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Construction Specification Manual

Salt River Project

Technical Specification Index – April 2022

Division 32

Division	Title	Updated
DIVISION 32: EXTERIOR IMPROVEMENTS		
320190	Operation and Maintenance of Planting	New 04/22
321216	Asphalt Paving	Revised 04/22
321216X	Asphalt Mixing and Paving Equipment	New 04/22
321600	Curbs, Gutters, Sidewalks, and Driveways	New 04/22
321723	Pavement Markings	New 04/22
328400	Planting Irrigation	New 04/22
329000	Planting	New 04/22

SECTION 32 01 90

OPERATION AND MAINTENANCE OF PLANTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide labor, materials, and installation necessary to provide a one (1)-year warranty period from date of acceptance of installation.
- B. Related Requirements:
 - 1. Section 32 84 00 "Planting Irrigation."
 - 2. Section 32 90 00 "Planting."

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 ACCEPTANCE OF INSTALLATION

- A. At the completion of landscape installation, Contractor shall request in writing an inspection for substantial completion in which Contractor and Owner shall be present. After this inspection, Contractor shall prepare a "Punch List". Upon completion of all punch list items, Owner will re-inspect the Project and issue a written statement of final acceptance and establish the beginning of the project warranty period.
- B. Landscape Work may be inspected for acceptance in phases agreeable to Owner provided work offered for inspection is completed, including maintenance as required.
- C. For Work to be inspected for partial or phased acceptance, Contractor shall provide a drawing outlining work completed and supply a written statement requesting acceptance of the Work completed to date.

3.2 WARRANTY

- A. The project warranty period shall begin upon written final acceptance of the project installation by Owner.
- B. General Warranty: Special warranty specified in this Section shall not deprive the Owner of other rights. Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

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- C. Special Warranty: Warrant living plants against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect or abuse by Owner, abnormal weather conditions unusual for warranty period, or incidents that are beyond Contractor's control. Warranty for the periods specified below.
- D. Remove and replace dead planting materials immediately. All plants to be replaced in-kind size specified in the original design.
- E. Replace planting materials that are in unhealthy condition at the end of warranty period.
- F. Contractor shall arrange with Owner to walk the site monthly during warranty period to review maintenance standards.
- G. Nursery-Grown Tree Warranty:
 - 1. Contractor shall warrant that all trees will be alive and in good health for a period of one year after final acceptance except for defects resulting from neglect by Owner, abuse, or damage by others.
 - 2. Contractor shall remove and replace dead, unhealthy or girdled trees or those that lose original form and size during the warranty period with material equal to that specified at no additional cost to Owner. Contractor shall replace any material that does not meet requirements within 15 days of notification.
 - 3. All replacement trees shall be subject to an additional one-year warranty period.
- H. Shrubs and Other Plantings Warranty:
 - 1. Contractor shall warrant all other planting to be alive and in satisfactory condition for a period of 90 days from date of final acceptance except for defects resulting from neglect by Owner, abuse, or damage by others.
 - 2. Contractor shall maintain all plant material in a healthy, sturdy condition during the warranty period.
 - 3. Contractor shall remove and replace dead or unhealthy plants or those that lose original form and size during the warranty period with material equal to that specified at no additional cost to Owner. Contractor shall replace any material that does not meet requirements within 10 days of notification.
 - 4. All replacement plants, including shrubs, cacti, groundcovers, vines and perennials, shall be subject to an additional 90-day warranty period.
- I. Irrigation System Warranty: Refer to Section 32 84 00 "Planting Irrigation."

3.3 MAINTENANCE PERIOD

- A. Maintenance shall begin immediately with the planting of each plant and continue for 90 days following final acceptance.
 - 1. The Landscape Contractor, in order to protect his guarantee, shall give typewritten to Owner, a complete maintenance instruction booklet in the care and feeding of the landscape.

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2. Contractor shall take every precaution to protect exterior surfaces from damage as a result of maintenance work and shall promptly report and repair any damage to the satisfaction of Owner.
- B. To ensure warranty standards, the following maintenance procedures shall be executed during construction and for the full project maintenance period.
1. Frequency: Site shall be visited / checked and maintained a minimum of once per week.
 2. Response Time: When environment dictates, work may require weekend, after hours or holiday schedules. Contractor shall respond to a call per the following schedule:
 - a. General Maintenance: Three business days
 - b. Irrigation Issues: 24 hours or less, depending on severity
 - c. Safety Issues (obstructions, etc.): Immediately
 3. Maintenance of Trees, Shrubs and Accents, Groundcovers:
 - a. Contractor shall be responsible for any and all replacement of any plant materials that are dead, are in an unhealthy or unsightly condition, or that have lost natural shape resulting from die-back, excessive pruning or inadequate or improper maintenance.
 - b. Replace planting materials that are damaged or destroyed as a result of Acts of Nature (frost, storm, wildlife and wind damage) during installation and maintenance period.
 - c. Replacements must meet specifications, i.e., quality, size, form, species of plant material and planting procedures, to receive approval of replacement.
 - d. Costs for replacements are assumed part of bid quotations and will not result in an additional cost to Owner.
 - e. Contractor shall be responsible for watering all plantings and shall keep guy wires taut, raise tree root balls that settle, and furnish chemicals and pesticides as necessary to keep the plantings free of disease and insects until the end of the maintenance period. Provide cover to protect from frost damage, as required.
 - f. Fertilization: Apply fertilizer as required by manufacturer's recommendations in order to maintain a healthy and vigorous condition.
 - g. Insecticide Application: Furnish and apply chemicals and pesticides as necessary to keep the plantings free of disease and insects throughout the maintenance period.
 - h. Remove and replace trees, shrubs, or other plants found to be dead or in an unhealthy condition. Remove and replace rejected plants and materials promptly. Replace all trees and shrubs where their health is in doubt, unless, in opinion of Owner, it is advisable to extend warranty period. Remove all stakes, guy wires, tree wrap paper, dead twigs and branches from tree and plant material at the end of the maintenance period. Keep planting beds free of weeds during maintenance period.

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- i. Pruning:
 - 1) Trees: The objective in tree pruning shall be to preserve the structural integrity, design purpose and natural beauty of trees. Branch collars shall not be removed. Stubs shall not be allowed to remain. All pruning shall be done in accordance with the guidelines of the Western Chapter of the International Society of Arboriculture.
 - 2) Shrubs: Pruning shall be done by hand pruners or lopping shears. Hedge shears shall not be allowed. Shrubs shall be selectively pruned to remove old seed heads and stems. Shrubs shall be pruned on a very limited basis, only to maintain natural appearance. Shrubs shall not be pruned into ball or geometric shapes. Shrubs and groundcovers shall be pruned to remove all frost-damaged foliage and branches as soon as new buds appear. Shrubs shall be trimmed to prevent overhang at sidewalks and curbs.
- j. Staking:
 - 1) Staking shall be inspected monthly. The goal is to wean trees from stakes. As trees are strong enough to stand on their own, stakes shall be removed.
 - 2) Staked that are not judged to be ready for removal shall be maintained according to the detail in the Construction Documents. Rubber hose and wire encircling trunks shall be maintained so as not to cause girdling. Stakes and wire shall be maintained to prevent rubbing against trunks or branches. Materials for staking and/or restaking shall match original specification.
- 4. Maintenance of Decomposed Granite and Drainage Elements:
 - a. All Decomposed granite and retention areas shall be inspected weekly for any debris. Landscape Contractor shall be responsible for the removal of the debris.
 - b. All decomposed granite areas shall be raked or groomed as required to maintain a smooth and level appearance.
 - c. From time to time after heavy storms, erosion in the decomposed granite areas will occur. Contractor shall rake these areas smooth. Where erosion is severe, Contractor shall provide fill material and/or additional decomposed granite as required (color and size to match original specifications.) Contractor is entitled to additional compensation for Work; however, if compensation is requested, this Work shall not commence without written approval by Owner.
- 5. Maintenance of Irrigation System: Refer to Section 32 84 00 "Planting Irrigation."
- 6. Weed Control: Project Area is to be maintained in a weed-free condition. All planting areas shall be kept clean bi-weekly of all noxious weeds and grasses. If the construction period and maintenance period exceeds five months time from the initial application of pre-emergent apply a second treatment.
- 7. Trash and Litter:
 - a. Definition of trash and litter shall be any item not installed as part of the landscape or hardscape. This includes but is not limited to leaf litter, wind blown material, trash, cigarette butts and tree limbs.

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- b. Landscape area shall be litter free throughout the duration of the maintenance period.
 - 8. Graffiti: Any graffiti appearing on exterior walls, fences, gates, etc. shall be immediately brought to the attention of Owner.
- C. Maintenance Acceptance
- 1. If Contractor's maintenance is unsatisfactory, the maintenance period shall be extended, at Contractor's expense, until such time as all corrections are made and the Work is re-inspected and approved by Owner.
 - 2. Notify Owner 5 days prior to end of the maintenance period that a final inspection is requested. Owner will make notations of any items not acceptable or requiring corrections and will notify Contractor for immediate action.

END OF SECTION

SECTION 32 12 16

ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes asphalt concrete pavement on prepared base course or subgrade parking lots, driveways, access roads, etc.

1.2 REFERENCES

- A. The following standards shall be made a part of this Specification:
 - 1. AASHTO M156 Standard Specification for Requirements for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
 - 2. ASTM C117 Materials Finer than #200 Sieve in Mineral Aggregates by Washing
 - 3. ASTM C136 Sieve Analysis of Fine and Coarse Aggregates
 - 4. ASTM C448 Sizes of Aggregate for Road and Bridge Construction
 - 5. ASTM C979 Sampling Bituminous Paving Mixtures
 - 6. ASTM D276 Standard Test Methods for Identification of Fibers in Textiles
 - 7. ASTM D1559 Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
 - 8. ASTM D2172 Quantitative Extraction of Bitumen for Bituminous Paving Mixture
 - 9. ASTM D3776 Standard Test Methods for Mass Per Unit Area (Weight) of Fabric
 - 10. ASTM D4632 Grab Breaking Load and Elongation of Geotextiles
 - 11. ASTM D6140 Test Method to Determine Asphalt Retention of Paving Fabrics Used in Asphalt Paving for Full-Width Applications
 - 12. MAG 321 Asphalt Concrete Placement
 - 13. MAG 710 Asphalt Concrete
 - 14. MAG 711 Paving Asphalt
 - 15. MAG 713 Emulsified Asphalts
- B. Permission for deviation must be approved in writing by the Engineer prior to the award of the Contract.

1.3 SUBMITTALS

- A. Submit the asphalt concrete job mix formula and hot mixing plant certification to the Engineer at least 7 days prior to paving. The Engineer will review and approve the mix design to assure it contains all of the required information.
 - 1. Target values for gradations, binder contents, and air voids will be established as the accepted Job Mix Formula (JMF) based upon the mix design.

2. Mix designs not containing all of the information will be returned within 7 days of receipt of all mix design information, for action and resubmission by the Contractor.

- B. Once the mix design has been approved by the agency and the mixing plant selected, changes to plants, or utilizing additional mixing plants, is not permissible without prior approval of the Engineer. If source of material changes, furnish the Engineer with a new mix design.

1.4 JOB CONDITIONS

- A. Asphalt concrete shall be placed only when the surface is dry and when the atmospheric temperature in the shade is 40 degrees F. (50 degrees F for asphalt concrete lift less than 2-inch thick) or above.
 1. No asphalt concrete shall be placed when the weather is foggy or rainy, or when the base or sub base on which the material is to be placed is unstable.
 2. Asphalt concrete shall be placed only when the Engineer determines that weather conditions are suitable.
- B. If previously accepted subgrade or base course has been weather damaged and, in the opinion of the Engineer, adequate time existed to cover the subgrade or base course before damage occurred, then any costs for work required to bring the subgrade to acceptable standards shall be the Contractor's responsibility.
- C. Traffic shall be kept off all bituminous material until sufficiently cured.

1.5 SURFACE TOLERANCES

- A. Subgrade and base course surfaces upon which pavement is to be directly placed shall be smooth, firm and true to the grade and cross section as shown on the drawings and shall be so maintained throughout the period of placing asphalt concrete.
- B. Subgrade and base course surfaces shall not vary more than ½-inch in any 10 feet from the specified grade and cross-section. Variations within the above specified tolerance shall be compensating so that the average grade and cross-section specified are met.
- C. The completed asphalt concrete surface shall be thoroughly compact, smooth and true to grade and cross-section, and free from ruts, humps, depressions or irregularities. An acceptable surface shall not vary more than ¼-inch throughout the length of a 12-foot straightedge. Provide straightedge used as part of the work.
- D. The surface in the area of transverse and longitudinal joints shall not deviate more than ¼-inch from a 12-foot straightedge, when tested with the straightedge placed across the joint, parallel to the centerline.

PART 2 - PRODUCTS

2.1 ASPHALT CONCRETE AND JOB MIX FORMULA

- A. Asphalt concrete shall be in accordance with Maricopa Association of Governments Uniform Standard Specifications for Public Works Construction (MAG Specification) Section 710, "Asphalt Concrete."
- B. All materials shall be proportioned by weight in a hot mix asphalt plant in the proportions required by the mix design to provide a homogeneous and workable mass.
 - 1. The hot mix asphalt plant shall be inspected in accordance with the provisions contained in the 'Hot Mix Asphalt Production Facilities' by the Arizona Rock Products Association and shall have a current inspection certificate.
 - 2. All measuring devices shall be calibrated at least annually by a technician licensed by the Arizona Bureau of Weights & Measures.
 - 3. Mixing plants shall conform to the requirements of AASHTO M 156.
 - 4. Mix production shall be done in accordance with MAG Section 321.6.

2.2 ASPHALT OVERLAY INTERLAYER FABRIC

- A. Pavement fabric shall be constructed of at least 95 percent (by weight) nonwoven synthetic fibers of polyester or polypropylene, thermally bonded on one side. The fabric material shall additionally conform to the physical properties shown in Table 32 12 16.1.

Table 32 12 16.1			
Property	Class A	Class B	Test Method
Weight: oz/yd ²	4.1 min.	4.0 min.	ASTM D3776
Grab tensile strength: lbs.	100 min.	90 min.	ASTM D4632
Elongation at break: %	50 min.	50 min.	ASTM D4632
Melting point: degree F	300 min.	300 min.	ASTM D276
Asphalt retention: gal/yd ²	0.25 min. ⁽¹⁾	0.20 min.	ASTM D6410

(1) May be reduced within street intersections, on steep grades or in other zones where vehicle braking is common, but not less than 0.20 gal/yd², when approved by the Engineer.

2.3 TACK COAT

- A. Tack coat or flush coat shall consist of emulsified asphalts, conforming to the requirements of MAG Section 713. As specified on the Drawings or in the Specification, tack coat or flush coat type and grade shall be either SS-1h, CSS-1h and shall be diluted in the proportion of 50 percent water and 50 percent emulsified asphalt.

2.4 BLOTTING SAND

- A. Sand for blotting excess bituminous material shall be non-plastic, meet ASTM C448 and graded as shown in Table 32 12 16.2.

Table 32 12 16.2	
Sieve Size	Percent Passing (by weight)
No. 4	100
No. 8	90-100
No. 30	40-75
No. 200	0-10

2.5 PAVEMENT FABRIC INTERLAYER BINDER

- A. Asphalt binder coat used to bond the fabric to the pavement shall be paving asphalt PG 70-10 asphalt cement conforming to the requirements of MAG Section 711.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. Prepare the surface to be paved prior to placement of prime coat or asphalt concrete pavement, per the drawings and specifications.
- B. For overlay projects, repair existing pavement to be overlaid per the Drawings and Specifications.
- C. After completion of existing pavement repair and/or milling, clean all loose material, mud spots and other objectionable material from the pavement. Any standard cleaning method used is acceptable, except water flushing will not be permitted in cracked pavement areas.
- D. Milling machines for surface preparation of overlay work shall be self-contained, self-propelled, automated rotary millers capable of milling and leveling the existing asphalt concrete pavement to the specified depth shown. Millers shall be equipped with separate, automatic height adjustments which allow clearance over manholes and other obstructions.

3.2 INTERLAYER PLACEMENT FOR OVERLAY OR INLAY

- A. Cracks between 1/4" and 1/2" shall be filled with hot pour rubberized crack filler or other crack filler as specified by the Engineer. Wider cracks are to be repaired with fine hot mix asphalt.
- B. The asphalt binder and fabric interlayer shall only be placed when the pavement is dry, the ambient air temperature is 50 degrees F and rising, and pavement temperature is 40 degrees F and rising.
- C. The application and distributing equipment for the asphalt binder shall conform to the requirements of Appendix 01.

- D. The asphalt binder coat shall be uniformly spray applied to the prepared pavement surface at the rate noted in Table 2.1 for the job-specific fabric. Some underlying surfaces may require a higher or lower application rate. A test strip may be necessary to determine the proper application rate. The width of liquid asphalt cement application shall be the fabric width, plus six inches.
- E. Pavement fabric interlayer shall be placed onto the asphaltic binder with the heat bonded side up with a minimum amount of wrinkling or folding. Remaining wrinkles or folds 1-inch and larger shall be removed or slit and shingle-lapped in the direction of paving. Burning or torching of wrinkles is not allowed. Fabric shall overlap three to six inches to insure full closure of the joint. Transverse joints shall be shingle-lapped in the direction of paving to prevent edge pickup by the paver. A second application of hand-placed asphalt binder may be required at laps and repairs as determined by the Engineer to ensure proper binding of the narrow double fabric layer
- F. Pavement fabric interlayer shall not be placed if the in-place binder is hotter than 325 degrees F or has cooled to 180 degrees F or below (as determined by non-contact thermometer).
- G. Equipment for placing the fabric shall be mechanized and capable of handling full rolls of fabric. The equipment shall be able to lay the fabric smoothly to maximize pavement contact and remove air bubbles. Stiff bristle brooms shall be used to smooth the fabric. The equipment used to place the fabric shall be in good working order and is subject to approval by the Engineer.
- H. Areas where fabric has been placed shall be paved with asphaltic concrete during the same workshift. Placement of the asphaltic concrete shall closely follow fabric lay down. The temperature of the asphaltic concrete immediately behind the laydown machine shall not exceed 325 degrees F. In the event that the asphalt binder coat bleeds through the fabric causing construction problems before the overlay is placed, the affected areas shall be sanded with a sand blotter in compliance with Section 2.3. Excess sand shall be removed before beginning the paving operation. In the event of rainfall prior to the placement of the asphaltic concrete, the fabric shall be allowed to dry before the asphalt concrete is placed.
- I. Turning of the paving machine or of other vehicles on the fabric shall be gradual and kept to a minimum to avoid damage to the fabric. Should equipment tires stick to the fabric during pavement operations, small quantities of paving asphalt concrete shall be broadcast on the fabric to prevent pick-up. Decrease of binder rate in order to minimize pick-up on tires is not allowed.

3.3 TACK COAT APPLICATION

- A. A tack coat shall be applied to all existing and to each new course of asphalt concrete and concrete surfaces prior to placement of a succeeding lift of asphalt concrete. The tack coat may be deleted when a succeeding layer of asphalt concrete is being applied over a freshly laid course (in place less than one week) that has been subjected to very little traffic when approved by the Engineer.

- B. A tack coat shall be applied to the vertical surfaces of existing pavements, curbs, and gutters, against which asphalt concrete is to be placed.
- C. The tack coat shall be applied only so far in advance of placing the asphalt concrete as can be covered by the asphalt concrete during the day. Tack coat not covered by asphalt concrete the same day, shall require another application before being covered.
- D. Apply tack coat at a rate of approximately 0.05 to 0.10 gallons per square yard of diluted material.
- E. Unless otherwise specified, temperatures during handling, application, cooling and reheating for the various grades of emulsified asphalt shall be within temperature limits specified in Table 713-2 of MAG 713.

3.4 ASPHALT CONCRETE APPLICATION

- A. Asphalt concrete shall be delivered and placed at temperatures within the job mix formula specified for the project (job mix developed by the requirements in Section 2.5). Tarpaulins shall be furnished and used to cover all loads during transportation if the temperature of the mixture is below the job mix formula limits. Temperatures shall be taken at a point 6 inches below the exposed surface of the material in the truck (at the job site) just prior to placement. No free fluid shall be present in the truck bodies at the time of asphalt concrete loading. Diesel fuel shall not be used as a treating fluid.
- B. Asphalt concrete immediately behind the laydown machine shall be at or above minimum temperatures shown in Table 32 12 16.3.
- C. The handling of the completed mixture shall at all times be such as to prevent segregation, and the material as spread shall be free from areas of excess coarse, or fine material. Float rock developed in the process of raking shall be placed on an underlying course or otherwise disposed of. In no case shall it be scattered over the surface of a final course.
- D. If the asphalt concrete is dumped from the hauling vehicles directly into the paving machine, care shall be taken to avoid jarring the machine or moving it out of alignment. No vertical load shall be exerted on the paving machine by the truck.

Table 32 12 16.3 Minimum Asphalt Concrete Placement Temperatures						
Base ⁽¹⁾ Temp (degree F)	Mat Thickness (inches)					
	1/2	3/4	1	1 1/2	2	3 and greater
40-50	--	--	310	300	285	275
50-60	--	310	300	295	280	270
60-70	310	300	290	285	275	265
70-80	300	290	285	280	270	265
80-90	290	280	270	270	265	260
+90	280	275	265	265	260	255

(1) Base on which mix is to be placed

- E. If asphalt concrete is dumped upon the surface being paved and subsequently loaded in the paving machine, the loading equipment shall be self-supporting and shall not exert any vertical load on the paving machine. Substantially all of the asphalt concrete shall be picked up and loaded into the paving machine.
- F. At locations where the mixture is to be placed over areas inaccessible to the required spreading and compacting equipment or over areas where the use of the required spreading and compacting equipment would not be practicable, the mixture shall be spread and thoroughly compacted with tampers to provide a uniform and smooth layer over the entire area compacted by other methods as approved by the Engineer.
- G. The compacted thickness of layers placed shall not exceed 4 inches for the initial asphalt course or 2 inches for surface course except as otherwise provided in the plans and specifications or if approved in writing by the Engineer.
- H. Transverse joints: Before a surface course is placed in contact with a cold transverse construction joint, the cold existing asphalt concrete shall be trimmed to a vertical face for its full depth and exposing a fresh face. After placement and finishing the new asphalt concrete, both sides of the joint shall be dense and the joint shall be smooth and tight.
- I. Longitudinal Joints of each course shall be staggered a minimum of 6 inches with relation to the longitudinal joint of the immediate underlying course cold transverse construction joint, the cold existing asphalt concrete shall be trimmed to a vertical face for its full depth and exposing a fresh face. The fresh face shall be tacked prior to placement of the adjacent course. After placement and finishing the new asphalt concrete, both sides of the joint shall be dense and the joint shall be smooth and tight. The joint will be tack coated if required by the Engineer.
- J. Asphalt compaction equipment shall be of sufficient size and weight to accomplish the required compaction. Compaction equipment shall be operated and maintained in accordance with the manufacturer's recommendations and the project requirements. During the rolling operation, the speed of the roller shall not exceed 3 miles per hour, unless otherwise approved by the Engineer, and shall be slow enough to avoid displacement of the mixture.
- K. Pneumatic tired compactors shall be equipped with skirt-type devices mounted around the tires so that the temperature of the tires will be maintained during the compaction process.
- L. Breakdown rolling shall begin as soon as the mixture will bear the roller without undue displacement. Rolling shall be longitudinal, overlapping on successive trips by at least $\frac{1}{2}$ but not more than $\frac{3}{4}$ the width of the rear wheels. Alternate trips of the roller shall be of slightly different lengths.
- M. Compaction rolling shall be done by means of pneumatic-tired rollers and continue until the in-place density of the compacted mixture is not less than 95 percent of the theoretical density of the same material tested in similar proportions and methods from the approved job mix formula.

- N. Finish rolling shall be done by means of a steel-wheeled roller or vibratory roller operated in the static mode.
- O. Rollers shall be operated continuously from the breakdown through finish rolling. Vibratory rollers in lieu of steel-wheeled rollers are permissible when the lift is 1-inch thick or less, all rolling shall be done in the static mode.

3.5 QUALITY CONTROL

- A. Monitor asphalt concrete mix production to achieve the required compaction and the required mix properties. The asphalt concrete produced shall conform to the properties of the mix design. When the asphalt concrete does not conform to the approved mix design properties, it shall be reported to the Engineer, and corrective quality control measures shall be implemented, or production shall cease immediately at no additional cost to the Owner.
- B. The Engineer shall be responsible for shall obtaining samples of any portion of any material at any point of the work and field testing of in-place asphalt concrete. Also, the Engineer may order the use of any drying, proportioning and mixing equipment or the handling of any material discontinued which, in his/her opinion, fails to produce a satisfactory mixture.
- C. A minimum of one density determination by nuclear method or coring shall be obtained for each 1,000 square yards of pavement placed or fraction thereof. A minimum of three density determinations shall be made regardless of the project size. Additional densities may be obtained at the discretion of the Engineer.
- D. When, in the opinion of the Engineer, the compaction of the mixture is deficient, cores shall be taken at random locations for testing, with one core for each 4,000 square feet of area with a minimum of three cores for the area being paved.
- E. When, in the opinion of the Engineer, the pavement is deficient in thickness, cores will be taken at random locations, with one core for every 4,000 square feet or a minimum of three cores for the area being paved. When a deficiency of more than ¼-inch is found, two additional cores may be taken not closer than 100 feet apart nor closer than 100 feet from the original core and the average of these three cores will be used to determine the amount of the deficiency. Thickness of the cores shall be determined by the average caliper measurement.
- F. When asphalt cement content exceeds the limits established in the job mix formula, 2 additional core tests will be made for each deficient test taken, and the average of all 3 tests made shall be used to determine the asphalt cement content.
- G. If the test results specified in this Section meet the requirements, the laboratory tests fees will be paid by the Owner. If such tests fail to meet specified requirements, the costs of such tests shall be paid by the Contractor and the Contractor shall immediately correct the deficiency.

- H. Sampling of asphalt concrete mixtures for acceptance testing shall be a minimum of one mixture sample per day for every 500 tons of asphalt concrete produced. Sampling will be in accordance with ASTM D979 as applicable. Mixture samples shall be tested for extraction and gradation by ASTM D2172, and ASTM C136, C117, respectively. Additionally, laboratory Marshall density shall be determined on the mix sample in accordance with ASTM D1559 using the same compactive effort as the job-mix formula. Temperature of the mixture immediately prior to laboratory compaction shall be $250^{\circ}\text{F} \pm 5^{\circ}\text{F}$.

3.6 DEFICIENCIES

- A. Dimensional deviations of the tolerances specified in this Section (such places as humps or depressions) shall be corrected to meet the specified tolerance or shall be cut out along neat straight lines and replaced with fresh hot mixture and thoroughly compacted to conform with and bond to the surrounding area. Materials and work necessary to correct such deviations shall be at no additional cost to the Owner.
- B. Where the average density is deficient by one percent or less, payment shall be based on the contract price.
- C. Where the density is deficient by more than one percent, and the Contractor is unable to correct the deficiency, asphalt concrete payment will be reduced as noted in Table 32 12 16.4.

Table 32 12 16.4 Payment Reduction for Deficient Density	
Deviation Below Specification	Reduction in Payment
1% to 2% points	2%
2% to 3% points	5%
3% to 5% points	10%

- D. Where the deviation is more than five percent, at no cost to the Owner, place a Type II or III slurry seal as specified by the Engineer, or, at the option of the Engineer, remove and replace with new material meeting the specification requirements for the mix type and area involved.
- E. When the paving asphalt content exceeds the job mix formula limits and the air voids in the total mix are less than 2%, the Contractor shall remove and replace the affected material at no cost to the Owner.
- F. Where the asphalt cement content is from 0.0% to 0.2% deficient (weight of the total mixed material less than the minimum permitted by the job mix formula), asphalt concrete payment will be reduced as noted in Table 32 12 16.5:

Table 32 12 16.5 Payment Reduction for Deficient Asphalt Content	
Deviation Below Specification	Reduction in Payment
0.0% to 0.1%	2%
0.1% to 0.2%	5%

- G. When the paving asphalt content is deficient by 0.2% to 0.4% (weight of the total mixed material less than the minimum permitted by the job mix formula), the Engineer shall evaluate and consider Type II or III slurry seal or overlay to be corrected and paid by the Contractor.
- H. When the paving asphalt content deviation is deficient by more than 0.4% of the permitted deviation, the Engineer shall evaluate and consider removal or overlay to be corrected and paid by the Contractor.
- I. When the mineral aggregate gradation, plasticity index or quality of the aggregate deviates from the specified requirements of this specification in amounts which will affect the pavement performance, the materials shall be removed or overlaid at no cost to the Owner to satisfy the intended function.
- J. Where the average pavement thickness is deficient by $\frac{1}{4}$ -inch or less, it will be paid for at the contract price. The Contractor shall reimburse the Owner the full cost of coring when the average pavement thickness is deficient by more than $\frac{1}{4}$ -inch.
- K. Where the pavement is deficient in thickness by more than $\frac{1}{4}$ -inch, but not more than $\frac{1}{2}$ -inch, payment will be reduced as noted in Table 32 12 16.6.
- L. When the deficiency of the pavement thickness exceeds $\frac{1}{2}$ -inch, the pavement shall be overlaid on the area affected at no cost to the Owner, with a new mat of material specified by the Engineer, equal in thickness to the deficiency, but not less than $\frac{1}{2}$ -inch in any instance. Furthermore, removal and replacement of the affected area will be required if existing grades do not allow the required overlay to be placed.

Table 32 12 16.6 Payment Reduction for Deficient Pavement Thickness	
Specified May Thickness	Reduction in Payment
Less than 1 $\frac{1}{2}$ "	50%
1 $\frac{1}{2}$ " to 2"	33%
2" to 2 $\frac{1}{2}$ "	25%
2 $\frac{1}{2}$ " to 3"	20%
3" and over	17%

- M. When the pavement is segregated and shows signs of excessive coarse material on the surface, the Contractor shall, per method directed by the Engineer, remove and replace the unstable material, apply a Type II or III slurry seal or overlay at no cost to the Owner.

3.7 CLEAN-UP

- A. Clean up the job site prior to acceptance of the work. Dirt, spoil, and debris of any nature shall be removed, and the entire site shall present a clean, workmanlike appearance. Damage to paint-work, including that resulting from prime-coating or tack-coating operations, shall be corrected.
- B. Assure that bituminous material is prevented from spraying upon adjacent pavements, curbs, and gutters, that portion of the traveled way being used by traffic, structures, planter islands, railings and barriers, markers, trees and shrubbery, adjacent property and improvements, and/or facilities not mentioned herein.

3.8 ATTACHMENTS

- A. Appendix No. 1: SRP Asphalt Mixing and Paving Equipment.

END OF SECTION

SECTION 32 12 16 – ASPHALT PAVING
APPENDIX No. 1

SALT RIVER PROJECT
ASPHALT MIXING AND PAVING EQUIPMENT
(SRP 02510)

1.0 GENERAL

- 1.1 This Supplemental Specification augments the requirements to Division 32 Section 32 12 16 “Asphalt Paving” for equipment used to mix, transport, distribute, prepare, laydown, and compact asphaltic paving products.
- 1.2 Equipment shall be subject to approval by the Engineer and shall be maintained in satisfactory operating condition. Acceptance of equipment by the Engineer does not relieve the Contractor of any obligation to fully comply with the material and application project specifications.

2.0 ASPHALT MIXING AND HANDLING AND DELIVERY

- 2.1 A temperature indicating device reading to 500°F±5° shall be fixed in the asphalt line or storage tank at a suitable location. Thermometric equipment shall be provided to indicate the temperature of the asphalt near the charging valve at the mixer.
- 2.2 Mix Production: Mix production shall be in accordance with MAG Section 321.6
- 2.3 Delivery:
- 2.3.1 The temperature of the mixture discharged into the hauling vehicles shall not vary more than 30°F for successive batches. The discharge end of the asphalt binder circulating pipe shall be maintained below the surface of the asphalt binder in the storage tank to prevent discharging hot bituminous binder into open air.
- 2.3.2 Beds of transport units used to haul asphalt concrete mixtures shall be coated with a release agent before loading. Petroleum distillates or other substances that will have a detrimental effect on the asphalt concrete shall not be used as a release agent. If required, the bed of the truck shall be raised to drain off excessive amounts of oil prior to loading. The beds of all transportation units shall be clean and smooth to allow the free flow of material into the paving machine’s hopper.
- 2.3.3 At the time of delivery to the job site, the Engineer shall be provided with a legible weight master's certificate (delivery ticket) containing the following information:
- a. Date
 - b. Supplier's name
 - c. Plant location and plant number
 - d. Ticket number
 - e. Contractor's name

- f. Project name and/or location
- g. Product code/description with percent asphalt
- h. Mineral filler/additive and percent
- i. Temperature at batching
- j. Time of batching, arrival and unloading
- k. Material weight or vehicle weight with and without material
- l. Weight of accumulative loads.

3.0 DISTRIBUTION EQUIPMENT

- 3.1 Distributor trucks shall be of the pressure type with insulated tanks. Gravity distributors will not be permitted.
- 3.2 Spray bars and extensions shall be of the full circulating type. The spray bar shall be adjustable to permit varying height above the surface to be treated.
- 3.3 The distance center to center of the nozzles shall not exceed 6 inches. The valves shall be operated so that one or all valves may be quickly opened or closed in one operation. Nozzle flow control valves shall be positive acting to provide a uniform unbroken spread of bituminous material on the surface.
- 3.4 The distributor shall be equipped with devices and charts to provide for accurate and rapid determination and control of the amount of bituminous material being applied, with an auxiliary wheel type tachometer reading speed in feet per minute (or meters per minute). The spreading equipment shall be designed so that uniform application of a bituminous material, in controlled amounts, may be made ranging from 0.05 to 2.0 gallon per square yard of surface and with a range of pressure from 25 to 75 psi. Transverse variation rate shall not exceed 10% of the specified application rate. The distributor shall be equipped with a hose and nozzle attachment for spotting skipped areas and areas inaccessible to the distributor. The distributor shall also be equipped with pressure gauges and an accurate thermometer for determination of the temperature of bituminous material. Distributor and booster tanks shall be so maintained at all times to prevent dripping of bituminous material from any part of the equipment.

4.0 HAND SPRAYERS

- 4.1 Hand spraying by means of hose or bar through a gear pump or air tank shall be acceptable for light application up to 0.10 gallons per square yard for resurface work of corners or tacking of vertical edges. Care shall be exercised to provide uniform coverage.

5.0 PLACING AND FINISHING EQUIPMENT

- 5.1 Courses of asphalt concrete shall be placed and finished by means of a self-propelled paving machine equipped with an automatically actuated control system, except under certain conditions or at locations where the Engineer deems the use of a self-propelled paving machine impracticable.

- 5.2 The control system shall control the elevation of the screed at each end by controlling the elevation of one end directly and the other end indirectly either through controlling the transverse slope or alternatively when directed, by controlling the elevation of each end independently.
- 5.3 The control system shall be capable of working with one of the following devices:
- a. Ski or non-contact device of not less than 30 feet in length, supported throughout its entire length
 - b. Taut stringline or wire set to grade
 - c. Short ski or sonar sensing units from curb control
 - d. Joint matching shoe
- 5.4 Failure of the control system to function properly shall be cause for the suspension of asphalt concrete production. In order to achieve a continuous operation, the speed of the paving machine shall be coordinated with the hot mix plant and transport units.
- 5.5 Self-propelled paving machines shall spread the mixture without segregation or tearing, true to line, grade and crown indicated on the Project plans. Pavers shall be equipped with hoppers and augers that will distribute the mixture uniformly in front of an adjustable floating screed. The raising of the hopper wings must be minimized and the paving machine will not be operated when in an empty condition.
- 5.6 Screeds shall include any strike-off device operated by tamping or vibrating action which is effective, without tearing, shoving or gouging the mixture and which produces a course with a uniform texture and density for the full width being paved. Screeds shall be adjustable as to height and crown and shall be equipped with a controlled heating device for use when required. In the case of the screed, auger extensions and vibrators shall be installed wherever the screed is extended more than one foot beyond the end of the base auger or auger extension. However, when placing material against an extremely uneven curb or edge over a short distance, the Engineer may waive the auger extensions and vibrators.
- 5.7 In conditions where the curb and/or gutter is not even and true to grade, the Engineer may require the Contractor to use a ski-type device or stringline as described above to establish the grade of the pavement surface adjacent to the curb and/or gutter.
- 5.8 The use of spreader boxes will be permitted by the Engineer only in writing, under certain conditions such as in alleys and on narrow paving projects where it is not practical to use a laydown machine. The spreader box will be equipped with a readily adjustable strike off blade. In order to obtain a smooth surface, manipulation of the spreader box controls shall be minimized.
- 5.9 If approved in writing by the Engineer, asphalt base course material may be placed with a self-propelled pneumatic tired blade grader equipped with an automatic leveling device capable of accurately maintaining the transverse slope of the blade at a preset angle. The grader shall have a blade not less than 12 feet long. Motor graders shall be free from appreciable lost motion in the blade control.

END OF DOCUMENT

SECTION 32 16 00

CURBS, GUTTERS, SIDEWALKS, and DRIVEWAYS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes concrete curbs, combination curb and gutters, valley gutters, driveway entrances, and sidewalks, including all necessary incidental work such as form work, joints, finishing and curing.

1.2 REFERENCES

- A. The following standards shall be made a part of this Specification:
 - 1. AASHTO M148 Liquid Membrane-Forming Compounds for Curing Concrete
 - 2. AASHTO M171 Sheet Materials for Curing Concrete
 - 3. AASHTO M182 Burlap Cloth made from Jute or Kenaf
 - 4. ACI 305R Hot Weather Concreting
 - 5. ACI 306.1 Standard Specification for Cold Weather Concreting
 - 6. ACI 347 Standard Recommended Practices for Concrete Formwork
 - 7. ASTM D1751 Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Type)
 - 8. ASTM D1752 Preformed Spong Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
 - 9. ASTM D2628 Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
 - 10. MAG 725 Portland Cement Concrete

1.3 TOLERANCES

- A. The surface of concrete sidewalk shall be tested with a 5-foot (1.5m) straightedge. Deviations shall not exceed 1/8 inch (3mm).
- B. The face, top, back, and flow line of the curb and gutter shall allow water flow in the specified direction without ponding and shall be tested with a 10-foot (3m) straightedge or curve template, longitudinally along the surface. Deviations shall not exceed 1/4 inch (6mm).

1.4 FIELD CONDITIONS

- A. Subgrade shall be moist but free of standing water.

- B. Placing of concrete shall be discontinued when the rainfall causes surface flow. Any concrete already placed and partially cured shall be covered to prevent dimpling. Install a construction joint prior to shut down.
- C. During conditions of high temperatures, low relative humidity, or wind which might impair quality of concrete, setting time shall be delayed by using proper admixtures. Hot weather concreting shall be in accordance with ACI 305R.
- D. Cold weather concreting shall be in accordance with ACI 306.1.

1.5 QUALITY ASSURANCE

- A. Sufficient traffic control (including barriers) shall be provided to adequately protect the fresh concrete with the time of protection required dependent upon the concrete type and climatic condition.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Delivery, transport and handling of ready-mix concrete to the jobsite shall conform to the requirements of MAG 725.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Forms:
 - 1. Forms for curbs shall be of rigid steel except on returns or curved sections. Forms for sidewalks and driveway entrances may be wood or steel.
 - 2. With wood sidewalk forms, the least dimension shall be nominally 2 inches (50mm) and lumber shall be free of loose knots and knotholes.
 - 3. All forms shall be in good condition with not more than 1/4 inch (6mm) variation in horizontal and vertical alignment for each 10 feet (3m) in length.
 - 4. Forms shall be designed and constructed to permit their removal without damage to concrete.
- B. Expansion Joints:
 - 1. Expansion joint filler shall consist of premolded strips of a durable resilient compound and comply with ASTM D1751, D1752, or D2628, as indicated on the Drawings or in the Specifications.
- C. Concrete:
 - 1. Concrete shall be Class B (f'_c @ 28 days = 2,500 psi (17.5MPa)), conforming to the material requirements of MAG 725.

D. Concrete Curing Materials:

1. Curing materials shall consist of waterproof paper (AASHTO M-171), polyethylene film (AASHTO M-171) or liquid membrane-forming compounds (AASHTO M-148) which, when applied to fresh concrete, will inhibit moisture loss and reduce temperature rise during the curing period.
2. Curing materials and methods shall be approved by the Engineer prior to use.
3. Wet coverings such as burlap (AASHTO M-182) or other moisture-retaining fabrics also may be used.
4. Film or membrane curing compounds shall contain a fugitive dye which remains visible on concrete for at least four hours after application.

E. Base Course:

1. Base course below concrete (when specified for use on the Drawings) shall be approved by Owner.

PART 3 - EXECUTION

3.1 GENERAL

- A. Existing pavements and concrete that are joined by new construction shall be saw cut as required. Sidewalks and driveways which are necessarily disturbed by construction shall be removed to a distance required to maintain specified slope.

3.2 EQUIPMENT

- A. Equipment used in the performance of the work shall be subject to approval by the Engineer or his representative and shall be maintained in satisfactory working condition.

3.3 PREPARATION

- A. Material displaced in construction shall not be laid on an in-place base or surfacing material, nor shall it be placed in such a manner as to interfere with access to property or traffic flow.
- B. If specified in the Drawings, the subgrade shall be covered with a course of compacted ABC and brought to final base surface grade. ABC shall be approved by Owner.

3.4 FORM WORK

- A. Form work shall conform to the requirements of ACI 347," Standard Recommended Practice for Concrete Formwork.
- B. Concrete curbs, combination curb and gutters and valley gutters shall be constructed by conventional forming and placing methods or may be constructed by means of an appropriate machine when approved by the Engineer.

CURBS, GUTTERS, SIDEWALKS, and DRIVEWAYS

32 16 00 - 3

- C. If machines designed specifically for such work are approved for use by the Engineer, the results must be equal to or better than that produced by use of forms. If the results are not satisfactory to the Engineer, the use of machines shall be discontinued and the Contractor shall make necessary repairs at his own expense. Applicable requirements for construction by use of forms shall apply to the use of machines.
- D. Forms shall be carefully set to line and grade and securely staked in position. Water forms and subgrade immediately in advance of placing concrete.
- E. Forms shall be thoroughly cleaned each time used and coated with a light oil or other releasing agent which will not discolor the concrete.

3.5 CONCRETE PLACEMENT

- A. The concrete shall be thoroughly spaded away from the forms so that there will be no rock pockets next to the forms. The concrete may be compacted by mechanical vibrators approved by the Engineer. Tamping or vibrating shall continue until the mortar flushes to the surface and the coarse aggregate is below the concrete surface. The surface shall then be struck off and worked to grade and cross section with a wood float.
- B. If machine placement is used, the machine shall place, consolidate and finish the concrete in one complete pass, requiring a minimum of hand finishing to produce a dense and homogeneous section. A form shall trail behind the machine for such a distance that no appreciable concrete slumping will occur. Final finishing shall be as specified hereinafter.

3.6 JOINTS

- A. Joints, unless otherwise specified, shall be constructed in accordance with the standard details and in a straight line and vertical plane perpendicular to the longitudinal line of the sidewalk or curb and gutter, except in cases of curved alignment, when they will be constructed along the radial lines of the curve.
- B. Expansion joints shall be constructed to the full cross section of the concrete and shall match the joints in the adjacent pavement, sidewalk or curb and gutter. Joints shall be constructed at all radius points, driveway entrances, and at adjoining structures with a maximum interval of 50 feet between joints.
- C. Expansion joint filler shall be cut to the configuration of and be in contact with the full concrete cross section. Joint material shall be secured so as not to move during depositing and compacting of concrete.
- D. Expansion joints in machine-placed construction shall be made by removing a portion of the freshly placed concrete, inserting joint filler and replacing hand finished concrete at the joint. Rigid forms shall be placed at these joints long enough to ensure that no appreciable slumping of the concrete will occur.

- E. Contraction joints on sidewalks, curbs, gutters and valley gutters, unless otherwise specified, shall be 1/8 inch (3mm) wide by 1 inch (25mm) deep and at 10-foot (3m) intervals where sidewalks are 4 to 5 feet (1.2 to 1.5 m) wide, or where there is no sidewalk. Contraction joint spacing where sidewalk widths are larger shall be as specified on the plans. Sidewalk and driveway entrance joints shall match adjacent curb and gutter joints.
- F. Score marks in sidewalks, unless otherwise specified, shall be 1/8 inch (3mm) wide by 1/2 inch (13mm) deep and located every 5 feet (1.5m) between contraction joints.

3.7 EDGES

- A. Joint edges shall be shaped with a suitable edging tool so as to form rounded edges to a radius as indicated on the plans. Exposed joint surfaces shall be sealed with curing material.

3.8 FORM REMOVAL AND FINAL FINISH

- A. The front face form shall not be removed before the concrete has taken the initial set and has sufficient strength to carry its own weight. Gutter forms and rear forms shall not be removed until concrete has hardened sufficiently to prevent damage to the edges. Special care shall be taken to prevent any damage to green concrete.
- B. After the forms and templates are removed, the joints shall be tooled and the surface finished with a wood or cork float to remove all imperfections without additional mortar or drier. In all cases, the resulting surface shall be smooth and of uniform color with all rough spots, projections, and form stakes removed.
- C. No plastering of the concrete will be allowed.
- D. The concrete work shall have a true surface; shall be free from sags, twists, or warps; have a uniform appearance; and be true to the lines, grades, and configurations indicated on the drawings.
- E. Surfaces shall be sweat finished by means of a steel trowel or light brooming.

3.9 CURING

- A. As soon after the completion of finishing operations as the condition of the concrete will permit without danger of consequent damage thereto, exposed surface shall either be water cured, sprayed, or covered with a material conforming with Section 2.1.4.
- B. Concrete that is water cured must be kept continuously wet for at least 10 days after placement; preferably being covered with at least two layers of not lighter than 7 ounce (0.2kg) burlap. Sidewalks that are water cured may, in lieu of burlap, be covered with at least a two inch depth of sand and must remain wet and in place at least 10 days unless otherwise directed by the Engineer.

- C. When a sprayed impervious membrane is used it shall be applied under pressure through a spray nozzle in such manner and quantity as to entirely seal exposed concrete surfaces with a uniform film. The membrane shall be applied in two applications for a total coverage of 150 square feet per gallon (3.7m²/L).
- D. Concrete surfaces shall be kept damp until the membrane is applied. Should the membrane seal be broken or damaged before the expiration of 10 days after the placing of the concrete, the break shall be immediately repaired by the application of additional impervious membrane over the damaged area.
- E. If there is likelihood of the fresh concrete checking or cracking before the curing operations, it shall be kept damp (not wet) by indirect fine spray of water until such danger is past, or until curing operations are started in the particular area affected.
- F. In hot weather, water curing should be used wherever practical and should be continuous. The need for adequate continuous curing is greatest during the first few hours after placement of concrete.

3.10 CLEAN-UP

- A. Unless otherwise specified, backfill behind curbs and sidewalks with approved fill as shown on the Drawings.
- B. Clean up the job site prior to acceptance of the work. Dirt, spoil and debris shall be removed and the entire site shall present a clean, workmanlike appearance. Damage to paint-work or adjacent paving, including that resulting from concrete placement operations, shall be corrected.

END OF SECTION

SECTION 32 17 23

PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes pavement marking on asphalt concrete parking lots, driveways, access roads, etc., using paint, reflectorized media, raised reflectors and/or pre-formed tape.
- B. These products are intended for use in marking centerlines and edge lines, crosswalks, stop lines, parking spaces, storage zones, traffic aisles, traffic control marks, etc.
- C. Provide labor, materials and equipment necessary for surface preparation and application.

1.2 REFERENCES

- A. The following standards shall be made a part of this Specification:
 - 1. AASHTO M247 Glass Beads Used in Traffic Paint
 - 2. AASHTO M248 Ready-Mixed White and Yellow Traffic Paints
 - 3. ASTM D185 Coarse Particles in Pigments, Pastes and Paints
 - 4. ASTM D562 Consistency of Paints Using the Stormer Viscometer
 - 5. ASTM D711 No-Pick-Up Time of Traffic Paint
 - 6. ASTM D1210 Fineness of Dispersion of Pigment Vehicle Systems
 - 7. ASTM D1475 Density of Paint, Varnish, Lacquer and Related Products
 - 8. ASTM D2805 Hiding Power of Paints by Reflectometry
 - 9. ASTM D4280 Extended Life Type, Non-plowable, Prismatic, Raised, Retro-reflective Pavement Markers
 - 10. ASTM D4505 Pre-formed Plastic Pavement Marking Tape for Extended Life Service
 - 11. FS TT-P-115 Paint, Traffic (Highway, White and Yellow) (includes Federal Test Methods 141, 4021, 4051 and 4081)
 - 12. FF TT-P-1952 Paint, Traffic and Airfield Marking, Waterborne
- B. Permission for deviation from these standards and/or specifications must be approved in writing by the Engineer prior to award of the Contract.

1.3 SUBMITTALS

- A. Provide the following information to the Engineer at least five days prior to traffic marking application:

1. Traffic paint manufacturer's technical data and Materials Safety Data Sheet (MSDS), including the quantitative requirements as described in Table 32 12 23.1 of this specification for each type of paint proposed for use. Include type of paint vehicle to be used (water-based, alkyd, vinyl or chlorinated rubber).
2. Certificate stating that the proposed pavement marking paint meets the VOC regulation of the local Air Pollution Control District having jurisdiction over the project area.
3. Description of the application method and a list of equipment to be used for pavement marking application.

1.4 JOB CONDITIONS

- A. Traffic paint shall not be applied until both the pavement surface and air temperatures are at least 40°F (5°C) and rising, unless otherwise directed by the paint manufacturer's recommendations.
- B. Pre-formed tape shall not be applied until both the pavement surface and air temperatures are at least 60°F (15°C) and rising, unless otherwise directed by the tape manufacturer's recommendations.
- C. Relative humidity shall be below 50% and there shall be no threat of rain. The pavement shall be dry at the time of pavement marking application.
- D. Sufficient traffic control (including barricades) shall be provided to adequately protect pavement markings, with the time of protection required dependent upon manufacturer's recommended drying time and the weather conditions.

1.5 TOLERANCES

- A. Finished lines shall be straight within 3/4-inch (19-mm) over 10 feet (3-m). Curved lines shall maintain the required radius to within 3/4-inch (19-mm). Line widths shall be within 1/2-inch (13-mm) of the size specified on the Drawings or in the Specifications. Edges of markings shall be sharply outlines.

1.6 QUALITY ASSURANCE

- A. Traffic paint and its application shall comply with city, county and state air pollution control regulations and U.S. federal hydrocarbon and volatile emission regulations.
- B. Application and handling of traffic paint shall comply with all OSHA regulations regarding toxic substances contained in the paint.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Materials shall be delivered to the job site in new, unopened air-tight containers, appropriately identified with the manufacturer's name, date of manufacture, type of paint or paint material, specifications paint number, and lot or batch number.

1. Containers shall have a formula label.
 2. Materials shall be stored in the designated area and storage areas will be kept neat and clean.
 3. Paint shall not be used until at least 7 days have elapsed or after two years past the date of manufacture.
- B. Handle all materials in strict accordance with the manufacturer's directions and Specifications.

1.8 EQUIPMENT

- A. Hand-operated, push-type paint machines shall be acceptable for access roads and parking lots. Applicator machine shall be equipped with the necessary paint tanks and spraying nozzles and shall be capable of applying paint uniformly at coverage specified and widths required. Sandblasting equipment (if needed) shall be provided as required for cleaning surfaces to be painted. Hand-operated spray guns shall be provided for use in areas where push-type machines cannot be used.
- B. Dispenser for applying reflective media (beads) shall be attached to the paint dispenser and operate automatically and simultaneously with the applicator through the same control mechanism. Dispenser shall be capable of adjustment and designed to provide uniform flow of reflective media over the full length and width of the stripe at the rate of coverage specified. Application, at all operating speeds of the applicator to which it is attached.
- C. Mechanical equipment shall be used for the placement of pre-formed marking tape and shall be specifically designed for use in applying pre-coated, pressure-sensitive pavement marking tape of varying widths, up to 12 inches (300-mm). The applicator shall be equipped with rollers, or other suitable compactive devices, to provide initial adhesion of the pre-formed, pressure-sensitive marking tape with the pavement surface. Additional hand-operated rollers shall be used as required to properly seat the thermoplastic tape.
- D. Machines, tools and equipment used in the performance of the work shall be subject to approval by the Engineer or his representative and shall be maintained in satisfactory working condition.
- E. Application equipment must be clean from paints and solvents prior to initial application and between application of different colors.

PART 2 - PRODUCT

2.1 PAINT

- A. Type(s) and color(s) of traffic paint to be used shall be noted on the Drawings or within the Specifications.

- B. Traffic paint shall be homogeneous, easily stirred to smooth consistency, free of contaminants, and shall show no hard settlement or other objectionable characteristics during a storage period of 6 months.
- C. Water-based traffic paint (fast-dry) shall conform to AASHTO M248 or FF TT-P-1952. Mixed paint shall meet the requirements specified in Table 32 17 23.1
- D. Water based traffic paint (rapid-dry), with no lead or chrome content, shall conform to FF TT-P-115. Mixed paint shall meet the requirements specified in Table 32 17 23.1

Table 32 17 23.1 Quantitative Requirements of Mixed Paints		
Requirement	Rapid Dry	Fast Dry
Pigment, percent by weight (Fed Test Method Std. #141/4021)	54 min.	46 min.
Vehicle, percent by weight (Fed Test Method Std. #4051)	41 min.	--
Total Solids, percent by weight (Fed Test Method Std. #4081)	75 min.	64 min.
Coarse particles and skins (retained on a No. 325 sieve) (50µm) percent by weight of pigment (ASTM D185)	1.0 max.	1.0 max.
Viscosity, Krebs Units (ASTM D562)	70-80	75-80
Weight per gallon, lb. (kg), minimum (ASTM D1475)	13.3 (6.0)	12.4 (5.6)
Drying time for no pick-up, minutes @ 70-77° F (21-25°C) (ASTM D711)	10 max.	75 max.
Fineness of grind, Hegman (ASTM D1210)	3 min.	4 min.
Dry opacity (@ wet-film thickness equal to a spread rate of 32 gallons) White (ASTM D2805) Yellow (ASTM D2805)	0.90 min. 0.95 min.	0.90 min. 0.95 min.

Unless otherwise specified, all tests shall be conducted at standard conditions which are 73±2°F (23±1°C) and relative humidity of 50±4 percent.

- E. Use of any other paint vehicle (alkyd, vinyl or chlorinated rubber) requires pre-approval by the Engineer at the time of bid submittal. Maximum dry time shall be 30 minutes at 70-77°F(21-25°C) when tested in accordance with ASTM D711.
- F. Traffic paint shall not contain lead and chromate.
- G. Traffic paint shall be available in white and yellow, as shown on the Drawings and stated in the Specifications. Other color paints may be required and will be per the Specifications.
- H. The in-service temperature limit on traffic paint shall be 250°F (121°C) Maximum 2.2

2.2 REFLECTIVE MEDIA (GLASS BEADS)

- A. Reflective media shall conform to AASHTO M247, Type I.

2.3 RAISED REFLECTIVE MARKERS

- A. Either metallic or non-metallic markers of the button or prismatic reflector type may be used. Markers shall be of permanent colors as specified for pavement markings, and shall retain the color and brightness under the action of traffic. Button markers shall have a diameter of not less than 4 inches (100-mm) with rounded surfaces presenting a smooth contour to traffic and shall not project more than $\frac{3}{4}$ -inch (19-mm) above level pavement. Pavement markers and adhesive epoxy shall conform to ASTM D4280.

2.4 PRE-FORMED TAPE

- A. Pre-formed tape shall be an adherent reflectorized strip in accordance with ASTM D4505, Type I or IV (class is optional).

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surfaces to be painted shall be thoroughly dry and free from dirt, dust, loose paint, oil, grease, wax, and other contaminants. Perform pavement cleaning to assure that pavement markings will properly adhere. Pavement markings shall not be applied until the prepared pavement surface has been inspected by the Engineer.
- B. The traffic paint shall be mixed thoroughly just prior to application and shall be homogeneous, free of contaminants, and of a consistency suitable for the intended user. The pigment shall be properly dispersed in the vehicle according to the requirements of the paint, and this dispersion shall be of such nature that the pigment does not settle appreciably, does not cake or thicken in the container, or become granular or curdled.
- C. When required by the Drawings or Specifications, perform wet sandblasting of sufficient capacity and with sufficient materials to completely remove existing striping or markings. Work shall comply with requirements of the local air pollution control district. Used sand and removed paint debris shall be cleaned from the pavement without delay as the sandblasting operation progresses.

3.2 APPLICATION

- A. The centerline of all pavement markings shall be accurately located and marked on the pavement prior to application.
- B. Paint shall be applied pneumatically with approved equipment at the rate of coverage specified herein. Provide guide lines, stencils, and templates as necessary to control paint application. Special precautions shall be taken in marking numbers, letters, and symbols.

- C. Paint shall be applied evenly to the pavement surface to be coated at thickness of 15 mils (380- μ m), which should be equal to an application rate of 100 $\pm$ 5 square feet per gallon (10 $\pm$ 0.5 m²/L) of paint.
- D. Reflective media (glass beads) shall be applied uniformly to the wet paint on the pavement at a rate of 6 $\pm$ 0.5 pounds per gallon (700 $\pm$ 60 g/L) of paint. Should there be a malfunction of either paint applicator or reflective media dispenser, operation shall be discontinued immediately until deficiency is corrected. Use of pre-mixed glass bead paints requires review and approval by the Engineer at the time of bid submittal.
- E. Pre-formed tape shall be applied in accordance with manufacturer's recommendations.
- F. Raised reflective markers shall be aligned carefully at the required spacing and permanently fixed in place by means of epoxy resin adhesives. Applications shall be in accordance with manufacturer's recommendations.
- G. The maximum drying time requirements of the paint specifications will be strictly enforced to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. Traffic shall be kept off of markings until paint has dried so that it cannot be tracked. If there is a delay in drying of the markings, painting operations shall be discontinued immediately until the cause of the slow drying is determined and corrected.
- H. Unless otherwise specified, newly placed asphalt and concrete pavements shall be cured for at least 30 days prior to paint application. For recent surface treatments (seal coats, chip seals, etc.), no traffic paint shall be applied until 7 days after the date of application.
- I. Contractor shall protect surrounding pavement, curbs, gutters, sidewalks, lawn, shrubbery, buildings or any other object providing suitable coverings.

3.3 CLEAN UP

- A. Clean up the job site prior to acceptance of the work. Dirt, spoil, and debris shall be removed, and the entire site shall present a clean, workmanlike appearance. Damage (including that resulting from pavement marking operations) shall be corrected.
- B. Remove unused paint and all waste generated from traffic striping from the job site following completion of the work. No waste generated from traffic striping activities shall be placed in Owner's waste receptacles.
- C. Comply with regulations regarding handling, storage, and disposal of all hazardous materials and waste.

END OF SECTION

PAVEMENT MARKINGS

32 17 23 - 6

SECTION 32 84 00

PLANTING IRRIGATION

PART 1 -GENERAL

1.1 SUMMARY

- A. Section Includes: Underground irrigation system including the following:
 - 1. Trenching, stockpiling, excavation of materials, and refilling trenches.
 - 2. Complete systems including but not limited to piping, pump station, backflow preventer, assemblies, valves, fittings, heads, controller wiring, and final adjustments to ensure efficient coverage as determined by Architect.

1.2 REFERENCES

- A. Perform Work in accordance with requirement of Conditions of the Contract and Division 01 General Requirements as well as provisions of all applicable laws, codes, ordinances, rules and regulations. Conform to requirements of reference information listed below, except where more stringent requirements are indicated in the Contract Documents.
 - 1. American Society for Testing and Materials (ASTM) - Specifications and Test Methods specifically referenced in this Section.
 - 2. Underwriters Laboratories (UL) - UL wires and Cables.

1.3 CLOSEOUT SUBMITTALS

- A. Project Record Drawings:
 - 1. Contractor shall draw lateral piping, controller station numbers, and all other record information. Record Drawings shall be available at the Project Site for review. Upon completion of Project, Contractor shall submit Record Drawings for review, prior to final acceptance.
 - 2. Dimension from two permanent points of reference, (building corners, sidewalks, road intersections, or permanent structures), location of the following items:
 - a. Routing of pressure supply lines (dimension every 100 feet along the routing).
 - b. Electric control valves.
 - c. Control wire routing (if not with pressure supply line).
 - d. Record Drawings shall be to same scale and in the same format as the Contract Drawings.
 - 3. Prior to scheduling walk-through for Substantial Completion, submit all Field Record information to Owner for approval.
 - 4. Contractor shall also provide both a hard copy and Electronic Form version of the Controller Data Sheets to the Architect.

- B. Controller Charts: Do not prepare controller charts until record drawings have been approved by the Architect.
1. Provide controller chart, automatic controller.
 - a. Controller drawing may be same size reproduction of the record drawings, if scale permits fitting them inside the controller door without folding drawing. If photo reduction prints are required, keep reproduction to maximum size possible to retain full legibility. Chart may also be Controller Data Sheet as for central-satellite systems, if approved by Architect.
 - b. Controller chart shall be bond print of actual as-built system, showing area covered by that controller; or Controller Data Sheet showing information on each station, and with complete description of each station's location.
 - c. Identify area of coverage of each remote control valve, using a distinctly different pastel color for each zone. Highlight heads, lateral piping, and control valves.
 - d. Following review of controller drawings by Architect, hermetically seal each chart between two layers of 20 mm thick clear plastic.
 - e. Controller chart shall be completed and approved by Architect prior to final completion walk-through of irrigation system.
 - f. Attach approved controller chart to inside of each controller door using self adhesive Velcro strips.
 2. Following installation of each controller, record all station data on a "Data Sheet" furnished by the Architect. Data shall include the type and quantity of irrigation devices on each station, nozzle type, arc, area of control (turf, trees, shrubs, etc), valve size, gpm, location, etc. as shown on the Data Sheet.
 3. Prior to final walk-through for each area of the Project, Contractor shall confirm that the following has been completed:
 - a. Construction record drawings.
 - b. Data Sheets for controllers.
- C. Operational Manual: Submit 3 sets of operations manual to Architect for review, prior to scheduling the final completion walk-through. Manual is to include the following in a 1-inch 3-ring binder:
1. Index sheet stating project name, and listing Contractor name, address, phone number, and contact person. Include same information for primary subcontractors.
 2. Manufacturer cut sheets for all material components of irrigation system. Highlight or circle specific models or items.

1.4 EXTRA STOCK MATERIALS

- A. In addition to installed system furnish the following items to Owner:
1. 4 per 100 installed drip emitters of each type used.
 2. 2 pop-up heads of each type used.

1.5 MAINTENANCE TOOLS

- A. Furnish the following maintenance items to Owner prior to final Acceptance:

1. 2 sets of special tools required for moving, disassembling, and adjusting each type of sprinkler head and valve supplied on this Project.
2. 2 keys for each automatic controller.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Installer shall have had considerable experience and demonstrated ability in the installation of irrigation system(s) of specified type(s) in a neat, orderly, and responsible manner in accordance with recognized standards of workmanship.
- B. Special Requirements:
 1. Tolerances: Specified depths and separations of pressure supply lines and laterals and pitch of pipes are minimums. Settlement of trenches is cause for removal of finish grade treatment and repair of finished grade treatment.
 2. Coordination with Other Contracts: Protect, maintain, and coordinate Work with Tasks under other sections.
 3. Damage to Other Improvements: Contractor shall replace or repair damage to grading, soil preparation, seeding, sodding, or planting done under other Sections during work associated with installation of irrigation system at no additional cost to the Owner.
 4. Work involving substantial plumbing for installation of pump station, backflow preventers, copper service, and related work shall be executed by licensed and bonded plumber(s), performed in accordance with all prevailing codes and regulations.
 5. Work involving connection to, installation, or extension of 120-volt or greater electrical service shall be executed by a licensed and bonded electrician, performed in accordance with all prevailing codes and regulations.
- C. Irrigation Control System Procedures:
 1. Furnish and install all specified control equipment to result in a complete and working system, whether or not all appurtenances are indicated on Drawings. System shall include controllers; all grounding and surge protection; master valves; and weather communication source.

1.7 DELIVERY, STORAGE and HANDLING

- A. Deliver, unload, store and handle materials, packaging, bundling, products, in dry conditions, or a weatherproof manner, to prevent damage, breakage, deterioration, intrusion, ignition, and vandalism.
- B. Deliver in original unopened packaging containers prominently displaying manufacturer name, volume, quantity, contents, instructions, and conformance to local, state, and federal law.
 1. Remove and replace cracked, broken, or contaminated items or elements prematurely exposed to moisture, inclement weather, snow, ice, temperature extremes, fire, or job site damage.

- C. Handling of PVC Pipe: Exercise care in handling, loading, and storing of PVC pipe.
 - 1. PVC pipe shall be transported in a vehicle, which allows the entire length of pipe to lie flat so as not to subject it to undue bending or concentrated external loads.
 - 2. All sections of pipe that have been dented or damaged shall be discarded, and if installed, shall be removed and replaced with new piping.

1.8 FIELD CONDITIONS

- A. Protection of Property:
 - 1. Preserve and protect all trees, plants, monuments, structures, and paved areas from damage due to Work in this Section. In the event damage does occur, all damage to inanimate items shall be completely repaired or replaced to the satisfaction of the Owner. All injuries to living plants shall be repaired by the Owner, and all costs of such repairs shall be charged to and paid by the Contractor.
 - 2. Protect buildings, walks, walls, and other property from damage. Flare and barricade open ditches. Damage caused to asphalt, concrete, or other building material surfaces shall be repaired or replaced at no cost to the Owner. Restore disturbed areas to original condition.
- B. Existing Trees: All trenching or other Work under limb spread of any and all evergreens or low branching deciduous material shall be done by hand or by other methods so as to prevent damage to limbs or branches.
- C. Protection and Repair of Underground Lines: Request proper utility company to stake exact location (including depth) of all underground utilities. Take whatever precautions necessary to protect underground lines from damage. In the event damage occurs, all damages shall be repaired by Contractor unless other arrangements have been made.
- D. Replacement of Paving and Curbs: Where trenches and lines cross existing roadways, paths, curbing, etc., damage to these shall be kept to a minimum and shall be restored to original condition.

1.9 WARRANTY

- A. Contractor shall warrant materials against defects for a period of one year from the date of Substantial Completion. Warrant workmanship for similar period. Contractor shall be responsible for coordinating material warranty items with the manufacturer / distributor.
- B. Settling of backfilled trenches which may occur during guaranty period shall be repaired by Contractor at no expense to the Owner, including complete restoration of damaged property.
- C. Expenses due to vandalism before substantial completion shall be borne by Contractor.
- D. Owner or representative maintenance company will maintain turf and planting areas during warranty period, so as not to hamper proper operation of the irrigation system.

PART 2 -PRODUCTS

2.1 MATERIALS

A. General Piping:

1. Piping for reclaimed water systems shall be purple-colored or wrapped with reclaimed "sock" or reclaimed marking tape, and main lines shall have detectable reclaimed marking tape in trench 12 inches above top of pipe continuously.
2. Pressure Supply Lines (downstream of Pump Station): Schedule 40 PVC, solvent-weld, belled end for 2-1/2 inches or smaller, and rubber-ring joint for 3 inches and larger with ductile iron fittings and taps.
3. Non-Pressure Lines: PVC, Solvent Weld Belled End.
4. Drip Piping: 3/4-inch Sch. 40, solvent weld unless otherwise indicated.
5. Emitter Tubing: By emitter manufacturer.

B. Plastic Pipe and Fittings:

1. Identification Markings:
 - a. All pipe to be identified with following indelible markings:
 - 1) Manufacturer's Name.
 - b. All fittings including valve taps for rubber-ring pipe shall be cast or ductile iron, rubber-ring for PVC.
2. Solvent Weld Pipe - Manufactured from virgin polyvinyl chloride (PVC) compound in accordance with ASTM D2241 and ASTM D1784; cell classification 12245-B, Type 1, Grade 1.
 - a. Fittings - Standard weight, Schedule 40, injection molded PVC; complying with ASTM D1784 and D2466, cell classification 12454-B.
 - 1) Threads - Injection molded type (where required).
 - 2) Tees and ells - Side gated.
 - b. Threaded Nipples - ASTM D2464, Schedule 80 with molded threads.
 - c. Joint Cement and Primer - Type as recommended by manufacturer of pipe and fittings.

C. Low Pressure / Volume Systems:

1. Emitters as indicated on Drawings.
2. Drip Piping: PVC compound conforming to ASTM D2241 and ASTM D1784, Type 1, Grade 1.
3. Fittings: Schedule 40 PVC, or as recommended by piping manufacturer.
4. Drip Valve Assembly: Type and size indicated on Drawings.
 - a. Wye Strainer: Plastic / Fiberglass construction with 150 mesh nylon screen and blow out assembly.
 - b. Control Valve: 2-way, solenoid pilot operated type made of synthetic, non-corrosive material; diaphragm-activated and slow closing. Include freely pivoted seat seal; retained (mounted) without attachment to diaphragm.
 - c. Pressure Regulator: Plastic / Fiberglass construction, preset type with pressure setting per Drawings.

- D. Copper Pipe and Fittings:
 - 1. Copper Pipe: Type K hard tempered.
 - 2. Fittings: Wrought copper, solder joint type.
 - 3. Joints: Soldered with solder, 45% silver, 15% copper, 16% zinc, and 24% cadmium and solids at 1125 F and liquids at 1145 F.
- E. Brass Pipe and Fittings:
 - 1. Fittings: Medium brass, screwed 125 pound class.
 - 2. Brass Pipe: 85% red brass, AMSI Schedule 40 screwed pipe.
- F. Valve Boxes:
 - 1. Note: All box covers for reclaimed water systems shall be purple colored, and marked for reclaimed. Nominal pipe size.
 - 2. Schedule or class.
 - 3. Pressure rating.
 - 4. NSF (National Sanitation Foundation) seal of approval.
 - 5. Date of extrusion.
 - a. Otherwise, valve box color to be selected based upon a review of the location and adjacent material by Owner and Architect prior to installation.
 - 6. Drip Line Blow-out Stubs, and Wire Stub Box: Carson #910-12.
 - 7. 1-inch through 2-inch Control Valves: Carson #1419-13B.
 - 8. Drip Valve Assemblies: Carson #1419-13B.
 - 9. Control Wiring Splices: Carson #910-12.
 - 10. Main Line Gate Valves: Carson #910-12.
 - 11. Air-Relief Valves: Carson #1419-13B.
 - 12. Manual Drain Valves: Carson #1419-13B.
 - 13. Master Control Valve: As indicated on Drawings.
- G. Electrical Control Wiring:
 - 1. Low Voltage:
 - a. Electrical Control Wire: Hunter two-wire.
 - b. If multiple controllers are utilized, a different two wire for each controller.
 - 2. High Voltage: Type required by local codes and ordinances, of proper size to accommodate needs of equipment serviced.
- H. Sprinkler Heads: As indicated on Drawings. Use purple caps or nozzles for Reclaimed Water use.
- I. Electric Control Valves: As noted on Drawings. Purple handles for Reclaimed Water use. Install pressure regulating devices where indicated on Drawings.
- J. Pipe Bedding Material: Construction grade sand approved by Architect.

- K. Automatic Controller: As indicated on Drawings. Provide two (2) remote control units (compatible as specified by Owner) as part of the work.
- L. Manual Drain Valve: As indicated on Drawings.
- M. Air-Relief Valve: As indicated on Drawings.
- N. Master Control Valve: As indicated on Drawings.
- O. Pump Station: As indicated on Drawings.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which Work of this Section is to be performed. Do not proceed until unsatisfactory conditions have been corrected.
- B. Grading operations, with the exception of final grading, shall be completed and approved by Owner prior to staking or installation of any portion of irrigation system except sleeving.

3.2 PREPARATION

- A. Staking Shall Occur as Follows:
 - 1. Mark with powdered lime or marking paint routing of pressure supply lines, and flag heads and control valve locations for first series of zones for approval.
- B. Sleeving: Install sleeving under all asphalt paving and concrete walks, prior to the installation of concrete or paving operations, to accommodate piping and wiring. Compact backfill around sleeves to 95% Standard Proctor Density within 2% of optimum moisture content in accordance with ASTM D1557.
- C. Trenching: Trench excavation shall follow, as much as possible, layout indicated on Drawings. Excavate trenches straight, and support pipe continuously on bottom of trench. Trench bottom shall be clean and smooth with all rock and organic debris removed. Pressure supply line trenches shall be over-excavated as required to allow for bedding material. Trench depth shall be uniform as required to meet minimum depth requirements for the type of piping being installed.
 - 1. Clearances:
 - a. Piping Smaller Than 3 Inches: Trenches shall have a minimum width of 7 inches. 12 inches for 3-inch and larger pipe.
 - b. Line Clearance: Not less than 6 inches of clearance between each line, and not less than 12 inches of clearance between lines of other trades.
 - c. Reclaimed Water Systems: 2-foot vertical (below) and 6-foot horizontal separations from potable lines are required per MAG and industry standards.
 - 2. Pipe and Wire Depth:

- a. Pressure Supply Piping: 24 inches from top of pipe (30 inches where 6-inch and larger pipe is indicated).
- b. Non-Pressure Piping: 12 inches from top of pipe.
- c. Two-Wire: Side and bottom of pressure supply line.
- d. Drip Piping: 12 inches from top of pipe.
- e. Emitter Tubing: 12 inches from top of pipe (non slope plantings). 4 inches from the top of pipe (slopes 2:1 of greater).

3.3 INSTALLATION

- A. Other Equipment: Locate other equipment as near as possible to location designated on Drawings. Deviations shall be approved by Architect prior to installation.
- B. PVC Piping:
 1. Snake pipe in trench as much as possible to allow for expansion and contraction.
 2. When pipe laying is not in progress, or at end of each day, close pipe ends with tight plug or cap. Perform work in accordance with good practices prevailing in piping trades.
 3. Coordinate pressure supply line installation with required bedding operations. Concrete thrust blocks or steel joint restraints shall be utilized for all rubber-ring joint fittings per industry standards. In sandy soil, mechanical joint fittings shall be used with thrust blocks.
 4. Stake all above-grade PVC piping per details.
 5. Use 45-degree ells when making perpendicular crossings of above-grade PVC piping, to depress bottom pipe.
 6. Lay pipe and make all plastic-to-plastic joints in accordance with manufacturer's recommendations.
- C. Drip Piping:
 1. Install fitting connections per manufacturer's recommendations.
 2. Use threaded risers and Sch. 40 or Sch. 80 fittings per details when making connections in drip piping for emitters and fittings.
 3. Install drip line blow-out stubs at all dead ends of drip piping.
 4. Any deviations from drip pipe routing indicated on Drawings must be approved by Architect prior to installation.
- D. Control Wiring:
 1. Low Voltage Wiring (Two Wire):
 - a. Bury control wiring between controller and electric valves in pressure supply line trenches, with wires consistently located to one side of pipe, on top of initial pipe bedding, or in separate trench.
 - b. Provide an expansion loop at pressure supply line angle fittings, every electric control valve location (in valve box), and at minimum 500 feet intervals. Form expansion loop by wrapping wire at least 8 times around a 1-inch pipe and withdrawing pipe.

- c. Make splices and electric control valve connections using DBY connectors or similar dry splice method.
 - d. Install two wire splices not occurring at control valve in a separate splice valve box.
 - 2. High Voltage Wiring for Automatic Controller:
 - a. Provide 120-volt power connection to automatic controller.
- E. Automatic Controller:
 - 1. Install controller in accordance with manufacturer's instructions as detailed and where indicated on Drawings.
 - 2. Connect remote control valves to controller in numerical sequence as indicated on Drawings.
 - 3. Final location of controller shall be approved by Architect prior to installation.
 - 4. Each controller shall have a dedicated separate ground wire and surge protection.
 - 5. Above-ground conduit shall be rigid galvanized steel with appropriate fittings. Below-ground conduit shall be Schedule 40 PVC.
- F. Drip Valve Assemblies: Install drip valve assembly as detailed.
- G. Drip Emitters: Install drip emitters as detailed.
- H. Valve Boxes:
 - 1. Install one valve box for each type of valve installed as detailed flush with grade for all sodded areas, and above-grade for all seeded areas.
 - 2. Valve box extensions are not acceptable, except for master valve.
 - 3. Install gravel sump after compaction of all trenches. Valve box to rest on gravel sump. Place final portion of gravel inside valve box after valve box is backfilled and compacted.
 - 4. Install "Christy" stainless steel or 2.5-inch by 5-inch plastic valve label tags for each valve box (1-800-258-4583). Entire controller & station number shall be printed on each tag. Letter and number size shall be no smaller than 1/8-inch and no greater than 1/4-inch. Label each valve box as follows:
 - a. Control Valves: Controller letter and station number.
 - b. Quick Coupler Valves: Label "QCV."
 - c. Wire Splices: Label wire splices with the letters "W.S."
 - d. Drip Piping Blow-out Stubs: Controller letter and station number of each drip piping blow out.
 - e. Gate Valves: Label with letters "GV" typical.
 - f. Air-Relief Valves: Label with letters "ARV" typical.
 - g. Manual Drain Valve: Label with letters "MDV."
 - 5. Valve box color to be selected based upon a review of the location and adjacent material by Owner and Architect prior to installation. These guidelines are typical of all installations unless water source is effluent. In that case all valve boxes no matter the location shall be purple in color and meet all applicable codes and ordinances.

- I. Pump Station: Install as detailed on Drawings.
- J. Electric Control Valves:
 - 1. Install top of cross handle a maximum of 3 inches below finished grade where indicated on Drawings and as detailed.
 - 2. When grouped together, allow a minimum of 12 inches between valve box sides.
 - 3. Space control valves accordingly.
 - 4. Install each remote control valve in a separate valve box.
 - 5. Install valve boxes flush with grade.
 - 6. When parallel to roadway, sidewalk or other permanent element or structure, control valve and box are to be installed perpendicular to element or structure, spaced equally.
 - 7. For athletic areas such as football fields where concrete curbs exist, place the electric valves within one foot of the curb (no further into the playfield).
- K. Main Line Gate Valves: Install as detailed on Drawings.
- L. Air-Relief Valves: Install as detailed on Drawings.
- M. Control Wiring:
 - 1. All control wiring to be laid to bottom and side of pressure supply line trench. Separate wire trenches are not permitted unless approved by Architect prior to installation.
- N. Backfilling: Do not begin backfilling operation until required system tests have been completed. Backfill shall not be done in freezing weather except with prior written approval by Architect. Leave trenches slightly mounded to allow for settlement after backfilling is complete. Trenches shall be finished graded prior to walk-through of system by Architect.
 - 1. All pressure supply lines shall be bedded with construction grade sand 4 inches below invert of pipe, to 6 inches above top of pipe and width of trench when site conditions are rocky or otherwise unfavorable.
 - 2. Materials: Excavated material is generally considered satisfactory for backfilling purposes after completing bedding requirements.
 - a. Backfill materials shall be free of rubbish, vegetative matter, frozen materials, and stones larger than 2 inches in maximum dimension.
 - b. Do not mix subsoil with topsoil.
 - c. Material not suitable for backfill shall be hauled away.
 - d. Contractor shall be responsible for providing suitable backfill if excavated material is unacceptable, or not sufficient to meet backfill, compaction, and final grade requirements.
 - 3. Do not leave trenches open for a period of more than 48 hours. Open excavations shall be protected in accordance with OSHA regulations.
 - 4. Compact backfill to 90% maximum density in 6-inch lifts, determined in accordance with ASTM D155-7 utilizing the following methods:
 - a. Mechanical tamping.

- b. Puddling or ponding and/or jetting is prohibited within 10 feet of building or foundation walls.

O. Piping Under Paving:

1. Provide for a minimum cover of 24 inches between the top of the pipe and the bottom of the aggregate base for all pressure and non-pressure piping installed under asphalt concrete or concrete paving. Provide sleeving as required by municipality, or as indicated on Drawings.
2. Piping shall be bedded with construction grade sand - 6 inches below pipe to 6 inches above pipe and the width of the trench.
3. Compact backfill material in 6-inch lifts at 95% maximum density determined in accordance with ASTM D1557 using manual or mechanical tamping devices.
4. Set in place, cap, and pressure test all piping under paving, in presence of Architect or Owner prior to backfilling and paving operations.
5. Piping under existing walk or concrete pavement shall be done by jacking, boring, or hydraulic driving, but where cutting or breaking of walks and/or concrete is necessary, it shall be done and replaced at no cost to the Owner. Obtain permission and prior approval from Owner to cut or break walks and / or concrete.

3.4 FIELD QUALITY CONTROL

- A. Flushing: After piping, risers, and valves are in place and connected, but prior to installation of emitter heads, quick coupler valves, and air relief valves, thoroughly flush piping system under full head of water pressure from dead end fittings. Maintain flushing for 5 minutes through furthest most valves. Cap riser after flushing.
- B. Testing: Conduct tests in presence of Architect. Arrange for presence of Architect a minimum of 48 hours in advance of testing. Supply force pump and all other test equipment.
 1. After backfilling, and installation of all control valves & quick coupler valves, fill pressure supply line with water, and pressurize to 40 PSI over the designated static pressure or 120 PSI, whichever is greater, for a period of 2 hours.
 2. Leakage, Pressure Loss: Test is acceptable if no leakage or loss of pressure is evident during test period.
 3. Leaks: Detect and repair leaks.
 4. Retest system until pressure can be maintained for the duration of the test.
 5. Before final acceptance, pressure supply line shall remain under pressure for a period of 48 hours.
- C. Walk-Through for Substantial Completion:
 1. Arrange for Architect's presence a minimum of 48 hours in advance of walk-through.
 2. Entire System shall be completely installed and operational prior to scheduling of walk-through. All sodded areas are to be complete with head height and valve boxes adjusted accordingly.

3. Operate each zone in its entirety for Architect at time of walk-through, and open all valve boxes.
4. Architect shall generate a list of items to be corrected prior to Final Completion ("Punch List").
5. Furnish all materials and perform all Work required to correct all inadequacies due to deviations from Contract Documents, and as directed by Architect.
6. During walk-through, expose all drip emitters and sprinklers under operations for observation by Architect to demonstrate that they are performing and installed as designed; prior to placing of all mulch material. Schedule separate walk-through if necessary.

D. Walk-Through for Final Completion:

1. Arrange for Architect's presence a minimum of 48 hours in advance of walk-through.
2. Show evidence to Architect that Owner has received all accessories, charts, record drawings, and equipment as required before Final Completion walk-through is scheduled.
3. Operate each zone identified as deficient at substantial completion walk-through for Architect to review at time of final completion walk-through to ensure correction of all incomplete items.
4. Items deemed not acceptable by Architect shall be reworked to the complete satisfaction of Architect.
5. If after request to Architect for a walk-through for Final Completion of the irrigation system,
6. Architect finds items during walk-through to be deficient, Contractor shall be charged for all subsequent walk-throughs. Funds will be withheld from final payment and/or retainage to Contractor, in amount equal to additional time and expenses required by Architect to conduct and document further walk-throughs as deemed necessary to ensure compliance with Contract Documents.

3.5 ADJUSTING

- A. Upon Substantial Completion of installation, fine-tune entire system by regulating valves, adjusting spray patterns and break-up arms/screws, and setting pressure reducing valves or throttling electric valve flow control stems to proper pressure settings to provide optimum and efficient coverage. Flush and adjust all sprinkler heads for optimum performance and to prevent overspray onto walks, roadways, and buildings as much as possible. Heads of same type shall be operating at same pressure +/- 7%.
- B. If it is determined that irrigation adjustments will provide proper and more adequate coverage, make such adjustments prior to Final Acceptance, as directed, at no additional cost to Owner. Adjustments may also include changes in nozzle sizes, degrees of arc, and control valve throttling.
- C. All sprinkler heads shall be set perpendicular to finish grade unless otherwise designated.

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- D. Areas which do not conform to designated operation requirements due to unauthorized changes or poor installation practices shall be immediately corrected at no additional cost to the Owner.

END OF SECTION

SECTION 32 90 00

PLANTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: All labor, materials and installation necessary to complete fine grading; incidental grading; lightweight soils and regular soils; planting; and related Work as required.
 - 1. In case of discrepancy between quantities of plants shown on Drawings and in the plant list, the quantity indicated on the Drawings will be considered the correct number of plants to be furnished.
- B. Related Requirements:
 - 1. Section 32 84 00 "Planting Irrigation."
 - 2. Section 32 01 90 "Operation and Maintenance of Planting."

1.2 REFERENCES

- A. ANSI Z260.1 - American Standards for Nursery Stock.
- B. Arizona Nursery Association Growers Committee Recommended Average Tree Specifications (latest edition).
- C. American Society for Testing and Materials (ASTM) - ASTM C136, Standard Methods for Sieve Analysis of the Fine and Course Aggregate.

1.3 DEFINITIONS

- A. Backfill: Earth used to replace or the act of replacing earth in a plant pit excavation.
- B. Imported Topsoil: Soil that is transported to the Project site for use.
- C. Existing Surface Topsoil: Soil that is present at the top layer of the existing soil profile once rough-grading has been completed.
- D. Blended Planting Soil: Topsoil that has been amended to acceptable ranges for planting.

1.4 COORDINATION

- A. Coordinate as required with other trades to assure their proper and adequate interface with the Work of this Section.

1. Coordinate schedules for installation of the Work of this Section with schedules for other installations in order to assure orderly progress of the total construction sequence.

1.5 PREINSTALLATION MEETINGS

- A. Schedule a Pre-Construction Conference at Project site with Installer, Owner, and Architect at least thirty (30) days before beginning Work of this Section.
 1. Review administrative procedures during construction, Project work schedule, and coordination with other trades and work activities.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product:
 1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
 2. Plant Photographs: Include color photographs in digital format of each required species and size of plant material as it will be furnished to Project.
 - a. Take photographs from an angle depicting true size and condition of the typical plant to be furnished.
 - b. Include a scale rod or other measuring device in each photograph.
 - c. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.
 3. Soil amendments, conditioners and fertilizers, based on soils report analysis and laboratory recommendations. Include product label, manufacturer's certified product analysis, and manufacturer's application instructions specific to Project.
 4. Pesticides and Herbicides: product label, manufacturer's certified product analysis and manufacturer's application instructions specific to Project.
 5. Tree stakes.
 6. Tree ties.
 7. Hose covering.
- B. Samples for Verification: For each of the following:
 1. Decomposed Granite: Two quart-sized samples of decomposed granite of each size and color indicated. Samples shall be representative of variations within size and color to be provided. Samples shall be washed and dry.
 2. Rip Rap: Indicating gradation and color. Sample shall be representative of variations within size and color to be provided.
 3. Boulders: Either photographs of boulders for approval of gradation and color or deliver samples to the Project Site for review and approval.
 - a. Photos or samples shall be representative of variations within size and color to be provided.
 - b. Include a scale rod or other measuring device in each photograph.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.
- B. Material Certificates shall accompany materials shipments as proof of inspection and quality as may be required by federal, state, or other authorities. Each shipment shall be declared free of disease and insects of any kind.
- C. Provide a letter stating verification of availability of the plant materials and sizes specified within 20 days of receipt of Notice to Proceed. Secure plant materials and have them available for installation at the appropriate time.
- D. Preconstruction Soils Test Reports.

1.8 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.
 - 1. Professional Membership: Installer shall be a member in good standing of either the National Association of Landscape Professionals or the AmericanHort.
 - 2. Experience: Three years' experience in landscape installation in addition to requirements in Section 01 40 00 "Quality Requirements."
 - 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when Work is in progress.
 - 4. Pesticide Applicator: State licensed, commercial.
- B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.
- C. Plant Material Observation: Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
 - 1. Notify Architect of sources of planting materials at least 30 days in advance of delivery to site.

- D. Owner and Architect reserve the right to take and analyze samples of materials and plants for conformity to specifications and/or submittals at any time. Contractor shall furnish samples upon request. Rejected materials and plants shall be immediately removed from the site at Contractor's expense. The cost of testing materials and plants not meeting specifications shall be paid by Contractor.
- E. Architect and Owner may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Architect and Owner may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
- F. Quality and size of plant material shall conform with the current edition of "Horticultural Standards" for #1 Grade Nursery Stock as adopted by the American Association of Nurserymen and/or Arizona Nursery Association (ANA) Grower's Committee Recommended Average Tree Specifications.
- G. Regulatory Requirements: Perform Work in accordance with all applicable laws, codes and regulations required by authorities having jurisdiction over such Work and provide for all inspections and permits required by federal, state and local authorities in furnishing, transporting and installing materials as shown or for completing the Work identified herein.

1.10 PRECONSTRUCTION TESTING

- A. General: It is assumed that the existing surface topsoil, once tested and amended to meet planting requirements, will be suitable for planting. Notify Architect if imported topsoil will be brought onto the site. Imported topsoil shall undergo the same testing and potential amending as the existing surface topsoil.
- B. Preconstruction Testing Service: Engage a certified testing agency to perform preconstruction soil analyses on existing surface topsoil and any imported topsoil that may be needed for the Project.
- C. Preconstruction Soil Analysis: For each soil type (i.e., existing surface topsoil and any imported topsoil), perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment and fertilizer recommendations by the certified testing agency.
 - 1. Soil amendment recommendations from the testing agency shall be specific to the irrigated plant types on the project (i.e., amendments specific to tree and shrub areas, and/or amendments specific to turf areas).
 - 2. Reports shall be submitted no less than two (2) weeks prior to the start of Work.
- D. Existing Surface Topsoil Samples: A minimum of two (2) soil samples shall be taken at locations determined by Architect. Sampling procedures and depths shall conform to USDA-NRCS 'Field Book for Describing and Sampling Soils' standards.

- E. Soil testing of each sample shall include but is not limited to the following:
 - 1. Plasticity index (PI)
 - 2. Soil pH
 - 3. Particle size, percentage soil texture
 - 4. Percentage organic mater
 - 5. Nutrient level analysis
 - 6. All macro, secondary and micronutrients
 - 7. Salinity
 - 8. ESP
 - 9. Free lime
 - 10. Percolation rate
- F. Based on results of the above testing, laboratory shall make recommendations on type and quantity of amendments required to bring the soils into acceptable ranges.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.
- B. Bulk Materials: Provide bulk materials processed and blended off site when specified. Materials shall be delivered in clean, washed, and covered trucks to eliminate contamination during transportation.
 - 1. On-site stockpiling locations shall be coordinated with the Owner.
 - 2. Stockpile shall occur in areas free of debris and away from drainage routes.
 - 3. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 - 4. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 - 5. Accompany each delivery of bulk materials with appropriate certificates.
 - 6. Bulk material shall be covered with plastic or geotextile if material is to be stockpiled more than 24 hours.
- C. Each tree, shrub, groundcover, flat, container of fertilizer or other construction material shall be labeled by grower or manufacturer as a separate item. Bulk deliveries of mulch, granite, topsoil, etc. shall be accompanied by two delivery tickets. One delivery ticket shall be submitted to the Owner.
- D. Excavate, transport, and protect all plant material in accordance with the requirements of this Section, "American Standards for Nursery Stock," and accepted good practice.

- E. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
- F. Handle planting stock by root ball.
- G. Deliver materials after preparations for planting have been completed and plant immediately. If planting is delayed for more than six hours after delivery, set plant material in shade, protect from weather and mechanical damage and keep roots moist.
 - 1. Contractor is liable for replacement of damaged material with like material from the same supplier.
 - 2. Do not remove container-grown stock, including ground cover, from containers until planting time.
- H. Boulders are to be harvested and delivered and placed in a manner to avoid marking, scraping, or damaging the natural condition of the boulder. Unacceptable and/or damaged boulders shall be removed from the site and replaced or treated with Permeon natural desert pavement varnish (or equal) at no additional cost to the Owner.

1.12 FIELD CONDITIONS

- A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.
- B. Locate and identify existing underground and overhead services and utilities within contract limit work areas. Provide adequate means of protection of utilities and services designated to remain. Utilities damaged during landscaping operations shall be repaired at the Contractor's expense.
- C. When uncharted or incorrectly charted underground piping or other utilities and services are encountered, notify the applicable utility company immediately to obtain procedure directions. Cooperate with the applicable utility company to maintain active services in operation.
- D. Cooperate and coordinate with other trades working in and adjacent to landscape areas. Confirm the sequencing of installing landscape and irrigation equipment to avoid conflict with or damage to future and/or installed work.
- E. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

- F. Protect and maintain during construction any plant material designated to remain on site. If any plant material that is to remain becomes damaged, Contractor shall pay for replacement plant of the same size and species (to be approved by the Owner). Location of stored materials shall be approved by Owner.
- G. Protect existing paving, structures, and other facilities from damage during landscaping operations.
- H. Stockpiled topsoil locations shall be as designated by the Owner. Use care in protecting stockpiled soil.
- I. Protect and maintain control boxes, curb boxes, valves, and other services, except items designated for removal.
- J. Protect and maintain grade control stakes set by others until directed otherwise.

1.13 MAINTENANCE AND WARRANTY

- A. Refer to Section 32 01 90 "Operation and Maintenance of Planting."

PART 2 - PRODUCTS

2.1 PLANT MATERIALS, GENERAL

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
- B. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
 - 1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch (19 mm) in diameter; or with stem girdling roots are unacceptable.
 - 2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

- C. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.
- D. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.
- E. Labeling: Label each plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant.
 - 1. Plant names shall conform to those given in "Standardized Plant Names" latest edition, prepared by the American Committee on Horticultural Nomenclature, or be names generally accepted by the trade. If any questions arise, Contractor shall obtain written verification from Owner and/or Architect.
- F. Plants of kinds other than those indicated on the plant list will be considered and approved by the Owner and/or Architect upon submission of evidence that originally scheduled plant is not reasonably procurable in the local region. In no case shall the average cost and value of the substituted plants be less than the cost and value of plants indicated.

2.2 PLANT MATERIALS

- A. Quality of plants shall conform to the State of Arizona Grading Code and be full-sized #1 Grade Nursery Stock. Plants shall be high quality, exhibit a growth habit that is normal for the species, and be sound, vigorous, healthy, and free from insects, plant diseases and injury. Container, box, ball, height and spread dimensions shall be measured according to specified standards and good practice.
- B. Container plants, including boxed trees, shall have been in the containers for sufficient length of time for the root system to hold the earth when taken from the container but not long enough to become root-bound or cause "hardening-off." Heeled-in stock or stock from cold storage is not acceptable. Plants cut back from larger sizes to meet specifications will not be acceptable.
- C. Trees: Trees 15 gallon and larger shall conform to the standards of Container Size to Caliper Height and Spread established and published by the Arizona Nurseryman's Association (ANA) Grower's Committee Recommended Average Tree Specifications.
- D. Pruning shall not be performed prior to delivery except with specified written approval from the Owner and Architect. After installation, structure inappropriate for the normal plant shape or good growth shall be removed. Dead or damaged branches or cross-over growth shall be removed.
- E. Inspection of plant materials as required by city, county, state, or federal authorities shall be the responsibility of the Contractor, who shall have secured permits or certificates prior to delivery of plants to site.

- F. Plants shall be subject to inspection and approval or rejection at the nursery source or on the Project site at any time before or during progress of Work for size, variety, condition, latent defects, and injuries. Rejected plants shall be removed from the Project site immediately.

2.3 SOIL MATERIALS

A. Existing Surface Topsoil and Imported Topsoil:

1. All topsoils shall be screened fertile, friable soils, obtained from well-drained arable land, and shall be free from nut grass, refuse, roots, heavy clay, clods, noxious weeds or any other material toxic to plant growth.
2. To be acceptable, the pH factor shall not exceed 7.5 or be lower than 5.5, soluble salts shall not exceed 1500 PPM, and the plasticity index shall be in the range of 3 to 15 inclusive. Topsoil shall contain approximately 1-1/2%, by dry weight, organic matter either natural or added. Gradation shall be in accordance with the table shown below:

Sieve Size	Percent Passing
1"	100
1/2"	95-100
No. 4	90-100
No. 10	70-100
No. 200	15-70

3. To be acceptable, topsoils will also require amendment as recommended by preconstruction soil analysis.

B. Soil Conditioner: Soil conditioner for planting backfill (to be used in heavy compacted clay soils shall be a lightweight aggregate pumice.

C. Additional Soil Amendments:

1. Sulphate of potash shall be agricultural grade containing water soluble potash.
2. Iron chelate (ferrous or ferric) shall be Iron-Sul, as manufactured by Duvall or approved equal.
3. Soil sulfur shall be Agri-Sul, Dispersul or approved equal (use only for sulfur).
4. Gypsum soil amendments shall be fine-grade agriculture gypsum containing calcium sulphate.
5. Ammonium sulphate shall be commercial-grade containing ammonia.
6. Single superphosphate shall be commercial grade containing available phosphoric acid.
7. Urea shall be granular commercial-grade containing nitrogen.
8. Root stimulator shall be Vitamin B-1.
9. Slow release fertilizer plant tablets shall be Osmocote or approved equal.

2.4 ACCESSORY MATERIALS

- A. Commercial Fertilizer: Fertilizer shall be commercial grade, granular or tablet form. Fertilizer shall be delivered to the site in the original unopened container, bearing the manufacturer's guaranteed analysis. Any fertilizer that becomes caked or damaged, making it unsuitable for use, will not be accepted.
- B. Herbicides:
 - 1. Pre-emergent herbicide shall be Surflan 75W as manufactured by Elanco Chemical Company, or approved equal.
 - 2. Contact herbicide shall be Round-up as manufactured by Monsanto, or approved equal.
- C. Decomposed Granite: Decomposed granite shall be the color, type and size as shown on the plans. All decomposed granite shall be from a single source and shall present a uniform appearance.
 - 1. Decomposed granite shall not contain lumps or balls of clay, caliches, organic matter or calcareous coating and shall be consistent in color with approved sample.
 - 2. Material shall remain stable when saturated in water. Particles larger than the size specified on the drawings, which will not be broken in the process of rolling during construction, shall not be used.
 - 3. Decomposed granite shall conform to the following requirements:
 - a. When in accordance with this specification, no more than 5% shall pass the No. 200 mesh sieve.
 - b. The PI of material passing the No. 200 sieve, prior to testing, shall not be less than 3 nor greater than 10.
- D. Rip Rap: Rip rap shall be the color, type and size as shown on the plans. All rip rap shall be from a single source and shall present a uniform appearance.
 - 1. Rip rap shall not contain lumps or balls of clay, caliches, organic matter or calcareous coating and shall be consistent in color with approved sample.
- E. Landscape Boulders: Boulders for landscape areas shall be surface select granite boulders. Boulder size as noted on plans.
- F. Tree Stakes: Lodge wood poles, free of knots and cracks, in size as follows:
 - 1. 2-inch diameter by 10 foot at 24-inch box trees.
 - 2. 3-inch diameter by 10 foot at 36-inch box trees and larger.
- G. Tree Ties: Pliable galvanized steel, #12 gage. Provide a minimum of two per tree.
- H. Hose Covering: 2-ply reinforced, rubber garden hose, minimum of 1-inch diameter.
- I. Water: Use clean, fresh water free from impurities injurious to vegetation. Water for planting purposes will be furnished by Owner. Provide all hoses, connections, and other equipment necessary to distribute water from source to required locations.

- J. No material or method shall affect landscape planting and establishment. Materials and methods must conform to federal, state and local regulations.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Site and Topsoil Preparation:
1. Apply contact herbicide as per label directions to weed growth on site. Provide three applications, each one week apart.
 2. The existing soil surface shall be scarified and cultivated to a minimum depth of 8 inches to remove any compaction from site work and construction operations and to provide adequate aeration.
 3. Remove weeds, clods or rocks one-inch in diameter.
 4. Thoroughly mix in-place all recommended amendments to the full depth of cultivated existing soil and/or add imported topsoil to produce required planting soil. Do not apply materials or till if existing soil is frozen, muddy or excessively wet.
 5. Compact blended planting soil to 75-82% of maximum Standard Proctor density according to ASTM D 698.
- B. No soil preparation or planting shall begin before planting areas have been cleared of construction debris and/or toxic material and graded to within +/- 1/10 of one foot of final finish grades.

1. Trenches, foundation backfill, and other filled excavations shall be compacted prior to start of landscape Work.
 2. All areas shall be free of waste or debris developed by other trades.
 3. Any discrepancy from these conditions shall be reported to the Owner and/or Architect before beginning construction.
 4. Commencement of Work indicates Contractor's acceptance of job site conditions.
- C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.
- D. Lay out plants at locations directed by Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

3.3 INSTALLATION

- A. Fine grade all planting areas. Provide incidental grading of all areas adjacent to curbs and sidewalks. Soil (not finish) grades adjacent to paving, curbs or headers shall be adjusted for surface materials (i.e., 2 inches of decomposed granite). Finish grade shall be defined as the top of surface materials. Refer to details on Drawings for soil and finish grade and their relationship next to paving.
- B. Unless otherwise specified in the details, final grade (at top of any surface materials) shall be set at 1/2 inch maximum below adjacent paving, curb and headers.
- C. Maintain or provide positive drainage away from all building structures. Contractor shall ensure that drainage flows are not impaired by obstructions during construction and that final grades following construction conform to project grading and drainage plans.
- D. Install boulders as indicated in details. Boulders are to be moved and placed in a manner to avoid marking, scraping, or damaging the natural condition of the boulder. Unacceptable and/or damaged boulders shall be removed from the site and replaced or treated with Permeon natural desert pavement varnish (or equal) at no additional cost to the Owner.
- E. Stake locations for all plant materials for review by Owner and/or Architect prior to installation.
- F. Pits for container-grown plant material shall be excavated the width and depth indicated in the planting details. Scarify all sides of the pit.
- G. Test tree pits shall be required to determine hardpan conditions. See planting details.
- H. Remove plants from containers without disturbing the rootball. See planting details for additional requirements.

- I. Backfill planting pits as follows:
 - 1. When the plant is set and the backfill has been water-settled, the top of the rootball shall be flush with (or even slightly higher than) finish grade. The top of the rootball shall in no case be lower than finish grade. The base of the rootball shall be set on undisturbed or compacted soil to avoid any settlement of the plant.
 - 2. Desert Tree and Shrub Backfill (salvaged or field-grown) Composition: The Contractor shall provide clean, dry, and loose on-site (native) soil for planting backfill at desert plants as blended below for a typical four (4) CY mixture:
 - a. 4 CY on-site soil.
 - b. 1 pound fertilizer (21-26-6).
 - c. 2 pounds soil sulfur.
 - d. 20 pounds gypsum.
 - e. 1 cup Iron-sul.
 - f. Slow release fertilizer plant tablets shall be placed approximately six inches below finish grade in this process in the quantity as follows:
 - 1) 4 per 15-gallon plant.
 - 2) 2 per 1/2-inch of trunk diameter on boxed field-grown trees.
- J. Apply vitamin B-1 root stimulator at the rate recommended by the manufacturer's recommendations.
- K. Stake trees as indicated.
- L. Prune each tree and shrub to preserve the natural character of the plant per American Standards for Nursery Stock, as published by the American Association of Nurserymen. Prune as directed by arborist or Architect to remove all suckers, deadwood, and broken or badly bruised branches.
- M. Decomposed Granite: Specified top dressing shall be applied and raked to the finished grade. Thoroughly water-settle the top dressing to dissipate fines and then rake entire surface. Apply pre-emergent weed control to soil per manufacturer's recommendations. Pre-emergent shall be applied to soil prior to installation of granite and after granite has been spread, raked and water-settled.

3.4 REPAIR AND REPLACEMENT

- A. General: Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by Architect.
 - 1. Submit details of proposed pruning and repairs.
 - 2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
 - 3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.

3.5 CLEANING AND PROTECTION

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

3.6 MAINTENANCE

- A. Comply with Section 32 01 90 "Operation and Maintenance of Planting."

END OF SECTION