, yields gradation specified. Each component size to form approximately equal percentage of total coarse aggregate.
 - 2. Gradation: to CSA A23.1/A23.2, table 5, nominal size 28-5.
 - 3. Flat and elongated particles: to CSA A23.1/A23.2 (13A) (length to width and width to thickness ratio greater than 3) not to exceed 0.5% by mass.
 - 2. Fine aggregate:
 - 1. Gradation: to CSA A23.1/A23.2, Table 1. Material passing 0.160 mm sieve: maximum 5%.
 - 2. Aggregates for use in concrete pavement shall not be susceptible to D-cracking. Unless field experience, aggregate history or prior laboratory testing have proven otherwise.
 - 3. Aggregates for use in concrete pavement shall be tested in accordance with ASTM C666/C666M. Test shall be in accordance with Procedure A for a period of 350cycles.
- C. Supplementary cementing materials: to CSA A3000.
- D. Air entraining admixture: to ASTM C260/C260M.
- E. Chemical admixtures: to ASTM C494/C494M. Construction Manager to approve accelerating or set retarding admixtures during cold and hot weather placing.
- F. Curing compound: to ASTM C309, Type 1-D or 2.
- G. Joint seal, preformed polyurethane sealant: to ASTM C920.
- H. Polyethylene backer rod, properly friction-fitted for use with self-leveling sealants.
- I. Preformed 12.7 mm thick bituminous expansion joint filler: to ASTM D1752.
- J. Dowels and tie-bars: to CSA G30.18.
 - 1. Dowels: clean, straight and free from flattened or burred ends, plain round bars of grade 300 or better conforming to CSA G40.20/G40.21 and be epoxy-coated to ASTM A775/A775M.

2. Tie-Bars: deformed steel bars in compliance with CSA G30.18 and be epoxy-coated to ASTM A775/A775M.
- K. Protective covers and insulation for cold weather concreting: to CSA A23.1/A23.2.
- 2.2 MIXES
- A. Job mix formula to be reviewed by Construction Manager in accordance with CSA A23.1/A23.2, Table 13 and as specified below.
- B. For concrete proportioned in accordance with Alternative 1:
1. Use type 10 cement.
 2. Compressive strength when tested in accordance with CSA A23.1/A23.2, (9C): average 28day compressive strength to be minimum 28MPa for pedestrian paving and 35MPa for heavy duty vehicular paving.
 3. Cementing materials content: 290 to 335kg/m³ of concrete mix.
 4. Air content when tested in accordance with CSA A23.1/A23.2, (4C), immediately after discharge: in accordance with CSA A23.1/A23.2, Table 10.
 5. Class of exposure: Class C-2.
 6. Use of chemical admixture will be approved only when specified mix requirements or workability cannot be achieved by proportioning of aggregates, water, cement and air entraining admixture.
- PART 3 EXECUTION
- 3.1 EXAMINATION
- A. Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for concrete paving installation in accordance with manufacturer's written instructions.
1. Visually inspect substrate in presence of Construction Manager.
 2. Inform Construction Manager of unacceptable conditions immediately upon discovery.
 3. Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Construction Manager.
- 3.2 EQUIPMENT
- A. Concrete plant: in accordance with CSA A23.1/A23.2.
- B. Where fixed form paving is used provide equipment with following features:
1. Mechanical self-propelled spreader capable of moving concrete forward and laterally.

2. Vibrator locations and spacings whether surface or internal to be installed as per manufacturer's specifications or as directed by the Construction Manager .
 3. Mechanical, self-propelled finisher with two independently operated transverse screeds.
 4. Float to be aluminium or magnesium, straight, smooth, sufficiently light to avoid sinking into concrete surface, operated mechanically or manually from edge to edge while advancing longitudinally.
- C. Use following equipment on approval of Construction Manager :
1. Hand operated transverse screeds spanning side forms.
 2. Mechanically powered vibrating beam spanning side forms.
 3. Hand operated floats and fluting tools used by skilled workers.
- D. Provide following miscellaneous equipment where required:
1. Edging tool.
 2. Water truck equipped with pump, hose line and fine spray nozzle.
 3. Self-propelled concrete saws equipped with rubber-tired wheels, readily adjustable blade depth controls, and sawing line guide pointers both front and rear. Provide adequate number of units to complete sawing at rate required and have ample supply of suitable saw blades and at least one standby sawing unit available on job site before concrete placement is started.

3.3 SUBGRADE AND SUBBASE PREPARATION

- A. Soft, yielding materials or other portions of subgrade that will not compact to specification shall be removed and replaced with suitable material. Subgrade to be brought to a firm unyielding condition with a uniform density. It shall be compacted at or above optimum moisture content to 95% Standard Proctor density.
- B. When concrete is placed directly on subgrade, it will be checked for conformity with the cross-section tolerance. Finished surface shall not deviate more than 0mm above and 20mm below specified grade and cross-section, and the surface shall not deviate more than 10mm at any place on a 3mm template.
- C. Subbase to consist of specified material and have a compacted thickness of not less than specified.
- D. Subbase shall be compacted to specified density.
- E. Prepared subbase shall be checked for conformity with the cross-section and grad tolerances. Finished surface of subbase shall not deviate more than 0mm above and 20mm below specified grade and cross-section, and surface shall not deviate more than 10mm at any place on a 3mm template.

- F. Repair damage to subbase resulting from hauling or equipment operations.
- G. Prior to placing concrete, subbase shall be thoroughly wetted. Wetting shall be carried out, such that standing water is not present on grade.
- H. Surface condition of base to be approved by Construction Manager before placing concrete.

3.4 REINFORCING STEEL AND DOWELS

- A. Place reinforcing steel and dowels as indicated and to Section 03 20 00- Concrete Reinforcing.
- B. Dowel bars shall be plain round bars of grade 300 or better conforming to CSA G40.20/G40.21 and be epoxy-coated to requirements of ASTM A775/A775M, also coated with bond breaker material.
- C. Steel for tie bars or tie bolts to comply to CSA G30.18 and be epoxy-coated to ASTM A775/A775M.
- D. Place sufficient number of joint dowel assemblies in advance of paver to avoid delay in concrete placement.
- E. Remove oil, grease, dirt and deleterious material from reinforcing bars before placing concrete.
- F. Steel placement to be approved by Construction Manager before placing concrete.

3.5 PLANT AND MIXING REQUIREMENTS

- A. If crusher screenings are approved as mixture component, proportion separately from sand.
- B. If washing of aggregate required, allow aggregate to drain for 24 hours or longer as required to stabilize moisture content.
- C. For truck mixers, mixing to be in accordance with CSA A23.1/A23.2.
- D. Mix produced to be within following tolerances from mix design:
 - 1. Air content: as per CSA A23.1/A23.2, Table 10.

3.6 TRANSPORT AND DELIVERY OF MIX

- A. Time from initial mixing to final placing to be not more than 120 minutes if mix is transported by agitating equipment (e.g. truck mixer) in accordance with CSA A23.1/A23.2, clause 18.4.2 - Delivery with Agitating Equipment.
- B. Transport mix by non-agitating equipment only if;
 - 1. Time from addition of cement to time of placing not to exceed 45 minutes.

2. Haul units to be of sufficient capacity to transport at least one regular size batch from mixer.
3. Haul routes to be well maintained to prevent undue disturbance of concrete mix during transport.

3.7 PLACING

- A. Place concrete to lines, grades and depths as indicated.
- B. Discharge concrete into forms as soon as practical after mixing.
- C. Construct pavement lanes in sequence approved by Construction Manager.
- D. Use hand placing where machine spreading is not feasible.
- E. Spread uniformly with approved equipment to thickness sufficient to allow for proper consolidation and finishing. Do not apply external tractive force to paver.
- F. Operate with continuous forward momentum. Schedule concrete supply to minimize interruptions.
- G. Insert tie bars as indicated.
- H. When completing concrete placement for day, carry placement through to scheduled control joint location.
- I. Where concrete placement is stopped for more than 30 min due to breakdowns, weather or other reasons, construct extra bulkhead and construction joint as directed by Construction Manager.
- J. Do not place concrete on frozen surface.
- K. No concrete shall be placed during rain.
- L. When rain appears imminent paving operation should cease. Protect freshly laid concrete from rain damage and adverse weather condition and in accordance with CSA A23.1/A23.2. Extend protective coverings over edges of concrete and arrange so as not to bear on unprotected edges.
- M. Concrete shall be placed when the projected temperature is 10 degrees C or higher for a minimum of 72 hours.
- N. If concrete has been placed when the ambient temperature is at or above 32 degrees C, the concrete is to be cured by continuous water curing from soaker hoses providing complete coverage of the pavement to minimize the temperature rise of the concrete.
- O. If concrete has been placed in cold weather and the site temperature is expected to drop below 10 degrees C, insulating curing blankets or other suitable material shall be placed on the concrete pavement and weighted to prevent movement. Curing to continue until the cumulative number of days, or fraction thereof, during which the temperature of the concrete is above 10 degrees C, has totalled a minimum of 7days. Alternatively, if

compressive tests of cylinders cured under field conditions achieve at least 70% of the specified compressive strength, curing may be discontinued.

- P. Concrete pavement placed in cool weather shall experience a minimum of 30 day air-drying period, following final curing, before first application of de-icing salts.

3.8 CONSOLIDATION

- A. When internal vibrators are used:

1. For slab depths up to 50mm, mount vibrators parallel to base at mid depth. For slab depths greater than 50mm, mount vibrators with tips minimum 50mm above base and tops minimum 50mm beneath pavement surface.
2. Operate at manufacturer's recommended number of vibrations and specifications.

- B. When surface vibrators are used:

1. Synchronize units on each individual screed or pan.
2. Operate at minimum of 3,500 vibrations per minute and minimum amplitude of 0.4mm.
3. Treat each pavement section to at least 2 passes of vibratory equipment unless otherwise directed by Construction Manager.

- C. Stop vibrators when paver stops.

- D. Use hand operated vibrator on odd shaped slabs inaccessible to frame mounted units. Do not operate vibrator in one location longer than 5 seconds.

- E. Ensure concrete adjacent to edge forms or previously constructed slabs is thoroughly vibrated.

3.9 FINISHING

- A. After consolidation by vibration, finish with equipment approved by Construction Manager.

- B. When striking off concrete surface, maintain uniform roll of concrete ahead of first screed for its full length when finishing machine is on first pass.

- C. Make 2 passes with transverse finishing machine.

- D. Where joints are formed rather than sawn, form longitudinal and transverse joints after final pass of finishing machine.

- E. Hand finish areas inaccessible to finishing machines to same quality and surface characteristics as machine finished surfaces.

- F. Finish concrete surface with approved float at proper time. Operate from edge to edge with wiping motion while advancing, with each succeeding pass overlapping previous one.
- G. Check surface with approved 3.5m long straightedge. Correct irregularities exceeding 5mm before concrete takes initial set.
- H. Finish edges of slabs with edging tool to form smooth squared surface on city sidewalks only. Do not apply the smooth squared surface on internal site concrete paving inside property lines. Do not patch with cement paste.

3.10 SURFACE TEXTURING

- A. Commence texturing immediately after float finishing.
- B. Use stiff bristled broom to produce nonslip concrete surface finish approved by Construction Manager, with fine granular texture free from disfigurations.
- C. Texturing to be straight, precise and not damaging to pavement edges.

3.11 CURING

- A. Cure for minimum 7 days by one of following methods:
 - 1. Curing compound:
 - 1. Apply in two coats with approved spray equipment to form complete and unbroken film on surface of concrete. Mechanically agitate compound before and during use.
 - 2. For hand application apply first coat immediately after texturing operations, second coat to be applied immediately after first coat in a perpendicular direction.
 - 3. For machine application curing compound to be applied in accordance with manufacturers' specifications.
 - 4. Apply second spray in accordance with manufacturer's instructions.
 - 5. Apply each spray at application rate recommended by manufacturer.
 - 6. Spray slab edges immediately after removal of forms.
 - 7. Protect formed or sawed joints from evaporation during curing period.
 - 8. Respray areas where membrane is damaged during curing period.
 - 2. Burlap or cotton mats:
 - 1. As soon as concrete surface has been finished and can bear weight without marking, carefully cover with burlap or cotton mats.

2. Place mats to overlap each other by 300mm or more and to overlap concrete slab by 300mm or more at each side secured by a continuous bank of sand and gravel.
3. Cover sides and ends of slab with mats as soon as forms are removed.
4. Thoroughly wet mats before placing them on concrete and keep saturated during curing period with water spray sufficiently fine to avoid damaging concrete surface, avoiding wet/dry cycles.

3.12 PROTECTION

- A. Do not open concrete pavement to traffic or construction equipment until joints have been sealed and concrete has cured for a minimum of 3 days.
- B. When placing concrete in lanes adjacent to existing concrete, operate placing equipment on rubber wheels or pads to prevent damage to existing surface.

3.13 TOLERANCES

- A. Finished concrete surface to be within 5mm of design grade but not uniformly high or low.
- B. Finished concrete surface not to have irregularities exceeding 5mm when checked with 4.5m straight edge placed in any direction.
- C. Horizontal deviations of slab edge from alignment of pavement not to exceed 10mm.

3.14 JOINTS

- A. General:
 1. Construct joints plumb, straight and square to details indicated.
 2. Transverse joints to coincide with those in adjacent pavement unless indicated or directed otherwise.
 3. Install preformed joint filler at locations and to details indicated.
 4. Install isolation joints around structures and features that project through, into or against pavement.
- B. For sawn joints.
 1. Ensure joints are sawn straight. Install end stakes to ensure straight joint alignment across paved area. Mark joint alignment with chalk line or other suitable guide to approval of Construction Manager .
 2. Saw joints using approved equipment and methods to produce joint dimensions indicated.

3. Restrict speed of saw cutting to ensure proper joint alignment and to avoid damage to concrete.
4. Supply sufficient workers and equipment including standby equipment, to maintain satisfactory sawing schedule.
5. Make initial saw cuts in progressive manner and as soon as concrete surface has hardened sufficiently to resist ravelling as cut is made and before shrinkage cracks occurs.
6. If cracking occurs ahead of saw cut, stop sawing immediately. Move ahead several joints and cut one or more joints before returning to saw intermediate joints. Where cracking persists, make 1m saw cut from one edge and complete sawing from opposite edge. Adjust sawing schedule accordingly.
7. If uncontrolled cracking or other surface damage results from inadequate or improper sawing techniques suspend further concrete operations until situation is corrected and immediately remove and replace damaged slabs.
8. Immediately on completion of sawing, flush joints with water to remove laitance.

C. Sealing:

1. Seal joints before allowing vehicular traffic on new pavement.
2. Provide Construction Manager with copy of sealant manufacturer's instructions for application.
3. Just prior to sealing joint, clean with compressed air or flush with high pressure water to remove laitance, curing compound and protrusions of hardened concrete. Clean and dry by compressed air and vacuum to remove loose and foreign material.
4. Do not apply joint sealant in rainy weather or when ambient temperature is less than 5degrees C.
5. Insert approved filler and bond breaking material in joint prior to applying sealant, then fill joint from bottom up with sealant to avoid trapping air.
6. Prepare sealant for application using equipment and methods approved by Construction Manager.
7. Apply sealant strictly in accordance with manufacturer's recommendations and cleanliness of concrete to be bonded.
8. On completion of first application of sealant, return and top up any underfilled areas.
9. Replace sealant which fails to bond to concrete or fails to cure properly, as directed by Construction Manager .

3.15 DEFECTIVE CONCRETE

- A. Concrete is defective when:

1. It contains: honeycombing, embedded debris, uncontrolled shrinkage cracking, or other surface defects.
2. It is damaged by freezing.
3. It is placed at too high temperature.
4. Standard deviation of 28 day strength test results exceeds CSA A23.1/A23.2 clause 17.6.7.1 requirements.

3.16 REPAIR/RESTORATION

A. Repair of defective concrete work:

1. Where defective concrete is identified by Construction Manager during plastic condition, repair using methods approved by Construction Manager .
2. Grind off high surface variations where directed by Construction Manager .

B. Remove and replace defective concrete where directed by Construction Manager .

1. Remove minimum 3m of pavement by sawing through concrete across full lane width.
2. Replace with new concrete to this specification.
3. Construct contraction joint at boundary between sawn face of existing concrete and new concrete.

3.17 CLEANING

A. Progress Cleaning: clean in accordance with Section 01 74 11- Cleaning.

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

B. Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11- Cleaning.

3.18 PROTECTION

A. Keep vehicular traffic off newly paved areas until paving has properly cured and joints have been sealed.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cold-applied joint sealants.
 - 2. Joint-sealant backer materials.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 13-mm-wide joints formed between two 150-mm-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- C. Paving-Joint-Sealant Schedule: Contractor to submit the following information to the architect:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant colour – submit samples or colour chart.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of joint sealant and accessory.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Product Testing: Test joint sealants using a qualified testing agency.

1.7 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 5 deg C.
 2. When joint substrates are wet.
 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

2.2 COLD-APPLIED JOINT SEALANTS

- A. Single-Component, Self-Leveling, Silicone Joint Sealant: ASTM D 5893/D 5893M, Type SL.
1. Pourthane SL Self Leveling Joint Sealant by W. R. Meadows of Canada, 70 Hannant Court, Milton ON, L9T 5C1, 905-878-4122.
 2. Other approved equal: Contractor to submit product and manufacturer's info to architect for approval.

2.3 JOINT-SEALANT BACKER MATERIALS

- A. Joint-Sealant Backer Materials: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint-sealant manufacturer, based on field experience and laboratory testing.
- B. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D 5249, Type 1 or 3, of diameter (25% larger than joint to be sealed) and density required to control sealant depth and prevent bottom-side adhesion of sealant.

2.4 PRIMERS

- A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer's written instructions.
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
- B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

- A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
- B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions.
- C. Install joint-sealant backings to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of joint-sealant backings.
 - 2. Do not stretch, twist, puncture, or tear joint-sealant backings.
 - 3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install joint sealants immediately following backing installation, using proven techniques that comply with the following:
 - 1. Place joint sealants so they fully contact joint substrates.
 - 2. Completely fill recesses in each joint configuration.

3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
 - E. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.
- 3.4 CLEANING AND PROTECTION
- A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.
 - B. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.
- 3.5 PAVING-JOINT-SEALANT SCHEDULE
- A. Joint-Sealant Application: Joints within concrete paving.
 1. Joint Location:
 1. Expansion and isolation joints in concrete paving.
 2. Other joints as indicated.
 2. Joint Sealant: Single-component, self-leveling, silicone joint sealant
 3. Joint-Sealant Color: As selected from manufacturers standard colour palette.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Concrete pavers set in aggregate setting beds.
2. Aluminum edge restraints.
3. Cast-in-place concrete edge restraints.

B. Related Requirements:

1. Section 321313 "Concrete Paving" for concrete base under unit pavers and for cast-in-place concrete curbs and gutters serving as edge restraints for unit pavers.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For materials other than water and aggregates.

B. Product Data: For the following:

1. Concrete Pavers.
2. Edge restraints.

- C. Sieve Analyses: For aggregate setting-bed materials, according to ASTM C 136.

- D. Samples for Verification: For full-size units of each type of unit paver indicated.

1.5 INFORMATIONAL SUBMITTALS

1.6 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store pavers on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Store liquids in tightly closed containers protected from freezing.

1.8 FIELD CONDITIONS

- A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of unit paver, joint material, and setting material from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

2.2 CONCRETE PAVERS

- A. Concrete Pavers: Solid interlocking paving units complying with ASTM C 936/C 936M and resistant to freezing and thawing when tested according to ASTM C 67, made from normal-weight aggregates.

B. Materials

1. Unit Paver

- 1. Manufacturer: 'Unilock'.
- 2. Model: 'Promenade Plank Paver'.
- 3. Size: 400mm X 100mm X 100mm (4" X 16" X 4").
- 4. Colours:
 - 1. Type 1: 'Steel Grey Blend'.
 - 2. Type 2: 'Opal Blend'.
- 5. Colour Mix:
 - 1. Mix areas: 70% Opal Blend, 30% Steel Grey.

2. Pattern: Random.

6. Finish: Standard.

7. Unit Paving Pattern: 'Running Bond'.

2.3 CURBS AND EDGE RESTRAINTS

A. Aluminum Edge Restraints: Manufacturer's standard L-shaped, 4.8-mm-thick by 57-mm-high by 57-mm wide extruded-aluminum edging.

1. 'StructureEdge' – by 'Permaloc' or approved equal. www.permaloc.com

B. Built Concrete Edge Restraints: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mixed concrete with minimum 28-day compressive strength of 20 MPa.

2.4 AGGREGATE SETTING-BED MATERIALS

A. Graded Aggregate for Subbase for walkways: Sound, crushed stone or gravel complying with ASTM D 448 for Size No. 57.

B. Graded Aggregate for Base for traffic areas: Sound, crushed stone or gravel complying with ASTM D 448 for Size No. 8.

C. Graded Aggregate for Leveling Course over traffic areas on concrete slab: Sound crushed stone or gravel complying with ASTM D 448 for Size No. 9.

1. Aggregate Material: Crushed granite.

D. Sand for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C 33/C 33M for fine aggregate.

E. Stone Screenings for Leveling Course: Sound stone screenings complying with ASTM D 448 for Size No. 10.

F. Polymeric Joint Sand: Dry mix, contains polymeric binding agent, activated with water.

1. Provide Polymeric Joint Sand meeting the minimum material and physical properties as follows:

1. Compression Strength: minimum compression of 550 PSI after drying for 7 days under controlled conditions 23C at 50% humidity.

2. Test sand sample shape: cylinder 5 cm dia. X 10 cm high.

3. Gradation: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing 1.18-mm sieve and no more than 10 percent passing 0.075-mm sieve.

4. Colour: grey.

- G. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications; made from polyolefins or polyesters, with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Survivability: Class 2, AASHTO M 288.
 - 2. Apparent Opening Size: 0.250-mm sieve, maximum; ASTM D 4751.
 - 3. Permittivity: 0.02 per second, minimum; ASTM D 4491.
 - 4. UV Stability: 50 percent after 500 hours' exposure, ASTM D 4355.
- H. Drainage Geotextile: Nonwoven needle-punched geotextile fabric, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Survivability: Class 2, AASHTO M 288.
 - 2. Apparent Opening Size: 0.425-mm sieve, maximum; ASTM D 4751.
 - 3. Permittivity: 0.5 per second, minimum; ASTM D 4491.
 - 4. UV Stability: 50 percent after 500 hours' exposure, ASTM D 4355.
- I. Herbicide: Commercial chemical for weed control, registered with the CE. Provide in granular, liquid, or wettable powder form.

2.5 ACCESSORIES

- A. Compressible Foam Filler: Preformed strips complying with ASTM D 1056, Grade 2A1.
- B. Aluminum edge restraint as specified in Curb and Edge Restraints section.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces indicated to receive unit paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Where unit paving is to be installed over waterproofing, examine waterproofing installation, with waterproofing Installer present, for protection from paving operations, including areas where waterproofing system is turned up or flashed against vertical surfaces.
- C. Proceed with installation only after unsatisfactory conditions have been corrected and waterproofing protection is in place.

3.2 PREPARATION

- A. Sweep concrete substrates to remove dirt, dust, debris, and loose particles.

- B. Proof-roll prepared subgrade according to requirements in Section 312000 "Earth Moving" to identify soft pockets and areas of excess yielding. Proceed with unit paver installation only after deficient subgrades have been corrected and are ready to receive subbase and base course for unit pavers.

3.3 INSTALLATION, GENERAL

- A. Do not use unit pavers with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.
- B. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.
- C. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.
 - 1. For concrete pavers, a block splitter may be used.
- D. Joint Patterns: As indicated.
- E. Pavers over Waterproofing: Exercise care in placing pavers and setting materials over waterproofing so protection materials are not displaced and waterproofing is not punctured or otherwise damaged. Carefully replace protection materials that become displaced and arrange for repair of damaged waterproofing before covering with paving.
 - 1. Provide joint filler at waterproofing that is turned up on vertical surfaces unless otherwise indicated; where unfilled joints are indicated, provide temporary filler or protection until paver installation is complete.
- F. Tolerances: Do not exceed 0.8-mm unit-to-unit offset from flush (lippage) or 3 mm in 3 m from level, or indicated slope, for finished surface of paving.
- G. Tolerances: Do not exceed 1.6-mm unit-to-unit offset from flush (lippage) nor 3 mm in 600 mm and 6 mm in 3 m from level, or indicated slope, for finished surface of paving.
- H. Expansion and Control Joints: Provide for sealant-filled joints at locations and of widths indicated. Provide compressible foam filler as backing for sealant-filled joints unless otherwise indicated; where unfilled joints are indicated, provide temporary filler until paver installation is complete. Install joint filler before setting pavers. Sealant materials and installation are specified in Section 32 13 73 Concrete Paving Joints Sealants.
- I. Provide edge restraints as indicated. Install edge restraints before placing unit pavers.
 - 1. Install edge restraints to comply with manufacturer's written instructions. Install stakes at intervals required to hold edge restraints in place during and after unit paver installation.
 - 2. For metal edge restraints with top edge exposed, drive stakes at least 25 mm below top edge.

3. Install job-built concrete edge restraints to comply with requirements in Section 033000 "Cast-in-Place Concrete."

3.4 AGGREGATE SETTING-BED APPLICATIONS

- A. Compact soil subgrade uniformly to at least 95 percent of ASTM D 698 laboratory density.
- B. Proof-roll prepared subgrade to identify soft pockets and areas of excess yielding. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- C. Place aggregate subbase and base, compact to 100 percent of ASTM D 1557 maximum laboratory density, and screed to depth indicated.
- D. Place leveling course and screed to a thickness of 25 to 38 mm, taking care that moisture content remains constant and density is loose and uniform until pavers are set and compacted.
- E. Treat leveling course with herbicide to inhibit growth of grass and weeds.
- F. Set pavers with a minimum joint width of 1.5 mm and a maximum of 3 mm, being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars. Use string lines to keep straight lines. Fill gaps between units that exceed 10 mm with pieces cut to fit from full-size unit pavers.
- G. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 16- to 22-kN compaction force at 80 to 90 Hz. Use vibrator with neoprene mat on face of plate or other means as needed to prevent cracking and chipping of pavers. Perform at least three passes across paving with vibrator.
 1. Compact pavers when there is sufficient surface to accommodate operation of vibrator, leaving at least 900 mm of uncompacted pavers adjacent to temporary edges.
 2. Before ending each day's work, compact installed concrete pavers except for 900-mm width of uncompacted pavers adjacent to temporary edges (laying faces).
 3. As work progresses to perimeter of installation, compact installed pavers that are adjacent to permanent edges unless they are within 90 mm of laying face.
 4. Before ending each day's work and when rain interrupts work, cover pavers that have not been compacted and cover leveling course on which pavers have not been placed with nonstaining plastic sheets to protect them from rain.
- H. Spread dry sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.
- I. Install Polymeric Joint Sand per manufacturer's recommended instructions.
- J. Do not allow traffic on installed pavers until sand has been vibrated into joints.
- K. Repeat joint-filling process 30 days later.

3.5 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cast-in-place steel detectable warning tiles.

B. Related Requirements:

1. Section 32 13 13 "Concrete Paving" for concrete walkways serving as substrates for tactile warning surfacing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

B. Shop Drawings required for tactile plate installation:

1. Include plans, layout, and attachment details.

- C. Samples for Initial Selection: For each type of exposed finish requiring color selection.

- D. Samples for Verification: For each type of tactile warning surface, in manufacturer's standard sizes unless otherwise indicated, showing edge condition, truncated-dome pattern, texture, color, and cross section; with fasteners and anchors.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For tactile warning surfacing, to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.7 PROJECT CONDITIONS

- A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.
- B. Weather Limitations for Adhesive Application:
1. Apply adhesive only when ambient temperature is above 10 deg C and when temperature has not been below 2 deg C for 12 hours immediately before application. Do not apply when substrate is wet or contains excess moisture.
- C. Weather Limitations for Mortar and Grout:
1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
 2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. Provide artificial shade and windbreaks, and use cooled materials as required. Do not apply mortar to substrates with temperatures of 38 deg C and higher.
 1. When ambient temperature exceeds 38 deg C, or when wind velocity exceeds 13 km/h and ambient temperature exceeds 32 deg C, set unit pavers within 1 minute of spreading setting-bed mortar.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of tactile warning surfaces that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 1. Deterioration of finishes beyond normal weathering and wear.
 2. Separation or delamination of materials and components.
 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TACTILE WARNING SURFACING, GENERAL

- A. Accessibility Requirements: Comply with applicable provisions in The Accessibility for Ontarians with Disabilities Act (OADA) for tactile warning surfaces.
1. For tactile warning surfaces composed of multiple units, provide units that when installed provide consistent side-to-side and end-to-end dome spacing that complies with requirements.

- B. Source Limitations: Obtain each type of tactile warning surfacing, setting material, anchor, and fastener from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

2.2 DETECTABLE WARNING TILES

- A. Product: Cast-in-place steel detectable warning tiles.

- B. Manufacturers:

- 1. Brad Dunlop, Regional Sales Manager

- 1. Bibby Ste Croix (Div of Canada Pipe Co. Ltd.)
 - 2. 1757 Burlington Street East
 - 3. Hamilton ON L8H 3L5
 - 4. brad.dunlop@bibby-ste-croix.com

- 2. John DiCesare

- 1. GORA Construction Products
 - 2. 1939 Kilgorman Way
 - 3. London ON N6K 0G6
 - 4. john@goracon.ca

- 3. Ted Lalogiannis, Director of Business Development

- 1. Ontario Utility Castings Inc.
 - 2. P.O. Box 96761
 - 3. RPO Jane/Major Mac
 - 4. Vaughan ON L6A-0A2
 - 5. ted@oucastings.

- C. Mounting:

- 1. Permanently embedded detectable warning tile wet-set into freshly poured concrete.
 - 2. Permanently embedded detectable warning tile set into formed recess in concrete and adhered with mortar.

3. Replaceable embedded detectable warning tile fastened to permanently installed anchors.

2.3 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of tactile warning surfaces, noncorrosive and compatible with each material joined, and complying with the following:
 1. Furnish Type 304 or 308 stainless-steel fasteners for exterior use.
 2. Fastener Heads: For nonstructural connections, use flathead or oval countersunk screws and bolts with tamper-resistant heads, colored to match tile.
- B. Adhesive: As recommended by manufacturer for adhering tactile warning surfacing unit to pavement.
- C. Sealant: As recommended by manufacturer for sealing perimeter of tactile warning surfacing unit.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions. Verify that installation of tactile warning surfacing will comply with accessibility requirements upon completion.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF TACTILE WARNING SURFACING

- A. General: Prepare substrate and install tactile warning surfacing according to manufacturer's written instructions unless otherwise indicated.
- B. Place tactile warning surfacing units in dimensions and orientation indicated. Comply with location requirements of AASHTO MP 12.

3.3 INSTALLATION OF DETECTABLE WARNING TILES

- A. Cast-in-Place Detectable Warning Tiles:
 1. Concrete Paving Installation: Comply with installation requirements in Section 32 13 13 "Concrete Paving." Mix, place, and finish concrete to conditions complying with detectable warning tile manufacturer's written requirements for satisfactory embedment of tile.
 2. Set each detectable warning tile accurately and firmly in place and completely seat tile back and embedments in wet concrete by tamping or vibrating. If necessary, temporarily apply weight to tiles to ensure full contact with concrete.

3. Set surface of tile flush with surrounding concrete and adjacent tiles, with variations between tiles and between concrete and tiles not exceeding plus or minus 3 mm from flush.
4. Protect exposed surfaces of installed tiles from contact with wet concrete. Complete finishing of concrete paving surrounding tiles. Remove concrete from tile surfaces.
5. Clean tiles using methods recommended in writing by manufacturer.
6. Protect exposed surfaces of installed tiles from contact with wet concrete. Complete finishing of concrete paving surrounding tiles. Remove concrete from tile surfaces.
7. Clean tiles using methods recommended in writing by manufacturer.

3.4 CLEANING AND PROTECTION

- A. Remove and replace tactile warning surfacing that is broken or damaged or does not comply with requirements in this Section. Remove in complete sections from joint to joint unless otherwise approved by Architect. Replace using tactile warning surfacing installation methods acceptable to Architect.
- B. Protect tactile warning surfacing from damage and maintain free of stains, discoloration, dirt, and other foreign material.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Decorative 3-Rail Aluminum Picket Fence.
- B. Related Requirements:
 - 1. Section 03 30 00 "Cast-in-Place Concrete" for concrete.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings Required:
 - 1. Include plans, elevations, sections, post spacing, mounting/ attachment details and locking mechanisms for the following:
 - a. Decorative Aluminum Fence.
 - b. Decorative Picket Fence.
- C. Samples: For each fence material and for each color specified.
 - 1. Provide Samples 300 mm in length for linear materials.
 - 2. Provide Samples 300 mm square for bar grating and sheet or plate materials.
- D. Product Schedule: For site metal fencing.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For site furnishings to include in maintenance manuals.

1.6 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.

- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation. Mockups may form a part of the completed work.
 - 1. Include 1 panel of fence complying with requirements.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 WARRANTY

- A. Manufacturer's Warranty: Provide manufacturer's standard limited warranty against defects in materials and workmanship for a period of 5 Years.

PART 2 - PRODUCTS

2.1 DECORATIVE 3-RAIL ALUMINUM FENCE

- A. Manufacturer: Knotwood Aluminum Fencing – Knotwood, 404 – 12914 Anvil Way, Surrey, BC V3W 8E7, (604) 501-0151, ext 311/316.
- B. Product:
 - 1. Material: Aluminum.
 - 2. Style: Manufacturer's standard with 3 rails.
 - 3. Length: As indicated in the drawings.
 - 4. Overall Height: As indicated in the drawings.
 - 5. Overall Width: As indicated in the drawings.
 - 6. Overall Depth: As indicated in the drawings.
 - 7. Accessories: Manufacturer's standard components.
 - 8. Fasteners: Manufacturer's standard hardware.
 - 9. Installation Method: Embedded in concrete footings as indicated in the drawings.
 - 10. Finish: Black Ash simulated wood pattern.

2.2 DECORATIVE ALUMINUM FENCES - FENCES MADE FROM ALUMINUM EXTRUSIONS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Iron Eagle Industries, Inc.
- B. Product:
 - 1. Material: Aluminum.
 - 2. Style: Manufacturer's standard 'Iron Eagle II' Series.
 - 3. Length: As indicated in the drawings.
 - 4. Overall Height: As indicated in the drawings.
 - 5. Overall Width: As indicated in the drawings.
 - 6. Overall Depth: As indicated in the drawings.
 - 7. Post Cap: As indicated in the drawings.
 - 8. Installation Method: Embedded in concrete retaining wall as indicated in the drawings.
 - 9. Finish: Black Powder Coat.

2.3 ALUMINUM

- A. Aluminum, General: Provide alloys and tempers with not less than the strength and durability properties of alloy and temper designated in paragraphs below for each aluminum form required.
- B. Extrusions: ASTM B 221M, Alloy 6063-T5.
- C. Tubing: ASTM B 429/B 429M, Alloy 6063-T6.
- D. Plate and Sheet: ASTM B 209M, Alloy 6061-T6.
- E. Die and Hand Forgings: ASTM B 247M, Alloy 6061-T6.
- F. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.

2.4 COATING MATERIALS

- A. Polyurethane Intermediate Coat and Topcoat: Complying with MPI #72 and compatible with undercoat.

2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
 - 1. For aluminum, provide type and alloy as recommended by producer of metal to be welded and as required for strength and compatibility in fabricated items.
- B. Concrete: Normal-weight, air-entrained, ready-mix concrete complying with requirements in Section 033000 "Cast-in-Place Concrete" with a minimum 28-day compressive strength of 20 MPa, 75-mm slump, and 25-mm maximum aggregate size or dry, packaged, normal-weight concrete mix complying with ASTM C 387/C 387M mixed with potable water according to manufacturer's written instructions.
- C. Nonshrink Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M and specifically recommended by manufacturer for exterior applications.

2.6 ALUMINUM FINISHES

- A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 0.05 mm. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, construction layout, and other conditions affecting performance of the Work.
- B. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 152.5 m or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 DECORATIVE FENCE INSTALLATION

- A. Install fences according to manufacturer's written instructions.
- B. Install fences by setting posts as indicated and fastening rails and infill panels to posts. Peen threads of bolts after assembly to prevent removal.
- C. Post Setting: Set posts in concrete footing at indicated spacing.
 - 1. Posts Set into Voids in Concrete: Form or core drill holes not less than 20 mm larger than outside diagonal dimension of post.
 - a. Extend posts at least 125 mm into concrete.
 - b. Clean holes of loose material, insert posts, and fill annular space between post and concrete with non-shrink, waterproof grout, mixed and placed to comply with grout manufacturer's written instructions. Finish and slope top surface of grout to drain water away from post.
 - 2. Space posts uniformly at standard manufacturers panel size.

3.4 PROTECTION

- A. Clean and protect products in accordance with the manufacturer's recommendations.
- B. Touch-up, repair or replace damaged products before substantial completion.
 - 1. Touch-up any necessary areas by following the manufacturer instructions.
 - 2. Touch-up paint available from the manufacturer.
- C. Level uneven areas due to excavations created by fence installation.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Bench.
2. Bicycle racks.
3. Waste Receptacle.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing pipe sleeves cast installing anchor bolts cast formed voids in concrete footings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Data for all:

1. Include styles, material descriptions, construction details, fabrication details, dimensions of individual components and profiles, hardware, fittings, mounting accessories, features, and finishes.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

C. Shop Drawings required for all furnishings and hardware:

1. Include plans, elevations, sections, mounting heights, and attachment details.
2. Detail fabrication and assembly of components.
3. Show locations for blocking, reinforcement, and supplementary structural support.

D. Samples: For each exposed product and for each color and texture specified.

E. Product Schedule: For site furnishings. Use same designations indicated on Drawings.

F. Warranty: for all site furnishings.

PART 2 - PRODUCTS

2.1 BENCH

A. Hauser Bench

1. Manufacturer – Hauser Site Furniture, sales@hausersite.com Phone: 1-800-268-7328.
 1. Owner provided contractor installed.
2. 'Rio-Can' Aluminum Bench with Back & Arms (Model No. PS-882-AL-EW-A-TC-SB-BD).
 1. Quantity: 6.
 2. Backed bench.
 3. With arms.
 4. Bolt down.
 1. Hardware: Refer to attachment hardware in the detail.
3. Finish/ Colour:
 1. Envirowood slats in colour 'Sand'.
 2. Frame Metal Colour 'Designer White'.
 3. Inset Metal Colour Red.

2.2 BICYCLE RACK

- A. Manufacturer – Hauser Site Furniture, sales@hausersite.com Phone: 1-800-268-7328.
 1. Owner provided contractor installed.
- B. Style – 'Rio-Can Skyline' Bicycle Rack (Model No. PS-78-102-21-TC-A).
 1. Quantity: 4.
 2. Size: 762mm X 806mm X 50.8mm.
 3. Bolt down.
 1. Hardware: Refer to attachment hardware in the detail.
 4. Finish/ Colour:
 1. Aluminum Frame in colour 'Designer White'.
 2. Formed aluminum insert with metal colour Red.
 5. Installation: Bolt down with embedded anchors to a concrete base as per manufacturer specifications.

2.3 WASTE RECEPTACLE

- A. Manufacturer – Hauser Site Furniture, sales@hausersite.com Phone: 1-800-268-7328.
 1. Owner provided contractor installed.
- B. Style – 'Rio-Can City 3-Stream' Waste Receptacle (Model No. GS-945-AL-TC-35-BD).
 1. Quantity: 2.
 2. Size: 889mm X 1206.5mm X 584.2mm.

3. Bolt down.
 1. Hardware: Refer to attachment hardware in the detail.
4. Finish/ Colour:
 1. Aluminum Frame in colour 'Designer White'.
 2. Bolt down deflectors colour 'Gunmetal'.
 3. Inset metal colour 'Gunmetal'.
5. Accessories:
 1. Polyliners.
 2. Back Panel.
 3. Coin lock for front loading door.
6. Installation: Bolt down with embedded anchors to a concrete base as per manufacturer specifications.

2.4 MATERIALS

A. Steel and Iron: Free of surface blemishes and complying with the following:

1. Plates, Shapes, and Bars: ASTM A 36/A 36M.
2. Steel Pipe: Standard-weight steel pipe complying with ASTM A 53/A 53M, or electric-resistance-welded pipe complying with ASTM A 135/A 135M.
3. Tubing: Cold-formed steel tubing complying with ASTM A 500/A 500M.
4. Mechanical Tubing: Cold-rolled, electric-resistance-welded carbon or alloy steel tubing complying with ASTM A 513/A 513M, or steel tubing fabricated from steel complying with ASTM A 1011/A 1011M and complying with dimensional tolerances in ASTM A 500/A 500M; zinc coated internally and externally.

B. Plastic: Color impregnated, color and UV-light stabilized, and mold resistant.

1. Polyethylene: Fabricated from virgin plastic HDPE resin.

C. Galvanizing: Where indicated for steel and iron components, provide the following protective zinc coating applied to components after fabrication:

1. Hot-Dip Galvanizing: According to ASTM A 123/A 123M, ASTM A 153/A 153M, or ASTM A 924/A 924M.

2.5 FABRICATION

A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.

B. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed

connections, finish surfaces smooth and blended, so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.

- C. Pipes and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.
- D. Preservative-Treated Wood Components: Complete fabrication of treated items before treatment if possible. If cut after treatment, apply field treatment complying with AWPA M4 to cut surfaces.
- E. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.
- F. Factory Assembly: Factory assemble components to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

2.6 GENERAL FINISH REQUIREMENTS

- A. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

- A. Powder-Coat Finish: Manufacturer's standard polyester powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

2.8 STEEL AND GALVANIZED-STEEL FINISHES

- A. Powder-Coat Finish: Manufacturer's standard polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.
- B. PVC Finish: Manufacturer's standard, UV-light stabilized, mold-resistant, slip-resistant, matte-textured, dipped or sprayed-on, PVC-plastisol finish, with flame retardant added; complying with coating manufacturer's written instructions for pretreatment, application, and minimum dry film thickness.

2.9 IRON FINISHES

- A. Powder-Coat Finish: Manufacturer's standard polyester powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

2.10 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run directional finishes with long dimension of each piece.
2. Directional Satin Finish: No 4.
3. Dull Satin Finish: No. 6.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.
- B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.
- C. Install site furnishings level, plumb, true, and securely anchored at locations indicated on Drawings.
- D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.
- E. Posts Set into Voids in Concrete: Form or core-drill holes for installing posts in concrete to depth recommended in writing by manufacturer of site furnishings and 3/4 inch (19 mm) larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with non-shrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.
- F. Pipe Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with non-shrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes planting soils specified by composition of the mixes.
- B. Related Requirements:
 - 1. Section 329200 "Turf and Grasses" for placing planting soil for turf and grasses.
 - 2. Section 329300 "Plants" for placing planting soil for plantings.

1.3 DEFINITIONS

- A. AAPFCO: Association of American Plant Food Control Officials.
- B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.
- C. CEC: Cation exchange capacity.
- D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.
- E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.
- F. Imported Soil: Soil that is transported to Project site for use.
- G. Layered Soil Assembly: A designed series of planting soils, layered on each other, that together produce an environment for plant growth.
- H. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.
- I. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.
- J. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."

- K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
 - L. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.
 - M. SSSA: Soil Science Society of America or CSSS: Canadian Society of Soil Science
 - N. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
 - O. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
 - P. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.
 - Q. CCME: The Canadian Council of Ministers of the Environment
- 1.4 PREINSTALLATION MEETINGS
- A. Preinstallation Conference: Conduct conference at Project site.
- 1.5 ACTION SUBMITTALS
- A. Product Data: For each type of product.
 - 1. Include test data substantiating that products comply with requirements.
 - 2. Material Certificates: For each type of imported soil before delivery to the site, according to the following:
 - a. Manufacturer's qualified testing agency's certified analysis of standard products.
- 1.6 QUALITY ASSURANCE
- A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.
- 1.7 TESTING REQUIREMENTS
- A. General: Perform tests on soil samples according to requirements in this article.
 - B. Physical Testing:
 - 1. Soil Texture: Soil-particle, size-distribution analysis by one of the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":
 - a. Hydrometer Method: Report percentages of sand, silt, and clay.

- C. Fertility Testing: Soil-fertility analysis according to standard laboratory protocol of SSSA NAFT NCR-13, including the following:
1. Percentage of organic matter.
 2. CEC, calcium percent of CEC, and magnesium percent of CEC.
 3. Soil reaction (acidity/alkalinity pH value).
 4. Buffered acidity or alkalinity.
 5. Nitrogen ppm.
 6. Phosphorous ppm.
 7. Potassium ppm.
 8. Manganese ppm.
 9. Manganese-availability ppm.
 10. Zinc ppm.
 11. Zinc availability ppm.
 12. Copper ppm.
 13. Sodium ppm and sodium absorption ratio.
 14. Soluble-salts ppm.
 15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
 16. Other deleterious and hazardous materials, including their characteristics and content of each.
- D. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."
- E. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients. Amend soil as per soil testing amendment recommendations in the soil test report and re-test if not within recommended nutrient/fertility ranges. Hazardous materials to human and/or plant health shall not be permitted in the final installed planting soil.

1.8 SOURCE QUALITY CONTROL

- A. Provide a minimum of 3 samples of planting soil/ topsoil to a qualified testing lab for analysis.
- B. Planting soil/ topsoil to meet the following criteria:

Description	Typical Guidelines
pH	5.5 – 7.0
Organic Matter (%)	4 – 10
Total Salts	<1.5
Phosphorus (ppm)	10 - 60
Potassium (ppm)	80 - 250

Calcium (ppm)	1000 – 4000
Magnesium (ppm)	100 - 300
Chloride (ppm)	<100
Sodium (ppm)	<200
Sodium Adsorption Ratio	<15
Sand Fraction (%)	40 – 75
Silt Fraction (%)	5 – 50
Clay Fraction (%)	20 - 30
Texture	Loam / Sandy Loam

- C. All required planting soil topsoil amendments to meet the above-mentioned criteria.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. **Packaged Materials:** Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.
- B. **Bulk Materials:**
 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 3. Do not move or handle materials when they are wet or frozen.
 4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

PART 2 - PRODUCTS

2.1 PLANTING SOILS SPECIFIED BY COMPOSITION

- A. **General:** Soil amendments, fertilizers, and rates of application specified in this article are guidelines that may need revision based on testing laboratory's recommendations after preconstruction soil analyses are performed.
- B. **Planting-Soil Type:** Imported, naturally formed soil from off-site sources and consisting of sandy loam loam silt loam soil according to USDA textures; and modified to produce viable planting soil.

1. Sources: Take imported, unamended soil from sources that are naturally well-drained sites where topsoil occurs at least 100 mm deep, not from agricultural land, bogs, or marshes; and that do not contain undesirable organisms; disease-causing plant pathogens; or obnoxious weeds and invasive plants including, but not limited to, quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and bromegrass.
2. Additional Properties of Imported Soil before Amending: Soil reaction of pH 6 to 7 and minimum of 4 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.
3. Unacceptable Properties: Clean soil of the following:
 - a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and extraneous materials that are harmful to plant growth.
 - b. Contain no toxic elements or growth inhibiting materials.
 - c. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 8 percent by dry weight of the imported soil.
 - d. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 50 mm in any dimension.
4. Amended Soil Composition: Blend imported, unamended soil with the following soil amendments and fertilizers to produce planting soil:
 - a. Ratio of Loose Compost to Soil: 1:4 by volume.
 - b. Soil amendment to be provided as recommended in soil reports from a qualified testing agency.

2.2 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
 1. Class: T, with a minimum of 99 percent passing through a 2.36-mm sieve and a minimum of 75 percent passing through a 0.25-mm sieve.
 2. Form: Provide lime in form of ground dolomitic limestone.
- B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a 3.35-mm sieve and a maximum of 10 percent passing through a 0.425-mm sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through a 0.30-mm sieve.

- E. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C 33/C 33M.

2.3 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing CCME's "Seal of Testing Assurance," and as follows:
- B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture with 100 percent passing through a 13-mm sieve, a pH of 3.4 to 4.8, and a soluble-salt content measured by electrical conductivity of maximum 5 dS/m.
- C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture with 100 percent passing through a 13-mm sieve, a pH of 6 to 7.5, a soluble-salt content measured by electrical conductivity of maximum 5 dS/m, having a water-absorbing capacity of 1100 to 2000 percent, and containing no sand.
- D. Wood Derivatives: Shredded and composted, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.
 - 1. Partially Decomposed Wood Derivatives: In lieu of shredded and composted wood derivatives, mix shredded and partially decomposed wood derivatives with ammonium nitrate at a minimum rate of 2.4 kg/cu. m of loose sawdust or ground bark, or with ammonium sulfate at a minimum rate of 4 kg/cu. m of loose sawdust or ground bark.
- E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.4 FERTILIZERS

- A. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
- B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 - 1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.
- C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.
- D. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

PART 3 - EXECUTION

3.1 GENERAL

- A. Place planting soil and fertilizers according to requirements in other Specification Sections.
- B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.
- C. Proceed with placement only after unsatisfactory conditions have been corrected.

3.2 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

- A. General: Apply and mix unamended soil with amendments on-site to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Subgrade Preparation: Till subgrade to a minimum depth of 100 mm. Remove stones larger than 38 mm in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Apply, add soil amendments, and mix approximately half the thickness of unamended soil over prepared, loosened subgrade according to "Mixing" Paragraph below. Mix thoroughly into top 50 mm of subgrade. Spread remainder of planting soil.
- C. Mixing: Spread unamended soil to total depth of 100 mm, but not less than required to meet finish grades after mixing with amendments and natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.
 - 1. Amendments: Apply soil amendments, except compost, and fertilizer, if required, evenly on surface, and thoroughly blend them with unamended soil to produce planting soil.
 - a. Mix lime and sulfur with dry soil before mixing fertilizer.
 - b. Mix fertilizer with planting soil no more than seven days before planting.
 - 2. Lifts: Apply and mix unamended soil and amendments in lifts not exceeding 200 mm in loose depth for material compacted by compaction equipment, and not more than 100 mm in loose depth for material compacted by hand-operated tampers.
- D. Soil Depth Minimum:
 - 1. Sodded areas: Minimum 150 mm depth.
 - 2. Planting Beds – grasses, perennials and groundcover: Minimum 450 mm depth.
 - 3. Planting Beds – Medium to small shrubs: Minimum 600 mm depth.
 - 4. Raised Planters: 600 mm depth.
 - 5. Shade and Ornamental Trees: 1200 mm depth where possible.
- E. Compaction: Compact each blended lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698 and tested in-place.

- F. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.3 PROTECTION

- A. Protection Zone: Identify protection zones according to Section 015639 "Temporary Tree and Plant Protection."
- B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.
 - 3. Vehicle traffic.
 - 4. Foot traffic.
 - 5. Erection of sheds or structures.
 - 6. Impoundment of water.
 - 7. Excavation or other digging unless otherwise indicated.
- C. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Contract Administrator and replace contaminated planting soil with new planting soil.

3.4 CLEANING

- A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.
 - 1. Dispose of excess subsoil and unsuitable materials on-site where directed by Owner.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Sodding.

- B. Related Requirements:

- 1. Section 329300 "Plants" for trees, shrubs, ground covers, and other plants as well as border edgings and mow strips.

1.3 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation" and drawing designations for planting soils.
- E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For landscape Installer.
- B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

1. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.
- C. Product Certificates: For fertilizers, from manufacturer.
- D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.
- 1.6 QUALITY ASSURANCE
- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.
1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the Canadian Nursery Landscape Association.
 2. Experience: Five years' experience in turf installation in addition to requirements in Section 014000 "Quality Requirements."
 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:
 - a. Landscape Industry Certified Technician - Exterior.
 - b. Landscape Industry Certified Lawncare Manager.
 - c. Landscape Industry Certified Lawncare Technician.
 5. Pesticide Applicator: State licensed, commercial.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.
- B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.
- C. Bulk Materials:
1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 3. Accompany each delivery of bulk materials with appropriate certificates.

1.8 FIELD CONDITIONS

- A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of planting completion.
 - 1. Spring Planting: May-June.
 - 2. Fall Planting: September-October.
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 TURFGRASS SOD

- A. Turfgrass Sod: Number 1 Quality/Premium, including limitations on thatch, weeds, diseases, nematodes, and insects, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture that is strongly rooted and capable of vigorous growth and development when planted.
- B. Turfgrass Species: Sod of grass species as follows, with not less than 85 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed:
 - 1. Full Sun: Kentucky bluegrass (*Poa pratensis*), a minimum of three cultivars.
 - 2. Sun and Partial Shade: Proportioned by weight as follows:
 - a. 50 percent Kentucky bluegrass (*Poa pratensis*).
 - b. 30 percent chewings red fescue (*Festuca rubra* variety).
 - c. 10 percent perennial ryegrass (*Lolium perenne*).
 - d. 10 percent redtop (*Agrostis alba*).
 - 3. Shade: Proportioned by weight as follows:
 - a. 50 percent chewings red fescue (*Festuca rubra* variety).
 - b. 35 percent rough bluegrass (*Poa trivialis*).
 - c. 15 percent redtop (*Agrostis alba*).

2.2 FERTILIZERS

- A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 - 1. Composition: 0.45 kg/92.9 sq. m of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
 - 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

- B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
 - 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.3 PESTICIDES

- A. General: Pesticide, registered and approved by Environment Canada, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.
 - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 - 2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 - 3. Uniformly moisten excessively dry soil that is not workable or which is dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by the Consultant and replace with new planting soil.

3.2 PREPARATION

- A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
 - 1. Protect grade stakes set by others until directed to remove them.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

- A. General: Prepare planting area for soil placement and mix planting soil according to Section 329113 "Soil Preparation."
- B. Placing Planting Soil: Blend planting soil in place.
 - 1. Reduce elevation of planting soil to allow for soil thickness of sod.
- C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- D. Before planting, obtain Consultant's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 SODDING

- A. Lay sod within 24 hours of harvesting unless a suitable preservation method is accepted by Consultant prior to delivery time. Do not lay sod if dormant or if ground is frozen or muddy.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to soil or sod during installation. Tamp and roll lightly to ensure contact with soil, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
 - 1. Lay sod across slopes exceeding 1:3.
 - 2. Anchor sod on slopes exceeding 1:6 with wood pegs spaced as recommended by sod manufacturer but not less than two anchors per sod strip to prevent slippage.
- C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 38 mm below sod.

3.5 TURF MAINTENANCE

- A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
 - 1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
 - 2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
 - 3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 100 mm.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas if no irrigation is available.
 2. Water turf with fine spray at a minimum rate of 25 mm per week unless rainfall precipitation is adequate.
- C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
1. Mow Kentucky bluegrass annual ryegrass chewings red fescue to a height of 38 to 50 mm.
- D. Turf Postfertilization: Apply commercial fertilizer after initial mowing and when grass is dry.
1. Use fertilizer that provides actual nitrogen of at least 0.45 kg/92.9 sq. m to turf area.

3.6 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by the Consultant:
1. Satisfactory Sodded Turf: At end of maintenance and warranty period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities. Sodded turf in dead or poor condition during the maintenance and warranty period shall be replaced by the contractor to the satisfaction of the consultant.
- B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

3.7 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.8 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.
- C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

- D. Remove nondegradable erosion-control measures after grass establishment period.

3.9 MAINTENANCE SERVICE

- A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:
 - 1. Sodded Turf: 24 months from date of Substantial Completion.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Plants.
2. Tree stabilization.
3. Aluminum edge restraint.
4. Decorative Mineral Mulch

B. Related Requirements:

1. Section 329113 "Soil Preparation" for planting soils specified by composition of the mixes.
2. Section 329200 "Turf and Grasses" for turf (lawn) and meadow planting, hydroseeding, and erosion-control materials.

1.3 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with a ball size not less than diameter and depth recommended by CSNS 8th Edition for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by CSNS 8th Edition.
- C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by CSNS 8th Edition for type and size of plant required.
- D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than the minimum root spread according to CSNS 8th Edition for type and size of plant required.
- E. Canadian Standards for Nursery Stock 8th Edition (**CSNS 8th Edition**).
- F. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root

mass during shipping and be sized according to CSNS 8th Edition for type and size of plant required.

- G. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by CSNS 8th Edition for type and size of plant.
- H. Finish Grade: Elevation of finished surface of planting soil.
- I. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.
- J. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- K. Planting Area: Areas to be planted.
- L. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation" for drawing designations for planting soils.
- M. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.
- N. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.
- O. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.
- P. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 COORDINATION

- A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.
 - 1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
 - B. Samples for Verification: For each of the following:
 1. Organic Compost Mulch: 0.5-L volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
 2. Mineral Mulch: 1.0 kg of each mineral mulch required, in sealed plastic bags labeled with source of mulch. Sample shall be typical of the lot of material to be delivered and installed on-site; provide an accurate indication of color, texture, and makeup of the material.
 3. Weed Control Barrier: 300 by 300 mm.
- 1.7 INFORMATIONAL SUBMITTALS
- A. Contractor to submit a phasing completion submittal prior the commencement of plant installation.
 - B. Qualification Data: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.
 - C. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
 1. Manufacturer's certified analysis of standard products.
 2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
 - D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.
 - E. Sample Warranty: For special warranty.
- 1.8 CLOSEOUT SUBMITTALS
- A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.
- 1.9 QUALITY ASSURANCE
- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.
 1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the Canadian Nursery Landscape Association.

2. Experience: Five years' experience in landscape installation in addition to requirements in Section 014000 "Quality Requirements."
 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:
 1. Landscape Industry Certified Technician - Exterior.
 2. Landscape Industry Certified Interior.
 3. Landscape Industry Certified Horticultural Technician.
 5. Pesticide Applicator: Province licensed, commercial.
- B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in CSNS 8th Edition.
1. Selection of plants purchased under allowances is made by Architect, who tags plants at their place of growth before they are prepared for transplanting.
- C. Measurements: Measure according to CSNS 8th Edition. Do not prune to obtain required sizes.
1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 150 mm above the root flare for trees up to 100-mm caliper size, and 300 mm above the root flare for larger sizes.
 2. Other Plants: Measure with stems, petioles, and foliage in their normal position.
- D. Plant Material Observation: Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
1. Notify Architect of sources of planting materials seven days in advance of delivery to site.
- 1.10 DELIVERY, STORAGE, AND HANDLING
- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.
 - B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 3. Accompany each delivery of bulk materials with appropriate certificates.
- C. Deliver bare-root stock plants within 24 hours of digging. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting. Transport in covered, temperature-controlled vehicles, and keep plants cool and protected from sun and wind at all times.
- D. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
- E. Handle planting stock by root ball.
- F. Store bulbs, corms, and tubers in a dry place at 16 to 18 deg C until planting.
- G. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.
- H. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.
- I. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
1. Heel-in bare-root stock. Soak roots that are in less than moist condition in water for two hours. Reject plants with dry roots.
 2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
 3. Do not remove container-grown stock from containers before time of planting.
 4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

1.11 FIELD CONDITIONS

- A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.
- B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.
 - 1. Spring Planting: May-June.
 - 2. Fall Planting: September-November.
- C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

1.12 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - 1. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
 - 2. Structural failures including plantings falling or blowing over.
 - 3. Faulty performance of tree stabilization.
 - 4. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Periods: From date of Substantial Completion.
 - 1. Within the City's right-of-way:
 - 1. Trees, Shrubs, Vines, and Ornamental Grasses: 24 months following written acceptance by the city.
 - 2. Ground Covers, Biennials, Perennials, and Other Plants: 24 months following written acceptance by the city.
 - 2. Within Private property:
 - 1. Trees, Shrubs, Vines, and Ornamental Grasses: 24 months from the date of substantial completion.
 - 2. Ground Covers, Biennials, Perennials, and Other Plants: 24 months from the date of substantial completion.

3. Include the following remedial actions as a minimum:
 1. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
 2. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with CSNS 8th Edition; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
 1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 19 mm in diameter; or with stem girdling roots are unacceptable.
 2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.
- B. Provide plants of sizes, grades, and ball or container sizes complying with CSNS 8th Edition for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.
- C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to CSNS 8th Edition. Root flare shall be visible before planting.
- D. Labeling: Label at least one plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant.
- E. If formal arrangements or consecutive order of plants is indicated on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.
- F. Annuals and Biennials: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery and that are in bud but not yet in bloom.

2.2 FERTILIZERS

- A. Planting Tablets: Tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
1. Size: 21-gram tablets.
 2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

2.3 MULCHES

- A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
1. Type: Shredded hardwood.
 2. Size Range: 76 mm maximum, 13 mm minimum.
 3. Color: Natural.
- B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through a 25-mm sieve; soluble-salt content of 2 to 5 dS/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
1. Organic Matter Content: 50 to 60 percent of dry weight.
 2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
- C. Decorative Mineral Mulch: Hard, durable stone, washed free of loam, sand, clay, and other foreign substances, of the following type, size range, and color:
1. Type: Riverstones: Washed and round granite riverstones.
 2. Size Range: 50 mm maximum, 100 mm minimum.
 3. Color: Readily available natural grey gravel color range.
 4. Installation: Min. 10mm depth (two layers of riverstones) on filter fabric and compacted granular A base.

2.4 ALUMINUM EDGE RESTRAINTS

- A. Aluminum Edge Restraints: Manufacturer's standard, 4.8-mm-thick by 127-mm-high extruded-aluminum edging.
1. 'Cleanline' Commercial Grade Landing Edging by 'Permaloc' or approved equal.
www.permaloc.com

1. Finish: Mill Finish – Natural Aluminum.

2.5 WEED-CONTROL BARRIERS

- A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 101g/sq. m minimum, composed of fibers formed into a stable network so that fibers retain their relative position. Fabric shall be inert to biological degradation and resist naturally encountered chemicals, alkalis, and acids.

2.6 PESTICIDES

- A. General: Pesticide registered and approved by Environment Canada, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.7 TREE-STABILIZATION MATERIALS (For use only if specifically requested or required)

- A. Trunk-Stabilization Materials:
 1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, free of knots, holes, cross grain, and other defects, 38-by-38-mm actual by length indicated, pointed at one end.
 2. Guys and Tie Wires: ASTM A 641/A 641M, Class 1, galvanized-steel wire, two-strand, twisted, 2.7 mm in diameter.
 3. Flags: Standard surveyor's plastic flagging tape, white, 150 mm long.

2.8 MISCELLANEOUS PRODUCTS

- A. Wood Pressure-Preservative Treatment: AWP A U1, Use Category UC4a; acceptable to authorities having jurisdiction, and containing no arsenic or chromium.
- B. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.
- C. Burlap: Non-synthetic, biodegradable.
- D. Drainage Gravel: Washed, sound crushed stone or gravel complying with ASTM D 448 for Size No. 8.
- E. Filter Fabric: Nonwoven geotextile manufactured for separation applications and made of polypropylene, polyolefin, or polyester fibers or combination of them.

- F. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per 0.45 kg of vesicular-arbuscular mycorrhizal fungi and 95 million spores per 0.45 kg of ectomycorrhizal fungi, 33 percent hydrogel, and a maximum of 5.5 percent inert material.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.
 - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 - 2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
 - 3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 - 4. Uniformly moisten excessively dry soil that is not workable or which is dusty.
- B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.
- D. Lay out plants at locations directed by Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.
- E. Install aluminum edge restraint as per manufacturer's installation guidelines.

3.3 PLANTING AREA ESTABLISHMENT

- A. General: Prepare planting area for soil placement and mix planting soil according to Section 329113 "Soil Preparation."

- B. Placing Planting Soil: Place manufactured planting soil over exposed subgrade.
- C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.
- D. Application of Mycorrhizal Fungi: At time directed by Architect, broadcast dry product uniformly over prepared soil at application rate according to manufacturer's written recommendations.

3.4 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits.
 - 1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
 - 2. Excavate approximately three times as wide as ball diameter for balled and burlapped, balled and potted, container-grown, fabric bag-grown stock.
 - 3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
 - 4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
 - 5. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
 - 6. Maintain supervision of excavations during working hours.
 - 7. Keep excavations covered or otherwise protected after working hours when unattended by Installer's personnel.
 - 8. If drain tile is indicated on Drawings or required under planting areas, excavate to top of porous backfill over tile.
- B. Backfill Soil: Subsoil and topsoil removed from excavations may not be used as backfill soil unless otherwise indicated.
- C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
 - 1. Hardpan Layer: Drill 150-mm-diameter holes, 600 mm apart, into free-draining strata or to a depth of 3 m, whichever is less, and backfill with free-draining material.
- D. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

- E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.5 TREE, SHRUB, AND VINE PLANTING

- A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to CSNS 8th Edition. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Balled and Burlapped Stock: Set each plant plumb and in center of planting pit or trench with root flare 25 mm above adjacent finish grades.
 - 1. Backfill: Planting soil.
 - 2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 - 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 - 4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 25 mm from root tips; do not place tablets in bottom of the hole.
 - 1. Quantity: As indicated on Drawings.
 - 5. Continue backfilling process. Water again after placing and tamping final layer of soil.
- D. Balled and Potted and Container-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 25 mm above adjacent finish grades.
 - 1. Backfill: Planting soil.
 - 2. Carefully remove root ball from container without damaging root ball or plant.
 - 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 - 4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 25 mm from root tips; do not place tablets in bottom of the hole.
 - 1. Quantity: As indicated on Drawings.
 - 5. Continue backfilling process. Water again after placing and tamping final layer of soil.

- E. Fabric Bag-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 25 mm above adjacent finish grades.
 - 1. Backfill: Planting soil.
 - 2. Carefully remove root ball from fabric bag without damaging root ball or plant. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 - 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 - 4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 25 mm from root tips; do not place tablets in bottom of the hole.
 - 1. Quantity: As indicated on Drawings.
 - 5. Continue backfilling process. Water again after placing and tamping final layer of soil.
- F. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.6 TREE, SHRUB, AND VINE PRUNING

- A. Remove only dead, dying, or broken branches. Do not prune for shape.
- B. Prune, thin, and shape trees, shrubs, and vines as directed by Architect.
- C. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.
- D. Do not apply pruning paint to wounds.

3.7 TREE STABILIZATION (For use only if specifically requested or required)

- A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated:
 - 1. Upright Staking and Tying: Stake trees of 50- through 125-mm caliper. Stake trees of less than 50-mm caliper only as required to prevent wind tip out. Use a minimum of two stakes of length required to penetrate at least 450 mm below bottom of backfilled excavation and to extend to the dimension indicated on Drawings above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.
 - 2. Upright Staking and Tying: Stake trees with two stakes for trees up to 3.6 m high and 63 mm or less in caliper; three stakes for trees less than 4.2 m high and up to 100 mm in caliper. Space stakes equally around trees.

3. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
 4. Support trees with two strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
- B. Trunk Stabilization by Staking and Guying: Install trunk stabilization as follows unless otherwise indicated on Drawings. Stake and guy trees more than 4.2 m in height and more than 75 mm in caliper unless otherwise indicated.
1. Site-Fabricated, Staking-and-Guying Method: Install no fewer than three guys spaced equally around tree.
 1. Securely attach guys to stakes 760 mm long, driven to grade. Adjust spacing to avoid penetrating root balls or root masses. Provide turnbuckle for each guy wire and tighten securely.
 2. For trees more than 150 mm in caliper, anchor guys to wood deadmen buried at least 900 mm below grade. Provide turnbuckle for each guy wire and tighten securely.
 3. Support trees with bands of flexible ties at contact points with tree trunk and reaching to turnbuckle. Allow enough slack to avoid rigid restraint of tree.
 4. Support trees with guy cable or multiple strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk and reaching to turnbuckle. Allow enough slack to avoid rigid restraint of tree.
 5. Attach flags to each guy wire, 760 mm above finish grade.
 6. Paint turnbuckles with luminescent white paint.

3.8 GROUND COVER AND PLANT PLANTING

- A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on Drawings in even rows with triangular spacing.
- B. Use planting soil for backfill.
- C. Dig holes large enough to allow spreading of roots.
- D. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to a depth not less than two nodes.
- E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.9 PLANTING AREA MULCHING

- A. Install weed-control barriers before mulching according to manufacturer's written instructions. Completely cover area to be mulched, overlapping edges a minimum of 300mm and secure seams with galvanized pins.
- B. Mulch backfilled surfaces of planting areas and other areas indicated.
 - 1. Trees and Treelike Shrubs in Turf Areas: Apply organic mulch ring of 75-mm average thickness, with 900-mm radius around trunks or stems. Do not place mulch within 75 mm of trunks or stems.
 - 2. Organic Mulch in Planting Areas: Apply 75-mm average thickness of organic mulch extending 300 mm beyond edge of individual planting pit or trench and over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 75 mm of trunks or stems.
 - 3. Mineral Mulch Areas: Apply 75-mm average thickness of mineral mulch over whole surface of area, and finish level with adjacent finish grades.
- C. Place device on top of the mulch at base of tree stem and fill with water according to manufacturer's written instructions.

3.10 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.
- B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.11 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas according to manufacturer's written recommendations. Do not apply to seeded areas.
- C. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.12 REPAIR AND REPLACEMENT

- A. General: Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by Architect.
 - 1. Submit details of proposed pruning and repairs.
 - 2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
 - 3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.
- B. Remove and replace trees that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.
 - 1. Provide new trees of same size as those being replaced for each tree of 100 mm or smaller in caliper size.
 - 2. Species of Replacement Trees: Same species being replaced.

3.13 CLEANING AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.
- C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- D. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.
- E. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

3.14 MAINTENANCE SERVICE

- A. Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:
 - 1. Maintenance Period: 24 months from date of Substantial Completion.
- B. Maintenance Service for Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin

maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:

1. Maintenance Period: 24 months from date of Substantial Completion.
- C. Weed Control: Hand remove all weeds and any plants that do not appear on the planting plan. Chemical weed control is not permitted. Schedule Weeding shall be as needed but not less than 5 times a year and not less than maintenance period below:
1. Maintenance Period: 24 months from date of Substantial Completion.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 RELATED SECTIONS

- A. Section Includes 32 91 13 Soil Preparation
- B. Section 32 93 00 Plants

1.3 SUMMARY

- A. Contractors must provide trees with the specified net soil volume within a structured rooting space provided by the soil cell system.
- B. Section includes:
 - 1. Furnishing and installing soil cell system, geotextile, geogrids, subbase material, backfill, drainage/aeration system, root barrier, and mulch, and the installation of Growing Medium.

1.4 DEFINITIONS

- A. Aggregate Subbase (below soil cells): Aggregate material between the bottom of the soil cell frame and the compacted subgrade below, designed to distribute loads from the frame to the subgrade.
- B. Aggregate Base Course (above cell deck): Aggregate material between the paving and the top of the soil cell deck below designed to distribute loads across the top of the deck.
- C. Backfill: The earth used to replace or the act of replacing earth in an excavation beside the soil cell to the excavation extents.
- D. Drainage/Aeration System: Perforated pipe system above growing medium with surface inlet/vent piping.
- E. Finish Grade: Elevation of finished surface of Growing Medium or paving.
- F. Geogrid: Net-shaped synthetic polymer-coated fibers that provide a stabilizing force within soil structure as the fill interlocks with the grid and as defined in Part 2 – Products.
- G. Geotextile: A geosynthetic fabric, applied to either the soil surface or between materials, providing filtration, separation, or stabilization properties.
- H. Growing Medium: Planting Soil as defined in Section "Soil Preparation" intended to fill the soil cell system and other planting spaces.
- I. Root Barrier: Plastic root diversion device.

- J. Root package: The earthen package containing the root system of the tree as shipped from the nursery.
- K. Soil Cells: Structural system designed to be filled with Growing Medium for tree rooting and support of vehicle loaded pavements.
- L. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill
- M. Subsoil: All soil beneath the topsoil layer of the soil profile and typified by the lack of organic matter and soil organisms.

1.5 SUBMITTALS

- A. Contractor shall provide submittals required in this section to the Consultant for review.
- B. Shop Drawings: Provide drawings signed and sealed by a professional engineer licensed to practice in the Province of Ontario.
- C. Product Data: For each type of product, submit manufacturer's product literature with technical data sufficient to demonstrate that the product meets these specifications.
- D. Samples for Verification: For each product where noted in the specification, submit samples as described.
- E. Compaction testing results: Submit results of all compaction testing required by the specifications including the bulk density test of the mock-up and installed soil, and the compaction testing log of penetrometer and moisture meter readings to the Consultant for review.
- F. Qualification Data: Submit documentation of the qualifications of the soil cell installer sufficient to demonstrate that the installer meets the requirements of paragraph "Quality Assurance".
- G. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
 - 1. Manufacturer's certified analysis for standard products.
 - 2. Soil cell manufacturer's letter of review and approval of the project, plans, details and specifications for compliance with product installation requirements.

1.6 SEQUENCING AND SCHEDULING

- A. General: Prior to the start of Work, prepare a detailed schedule of the work for coordination with other trades.
- B. Schedule all utility installations prior to beginning work in this section.
- C. Where possible, schedule the installation of soil cells after the area is no longer required for use by other trades and work. Protect installed soil cells from damage in the event that work must occur over or adjacent to the completed soil cells.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Soil cells and related products shall be installed by a qualified installer whose work has resulted in successful installation of Growing Mediums and planter drainage systems, underground piping, chambers and vault structures.
1. Submit list of completed projects of similar scope and scale to the Consultant, demonstrating capabilities and experience.
 2. The installer and the field supervisor shall have a minimum of five years successful experience with construction of similar scope in dense urban areas.
 3. Installer's Field Supervision: Installer is required to maintain an experienced full-time supervisor on Project site when work is in progress. This person shall be identified during the Pre-installation Conference, with appropriate contact information provided, as necessary. The same supervisor shall be utilized throughout the Project, unless a substitution is submitted to and approved in writing by the Consultant.
 4. Installer will be required to take part in a half-day training session provided by the manufacturer. Training session to be attended by all foremen and key personnel involved in installation. Manufacturer will provide additional training during mock- up installation.
- B. Provide mock-up of soil installation and compaction evaluation:
1. Prior to the installation of soil cells, construct a mock-up of the complete installation at the site. The installation of the mock-up shall be in the presence of the Contract Administrator.
 2. The mock-up shall be a minimum of 10 square meters and include the complete soil cell system installation with subbase compaction, drainage installation, base course aggregate and geotextile as required, geogrids, backfill, Growing Medium with compaction, and top geotextile.
 3. The mock-up area may remain as part of the installed work at the end of the Project provided that it remains in good condition and meets requirements of the Contract Documents.
- C. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following.
1. Manufacturer's certified analysis for standard products.
 2. Soil cell manufacturer's letter of review and approval of the project, plans, details and specifications for compliance with product installation requirements.
- D. Quality control required.
1. The contractor shall, engage the soil cell manufacturer to provide shop drawings, stamped by an Ontario licensed professional engineer, and to provide periodic construction review by an Ontario licensed professional engineer to ensure that the soil cells are constructed in accordance with the construction documents.

2. The soil cell Ontario Professional Engineer responsible for the periodic review of the installation shall attend the pre-installation meeting.

1.8 LAYOUT AND ELEVATION CONTROL

- A. Provide layout and elevation control during installation of soil cells. Utilize grade stakes, benchmarks, surveying equipment and other means and methods to assure that layout and elevations conform to the layout and elevations indicated on the plans.

1.9 PERMITS AND CODE COMPLIANCE

- A. Comply with applicable requirements of the laws, codes, ordinances and regulations of Federal, Provincial and Municipal authorities having jurisdiction. Obtain necessary permits/approvals from all such authorities.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. **Packaged Materials:** Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer. Protect materials from deterioration during delivery and while on the project site.
- B. **Bulk Materials:** Do not deliver or place backfill, soils and soil amendments in frozen, wet, or muddy conditions.
- C. Do not dump or store bulk materials near structures, utilities, sidewalks, pavements, and other facilities, or on existing trees, turf areas or plants.
- D. Provide protection including tarps, plastic and or matting between all bulk materials and any finished surfaces sufficient to protect the finish material.
- E. Provide erosion-control measures to prevent erosion or displacement of bulk materials and discharge of soil-bearing water runoff or airborne dust to adjacent properties, water conveyance systems, and walkways. Provide additional sediment control to retain excavated material, backfill, soil amendments and planting mix within the project limits as needed.
- F. **Soil cells:** Protect soil cells from damage during delivery, storage and handling.
- G. Store under tarp to protect from sunlight when time from delivery to installation exceeds one week. Storage should occur on smooth surfaces, free from dirt, mud and debris.
- H. Handling is to be performed with equipment appropriate to the size (height) of Cells and site conditions, and may include, hand, handcart, forklifts, extension lifts, small cranes, etc., with care given to minimize damage to soilcells. Backhoes, front-end loaders and skid steers are considered inappropriate for soil cell transport and placement.

1.11 PROJECT CONDITIONS

- A. **Verification of Existing Conditions and Protection of New or Existing Improvements:** Before proceeding with work in this section, the Installer shall carefully check and verify all dimensions, quantities, and grade elevations, and inform the Consultant immediately of any discrepancies.

- B. Carefully examine the civil, record, and survey drawings to become familiar with the existing underground conditions before digging. Verify the location of all aboveground and underground utility lines, infrastructure, other improvements, and existing trees, shrubs, and plants to remain including their root system, and take proper precautions as necessary to avoid damage to such improvements and plants.
- C. In the event of conflict between existing and new improvements notify the Consultant in writing and obtain written confirmation of any changes to the work prior to proceeding.
- D. When new or previously existing utility lines are encountered during the course of excavation, notify the Consultant in writing and make recommendations as to remedial action. Proceed with work in that area only upon approval of appropriate remedial action. Coordinate all work with the appropriate utility contractors, utility company or responsible public works agency.
- E. Weather Limitations: Do not proceed with work when subgrades, soils and Growing Mediums are in a wet, muddy or frozen condition.
- F. Where construction sequencing requires work during cold weather, protect sub grades and bulk materials from freezing using covers or as needed heated tenting. Sub grades that are sufficiently well drained to preclude the buildup of ice may be installed and built upon during freezing weather provided the surface is cleared of snow and any ice bound material.
- G. Protect partially completed soil cell installation against damage from other construction traffic when work is in progress, and following completion with highly visible construction tape, fencing, or other means until construction is complete. Prevent all non-installation related construction traffic over the completed soil cell installation; only allowing loads less than the design loads.

1.12 PROTECTION

- A. Protect open excavations and partially completed Soil Cell installation from access and damage when work is in progress, and following completion with highly visible construction tape, fencing, or other means until all construction is complete.

1.13 WARRANTY

- A. Soil cell manufacturer's product warranty shall apply. Submit manufacturer's product warranty.
- B. Warranty for other products and installation of soil cells in this section shall be as described in Division 1.

1.14 PROJECT WORK

- A. Coordinate installation with all other work that may impact the completion of the work.

1.15 PRECONSTRUCTING MEETING

- A. Prior to the start of the installation of soil cells, meet at the site with the Consultant, general contractor and the soil cells installer to review installation layout, procedures, means and methods.

PART 2 - PRODUCTS

2.1 SOIL CELLS

- A. Structural system designed to be filled with Growing Medium for tree rooting and support of vehicle loaded pavements meeting the following requirements:
1. The structure shall be designed to support loads up to and including AASHTO H- 20 and Relevant Ontario Building Code standards for sidewalks.
 - a. The structures shall be designed to be filled with the growing medium as specified in section 32 91 13 "Soil Preparation" including the type of soil specified; the required limitations of delivery, storage, and handling; the requirement to retain soil peds; and requirements to compact and in-situ test soil compaction to the ranges specified.
 - b. The soil cells shall have been specifically designed and tested for the purpose of growing tree roots, and rainwater filtering, detention and retention.
 - c. Critical to the soil cell design is that each soil cell or stack of soil cells shall be structurally independent of all adjacent soil cell stacks such that a single stack or group of stacks can be removed after the completion of installation to facilitate future utility installation and repair.
 - d. The structural design of each Soil Cell unit shall facilitate the movement of roots and water between each cell and between the edges of the cell system and the surrounding soils. The design shall facilitate the installation, compaction and in- situ soil compaction testing; installation and maintenance of utilities within and under the soil cells; the movement and expansion of roots; and the lateral capillary movement of water.

2.2 INSPECTION RISER AND CAP

- A. Inspection riser shall consist of a rigid, schedule 40 non-perforated 100mm +/- diameter PVC pipe.
- B. Cap shall be cast iron clean out caps with screw top and inset lug designed to fit standard PVC schedule 40 pipe fittings.

2.3 GEOGRID

- A. Geogrid shall be high strength, high tenacity, high molecular weight polyester with the following properties:
- Ultimate Wide Width Tensile Strength 29.2 kN/m
- Creep Reduced Strength 18.5 kN/m
- Long Term Design Strength 16.0 kN/m:

2.4 GEOTEXTILE

- A. Refer to Class II non-woven geotextile per OPSS 1860.

- 2.5 AGGREGATE SUBBASE (BELOW CELL FRAME):
- A. 19mm crusher run limestone per OPSS 1010.
- 2.6 AGGREGATE BASE COURSE (ABOVE CELL DECK):
- A. 19mm crusher run limestone per OPSS 1010.
- 2.7 BACKFILL MATERIAL (ADJACENT TO SOIL CELLS):
- A. Refer to OPSS 1010. Clean, compactable, coarse grained fill soil meeting the requirements of the Unified Soil Classification system for soil type GW, GP, GC with less than 30% fines, SW, and SC with less than 30% fines. Backfill material shall be free of organic material, trash and other debris, and shall be free of toxic material injurious to plant growth.
- 2.8 GROWING MEDIUM – (See Specification Section – Soil Preparation)
- 2.9 ROOT BARRIER
- A. Root barrier shall prevent root penetration. The material shall be impermeable and ribbed with a thickness of 1mm to 2mm. The root barrier shall be the full depth of the soil cells.

PART 3 - EXECUTION

3.1 LAYOUT APPROVAL

- A. Prior to the start of work, layout and stake the limits of excavation and horizontal and vertical control points sufficient to install the soil cells and required drainage features in the correct locations.

3.2 UTILITY COORDINATION

- A. Confirm that the layout of the soil cells is not in conflict with any existing or proposed utility lines or structures. In event that there is a conflict notify the Consultant and take remedial actions to resolve the conflict as instructed by the Consultant. Where needed and approved by the Consultant utility lines may be installed through the spaces within the soil cell frames.
 1. Secure and brace all utility lines placed within the frames.
 2. Where lines require that the space between cells is larger than 75mm, use the manufacturer's recommended spanning techniques to bridge paving over the gaps between frames.

3.3 EXCAVATION

- A. Check compaction of the subgrade below the soil cells and confirm that the subgrade soil is compacted to a minimum of 95% of maximum dry density at optimum moisture content in accordance with ASTM D 698 Standard Proctor Method.
- B. Excavate per manufacturer's instructions.

3.4 SUBGRADE COMPACTION

- A. Check compaction of the subgrade below the soil cells and confirm that the subgrade soil is compacted to a minimum of 95% of maximum dry density at optimum moisture content in accordance with ASTM D 698 Standard Proctor Method.
 - 1. Proof compact the subgrade with a minimum of three passes of a suitable vibrating compacting machine or apply other compaction forces as needed to achieve the required subgrade compaction rate.
- B. Apply additional compaction forces at optimum water levels.

3.5 INSTALLATION OF GEOTEXTILE OVER SUBGRADE

- A. Where indicated on the drawings by the project engineer, install geotextile over the compacted subgrade material.
- B. Install the geotextile with a minimum joint overlap of 450 mm between sections of material.

3.6 INSTALLATION OF SOLID AND PERFORATED DRAIN LINES

- A. Lay out the location of all drain lines. Adjust the alignments to conform to the final locations of sleeves and risers. Do not locate drain lines within 150mm of the edge of any soil cell edge.

3.7 INSTALLATION OF AGGREGATE SUBBASE BELOW SOIL CELL FRAME

- A. Install aggregate subbase to the depths indicated on the drawings, under the first layer of soil cell frames.
- B. Compact aggregate subbase layer to a minimum of 95% of maximum dry density at optimum moisture content in accordance with ASTM D 698 Standard Proctor Method.
 - 1. Compact the subgrade with a minimum of three passes of a suitable vibrating compacting machine or apply other compaction forces as needed to achieve the required subgrade compaction rate.
- C. Grade surface in a plane parallel to the grades of the paving above.
 - 1. The tolerance for dips and bumps in the aggregate under soil cells shall be a 9 mm deviation from the plane in 3000mm and 3 mm in 1200 mm.
 - 2. The grade and elevations of the base under the soil cells shall be approved by the Contract Administrator prior to proceeding with the installation of the soil cells.

3.8 INSTALLATION OF SOIL CELLS, GROWING MEDIUM, GEOGRID, AND BACKFILL

- A. Refer to manufacturer's instructions.
- B. Identify the outline layout of the structure and the edges of paving around tree planting areas on the floor of the excavation, using spray paint or chalk line. The layout shall be calculated to include shift in layout locations due to depth and the slope of the cells.

- C. Lay out the first layer of soil cell frames on the subbase. Verify that the layout is consistent with the required locations and dimensions of paving edges to be constructed over the soil cells.
1. Check each soil cell frame unit for damage prior to placing in the excavation. Any cracked or chipped unit shall be rejected.
- D. Place frames no less than 25 mm and no more than 75 mm apart.
- E. Assure that each soil cell sits solidly on the surface of the subbase. Soil cells shall not rock or bend over any stone or other obstruction protruding above the surface of the subbase material. Soil cells shall not bend into dips in the subbase material. The maximum tolerance for deviations in the plane of the subbase material under the bottom of the soil cells shall be 6 mm in 1200 mm. Adjust subbase material including larger pieces of aggregate under each soil cell to provide a solid base of support.
- F. For additional layers, comply with manufacturer's requirements to correctly register and connect the soil cells together.
- G. Install Growing Medium, geogrid and geotextile curtain, rainwater harvesting system and backfill as indicated on the drawings and per specification. The process of installation requires that these materials be installed and compacted together in several alternating operations to achieve correct compaction relationships within the system.
- H. Where required install utility lines within the soil cells during the installation of the system.
- I. Where required, place the geogrid and geotextile curtain along the outside of the limit of the soil cell frames.
1. Geogrid and geotextile curtains are required between the edge of the Soil Cells and any soils to be compacted to support paving beyond the area of Soil Cells. Do not place geogrid and geotextile curtains between the edge of the Cells and any planting area adjacent to the Cells.
 2. Pre-cut the geogrid and geotextile to allow for 150 mm minimum under lapping below backfill, and 300 mm minimum overlapping top of soil cells.
 3. Where cell layout causes a change direction in the plane of the geogrid or geotextile, slice the top and bottom flaps of the material so that it lies flat on the top of the soil cells and aggregate base course along both planes.
 4. Provide a minimum of 300mm overlaps between different sheets of geogrid or geotextile.
 5. Place the geogrid and geotextile in the space between the soil cells and the sides of the excavation. Attach the geogrid to the soil cells at every soil cell then place the geotextile over the geogrid.
- J. Install no more than two layers of soil cell frames before beginning to install Growing Medium and backfill. Compact the Growing Medium within the soil cells and the backfill material outside the frames in alternating lifts until the desired elevations and density is achieved in both soils.

- K. Install and compact backfill material in the space between the soil cells and the sides of the excavation in lifts that do not exceed 250 mm in depth.
 - 1. Compact backfill to minimum 95% of maximum dry density using a powered mechanical compactor. Use a pneumatic compacting tool or narrow foot jumping jack compactor for spaces less than 300 mm wide and a 300 mm wide jumping jack compactor or larger equipment in wider spaces.
 - 2. Maintain the geogrid and geotextile curtain between the soil cells and the backfill material.
 - 3. Install backfill in alternating lifts with the Growing Medium inside the soil cells.

 - L. Fill the first layer or layers of frames with Growing Medium, specified in Section "Growing Medium". Install in lifts that do not exceed 250 mm. Lightly compact the soil inside the frames at each lift to remove air pockets and settle the soil within the frames. Refer to manufacturer's instructions.
 - 1. Lightly compact each lift to achieve the following test results. Growing Medium compaction shall be tested at each lift using a cone penetrometer to between 70,000 and 140,000 kg/m² (100 and 200 psi) when the soil is between 12% and 20% moisture.
 - 2. If the Growing Medium becomes overly compacted, remove the soil and reinstall. Use hand tools or other equipment that does not damage the soil cells.
 - 3. Eliminate air pockets and voids. Fill each frame such that there is a minimum of 200 mm of soil over the top of the soil cells before beginning compaction.

 - M. After the first two layers of soil cells have been installed, filled with Growing Medium and backfilled, proceed to install the third layer of soil cells, if required. Comply with manufacturer's requirements to correctly register and connect the soil cells together.

 - N. Continue to install and compact the Growing Medium within the soil cells and the backfill material outside the frames in alternating lifts until the desired elevations and density is achieved in both soils.
 - 1. When using mulch, add a final layer of Growing Medium as required to bring the Growing Medium level to not more than 25 mm below the bottom of the soil cell when installed.
 - 2. Obtain final approval by the Contract Administrator for the soil installation.

 - O. Leave 25 mm air space, below top layer of soil cells.

 - P. Install and compact remaining backfill material such that the soil outside the limits of the soil cells is flush with the top of the installed deck.
- 3.9 INSTALLATION OF RAINWATER DISTRIBUTION SYSTEM WITHIN THE SOIL CELLS
- A. Install perforated rainwater distribution lines as per manufacturers standard.

- B. Assure that lines are laid level within the growing medium at the depths indicated on the drawings.
- 3.10 INSTALLATION OF GEOTEXTILE, GEOGRID, INSPECTION AND AGGREGATE OVER SOIL CELLS
- A. Refer to manufacturer's instructions.
- B. Overlap geogrid over the top of the soil cells, with minimum of 300mm overlap.
- C. Place geotextile over the top of the soil cells and as indicated on the drawings, extending beyond the outside edge of the excavation by at least 450 mm. Any joints must be overlapped by a minimum of 450 mm.
- D. Cut geotextile larger than the size of the soil cell area to be covered to accommodate for required conforming of the geotextile and aggregate to the soil cell contours and all required overlaps.
- E. Install 100mm solid P.V.C. inspection risers above the soil cells as indicated on the plan or directed in the field. Install a minimum of one inspection riser for each four trees.
1. Place inspection risers on top of the soil cells, assemble riser and fittings to dimensions required such that the rim of the riser cap is flush with the paving. Set the rim top with a slope consistent with the slope of the pavement.
 - a. Adjust the location of the riser such that the center of the riser falls along the centerline of one of the soil cell slots. Cut the soil cell geotextile with an 'X' cut.
 - b. Make a geotextile collar secured to the riser with zip ties that overlap the surrounding geotextile a minimum of 300mm. Secure in place with tape.
 2. Brace all risers while backfill and paving is being installed to secure its location and elevation.
- F. Install the aggregate base course over the geotextile immediately after completing the installation of the fabrics and inspection risers. Work the aggregate from one side of the soil cell to the other to ensure that the fabric and aggregate conforms to the soil cell contours. Do not apply aggregate in several positions at the same time.
1. Load the aggregate from equipment that is outside the limits of the excavated area. Use small, low impact material mover such as a concrete buggy or Georgia Buggy to move aggregate over the cells. Work over material already in place. Never allow any motorized equipment of any size to operate directly on top of the soil cells.
 2. For large or confined areas, where aggregate cannot easily be placed from the edges of the excavated area, obtain approval for the installation procedure and types of equipment to be used in the installation from the soil cell manufacturer.
 3. Compact aggregate base course(s) in lifts not to exceed 150mm in depth, to minimum 95% of maximum dry density. Utilize a roller or plate compactor with a maximum weight of 450 kg. Make sufficient passes with the compacting equipment to attain the required compaction.

3.11 INSTALLATION OF PAVING ABOVE THE SOIL CELL SYSTEM

- A. Place planter curb and paving material over the soil cell system as specified in Sections Concrete and Unit Pavers. Take care when placing paving or other backfill on top of the soil cell system not to damage the system components.

3.12 INSTALLATION OF ROOT BARRIERS

- A. Install root barrier in accord with manufacturer's reviewed installation instructions.
- B. Install with vertical root directing ribs facing inwards towards trees or plants.

3.13 INSTALLATION OF GROWING MEDIUM WITHIN THE TREE PLANTING AREA

- A. Prior to planting trees, install additional Growing Medium, to the depths indicated, within the tree opening adjacent to paving supported by soil cells.
- B. Remove all rubble, debris, dust and silt from the top of the Growing Medium that may have accumulated after the initial installation of the Growing Medium within the soil cells.
- C. Assure that the Growing Medium under the tree root ball is compacted to approximately 85-90% to prevent settlement of the root ball.
- D. The Growing Medium within the tree opening shall be the same soil as in the adjacent soil cells.

3.14 REPAIR OF CUT GEOTEXTILE

- A. In the event that any geotextile over subgrades or the soil cells must be cut during or after installation, repair the seam with a second piece of geotextile that overlaps the edges of the cut by a minimum of 300mm in all directions prior to adding aggregate material.

3.15 PROTECTION

- A. Ensure that all construction traffic is kept away from the limits of the soil cells until the final surface materials are in place. No vehicles shall drive directly on the soil cells or aggregate base course.
- B. Provide fencing and other barriers to keep vehicles from entering into the area with soil cell supported pavement.
- C. Maintain a minimum of 100 mm of aggregate base course over the geotextile material during construction.
- D. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.
- E. When vehicles must cross soil cells that do not have final paving surfaces installed, use construction mats and thicker aggregate layers designed to distribute vehicle loads to levels that would be expected at the soil cell surface once final paving has been installed. Use only low impact track vehicles with a maximum surface pressure under the vehicle of 20 kg/m², on top of the mats over soil cells prior to the installation of final paving.

3.16 CLEAN UP

1. Perform cleanup during the installation of work and upon completion of the work. Maintain the site free of soil and sediment, free of trash and debris. Remove from site all excess soil materials, debris, and equipment. Repair any damage to adjacent materials and surfaces resulting from installation of this work.

END OF SECTION