

DIVISION 32: EXTERIOR IMPROVEMENTS

32 0100 OPERATION AND MAINTENANCE OF EXTERIOR IMPROVEMENTS

32 0113 ASPHALT PAVING SURFACE TREATMENT: ASPHALT BASE PENETRATION SEAL

32 1000 BASES, BALLASTS, AND PAVING

32 1216 ASPHALT PAVING – SUPERPAVE
32 1217 ASPHALT REINFORCEMENT FIBERS
32 1723 PAVEMENT MARKINGS

32 3000 SITE IMPROVEMENTS

32 3113 CHAIN LINK FENCES AND GATES

32 8000 IRRIGATION

32 8423 UNDERGROUND SPRINKLERS

32 9000 PLANTING

32 9001 COMMON PLANTING REQUIREMENTS
32 9120 TOPSOIL AND PLACEMENT
32 9122 TOPSOIL GRADING
32 9223 SODDING
32 9300 PLANTS

END OF TABLE OF CONTENTS

SECTION 32 0113**ASPHALT PAVING SURFACE TREATMENT: Asphalt Based Penetrating Seal****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
 - 1. Furnish and apply asphalt based penetrating seal on new asphalt paving as described in Contract Documents.
- B. Related Requirements:
 - 1. Section 01 1200: 'Multiple Contract Summary' for multiple contracts.
 - 2. Section 01 4523: 'Testing and Inspecting Services' for testing and inspection, and testing laboratory services for materials, products, and construction methods.
 - 3. Section 32 1216: 'Asphalt Paving: Superpave Method'.
 - 4. Section 32 1723: 'Pavement Markings'.

1.2 REFERENCES

- A. Association Publications:
 - 1. Asphalt Institute:
 - a. MS-4, '*The Asphalt Handbook*' (Seventh Edition).
 - b. MS-16, '*Asphalt in Pavement Preservation and Maintenance*' (Fourth Edition).
 - 2. Asphalt Emulsion Manufacturers Association:
 - a. MS-19, '*Basic Asphalt Emulsion Manual*' (Fourth Edition).
- B. Definitions:
 - 1. Seal Coat: Thin surface treatment used to improve surface texture and protect asphalt surface. Main types of surface treatments are asphalt based emulsion seals, cape seals, chip seals, fog seals, micro surfacing, penetrating seals, refined coal tar emulsion seals, sand seals, sandwich seals and slurry seals.
- C. Reference Standards:
 - 1. ASTM International:
 - a. ASTM D4552/D4552M-10(2016), 'Standard Practice for Classifying Hot-Mix Recycling Agents'.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Conferences:
 - 1. Participate in MANDATORY pre-installation conference as specified in Section 01 3100:
 - 2. Schedule asphalt based penetrating seal pre-installation conference to be held jointly with any other 'Asphalt Surface Treatment' sections involving asphalt maintenance:
 - 3. In addition to agenda items specified in Section 01 3100, review following:
 - a. Review crack repair schedule and verify that other repairs will be completed before application of asphalt based penetrating seal.
 - b. Review asphalt based penetrating seal schedule.
 - c. Review asphalt based penetrating seal mix design.
 - d. Review asphalt based penetrating seal preparation requirements:
 - e. Review safety issues.
- B. Scheduling:
 - 1. Manufacturer Instructions:

- a. Provide to Owner's Representative at least seven (7) days before asphalt based penetrating seal placement commences, approved Laboratory Report and Manufacturer's Certificate of compliance with these specifications covering specific materials to be used on this project.

1.4 SUBMITTALS

- A. Action Submittals:
 1. Provide Manufacturer's product literature.
- B. Informational Submittals:
 1. Design Submittals:
 - a. Asphalt Based Penetrating Seal:
 - 1) Provide mix design for application rate of asphalt based penetrating seal.
 2. Manufacturer Instructions:
 - a. Asphalt Based Penetrating Seal:
 - 1) Provide Manufacturer's written substrate preparation and sealant application instructions.
 3. Qualification Statement:
 - a. Installer / Supervisor:
 - 1) Provide Qualification documentations if requested by Owner's Representative.
- C. Closeout Submittals:
 1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
 - a. Record Documentation:
 - 1) Manufacturer's documentation:
 - a) Asphalt based penetrating seal product literature.
 - b) Design Data Submittal.

1.5 QUALITY ASSURANCE

- A. Qualifications: Requirements of Section 01 4301 applies but not limited to following:
 1. Installer:
 - a. Minimum five (5) years experience in asphalt surface treatment installations.
 - b. Minimum five (5) years satisfactorily completed projects of comparable quality, similar size, and complexity in past three (3) years before bidding:
 - 1) Project names and addresses.
 - 2) Date of installations.
 2. Supervisor:
 - a. Minimum of five (5) years satisfactorily completed projects of comparable quality, similar size, and complexity in past five (5) years as Supervisor of Applicators:
 - 1) Project names and addresses.
 - 2) Date of installation.
 - 3) Name of Supervisor or Owner.
 3. Upon request, submit documentation.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Storage And Handling Requirements:
 1. Asphalt Based Penetrating Seal:
 - a. Following Manufacturer's recommendations.

1.7 FIELD CONDITIONS

- A. Ambient Conditions:
 1. Asphalt Based Penetrating Seal:

- a. Do not apply asphalt based penetrating seal when ambient temperatures will be less than 55 deg F (13 deg C) for twenty-four (24) hour period or surface temperature will be less than 60 deg F (16 deg C) for twenty-four (24) hour period.
- b. Do not apply asphalt based penetrating seal if subsequent temperatures for forty-eight (48) hours are anticipated to drop below 50 deg F (10 deg C).
- c. Do not apply asphalt based penetrating seal if it will be adversely affected by rain, or wet conditions or when surface contains standing water.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Asphalt Based Penetrating Seal:

1. Type One Acceptable Product and Manufacturers:
 - a. APR-100 by Mariani Asphalt (An Associated Asphalt Company), Tampa, FL (813) 623-3941, www.associatedasphalt.com/companies/mariani-asphalt.
 - b. GSB-78 Pavement Sealer and Rejuvenator by Asphalt Systems, Inc., Salt Lake City, UT (801) 972-6433 www.asphaltsystemsinc.com. (Use GSB-88 instead of GSB-78 on pavements less than two (2) years old).
 - c. GSB-88 Pavement Sealer and Rejuvenator by Asphalt Systems, Inc., Salt Lake City, UT (801) 972-6433 www.asphaltsystemsinc.com.
 - d. Quick-Dry Anti-Oxidene Penetrating Asphalt Coating (asphalt, air-blown (CAS# 64742-93-4), equal to /or not less than 50 to 65 percent by weight, white stoddard solvent (CAS# 8052-41-3) 35 to 50 percent by weight. No other unnecessary binders, fillers or additives) by Texas Refinery Corp., Fort Worth, TX (956) 492-6254 www.texasrefinery.com.
 - e. Reclamite Preservative Seal by Tricor Refining LLC, Bakersfield, CA (661) 393-7110 www.reclamite.com.
 - f. RS-90 Cutback Asphalt Seal Coating/Rejuvenator by Denver Industrial Sales & Service Company (DISSCO), Denver, CO (303) 935-2485 www.dissco.net.
 - g. Equal as approved by Owner's Representative before bidding. See Section 01 6200.
2. Performance Requirement:
 - a. Asphalt Based Penetrating Seal consisting of the following:
 - 1) Asphalt, CAS 8052-42-4 (or CAS 8052-41-3), 50 to 65 percent by weight and naphtha, CAS 8030-30-6, 35 to 50 percent by weight (or CAS 8008-20-9, 40 to 60 percent by weight) or white Stoddard solvent, CAS 64742-93-4, 35 to 50 percent by weight.
 - a) No water is acceptable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Evaluation And Assessment:

1. Do not apply sealer on asphalt that has not aged for at least one (1) month minimum.
2. Do not apply sealer over wet or damp pavement, or when precipitation is imminent.

3.2 PREPARATION

A. Owner Responsibilities:

1. Remove Scout Trailer(s) if needed.

B. Surface Preparation:

1. General:
 - a. Do not allow irrigation watering for at least twenty-four (24) hours prior to application.

- b. Do not apply to new asphalt pavements (less than one (1) month) in that softening may occur.
- c. New asphalt and patched areas should be allowed to cure for at least thirty (30) days at 60 deg F (16 deg C) temperature prior to application to eliminate any concentration of oils on pavement surface. Longer cure times of up to sixty (60) days may be required. New asphalt must not exhibit ribboning, crawling nor show oil rings when clean water is poured onto surface.
 - 1) To determine if surface oils have dissipated, pour one (1) or two (2) gallons of clean water over pavement surface:
 - a) If water sheets out, uniformly wetting surface and no oil rings appear, surface is ready to be sealed.
 - b) If water balls up and/or shows signs of oil rings, additional curing time is required prior to sealing.
2. Paint Stripes:
 - a. During Evaluation and Assessment, verify if acrylic, thermoplastic or paint stripes must be removed in preparation for asphalt based penetrating seal application.
3. Grease or Oil Patches:
 - a. Remove grease or oil patches, and spillage of any material that has adhered to pavement. Do not place seal over unsound oil spots softened by fuel or oil.
 - b. Clean oil spots and treat with oil spot primer.
 - c. Seal areas damaged by oil or grease with an oil spot primer compatible with seal being used in accordance with Manufacturer's recommendations.
4. Cleaning:
 - a. Remove all debris, dirt, dust, leaves, loose material, moisture, mud spots, sand, silt spots, vegetation (including moss), water and other objectionable and foreign material from existing surface prior to placing seal. In areas where moss is prevalent, apply herbicide.
 - b. Power brooms, power blowers, air compressors, vacuum sweepers, rotary brooms, water flushing equipment, and blowers, or by another approved method.
5. Cracks:
 - a. Repair cracks if required per Section 32 0117.01 'Asphalt Paving Crack Seal' or Section 32 0117.02 'Asphalt Paving Crack Fill' prior to placing asphalt based penetrating seal. Cracks that contain weed and other live vegetation matter must be treated with Pre-Emergent Herbicide prior to crack repair.

3.3 APPLICATION

- A. Asphalt Based Penetrating Seal:
 1. Applied after Asphalt Paving is installed as specified in Section 1216: 'Asphalt Paving' as follows:
 - a. Mandatory Asphalt Paving Surface Treatment (Asphalt Based Penetrating Seal) to be applied no sooner than thirty (30) days or no later than eighteen (18) months of placing Asphalt Paving to be included with this project.
 2. Surface preparation:
 - a. Do not apply asphalt based penetrating sealer until completion of surface preparation items.
 3. Follow Manufacturer's recommendations for application of sealer.
 4. Apply sealer without thinning from container using squeegee, brush, or sprayer at rate of 1-1/2 gallons (5.6 liters) per 100 square feet (9.3 square meters) minimum and 2 gallons (7.6 liters) per 100 square feet (9.3 square meters) maximum, depending on absorbency of pavement.
- B. Paint Stripes:
 1. If paint stripes were removed in preparation for penetration seal, include following:
 - a. Apply paint stripes after asphalt based penetrating seal has been applied and cured.

3.4 CLEANING

- A. General:
 1. Upon completion of asphalt based penetrating seal operations, clean up and remove debris.

3.5 PROTECTION

- A. Do not allow traffic on paving until asphalt based penetrating seal is thoroughly cured:
 - 1. Warm weather condition is approximately twenty-four (24) hours.
- B. Do not allow irrigation watering for at least twenty-four (24) hours after application.

END OF SECTION

SECTION 32 1216**ASPHALT PAVING: Superpave Method****PART 1 - GENERAL****1.1 SUMMARY****A. Includes But Not Limited To:**

1. Furnish and install asphalt paving in driveways and parking areas as described in Contract Documents including the following, but not limited to:

- a. Asphalt Mix Design Criteria Summary:

- 1) Not used.

- 2) Asphalt Binder: PG 58-28 (or Binder locally used by DOT)

- 3) Nominal Maximum Size Aggregate (Nmas): 3/8 inch (9.5 mm)

- 4) Maximum Size Aggregate: 1/2 inch (12.5 mm)

- 5) Mix Designator (compaction effort); Ndesign: 50

- 6) Antistrip Agent: If required by supplier's mix design (use 1 percent or greater lime slurry when required).

- 7) Asphalt Reinforcement Fibers: Specified in Section 32 1217.

- 8) Reclaimed Asphalt Pavement (RAP): Allowed up to 25 percent. Asphalt binder shall be one grade softer when more than 15 percent RAP is used.

- 9) ROSP: Not allowed.

- 10) Mineral Filler: Not allowed.

- 11) Warm Mix Additive: If required by supplier's mix design.

- 12) Recycle Agent: If required by supplier's mix design.

- b. Design Air Voids:

- 1) Three and one-half percent (3.5 percent).

- c. Tack coat: Application of asphaltic material to existing asphalt concrete or Portland concrete surfaces before asphalt concrete pavement.

- d. Blotter materials and procedures for absorbing excess asphalt as required.

B. Related Requirements:

1. Section 01 1200: 'Multiple Contract Summary' for multiple contracts.
2. Section 01 4523: 'Testing and Inspecting Services' for testing and inspection, and testing laboratory services for materials, products, and construction methods.
3. Section 31 0501: 'Common Earthwork Requirements' for:
 - a. General procedures and requirements for earthwork.
 - b. Pre-installation conference held jointly with other common earthwork related sections.
4. Section 31 1123: 'Aggregate Base' for compaction of aggregate base.
5. Section 31 2213: 'Rough Grading' for rough grading and preparation of natural soil subgrades below fill and aggregate base materials.
6. Section 31 2216: 'Fine Grading' for grading of subgrade below aggregate base and topsoil.
7. Section 31 2323: 'Fill' for compaction procedures and tolerances for base.
8. Section 32 0113.01: 'Asphalt Paving Surface Treatment: Penetrating Seal'.
9. Section 32 1717: 'Asphalt Reinforcement Fibers'.
10. Section 32 1723: 'Pavement Markings'.

1.2 REFERENCES

A. Association Publications:

1. Asphalt Institute, 2696 Research Park Dr., Lexington, KY www.asphaltinstitute.org:
 - a. MS-2, 'Mix Design Methods' (7th Edition 2015).

B. Definitions:

1. Aggregate: Hard inert mineral material, such as gravel, crushed rock, slag, or sand.
 - a. Coarse Aggregate: Aggregate retained on or above No. 4 (4.75 mm) sieve.
 - b. Coarse-Graded Aggregate: Aggregate having predominance of coarse sizes.
 - c. Dense-Graded Aggregate: Aggregate that is graded from maximum size down through filler with object of obtaining an asphalt mix with controlled void content and high stability.
 - d. Fine Aggregate: Aggregate passing No. 4 (4.75 mm) sieve.
 - e. Fine-Graded Aggregate: Aggregate having predominance of fine sizes.
 - f. Mineral Filler: Fine mineral product at least 70 percent of which passes a No. 200 (75 μ m) sieve.
2. Air Voids: Total volume of small air pockets between coated aggregate particles in asphalt cement concrete (ACC); expressed as percentage of bulk volume of compacted paving mixture.
3. Anti-Stripping Agent: Chemicals added to bitumen to improve the adhesion of the bitumen to hydrophilic aggregates
4. Asphalt Binder: Asphalt cement or modified asphalt cement that binds aggregate particles into dense mass.
 - a. Asphalt Cement used in paving applications that has been classified according to the Standard Specification for Performance Graded Asphalt Binder, AASHTO Designation MP 320. It can be either unmodified or modified Asphalt Cement, as long as it complies with specifications.
5. Asphalt-Aggregate Designator: Alpha-numeric code that indicates nominal maximum size of aggregate, and type and grade of asphalt in aggregate-asphalt mix.
 - a. Example: "12.5 PG70-28" means aggregate asphalt mix shall be composed of aggregate gradation with 12.5 mm (1/2 inch) nominal maximum size and performance grade asphalt binder designed to perform between temperatures of 70 deg C and -28 deg C (158 deg F and -18.4 deg F).
6. Equivalent Single Axle Load (ESAL): Effect on pavement performance of any combination of axle loads of varying magnitude equated to number of 18,000-lb. (80-kN) single-axle loads that are required to produce an equivalent effect.
7. Maximum Size (Superpave): One sieve larger than the nominal maximum size.
8. Ndesign (Superpave): Design number of gyrations used for design of Hot Mix Asphalt (HMA).
9. Nominal Maximum Size: One sieve size larger than first sieve size retaining more than 10 percent of Sample. Nominal maximum size sieve will retain minimum of 0 and maximum of 10 percent of sample. Maximum size is one sieve size larger than nominal maximum size.
10. Performance Graded Asphalt Binder (PGAB): Asphalt binder designed to produce HMA that meets certain performance standards. Designations for performance-graded asphalt binders are prefixed with PG. Each grade designation also includes two sets of numbers that denote temperature range. This is a range of climate temperatures to which road may be exposed and still be expected to give superior performance. PG numbers do not indicate viscosity as in conventional liquid asphalt designations.
11. Pre-emergent Herbicide: Chemical that is applied before weeds emerge. It acts by killing weed seedlings and /or establishing layer of chemical on or near soil surface that is toxic to germinating seeds and young seedlings.
12. Reclaimed Asphalt Pavement (RAP): Existing asphalt mixture that has been pulverized, usually by milling, and is used like aggregate in recycling of asphalt pavements.
13. Subgrade (definition varies depending upon stage of construction and context of work being performed):
 - a. Prepared natural soils on which fill, aggregate base, or topsoil is placed.
 - or
 - b. Prepared soils immediately beneath paving.
14. Tack Coat: Very light application of liquid asphalt, or asphalt emulsion diluted with water.

C. Reference Standards:

1. American Association of State and Highway Transportation Officials:

- a. AASHTO T 304-17: 'Standard Method of Test for Uncompacted Void Content of Fine Aggregate'.
- b. AASHTO T 322-07(2016), 'Standard Method of Test for Determining the Creep Compliance and Strength of Hot-Mix Asphalt (HMA) Using the Indirect Tensile Test Device.'
- 2. ASTM International:
 - a. ASTM C29/C29M-17a, 'Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate'.
 - b. ASTM C88-18, 'Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate'.
 - c. ASTM C117-17, 'Standard Test Method for Materials Finer than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing'.
 - d. ASTM C131/C131M-14, 'Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine'.
 - e. ASTM C142/C142M-17, 'Standard Test Method for Clay Lumps and Friable Particles in Aggregates'.
 - f. ASTM D242/D242M-18, 'Standard Specification for Mineral Filler For Bituminous Paving Mixtures'.
 - g. ASTM D977-17, 'Standard Specification for Emulsified Asphalt'.
 - h. ASTM D979/D979M-15, 'Practice for Sampling Bituminous Paving Mixtures'.
 - i. ASTM D2041/D2041M-11, 'Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures'.
 - j. ASTM D2172/D2172M-17, 'Standard Test Methods for Quantitative Extraction of Bitumen From Bituminous Paving Mixtures'.
 - k. ASTM D2256/ D2256M-10(2015), 'Standard Test Method for Tensile Properties of Yarns by the Single-Strand Method'.
 - l. ASTM D2397/D2397M-17, 'Standard Specification for Cationic-Emulsified Asphalt'.
 - m. ASTM D2419-14, 'Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate'.
 - n. ASTM D2950/D2950M-17, 'Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods'.
 - o. ASTM D3203/D3203M-17, 'Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures'.
 - p. ASTM D3549/D3549M-18, 'Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens'.
 - q. ASTM D3665-12(2017), 'Standard Practice for Random Sampling of Construction Materials'.
 - r. ASTM D4318-17, 'Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils'.
 - s. ASTM D4552/D4552M-10(2016), 'Standard Practice for Classifying Hot-Mix Recycling Agents'.
 - t. ASTM D4759-11(2018), 'Standard Practice for Determining the Specification Conformance of Geosynthetics'.
 - u. ASTM D4791-10, 'Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate'.
 - v. ASTM D5444-15, 'Standard Method for Mechanical Size Analysis of Extracted Aggregate'.
 - w. ASTM D5821-13(2017), 'Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate'.
 - x. ASTM D6307-19, 'Standard Test Method for Asphalt Content of Hot-Mix Asphalt by Ignition Method'.
 - y. ASTM D6932/D6932M-08(2013), 'Standard Guide for Materials and Construction of Open-Graded Friction Course Plant Mixtures'.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Conferences:
 - 1. Participate in MANDATORY pre-installation conference as specified in Section 31 0501 'Common Earthwork Requirements':
 - 2. In addition to agenda items specified in Section 01 3100 'Project Management and Coordination' and Section 31 0501 'Common Earthwork Requirements', review following:
 - a. Review surveying and staking of parking areas and installation of sleeves.

- b. Review proposed aggregate base schedule.
- c. Review rough grading elevations before placing paving fill.
- d. Review fine grading elevations of subgrade fine grading operations before placing aggregate base and paving.
- e. Review proposed asphalt paving schedule.
- f. Review asphalt paving mix design.
- g. Review pre-emergent herbicide protection of adjoining property and planting area on site requirements, schedule and application requirements.
- h. Review schedule of mandatory asphalt paving surface treatment to be applied after placement of asphalt paving.
- i. Review schedule of paint stripes to be applied after asphalt paving surface treatment.
- j. Review safety issues.
- k. Review Section 01 4523 'Testing and Inspecting Services' for administrative requirements and responsibilities and Field Quality Control tests and inspections required of this section.
 - 1) Review requirements and frequency of testing and inspections.
 - 2) Review Contractor Testing Agency Qualifications.

- B. Scheduling: Notify Testing Agency and Architect twenty-four (24) hours minimum before placing asphalt paving.

1.4 SUBMITTALS

A. Action Submittals:

- 1. Product Data:
 - a. Pre-Emergent Herbicide:
 - 1) Manufacturer's published product data on pre-emergent herbicide.

B. Informational Submittals:

- 1. Certificates:
 - a. Require mix plant to furnish delivery/load tickets for each batch of asphalt. Keep delivery tickets at job-site for use of Owner's Representative. Tickets shall show following:
 - 1) Name of mix plant.
 - 2) Date.
 - 3) Name of contractor.
 - 4) Name and location of Project.
 - 5) Serial number of ticket.
 - 6) Asphalt mix type.
 - 7) Time loaded.
 - 8) Identity of truck.
 - b. Installer to provide Manufacturer's Certificate of Compliance stating material authenticity and properties for review and acceptance by Architect before product use.
- 2. Design Data:
 - a. Hot Mix Asphalt:
 - 1) Design Criteria:
 - a) Develop mix design according to current Asphalt Institute MS-2 'Asphalt Mix Design Methods' for Superpave Method.
 - b) Submittal format:
 - (1) Design mix submittal shall follow format as indicated in current Asphalt Institute MS-2, 'Mix Design Methods'.
 - 2) Mix design of asphalt paving must meet Design Criteria minimum requirements and show conformance to the following:
 - a) Location and name of hot mix asphalt concrete production facility.
 - b) Date of mix design. If older than two (2) years, recertify mix design.
 - c) Asphalt mix type.
 - d) Mix design method used.
 - e) Mix density.
 - f) Design air voids (three and one half (3.5) percent).
 - g) Asphalt content in percent.
 - h) Performance grade of asphalt binder.

- i) Nominal maximum size of aggregate.
 - j) Maximum size of aggregate.
 - k) Aggregate source and gradation.
 - l) Mix properties and design parameters.
 - m) Temperature of mix at plant and in the field for optimum field compaction.
 - n) Amount of recycled asphalt pavement (RAP).
 - o) Mineral fillers, antistripping, and recycle agent percentages.
 - p) Identify if warm mix technologies will be used and how much warm mix additive will be used.
- 3) Within thirty (30) days prior to asphalt construction, submit actual design mix to Architect, Civil Engineering Consultant of Record and Independent Testing Laboratory for review and approval.
- 3. Test And Evaluation Reports:
 - a. Hot Mix Asphalt:
 - 1) Contractor's Testing Agency copies of Field Test results to show compliance with all contract requirements and quality control for quality of asphalt mixture and asphalt installation.
 - 2) Owner's Testing Agency copies of Field Tests and Inspections used to validate or determine discrepancies with testing by Contractor.
 - 4. Manufacturer Instructions:
 - a. Pre-Emergent Herbicide:
 - 1) Application instructions for pre-emergent herbicide.
 - 5. Qualification Statement:
 - a. Installer:
 - 1) Provide Qualification documentation if requested by Owner's Representative.
- C. Closeout Submittals:
 - 1. Include following in Operations And Maintenance Manual specified in Section 01 7800 'Closeout Submittals':
 - a. Record Documentation:
 - 1) Manufacturer's documentation:
 - a) Pre-emergent herbicide documentation.
 - b) Asphalt paving design.
 - c) Test reports.
 - d) Certificates from mix plant of delivery/load tickets.
 - e) Manufacturer's Certificate of Compliance.
 - 2) Testing and Inspection Reports:
 - a) Testing Agency Testing and Inspecting Reports of asphalt paving.

1.5 QUALITY ASSURANCE

- A. Qualifications. Requirements of Section 01 4301 'Quality Assurance - Qualifications' applies but not limited to following:
 - 1. Asphalt Paving:
 - a. Foreman of asphalt paving crew has completed at least three (3) projects of similar size and nature.
 - b. Upon request, submit documentation.
 - 2. Pre-emergent herbicide:
 - a. Applicator:
 - 1) Pre-emergent herbicide shall be applied by applicator certified by State in which Project is located as an applicator of agricultural chemicals.
- B. Testing and Inspection:
 - 1. Owner is responsible for Quality Assurance. Quality assurance performed by Owner will be used to validate Quality Control performed by Contractor.
 - 2. Owner will provide Testing and Inspection for asphalt paving:
 - a. Owner will employ testing agencies to perform testing and inspection for asphalt paving as specified in Field Quality Control in Part 3 of this specification.

- 1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform the Work in strict accordance with requirements of Contract Documents and perform contractor testing and inspection.
- 2) See Section 01 1200: 'Multiple Contract Summary'.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery And Acceptance Requirements:

1. Asphalt Material:
 - a. Each shipment must:
 - 1) Be uniform in appearance and consistency.
 - 2) Show no foaming when heated to specified loading temperature.
 - b. Do not supply shipments contaminated with other asphalt types or grades than those specified:
 - 1) Do not use petroleum distillate as a release agent.
2. Pre-emergent herbicide:
 - a. Materials shall be delivered in original, unopened packages with labels intact.

B. Storage And Handling Requirements:

1. Pre-emergent herbicide:
 - a. Do not freeze. Store in at temperatures above 41 deg F (5 deg C).
 - b. Follow Manufacturer's storage and handling requirements.

1.7 FIELD CONDITIONS

A. Ambient Conditions:

1. Pre-emergent herbicide:
 - a. Follow printed Manufacturers instruction for environmental hazards:
 - b. Follow printed Manufacturers instruction ambient conditions for application of product.
2. Tack Coat:
 - a. Apply only when air and roadbed temperatures in shade are greater than 40 deg F (4.4 deg C). Temperature restrictions may be waived only upon written authorization from Architect or Civil Engineer.
 - b. Do not apply to wet surfaces.
 - c. Do not apply when weather conditions prevent tack coat from adhering properly.
3. Asphalt paving:
 - a. Do not perform work during following conditions:
 - 1) Ambient temperature is below 45 deg F (7.2 deg C) or will fall below 45 deg F (7.2 deg C) during placement.
 - 2) Temperature of aggregate base below 50 deg F (10 deg C).
 - 3) Cold Weather Asphalt Paving Plan: If asphalt pavement is placed outside of these temperature limits or those identified in MINIMUM Temperature Degrees, a plan is required which includes:
 - a) Haul times.
 - b) Placement details.
 - c) Compaction aids used in production.
 - d) Owner does not assume responsibility for asphalt when placed outside temperature limits.
 - 4) Presence of free surface water or weather is unsuitable.
 - 5) Wind or ground cools mix material before compaction.

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

A. General:

1. Follow current Asphalt Institute MS-2 'Asphalt Mix Design Methods' for Superpave Method.

B. Asphalt Mix:

1. Asphalt Binder:
 - a. Performance Graded Asphalt Binder:
 - 1) Use performance graded asphalt binder identified under Asphalt Mix Design Criteria.
2. Aggregates:
 - a. Use clean, hard, durable, angular, sound, consisting of crushed stone, crushed gravel, slag, sand, or combination.
 - b. Use nominal maximum size aggregate and maximum size aggregate per Asphalt Mix Design Criteria. Aggregate gradation to meet **Table 1 - MASTER GRADING BANDS** requirements:

Table 1 - MASTER GRADING BANDS			
Sieve (mm)		Nominal Maximum Aggregate Size	
		12.5 mm	9.5 mm
Control Sieves	19	100	-
	12.5	100	100
	9.5	< 90	90 – 100
	4.75	--	< 90
	2.36	28 – 58	32 – 60
	0.075	2 – 10	2 – 10
Restricted Zone	2.36	39.1	47.2
	1.18	25.6 – 31.6	31.6 – 37.6
	0.6	19.1 – 23.1	23.5 – 27.5
	0.3	15.5	18.7

NOTES:

1. It is assumed fine and coarse aggregate have same bulk specific gravity.
2. Gradation is expressed in percent passing by weight, ASTM C136. Percentage of fines passing 0.075 mm control sieve determined by washing, ASTM C117.

- c. Provide aggregate material properties to meet **Table 2 – AGGREGATE PHYSICAL PROPERTIES** requirements:

Table 2 –AGGREGATE PHYSICAL PROPERTIES				
Property	ASTM	ESAL	Min	Max
Coarse Aggregate (does not pass No. 4 sieve)				
Angularity (fractured faces), percent	D5821	less than 0.3	55	--
		0.3 to 3.0	75	--
		greater than 3.0	85/80	--
Wear (hardness or toughness), percent	C131/C131M	less than 0.3	--	40
		0.3 to 3.0	--	35
		greater than 3.0	--	35
Flats or elongates (3:1 length to width), percent, maximum	D4791	--	--	20
Fine Aggregate (passing No. 4 sieve)				
Angularity (uncompacted void content), percent (AASHTO T304)	--	less than 0.3	--	--
		0.3 to 3.0	40	--
		greater than 3.0	45	--
Sand equivalent, percent	D2419	less than 0.3	40	--
		0.3 to 3.0	40	--
		greater than 3.0	45	--
Friable particles, percent	C142	--	--	2
Plastic limit, maximum	Liquid limit	D4318	--	25
	Plastic limit	D4318	--	6
Notes:				
1. ESAL in millions.				
2. Angularity by weight retained above 9 mm sieve, with at least one fractured face. 85/80 denotes 85 percent coarse aggregate has one fractured face and 80 percent has two or more fractured faces.				
3. Wear of aggregate retained above 2.36 mm sieve unless specific aggregates have higher values are known to be satisfactory.				
4. Flats or elongates retained above 4.75 mm sieve.				
5. Friable particles passing No. 4.75 mm sieve.				
6. Plasticity, passing No. 4.75 sieve. Aggregate is no-plastic even when filler material is added to aggregate.				
Blended Physical Properties				
Dry-rodded unit weight, lb/ft ³ , minimum	C29/C29M	-	75	--
Weight loss (soundness), percent, maximum	C88		--	16
Clay content or cleanliness (sand equivalent), percent	D2419	less than 0.3	45	--
		more than 0.3	60	--
Notes:				
1. Weight loss using sodium sulfate.				
2. Sand equivalent value is after going through dryer or before drum mixer. The sand equivalent requirement is waived for RAP aggregate but applies to remainder of aggregate blend.				
3. Friable particles of clay lumps, shale, wood, mica, and coal passing 4.75 sieve.				

3. Admixture:

- a. Antistrip: Heat stable, cement slurry, lime slurry, dry lime, or liquid antistrip:
 - 1) Add if mix is moisture sensitive as determined by 'Moisture Susceptibility' paragraph below.
- b. Mineral Filler: Comply with requirements of ASTM D242/D242M.
- c. Recycle Agent: Comply with requirements of ASTM D4552/D4552M.

2.2 MATERIAL

- A. Aggregate Base: Conform to applicable requirements as specified in Section 31 1123: 'Aggregate Base'.
- B. Asphalt Paving Surface Treatment:
 - 1. Include mandatory Asphalt Paving Surface Treatment to be applied no sooner than thirty (30) days or no later than eighteen (18) months of placing Asphalt Paving to be included with this project:
 - a. Asphalt Based Penetrating Seal as specified in Section 32 0113.01 'Asphalt Paving Surface Treatment: Asphalt Based Penetrating Seal'.
- C. Pre-Emergent Herbicide:
 - 1. Design Criteria:
 - a. Selective type pre-emergence control chemical containing twenty-five (25 percent) Prometon minimum for control of annual grasses and broadleaf weeds.
 - b. Non-oil based sterilant.
 - c. Labeled for under-pavement use.
 - 2. Type Two Acceptable Products:
 - a. Pramitol 25E Herbicide by WinField United, St Paul MN www.winfieldunited.com.
 - 1) Apply at a rate of 10 gal (37.85 liter) per 1 acre (0.4046863 hectare) conforming to application rates indicated on product label.
 - b. Equal as approved by Architect before installation. See Section 01 6200.
- D. Reclaimed Asphalt Pavement (RAP). Aggregate: Restrictions include:
 - 1. Allowed up to 25 percent. Asphalt binder shall be one grade softer when more than 15 percent RAP is used.
- E. Tack Coat:
 - 1. Emulsified asphalt meeting requirements of ASTM D977, Grade SS-1H, CQS-1H, or ASTM D2397/D2397M, Grade CSS-1H.

PART 3 - EXECUTION

3.1 INSTALLERS

- A. Approved Applicators. See Section 01 4301 'Quality Assurance - Qualifications':

3.2 PREPARATION

- A. General:
 - 1. Aggregate base and paving must be placed before any moisture or seasonal changes occur to subgrade that would cause compaction tests previously performed to be erroneous. Re-compact and retest subgrade soils that have been left exposed to weather.
- B. Protection Of In-Place Conditions:
 - 1. Pre-emergent herbicide:
 - a. Take necessary precautions to protect adjoining property and areas designated for planting on building site.
 - b. Do not contaminate any body of water by direct application, cleaning of equipment or disposal of wastes.
 - 2. Asphalt Paving:
 - a. Protect all structures, including curb, gutter, sidewalks, guard rails and guide posts.
 - b. Protect neighborhood, storm drains and down-stream fish habitat.
- C. Surface Preparation:
 - 1. Survey and stake parking surfaces to show grading required by Contract Documents.
 - 2. Subgrade (soil below aggregate base):

- a. Prepare natural soil subgrade as specified in Section 31 2213 'Rough Grading' or prepare fill subgrade as described in Section 31 2216 'Fine Grading'.
- 3. Aggregate base:
 - a. Finish grade parking surface area to grades required by Contract Documents.
 - b. Compact aggregate base as specified in Section 31 1123 'Aggregate Base'.
 - c. Tolerances:
 - 1) Elevation of aggregate base shall be 0.00 inches (0.00 mm) high and no more than 1/2 inch (12.7 mm) low.
 - 2) Measure using string line from curb to curb, gutter, flat drainage structure, or grade break.
- 4. Tack coat:
 - a. Clean surface of all materials such as mud, dirt, leaves, etc. that prevent tack from bonding to existing surfaces.
 - 1) If flushed, allow surface to dry.
- 5. Asphalt paving:
 - a. Area shall be clean and tack coat applied before placing of asphalt paving.
 - 1) Remove all moisture, dirt, sand, leaves, and other objectionable material from prepared surface before placing asphalt.
 - 2) Locate, reference, and protect all utility covers, monuments, curb, and gutter and other components affected by asphalt paving operations.
 - 3) Allow sufficient cure time for tack coat before placing asphalt.

3.3 APPLICATION

- A. Interface With Other Work:
 - 1. Section 31 1123: 'Aggregate Base' for compaction of aggregate base.
 - 2. Section 31 2213: 'Rough Grading' for rough grading and preparation of natural soil subgrades below fill and aggregate base materials.
 - 3. Section 31 2216: 'Fine Grading' for grading of subgrade below aggregate base and topsoil.
 - 4. Section 31 2323: 'Fill' for compaction procedures and tolerances.
- B. Pre-Emergent Herbicide:
 - 1. Asphalt paving areas:
 - a. Follow Manufacturer's printed application requirements:
 - b. Apply to prepared subgrade dispersed in liquid. Concentrate shall be such that Manufacturer's full recommended amount of chemical will be applied to every 1000 sq ft (93 sq m) and liquid will penetrate minimum of 2 inches (50 mm).
 - c. Application shall be no more than one (1) day before installation of aggregate base.
- C. Tack Coat:
 - 1. General:
 - a. Tack coat vertical surfaces or existing asphalt cement concrete or portland cement concrete that will be in contact with asphalt paving.
 - b. Use tack coat diluted to a 2:1 (concentrate water) ratio.
 - c. Use pressure distributor to apply in uniform, continuous spread.
 - d. Cover all tacked surface areas with surfacing materials same day of application.
 - 2. Application rate. Typically, as follows:
 - a. Emulsions, 0.08 to 0.15 gallons per sq yd (0.303 to 0.679 L per sq m) of diluted material:
 - 1) Apply sufficient to achieve ninety-five (95) percent or better coverage of existing surfaces.
 - 2) Above application rates may vary according to field conditions. Obtain approval from Civil Engineer for quantities, rate of application, temperatures, and areas to be treated before any application.
- D. Asphalt Paving:
 - 1. General:
 - a. Paving adjacent to cast-in-place concrete site elements shall be between 1/4 inch (6 mm) higher than concrete.
 - b. Surface texture of hand worked areas shall match texture of machine-laid areas.

- c. Surface shall be uniform with no 'birdbaths'. Leave finished surfaces clean and smooth. Variations from specified grades shall not exceed 1/2 inch (12.7 mm).
- d. Cross Slope: 1/4 inch (6 mm) in 10 feet (3.0 m) perpendicular to centerline except at cross section grade breaks.
- e. Grade: 1/8 inch (3 mm) in 10 feet (3.0 m) parallel to centerline.
- f. Do not place on frozen aggregate base or during adverse climatic conditions such as precipitation or when roadway surface is icy or wet.
- g. Uniformly mix materials so aggregate is thoroughly coated with asphalt.
- h. Place at temperatures established by the mix design with self-propelled laydown machine.
- i. Use **Table 3 – MINIMUM TEMPERATURE, DEGREES** as guide:

Table 3 – MINIMUM TEMPERATURE, DEGREES							
Ambient Air Temperature Deg F.	Ambient Air Temperature Deg C.	Compacted Paving Mat Thickness					
		3/4" (19 mm)	1" (25 mm)	1 1/2" (38 mm)	2" (50 mm)	3" (75 mm)	4" + (100 mm) +
45 – 50	7 – 10	---	---	---	---	280	265
50 – 59	10 – 15	---	---	---	280	270	255
60 – 69	16 – 20	---	---	285	275	265	250
70 – 79	21 – 29	285	285	280	270	265	250
80 - 89	27 - 31	280	275	270	265	260	250
90+	32+	275	270	265	260	250	250

- j. Longitudinal bituminous joints shall be vertical and properly tack coated if cold. Transverse joints shall always be tack coated.
2. Compaction:
 - a. Compact asphalt paving to ninety-four (94) percent plus or minus two (2) percent of theoretical maximum specific gravity, ASTM D2041/D2041M (Rice Method - maximum theoretical density).
 - b. Roll with powered equipment capable of obtaining specified density while providing required smoothness.
 - c. Begin breakdown rolling immediately after asphalt is placed when asphalt temperature is at maximum.
 - d. Complete handwork compaction concurrently with breakdown rolling.
 - e. Execute compaction so visibility of joints is minimized:
 - f. Complete finish rolling to improve asphalt surface as soon as possible after intermediate rolling and while asphalt paving is still warm.
 - g. Do not use vibration for finish rolling.
 3. Lift Thickness:
 - a. Preferred Method:
 - 1) For pavements 3-1/2 inch (89 mm) or thinner apply asphalt paving in single lift.
 - 2) For pavements greater than 3-1/2 inch (89 mm), use alternate method below.
 - 3) two (2) times maximum aggregate size in compacted asphalt concrete mixes.
- E. Asphalt Paving Surface Treatments:
1. Apply mandatory Asphalt Paving Surface Treatment no sooner than thirty (30) days or no later than eighteen (18) months of placing Asphalt Paving to be included with this project. Do not apply prior to asphalt curing (refer to 'Asphalt, Concrete and Pervious Concrete Maintenance Guidelines'):
 - a. Asphalt Based Penetrating Seal as specified in Section 32 0113.01 'Asphalt Paving Surface Treatment: Asphalt Based Penetrating Seal'.
- F. Paint Stripes:
1. Apply paint stripes after asphalt paving surface treatment has been applied to asphalt paving.

3.4 FIELD QUALITY CONTROL

- A. Field Tests And Inspections:
1. Civil and structural field tests, laboratory testing, and inspections are provided by Owner's independent Testing Agency as specified in Section 01 4523 'Testing And Inspection Services':
 - a. Quality Control is sole responsibility of Contractor:
 - 1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform testing and inspection as part of his Quality Control:
 - a) Testing and inspections will be responsibility of Contractor to be performed by an independent entity.
 - 2) Contractor bears full responsible for compliance with all contract requirements and quality control on project and will be responsible for quality of asphalt mixture and asphalt installation.
- B. Field Tests (Provided by Contractor):
1. General:
 - a. Contractor bears full responsibility for compliance with all contract requirements and quality control on project and will be responsible for quality of asphalt mixture and asphalt installation.
 - b. Testing and Inspection Reports to be distributed as specified in Section 01 4523 'Testing And Inspection Services'.
 2. Compaction Tests:
 - a. Contractor to provide compaction tests of asphalt being placed to establish rolling patterns and installation procedures.
 - b. Compaction tests by Contractor are independent of compaction tests being provided by Owner. See Section 01 4523 'Testing And Inspection Services'.
 - c. Asphalt paving shall be compacted to ninety-four (94) percent of Theoretical Maximum Specific Gravity (Rice) plus three (3) percent or minus two (2) percent. Determine percent compaction by ASTM D2041/D2041M.
 3. Thickness Tests:
 - a. Determine thickness of paving being placed, no less than one (1) test per 10,000 sq. ft. (930 sq. m) of paving or portion thereof, three (3) tests minimum.
- C. Field Tests And Inspections (Provided by Owner):
1. General:
 - a. Compaction tests provided by Owner will be used to validate or determine discrepancies with testing by Contractor.
 - b. Civil engineer applies pay factor for Gradation/Asphalt Content, In-Place Density. Civil engineer computes pay factor for each lot.
 - c. Opening paved surface to traffic does not constitute acceptance.
 - d. Unless required by the Owner's Representative, Testing Agency is to base compaction testing on Contractor's submitted mix design for theoretical maximum specific gravity (Rice) or Marshall specific gravity (Bulk) values.
 - e. Asphalt-aggregate mix sampling as per ASTM D979/D979M.
 - 1) Test for:
 - a) Air voids as per ASTM D3203/D3203M.
 - b) Asphalt binder content as per ASTM D6307.
 - c) Aggregate gradation as per ASTM D5444.
 - f. Lot size: 10,000 sq. ft. (930 sq. m) or part thereof.
 - g. Sub lot size: 5,000 sq. ft. (465 sq. m) or part thereof.
 2. At Site Testing and Inspection:
 - a. Asphalt Paving:
 - 1) Testing Agency shall provide full time nuclear density testing and inspection for asphalt paving during asphalt paving operations (nuclear density testing is informational testing only and does not constitute acceptance by Owner).
 - 2) Inspection to include:
 - a) Aggregate coating.
 - b) Compaction control and effort required.
 - c) Suitability of spreading and asphalt paving equipment.
 - d) Temperature of mix as delivered and placed.

- (1) Reject mixes exceeding 325 deg F (163 deg C) in transport vehicle as required in Non-Conforming Work below.
 - (2) Dispose of cold mix in paver hopper as thin spread underlay.
- 3) Field Tests:
- a) When tested with 10 foot (3 meter) straight edge, surface of completed work shall not contain irregularities in excess of 1/4 inch (6 mm).
 - b) Determine percent compaction per ASTM D2950/D2950M unless other nondestructive nonnuclear methods such as sonar are used.
 - c) Provide written nuclear density testing, or other nondestructive nonnuclear methods such as sonar, of asphalt paving at minimum rate of one (1) per 2,500 sq. ft. (232 sq. m). Select test locations by ASTM D3665 and sample per ASTM D979/D979M before compaction. Minimum of three (3) tests required.
 - d) Compact asphalt paving to ninety-four (94) percent of Theoretical Maximum Specific Gravity (Rice) plus three (3) percent or minus two (2) percent.
 - e) Maximum average total air voids in completed hot mix asphalt shall be eight (8) percent but more than three (3) percent as determined by ASTM D2041/D2041M.
 - f) Determine thickness of paving being placed, no less than one (1) test per 10,000 sq. ft. (930 sq. m) of paving or portion thereof, three (3) tests minimum.
3. At Laboratory Testing:
- a. General:
 - 1) Provide at least one (1) laboratory test series for every 10,000 sq. ft. (930 sq. m) or part thereof (minimum of one (1) test):
 - a) Test reports will show compliance with Contract Documents regarding type and depth of aggregate base, depth and density of asphalt paving.
 - b) Reports will also give test procedures used by testing laboratory.
 - b. Compaction and Final Density:
 - 1) Pavement thickness and final density to be determined by results of coring. Provide one (1) core per 10,000 sq. ft. (930 sq. m) or part thereof. Minimum of three (3) tests required if under 30,000 sq. ft. (2 787 sq. m).
 - a) Based upon core samples, compaction is acceptable if test deviations are within pay factor 1.00 limits.
 - b) At Project Manager's discretion, after consulting with Design Team, a Lot with a sub-lot test deviation greater than Reject may stay in place at fifty (50) percent cost.
 - c) Select test locations by ASTM D3665 and sample per ASTM D979/D979M after compaction.
 - c. Compaction Pay Factor:
 - 1) Based upon core samples, compaction is acceptable if test deviations are within pay factor 1.00 limits.
 - 2) At Project Manager's discretion, after consulting with design team, a Lot with a sub-lot test deviation greater than Reject may stay in place at fifty (50) percent cost.
 - 3) Average Density, in percent as shown in **Table 4 – COMPACTION PAY FACTORS**:

Table 4 – COMPACTION PAY FACTORS (94 percent of theoretical maximum specific gravity – Superpave (Rice) (ASTM D2041/D2041M plus three (3) or minus two (2) percent)		
Pay Factor	Density, in Percent	
	Average	Lowest Test
0.70	More than 96	---
1.00	92 to 96	89 or Greater
0.90	92 to 96	Less than 89
Reject	Less than 92	---

Notes:

- At Contractor's discretion and expense, do Hamburg wheel track test (AASHTO T 304) on 3 additional random core samples from non-complying sub-lot of 5,000 sq. ft. (465 sq. m). Sub-lot will be accepted if average rut depth is less than 10 mm at 20,000 passes.

- d. Pavement Thickness is to be 3" after compaction:
- Pavement thickness and final density to be determined by results of coring. Provide one (1) core per 10,000 sq. ft. (930 sq. m) or part thereof. Minimum of three (3) tests required if under 30,000 sq. ft. (2 787 sq. m).
 - Acceptance will be based on the average of all thickness tests.
 - At Project Manager's discretion, after consulting with design team, payment may be made for areas deficient in thickness by more than 0.75 inches (19.05 mm) at fifty (50) percent. If not, remove and replace at no additional cost to the Owner as shown in **Table 5 – THICKNESS PAY FACTORS**:

Table 5 – THICKNESS PAY FACTORS	
Pay Factors	Thickness Deficiency, in Inches (ASTM D3549/D3549M)
1.00	0.00 to 0.25
0.90	0.26 to 0.50
0.70	0.51 to 0.75
Reject	0.76 to 1.00

- e. Air Voids:
- Basis of evaluation is laboratory compacted samples (not field compacted samples).
 - Air voids will be mix design target plus or minus one (1) percent.
 - If test results are not within this Section's limits, options include correction of production procedures or alternate mix design acceptable to Civil Engineer.

D. Non-Conforming Work: Non-conforming work as covered in the General Conditions applies, but is not limited to the following:

- Asphalt Paving:
 - Deficient asphalt paving thickness:
 - Place additional material over deficient areas. Do not skin patch. Mill for inlay if necessary. Correct deficient asphalt paving thickness at no additional cost to the Owner.
 - Rejection and Removal of Asphalt Paving:
 - Remove asphalt paving found defective after installation and install acceptable product at no additional cost to the Owner.
 - Removal of Asphalt Paving:
 - Remove spatter, over-coat, or mar at no additional cost to the Owner.
 - Remove asphalt from borrow pits or gutters at no additional cost to the Owner.
 - Repair of Asphalt Paving:

- 1) Repair or replace defective joints, seams, edges at no additional cost to the Owner.

3.5 PROTECTION

A. Tack Coat:

1. Protect all surfaces exposed to public view from being spattered or marred. Remove any spattering, over-coating, or marring at no additional cost to Owner.
2. Traffic:
 - a. Do not permit traffic to travel over tacked surface until tack coat has cured and dried.

B. Asphalt Paving:

1. Protect hot mixed asphalt (HMA) pavement from traffic until mixture has cooled enough not to become marked.

3.6 CLEANING

A. Waste Management:

1. Pre-emergent herbicide:
 - a. Follow Manufacturer's recommendations for disposal of product at approved waste disposal facility.
 - 1) Do not reuse empty containers.

END OF SECTION

SECTION 32 1217**ASPHALT REINFORCEMENT FIBERS****PART 1 - GENERAL****1.1 SUMMARY****A. Includes But Not Limited To:**

1. Furnish and install materials and equipment for mixing Asphalt Reinforcement Fibers into Asphalt Mix as specified in Section 32 1216.

B. Related Requirements:

1. Section 32 1216: 'Asphalt Paving'.

1.2 REFERENCES**A. Association Publications:**

1. Arizona State University, School of Sustainable Engineering and the Built Environment
Department of Civil, Environmental, and Sustainable Engineering, Tempe, Arizona:
 - a. 'Extraction of Aramid Fibers from Fiber Reinforced Asphalt Concrete – Special Test Method' (May 11, 2016) by Waleed Zeiada and Shane Underwood.

B. Definitions:

1. Asphalt Reinforcement Fibers: High tensile strength aramid fiber blend specially formulated to reinforce hot mix or warm asphalt. A blend of high tensile-strength synthetic fibers that are uniformly dispersed into hot or warm mix asphalt to increase durability and longevity of asphalt paving. Asphalt reinforcement fibers can be of polyester, polypropylene or aramid (This specification requires use of aramid fibers).
 - a. Aramid Fibers: Uniformly mixed and coated with asphalt at asphalt plant and dispersed into asphalt mix using delivery systems such as being combined with fibrillated polyolefin fibers or being wax coated.
 - b. Aramid Dispersion State Ratio (ADSR): Mass of aramid in individual state compared to total mass of extracted aramid fibers, expressed as percentage.
2. See Section 32 1216: 'Asphalt Paving' for additional common asphalt paving definitions.

C. Reference Standards:

1. American Association of State and Highway Transportation Officials:
 - a. AASHTO T322-07(2016): 'Determining the Creep Compliance and Strength of Hot-Mix Asphalt (HMA) Using the Indirect Tensile Test Device'.
2. ASTM International:
 - a. ASTM D2172/D2172M-17, 'Standard Test Methods for Quantitative Extraction of Bitumen From Bituminous Paving Mixtures'.
 - b. ASTM D2256/ D2256M-10(2015), 'Standard Test Method for Tensile Properties of Yarns by the Single-Strand Method'.
 - c. ASTM D6932/D6932M-08(2013), 'Standard Guide for Materials and Construction of Open-Graded Friction Course Plant Mixtures'.

1.3 SUBMITTALS**A. Action Submittals:****1. Product Data:****a. Asphalt Reinforcement Fibers:**

- 1) Manufacturer's published product data and certification that product supplied meets requirements of this specification.
- 2) Provide certified test data for asphalt reinforcement fibers.

- 3) Manufacturer's instructions and general recommendations.
 2. Submit a minimum of five unique project examples and references where the reinforcing fiber product was used.
 3. Samples:
 - a. Asphalt Reinforcement Fibers:
 - 1) Manufacturer to provide statement certifying:
 - a) Fiber material and mix rate meet requirements of this specification.
- B. Informational Submittals:**
1. Tests And Evaluation Reports:
 - a. Asphalt Reinforcement Fibers:
 - 1) Indirect Tensile (IDT) Strength Test results (AASHTO T322 or D6932/D6932M) from minimum of three (3) separate laboratory trials:
 - a) Tests must be performed by AASHTO Independent Testing Agency meeting qualifications as specified in Section 01 4301 'Quality Assurance - Qualifications' and reviewed and approved by project engineer.
 - b) Perform indirect tensile tests using the following protocol:
 - (1) Specimen height range of 1.50 inches (38 mm) to 2.46 inches (62.48 mm).
 - (2) Specimen diameter range of 4.00 inches (101.6 mm) to 5.91 inches (150.11 mm).
 - (3) Actuator displacement rate of 2.0 inches (50.8 mm) /min (plus or minus 0.10 inches (2.54 mm) / minute).
 - (4) Test temperature range 40 deg F (4.4 deg C) to 77 deg F (25 deg C).
 - (5) Other test parameters and methods as detailed in AASHTO T322 or ASTM D6932/D6932M.
 - c) Tests results shall include control and fiber reinforced mix. Fiber reinforced asphalt concrete (FRAC) mix shall be identical to control mix except for inclusion of fibers added at same dosage as proposed on Project.
 - d) Indirect tensile test results from fiber specimens shall show average tensile strength increase of fifteen (15) percent over control specimen with no single result less than ten (10) percent increase of average tensile strength.
 - 2) Perform Aramid Dispersion State Ratio (ADSR) Tests from minimum of two separate laboratory trials:
 - a) Perform ADSR tests based on modified ASTM D2172/D2172M procedures as provided in document 'Extraction of Aramid Fibers from Fiber Reinforced Asphalt Concrete – Special Test Method' by Arizona State University:
 - (1) Samples must be obtained during production run of fiber reinforced asphalt concrete (FRAC) mixed at full-scale asphalt plant.
 - (2) Fiber extraction results should result in average extracted fiber content of not less than 0.007 percent by total sample weight with no individual result less than 0.005.
 - (3) All tested fiber mixes must achieve a minimum ADSR of 85 percent.

1.4 QUALITY ASSURANCE

- A. Qualifications.** Requirements of Section 01 4301 'Quality Assurance - Qualifications' applies but not limited to following:
1. Asphalt Reinforcement Fiber:
 - a. Provide list of five (5) project examples and references of completed projects of comparable quality, similar size, and complexity in past five (5) years before bidding.
 - b. Upon request, submit documentation.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Storage And Handling Requirements:**
1. Asphalt Reinforcement Fibers:
 - a. Store fibers in dry environment.
 - b. Do not allow contact with moisture.

- c. Keep sand and dust out of boxes.

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Asphalt Reinforcement Fibers:
 1. General:
 - a. Reinforcing fiber blend of virgin polyolefins and virgin aramids.
 2. Design Criteria - Comply with following fiber characteristics:
 - a. Tensile Strength: 400,000 psi (2 758 MPa) as per ASTM D2256/ D2256M.
 - b. Specific Gravity: 1.44 +/- 0.01.
 - c. Acid/Alkali Resistance: Inert.
 - d. Melting Temperature: 800 deg F (427 deg C).
 - e. Melting Temperature for dispersing fibers, if used: 212 deg F (100 deg C) maximum.
 - f. Fiber Size:
 - 1) Fiber length shall be 3/4 inch +/- 1/16 inch (19 mm +/- 2 mm) for surface course mixes.
 - 2) Fiber diameter shall be 0.00047 inches (12 microns +/- 2 microns).
 - g. Non-aramid fiber blends will not be considered as acceptable.
 3. Dosage Rate:
 - a. Pure aramid fibers, not including any blended fibers or coatings, shall be used at minimum dosage rate of 2.1 oz (59.5 g) per 1 ton (1.02 metric ton) of asphalt.
 - b. Mixture of pure aramid fibers combined with distributing fibers to be 16 oz (454 g) per 1 ton (1.02 metric ton).
 4. Type One Acceptable Products:
 - a. FORTA-FI asphalt reinforcement fibers as manufactured by Forta Corporation, Grove City, PA www.forta-fi.com. Distributed by Alliance Geosynthetics, Inc.
 - 1) Contact Information: phone (949) 610-6098, email - joseph@alliancegeo.com.
 - b. Equal as approved by Architect at least two weeks prior to bid date. See Section 01 6200.

PART 3 - EXECUTION

3.1 INSTALLERS

- A. Acceptable Applicators:
 1. Meet Quality Assurance Installer Qualifications as specified in Part 1 of this specification:

3.2 APPLICATION

- A. Asphalt Reinforcement Fibers:
 1. Batching and Mixing:
 - a. General:
 - 1) Add fiber manually or through specialized equipment that can accurately proportion or meter, by weight, proper amount per batch for batch plants, or continuously and in steady uniform manner for drum plants.
 - 2) Add aramid and polyefin reinforcing fiber blends at a dosage rate of one pound per one ton of asphalt.
 - 3) Add alternative aramid fiber blends at a rate proposed by the manufacturer that achieves the IDT and ADSR results required.
 - b. Batch Plant:
 - 1) When batch plant is used, add fibers to aggregate in weigh hopper and follow Manufacturer recommendations for both dry and wet mixing times.
 - 2) Ensure fibers are uniformly distributed before injection of asphalt cement into mixture.
 - 3) Accurately proportion by weight proper amount per batch controlled to within plus or minus ten (10) percent of required weight of asphalt reinforcement fibers.

- 4) Where warm mix technologies are used, remove fibers from bags.
- c. Drum Plant:
 - 1) Accurately proportion by weight the proper amount per batch controlled to within ten (10) percent of required weight of asphalt reinforcement fibers.
 - 2) Inject fibers through RAP collar by placing 1 lb (0.45 kg) bags of fibers on RAP belt or by feeding them through blower tube.
 - 3) Rate feeding of fibers with rate plant is producing asphalt mix.
 - 4) For blower tube system, add fibers continuously in steady uniform manner. Provide automated proportioning devices and control delivery within plus or minus ten (10) percent of mass of fibers required. Perform equipment calibration to satisfaction of Fiber Manufacturer's Representative to show that fiber is being accurately metered and uniformly distributed into mix (visual inspection at discharge chute).
 - 5) If there is evidence of clumps of fibers at discharge chute or during laydown, increase mixing time and/or temperature or change angle of fiber feeder line to increase dry mixing time.
- d. Have Fiber Manufacturer's Representative on site during first day of mixing and production. This requirement can be waived if fiber manufacturer and asphalt producer can supply evidence of manufacturer's brand of fiber having been successfully produced minimum of three (3) times at asphalt plant to be used for Project.

3.3 FIELD QUALITY CONTROL

A. Field Tests And Inspections:

1. Civil and structural field tests, laboratory testing, and inspections are provided by Owner's independent Testing Agency as specified in Section 01 4523 'Testing And Inspection Services':
 - a. Quality Control is sole responsibility of Contractor:
 - 1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform testing and inspection as part of his Quality Control:
 - a) Testing and inspections, if performed by Contractor, will be responsibility of Contractor to be performed by an independent entity.
 - 2) Contractor bears full responsible for compliance with all contract requirements and quality control on project and will be responsible for quality of asphalt mixture and asphalt installation.

B. Aramid Dispersion Visual Test:

1. Collect 10kg sample of mix from discharge chute during first 50 tons of production. Visually asses state of aramid fibers in sample and rate sample as "Pass" or "Fail".
 - a. "Pass": All fibers exist in an Individual State.
 - b. "Fail": One or more Agitated Bundles are detected.
2. If sample is rated as "Fail", adjust mixing operations to improve fiber dispersion and repeat test.
3. If visual test results in three consecutive "Fail" ratings, plant mix samples should be sent to a third party laboratory for complete ADSR testing before production is allowed to commence.
4. In addition to visual test, observe FRAC mix in back of first three trucks and every tenth truck thereafter to confirm adequate blending of fiber.
5. Remove any observed fiber balls from placed mixture and adjust operations per manufacturer's recommendation to eliminate future fiber ball development, and repeat Steps 1 through 3 above to confirm adequate aramid fiber dispersion.

END OF SECTION

SECTION 32 1723**PAVEMENT MARKINGS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
1. Furnish acrylic paint and apply pavement and curb markings as described in Contract Documents including:

1.2 REFERENCES

- A. Reference Standards:
1. Federal Specifications and Standards:
 - a. FED-STD-595C, 'Federal Standard: Colors Used in Government Procurement' (16 Jan 2008).
 - b. FED TT-P-1952F, 'Paint, Traffic and Airfield Marking, Waterborne' (17 Feb 2015).
 2. U.S. Department of Transportation Federal Highway Administration:
 - a. FHWA MUTCD-10, 'Manual on Uniform Traffic Control Devices'.

1.3 SUBMITTALS

- A. Action Submittal:
1. Product Data:
 - 1) Manufacturer's published product data and certification that product supplied meets requirements of this specification.
- B. Informational Submittal:
1. Test And Evaluation Reports:
 - a. Acrylic Paint:
 - 1) Provide reports showing compliance to FED TT-P-1952F.
- C. Closeout Submittals:
1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
 - a. Record Documentation:
 - 1) Manufacturer's Documentation:
 - a) Product data.
 - b) Specification compliance documentation.
 - 2) Testing and Inspection Reports:
 - a) Reports showing compliance.

1.4 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
1. Paint must meet requirements of FED TT-P-1952-F and local regulations for VOC.
 2. Paint handicap spaces to conform to ADA Standards and local code requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Acceptance Requirements:
1. Materials shall be delivered in original, unopened containers with labels intact.

- a. Labels to include:
 - 1) Manufacturer's name and address.
 - 2) TT-P-1952F reference.
 - 3) Classification Type.
 - 4) Color.

- B. Storage And Handling Requirements:
 1. Follow Manufacturer's storage and handling requirements.
 2. Protect stored material from freezing at temperatures above 35 deg F (2 deg C) or above 115 deg F (46.1 deg C).
 3. Do not invert or roll containers.

1.6 FIELD CONDITIONS

- A. Ambient Conditions:
 1. Acrylic Paint:
 - a. Apply only on dry clean surfaces, during favorable weather (not excessively windy, dusty, or foggy), and when damage by rain, fog, or condensation not anticipated.
 - b. Paving surface and Ambient temperature shall be minimum 50 deg F (10 deg C) and rising.
 - c. Temperature shall not drop below 50 deg F (10 deg C) within twenty-four (24) hour period following application.
 - d. Acetone based paints that are one hundred (100) percent acrylic shall not drop below 32 deg F (0 deg C) within twenty-four (24) hour period following application.

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Acrylic Paint:
 1. Description:
 - a. Low VOC, ready-mixed, one- component, acrylic waterborne traffic marking paint suitable for application on concrete, asphalt, sealers, and previously painted areas of these surfaces.
 2. Design Criteria:
 - a. General:
 - 1) Traffic Paint.
 - 2) Non-volatile portion of vehicle for all classification types shall be composed of one hundred (100) percent acrylic.
 - 3) Meet FED TT-P-1952F specification requirements.
 - 4) Fast drying when applied at ambient conditions requirement.
 - 5) Low VOC.
 - 6) Non-Reflectorized.
 - 7) Traffic paints not intended for use as floor paints. Do not use on pedestrian walkways or large surfaces such as ramps, floors and stairs which may become slippery when wet.
 - b. Classification:
 - 1) Type I for use under normal conditions.
 - c. Composition:
 - 1) Non-volatile portion for all types shall be composed of one hundred (100) percent acrylic polymer as determined by infrared spectral analysis.
 - 2) Prohibited material:
 - a) Product does not contain mercury, lead, hexavalent chromium, toluene, chlorinated solvents, hydrolysable chlorine derivatives, ethylene-based glycol ethers and their acetates, nor any carcinogen.
 - d. Qualitative Requirements:
 - 1) Meet FED TT-P-1952F requirements for:
 - a) Abrasion resistance.

- b) Accelerated package stability.
 - c) Accelerated weathering.
 - d) Appearance.
 - e) Color requirements:
 - (1) Color Match (all colors except white and yellow).
 - (2) Daylight directional reflectance.
 - (3) Yellow color match.
 - f) Condition in container.
 - g) Dry-through (early washout) for Type II only.
 - h) Flexibility.
 - i) Freeze/thaw stability.
 - j) Heat-shear stability.
 - k) Scrub resistance.
 - l) Skinning.
 - m) Titanium dioxide content.
 - n) Water resistance.
- e. Quantitative requirements:
- 1) Meet FED TT-P-1952F requirements (Table 1).
 - 2) Acetone based paints that are one hundred (100) percent acrylic and have exempt status under Federal law are exempt from meeting FED TT-P-1925F requirements.
3. Colors:
- a. General:
 - 1) Traffic Paint will be furnished in white and any Federal Standard 595 color in accordance to FED-STD-595C:
 - a) Yellow: 33538.
 - b) Blue: 35180.
 - c) Red: 31136.
 - b. White (Yellow may be used at Owner Representative's discretion):
 - 1) Lane lines, edge lines, transverse lines, arrows, words, symbol markings, speed bump markings, parking space markings.
 - c. Yellow:
 - 1) Cross-hatching in medians, cross hatching in safety zones separating opposing traffic flows, crosswalk stripes, safety markings, centerlines, edge lines along left edge of one-way roadway or one-way ramp.
 - d. Blue And White:
 - 1) In parking spaces specifically designated as reserved for disabled.
 - e. Red:
 - 1) Fire lanes, no parking zones, special raised pavement markers that are placed to be visible to "wrong-way" drivers.
4. Type Two Acceptable Products:
- a. Any product meeting design criteria of this specification as approved by Architect/Owner's Representative before application. See Section 01 6200.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Acrylic Paint:
 - 1. Asphalt Surfaces:
 - a. Do not apply paint until asphalt has cooled.
 - b. Allow new seal coated surfaces to cure for at least twenty-four (24) hours before applying paint.
 - 2. Concrete Surfaces:
 - a. Do not apply paint to new concrete surfaces until concrete has cured seven (7) days minimum.
- B. Surfaces shall be dry and free of grease and loose dirt particles.
 - 1. Scrape and wire brush chipped, peeling, or damaged paint on existing curbs.

- C. Perform layout with chalk or lumber crayon only.

3.2 APPLICATION

- A. General:
 - 1. Mix in accordance and apply as per Manufacturer's instructions.
 - 2. Apply at locations and to dimensions and spacing as shown on Contract Drawings.
- B. Tolerances:
 - 1. General: Make lines parallel, evenly spaced, and with sharply defined edges.
 - 2. Line Widths – 2 inches:
 - a. Plus or minus 1/4 inch (6 mm) variance on straight segments.
 - b. Plus or minus 1/2 inch (13 mm) variance on curved alignments.
- C. Coverage:
 - 1. Paint stripes added to new asphalt and concrete surfaces:
 - a. Apply single coat.
 - 2. Paint stripes applied to existing asphalt and concrete surfaces:
 - a. Apply single coat to existing asphalt parking lots which are being re-striped and where no surface treatments are being applied to asphalt.
 - b. Apply single coat to existing concrete parking lots which are being re-striped.
 - c. Apply single coat to existing concrete curbs.
 - 3. Paint stripes applied to new asphalt paving surface treatment over existing asphalt paving.
 - a. Except for slurry seal:
 - 1) Apply single coat after seal coat has completely dried.
 - b. Slurry seal coat:
 - 1) Apply first coat after seal coat has completely dried.
 - 2) Apply second coat after first coat has thoroughly dried and then wait thirty (30) to forty-five (45) days and after ravel sweeping to apply second coat.
 - 4. Apply traffic paint at rate of 13 to 15 mils minimum wet thickness, 8 to 9 mils dry thickness. Application at more than 15 mils may result in extended dry times and may cause lifting or cracking on some asphalt surfaces.

3.3 FIELD QUALITY CONTROL

- A. Non-Conforming Work:
 - 1. Replace or correct defective material not conforming to requirements of this specification or any work performed that is of inferior quality at no cost to Owner.

3.4 CLEANING

- A. General:
 - 1. Remove drips, overspray, improper markings, and paint material tracked by traffic by sand blasting, wire brushing, or other method approved by Architect/Owner's Representative before performance.
- B. Waste Management:
 - 1. Remove debris resulting from work of this Section. Dispose of or recycle all trash and excess material in manner conforming to current EPA regulations and local laws.

END OF SECTION

SECTION 32 3113**CHAIN LINK FENCES AND GATES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
 - 1. Furnish and install complete fence and gates as described in Contract Documents.
- B. Products Furnished But Not Installed Under This Section:
 - 1. Chain link gate complete with mounting hardware.
- C. Related Requirements:
 - 1. Section 03 3111: 'Cast-In-Place Structural Concrete' for mow strips at fencing and setting sleeves in concrete retaining walls.
 - 2. Sections Under 04 2000 Heading: Installation of gate and hardware built into masonry mechanical equipment enclosures.
 - 3. Section 05 0503: 'Shop-Applied Metal Coatings' for priming and galvanizing repair.
 - 4. Section 05 0523: 'Metal Fastening' for welding requirements.

1.2 REFERENCES

- A. Association Publications: / Organizations:
 - 1. Chain Link Fence Manufacturers Institute (CLFMI), Columbia, MD www.chainlinkinfo.org.
 - a. WLG 2445, '*Chain Link Fence Wind Load Guide for the Selection of Line Post and Line Post Spacing*' (2012).
 - b. CLF-SFR0111, '*Chain Link Fence Manufacturers Institute Security Fencing Recommendations*'.
 - c. CLF-PM0610, '*Field Inspection Guide*'.
 - d. CLF-TP0211, '*Tested and Proven Performance of Security Grade Chain Link Fencing Systems*'.
- B. Reference Standards:
 - 1. ASTM International:
 - a. ASTM A123/A123M-17, 'Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products'.
 - b. ASTM A153/A153M-16a, 'Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware'.
 - c. ASTM A392-11a(2017), 'Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric'.
 - d. ASTM A1011/A1011M-18a, 'Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength'.
 - e. ASTM C1107/C1107M-17, 'Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)'.
 - f. ASTM F1043-18, 'Standard Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework'.
 - g. ASTM F1083-18, 'Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures'.
 - h. ASTM F3000/F3000M-13(2018), 'Standard Specification for Polymer Privacy Insert Slats for Chain Link Fabric and Privacy Chain Link Fabric Manufactured Containing Pre-Installed Privacy Slats'.

1.3 SUBMITTALS

- A. Action Submittals:
1. Product Data: Manufacturer literature or cut sheets on fence components.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

- A. Materials:
1. Fabric:
 - a. Chain Link Fabric of 9 ga (3.7 mm) wire, galvanized before or after weaving with 1.2 ounce (34 grams) zinc coating conforming to requirements of ASTM A392, Class I.
 - b. Mesh:
 - 1) Without Visual Privacy / Security Slats at mechanical enclosure:
 - a) 2 inch (50 mm) square mesh as selected by Architect.
 - c. Knuckle both selvages.
 2. Framework:
 - a. Posts and Rails shall be roll-formed, self-draining shapes meeting strength requirements of ASTM F1043, Table 3, and with 2 ounce (56.7 grams) zinc coating per 1 sq ft (0.0929 sq meter) of surface area conforming to ASTM A123/A123M.
 - b. Line Posts:
 - 1) Line Posts 8 feet (2.45 m) and under:
 - a) 1.875 by 1.625 inch (48 by 41 mm) C-section roll formed from steel conforming to ASTM A1011/A1011M, Grade 45, with minimum theoretical bending strength of 247 lbs (112 kg) under 6 foot (1.80 m) cantilever load.
 - b) 2.375 inch (60 mm) outside diameter Schedule 40 tubular section weighing 3.65 lbs (1.6 kg) per lineal 1 ft (305 mm) meeting requirements of ASTM F1083.
 - c) 2.375 inch (60 mm) outside diameter Schedule 40 tubular section weighing 3.12 lbs (1.42 kg) per lineal 1 ft (305 mm) formed from steel meeting requirements of ASTM A1011/A1011M.
 - c. Terminal And Gate Posts:
 - 1) Gate Posts and gate posts for gate leaves under 6 feet (1.80 m) wide:
 - a) 3.5 by 3.5 inch (89 by 89 mm) roll formed section with minimum theoretical bending strength of 486 pounds (220.5 kg) under 6 foot (1.80 m) cantilever load.
 - b) 3 inch (76 mm) outside diameter Schedule 40 pipe weighing 5.79 lbs (2.63 kg) per lineal 1 ft (305 mm) meeting requirements of ASTM F1083.
 - c) 3 inch (76 mm) outside diameter Schedule 40 tubular section weighing 4.64 lbs (2.11 kg) per lineal 1 ft (305 mm) formed from steel meeting requirements of ASTM A1011/A1011M.
 - d. Top And Brace Rail:
 - 1) 1.625 by 1.25 inch (41 by 32 mm) roll formed section of 45,000 psi (310 MPa) yield strength channel shaped rail with minimum theoretical bending strength of 247 lbs (112 kg) on 10 foot (3.050 m) midpoint load.
 - 2) 1.660 inch 42 mm outside diameter Schedule 40 pipe weighing 2.27 lbs (1.03 kg) per lineal 1 ft (305 mm) meeting requirements of ASTM F1083.
 - 3) 1.660 inch 42 mm outside diameter Schedule 40 tubular section weighing 1.84 lbs (0.83 kg) per lineal 1 ft (305 mm) formed from steel meeting requirements of ASTM A1011/A1011M.
 - e. Fittings:
 - 1) Pressed steel or malleable iron, hot-dip galvanized conforming to ASTM A153/A153M.
 - 2) Tie wires shall be 12 ga (2.05 mm) minimum galvanized steel or 9 ga (3 mm) minimum aluminum wire.
 - f. Tension Wire: 7 ga (3.66 mm) minimum galvanized spring steel.
 3. Gate Leafs Wider Than 6 Feet (1.80 Meters):

- a. Fabricate perimeter frames from metal and finish to match fence framework. Assemble frames by welding or with special fittings and rivets, for rigid connections, providing security against removal or breakage connections.
 - 1) Provide same fabric as for fence. Install fabric with stretcher bars at vertical edges and at top and bottom edges. Attach stretchers bars to frame at not more than 15 inches (380 mm) on center.
 - 2) Install diagonal cross-bracing consisting of 3/8 inch (9.5 mm) diameter adjustable length truss rods to ensure frame rigidity without sag or twist.
- b. Swing Gates: Fabricate perimeter frames of minimum 1.90 inches (48.26 mm) OD pipe.
- c. Gate Hardware: Provide hardware and accessories for each gate, galvanized per ASTM A153/A153M, and in accordance with following:
 - 1) Hinges: Size and material to suit gate size, non-lift-off type, offset to permit 180 degree gate opening. Provide 1-1/2 pair of hinges for each leaf over 6 foot (1.80 m) nominal height.
 - 2) Latch At Paving: Forked type or plunger-bar type to permit operation from either side of gate, with padlock eye as integral part of latch.
- d. Keeper: Provide keeper for vehicle gates, which automatically engages gate leaf and holds it in open position until manually released.
- e. Double Gates:
 - 1) Provide gate stops for double gates, consisting of mushroom type flush plate with anchors, set in concrete, and designed to engage center drop rod or plunger bar.
 - 2) Include locking device and padlock eyes as integral part of latch, permitting both gate leaves to be locked with single padlock.
- f. Sliding Gates: Provide Manufacturer's standard heavy-duty inverted channel track, ball-bearing hanger sheaves, overhead framing and supports, guides, stays, bracing, hardware, and accessories as required.

B. Mixes:

1. Post Foundation Concrete:
 - a. One cu ft cement, 2 cu ft (0.0566 cu m) sand, 4 cu ft (0.1132 cu m) gravel, and 5 gallons (18.93 liters) minimum to 6 gallons (22.71 liters) maximum water.
 - b. Mix thoroughly before placing.

2.2 ACCESSORIES

- A. Post Setting Grout at Sleeves:
 1. Commercial nonshrink grout conforming to requirements of ASTM C1107/C1107M, Type B or C.
 2. Type Two Approved Products:
 - a. Normal Construction Grout A by W R Bonsal, Charlotte, NC www.bonsal.com.
 - b. Advantage 1107 Grout by Dayton Superior, Miamisburg, OH www.daytonrichmond.com.
 - c. NS Grout by Euclid Chemical Co, Cleveland, OH www.euclidchemical.com.
 - d. 5 Star Special Grout 110 by Five Star Products Inc, Fairfield, CT www.fivestarproducts.com.
 - e. Duragrout by L&M Construction Chemicals Inc, Omaha, NE www.lmcc.com.
 - f. Masterflow 713 Pre-mixed Grout by Master Builders, Cleveland, OH www.masterbuilders.com.
 - g. Tamms Grout 621 by TAMMS Industries, Mentor, OH www.tamms.com.
 - h. U S Spec MP Grout by U S Mix Products Co www.usspec.com.
 - i. CG-86 Grout by W R Meadows, Elgin, IL www.wrmeadows.com.
 - j. Equal as approved by Architect before use. See Section 01 6200.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fence shall be installed by mechanics skilled and experienced in erecting fences of this type and in accordance with Contract Documents.

1. When general ground contour is to be followed, make changes of grade in gradual, rolling manner.
 2. Evenly space posts in line of fence a maximum of 10 feet (3.050 meter) center to center.
- B. Post Foundations:
1. Except atop retaining walls, set posts with concrete post foundations as specified below:
 - a. Line Posts:
 - 1) Diameter 8 inch (200 mm)
 - 2) Depth 36 inch (915 mm).
 - b. Gate, End, And Corner Posts:
 - 1) Diameter 12 inch (305 mm)
 - 2) Depth 42 inch (1 065 mm).
 - c. At mow strips, set top of post foundation below grade sufficient to allow for placing of mow strip. Measure post foundation depth from top of mow strip.
 - d. Where fences are incorporated into slabs, measure post foundation depth from top of slab. Extend bottom of slab footing sufficient to allow specified amount of concrete around post. At existing slabs, install fence outside perimeter of slab.
 - e. For fences on retaining walls, provide 12 inch (305 mm) long sleeves to be cast into retaining wall. Set pipe in sleeve and grout space between sleeve and post full.
- C. Fence:
1. After posts have been permanently positioned and concrete cured for one (1) week minimum, install framework, braces, and top rail. Join top rail with 6 inch (150 mm) minimum couplings at not more than 21 foot (6.40 meter) centers.
 2. Stretch fabric by attaching one end to terminal post and supplying sufficient tension to other end of stretch so slack is removed.
 - a. Fasten fabric to line posts with tie wires. Pass ties over one strand of fabric and hook under line post flange.
 - b. Place one tie as close to bottom of fabric as is possible with additional ties equally spaced between top and bottom band on approximately equal spacing not to exceed 14 inches (355 mm) on center.
 - c. Attach fabric to roll formed terminals by weaving fabric into integral lock loops formed in post. Attach fabric to tubular terminals with tension bars and bands.
 - d. Hold fabric approximately 2 inches (50 mm) above finish grade line.
 - e. On top rail, space tie wires at no more than 24 inches (610 mm) on center.
 - f. Securely attach fittings and firmly tighten nuts.
- D. Gates:
1. Weld gate frames and provide for free and easy operation.
 2. Provide gate latching device with padlocking capabilities. Provide cane bolt to engage sleeve set in concrete at double gates.
 3. Align top bar of gates with top rail of fence.
 4. Gates shall be plumb and on same plane as fence, both vertically and horizontally.
 5. Set gate stops and other catches in concrete.

3.2 CLEANING

- A. Spread dirt from foundation excavations evenly around surrounding area unless otherwise directed. Leave area free of excess dribbles of concrete, pieces of wire, and other scrap materials.

END OF SECTION

SECTION 32 8423**UNDERGROUND SPRINKLERS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
1. Furnish and install landscape irrigation system as described in Contract Documents complete with accessories necessary for proper function.
- B. Related Requirements:
1. Section 01 4301: 'Quality Assurance – Qualifications'.
 2. Section 31 2213: 'Rough Grading'.
 3. Section 31 2216: 'Fine Grading'.
 4. Section 31 2316: 'Excavation'.
 5. Section 31 2323: 'Fill' for trench compaction.
 6. Section 32 9001: 'Common Planting Requirements'.
 - a. Pre-installation conference held jointly with other common planting related sections.
 7. Section 32 9120: 'Topsoil And Placement' for topsoil evaluation and placement required for topsoil grading.
 8. Section 32 9121: 'Topsoil Physical Preparation' for physical preparation of topsoil (section included based on Topsoil Testing Report).
 9. Section 32 9122: 'Topsoil Grading' for preparation of topsoil and addition of amendments prior to landscaping.
 10. Section 32 9223: 'Sodding'.
 11. Section 32 9300: 'Plants'.

1.2 REFERENCES

- A. Definitions:
1. Dielectric Fittings: Special type of fitting used between dissimilar metals to prevent galvanic action from causing corrosion failure.
 2. High Wind Area: As defined in this specification, area with average sustained wind speed of over 7.5 mph (12 km/hr).
 3. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
 4. Landscape Management Plan (LMP): See Section 32 9001 for definition.
 5. Lateral Line: Downstream from electric control valves to application devices, heads and emitters. Piping or tubing is under pressure during flow. In areas where potable or secondary water are used, line shall be white. In areas where non-potable or reclaimed water are used, line shall be purple.
 6. Main Line: Downstream from point of connection to electric control valves. Piping is under water-distribution-system pressure when activated by master valve or hydrometer. In areas where potable or secondary water are used, line shall be white. In areas where non-potable or reclaimed water are used, line shall be purple.
 7. Peak Flow: Maximum required flow for given month based on six (6) day week, nine (9) hour day watering window to be used for irrigation system design and to be used in hydraulic analysis.
 8. Plant Establishment Period: See Section 32 9001 for definition.
 9. Point of Connection: Location where water enters irrigation system.
 10. Static Water Pressure: Pressure at point of connection when system is not operable.
 11. Source Pressure Test: Test to determine water source pressure.
 12. System Pressure Test: Test to evaluate system when pressurized.
 13. Working Pressure: Pressure at point of connection when system is operable.

- B. Reference Standards:
 - 1. ASTM International:
 - a. ASTM D2564-12, 'Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems'.
 - b. ASTM F656-15, 'Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings'.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Provide Coordination for required tests and inspections as described under Field Quality Control in Part 3 EXECUTION for following:
 - a. Manufacturer's Field Service: Provide necessary manufacturer's field service.
 - b. Pressure Test: In presence of Landscape Architect or designated Representative(s), provide pressure test.
 - c. Substantial Completion Walkthrough: In presence of Landscape Architect or designated Representative(s), plan and provide walk through after completion of irrigation system.
 - d. Landscape Final Acceptance: Inspection, no less than thirty (30) days following substantial completion, when all work has been completed, demonstrated, and approved by Landscape Architect. Coordinate with Section 32 8466 and Section 32 9000.
- B. Pre-Installation Conference:
 - 1. Participate in pre-installation conference as specified in Section 32 9001.
 - 2. Schedule pre-installation conference before irrigation system installation begins:
 - a. In addition to agenda items specified in Section 01 3100, review following:
 - 1) Review mockup requirements.
 - 2) Review required tests and inspections and submittal requirements.
 - 3) Review Landscape Management Plan (LMP) requirements.
- C. Sequencing:
 - 1. Install sleeves and conduit before installation of cast-in-place concrete site elements and paving.

1.4 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data:
 - a. Manufacturer's cut sheets for each element of system.
- B. Informational Submittals:
 - 1. Certificates (Coordinate with 32 8466 and 32 9000 Sections):
 - a. Irrigation System Approval:
 - 1) When irrigation system is approved, Landscape Architect will provide signed certificate:
 - a) Certificate will include name and signature of Landscape Architect, Landscape Architect's company, Landscape Architect's telephone number, and date of review.
 - b) Certificate will state to best of Landscape Architect's knowledge that the system is in full compliance with Contract Documents.
 - b. Establishment Period Acknowledgement:
 - 1) Establishment Period begins at date of Substantial Completion. Landscape Architect will provide certificate acknowledging Establishment Period commencement:
 - a) Certificate will include name and signature of Installer, Installer's company, Installer's telephone number, and date.
 - b) Certificate will include name and signature of Owner's Representative, Owner's Representative Group name, Owner's Representative Group telephone number, and date.
 - c) Certificate will acknowledge date when Establishment Period begins and that it extends one (1) year from that time.
 - c. Training Acknowledgement:

- 1) Landscape Architect will provide certificate acknowledging training has been performed:
 - a) Certificate will include name and signature of Installer, Installer's company, Installer's telephone number, and date.
 - b) Certificate will include name and signature of Owner's Representative, Owner's Representative Group name, Owner's Representative Group telephone number, and date.
 - c) Certificate will acknowledge Owner's Representative has been trained in operation and maintenance of system.
 2. Test And Evaluation Reports:
 - a. Provide report for results of system pressure testing before burial of mainline.
 - b. Provide following from system pressure test and observation:
 - 1) Record and submit documentation of system pressure tests, issues, and measure taken to correct problems.
 3. Manufacturer Instructions:
 - a. Manufacturer's printed literature on operation and maintenance of operating elements of system.
 4. Qualification Submittals:
 - a. Irrigation Subcontractor:
 - 1) Provide documentation if requested by Architect.
 - b. Irrigation Installer:
 - 1) Provide documentation if requested by Architect.
- C. Closeout Submittals:
1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
 - a. Submittal Format: Digital format only.
 - b. Operations And Maintenance Data:
 - 1) Include additional copy for Landscape Management Plan (LMP) of the following information:
 - a) Provide irrigation system operation and maintenance recommendations.
 - b) Provide irrigation system operation and maintenance recommendations from manufacturers.
 - c) Provide irrigation system winterization instructions.
 - d) Provide plant establishment period watering schedule.
 - e) Provide post plant establishment period watering schedule.
 - c. Warranty Documentation (include additional copy for Landscape Management Plan (LMP):
 - 1) Irrigation System Warranty.
 - d. Record Documentation:
 - 1) Provide manufacturer's printed literature and cut sheets for each element of system.
 - 2) Certificates:
 - a) Irrigation System Approval.
 - b) Training Acknowledgement.
 - 3) Testing and Inspection Reports:
 - a) System Pressure Test.
 - 4) Irrigation Record Drawings. As installation occurs, prepare accurate record drawing to be submitted before final inspection, including:
 - a) Detail and dimension changes made during construction. Record at time of installation.
 - b) Significant details and dimensions not shown in original Contract Documents.
 - c) Take dimensions from permanent constructed surfaces or edges located at or above finish grade.
 - d) Take and record dimensions at time of installation.
 2. Irrigation Drawings:
 - a. Irrigation Plan:
 - 1) Laminated reduced size:
 - a) Size: 11 by 17 inches (275 by 425 mm).
 - b) Show color key circuits and laminated both sides with 5 mil thick or heavier plastic.
 - c) Mount on 12 by 18 inch (300 by 450 mm) hard board drilled with two (2) 1/2 inch (13 mm) holes at top of board.

- d) Hang on hooks in Custodial Room or location designated by Owner's Representative.
- 2) Un-Laminated reduced size to be included in Landscape Management Plan (LMP):
 - a) Size: 11 by 17 inches (275 by 425 mm).
 - b) Show color key circuits.
- 3. Landscape Management Plan (LMP):
 - a. Submittal Format: Digital format and hard copy of each:
 - 1) Irrigation Section: Include additional copies included in Operations and Maintenance Manual of following:
 - a) Provide irrigation system operation and maintenance recommendations.
 - b) Provide irrigation system operation and maintenance recommendations from manufacturers.
 - c) Provide irrigation system winterization instructions.
 - d) Provide plant establishment period watering schedule.
 - e) Provide post plant establishment period watering schedule.
 - f) Provide Warranty Documentation: Irrigation System Warranty.
 - g) Provide Un-Laminated, Reduced Size Irrigation Plan.
- 4. Final payment for system will not be authorized until Closeout Submittals are received and accepted by Architect and Landscape Architect.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. General:
 - a. Work and materials shall be in accordance with latest rules and regulations, and other applicable state or local laws.
 - b. Nothing in Contract Documents is to be construed to permit work not conforming to these codes.
- B. Qualifications: Requirements of Section 01 4301 applies, but not limited to following:
 - 1. Irrigation Subcontractor:
 - a. Company specializing in performing work of this section.
 - b. Minimum five (5) years experience in irrigation sprinkler installations.
 - c. Minimum five (5) satisfactorily completed irrigation sprinkler installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
 - d. Use trained personnel familiar with required irrigation sprinkler procedures and with Contract Documents.
 - e. Foreman or supervisor required to attend pre-installation conference.
 - f. Upon request, submit documentation.
 - 2. Irrigation Installer:
 - a. Perform installation under direction of foreman or supervisor.
 - b. Minimum three (3) years experience in irrigation sprinkler installations similar in size, scope, and complexity.
 - c. Upon request, submit documentation.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Storage And Handling Requirements:
 - 1. Protect materials from damage and prolonged exposure to sunlight.

1.7 WARRANTY

- A. Warranty:
 - 1. Irrigation System:
 - a. In addition to standard one (1) year guarantee stipulated in General Conditions Article 12.2., warranty shall include:

- 1) Filling and repairing depressions and replacing plantings due to settlement of irrigation system trenches.
- b. Warranty irrigation system for period of one (1) year from date of Substantial Completion. As part of warranty, Installer shall perform following:
 - 1) Filling and repairing depressions and replacing plantings due to settlement of irrigation system trenches.
 - 2) Repairing faulty equipment, wiring and pipe installations.
 - 3) Repairing equipment and pipe not properly winterized.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Manufacturers:

1. Manufacturer Contact List:
 - a. 3M, Austin, TX www.3m.com/elpd.
 - b. Apollo Valves by Conbraco Industries, Matthews, NC www.apollovalves.com.
 - c. Carson by Oldcastle Enclosure Solutions, Auburn, WA www.oldcastleenclosures.com.
 - d. IPS Corporation, Compton, CA www.ipscorp.com.
 - e. Netafim, Inc. www.netafimusa.com.
 - f. Nibco Inc, Elkhart, IN www.nibco.com.
 - g. Northstar Industries, LLC, Riverside, CA www.suresplice.com.
 - h. Paige Electric, Union, NJ www.paigewire.com.
 - i. Rain Bird Sprinkler Manufacturing Corp, Glendora, CA www.rainbird.com.
 - j. T. Christy Enterprises, Inc. (Christy's), Anaheim, CA www.tchristy.com.

B. Materials:

1. Rock-Free Soil:
 - a. For use as backfill around PVC pipe.
2. Pea Gravel:
 - a. For use around drains, valves, and quick couplers.
 - b. 1/2 inch (13 mm) maximum dimension, washed rock.
3. Sand: Fine granular material naturally produced by rock disintegration and free from organic material, mica, loam, clay, and other deleterious substances. To be used as bedding of all mainlines and lateral lines.
4. Native Material: Soil native to project site free of wood and other deleterious materials and rocks over 1-1/2 inches (38 mm).
5. Topsoil:
 - a. Use soil as described in Section 32 9120, Section 32 9121, and Section 32 9122.
 - b. Achieve depths as described in Section 32 9122.
6. Pipe, Pipe Fittings, And Connections:
 - a. General:
 - 1) Pipe shall be continuously and permanently marked with Manufacturer's name, size, schedule, type, and working pressure.
 - 2) Pipe sizes shown on Contract Drawings are minimum. Larger sizes may be substituted at no additional cost to Owner.
 - b. Piping:
 - 1) Main Line: Schedule 40 PVC.
 - 2) Lateral Lines: Schedule 40 PVC.
 - c. Fittings: Same material as pipe, except where detailed otherwise.
 - d. Sleeves:
 - 1) Under Parking Area And Driveway Paving: Schedule 40 PVC Pipe.
 - 2) All Other: Class 200 PVC Pipe.
 - 3) Sleeve diameter shall be two (2) times larger than pipe installed in sleeve.
7. Sprinkler Heads:
 - a. Each type of head shall be product of single manufacturer.
 - b. Spray Heads in Lawn Areas:
 - 1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:

- a) Refer to Irrigation Schedule on plans.
- 8. Sprinkler Risers:
 - a. Spray Heads (Pre-Manufactured Swing Assemblies):
 - 1) Type Two Acceptable Products:
 - a) Hunter: SJ-512 (12 inch (305 mm) x 1/2 inch (12.7 mm)) thread) or SJ-7512 (12 inch (305 mm) x 3/4 inch (19 mm) x 1/2 inch (12.7 mm)) thread).
 - b) Rain Bird model SA125050.
 - c) Equal as approved by Architect before use. See Section 01 6200.
 - b. Spray Heads (Field Manufactured Assemblies):
 - 1) Three (3) schedule 40 street ells or Marlex street ells connected to lateral tee to form an adjustable riser or pop-up riser as detailed.
 - 2) Risers for sprinkler heads 14 inches (355 mm) long minimum and 24 inches (610 mm) maximum.
 - a) Type Two Acceptable Products:
 - (1) Hunter: FLEXsg tubing with HSBE spiral barbed fittings.
 - (2) Rainbird: Swing Pipe with barbed fittings.
 - (3) Equal as approved by Architect before installation. See Section 01 6200.
 - c. Conduit:
 - 1) Exterior applications or inside mechanical shed:
 - a) Galvanized IMC. Where in contact with earth or concrete, wrap galvanized IMC conduit and fittings completely with vinyl tape.
 - 2) In-ground: commercial grade grey conduit.
 - 3) Size conduit as follows:
 - 4) Traditional Wiring:

Galvanized IMC Conduit						
Wire Size (AWG)	Number of Wires					
14	7	13	22	32	47	67
12	6	8	18	25	38	59
Conduit Size	3/4 inch (19 mm)	1 inch (25 mm)	1 1/4 inch (32 mm)	1 1/2 inch (38 mm)	2 inch (50 mm)	2 1/2 inch (64 mm)
PVC Sch. 40 Conduit						
Wire Size (AWG)	Number of Wires					
14	6	11	20	29	43	61
12	5	7	17	23	35	54
Conduit Size	3/4 inch (19 mm)	1 inch (25 mm)	1 1/4 inch (32 mm)	1 1/2 inch (38 mm)	2 inch (50 mm)	2 1/2 inch (64 mm)
PVC Sch. 80 Conduit						
Wire Size (AWG)	Number of Wires					
14	5	9	17	24	39	55
12	4	6	14	19	32	49

Conduit Size	3/4 inch (19 mm)	1 inch (25 mm)	1 1/4 inch (32 mm)	1 1/2 inch (38 mm)	2 inch (50 mm)	2 1/2 inch (64 mm)
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9. Drip System:
 - a. Distribution Tubing (from lateral lines to emitter):
 - 1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - a) Rainbird: SPX swing pipe with barbed fittings.
 - b) Hunter: SJ Series with barbed fittings.
 - b. Drip Emitters:
 - 1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - a) Refer to Irrigation Schedule on plans.
 - c. Indicator Emitter:
 - 1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - a) Tree drip indicator:
 - (1) Rainbird: XB-10PC with barbed fittings, DBC-025 diffuser cap, TS-025 stake, and XQ 1/4 inch (6.4 mm) tubing.
 - d. Distribution Tubing (from lateral lines to in-line emitter tubing).
 - 1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - a) Flexible polyethylene pipe.
 - e. In-Line Emitter Tubing:
 - 1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - a) Netafim: Techline CV tubing.
10. Solvent Cement:
 - a. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - 1) Primer:
 - a) Meet ASTM F656 standard and applicable sections of latest edition of '*Uniform Plumbing Code*'.
 - b) Meet NSF/ANSI standard for use on potable water applications.
 - c) Low VOC emissions and compliant with LEED.
 - d) Product: Weld-On P-70 primer by IPS.
 - 2) PVC Solvent Cement:
 - a) Heavy bodied, medium setting, high strength:
 - (1) Meet ASTM D2564 standard and applicable sections of latest edition of '*Uniform Plumbing Code*'.
 - (2) Meet NSF/ANSI standard for use on potable water applications.
 - (3) Meet CSA standards for use in pressure and non-pressure potable water applications.
 - (4) Low VOC emissions and compliant with LEED.
 - (5) Product: Weld-On 711 Low VOC PVC Cement by IPS.
11. Other Components:
 - a. Weed Barrier:
 - 1) Type Two Acceptable Products:
 - b. Recommended by Manufacturer and subject to Architect's review and approval before installation.
 - c. Provide components necessary to complete system and make operational.

PART 3 - EXECUTION

3.1 INSTALLERS

- A. Approved Irrigation System Installers:
 1. Star Landscaping
 2. Schramm Landscaping
 3. Western Meadows
 4. Terrafirma
 5. Equal approved by Architect and/or Landscape Architect before bidding. See Section 01 4301.

3.2 EXAMINATION

- A. Verification Of Conditions:
1. Perform source pressure test at stub-out on main water line provided for irrigation system, or at near-by fire hydrant.
 2. Notify Architect if pressures over 70 psi (480 kPA) or under 55 psi (379 kPA) are found to determine if some re-design of system is necessary before beginning work on system.

3.3 PREPARATION

- A. Protection:
1. Protection Of In-Place Conditions:
 - a. Repair or replace work damaged during course of Work at no additional cost to Owner. If damaged work is new, installer of original work shall perform repair or replacement.
 - b. Do not cut existing tree roots measuring over 2 inches (50 mm) in diameter in order to install irrigation lines.
- B. Surface Preparation:
1. Layout of Irrigation Heads:
 - a. Location of heads and piping shown on Contract Drawings is approximate. Actual placement may vary slightly as is required to achieve full, even coverage without spraying onto buildings, sidewalks, fences, etc.
 - b. During layout, consult with Architect to verify proper placement and make recommendations, where revisions are advisable.
 - c. Minor adjustments in system layout will be permitted to avoid existing fixed obstructions.
 - d. Make certain changes from Contract Documents are shown on Record Drawings.

3.4 INSTALLATION

- A. Trenching And Backfilling:
1. Pulling of pipe is not permitted.
 2. Excavate trenches to specified depth. Remove rocks larger than 1-1/2 inch (38 mm) in any direction from bottom of trench. Separate out rocks larger than 1-1/2 inch (38 mm) in any direction uncovered in trenching operation from excavated material and remove from areas to receive landscaping.
 3. Cover pipe both top and sides with 2 inches (50 mm) of sand as specified under PART 2 PRODUCTS. Remainder of backfill to topsoil depth as specified in Section 32 9122 using native material as specified under PART 2 PRODUCTS and topsoil as specified in Section 32 9120, Section 32 9121 and Section 32 9122.
 4. Do not cover pressure main, irrigation pipe, or fittings until Architect has inspected and approved system.
- B. Sleeving:
1. Sleeve water lines and control wires under walks and paving. Extend sleeves 6 inches (150 mm) minimum beyond walk or pavement edge. Cover sleeve ends until pipes and wires are installed to keep sleeve clean and free of dirt and debris.
 2. Position sleeves with respect to buildings and other obstructions so pipe can be easily removed.
- C. Grades And Draining:
1. In localities where winterization is required, grade piping so system can be completely drained or blown out with compressed air. If system is not designed to be blown out with compressed air:
 - a. Slope pipe to drain to control valve box where possible.
 - b. Slope pipes under parking areas or driveways to drain outside these areas.
- D. Installation of Pipe:
1. Install pipe in manner to provide for expansion and contraction as recommended by Manufacturer.

2. Unless otherwise indicated on Contract Drawings, install main lines with minimum cover of 18 inches (450 mm) based on finished grade. Install lateral lines, including those connecting drip tubing, with minimum of 12 inches (300 mm) of cover based on finish grade.
 3. Install pipe and wires under driveways or parking areas in specified sleeves 18 inches (450 mm) below finish grade or as shown on Contract Drawings.
 4. Locate pipe so no sprinkler head will be closer than 12 inches (300 mm) from building foundation.
 5. Cut plastic pipe square. Remove burrs at cut ends before installation so unobstructed flow will result.
 6. Make solvent weld joints as follows:
 - a. Do not make solvent weld joints if ambient temperature is below 35 deg F (2 deg C).
 - b. Clean mating pipe and fitting with clean, dry cloth and apply one (1) coat of primer to each surface.
 - c. Apply uniform coat of solvent cement to outside of pipe.
 - d. Apply solvent cement to fitting in similar manner.
 - e. Insert pipe completely into fitting.
 - f. Give pipe or fitting quarter turn to insure even distribution of solvent and make sure pipe is inserted to full depth of fitting socket.
 - g. Allow joints to set at least twenty-four (24) hours before applying pressure to PVC pipe.
 7. Tape threaded connections with teflon tape.
 8. If pipe is larger than 3 inches (75 mm), install joint restraints wherever change of direction occurs on PVC main lines.
- E. Sprinkler Heads:
1. Set sprinkler heads perpendicular to finish grade.
 2. Do not install sprinklers using side inlets. Install using base inlets only.
 3. Heads immediately adjacent to mow strips, walks, or curbs shall be one inch (25 mm) below top of mow strip, walk, or curb and have one inch (25 mm) to 3 inch (75 mm) clearance between head and mow strip, walk, or curb.
 4. Set sprinkler heads at consistent distance from walks, curbs, and other paved areas and to grade by using specified components or other method demonstrated in Pre-Construction Conference.
- F. Drip Assembly:
1. Install pipe providing for expansion and contraction as recommended by Manufacturer.
 2. Cut tubing square and remove burrs at cut ends.
 3. Distribution tubing shall be between 14 inches (350 mm) minimum and 48 inches (1 200 mm) maximum long. Layout PVC lateral lines as necessary to keep distribution tubing lengths within specified tolerances.
 4. Locate drip emitter on uphill side of plant within rootball zone.
 5. Layout in-line tubing for trees as indicated on Contract Drawings. Layout in-line tubing for shrubs and groundcovers so plants receive water within rootball zones.
 6. Locate in-line tubing on top of soil but under bark/rock mulch and weed barrier fabric.
 7. Staple in-line tubing to ground at 3 foot (900 mm) to 5 foot (1 500 mm) maximum intervals (sand = 3 foot (900 mm), loam = 4 foot (1 200 mm), clay = 5 foot (1 500 mm) and within 12 inches (300 mm) of ends and intersections.
 8. Assembly Using Solvent Weld Joints:
 - a. Do not make solvent weld joint if ambient temperature is below 35 deg F (2 deg C).
 - b. Clean mating pipe and fitting with clean, dry cloth.
 - c. Apply uniform coat of PVC solvent cement to outside of pipe and inside socket of fitting.
 - d. Insert pipe completely into fitting.
 - e. Give pipe or fitting quarter turn to insure even distribution of solvent and make sure pipe is inserted to full depth of fitting socket.
 - f. Allow joints to set twenty-four (24) hours minimum before applying pressure to pipe.
 9. Assembly Using 'Funny Pipe' Type Joints:
 - a. Connect distribution tubing to lateral line using barbed ell fitting.
 - b. Connect fitting to distribution tubing using straight barbed fitting with 1/2 inch (13 mm) threaded end.

3.5 FIELD QUALITY CONTROL

- A. Field Tests and Inspections:
 - 1. Substantial Completion Walkthrough:
 - a. Landscape Architect or designated representative(s) will inspect site and create list of non-conforming items to be resolved prior to Landscape Final Acceptance. Date on this list will act as date of Landscape Substantial Completion.
 - b. Installations completed after water source has been turned off for season, as determined by Landscape Architect, will be inspected following spring after system can be checked for proper operation.
 - 2. Irrigation Approval:
 - a. Irrigation will be approved when all non-conforming work is brought into conformance.
- B. Non-Conforming Work: Non-conforming work as covered in General Conditions applies, but is not limited to following:
 - 1. Underground Sprinkler System:
 - a. Correct any work found defective or not complying with Contract Document requirements at no additional cost to Owner.

3.6 ADJUSTING

- A. Sprinkler Heads:
 - 1. Adjust sprinkler heads to proper grade when turf is sufficiently established to allow walking on it without appreciable harm. Such lowering and raising of sprinkler heads shall be part of original contract with no additional cost to Owner.
 - 2. Adjust sprinkler heads for proper distribution and trim so spray does not fall on building.
- B. Watering Time:
 - 1. Adjust watering time of valves to provide proper amounts of water to plants.

3.7 CLOSEOUT ACTIVITIES

- A. Training:
 - 1. After system is installed and approved, instruct Owner's designated personnel in complete operation and maintenance procedures using Landscape Management Plan (LMP).
 - a. Describe difference between plant establishment schedule and long-term maintenance schedule.

END OF SECTION

SECTION 32 9001**COMMON PLANTING REQUIREMENTS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
1. Common procedures and requirements for landscaping work.
 2. Provide maintenance for new landscaping as described in Contract Documents.
- B. Related Requirements:
1. Pre-Installation conferences held jointly with Section 32 9001 as described in Administrative Requirements on Part 1 of this specification section:
 2. Section 01 4301: 'Quality Assurance – Qualifications'.
 3. Section 31 0501: 'Common Earthwork Requirements'.
 4. Section 31 1100: 'Clearing and Grubbing'.
 5. Section 31 1413: 'Topsoil Stripping And Stockpiling'.
 6. Section 31 2213: 'Rough Grading'.
 7. Section 31 2216: 'Fine Grading'.
 8. Section 31 2316: 'Excavation'.
 9. Section 31 2323: 'Fill'.
 10. Section 32 8423: 'Underground Sprinklers'.
 11. Section 32 9120: 'Topsoil And Placement'.
 12. Section 32 9122: 'Topsoil Grading'.
 13. Section 32 9223: 'Sodding'.
 14. Section 32 9300: 'Plants'.
 15. Section 32 9413: 'Landscape Edging'.

1.2 REFERENCES

- A. Definitions:
1. Landscape Management Plan (LMP): LMP is an Owner's Representative's quick reference maintenance document. It is a combination of Irrigation Sections from 32 8000 and Planting Sections from 32 9000. The LMP document is created from Operations and Maintenance Data, Warranty Documentation, and Record Documentation
 2. Landscape Final Acceptance: Inspection, no less than (30) days following substantial completion, when all work has been completed, demonstrated, and approved by the Landscape Architect. Coordinate with Sections 32 8423 and Sections under 32 9000 'Planting'.
 3. Plant Establishment Period: Time required for plants to successfully develop root systems into surrounding soil. Following this period, irrigation run times are typically modified. For purposes of this contract, the plant establishment period is assumed to be one (1) year from date of Substantial Completion.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Conference:
1. Participate in MANDATORY pre-installation conference and held jointly with following sections:
 - a. Section 32 8423: 'Underground Sprinklers'.
 - b. Section 32 9120: 'Topsoil And Placement'.
 - c. Section 32 9122: 'Topsoil Grading'.
 - d. Section 32 9223: 'Sodding'.
 - e. Section 32 9300: 'Plants'.

2. In addition to agenda items specified in Section 01 3100, review the following:
 - a. Site Visits:
 - 1) Landscape Architect to visit site two (2) times during project construction.
 - 2) If site conditions necessitate additional visits, Landscape Architect can schedule additional site visits with approval from Architect prior to bid.
 - 3) During construction, additional site visits may be approved in writing by Architect or Owner for special considerations before commencement.
 - 4) Site visits caused by lack of work progress by Landscape Subcontractor shall reimburse Landscape Architect amount determined by Architect or Owner for additional site visits.
 - b. Coordination:
 - 1) Landscape Subcontractor and Landscape Architect to coordinate site visits and include Architect and General Contractor in communications.
 - c. Landscape Maintenance:
 - 1) Establish responsibility for maintenance of new landscaping during all phases of construction period.
 - d. Percolation Test:
 - 1) Prepare two (2) typical landscape planting excavations and conduct percolation test to verify that water drains away within two (2) hours.
 - 2) Discuss results of percolation tests with Architect and Owner's Representative.
 - e. Review additional agenda items as specified in related sections listed above.
3. Approved Site Visits:
 - a. Site Visit No. 1:
 - 1) Description:
 - a) Landscape pre-installation Conference.
 - 2) Schedule: Conduct pre-installation conference after completion of Fine Grading specified in Section 31 2216, but one (1) week minimum before beginning landscape work.
 - 3) Required Attendees:
 - a) Project Manager, Facilities Manager, Architect, General Contractor, Landscape Subcontractor, Excavator, and Landscape Architect.
 - b) Include Landscaping Subcontractor Foreman and those responsible for installation of landscaping to be in attendance.
 - 4) Related Sections:
 - a) Section 31 0501: 'Common Earthwork Requirements'.
 - b) Section 32 8423: 'Underground Sprinklers'.
 - c) Section 32 9120: 'Topsoil And Placement'.
 - d) Section 32 9121: 'Topsoil Physical Preparation' (section included based on Topsoil Testing Report).
 - e) Section 32 9122: 'Topsoil Grading'.
 - f) Section 32 9219: 'Seeding'.
 - g) Section 32 9223: 'Sodding'.
 - h) Section 32 9300: 'Plants'.
 - 5) Notes:
 - a) Verify project site conditions and review scope of work before installation begins.
 - b) Verify appropriate sub-grades have been established.
 - 6) Description:
 - a) Irrigation system pressure test compliance, main line inspection, valve inspection.
 - 7) Schedule: Conduct site visit one (1) week minimum after notification before beginning irrigation system pressure test.
 - 8) Required Attendees:
 - a) General Contractor, Landscape Subcontractor, Landscape Architect.
 - 9) Recommended Attendees:
 - a) Project Manager, Facilities Manager.
 - 10) Related Sections:
 - a) Section 32 8423: 'Underground Sprinklers'.
 - b) Section 32 9120: 'Topsoil And Placement'.
 - c) Section 32 9122: 'Topsoil Grading'.
 - 11) Notes:
 - a) Verify finish grading in preparation for planting.
 - b. Site Visit No. 2:
 - 1) Description:

- a) Comprehensive Substantial Completion inspection prior to beginning thirty (30) day Landscape Subcontractor maintenance period.
- 2) Required Attendees:
 - a) Project Manager, Facilities Manager, Architect, General Contractor, Landscape Subcontractor, Landscape Architect.
- 3) Related Sections:
 - a) Section 32 8423: 'Underground Sprinklers'.
 - b) Section 32 9300: 'Plants'.
- 4) Notes:
 - a) Verify contract requirements have been followed including but not limited to: planting compliance, irrigation system coverage and irrigation system operation.

1.4 SUBMITTALS

A. Informational Submittals:

- 1. Certificates:
 - a. Landscape Architect will provide certificate acknowledging 'Plant Establishment Period' commencement:
 - 1) Certificate will include name and signature of Contractor, Contractor's company, Contractor's telephone number, and date.
 - 2) Certificate will include name and signature of Owner's Representative, Owner's Representative's Group name, Owner's Representative Group telephone number, and date.
 - 3) Certificate will acknowledge date when Establishment Period begins and that it extends one (1) year from that time.
- 2. Special Procedure Submittals:
 - a. Installer to provide two (2) copies of following recommendations to be included in Closeout Submittals:
 - 1) Landscape maintenance recommendations.
 - 2) Individual landscape maintenance recommendations.
 - 3) Plant establishment maintenance recommendations.
 - 4) Post-plant establishment maintenance recommendations.
- 3. Qualification Statement:
 - a. Landscape Subcontractor:
 - 1) Provide Qualification documentation if requested by Landscape Architect or Owner.
 - b. Installer:
 - 1) Provide Qualification documentation if requested by Landscape Architect or Owner.

B. Closeout Submittals:

- 1. Include following in Operations And Maintenance Manual specified in Section 01 7800 (combine with sections of 32 8000 and sections of 32 9000 if applicable):
 - a. Record Documentation:
 - 1) Submit one (1) copy certificate for 'Plant Establishment Period' acknowledgement.
 - 2) Submit one (1) copy of recommendations specified in Special Procedure Submittals.
 - 3) Record Drawings:
 - a) As installation occurs, prepare accurate record drawings. Submit one (1) full size copy prior to final inspection. Drawing shall include:
 - (1) Detail and dimension changes made during construction.
 - (2) Take dimensions from permanent constructed surfaces or edges located at or above finish grade.
 - b. Landscape Management Plan (LMP):
 - 1) Landscape Section:
 - a) Submit one (1) copy certificate for 'Plant Establishment Period' acknowledgement.
 - b) Submit one (1) copy of recommendations specified in Special Procedure Submittals.

1.5 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
 - 1. Herbicides:
 - a. Products shall be recognized for intended use by AHJ.
 - 2. Invasive and Non-native plants:
 - a. Comply with all applicable laws governing invasive and non-native plants.

- B. Qualifications:
 - 1. Landscape Subcontractor. Requirements of Section 01 4301 applies, but not limited to following:
 - a. Company specializing in performing work of this section.
 - b. Minimum five (5) years' experience in landscaping installations.
 - c. Minimum five (5) satisfactorily completed installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
 - d. Upon request, submit documentation.
 - 2. Installer:
 - a. Planting shall be performed under direction of foreman or supervisor with minimum three (3) years' experience in landscape installations similar in size, scope, and complexity.
 - b. Foreman or supervisor required to attend pre-installation conference.
 - c. Use trained personnel familiar with required planting procedures and with Contract Documents.
 - d. Upon request, submit documentation.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Storage And Handling Requirements:
 - 1. Deliver packaged materials in containers showing weight, analysis, and name of Manufacturer.
 - 2. Deliver sod, plants, and shrubs in healthy and vigorous condition.
 - 3. Protect materials from deterioration during delivery.

- B. Storage And Handling Requirements:
 - 1. Store in location on site where they will not be endangered and where they can be adequately watered and kept in healthy and vigorous condition.
 - 2. Protect materials from deterioration while stored at site.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 INSTALLERS

- A. Acceptable Installers:
 - 1. Star Landscaping.
 - 2. Schramm Landscaping.
 - 3. Western Meadows
 - 4. Terrafirma.
 - 5. Equal approved by Architect and / or Landscape Architect before bidding. See Section 01 4301.

- B. Verification Of Conditions:
 - 1. Inspect site and Contract Documents to become thoroughly acquainted with locations of irrigation, ground lighting, and utilities.

3.2 PREPARATION

- A. Before proceeding with work, verify dimensions and quantities. Report variations between Drawings and site to Architect before proceeding with landscape work.
 - 1. Plant totals are for convenience of Contractor only and are not guaranteed. Verify amounts shown on Drawings.
 - 2. All planting indicated on Contract Documents is required unless indicated otherwise.
- B. Protection:
 - 1. Take care in performing landscaping work to avoid conditions that will create hazards. Post signs or barriers as required.
 - 2. Provide adequate means for protection from damage through excessive erosion, flooding, heavy rains, etc. Repair or replace damaged areas.
 - 3. Keep site well drained and landscape excavations dry.

3.3 INSTALLATION

- A. Interface With Other Work:
 - 1. Do not plant shrubs until major construction operations are completed. Do not commence landscaping work until work of Section 31 2216 and Section 32 8423 has been completed and approved.
- B. Coordinate installation of planting materials during normal planting seasons for each type of plant material required.
- C. Hand excavate as required.
- D. Maintain grade stakes until parties concerned mutually agree upon removal.
- E. When conditions detrimental to plant growth are encountered, such as rubble fill or adverse drainage conditions, notify Architect before planting.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection:
 - 1. Landscape Architect will inspect landscaping installation for Substantial Completion.
- B. Non-Conforming Work. Non-conforming work as covered in the General Conditions applies, but is not limited to the following:
 - 1. Replace damaged plantings within (10) days of notification at no additional cost to Owner.
 - 2. Repair damage to irrigation, ground lighting, utilities, paving, concrete curb and gutters and other items adjacent to landscaping caused by work of this Section or replace at no additional cost to Owner.

3.5 CLEANING

- A. Waste Management:
 - 1. Immediately clean up soil or debris spilled onto pavement and dispose of deleterious materials.

3.6 CLOSEOUT ACTIVITIES

- A. Instruction to Owner:
 - 1. Include following training:
 - a. Review Landscape Management Plan (LMP):
 - 1) Review maintenance recommendations.
 - b. Review Maintenance as specified at the end of this specification.

2. Establishment Period Acknowledgement (coordinate with 32 8000 section):
 - a. Landscape Architect will acknowledge Establishment Period commencement.

3.7 PROTECTION

- A. Protect planted areas against traffic or other use immediately after planting is completed by placing adequate warning signs and barricades.
- B. Provide adequate protection of planted areas against trespassing, erosion, and damage of any kind. Remove this protection after Architect has accepted planted areas.

3.8 MAINTENANCE

- A. General:
 1. Before beginning maintenance period, plants shall be in at least as sound, healthy, vigorous, and in approved condition as when delivered to site, unless accepted by Architect in writing at final landscape inspection.
 2. Maintain landscaping for thirty (30) continuous days minimum after Substantial Completion. If maintenance period is interrupted by non-growing season or irrigation winter shut-down, begin maintenance period after start of growing season as agreed with Architect, and continue one (1) continuous month therefrom.
 3. Replace landscaping that is dead or appears unhealthy or non-vigorous as directed by Architect before end of maintenance period. Make replacements within ten (10) days of notification. Lawn being replaced shall be guaranteed and maintained an additional thirty (30) days from date of replacement.
- B. Sodded Lawn:
 1. Maintain sodded lawn areas until lawn complies with specified requirements and throughout maintenance period.
 2. Water sodded areas in sufficient quantities and at required frequency to maintain sub-soil immediately under sod continuously moist 3 to 4 inches (75 to 100 mm) deep.
 3. Cut grass first time when it reaches 3 inches (75 mm) high. Continue to mow at least once each week throughout maintenance period. Remove clippings.
 4. Apply herbicide as necessary to maintain weed-free lawn. Apply herbicide in accordance with manufacturer's instructions during calm weather when air temperature is between 50 and 80 deg F (10 and 27 deg C).
 5. At end of thirty (30) day maintenance period, fertilize lawns as recommended in Section 32 9122.
- C. Shrubs, And Plants:
 1. Maintain by pruning, cultivating, and weeding as required for healthy growth.
 2. Restore planting basins.
 3. Reset shrubs to proper grades or vertical positions as required.
 4. Spray as required to keep new shrubs free of insects and disease.
 5. Provide supplemental water by hand as needed in addition to water from sprinkling system.

END OF SECTION

SECTION 32 9120**TOPSOIL AND PLACEMENT****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
 - 1. Perform topsoil evaluation and placement required prior to topsoil grading as described in Contract Documents.
- B. Related Requirements:
 - 1. Section 31 0501: 'Common Earthwork Requirements':
 - 2. Section 31 1413: 'Topsoil Stripping And Stockpiling' for stripping and storing of existing topsoil.
 - 3. Section 31 2216: 'Fine Grading' for landscaping and planting areas.
 - 4. Section 32 9001: 'Common Planting Requirements':
 - a. Pre-installation conference held jointly with other common planting related sections.
 - 5. Section 32 9121: 'Topsoil Physical Preparation' for physical preparation of topsoil (section included based on Topsoil Testing Report).
 - 6. Section 32 9122: 'Topsoil Grading' for preparation of topsoil and addition of amendments prior to landscaping.

1.2 REFERENCES

- A. Reference Standards:
 - 1. ASTM International:
 - a. ASTM D1557-12, 'Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))'.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Conference:
 - 1. Participate in MANDATORY pre-installation conference as specified in Section 32 9001.
 - 2. In addition to agenda items specified in Section 01 3100 and Section 32 9001, review following:
 - a. Review finish grade elevation and tolerance requirements.
 - b. Review surface preparation requirements including disking, tilling, ripping, or aerating.
 - c. Review Attachment 'Topsoil Testing Report' including:
 - 1) Landscape Architect, Contractor, Testing, and Soil Testing Laboratory Instructions.
 - d. Review Field Quality Control testing requirements for 'Topsoil Testing Report' including:
 - 1) Corrections required for topsoil not meeting requirements of this specification.
 - 2) Approval requirement of 'Topsoil Testing Report' by Landscape Architect.
 - 3) Submittals required as identified in Closeout Submittals.

1.4 SUBMITTALS

- A. Informational Submittals:
 - 1. Testing And Evaluation Reports:
 - a. Use 'Topsoil Testing Report' attachment to this specification for Topsoil Testing as specified in 'Field Quality Control' in Part 3 of this specification for imported and site topsoil and account of recent use:
 - 1) Owner will pay for one (1) final test.

- 2) Additional test(s) if necessary will be paid by Contractor.
 - 3) Submit two (2) copies of Final 'Topsoil Testing Report' approved by Landscape Architect to be included with Closeout Submittals.
2. Field Quality Control Submittals:
- a. Submit report stating location of source of imported topsoil and account of recent use.
 - b. Submit delivery slips indicating amount of physical amendments delivered to Project site.
- B. Closeout Submittals:
1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
 - a. Record Documentation:
 - 1) Submit one (1) copy Final approved 'Topsoil Testing Report'.
 - 2) Provide report stating location of source of imported topsoil and account of recent use.
 - b. Landscape Management Plan (LMP):
 - 1) Landscape Section:
 - a) Submit one (1) copy in LMP Landscape Section Final approved 'Topsoil Testing Report'.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Topsoil:
1. Design Criteria:
 - a. Topsoil used in landscaped areas shall be weed free, fertile, loose, friable soil meeting following criteria:
 - 1) Chemical Characteristics:
 - a) pH 5.5 to 8.0.
 - b) Soluble Salts: less than 3.0 mmhos/cm.
 - c) Sodium Absorption Ratio (SAR): less than 6.0.
 - d) Organic Matter: greater than one percent.
 - 2) Physical Characteristics:
 - a) Gradation as defined by USDA triangle of physical characteristics as measured by hydrometer.
 - (1) Sand: 15 to 60 percent.
 - (2) Silt: 10 to 60 percent.
 - (3) Clay: 5 to 30 percent.
 - b) Clean and free from toxic minerals and chemicals, noxious weeds, rocks larger than or equal to 1-1/2 inch (38 mm) in any dimension, and other objectionable materials.
 - c) Soil (Coordinate screening as specified in Section 31 1413 'Topsoil Stripping And Stockpiling' to meet these characteristics):
 - (1) Soil shall not contain more than five (5) percent by volume of rocks measuring over 1/4 inch (6 mm) in largest size.
 - (2) Soil shall be topsoil in nature.
 - (3) Soil resembling road base or other like materials are not acceptable.
 2. Project Topsoil Requirements:
 - a. It is anticipated that following percentages of material will be required to meet topsoil requirements of Project site:
 - 1) Imported Topsoil: 100 percent of new landscape area:

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification Of Conditions:

1. Do not commence work of this Section until grading tolerances specified in Section 31 2216 are met.
2. Do not commence work of this Section until coordination with Section 32 9121 'Physical Preparation' and Section 32 9122 'Topsoil Grading' and if required by these specifications prior to placement.
3. Receive approval from Landscape Architect of subgrade elevations prior to commencement of this Work.

3.2 PREPARATION

- A. Protection Of In-Place Conditions:
1. Protect utilities and site elements from damage.
- B. Surface Preparation:
1. Surfaces to receive Imported and Stockpiled Topsoil:
 - a. Disk, till, rip, or aerate with approved agricultural aerator to depth of 6 inches (150 mm).
 - b. Place specified and approved topsoil on prepared surface.

3.3 PERFORMANCE

- A. General:
1. After Surface Preparation requirements are completed, limit use of heavy equipment to areas no closer than 6 feet (1.80 meter) from building or other permanent structures. Use hand held tillers for preparation of subsoil in areas closer than 6 feet (1.80 m).
 2. Do not expose or damage existing shrub or tree roots.
- B. Topsoil Depth/Quantity:
1. Total topsoil (existing / in-place) depth of 12 inches minimum in new lawn planting areas.
 2. Total topsoil (imported) depth of 12 inches is required over entire new shrub planting areas.
 3. Provide no less than quantity required to achieve tolerance described in Section 32 9122 'Topsoil Grading' along with additional soil amendments required in Section 32 9121 'Topsoil Physical Preparation' and in Section 32 9122 'Topsoil Grading'. Installer of this section responsible for providing sufficient topsoil material.
- C. Imported Topsoil:
1. Place tested and approved topsoil:
 - a. Before placing topsoil, remove organic material, rocks and clods greater than 1-1/2 inch (38 mm) in any dimension, and other objectionable materials.
 - b. Do not place topsoil whose moisture content makes it prone to compaction during placement process.
 - c. Do not place topsoil when subgrade is either wet or frozen enough to cause clodding.
- D. In Place Topsoil:
1. At locations where topsoil can remain in place and has been tested and approved, perform the following:
 - a. Remove existing vegetation as required in preparation for new landscaping.
 - b. Remove vegetative layer, roots, organic material, rocks and clods greater than 1-1/2 inch (38 mm) in any dimension, and other objectionable materials.
- E. Grading:
1. Slope grade away from building for 12 feet (3.60 m) minimum from walls at slope of 1/2 inch in 12 inches (13 mm in 300 mm) minimum unless otherwise noted.
 - a. High point of finish grade at building foundation shall be 6 inches (150 mm) minimum below finish floor level.
 - b. Direct surface drainage in manner indicated on Contract Documents by molding surface to facilitate natural run-off of water.
 - c. Fill low spots and pockets with topsoil and grade to drain properly.

3.4 FIELD QUALITY CONTROL

A. Testing And Inspections:

1. Topsoil Testing:

- a. Test topsoil for project suitability using Owner supplied 'Topsoil Testing Report,' attachment to this specification:
 - 1) Testing requirements:
 - a) If testing report shows topsoil does not meet topsoil Design Criteria and 'Topsoil Testing Report: Soil Test Data' requirements, topsoil is non-conforming. Corrections and re-testing are required until topsoil meets requirements.
 - b) Use new 'Topsoil Testing Report', each time topsoil is tested.
 - c) After topsoil testing is approved by Landscape Architect, submit two (2) copies of Final 'Topsoil Testing Report as specified in Part 1 'Submittals' of this specification.

B. Non-Conforming Work:

1. If topsoil does not meet topsoil Design Criteria and 'Topsoil Testing Report: Soil Test Data' requirements topsoil will be re-tested at no cost to Owner.

a. Correction procedures:

- 1) Topsoil not meeting specified physical characteristics of sand, silt, and clay shall be removed from site.
 - 2) Topsoil not meeting specified organic or fertility specifications may be amended in place with materials recommended in Topsoil Testing Report.
 - 3) If amendments are necessary, submit proposed amendments and application rates required to bring topsoil up to minimum specified requirements.
 - 4) Re-test topsoil and remove and amend as required until it meets minimum specified requirements.
- b. Submit report to Landscape Architect for approval.
 - c. Receive approval from Landscape Architect prior to planting.

END OF SECTION

ATTACHMENTS

Topsoil Testing Report

Project	Name	Property Number	
	Site Street Address, City, State/Province		
Person Submitting Test	Name	Date Requested	Phone
	Address, City, State/Province		Fax
Soil Testing Laboratory	Name	Date Submitted	Phone
	Address, City, State/Province		Fax

General

- Owner will pay for pre-bid testing and one (1) final topsoil test.

Landscape Architect Instructions

- Landscape Architect shall determine by investigation quality and quantity of topsoil on site before landscape design. Add physical and fertility recommendations from laboratory recommendations to relevant Church specifications.

Contractor Instructions

- Test installed topsoil. Installed topsoil shall comply with Project Specifications.
- If installed topsoil does not comply, Contractor will enhance and test at no cost to Owner until installed topsoil complies with Project Specifications.

Testing Instructions

- Collect at least two (2) samples of on-site topsoil and each anticipated topsoil source. If site soil profile or borrow pit are not uniform, additional samples shall be taken. Uniform composite samples may also be used if properly acquired and documented.
- Submit required soil samples to soil testing laboratory along with all required (for this report and laboratory) information.

Soil Testing Laboratory Instructions

- This report must be completely filled out and provide soil interpretation and amendment, fertilizer, and soil conditioner recommendations for use by Landscape Architect. These recommendations should consider lawn areas, tree and shrub areas, and native plant areas.
- Provide appropriate times for fertilizing.
- Return completed Topsoil Testing Report to person submitting the test.

SOIL SAMPLE LOG		
Soil Sample No.	Description of location where sample was taken	History of use of the soil

Existing Conditions Test Report (“Acceptable Levels” refers to the allowable soil specifications prior to being amended)

SOIL TEST DATA												
Sample No.	pH ⁽¹⁾	EC ⁽¹⁾ Mmhos/cm	SAR ⁽¹⁾	% Sand	% Silt	% Clay	Text ⁽²⁾ Class	% ⁽³⁾ OM	NO3-N ⁽⁴⁾ ppm	P ⁽⁵⁾ ppm	K ⁽⁵⁾ ppm	Fe ⁽⁵⁾ Ppm
Acceptable Level(s)	5.5 - 8.4	<3.0	<6.0	15-60	10-60	5-30	(2)	>1.0	>20	>11	>130	>10

⁽¹⁾ Saturated soil paste 1:1 soil:water method (please Indicate)

⁽²⁾ Hydrometer method (Acceptable soil- sand:15-60 percent, silt:10-60 percent, clay-5-30 percent)

⁽³⁾ Potassium dichromate method (Walkey-Black) or loss of ignition

⁽⁴⁾ Chromotropic acid method

⁽⁵⁾ AB-DTPA method

If other methods are used for NO3-N, P, K, and Fe, then note.

ROCKS (Coarse Fragments)		
Sample No.	Percent > 1/4 inch (6.4 mm)	Rocks Present ≥ 1.5 inch (38 mm) Indicate as present or not present
	percent	
	percent	
Acceptable Level	≤ 5.0 percent	< 1.5 inch (38 mm)

Landscape Area Description

Lawn Areas: Receive 5 inch (125 mm) topsoil plus recommended amendments and fertilizers.

Shrub/Tree Areas: Unless otherwise indicated, plant pits are to be backfilled with three (3) parts native soil and one part compost or other recommended amendments. Additionally, contractor will add recommended fertilizer.

Native Grass/Shrub/Tree Areas: Planting to receive minimum recommended amendments and fertilizers for establishment.

INFILTRATION RATE	
Documented Infiltration rate of test sample(s) based on texture at 90 percent relative density (to nearest 1/10th of an inch)	
Sample No.	Rate
	Inches/Hour
	Inches/Hour

Interpretation Summary of Test Results:

Soil Amendments, Fertilizer and Soil Conditioner – Recommendations:

Lawn Areas

Shrub/Tree Areas

Native Grass/Shrub/Tree Areas

Long Term (5 Year) Fertilizer and Soil Conditioner – Recommendations:

Lawn Areas

Shrub/Tree Areas

Native Grass/Shrub/Tree Areas

SECTION 32 9122**TOPSOIL GRADING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
 - 1. Perform topsoil grading required to prepare site for installation of landscaping as described in Contract Documents.
 - 2. Perform topsoil placement and finish grading work required to prepare site for installation of landscaping as described in Contract Documents.
 - 3. Furnish and apply soil amendments as described in Contract Documents.

- B. Related Requirements:
 - 1. Section 31 0501: 'Common Earthwork Requirements':
 - 2. Section 31 1413: 'Topsoil Stripping And Stockpiling' for stripping and storing of existing topsoil.
 - 3. Section 31 2216: 'Fine Grading' for landscaping and planting areas.
 - 4. Section 32 9001: 'Common Planting Requirements':
 - a. Pre-installation conference held jointly with other common planting related sections.
 - 5. Section 32 9120: 'Topsoil And Placement' for topsoil evaluation and placement required for topsoil grading.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Conference:
 - 1. Participate in MANDATORY pre-installation conference as specified in Section 32 9001.
 - 2. In addition to agenda items specified in Section 01 3100, review the following:
 - a. Review compost requirements to be within acceptable range as per Attachment 'Compost Quality Guidelines For Landscaping' and 'Compost Verification Report' in this specification.
 - b. Review soil fertility amendments and fertilizer requirements as per Attachment 'Topsoil Testing Report' in Section 32 9120.

1.3 SUBMITTALS

- A. Action Submittals:
 - 1. Material Data:
 - a. Soil Amendments and Fertilizer:
 - 1) Product literature and chemical / nutrient analysis of soil amendments and fertilizers.
 - 2) Proposed application rates necessary to bring topsoil up to specified requirements.
 - 3) Source location of products.
 - 4) Submit to Landscape Architect for approval prior to installation.
 - 2. Samples:
 - a. Soil Fertility Amendments and Fertilizer:
 - 1) Soil conditioner sample for approval before delivery to site.
 - 2) Product analysis.

- B. Informational Submittals:
 - 1. Testing And Evaluation Reports:
 - a. 'Compost Verification Report':
 - 1) Provide signed copy certifying that compost meets requirements of this specification.
 - 2. Field Quality Control Submittals:

- a. Soil Fertility Amendments and Fertilizer:
 - 1) Delivery slips indicating amount of soil amendments, compost, conditioner, and fertilizer delivered to Project site.
- C. Closeout Submittals:
 - 1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
 - a. Record Documentation:
 - 1) Submit 'Compost Verification Report'.
 - 2) Submit delivery slips indicating amount of physical amendments delivered to Project site.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Soil Amendments:
 - 1. Incorporate following soil amendments into topsoil used for Project:
 - a. Acceptable Soil Amendments, Soil Conditioners, And Application Rates.
 - 1) 'Soil Pep' from Miller Companies, Hyrum, Utah: 5 cu yds / 1000 s.f. in lawn areas only. Other than the specified backfill in shrub plantings, no other conditioner is required.
 - 2) In addition to required Soil Pep, contractor to install Gro-Power Plus at label rates.
 - 3) Equals as approved by Architect before use. See Section 01 6200.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification Of Conditions:
 - 1. Do not commence work of this Section until imported topsoil is placed as specified in Section 32 9120 'Topsoil And Placement'.

3.2 PREPARATION

- A. Protection Of In-Place Conditions:
 - 1. Protect utilities and site elements from damage.
- B. Surface Preparation:
 - 1. Surfaces that meet specified topsoil elevations.
 - a. Seven (7) days maximum before beginning seeding and planting:
 - 1) Loosen topsoil 6 inch (150 mm) deep, dampen thoroughly, and cultivate to properly break up clods and lumps.
 - 2) Rake area to remove clods, rocks, weeds, roots, debris or other material 1-1/2 inches (38 mm) or more in any dimension.
 - 3) Grade and shape landscape area to bring surface to true uniform planes free from irregularities and to provide drainage and proper slope to catch basins.
 - 2. Addition of Soil Amendments:
 - a. Add specified soil amendments at specified rates to topsoil as directed by Topsoil Testing Report found in Section 32 9120 'Topsoil And Placement'.
 - b. Add specified fertilizers at specified rates into topsoil as directed by Soil Testing Laboratory.
 - c. Roto-till or otherwise mix soil amendments evenly into topsoil.

3.3 PERFORMANCE

- A. General:
 - 1. Limit use of heavy equipment to areas no closer than 6 feet (1.80 meter) from building or other permanent structures. Use hand held tillers for preparation of subsoil in areas closer than 6 feet (1.80 m).
 - 2. Do not expose or damage existing shrub or tree roots.
- B. Finish Grade Tolerances (As shown on General Planting Details in Contract Documents):
 - 1. Finish topsoil grade of planting areas before planting and after addition of soil additives shall be specified distances below top of adjacent pavement of any kind:
 - a. Sodded Areas: 2 inches (50 mm) below.
 - b. Tree and Shrub Areas (not individual trees): 4 inches (100 mm) below.
- C. Placed Topsoil:
 - 1. At locations where topsoil has been placed as per Section 32 9120 'Topsoil And Placement', perform the following:
 - a. Remove existing vegetation as required in preparation for new landscaping.
 - b. Remove organic material, rocks and clods greater than 1-1/2 inch (38 mm) in any dimension, and other objectionable materials.
- D. Grading:
 - 1. Coordinate grading as described in Section 32 9120 'Topsoil And Placement'.
- E. Immediately before planting lawn and with topsoil in semi-dry condition, roll areas that are to receive lawn in two directions at approximately right angles with water ballast roller weighing 100 to 300 lbs (45 to 135 kg), depending on soil type.
- F. Rake or scarify and cut or fill irregularities that develop as required until area is true and uniform, free from lumps, depressions, and irregularities.

3.4 PROTECTION

- A. After landscape areas have been prepared, take no heavy objects over them except lawn rollers.

END OF SECTION

ATTACHMENT

<h2 style="text-align: center;">COMPOST QUALITY GUIDELINES FOR LANDSCAPING</h2> <p style="text-align: center; font-size: small;">[Source: Von Isaman MS, President of QA Consulting and Testing LLC, Dr. Rich Koenig, USU Cooperative Extension Soils Specialist, and Dr. Teresa Cerny, USU Cooperative Extension Horticulturalist, 3 March 2003]</p>						
Category	pH ^a	Soluble Salts ^a dS/m or mmho/cm	Sodium Adsorption Ratio ^a (SAR)	Carbon Nitrogen Ratio ^b (C:N)	Percent Moisture ^c	≥ 98 percent Coarse Material Passing (dry wt basis)
Ideal	6 to 8	≤ 5	< 10	≤ 20:1	25 to 35	3/8 inch (9.5 mm)
Acceptable	5-6, 8-9	≤ 10	≤ 20	21:1 to 30:1	< 25, > 35	3/4 inch (19 mm)
Suspect	< 5, > 9	> 10	> 20	<10:1, > 30:1	< 20, > 50	< 98 percent 3/4 inch (19 mm)

^a 1.5 Compost: Water Slurry on Coarse Material passing 3/8 inch (9.5 mm).
^b on Coarse Material passing 3/8 inch (9.5 mm).
^c on Total Sample

For composts with biosolid feedstocks, biosolids must meet EPA 503 Class A standard.

Acceptable level Soluble Salts and/or SAR composts should not exceed 3 cu yds (2.29 cu m) /1,000 sq ft (93 sq m) for every 3 inches (76 mm) of soil depth.

<h2 style="text-align: center;">COMPOST VERIFICATION REPORT</h2>						
	pH ^a	Soluble Salts ^a dS/m or mmho/cm	Sodium Adsorption Ratio ^a (SAR)	Carbon Nitrogen Ratio ^b (C:N)	Percent Moisture ^c	≥ 98 percent Coarse Material Passing (dry wt basis)
Results						

See Compost Quality Guidelines for Landscaping for footnote references.

I hereby certify that the Compost meets Ideal or Acceptable requirements as set forth in COMPOST QUALITY GUIDELINES FOR LANDSCAPING as listed with the COMPOST VERIFICATION STATEMENT. If Compost does not fall within this range, explain why and justify.

Signature: _____ Printed Signature: _____

Date: _____

SECTION 32 9223**SODDING****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
1. Furnish and install sodded lawn as described in Contract Documents.
- B. Related Requirements:
1. Section 32 8423: Irrigation system.
 2. Section 32 9001: Common Planting Requirements:
 - a. Pre-installation conference held jointly with other common planting related sections.
 3. Section 32 9120: 'Topsoil And Placement'.
 4. Section 32 9122: 'Topsoil Grading'.

1.2 REFERENCES

- A. Definitions:
1. Crop Coefficients and Hydro-Zones: Crop coefficients (Kc) are used with ETo to estimate specific plant evapotranspiration rates. The crop coefficient is a dimensionless number (between 0 and 1.2) that is multiplied by the ETo value to arrive at a plant ET (ETc) estimate. Plants grouped by water needs, organized into one irrigation zone.
 2. Eco-Region Irrigation Design: A bio-regional approach to irrigation and planting design that is relevant to the geographic area for which the planting plan and irrigation system is designed. These geographic areas are defined by the Environmental Protection Agency and have been modified by the LDS church into 15 geographical areas throughout North America, and the Hawaiian Islands.
 3. Hardiness Zone: A hardiness zone is a more precisely geographically-defined zone within an Eco-Region in which a specific category of plant life is capable of growing, as defined by temperature hardiness, or ability to withstand the minimum temperatures of the zone. Hardiness Zones may be defined by one of two sources:
 - a. Sunset Western Garden Book Maps.
 - b. USDA Hardiness Zone Map.Plant Hardiness zone sources shall be listed by the architect through the planting and irrigation design process.
 4. Hydro-Zone: Plants grouped by water needs (similar Crop Coefficients (Kc), organized into one irrigation zone.
 5. Reference Evapotranspiration (ETo): The total water lost from the soil (evaporation) and from the plant surface (transpiration) over some period.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Conference:
1. Participate in pre-installation conference as specified in Section 32 9001.

1.4 SUBMITTALS

- A. Informational Submittals:
1. Certificates:

- a. Written certification confirming sod seed mix and quality:
 - 1) Include all species used.
 - 2) Include name and contact information of supplier.
- B. Closeout Submittals:
 1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
 - a. Record Documentation:
 - 1) Submit one (1) copy certificate for sod seed quality and mix.
 - b. Landscape Management Plan (LMP):
 - 1) Landscape Section:
 - a) Submit one (1) copy certificate for sod seed quality and mix.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery And Approval Requirements:
 1. Harvest, deliver, store, and handle sod in accordance with requirements of Turfgrass Producers International (TPI) (formally American Sod Producers Association) Specifications for Turfgrass Sod Materials and Transplanting / Installing.
 2. Schedule deliveries to coincide with topsoil operations and laying. Keep storage at job site to minimum without causing delays.
 - a. Deliver, unload, and store sod on pallets within 24 hours of being lifted.
 - b. Do not deliver small, irregular, or broken pieces of sod.
- B. Storage And Handling Requirements:
 1. Cut sod in pieces approximately 3/4 to one inch (19 to 25 mm) thick. Roll or fold sod so it may be lifted and handled without breaking or tearing and without loss of soil.
 2. During wet weather, allow sod to dry sufficiently to prevent tearing during lifting and handling.
 3. During dry weather, protect sod from drying before installation. Water as necessary to insure vitality and to prevent excess loss of soil in handling. Sod that dries out before installation will be rejected.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Description:
 1. Superior sod grown from certified, high quality, seed of known origin or from plantings of certified grass seedlings or stolons:
 - a. Assure satisfactory genetic identity and purity.
 - b. Assure over-all high quality and freedom from noxious weeds or an excessive amount of other crop and weedy plants at time of harvest.
 2. Sod shall be composed of three varieties minimum of Kentucky Bluegrass.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Interface With Other Work:
 1. Do not commence work of this Section until work of Sections 32 9122 and 32 9300 has been completed and approved.
- B. Tolerances:
 1. Final grade of soil after sodding of lawn areas is complete shall be one inch (25 mm below top of adjacent pavement of any kind.

- C. Laying of Sod:
1. Lay sod during growing season and within 48 hours of being lifted.
 2. Lay sod while top 6 inches (150 mm) of soil is damp, but not muddy. Sodding during freezing temperatures or over frozen soil is not acceptable.
 3. Lay sod in rows perpendicular to slope with joints staggered. Butt sections closely without overlapping or leaving gaps between sections. Cut out irregular or thin sections with a sharp knife.
 4. Lay sod flush with adjoining existing sodded surfaces.
 5. Do not sod slopes steeper than 3:1. Consult with Architect for alternate treatment.
- D. After Laying of Sod Is Complete:
1. Roll horizontal surface areas in two directions perpendicular to each other.
 2. Repair and re-roll areas with depressions, lumps, or other irregularities. Heavy rolling to correct irregularities in grade will not be permitted.
 3. Water sodded areas immediately after laying sod to obtain moisture penetration through sod into top 6 inches (150 mm) of topsoil.

3.2 FIELD QUALITY CONTROL

- A. Field Inspection:
1. Sodded areas will be accepted at Project closeout if:
 - a. Sodded areas are properly established.
 - b. Sod is free of bare and dead spots and is without weeds.
 - c. No surface soil is visible when grass has been cut to height of 2 inches (50 mm).
 2. Sodded areas have been mowed a minimum of twice.

END OF SECTION

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SECTION 32 9300**PLANTS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
1. Furnish and install landscaping plants as described in Contract Documents.
- B. Related Requirements:
1. Section 32 8423: 'Underground Sprinklers' for irrigation system.
 2. Section 32 9001: 'Common Planting Requirements' for:
 - a. Pre-installation conference held jointly with other common planting related sections.
 3. Section 32 9120: 'Topsoil And Placement'.
 4. Section 32 9122: 'Topsoil Grading'.
 5. Section 32 9223: 'Sodding'.

1.2 REFERENCES

- A. Definitions:
1. Crop Coefficients and Hydro-Zones: Crop coefficients (Kc) are used with ETo to estimate specific plant evapotranspiration rates. Crop coefficient is dimensionless number (between 0 and 1.2) that is multiplied by ETo value to arrive at plant ET (ETc) estimate. Plants grouped by water needs, organized into one irrigation zone.
 2. Eco-Region Irrigation Design: Bio-regional approach to irrigation and planting design that is relevant to geographic area for which planting plan and irrigation system is designed. These geographic areas are defined by Environmental Protection Agency and have been modified by the Church into 15 geographical areas throughout North America, and Hawaiian Islands.
 3. Hardiness Zone: Hardiness zone is more precisely geographically-defined zone within an Eco-Region in which specific category of plant life is capable of growing, as defined by temperature hardiness, or ability to withstand minimum temperatures of zone. Hardiness Zones may be defined by one of two sources:
 - a. Sunset Western Garden Book Maps.
 - b. USDA Hardiness Zone Map.Plant Hardiness zone sources shall be listed by Landscape Architect through planting and irrigation design process.
 4. Hydro-Zone: Plants grouped by water needs (similar Crop Coefficients (Kc), organized into one irrigation zone.
 5. Landscape Management Plan (LMP): See Section 32 9001 for definition.
 6. Plant Establishment Period: See Section 32 9001 for definition.
 7. Reference Evapotranspiration (ETo): Total water lost from the soil (evaporation) and from plant surface (transpiration) over some period.
- B. Reference Standards:
1. American Nursery & Landscape Association / American National Standards Institute:
 - a. ANLA / ANSI Z60.1-2004, 'American Standard for Nursery Stock'.
 2. American National Standard Institute / Tree Care Industry Association (TCIA):
 - a. ANSI A300 (Part 1)-2017 Pruning, 'American National Standard for Tree Care Operations – Tree, Shrub, and Other Woody Plant Maintenance – Standard Practices (Pruning)'.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Conference:
 - 1. Participate in MANDATORY pre-installation conference as specified in Section 32 9001.

1.4 SUBMITTALS

- A. Action Submittals:
 - 1. Samples:
 - a. Mulch for approval before delivery to site.
- B. Informational Submittals:
 - 1. Special Procedural Submittals:
 - a. Installer to provide written instructions covering Owner maintenance requirements during 'Plant Establishment Period'.
- C. Closeout Submittals:
 - 1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
 - a. Operations And Maintenance Data:
 - 1) Submit one (1) copy of recommendations specified in Special Procedure Submittals.
 - b. Warranty Documentation:
 - 1) Include written warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery And Acceptance Requirements:
 - 1. Deliver shrubs and other plants after preparations for planting have been completed and install immediately.
 - 2. Do not prune before delivery, except as approved by Landscape Architect.
 - 3. Protect bark, branches, and root systems from sun scald, drying, whipping, and other handling and tying damage.
 - 4. Do not bend or bind-tie shrubs in such a manner as to destroy natural shape.
 - 5. Provide protective covering during delivery.
- B. Storage And Handling Requirements:
 - 1. Handle balled stock by root ball or container. Do not drop shrubs during delivery.
 - 2. If planting is delayed more than six hours after delivery, set planting materials in shade and protect from weather and mechanical damage.
 - 3. Set balled stock on ground and cover ball with soil, saw dust, or other acceptable material approved by Landscape Architect.
 - 4. Do not remove container-grown stock from containers before time of planting.
 - 5. Do not store plant material on pavement.
 - 6. Water root systems of shrubs stored on site with fine spray. Water as often as necessary to maintain root systems in moist condition. Do not allow plant foliage to dry out.

1.6 WARRANTY

- A. Special Warranty:
 - 1. Provide written warranties as follows:
 - a. Warranty will extend thirty (30) continuous days minimum after Substantial Completion. If a continuous first thirty (30) days of the warranty period is interrupted by non-growing season or irrigation winter shut-down, begin warranty period after start of growing season as agreed on with Architect. Thereafter, continue warranty per the period described herein.
 - b. Warranty shrubs and other plants to live and remain in strong, vigorous, and healthy condition for 90 days minimum from date of Substantial Completion and meet or exceed material standards set forth in Materials heading of Part 2 of this specification.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Plants:
1. Conform to requirements of Plant List and Key on Contract Documents and to ANLA / ANSI Z60.1.
 2. Nomenclature:
 - a. Plant names used in Plant List conform to 'Standardized Plant Names' by American Joint Committee on Horticultural Nomenclature except in cases not covered. In these instances, follow custom of nursery trade. Plants shall bear tag showing genus, species, and variety of at least 10 percent of each species delivered to site.
 3. Quality:
 - a. Plants shall be sound, healthy, vigorous, free from plant disease, insect pests or their eggs, noxious weeds, and have healthy, normal root systems. Container stock shall be well established and free of excessive root-bound conditions.
 - b. Do not prune plants prior to delivery.
 - c. Plant materials shall be subject to approval by Landscape Architect as to size, health, quality, and character.
 - d. Provide plant materials from licensed nursery or grower.
 4. Measurements:
 - a. Measure height and spread of specimen plant materials with branches in their normal position as indicated on Contract Documents or Plant List.
 - b. Measurement should be average of plant, not greatest diameter. For example, plant measuring 15 inches (375 mm) in widest direction and 9 inches (225 mm) in narrowest would be classified as 12 inch (300 mm) stock.
 - c. Plants properly trimmed and transplanted should measure same in every direction.
 - d. Where caliper or other dimensions of plant materials are omitted from Plant List, plant materials shall be normal stock for type listed.
 - e. Plant materials larger than those specified may be supplied, with prior written approval of Landscape Architect, and:
 - 1) If complying with Contract Document requirements in all other respects.
 - 2) If at no additional cost to Owner.
 - 3) If sizes of roots or balls are increased proportionately.
 5. Shape and Form:
 - a. Plant materials shall be symmetrical or typical for variety and species and conform to measurements specified in Plant List.
 - b. Well grown material will generally have height equal to or greater than spread. However, spread shall not be less than 2/3's of height.

2.2 ACCESSORIES

- A. Planting Mix:
1. Mixture of three (3) parts excavated soil and one part well rotted composted manure, approved commercial mix, or other amendment recommended in 'Topsoil Testing Report'.
- B. Fertilizer:
1. Fertilizer as recommended on 'Topsoil Testing Report'.
- C. Pre-Emergent Herbicide:
1. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
 - a. Chipco Dimension Granular by The Andersons Inc, Maumee, IL www.andersonsinc.com.
 - b. Elanco XL2G granular by Crop Data Management Systems, Marysville, CA www.cdms.net.
 - c. Ronstar G granular by Bayer Crop Science, Monheim, Germany www.bayercropscience.com.
 - d. Surflan AS liquid by United Phosphorous Inc, Trenton, NJ www.upi-usa.com.
 - e. Oryzalin 4 A.S. liquid by FarmSaver, Seattle, WA www.farmsaver.com.

- D. Weed Barrier:
1. Type Two Acceptable Products:
 - a. DeWitt 5 oz (116 g) 20 year woven polypropylene weed barrier.
 - b. Equal as approved by Landscape Architect before bidding. See Section 01 6200.
- E. Rock Mulch:
1. Type Two Acceptable Products:
 - a. Refer to Planting Plan Miscellaneous Schedule.
 - 1) Size:
 - a) No rock s
 - b) For slopes 5:1 or less 3/4 inch (19 mm) to 1-1/2 inches (38 mm).
 - c) For steep slopes greater than 5:1: 4 inches (38 mm) to 8" (76 mm)
 - 2) Equal as approved by Landscape Architect before installation. See Section 01 6200.
 - b. Infield Mix – See Infield Mix Spec Section

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Evaluation And Assessment:
1. Before proceeding with work, check and verify dimensions and quantities. Report variations between Drawings and site to Landscape Architect before proceeding with work of this Section.
 2. Plant totals are for convenience only and are not guaranteed. Verify amounts shown on Contract Documents. All planting indicated on Contract Documents is required unless indicated otherwise.
 3. Do not commence with this Work until all work including grading tolerances specified in Section 32 9122 'Topsoil Grading' are completed and approved.

3.2 PREPARATION

- A. Plant Approval:
1. Compliance:
 - a. Prior to any plant installation, evaluate plants for compliance with material standards.
 - b. Remove plants from site that do not comply.
 2. Inspection:
 - a. In presence of Landscape Architect or by video recording, remove root container/packing material and inspect root balls for soil depth, firmness and root structure by washing soil off of roots.
- B. Layout individual shrub locations and areas for multiple plantings:
1. Stake locations and outline areas.
 2. Secure Landscape Architect's approval before planting.
 3. Make minor adjustments as may be requested.

3.3 INSTALLATION

- A. Excavation:
1. If underground construction work or obstructions are encountered in excavation of planting holes, Landscape Architect will select alternate locations.
 2. Plant Excavation Size:
 - a. Diameter: Twice diameter of root ball or container minimum.
 - b. Depth: Equal to container or rootball depth.
 3. Unless excavated material meets topsoil requirements as specified in Section 32 9120, remove from landscape areas and do not use for landscaping purposes.
 4. Roughen sides and bottoms of excavations.

5. With approval of Landscape Architect, select five (5) typical planting excavations throughout site for drainage testing.
 - a. Fill selected excavations with water and verify that water drains away at rate of 3 inches (75 mm) per hour minimum. Inform Landscape Architect in writing of excavations where water does not drain properly.
 - b. Select three (3) excavations approximately 5 feet (1 500 mm) away from each non-draining excavation and repeat tests. Continue testing process until non-draining areas have been identified.
 - c. In excavations located in identified non-draining areas, auger 6 inch (150 mm) diameter hole 4 feet (1 200 mm) deep in low point of each excavation and fill with tamped planting mix.
 - d. Do not plant shrubs in holes that do not properly drain.
- B. Planting:
 1. Removing Binders And Containers:
 - a. Remove plastic containers.
 2. Plant immediately after removing binding material and containers:
 - a. Place shrub root balls on undisturbed soil.
 - b. Shrub root balls shall be approximately one inch (25 mm) higher than finished grade.
 3. Properly cut off broken or frayed roots.
 4. Center plant in hole, remove remaining wire basket and burlap taking care not do damage root ball:
 - a. Replace damaged material.
 - b. Backfill with specified planting mix.
 - c. Except in heavy clay soils, make ring of mounded soil around hole perimeter to form watering basin.
 5. Add fertilizer in plant pit as per 'Topsoil Testing Report' and during proper season.
 6. Fill landscape excavations with tamped planting mix and recommended fertilizer:
 - a. Compact in 6 inch (150 mm) lifts.
 - b. Settle by watering to ensure top of root ball is one inch (25 mm) higher for shrubs than surrounding soil following compaction and settling.
 7. Do not use muddy soil for backfilling.
 8. Make adjustments in positions of plants as directed by Landscape Architect.
 9. Thoroughly water shrubs immediately after planting.
- C. Shrub Pruning:
 1. Prune shrubs to remove dead, broken, and split branches in conformance with ANSI A300 (Part 1) Pruning.
- D. Post Planting Weed Control:
 1. Apply specified pre-emergent herbicide to shrub planting areas after completion of planting.
 2. Areas shall be weed free prior to Landscape Final Acceptance.
- E. Weed Barrier Fabric:
 1. After planting and application of herbicide in shrub beds, apply covering of specified weed barrier fabric.
 2. Achieve 100 percent coverage over ground areas while allowing space for growth from root ball.
 3. Overlap seams 6 inches (150 mm) minimum.
 4. Staple at 5 feet (1500 mm) on center each way and within 3 inches (75 mm) of edge of shrub bed, with two (2) at each corner.
- F. Mulching:
 1. After application of herbicide, mulch shrub and ground cover planting areas with 3 inches (75 mm) deep layer of ¾ inch to 1 ½ inch specified rock mulch or 6 inches deep layer of 4 inch to 8 inch rock mulch.
 2. Place mulch to uniform depth and rake to neat finished appearance.

END OF SECTION