SECTION 20: EROSION CONTROL AND HIGHWAY PLANTING

20-1 GENERAL

20-1.01 DESCRIPTION

- This work shall consist of performing erosion control, highway planting (including installing or modifying irrigation facilities), and other work necessary for improving the appearance of the roadside and preserving and rehabilitating the highway investment.
- Erosion control and highway planting shall be performed in conformance with these specifications, the special provisions, the details shown on the plans, and as directed by the Engineer.

20-2 MATERIALS

20-2.01 TOPSOIL

- Topsoil shall be obtained from sources within the project or shall consist of imported topsoil obtained from sources outside the highway right of way or a combination of both sources, whichever is provided in the special provisions.
- Topsoil obtained from sources within the right of way shall be excavated to the lines and depths as directed by the Engineer. All lumps or clods shall be broken up before the topsoil is spread. Topsoil obtained from within the project will be considered as selected material within the meaning in Section 19-2.07, "Selected Material."
- Imported topsoil shall consist of material obtained from sources outside the limits of the project in conformance with the provisions in Section 6-2, "Local Materials." Unless designated in the special provisions, the Contractor shall make the arrangements for obtaining imported topsoil and the Contractor shall pay all costs involved.
- Imported topsoil shall consist of fertile, friable soil of loamy character, and shall contain an amount of organic matter normal to the region. It shall be obtained from well-drained arable land and shall be reasonably free from subsoil, refuse, roots, heavy or stiff clay, stones larger than one inch in size, coarse sand, noxious seeds, sticks, brush, litter and other deleterious substances. Imported topsoil shall be capable of sustaining healthy plant life.

20-2.02 COMMERCIAL FERTILIZER

- Commercial fertilizer shall conform to the requirements of the California Food and Agricultural Code.
- Commercial fertilizer for erosion control work shall be in pelleted or granular form and shall have a guaranteed chemical analysis of 16 percent nitrogen, 20 percent phosphoric acid and 0 percent water soluble potash, and shall contain a minimum of 12 percent sulfur.
- Commercial fertilizer for highway planting work shall be in pelleted, granular or tablet form and shall have the chemical analysis specified in the special provisions.

20-2.03 SOIL AMENDMENT

- Soil amendment shall be a wood or bark product, treated to absorb water quickly, or a relatively dry organic compost derived from sewage sludge, plant material or rice hulls; shall be friable and pass a one inch sieve and shall comply with the requirements in the California Food and Agricultural Code.
- Rice hull compost and plant material compost shall not contain living vegetation, dirt or other objectionable material, pathogenic viruses, fly larvae, insecticides, herbicides, fungicides nor poisonous chemicals that would inhibit plant growth.
- Soil amendment shall be packaged so that compliance can be readily determined, or shall be accompanied by a Certificate of Compliance in conformance with the provisions in Section 6-1.07, "Certificates of Compliance."

20-2.04 (BLANK)

20-2.05 IRON SULFATE

- Iron sulfate shall be ferrous sulfate in pelleted or granular form containing not less than 18.5 percent iron expressed as metallic iron. Iron sulfate shall conform to the requirements of the California Food and Agricultural Code.

20-2.06 STRAW

- Straw shall be derived from wheat, rice, or barley. The Contractor shall furnish evidence that clearance has been obtained from the County Agricultural Commissioner, as required by law, before straw obtained from outside the county in which it is to be used is delivered to the site of the work. Straw that has been used for stable bedding shall not be used.

20-2.07 FIBER

- Fiber shall be produced from natural or recycled (pulp) fiber, such as wood chips or similar wood materials or from newsprint, chipboard, corrugated cardboard or a combination of these processed materials, and shall be free of synthetic or plastic materials. Fiber shall not contain more than 7 percent ash as determined by the Technical Association of the Pulp and Paper Industry (TAPPI) Standard T 413, shall contain less than 250 parts per million boron and shall be otherwise nontoxic to plant or animal life.
- Fiber shall have a water-holding capacity by weight of not less than 1200 percent as determined by the procedure designated in the Department's Final Report, CA-DOT-TL-2176-1-76-36, "Water-Holding Capacity for Hydromulch," available at the Transportation Laboratory.
- Fiber shall be of such character that the fiber will disperse into a uniform slurry when mixed with water. Water content of the fiber before mixing into slurry shall not exceed 15 percent of the dry weight of the fiber. The percentage of water in the fiber shall be determined by California Test 226. Fiber shall have the moisture content of the fiber marked on the package. Fiber shall be colored to contrast with the area on which the fiber is to be applied, and shall not stain concrete or painted surfaces.
- A Certificate of Compliance for fiber shall be furnished to the Engineer in conformance with the provisions in Section 6-1.07, "Certificates of Compliance."

20-2.08 MULCH

- Unless otherwise specified in the special provisions or shown on the plans, mulch shall consist of wood chips, tree bark, or shredded bark, or any combination thereof, at the Contractor's option.
- Mulch materials produced from pine trees grown in Alameda, Monterey, Santa Clara, Santa Cruz, San Luis Obispo or San Mateo Counties shall not be used.
- Wood chips shall be manufactured from clean wood. The particle size of the chips shall be between 1/2 inch and 3 inches in length, and not less than 3/8 inch in width and 1/16 inch in thickness.
- At least 85 percent, by volume, of wood chips shall conform to the sizes specified.
- Wood chips produced from tree trimmings which contain leaves or small twigs will not be accepted.
- Tree bark shall have a particle size between 1/2 inch and 1 1/2 inches and shall be free of salt and foreign materials such as clods, coarse objects, sticks, rocks, weeds or weed seeds.
- Shredded bark shall be a mixture of shredded bark and wood; shall have a particle size between 1/8 inch and 1 1/2 inches in thickness and one inch to 8 inches in length; and shall be free of salt and deleterious materials such as clods, coarse objects and rocks. At least 75 percent, by volume, of shredded bark shall conform to the sizes specified.
- A Certificate of Compliance for mulch shall be furnished to the Engineer in conformance with the provisions in Section 6-1.07, "Certificates of Compliance."

20-2.09 (BLANK)

20-2.10 SEED

- Seed required to be labeled under the California Food and Agricultural Code, shall be labeled by the vendors supplying the seed. Seed shall have been tested for purity and germination not more than 12 months prior to the application of the seed. The test results from seed testing shall be delivered to the Engineer prior to applying the seed. Seed labels furnished by the seed vendors supplying the seed shall indicate the purity, germination and pure live seed as determined by testing.
- Seed with a germination rate lower than the minimum rate specified may be used when approved by the Engineer in writing.
- Before seeding, the Contractor shall furnish written evidence (seed label or letter) to the Engineer that seed, not required to be labeled under the California Food and Agricultural Code, has been tested for purity and germination by a seed laboratory certified by the Association of Official Seed Analysts, or a seed technologist certified by the Society of Commercial Seed Technologists.
- The percentage of seed germination shall include the germination percentage of any hard and dormant seed.
- Seed specified without a germination requirement, at the time of sowing, shall be from the previous or current year's harvest, and shall be labeled to include the name, date (month and year) collected and the name and address of the seed supplier.

- All shipments of seed not accompanied by a valid California Nursery Stock Certificate shall be reported to the County Agricultural Commissioner at the point of destination for inspection and shall be held until released by the Commissioner.
- Seed treated with mercury compounds shall not be used.
- Legume seed shall be pellet-inoculated with a viable bacteria compatible for use with that species of seed. All inoculated seed shall be labeled to show the weight of seed, the date of inoculation and the weight and source of inoculant materials.
- Legume seed shall be pellet-inoculated in conformance with the requirements in Bulletin 1842, "Range-Legume Inoculation and Nitrogen Fixation by Root-Nodule Bacteria," of the University of California, Division of Agriculture and Natural Resources. Inoculant shall be added at the rate of 2 pounds of inoculant per 100 pounds of legume seed.
- Inoculated seed shall be sown within 90 days of inoculation.

20-2.11 STABILIZING EMULSION

- Stabilizing emulsion shall be a concentrated liquid chemical that forms a plastic film upon drying and allows water and air to penetrate.
- Stabilizing emulsion shall be nontoxic to plant or animal life and nonstaining to concrete or painted surfaces. In the cured state, the stabilizing emulsion shall not be re-emulsifiable. The material shall be registered with and licensed by the State of California, Department of Food and Agriculture, as an "auxiliary soil chemical."
- Stabilizing emulsion shall be miscible with water at the time of mixing and application.
- A Certificate of Compliance for stabilizing emulsion shall be furnished to the Engineer in conformance with the provisions in Section 6-1.07, "Certificates of Compliance."

20-2.12 LUMBER

- Lumber shall be construction grade cedar, pressure treated Douglas fir, or heart redwood, rough cut, from sound timber, and shall be straight and free from loose or unsound knots, shakes in excess of one-third the thickness of the lumber, splits longer than the thickness of the lumber or other defect which would render the lumber unfit structurally for the purpose intended. Knots in all lumber shall be sound, tight, well spaced and shall not exceed 2 inches in size on any face. Sweep shall not exceed one inch in 6 feet.

20-2.13 PLANTS

- Plants shall be the variety and size shown on the plans or in the special provisions and shall conform to the provisions of these specifications.
- No plant shall be transported to the planting area that is not thoroughly wet throughout the ball of earth surrounding the roots. Any plant that, in the opinion of the Engineer, has a damaged root ball or is dry or in a wilted condition when delivered to the planting area will not be accepted, and shall be replaced by the Contractor at the Contractor's expense.
- Each plant shall be handled and packed in the approved manner for that species or variety, and all necessary precautions shall be taken to ensure that the plants will arrive at the site of the work in proper condition for successful growth. Trucks

used for transporting plants shall be equipped with covers to protect plants from windburn.

- All plants furnished by the Contractor shall be true to type or name as shown on the plans and shall be tagged identifying the plants by species or variety; however, determination of plant species or variety will be made by the Engineer and the Engineer's decision shall be final. Plants shall be individually tagged or tagged in groups by species or variety. Carpobrotus cuttings need not be tagged.
- All plants shall comply with Federal and State laws requiring inspection for plant diseases and infestations. Inspection certificates required by law shall accompany each shipment of plants, and certificates shall be delivered to the Engineer.
- The Contractor shall obtain clearance from the County Agricultural Commissioner, as required by law, before planting plants delivered from a source outside the County in which the plants are to be planted. Evidence that clearance has been obtained shall be filed with the Engineer.
- Plants furnished by the Contractor shall be healthy, shapely and well-rooted, and roots shall show no evidence of having been restricted or deformed at any time. Plants shall be well-grown, free from insect pests and disease, and shall be grown in nurseries which have been inspected by the State Department of Food and Agriculture and have complied with the regulations thereof.
- Root condition of plants furnished by the Contractor in containers will be determined by removal of earth from the roots of not less than 2 plants nor more than 2 percent of the total number of plants of each species or variety, except when container-grown plants are from several sources, the roots of not less than 2 plants of each species or variety from each source will be inspected by the Engineer. In case the sample plants inspected are found to be defective, including but not limited to, root bound or underdeveloped root ball, the State reserves the right to reject the entire lot or lots of plants represented by the defective samples. Plants rendered unsuitable for planting because of this inspection will be considered as samples and will not be paid for.
- The Contractor shall notify the Engineer when plants are to be shipped to the project site. The notification shall be given not less than 10 days prior to the actual shipment date.
- Carpobrotus cuttings shall be 10 inches or more in length and shall not be rooted. Delosperma cuttings shall be 6 inches or more in length and shall not be rooted. Cuttings shall be tip cuttings from healthy, vigorous and strong-growing plants, and shall be insect and disease free. Mature or brown-colored stem growths or cuttings which have been trimmed will not be accepted. Cuttings shall be planted not more than 2 days after cutting and shall not be allowed to dry or wither.
- Carpobrotus cuttings shall not be taken from any plants that indicate the presence of ice plant scale (Pulvinaria species).
- The Contractor shall notify the Engineer of the location where cuttings are to be taken at least 10 days prior to taking the cuttings and shall be responsible for all permit and inspection fees involved in obtaining cuttings.
- Carpobrotus and Delosperma cuttings, to the extent available, may be taken from existing plantings within the State highway right of way under permit if the

Contractor elects. The State makes no guarantee that there will be sufficient cuttings available from existing plantings on State highway right of way to complete the work. Information concerning areas from which the Contractor will be permitted to remove cuttings may be obtained at the office of the Permit Engineer of the district in which the work is situated.

20-2.13A Foliage Protector

- Foliage protectors shall be fabricated from one inch, hexagonal pattern, 20-gage mesh wire. Foliage protectors shall be approximately 4 feet high and 2 feet in diameter. Wire edges at the top of the cylinder shall be uncut (manufactured finished edge) and free of sharp points. Other wire edges that are cut shall be free of sharp points.
- The top of the cylinder shall be fastened as shown on the plans.
- Support stakes shall be 3/4 inch reinforcing steel bar a minimum of 5 feet long.

20-2.13B Root Protector

- Root protectors shall be fabricated from one inch, hexagonal pattern, 20-gage, mesh wire. The wire edge at the top of the cylinder shall be uncut (manufactured finished edge) and shall be free of sharp points. Galvanized mesh wire shall be treated in a chemical solution that will remove the galvanized material prior to installation.
- Root protectors shall be of a closed bottom design, and shall be of the height and diameter that will have a minimum 6 inches clearance between the root ball and the sides and bottom of the wire cylinder.

20-2.14 WATER

- Water shall be of such quality that it will promote germination of seeds and growth of plants.

20-2.15 PIPE

- Pipe and fittings for irrigation systems shall be as specified in these specifications and the special provisions.
- Unless otherwise shown on the plans, risers and threaded nipples for irrigation facilities shall be Schedule 80, PVC 1120 or PVC 1220, polyvinyl chloride (PVC) pipe conforming to the requirements in ASTM Designation: D 1785.

20-2.15A Steel Pipe

- Steel pipe and couplings and wrought iron couplings shall conform to the requirements in ASTM Designation: A 53, standard weight, galvanized, except that the zinc coating shall be not less than 90 percent of the amount specified in that ASTM Designation. Fittings, except couplings, shall be galvanized malleable iron, banded and threaded, conforming to the requirements in ANSI Standard: B16.3, Class 150.

20-2.15B Plastic Pipe

- Plastic pipe for irrigation systems will be shown on the plans as plastic pipe supply line and plastic pipe irrigation line.

20-2.15B(1) Plastic Pipe Supply Line

- Plastic pipe supply line shall be polyvinyl chloride (PVC) of the types and classifications shown on the plans or specified in the special provisions. Plastic pipe supply line shall be approved by the National Sanitation Foundation, and shall conform to the requirements in either ASTM Designation: D 2241 or D 2672, except that plastic pipe supply line with a bell socket formed as an integral part of the pipe for use with rubber ring gaskets shall conform to the requirements in ASTM Designation: D 2241. The belled portion of the pipe for use with rubber ring gaskets shall conform to the requirements in ASTM Designation: D 3139, except for the dimensional ratio, shall be formed to maintain uniformity in alignment and roundness and shall be free of irregularities and defects.
- The wall thickness of the bell shall be not less than the specified minimum wall thickness of the pipe or not less than the minimum thickness that will provide a joint assembly with a Hydrostatic Design Basis Category not lower than that of the Hydrostatic Design Basis Category of the pipe.
- For pipe with wall thickness of the bell less than the specified minimum wall thickness of the pipe the Contractor shall furnish to the Engineer the following:

a. A Certificate of Compliance from the manufacturer of the pipe, conforming to the provisions in Section 6-1.07, "Certificates of Compliance," certifying that the joint assembly conforms to the requirements in ASTM Designation: D 3139.
b. Detailed drawings of the joints, including all dimensions, along with certified copies of the tests performed to verify that the Hydrostatic Design Basis Category for the joint assembly is not lower than the Hydrostatic Design Basis Category of the pipe.
c. Certified copies of the laboratory qualifying tests for the Internal Pressure Test and for the Vacuum Test.
d. A minimum of 2 samples of each size and each Class of pipe, not less than 2 feet long, together with gaskets.

- Items b and c above may be submitted to the Transportation Laboratory on an annual basis or more often when required because of manufacturer's design changes. The Certificate of Compliance for pipe used on a specific project may refer to prior submittals, giving date of original submittal and any other information needed to identify the documents.
- The wall thickness of the bell end of the pipe may exceed maximum allowable wall thickness of the pipe for a length not to exceed 24 inches from the end of the pipe.
- Bell end pipe conforming to the requirements in ASTM Designation: D 2672 may be marked with either ASTM Designation: D 2672 or D 2241. Gasketed bell end pipe shall be marked in conformance with the requirements in ASTM Designation: D 2241.
- Plastic pipe supply line and fittings that are on the supply side of control valves and are 2 inches or larger in diameter shall be either the rubber ring gasket type or the solvent cemented type, except that all pipe and fittings installed in conduits

shall be the solvent cemented type. All other plastic pipe supply line and fittings shall be the solvent cemented type.

- Schedule 40 plastic pipe supply lines shall conform to the requirements in ASTM Designation D1785.
- Threaded fittings and fittings to be solvent cemented to plastic pipe supply line shall be injection molded PVC, Schedule 40, conforming to the requirements in ASTM Designation: D 2466.
- Fittings equipped with rubber ring gaskets for supply line shall be either injection molded PVC plastic pipe fittings, conforming to the requirements in ASTM Designation: D 2466 or D 3139, or machined pipestock fittings, conforming to the requirements in ASTM Designation: D 2241, with the exception in both applications of the dimensions and configurations of the barrel portion which receives the rubber ring. Rubber rings shall conform to the requirements in ASTM Designation: F 477.
- Solvent cement and primer for PVC plastic pipe and fittings for supply line shall be of commercial quality specifically manufactured for use with rigid PVC plastic pipe and fittings and shall be applied separately. Solvent cement shall conform to the requirements of the local Air Quality Management District. The solvent cement and primer used shall be made by the same manufacturer. The color of the primer shall contrast with the color of the pipe and fittings.

20-2.15B(2) Plastic Pipe Irrigation Line

- Plastic pipe irrigation line shall be polyethylene pipe conforming to the provisions in this Section 20-2.15B(2), as shown on the plans or as specified in the special provisions.
- Polyethylene pipe shall conform to the requirements in ASTM Designation: D 1248, Type I, Class C and shall withstand a 60-minute hydrostatic pressure of 50 psi when tested in conformance with the requirements in ASTM Designation: D 1598.
- Wall thicknesses of polyethylene pipe shall conform to the following when determined in conformance with the requirements in ASTM Designation: D 2122.

Pipe Size Nominal (Inch)	Minimum* (Inch)	Maximum* (Inch)	Range (Percent)
1/2	0.050	0.070	12
5/8	0.055	0.075	12
3/4	0.060	0.080	12

* as measured at any point on the cross section

- The polyethylene pipe shall provide leak-free, non-separating connections suitable for the purpose intended when connected to the fittings specified herein.
- Polyethylene pipe shall show no evidence of failure when tested by the following environmental test:

Environmental Stress Cracking Test - For each test, use 6 randomly selected 10-inch long specimens. Insert a 10 percent oversized barbed fitting into one end of each specimen. The barbed fitting shall have an outside

diameter which is 10 percent greater than the maximum outside barb diameter specified in Table 1 of ASTM Designation: D 2609 for the pipe size being tested. Place the specimens in a 10 percent "Igepal CO-630" solution at 122° F for a 24-hour period. After 24 hours, examine the specimens for failure.

- Utility grade polyethylene pipe will not be acceptable.
- A Certificate of Compliance for the polyethylene pipe shall be furnished to the Engineer in conformance with the provisions in Section 6-1.07, "Certificates of Compliance."
- Fittings to be used with polyethylene pipe shall be the compression type, shall be of commercial quality, and shall be recommended by the manufacturer of the polyethylene pipe. Fittings shall have female sockets with an internal barb to provide a positive pipe-to-fitting connection that will not separate at the designed pressure.

20-2.16 CONDUIT

- Conduit for irrigation crossovers shall conform to the provisions in this Section 20-2.16.
- Conduit placed by jacking or drilling shall be welded steel pipe conforming to the requirements in ASTM Designation: A 53. Welded steel pipe shall be either black or galvanized pipe and shall have welded or threaded joints.
- The minimum wall thickness for the various sizes of welded steel pipe shall conform to the following:

Nominal Pipe Size (Inches)	Minimum Wall Thickness (Inch)
3	0.216
4	0.237
6 and larger	0.250

- Pipe with wall thickness greater than above specified may be required to withstand jacking or drilling operations. Additional wall thickness required shall be determined by the Contractor and shall be furnished at the Contractor's expense.
- Conduit placed in open trenches shall be corrugated high density polyethylene pipe (CHDPE), corrugated steel pipe, corrugated aluminum pipe or acrylonitrile-butadiene-styrene (ABS) composite pipe. The size and kind of conduit to be installed will be designated in the Engineer's Estimate or specified in the special provisions. When alternative conduit is designated in the Engineer's Estimate or specified in the special provisions, the kind of conduit to be installed shall be selected by the Contractor from the allowable kinds of alternative conduit specified in the special provisions.
- Corrugated high density polyethylene pipe shall conform to the requirements in ASTM Designation: F 667, or shall be Type S conforming to the requirements in AASHTO Designation: M 294. Couplings and fittings shall be as recommended by the pipe manufacturer.
- Corrugated steel pipe and corrugated aluminum pipe shall conform to the provisions in Section 66, "Corrugated Metal Pipe." The nominal thickness of metal

sheets for the pipe shall be 0.064-inch for corrugated steel pipe and 0.060-inch for corrugated aluminum pipe. Coupling bands and coupling band hardware for corrugated steel pipe and corrugated aluminum pipe shall conform to the provisions in Section 66.

- Acrylonitrile-butadiene-styrene (ABS) composite pipe and couplings shall conform to the requirements in ASTM Designation: D 2680. Couplings shall be Type SC (solvent cemented).

20-2.17 SPRINKLERS

- Sprinklers shall conform to the requirements in the special provisions and as shown on the plans.

20-2.18 EMITTERS

- Emitters shall conform to the requirements in the special provisions and as shown on the plans.

20-2.19 FLUSH VALVES

- Flush Valves shall be garden valves. Garden valves shall conform to the provisions in Section 20-2.22 "Garden Valves."

20-2.20 PLASTIC PIPE (LOCATOR)

- Plastic Pipe (locator) shall be Schedule 40 white polyvinyl chloride (PVC) pipe.

20-2.21 QUICK COUPLING VALVES

- Quick coupling valves shall be $^{3}/_{4}$ inch double slot type, with self-closing cap unless otherwise shown on the plans. Except for the cap, quick coupling valves shall be of brass or bronze construction.

20-2.22 GARDEN VALVES

- Garden valves shall be the inverted nose type of brass or bronze construction with female thread inlet, replaceable seat washer, rising valve stem within a protective collar, male thread hose outlet and furnished with a loose key (handle).

20-2.23 CONTROL VALVES

- Control valves shall be electric remote control or the manual type, straight or angle pattern globe valves, and shall be of glass filled nylon, brass, bronze, or cast iron construction as shown on the plans or specified in the special provisions. All metal parts of glass filled nylon valves shall be stainless steel or brass. Cast iron bodied valves shall have replaceable, nonferrous, metallic seats. Compression disks or diaphragms in valves shall be replaceable. Valves shall be of the same size as the pipeline which the valves serve, unless otherwise shown on the plans. Control valves shall be capable of withstanding a cold water working pressure of 150 psi. Valve handles shall be brass, bronze or steel.
- Electric remote control valves shall conform to the following:

A. Valves shall be normally closed type.
B. Valves shall be completely serviceable from the top without removing the valve body from the system.

C. Valves shall be equipped with a device that will regulate and adjust the flow of water and shall be provided with a manual shutoff. The manual shutoff for valves larger than 3/4 inch shall be operated by a cross handle.
D. Valves for each irrigation controller shall be the same model series and shall be compatible with the model series of the irrigation controller.
F. Valve solenoids shall operate on the low voltage AC current supplied from the irrigation controller.
G. Valves shall be provided with manual bleeding devices.
H. Valves shall be equipped with internal diaphragms installed in the valve body casting.
I. Valve inlets and outlets shall have threaded fittings.

20-2.24 VALVE BOXES

- Valve boxes and valve box covers shall be precast portland cement concrete, fiberglass or reinforced plastic and shall conform to the special provisions. Valve box covers shall be marked "WATER" in cast-in letters not less than one inch high.
- Valve boxes shall not have side openings.

20-2.25 BACKFLOW PREVENTERS

- Backflow preventers shall be one of the reduced pressure principle devices as specified in these specifications and the special provisions.
- Backflow preventers shall be factory assembled and shall include 2 check valves, one pressure differential relief valve, 2 shut-off valves and 4 test cocks. Backflow preventer and valves shall be the same size as the pipeline in which they are installed, unless otherwise shown on the plans.
- Backflow preventer shut-off valves shall be manufactured from iron or bronze and shall be either resilient wedged gate valves, resilient seated and fully ported ball valves, or resilient seated butterfly valves. Threaded type shut-off valves shall be provided with a union on one side of each valve. Unions shall be brass or malleable iron.

20-2.26 CONCRETE

- Concrete for irrigation facilities, unless otherwise specified, shall be produced from commercial quality aggregates and cement and shall contain not less than 463 pounds of cement per cubic yard. Hand mixing of the concrete will be permitted.

20-2.265 FILTER ASSEMBLY UNITS

- Filter assembly units shall conform to the requirements in the special provisions.

20-2.27 FLEXIBLE HOSE

- Flexible hose shall be nonrigid polyvinyl chloride (nonrigid PVC) hose conforming to the requirements in ASTM Designation: D 2287, Cell-type 6464500.
- Wall thicknesses of nonrigid PVC hose shall conform to the following when determined in conformance with the requirements in ASTM Designation: D 2122.

Hose Size Nominal (Inch)	Minimum Wall Thickness* (Inch)	Range (Percent)
1/2	0.147	12
3/4	0.154	12
1	0.179	12

* as measured at any point on the cross section

- The hose shall provide leak-free, non-separating connections suitable for the purpose intended when connected to the fittings specified herein.
- Fittings for flexible hose shall be injection molded PVC, Schedule 40, conforming to the requirements in ASTM Designation: D 2466. Fittings shall be solvent cemented type.
- Solvent cement for flexible hose and fittings shall be of commercial quality specifically manufactured for use with nonrigid PVC hose. Primer for flexible hose fittings shall be the same as specified for plastic pipe supply line fittings.

20-2.28 GATE VALVES

- Gate valves shall be either flanged, threaded or ring type, iron or bronze body, bronze trimmed valves with rising (internally threaded) or non-rising stem, and shall withstand a cold water working pressure of 150 psi. Gate valves shall be of the same size as the pipeline which the valves serve, unless otherwise shown on the plans.

20-2.29 UNIONS

- Unions shall be brass or malleable iron. Unions shall withstand the working pressure range provisions for the pipes with which the unions are used.

20-2.30 WYE STRAINERS

- Wye strainers shall have a cast iron or all-bronze body with a removable stainless steel or monel strainer. Wye strainers shall be capable of withstanding a cold water working pressure of 150 psi. Wye strainers at backflow preventer assemblies shall be equipped with a gate valve at the outlet. All other wye strainers shall be equipped with a garden valve at the outlet.
- The strainer screen for the wye strainer in a backflow preventer assembly shall have an open area equal to at least 3 times the cross-sectional area of the pipe based on an iron pipe size and shall be 20-mesh woven wire mesh or perforated sheet with 0.045-inch diameter holes.
- All other wye strainers shall be equipped with 40-mesh strainer screens.

20-2.31 ELECTRICAL EQUIPMENT AND MATERIALS

- All electrical equipment and materials shall conform to the provisions in Section 86-1.02, "Regulations and Code," and these specifications.

20-2.31A Irrigation Controllers

- Irrigation controllers shall conform to the provisions specified herein and the special provisions.
- Irrigation controllers (battery) shall operate on batteries of the type and size recommended by the manufacturer of the controllers. Other irrigation controllers

shall operate on 120-V, 60 Hz AC, and shall supply 24-V to 30-V, 60 Hz AC for operating electric remote control valves.

- Irrigation controllers shall be housed in pedestal or wall-mounted enclosures as designated in the Engineer's Estimate, or as specified in the special provisions or as shown on the plans.
- Irrigation controllers not installed in irrigation controller enclosure cabinets shall be weatherproof, shall be constructed of fiberglass or metal and shall have a door lock for which 2 keys shall be provided.

20-2.31B Electrical Conduit

- Electrical conduit shall conform to the provisions in Sections 86-2.05A, "Material," and 86-2.05B, "Use."

20-2.31C Pull Boxes

- Pull boxes shall be No. 5 or larger unless otherwise shown on the plans, and shall conform to the provisions in Section 86-2.06A, "Materials." Pull box covers for pull boxes used solely for electrical service shall be marked in conformance with the provisions in Section 86-2.06B, "Cover Marking." All other irrigation system pull box covers shall be marked "SPRINKLER CONTROL" in conformance with the provisions in Section 86-2.06B.

20-2.31D Conductors

- Conductors shall conform to the provisions in Section 86-2.08, "Conductors," and the provisions specified herein.
- Conductors for operation below 50-V shall be rated for direct burial and shall be the underground feeder type identified as (UF) with a minimum thickness of polyvinyl chloride insulation of 56 mils for conductors No. 10 and smaller and 70 mils for conductors No. 8 and larger.

20-2.31E Electric Remote Control Valves

- Electric remote control valves shall conform to the provisions in Section 20-2.23, "Control Valves," and the provisions in the special provisions.

20-2.32 PRIMERS AND PAINTS

- Primers and paints for application on metal and wood surfaces shall be the best quality grade of the type specified in the special provisions and shall be manufactured by a recognized paint manufacturer. Thinners and coloring tints shall conform to the paint manufacturer's recommendations. Coatings shall not be thinned except as recommended by the paint manufacturer for application. Each application of paint shall be compatible with the previous application and shall be from paint made by the same manufacturer. Testing of primers and paints will not be required.

20-3 EROSION CONTROL

20-3.01 DESCRIPTION

- This work shall consist of furnishing and applying erosion control materials, including preparing areas to receive erosion control materials, placing topsoil, applying and incorporating straw and applying fertilizer, seed, fiber, stabilizing

emulsion and other materials to the areas shown on the plans, as specified in these specifications and the special provisions.

20-3.015 MATERIALS

- Materials shall conform to the provisions in Section 20-2, "Materials."

20-3.02 PREPARATION

- Preparation shall include all the work required to make ready the areas for application of topsoil and erosion control materials. Loose rocks larger than $2\frac{1}{2}$ inches in maximum dimension and debris shall be removed and disposed of outside the highway right of way in conformance with the provisions in Section 7-1.13, unless otherwise permitted by the Engineer.
- Topsoil shall be spread uniformly at the rate specified in the special provisions or shown on the plans. The finished surface after spreading topsoil shall be approximately one inch below the top of adjacent curbs or pavement.
- Topsoil shall not be placed until all equipment, except equipment required for spreading topsoil, is through working in an area.

20-3.03 APPLYING AND INCORPORATING STRAW

- Straw shall be uniformly spread at the rate specified in the special provisions.
- When weather conditions are suitable, straw may be pneumatically applied by means of equipment which will not render the straw unsuitable for incorporation into the soil.
- Straw shall be incorporated into the soil with a roller equipped with straight studs, made of approximately $\frac{7}{8}$ inch steel plate, placed approximately 8 inches apart and staggered. The studs shall not be less than 6 inches long nor more than 6 inches wide and shall be rounded to prevent withdrawing the straw from the soil. The roller shall be of such weight as to incorporate the straw sufficiently into the soil so that the straw will not support combustion, and will leave a uniform surface.

20-3.04 SEEDING AND FERTILIZING

- Seeding and fertilizing shall conform to the following provisions.

20-3.04A General

- Seed and commercial fertilizer shall be uniformly spread over the area at the rates specified in the special provisions.
- Unless otherwise specified in the special provisions, seed shall be either applied mechanically in a dry condition or with hydro-seeding equipment, at the Contractor's option. If the Contractor elects to hydro-seed, a minimum of 525 pounds of fiber per acre shall be mixed and applied with the seed, and fertilizer (if required) may be mixed with the seed and fiber and applied in the hydro-seeding operation. The fiber shall be furnished and applied at the Contractor's expense and shall be in addition to incorporating straw when an application or applications of straw are specified.
- The application rate for pellet-inoculated seed shall be determined using the seed weight exclusive of inoculant materials.

20-3.04B Hydro-Seeding

- Hydro-seeding shall consist of mixing and applying seed, commercial fertilizer, stabilizing emulsion and other materials, or any combination thereof, with fiber and water.
- The materials and the quantities thereof to be mixed with water will be specified in the special provisions. The quantity of water shall be as needed for application, except that when stabilizing emulsion is specified, the ratio of total water to total stabilizing emulsion in the mixture shall be as recommended by the manufacturer of the emulsion.
- Mixing of materials for application with hydro-seeding equipment shall be performed in a tank with a built-in continuous agitation system of sufficient operating capacity to produce a homogeneous mixture and a discharge system which will apply the mixture at a continuous and uniform rate. The tank shall have a minimum capacity of 1,000 gallons. The Engineer may authorize use of equipment of smaller capacity if it is demonstrated that the equipment is capable of performing all operations satisfactorily.
- A dispersing agent may be added to the mixture provided the Contractor furnishes evidence that the additive is not harmful. Any material considered harmful, as determined by the Engineer, shall not be used.
- Any mixture containing stabilizing emulsion shall not be applied during rainy weather or when soil temperatures are below 40° F. Pedestrians or equipment shall not be permitted to enter areas where mixtures containing stabilizing emulsion have been applied.

20-3.05 (BLANK)

20-3.06 MEASUREMENT

- Topsoil obtained from within the project limits will be considered as selected material and will be measured and paid for in conformance with the provisions in Section 19-2.07, "Selected Material."
- Imported topsoil will be measured by the ton or cubic yard, and quantities of fiber and straw will be measured by the pound or ton, determined in conformance with the provisions in Section 9-1.01, "Measurement of Quantities." When paid for by the cubic yard, imported topsoil will be measured in the vehicle at the point of delivery.
- Stabilizing emulsion will be measured by the pound or ton as the weight of solids applied. The weight of solids per gallon of stabilizing emulsion will be determined by multiplying the percent of solids in the emulsion by the weight per gallon of the emulsion. The percent of solids and the weight per gallon of the emulsion will be determined by California Test 402, in the same manner as provided for determining the percent of nonvolatile content and the weight per gallon of paint.
- Commercial fertilizer will be measured by the pound or ton, determined from marked weight and sack count.
- Pure live seed will be measured by the pound, determined by multiplying the percentage of purity by the percentage of germination by the bulk weight of the seed.

20-3.07 PAYMENT

- Items of work, measured in conformance with the provisions in Section 20-3.06, "Measurement," and Section 9-1.01, "Measurement of Quantities," will be paid for at the contract prices per ton or cubic yard for imported topsoil, and per pound or ton for straw, commercial fertilizer, pure live seed, fiber and stabilizing emulsion.
- Full compensation for temporarily placing topsoil along the tops of the slopes and later spreading the topsoil over the prepared slopes shall be considered as included in the contract price paid per cubic yard for roadway excavation or the contract price paid for imported topsoil or erosion control, as the case may be, and the material will not be considered as stockpiled within the meaning of Section 19-2.07, "Selected Material."
- Full compensation for removing and disposing of rocks and debris from embankments constructed as part of the work shall be considered as included in the contract prices paid for the various items of earthwork involved and no additional compensation will be allowed therefor.
- The above prices and payments shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all erosion control work, complete in place, including applying water, as shown on the plans, and as specified in these specifications and the special provisions, and as directed by the Engineer.

20-4 HIGHWAY PLANTING

20-4.01 DESCRIPTION

- This work shall consist of furnishing highway planting materials, clearing planting areas, preparing planting areas, planting plants, establishing plants and maintaining existing plants as shown on the plans and as specified in these specifications and the special provisions.

20-4.02 MATERIALS

- Materials shall conform to the provisions in Section 20-2, "Materials."

20-4.025 ROADSIDE CLEARING

- Roadside clearing shall consist of removing trash and debris, removing and controlling weeds, and removing existing plants as specified in these specifications and the special provisions.
- Roadside clearing shall be performed in those areas specified in the special provisions or shown on the plans.
- At the time of planting, each area to be planted shall be free of trash and debris.
- Existing trees and shrubs, where specified in the special provisions or designated on the plans to be removed, shall be removed. Removal of existing trees and shrubs shall include removing their stumps and roots 2 inches or larger in diameter to a minimum depth of 12 inches below finished grade. Holes resulting from stump removal shall be backfilled to finished grade with material obtained from adjacent areas.

- Weeds shall be controlled by killing or by mowing as specified in the special provisions. Killing weeds shall be performed by hand, by the use of pesticides or by other methods approved by the Engineer.
- Trash and debris shall be disposed of outside the highway right of way in conformance with the provisions in Section 7-1.13.

20-4.026 PESTICIDES

- Unless prohibited by the County Agricultural Commissioner, pesticides may be used for highway planting work. If the Contractor elects to use pesticides, such usage shall conform to the requirements of the California Food and Agricultural Code, these specifications and the special provisions.
- The pesticides used to control weeds shall be limited to those specified in the special provisions.
- Oil and granular or pelleted forms of pesticides for weed control shall not be used.
- Attention is directed to Section 7-1.01H, "Use of Pesticides."
- The Contractor shall obtain recommendations for the use of all pesticides from a licensed Pest Control Adviser in conformance with the requirements of the California Food and Agricultural Code. At least 15 days prior to using any pesticides, a copy of the recommendations shall be submitted to the Engineer for approval. The recommendations shall include, but not be limited to, the pesticides to be used, rates of application, methods of application and areas to which pesticides are to be applied.
- Before using any pesticides, the Contractor shall obtain the Engineer's written approval of the Pest Control Adviser's recommendations.
- When used, pesticides shall be used in conformance with the approved Pest Control Adviser's recommendations.
- The Contractor shall notify the Engineer at least 24 hours prior to each application of pesticide and shall indicate the hours of application. No application of pesticides shall be made on Saturdays, Sundays or legal holidays, unless otherwise approved by the Engineer in writing.
- Pesticides shall be mixed in conformance with the instructions provided on the applicable registered label. Prior to mixing any pesticide, a copy of the registered label for the pesticide to be mixed shall be given to the Engineer or, when the copy is unavailable, the Engineer shall be permitted to read the label on the container.
- Pesticides for weed control shall be applied with a photosensitive dye which will produce a contrasting color when sprayed upon the ground. The color shall disappear between 2 and 3 days after being applied. The dye shall not stain any surfaces nor injure plant or animal life, when applied at the manufacturer's recommended application rate.
- Pesticides shall not be applied when weather conditions, including wind conditions, are unsuitable for application work.
- Any new or existing plants and soil which, in the opinion of the Engineer, have been damaged by the application of pesticides shall be replaced by the Contractor at the Contractor's expense.

- At the end of each work week, a written report of that week's applications of all pesticides shall be submitted to the Engineer on forms furnished by the Department.

20-4.03 PREPARING PLANTING AREAS

- Preparing planting areas shall consist of preparing holes, preparing trenches, cultivating, germinating weeds, constructing basins and doing any other work necessary to prepare areas for planting, except roadside clearing work, as specified in these specifications and the special provisions and as shown on the plans. Constructing basins shall be considered as part of the work involved in preparing holes and trenches.
- Unless otherwise specified, a planting or planted area shall be any area in which the Contractor is required to do planting work.
- The Engineer will designate the ground location of all plants by directing the placing of the plants or by directing the placing of stakes or other suitable markers. The Contractor shall furnish all labor, materials and transportation required to adequately indicate the various plant locations.
- The work involved in preparing planting areas shall be so conducted that the existing flow line in drainage ditches will be maintained. Material displaced by the Contractor's operations which interferes with drainage shall be removed and disposed of as directed by the Engineer.
- Unless larger planting holes are specified in the special provisions or shown on the plans, plants shall be planted in holes large enough to receive the root ball, backfill, amendments and fertilizer. Where rock or other hard material prohibits holes from being excavated to the depth specified, new holes shall be excavated and the abandoned holes shall be filled with the excavated material.
- Planting holes may be excavated by hand digging or by drilling. Water shall not be used for the excavation of planting holes.
- At the locations shown on the plans, longitudinal basins shall be formed by constructing a continuous dike on each side of the planting line. Cross checks shall be formed to pond irrigation water around each plant.
- The planting areas to be cultivated will be designated in the special provisions or shown on the plans. The outer limits of the areas to be cultivated shall extend 12 inches beyond the outer rows of plants requiring cultivation, unless otherwise specified or shown on the plans.
- Cultivation shall be performed until the soil is in a loose condition to a minimum depth of 6 inches. Soil clods shall not be larger than 2 inches in any dimension after cultivation.
- The use of rubber-tired equipment will be permitted for cultivating operations, provided the equipment used completely eradicates any compaction caused by the tires. Rubber-tired equipment of any kind will not be allowed on cultivated areas after cultivation.
- Planting areas that have been cultivated and become compacted for any reason shall be recultivated by the Contractor at the Contractor's expense.
- Rocks and other debris encountered during soil preparation in planting areas shall be brought to the surface of the ground at the Contractor's expense. Removing and disposing of the rocks and debris will be paid for as extra work as

provided in Section 4-1.03D. The size of rocks and the quantity of rocks and debris to be disposed of will be determined by the Engineer.

- Pavement, sidewalk and similar paved areas encountered on or beneath the surface of the ground and not shown on the plans in areas to be prepared for planting, and if ordered by the Engineer, shall be removed and disposed of as directed by the Engineer. Excavating through these paved areas, furnishing and placing topsoil to fill these holes, and removing and disposing of all this pavement will be paid for as extra work as provided in Section 4-1.03D.
- Existing pavement shown on the plans where planting holes or trenches are to be excavated, or where cultivation is to be done, shall be removed and, unless otherwise permitted by the Engineer, disposed of outside the highway right of way in conformance with the provisions in Section 7-1.13.

20-4.04 HEADER BOARDS

- Header boards shall conform to the provisions in Section 20-2.12, "Lumber," and be constructed as shown on the plans.
- Header board stakes shall be of the size and shape shown on the plans. Each stake shall be driven flush with the top edge of the header board and the stake top shall be beveled away from the header board on a 45-degree angle. Stakes shall be attached to header boards with a minimum of two 12-penny hot-dip galvanized common nails per stake.
- Where asphalt concrete or portland cement concrete surfacing must be removed to permit the installation of header boards, and no joint exists between the surfacing to be removed and surfacing to remain in place, the surfacing shall be cut in a neat line to a minimum depth of 2 inches with a power driven saw before the surfacing is removed.

20-4.05 PLANTING

- Planting work shall consist of planting plants, applying fertilizer, iron sulfate and mulch and staking plants as specified in this Section 20-4.05 and the special provisions.
- No planting shall be done in any area until the area concerned has been prepared in conformance with these specifications and the special provisions and presents a neat and uniform appearance satisfactory to the Engineer. When an irrigation system is required, the irrigation system shall be installed and checked for coverage to the satisfaction of the Engineer prior to planting plants.
- Nursery stakes in plant containers stored at the project site shall be removed before transporting the plants to the planting areas, unless otherwise directed by the Engineer.
- Plant locations for trees and shrubs shall be adjusted so that no plant is closer than 8 feet to an impact, rotary, gear driven or pop-up type sprinkler.
- Where shrubs are shown on the plans to be planted in groups, the outer rows shall be parallel to the nearest roadway or right of way fence. Shrubs in adjacent rows shall be staggered. Adjustment in the number or alignment of plants shall be made between the outer rows.
- Where vines are to be planted against walls or fences, the vines shall be planted as close as possible to the wall or fence as shown on the plans.

- No more plants shall be distributed along the roadside on any day than can be planted and watered on that day.
- Plants shall be removed from their containers in such a manner that the ball of earth surrounding the roots is not broken. Plants shall be planted and watered as hereinafter specified immediately after removal from their containers. Plant containers shall not be cut prior to delivery of the plants to the planting area.
- Roots of plants not in containers shall be kept moist and covered until the plants are planted.
- Root protectors shall be installed at the time the plant holes are prepared in conformance with the details shown on the plans and these specifications. Root protectors shall be placed in the plant holes with approximately 3 inches of the wire cylinder extending above finished grade.
- Before planting in holes or trenches, water shall be applied to the backfill with a pipe or tube inserted to the bottom of the hole or trench until the backfill material is saturated for the full depth.
- Plants shall be set in the backfill material in flat bottomed holes, to such a depth that, after the backfill has settled, the soil shall be even with the top of the root ball as shown on the plans. If the backfill material settles below the top of the root ball after planting and watering, additional soil shall be added to bring the backfill even with the top of the root ball as shown on the plans.
- Plants shall be planted in such a manner that the roots are not restricted or distorted. Encircling roots shall be removed.
- Any plants which have settled deeper than as shown on the plans shall be raised back to the required level, or replaced, at the option of the Contractor.
- Planting done in soil that is too wet or too dry or not properly conditioned, as provided in these specifications, or in a condition not generally accepted as satisfactory for planting from an agricultural standpoint will not be accepted. No payment will be made for this planting and any further planting work will be suspended until the Contractor has complied in every way with the specifications.
- Ground cover plants in areas with an irrigation system shall be planted in blocks which conform to the design of the irrigation system. Each ground cover planting area covered by one control valve shall be completely planted and watered before planting other ground cover planting areas with ground cover plants.
- Ground cover plants shall be planted in moist soil and in neat, straight rows parallel to the nearest roadway. Plants in adjacent rows shall be staggered. Ground cover plants shall not be planted closer than 5 feet to trees or shrubs, nor closer than $6\frac{1}{2}$ feet to curbs, dikes, paved areas, walls and fences, unless otherwise shown on the plans or specified in the special provisions.
- Carpobrotus cuttings shall be planted to such depth that not less than 2 nodes are covered with soil. The basal end of Delosperma cuttings shall be not less than 2 inches below the surface of the soil and the basal end of Carpobrotus cuttings shall be not less than 4 inches below the surface of the soil.
- A root stimulant solution shall be applied to Delosperma cuttings prior to planting. The solution shall be applied by spraying or dipping the ends to be rooted in conformance with the printed instructions of the root stimulant manufacturer. A

copy of the instructions shall be furnished to the Engineer prior to applying the stimulant.

- No Carpobrotus or Delosperma cuttings shall be planted in soil that does not contain sufficient moisture at an average depth of 2 inches below the surface.
- Trees, shrubs and vines, to be planted in ground cover areas, shall be planted before ground cover plants or cuttings are planted.
- Commercial fertilizer and iron sulfate shall be applied or placed at the time of planting and at the rates and amounts shown on the plans.
- When iron sulfate is required by the special provisions or plans, the iron sulfate shall be evenly distributed within the plant basin and mixed into the plant soil a minimum depth of 2 inches.
- Commercial fertilizer (pelleted and granular) required during planting by the special provisions or plans, shall be mixed into the plant hole soil a minimum depth of 2 inches near the root ball.
- Commercial fertilizer (tablet) required by the special provisions or plans, shall be placed approximately half the depth of the root ball.
- Commercial fertilizer required during planting by the special provisions or plans, shall be applied to ground cover plants planted from cuttings or flats immediately after planting, and watered into the soil.
- Mulch shall be applied at the rate shown on the plans or specified in the special provisions and placed in the plant basins or spread in areas as shown on the plans after the plants have been planted. Mulch placed in plant basins shall not come in contact with the plant crown and stem.
- Plants shall be watered in conformance with the provisions in Section 20-4.06, "Watering."
- Vines planted next to fences shall be tied to the fences with tree tie material at the time of planting. Vines planted next to walls shall be staked and tied thereto as shown on the plans, at the time of planting.
- Foliage protectors shall be installed over the plants within 2 days after the plants have been planted in conformance with the details shown on the plans and these specifications.
- Support stakes for foliage protectors shall be installed vertically a minimum of 12 inches deep on opposite sides of the plant in a direction transverse to the prevailing winds. Support stakes shall be either woven through the wire cylinder mesh or fastened to the wire cylinder at 6 inches maximum centers. If the support stakes are woven through the wire cylinder mesh, the support stakes shall be woven in such a manner that holds the wire cylinder against the support stakes at 6-inch maximum centers. The cylinder shall be snug on the support stakes, yet loose enough to be raised for application of pesticides or to perform weeding within the plant basin.
- Foliage protectors shall be installed vertically and centered over the plant. When foliage protectors are not installed in plant basins, the bottom of the cylinder shall be cut to match the slope of the ground. Cuts shall be free from sharp points. Sharp points of wire shall be bent-over or blunted.
- Plants to be staked shall be staked at the time of planting as shown on the plans or specified in the special provisions. Two plant stakes shall be installed on

opposite sides of the plant in a transverse direction to the prevailing wind against but not through the root ball of the plant to a minimum depth of 18 inches below finished grade, unless otherwise directed by the Engineer.

- Plant stakes installed at trees and shrubs shall be of sufficient lengths to support each plant in an upright position. Plant stakes shall be either 2-inch nominal diameter round stakes or 2-inch x 2-inch nominal size square stakes, at the Contractor's option. The cross-sectional dimensions of the plant stakes may be reduced if the strength and durability of the smaller dimensioned stake is not less than a corresponding 2-inch redwood stake as determined by the Engineer. In no case shall stakes have a cross-section dimension of less than $1\frac{1}{4}$ inches, unless otherwise shown on the plans.
- After installation of plant stakes, the height of each stake shall be a maximum of 2 inches above the tree tie.
- Each plant requiring stakes shall be tied with one tie to each stake. The ties shall be installed at the lowest position which will support the plant in an upright position. Ties should provide trunk flexibility but not allow the trunk to rub against the stakes. Ties shall be extruded vinyl-base tape, one inch wide and a minimum of 10 mils thick. Each tie shall form a figure eight by crossing the tie between the plant and stake, and the figure eight shall be formed twice. Each end of the tie then shall be wrapped one and one-half turns around the stake and securely tied. Other materials and methods approved by the Engineer may be used for ties.
- From the time plants are planted until the beginning of the plant establishment period, damage caused by erosion shall be repaired in conformance with the provisions in Section 7-1.16, "Contractor's Responsibility for the Work and Materials;" plants shall be watered in conformance with the provisions in Section 20-4.06, "Watering;" unsuitable plants shall be replaced as provided in Section 20-4.07, "Replacement;" and trash and debris shall be removed and weeds shall be controlled in conformance with the provisions in Section 20-4.025, "Roadside Clearing."
- In addition to other provisions, planted areas shall be neat and clean before the Contractor is allowed to begin the plant establishment period.

20-4.055 PRUNING

- Pruning of plants shall be consistent with American National Standards Institute (ANSI) A300-1995, "Tree, Shrub and Other Woody Plant Maintenance-Standard Practices," and "Tree-Pruning Guidelines," published by the International Society of Arboriculture (ISBN 1-881956-07-5).

20-4.06 WATERING

- If water is available from an irrigation system to be installed under the contract or an existing State-owned facility within the limits of the project, water for highway planting work may be obtained from these facilities free of charge. Where water is not available from these facilities, the Contractor shall make the arrangements for furnishing and applying water and shall pay all costs involved.
- Existing plants within the limits of a project, designated to be maintained by the Contractor, shall be watered in conformance with the provisions specified herein for watering new plants.

- Trees, shrubs and vines shall be watered immediately after planting. Water shall be applied until the backfill soil around and below the roots or ball of earth around the roots of each plant is thoroughly saturated. Where watering is done with a hose, a water disbursement device or pressure reducing device approved by the Engineer shall be used. Under no circumstances shall the full force of the water from the open end of a hose be allowed to fall within the basin around any plant.
- Ground cover plants in areas provided with an irrigation system shall be watered by sprinklers. Several consecutive waterings may be necessary to thoroughly saturate the soil around each plant.
- Water shall be applied to plants as often and in sufficient amount as conditions may require to keep the plants in a healthy, growing condition during the life of the contract.
- Remote control valves shown as remote control valves (master) or gate valves on the discharge side of backflow preventers shall be kept closed at all times, except while the irrigation system is actually in use.
- Precautions shall be taken to prevent water from wetting vehicles, pedestrians, and pavement. Any erosion or slippage of the soil caused by watering shall be repaired by the Contractor at the Contractor's expense.
- Compliance with the provisions in this Section 20-4.06 shall not relieve the Contractor of the responsibility for the replacement of plants in conformance with the provisions in Section 20-4.07, "Replacement." Any additional watering measures required to maintain the plants in a healthy, growing condition shall be furnished by the Contractor at the Contractor's expense.

20-4.07 REPLACEMENT

- Plants that show signs of failure to grow at any time, or which are so injured or damaged as to render them unsuitable for the purpose intended, as determined by the Engineer, shall be removed and replaced. Unless otherwise permitted by the Engineer, the Contractor shall complete replacement of unsuitable plants within 2 weeks after the Engineer marks or otherwise indicates that the plants shall be replaced.
- Replacement planting shall conform to the original spacing and size provisions specified for the plants being replaced.
- Replacement ground cover plants shall be the same species as specified for the ground cover being replaced. Other replacement plants shall be either the same species as the plants being replaced, or the Contractor and Engineer may agree to the substitution of alternative species of plants to be used as replacements in conformance with the provisions in this Section 20-4.07.
- Replacement plants shall be furnished and planted by the Contractor at the Contractor's expense. At the option of the Contractor, plants of a larger container size than those originally specified may be used for replacement plants during the plant establishment period. The use of plants of a larger container size than those originally specified for replacement plants shall be at the Contractor's expense.

20-4.08 PLANT ESTABLISHMENT WORK

- Plant establishment work shall consist of caring for the highway planting as specified in this Section 20-4.08 and in the special provisions.

- The Engineer will notify the Contractor in writing of the start of the following plant establishment periods and will furnish statements regarding days credited to the plant establishment work after the notification:

A. Type 1 plant establishment period shall be the number of working days specified for plant establishment in the special provisions and shall begin after all work has been completed, except plant establishment work and other items of work specified to be performed for the life of the contract.

B. Type 2 plant establishment period shall be the time between completion of all planting work (except plant establishment work and other items of work specified to be performed for the life of the contract) and acceptance of the contract, provided however, that the contract will not be accepted unless the plant establishment work has been satisfactorily performed for at least the number of working days specified for plant establishment in the special provisions.

If relief from maintenance and responsibility is granted for a completed portion of the work, in conformance with the provisions in Section 7-1.15, "Relief From Maintenance and Responsibility," Type 2 plant establishment period for the completed portion shall be the time between completion of all planting work (except plant establishment work) and the granting of relief from maintenance and responsibility, provided however, that the relief will not be granted unless the plant establishment work in the completed portion of the work has been satisfactorily performed for at least the number of working days specified for plant establishment in the special provisions.

- The time required for plant establishment work shall be considered as included in the total time limit specified for the contract.
- The Contractor will be required to adequately water plants; replace unsuitable plants; do weed, rodent and other pest control; and perform other work, as determined necessary by the Engineer, every working day during the plant establishment period.
- During the plant establishment period, damage caused by erosion shall be repaired in conformance with the provisions in Section 7-1.16, "Contractor's Responsibility for the Work and Materials."
- Working days upon which no work will be required, as determined by the Engineer, will be credited as one of the plant establishment working days, regardless of whether or not the Contractor performs plant establishment work.
- Working days when the Contractor fails to adequately perform plant establishment work, including but not limited to watering plants, replacing unsuitable plants, repairing erosion damage, removing and disposing of trash and debris and doing weed, rodent and other pest control, determined to be necessary by the Engineer, will not be credited as plant establishment working days.
- When ground cover plant growth extends onto sidewalks, curbs, or dikes, all ground cover plant growth within 2 feet of the sidewalk, curb or dike shall be

removed. Ground cover plant growth within 2 feet of shoulders, walls or fences shall be removed.

- Ground cover also shall be kept removed from within the basins, including the basin walls, and from planting areas within header boards.
- Commercial fertilizer shall be applied to trees, shrubs, vines and ground cover areas as specified in the special provisions and shall be watered into the soil after each application. The Contractor shall notify the Engineer at least 5 days prior to applying each application of commercial fertilizer.
- Basins and basin walls shall be kept well formed and free of weeds.
- Plants shall be kept watered in conformance with the provisions in Section 20-4.06, "Watering," and unsuitable plants shall be replaced in conformance with the provisions in Section 20-4.07, "Replacement."
- During the plant establishment period, electric automatic irrigation systems shall be operated in the automatic mode, unless otherwise permitted by the Engineer. When any electric automatic irrigation component is operated manually on a working day, the day will not be credited as a plant establishment working day unless such manual operation has been permitted in writing by the Engineer.
- As part of the plant establishment work, 30 days prior to completion of the plant establishment period, instructions shall be given to the Engineer by a qualified person from the Contractor's personnel on the use and adjustment of the irrigation controllers installed.
- Vines next to walls and fences shall be kept staked and tied in conformance with the provisions in Section 20-4.05, "Planting."
- Weeds in all roadside clearing and planting areas as designated in the special provisions or shown on the plans shall be controlled as specified in the special provisions and as directed by the Engineer.
- Where pesticides are used to control weeds in conformance with the provisions in Section 20-4.026, "Pesticides," weeds shall be killed before they exceed 2 inches in length.
- Where weeds are to be mowed as specified in the special provisions, they shall be mowed as close to the ground as possible before they exceed 6 inches in length.
- Where weeds are to be pulled by hand as specified in the special provisions, they shall be pulled before they exceed 4 inches in length and disposed of outside the highway right of way, in conformance with the provisions in Section 7-1.13, on the same day in which they are pulled.
- Dead weed growth which, in the opinion of the Engineer, will interfere with subsequent plant establishment or become unsightly shall be removed and disposed of outside the highway right of way in conformance with the provisions in Section 7-1.13.
- Weed control, as specified in this Section 20-4.08, shall be performed as often as required to maintain the project in a neat and uniform condition at all times.
- Surplus earth, papers, trash and debris, which accumulate in the roadside clearing and planting areas as designated in the special provisions shall be removed and disposed of outside the highway right of way in conformance with the provisions in Section 7-1.13. The areas shall be so cared for as to present a neat and clean condition at all times.

- During the plant establishment period, trees, shrubs, vines and ground cover plants, planted as part of the contract, shall be pruned or headed back by the Contractor at the Contractor's expense, when and as directed by the Engineer.
- When the Engineer determines that the plant stakes are inadequate to support the plants during the plant establishment period, the plant stakes shall be replaced, at the Contractor's expense, with a larger diameter stake adequate to support the plant. Plant stakes shall be removed at any time during the plant establishment period when determined by the Engineer.
- A watering schedule program for each irrigation controller shall be submitted to the Engineer for approval not less than 40 working days prior to the completion of the plant establishment period. If the Engineer determines that the submitted watering schedule is unacceptable, a revised watering schedule shall be submitted to the Engineer for approval within 5 working days after receiving notice that the previously submitted schedule is unacceptable.
- Written instructions on the use and adjustment of the installed irrigation controllers shall be given to the Engineer during the plant establishment period. The approved watering schedule program shall be implemented by the Contractor not less than 10 working days prior to the completion of the plant establishment period. The programming shall not relieve the Contractor of the responsibility to apply sufficient water as conditions may require to keep the plants in a healthy condition.
- In order to carry out the plant establishment work, the Contractor shall furnish sufficient personnel and adequate equipment to perform the work during the plant establishment period.

20-4.09 MEASUREMENT

- The work performed under these specifications will be measured by the unit designated in the contract item, and unless otherwise provided, will be determined as units from actual count or measurement of the items in place in the completed work.
- Items to be paid for by the square yard will be calculated on the basis of actual or computed slope measurements.
- Quantities of cultivation to be paid for by the square yard will be calculated on the basis of the area shown on the plans to be planted with plants requiring cultivation as specified in the special provisions, plus the area 12 inches beyond the outer row of the plants in each area. Planting areas for plants within cultivation areas that do not require cultivation will not be deducted from the cultivation area to be paid for.
- Quantities of imported topsoil to be paid for by the ton or cubic yard will be determined in conformance with the provisions in Section 9-1.01, "Measurement of Quantities." When paid for by the cubic yard, imported topsoil will be measured in the vehicle at the point of delivery.
- Quantities of granular and slow release commercial fertilizer and iron sulfate to be paid for by the pound or ton will be determined from marked weight and sack count.
- Quantities of commercial fertilizer tablets to be paid for will be measured by the tablet.

- Quantities of soil amendment and mulch to be paid for by the cubic yard will be determined in conformance with the provisions in Section 9-1.01, "Measurement of Quantities," and will be measured in the vehicle at the point of delivery.
- Quantity of header boards to be paid for will be measured by the linear foot as determined from the actual length of the header boards in the finished work.
- Quantities of the various sizes and types of plants to be paid for by the unit will be determined, at the option of the Engineer, either by the product of the average plant density and the total area planted, or by actual count of the living plants in place. The average plant density will be the number of living plants per square yard, as determined by actual count of test areas chosen as representative of the total planted area. The size and location of the test areas shall be determined by the Engineer by consultation with the Contractor, except that the total area tested shall be equal to not less than 3 percent nor more than 5 percent of the planted area being determined. In case of disagreement, the Engineer will make the final determination of areas to be tested.

20-4.10 PAYMENT

- When the contract includes separate items and unit or lump sum prices for performing highway planting, the quantities will be paid for at the contract unit or lump sum price or prices for the item of work involved and identified.
- The contract lump sum price paid for plant establishment work shall include full compensation for furnishing all labor, materials (including pesticides, commercial fertilizer and replacement plants), tools, equipment, and incidentals, and for doing all the work involved in establishing plants, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.
- The contract lump sum price paid for maintain existing plants shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in maintaining existing plants, complete in place, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.
- All other highway planting work will be paid for at a single contract lump sum price for highway planting, or at the contract lump sum or item prices for separate items of roadside clearing, imported topsoil, prepare hole, prepare trench, cultivate, iron sulfate, soil amendment, mulch, header board, commercial fertilizer, root protector, foliage protector, and plant (of the group indicated). The item or items to be paid for and the unit of measure will be designated in the Engineer's Estimate.
- Full compensation for preparing planting areas in conformance with the provisions in Section 20-4.03, "Preparing Planting Areas," except as otherwise provided, shall be considered as included in the prices paid for the various contract items of work involved in planting and no additional compensation will be allowed therefor.
- The above prices and payments shall include full compensation for furnishing all labor, materials (including pesticides and replacement plants), tools, equipment, and incidentals, and for doing all the work involved in highway planting, complete in place, including watering, removing and disposing of trash, debris and weeds, and removing and disposing of existing pavement shown on the plans where

planting holes or trenches are to be excavated, and excavation and backfill for setting header boards, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

20-5 IRRIGATION SYSTEMS

20-5.01 DESCRIPTION

This work shall consist of furnishing and installing manual and automatic irrigation systems as shown on the plans and in conformance with these specifications and the special provisions.

20-5.02 MATERIALS

Materials shall be commercial quality unless otherwise specified. Materials containing asbestos fibers shall not be used. Materials shall conform to the provisions in Section 20-2, "Materials."

20-5.024 IRRIGATION CROSSOVERS

Irrigation crossovers shall include conduits, water line crossovers, sprinkler control crossovers and appurtenances. Sizes of the conduits, water line crossovers and sprinkler control crossovers shall be as shown on the plans or as specified in the special provisions.

20-5.025 MAINTAIN EXISTING WATER SUPPLY

The Contractor shall notify the Engineer at least 4 days prior to shutting off the water supply to any portion of an existing irrigation system. The Engineer shall also be notified when the water supply is returned to that portion of the irrigation system.

Water supply for maintaining existing plantings shall be maintained as specified herein until the permanent water supply or a temporary water supply system, approved by the Engineer, has been provided. If existing plantings are to be maintained by the State and Contractor from the same water supply, sufficient water shall be supplied to State landscape maintenance forces for watering plantings (within and outside the project limits) as necessary to maintain a healthy condition throughout the life of the contract.

If the work causes a continuous interruption of water supply for more than 3 consecutive days, the Contractor shall water at the Contractor's expense all existing plantings, including those being maintained by State landscape maintenance forces, in the area irrigated from that water supply as often as necessary to maintain healthy plant growth. At the option of the Contractor, temporary connections to the existing irrigation system may be provided until the water service has been restored to the irrigation system.

Existing irrigation facilities shown on the plans or specified in the special provisions to be removed, relocated or salvaged shall remain in place until their use is no longer required as determined by the Engineer.

Existing irrigation facilities that are to remain or are to be maintained, relocated or salvaged as part of this contract, shall be protected from damage. If the Contractor's operations damage the existing irrigation facilities, the damaged facilities shall be repaired or replaced, at the Contractor's expense, as follows:

Repair or replacement of damaged facilities shall be completed within 10 working days of the damage.

Replaced irrigation facilities shall be new and of equal or better quality than the damaged facility. Replacement irrigation facilities shall be compatible with the irrigation systems to remain.

After repair or replacement of the facilities is complete, the Contractor shall demonstrate to the Engineer that the repaired or replaced facilities operate properly. When remote control valves are repaired or replaced, the valves shall be tested with the irrigation controller in the automatic mode.

- Where work is performed on an existing irrigation system, the system shall be checked by the Contractor for proper operation after the work is completed and any malfunctions resulting from the Contractor's operations shall be corrected at the Contractor's expense.
- When ordered by the Engineer, gate valves shall be installed at various locations in the existing irrigation system as directed by the Engineer. Furnishing and installing gate valves, except gate valves shown on the plans, will be paid for as extra work as provided in Section 4-1.03D.

20-5.026 REMOVE EXISTING PLANTS FOR TRENCHING

- Where trenching for new irrigation facilities is performed in areas planted with existing trees or shrubs, the trenching alignment shall be adjusted as necessary to avoid damage to the trees or shrubs.
- Where trenching for new irrigation facilities is performed in existing ground cover, sufficient ground cover shall be removed to permit the proper installation of the facilities, but in no case shall the removal width exceed 6 feet. Removed ground cover shall be disposed of outside the highway right of way in conformance with the provisions in Section 7-1.13.
- The Contractor may, as an option, rototill existing Carpobrotus and Delosperma ground cover in lieu of removing the ground cover provided the backfill for the trenches will not contain plants longer than 6 inches in length.
- Ground cover removed or rototilled within the maximum 6-foot wide removal area shall be replaced with new plants of the same variety as the existing ground cover. Carpobrotus and Delosperma replacement plants shall be cuttings conforming to the provisions in Section 20-2.13, "Plants," and shall be planted 12 inches on center. Other ground cover replacement plants shall be from flats and shall be planted 12 inches on center.
- All ground cover replacement planting shall be performed before the start of the plant establishment period or at least 15 days prior to the acceptance of the contract if there is no plant establishment period.
- Planting of ground cover plants shall conform to the provisions in Section 20-4.05, "Planting."
- Replacement ground cover plantings shall be watered, at the Contractor's expense, in conformance with the provisions in Section 20-4.06, "Watering."

20-5.027 ELECTRICAL INSTALLATIONS FOR ELECTRIC AUTOMATIC IRRIGATION SYSTEMS

Electrical installations for electric automatic irrigation systems shall conform to the provisions in Section 86-1.02, "Regulations and Code," and these specifications.

20-5.027A Components

Electrical components for electric automatic irrigation systems shall include irrigation controllers with enclosures; base stations; field units; remote control valves; valve boxes; pull boxes; electrical conduits; conductors between controllers, pumps and valves; moisture sensors; flow sensors; remote control valve actuators; and all appurtenances, incidentals and accessories required for proper installation and operation of the electrical portions of the systems. Electrical components for electric automatic irrigation systems shall not include electrical service.

All voltages shown on the plans or specified in these specifications or the special provisions for electrical components for electric automatic irrigation systems shall be considered as nominal.

Electrical components requiring modifications to conform to the specified provisions shall have those modifications made by the manufacturer before shipment to the project.

20-5.027B Wiring Plans and Diagrams

Working drawings for the electrical components of the irrigation system (except electrical service) shall be submitted in conformance with the provisions in Section 5-1.02, "Plans and Working Drawings," not less than 30 working days prior to the installation of any electrical materials for an irrigation system (except electrical service). The working drawings shall consist of wiring plans which shall be reproducible, shall conform in scale to the contract plans for irrigation and shall bear the written approval of the controller manufacturer or the manufacturer's authorized agent. Information shown on the wiring plans shall include, but not be limited to, wire and conduit sizes, and the wire routes between electrical components.

Three copies of the schematic wiring diagram, including any wiring modifications, for each type of controller installed shall be submitted to the Engineer prior to completion of the contract.

For each controller, one additional copy of the schematic wiring diagram and a copy of the reduced irrigation plan showing the equipment controlled by the controller, including the installed locations and correct station numbers for each electric remote control valve, shall be laminated with clear, mat-finished plastic, not less than 10 mils thick, and placed in a heavy-duty plastic envelope. The envelope shall be attached securely to the inside of the controller enclosure or cabinet door. Where the controller enclosure door is not of sufficient size to secure the plastic envelope to the inside of the door, the envelope and contents shall be furnished to the Engineer.

20-5.027C Electrical Energy

Electrical energy for automatic irrigation systems may be obtained by the Contractor free of charge from the electrical service points shown on the plans.

20-5.027D Sprinkler Control Crossovers

- Sprinkler control crossover work shall consist of furnishing and installing electrical conduit, pull boxes and appurtenances as shown on the plans and as specified in these specifications and the special provisions.
- Sprinkler control crossovers shall be any electrical conduit for sprinkler controls that is installed inside a larger conduit under a roadway or other facility.
- Electrical conduit for sprinkler control crossovers shall be the rigid non-metallic type. The size of electrical conduit will be specified in the special provisions or shown on the plans.
- A No. 5 pull box, conforming to the provisions in Section 20-2.31C, "Pull Boxes," shall be installed at each end of sprinkler control crossovers as shown on the plans.

20-5.027E Service

- Electric service installations for irrigation controllers shall conform to the provisions in the special provisions.

20-5.027F Excavation and Backfill

- Excavation and backfill for installing irrigation facilities shall conform to the provisions specified for installing pipe in Section 20-5.03D, "Trenching and Backfilling."

20-5.027G Controllers

- Irrigation controllers shall be installed in conformance with the manufacturer's instructions, the details shown on the plans, these specifications, and the special provisions. When irrigation controllers are to be installed in irrigation controller enclosure cabinets, the controllers shall be installed in conformance with the details shown on the plans, these specifications, and the special provisions.
- The installation date and the expiration date of the guarantee for the controllers shall be permanently marked on the inside face of the controllers.
- A complete maintenance and operations manual for each type of controller installed shall be submitted to the Engineer when the schematic wiring diagrams are placed inside of the controller enclosure or cabinet door.

20-5.027H Valves and Valve Boxes

- Remote control valves and valve boxes for valves shall be installed in conformance with the provisions in Section 20-5.03F, "Valves and Valve Boxes."

20-5.027I Conductors, Electrical Conduit and Pull Boxes

- Low voltage control and neutral conductors, electrical conduit and pull boxes for irrigation systems shall be installed in conformance with the details shown on the plans, these specifications and the special provisions.
- Conductors shall be color coded when two or more controllers are located within one irrigation controller enclosure cabinet, or when conductors from more than one controller are installed in a common trench. The color of the conductors shall be uniform from any one controller to its valves. Neutral conductors shall be white. White shall not be used for control conductors. Conductors with green colored insulation shall not be used except as permitted by the National Electric Code.

- Conductors shall be of the size recommended by the manufacturer of the controllers to be installed, unless otherwise specified.
- Each irrigation controller shall have a common neutral conductor to its respective remote control valves.
- Each remote control valve shall have a separate control conductor from the irrigation controller with no other valves connected to the conductor.
- Conductors installed in a common trench, and not in a conduit, shall be wrapped together with electrical tape at 5-foot intervals.
- At least 2 feet of slack shall be left for each conductor at each pull box.
- At each valve box, at least 2 feet of slack shall be left for each conductor that is connected to other facilities within the box or is spliced within the box.
- Splices for low voltage control and neutral conductors shall conform to the provisions in Sections 86-2.09C, "Connectors and Terminals," 86-2.09D, "Splicing and Terminations," and 86-2.09E, "Splice Insulation," except "Method B" splice insulation, as shown on the plans, shall not be used. Tape used for insulating splices shall be a polyvinyl chloride type.
- Splices shall be made only in pull boxes or valve boxes.
- Conductors in irrigation controller cabinets shall not be spliced.
- Temporary splices used for testing valve circuits shall not be used as permanent splices.
- All permanent splice connections shall be made with freshly cut and skinned conductors.
- Conductors shall be buried directly in the ground, except as follows:

  Conductors shall be installed in electrical conduit when conductors are to be surface mounted, installed in or on bridge structures, installed under paved areas, installed in conduit for water line crossovers and sprinkler control crossovers, or placed in concrete. Surface-mounted conduits, conduits installed in or on bridge structures; conduits installed in concrete; and conduits installed by jacking or drilling shall be the rigid steel type. All other electrical conduit, including electrical conduit installed in irrigation crossover conduits for water line crossovers and sprinkler control crossovers and conduits under paved areas shall be non-metallic.

- Where conductors are installed in the same trench or opening as pipe (supply line), the conductors shall be placed at the same depth as the pipe. At other locations the conductors shall be installed not less than 12 inches below finished grade.
- Conductors located adjacent to curbs, dikes and paved shoulders, and not in a pipe (supply line) trench, shall be at least 4 feet from the curbs, dikes and paved shoulders.
- The Contractor, as an option, may install conductors for an irrigation system by methods and with equipment other than by trenching provided the conductors are installed at the depths specified and the conductor insulation is not damaged by the methods and equipment used.

- Pull boxes shall be installed on a continuous piece of 1/4 inch to 1/2 inch mesh, 19 gage minimum galvanized woven wire cloth over a bedding of gravel or crushed rock as shown on the plans for "Valve Box."
- Pull boxes for low voltage conductors shall not have side openings.
- Pull boxes shall be installed at the following locations:

1. At all conductor splices, except splices made in valve boxes.
2. At intervals not to exceed 500 feet along any low voltage, neutral and control conductor runs. Valve boxes installed along a conductor run shall not be considered as pull boxes in determining the spacing. When approved by the Engineer, the Contractor may, at the Contractor's expense, install additional pull boxes to facilitate the work.
3. Within 5 feet of irrigation controllers or within 5 feet of cabinets housing one or more controllers.
4. At ends of electrical conduits.
5. Other locations shown on the plans.

- The tops of pull boxes installed in walkway and paved areas shall be flush with the surrounding finished grade. The tops of pull boxes in other areas shall be installed 2 inches above the surrounding finished grade.

20-5.027J Testing

- Attention is directed to Section 6-3, "Testing."
- Field tests and a functional test shall be performed by the Contractor to demonstrate that all electrical components of the irrigation systems function as specified.
- Field tests shall be performed on all conductors in conformance with the provisions for lighting circuits in Section 86-2.14B, "Field Testing." Where the conductors are installed by trenching and backfilling, field tests shall be performed after at least 6 inches of backfill material has been placed over the conductors and the material has been compacted in conformance with the provisions in Section 20-5.03D, "Trenching and Backfilling."
- The functional test for each irrigation controller and associated automatic irrigation system served by a single electric service point, or a group of irrigation controllers and associated automatic irrigation systems served by a single electric service point, shall consist of not less than one complete cycle of operation The length of the cycle will be determined by the Engineer. If unsatisfactory performance of any system develops, the condition shall be corrected and the test repeated until one complete cycle of satisfactory operation is obtained.
- The functional test shall be satisfactorily completed prior to the start of the plant establishment period or prior to acceptance of the contract if there is no plant establishment period.

20-5.03 INSTALLATION

- Irrigation systems shall be installed in conformance with the provisions in Section 20-5.027, "Electrical Installations for Electric Automatic Irrigation Systems," and these specifications.

- The irrigation systems as shown on the plans, except for sprinkler locations, are diagrammatic.

20-5.03A General

- Underground metallic pipes, valves or fittings made of dissimilar metals shall be connected through a dielectric coupling or bushing. Pipe installed in this manner shall be physically separated from other metal objects. Dielectric couplings shall physically separate the pipes a minimum of 1/8 inch in all directions. Non-conducting spacers which will ensure physical separation of pipe from foreign objects may be required as determined by the Engineer.
- Repair of irrigation systems shall be made within 5 working days after a malfunction or damage to any portion of the system has occurred.
- Supply lines, control and neutral conductors and electrical conduits installed in common trenches shall not be installed above each other.
- Risers for sprinklers on slopes shall be set perpendicular to the plane of the slope.
- If the location of a supply line interferes with the excavation of plant holes, the plant holes shall be so located as to clear the supply lines. Supply lines shall not be installed through plant holes unless otherwise shown on the plans.
- Control valves and sprinklers shall be installed 6 1/2 feet to 8 feet from curbs, dikes, sidewalks and paved shoulders and 3 feet from fences and walls. If control valves and sprinklers cannot be installed within these limits, control valves and sprinklers shall be located as directed by the Engineer.
- Foreign material shall be prevented from entering the irrigation system during installation. Immediately prior to assembling, all pipes, valves, and fittings shall be cleaned. All unattached ends of pipe, fittings and valves shall be plugged or capped pending attachment of additional pipe or fittings. All lines shall be thoroughly flushed out prior to attachment of sprinklers, emitters and other terminal fittings.

20-5.03B Conduit for Irrigation Crossovers

- The installation of conduit for irrigation crossovers shall conform to the provisions in this Section 20-5.03B.
- Conduits for irrigation crossovers shall conform to the provisions in Section 20-2.16, "Conduit."
- Conduits shall be installed not less than 1 1/2 feet below the top of curb grade in sidewalk areas and not less than 40 inches below finished grade in all other areas measured to the top of the conduit. Conduits shall extend 2 feet beyond all paving unless otherwise shown on the plans.
- Conduits shall be installed under existing pavement by jacking or drilling methods. Pavement shall not be disturbed without the approval of the Engineer, and then only in the event obstructions are encountered. When permitted by the Engineer, small holes may be cut in the pavement to locate or remove obstructions. Jacking or drilling pits shall be kept at least 2 feet from pavement edge wherever possible. Excessive use of water that will soften subgrade or undermine the pavement will not be permitted.
- Where conduits are installed in open trenches, excavation and backfill shall conform to the provisions in Section 20-5.03D, "Trenching and Backfilling," and

these specifications. The bottom of the trench shall be graded and prepared to provide a firm and uniform bearing throughout the entire length of the conduit. During backfilling operations, the conduit shall be rigidly supported so that no movement of, or damage to, the conduit or joints will result.

- Couplings for conduits shall be installed in conformance with the manufacturer's written instructions; a copy of which shall be furnished to the Engineer prior to installation.
- After installation of conduits for water line crossovers and sprinkler control crossovers and placing of base and surfacing is completed, the Contractor shall demonstrate that such conduits are free of obstructions and restrictions.
- The ends of conduits shall be capped with a No. 30 asphalt-saturated felt secured with galvanized wire.
- Ground cover plants removed or damaged by the Contractor's operations shall be replaced at the Contractor's expense, in conformance with the provisions in Section 20-4.07, "Replacement," regardless of the type of installation involved.
- The location of each conduit shall be designated by cementing a Type A pavement marker to the paved shoulder near each end and over the center line of the conduit using a standard set type adhesive. Type A pavement markers and adhesive shall conform to the provisions in Section 85, "Pavement Markers."
- When existing conduits are to be incorporated in new work, exploratory holes for locating existing conduits shall be excavated at the locations indicated by existing markers or where directed by the Engineer. The Contractor shall excavate and backfill exploratory holes at any location to a maximum size of $2\frac{1}{2}$ feet in width, 5 feet in depth and 10 feet parallel with the roadway (5 feet on each side of the marker or directed location). If it is necessary or advisable, as determined by the Engineer, to increase the size of the exploratory holes beyond the dimensions specified above, the additional excavation and backfill will be paid for as extra work as provided in Section 4-1.03D.
- Before existing Type A pavement markers indicating the location of the existing crossover conduit are removed or disturbed, the location of the existing crossover conduit shall be marked on the pavement by the Contractor. Existing pavement markers, that are damaged or removed by the Contractor, shall be replaced by the Contractor at the Contractor's expense.

20-5.03C Water Line Crossovers

- Water line crossovers are supply line pipes installed in conduits.
- The work of installing water line crossovers shall include furnishing and installing appurtenances shown on the plans or specified in these specifications or the special provisions.
- Water line crossovers shall be polyvinyl chloride (PVC) plastic pipe with a minimum pressure rating (PR) of 315 and shall be of the sizes shown on the plans or specified in the special provisions.
- After completing conduit backfill and prior to performing the pressure test on a water line crossover, the Contractor shall demonstrate that the water line crossover can be moved longitudinally within the conduit. The water line crossover shall then be positioned to extend at least one foot beyond each end of the conduit.

- Where water line crossovers are not to be connected to other supply lines, the ends of the crossovers shall be capped immediately after testing.

20-5.03D Trenching and Backfilling

- Trenching and backfilling for installation of pipe, fittings and appurtenances; and electrical facilities, including removing and replacing improvements, shall conform to the details shown on the plans, and the provisions in Section 86-2.01, "Excavating and Backfilling," Section 86-2.02, "Removing and Replacing Improvements," and these specifications.
- Trenches for pipe, fittings and appurtenances, and electrical facilities shall be smooth and free of jagged rubble or sharp objects which will cause abrupt bending stresses and uneven load distribution to pipes, conduits and conductors during backfilling operations.
- Trenches for solvent cemented plastic pipe supply lines shall be of sufficient width to permit snaking of the pipe. Other trenches shall not be excavated wider than necessary for the proper installation of pipe supply lines.
- The backfilling of pipe trenches shall be accomplished in a manner that will protect the pipe from damage by sharp objects. Rocks shall not be placed directly on the pipe.
- Rocks and other debris encountered during trenching operations shall be brought to the surface of the ground at the Contractor's expense. Removing and disposing of the rocks and debris will be paid for as extra work as provided in Section 4-1.03D. The size of rocks and the quantity of rocks and debris to be disposed of will be determined by the Engineer.
- Pavement, sidewalk and similarly paved areas encountered on or beneath the surface of the ground and not shown on the plans in areas to be trenched, and if ordered by the Engineer, shall be removed and disposed of as directed by the Engineer. Excavating through the paved areas, furnishing and placing topsoil to fill resulting holes, and removing and disposing of all the pavement will be paid for as extra work as provided in Section 4-1.03D.
- Existing pavement shown on the plans where trenches are to be excavated shall be removed and, unless otherwise permitted by the Engineer, disposed of outside the highway right of way as provided in Section 7-1.13.
- Except as otherwise specified in this Section 20-5.03D, backfill material shall be material excavated from the trenches and shall be compacted by ponding or jetting with water until the backfill material, after settlement, is level with the surrounding soil.
- The backfill for excavations outside the right of way and excavations within surfaced areas shall be compacted in conformance with the provisions in Section 19-3, "Structure Excavation and Backfill."
- If for any reason the soil taken from the trench is determined by the Engineer to be unsuitable for a bedding material against the pipe, a suitable material, such as sand or topsoil, shall be furnished and placed as a bedding for the pipe before backfilling with the original soil taken from the trench. Furnishing and placing bedding material for pipe when ordered by the Engineer will be paid for as extra work as provided in Section 4-1.03D.

- When any backfilled area has settled, the area shall be refilled and compacted by the Contractor at the Contractor's expense, including furnishing, placing and compacting the fill material.

20-5.03E Pipe

- Plastic pipe supply lines, thrust blocks, plastic pipe irrigation lines, and fittings shall be installed in conformance with the pipe and fitting manufacturers' printed instructions and these specifications. A copy of such manufacturer's instructions shall be furnished to the Engineer before any pipe is installed.
- The Contractor may as an option install plastic pipe supply line with solvent cemented fittings and plastic pipe irrigation line by methods and with equipment other than by trenching, provided the pipes are installed at the depths specified.
- Where connection is made to existing supply lines, compression type fittings may be used.
- Pipe from water meters through a backflow preventer assembly to plastic pipe supply lines shall be galvanized steel or as otherwise shown on the plans.
- Supply lines shall be installed under paved ditches which are 3 feet deep or less at the flow line. Supply lines that cross paved ditches more than 3 feet deep shall be galvanized steel pipe and shall span the ditches.
- Supply line trenches located adjacent to curbs, dikes and paved shoulders shall be at least 4 feet from the curbs, dikes and paved shoulders.
- Plastic pipe supply lines with rubber ring gasket type joints shall be installed not less than 18 inches below the finished grade, measured to the top of the pipe.
- Plastic pipe supply lines with solvent cemented type joints shall be installed not less than 12 inches below the finished grade, measured to the top of the pipe.
- Pipe shall be cut straight and true. After cutting, the ends shall be reamed out to the full inside diameter of the pipe.
- PVC pipe $1\frac{1}{2}$ inches or less in diameter shall not be cut by sawing. PVC pipe $1\frac{1}{2}$ inches or less in diameter shall be cut with "PVC cutters."
- Male pipe threads on galvanized steel pipe shall be coated with a joint compound that is non-hardening and non-corrosive.
- Solvent cement welding shall be done in conformance with the printed instructions of the solvent cement manufacturer. A copy of the printed instructions shall be furnished to the Engineer before any joints are made.
- The male portion of each threaded plastic pipe and fitting shall be wrapped with at least 2 layers of approved pipe thread sealant tape.
- All plastic pipe installed by trenching and backfilling methods, except pipe connected with rubber ring-type fittings, shall be snaked when installed. Pipe connected with rubber ring-type fittings need not be snaked.

20-5.03F Valves and Valve Boxes

- Remote control valves, remote control valves (master), manual control valves, flow sensor, gate valves, pressure reducing valves, pressure regulating valves, pressure relief valves, ball valves, wye strainers and filter assembly units shall be installed in valve boxes in conformance with the details shown on the plans and these specifications.

- Spring action check valves (anti-drain valves) shall be installed at the locations shown on the plans. If locations for check valves are not shown on the plans and a contract item for the valves is included in the Engineer's Estimate, the valves shall be located as directed by the Engineer. The check valve spring shall be factory set at 10 psi.
- Valve boxes installed in paved areas or on slopes steeper than 4:1 (horizontal:vertical) shall be precast portland cement concrete.
- Valve boxes shall be installed on a continuous piece of 1/4 inch to 1/2 inch mesh, 19 gage minimum galvanized woven wire cloth on a bedding of gravel or crushed rock as shown on the plans.
- Covers for valve boxes shall be one piece, except when the weight of a valve box cover exceeds 35 pounds the cover shall be cut into equal sections so that no section exceeds 35 pounds in weight. Cuts on valve box covers shall be straight, uniform and smooth.
- Valve boxes that contain remote control valves shall be identified on the top surface of the valve box covers by the appropriate letters and numbers as shown on the plans. Valve boxes shall be identified by attaching to the covers labels that contain the appropriate abbreviations. The identifying abbreviations (letters and numbers for controller and station numbers of the irrigation facility contained in the valve box) shall be as shown on the plans.
- Labels for valve boxes identified by labels shall consist of engraved letters and numbers on a 2-layer white over black, exterior-sign-plate plastic or integrally molded or heat-embossed black letters and numbers on ultraviolet-resistant yellow polyurethane material. The dimensions of the labels shall be a minimum of 2" x 3" x 1/8" thick. The letters and numbers shall be a minimum of 1 1/8 inches in height. Polyurethane material shall be neatly trimmed to the proper shape. Labels shall be attached to the valve box covers with commercial quality brass or stainless steel machine screws, nuts and washers as shown on the plans. Screws and nuts shall not be over tightened. Valve boxes shall be provided with valve box extensions when required.
- The tops of valve boxes installed in walkway and paved areas shall be flush with finished grade. The tops of valve boxes in other areas shall be installed 2 inches above finished grade.

20-5.03G Backflow Preventer Assembly

- Backflow preventer assembly shall consist of a backflow preventer, wye strainer, gate valves, pipe, fittings, portland cement concrete supports and portland cement concrete pad for the assembly, and shall conform to the details shown on the plans, these specifications and the special provisions. Components of backflow preventer assemblies shall conform to the provisions in Section 20-2, "Materials," and shall be capable of withstanding a cold water working pressure of 150 psi.
- Gate valves attached to the outlets of the wye strainers shall be threaded, have a brass or bronze body, stem and wedge, be the same size as the outlet and be modified so that attachments can not be made to the outlet valves. Seating rings on the discharge side of the valves shall be Teflon. Valve wedges shall be driven obliquely by cam action into the seating rings.

- Exposed top surfaces of concrete foundations and pads shall have a medium broom finish applied parallel to the long dimension of foundations and pads.

20-5.03H Pressure Testing

- Pressure testing for leakage shall be performed on all pipe supply lines installed by the Contractor, except for nonrigid pipelines and pipelines with spray nozzles installed into the pipe. Pipelines to be tested shall be installed, and all open ends of the pipeline and fittings shall be plugged or capped prior to testing.
- Pressure tests shall be performed in one or more operations.
- Pipelines installed by trenching and backfilling and pipelines which are completely visible after installation shall be tested by either Method A or Method B as specified below. The method used will be at the Contractor's option. All other pipelines, including those installed in the ground by methods other than trenching and backfilling, shall be tested by Method A as specified below. Water line crossovers shall be tested by Method A as specified below except the testing period and allowable drop in pressure shall be modified from one hour to 0.5-hour and from 5 psi to no drop in pressure, respectively.

20-5.03H(1) Method A

- Method A pressure testing procedure for leakage shall conform to the following:

The Contractor shall notify the Engineer at least 24 hours prior to performing any pressure test. Pressure tests shall be performed only between the hours of 8:00 a.m. and 5:00 p.m. except that no pressure tests shall be made on Saturdays, Sundays or legal holidays, unless otherwise approved in writing by the Engineer. Each pressure test shall be observed by the Engineer.

Pipelines to be tested shall be filled with water, and a pressure gage shall be connected to the pipeline. The pipeline shall then be placed under a pressure of 125 psi except as otherwise specified below, by air or water pressure, after which the source of pressure shall be cut off leaving the line under the required pressure.

The pressure gage shall be calibrated from 0 psi to 200 psi in 5 psi increments and shall be accurate within a tolerance of 2 psi.

The pipeline shall be tested under the required pressure for a period of one hour. The pressure gage shall remain in place until each test period has been completed. Leaks that develop in the tested portion of the system shall be located and repaired after each test period when a drop of more than 5 psi is indicated by the pressure gage. After the leaks have been repaired, the one hour pressure test shall be repeated and additional repairs made until the drop in pressure is 5 psi or less.

When a system consists of new pipelines installed as part of this contract and existing pipelines, the new pipelines shall be isolated from the existing pipelines, at the Contractor's expense, and the new pipelines shall be tested at 125 psi in conformance with these specifications.

20-5.03H(2) Method B

Method B pressure testing procedure for leakage shall conform to the following:

The Contractor shall notify the Engineer at least 24 hours prior to performing any pressure test. Pressure tests shall be so performed that the testing periods end between the hours of 8:00 a.m. and 5:00 p.m. except that no pressure test period shall end on Saturdays, Sundays or legal holidays, unless otherwise approved in writing by the Engineer. Each pressure test shall be observed by the Engineer.

Before any portion of the pipeline on the supply side of a control valve is backfilled, water shall be turned into that portion of the line and maintained at full pressure from the water source for a period of not less than 8 consecutive hours after all air has been expelled from the line. Before any portion of the pipeline on the discharge side of a control valve is backfilled, a similar test shall be performed, except the test shall be for a duration of one hour. Leaks that develop in a tested portion of the system shall be repaired. After the leaks have been repaired, the pressure test shall be repeated and additional repairs made until no leaks occur as determined by the Engineer.

20-5.03I Repairs and Coverage

Leaks that develop and defective material in any portion of the irrigation system installed by the Contractor shall be repaired or replaced by the Contractor.

The entire system shall be checked and, if necessary, adjusted for uniform and complete coverage after installing the sprinklers. Emitters shall be checked for proper operation and, if necessary, cleaned or replaced.

Any revision of the proposed irrigation systems ordered by the Engineer and necessary to achieve complete and adequate coverage of the areas to be watered will be paid for as extra work as provided in Section 4-1.03D.

20-5.03J Check and Test Backflow Preventers

Backflow preventers shall be checked and tested for proper operation by a certified Backflow Preventer Tester. The tester shall hold a valid certification as a Backflow Preventer Tester from the local governing authority in which the device to be tested is located. The local governing authority shall be the county, city or water purveyor having the governing authority over testing of backflow preventers involved. If the local governing authority does not have a certification program for Backflow Preventer Testers, the tester shall have a certificate from one of the following:

A. The American Water Works Association.
B. A county which has a certification program for Backflow Preventer Testers.

Tests for proper operation shall conform to the requirements of the governing authority.

The Engineer shall be notified at least 5 days prior to testing backflow preventers.

- One copy of the test results for each backflow preventer tested shall be furnished to the Engineer.
- Backflow preventers, installed by the Contractor, failing required tests shall be repaired at the Contractors expense.

20-5.04 MEASUREMENT

- The work performed under these specifications for installing irrigation systems will be measured by units, by the linear foot, by the lump sum price or by any other unit designated in the contract item and will be listed in the Engineer' Estimate by type, classification, size, or whatever information is necessary.
- Quantities of galvanized steel pipe and plastic pipe supply lines and irrigation lines, and the quantities of extend conduit, corrugated high density polyethylene pipe conduit, high density polyethylene pipe conduit, welded steel pipe conduit, corrugated steel pipe conduit, corrugated aluminum pipe conduit, acrylonitrile-butadiene-styrene (ABS) composite pipe conduit and alternative conduit to be paid for by the linear foot will be determined from the slope length designated by the Engineer. Pipe and conduit placed in excess of the lengths designated will not be paid for.
- Quantities of control valves, flow sensors, gate valves, garden valves, pressure relief valves, pressure reducing valves, quick coupling valves, check valves, filter assembly units, irrigation controllers, base stations, field units, backflow preventer assemblies, sprinklers and wye strainers to be paid for by the unit will be determined from actual count in place.

20-5.05 PAYMENT

- When the contract includes separate items for performing irrigation system work, the irrigation system work will be paid for at the contract lump sum or item prices for the items of work involved and identified.
- Irrigation system work will be paid for at a single contract lump sum price for irrigation system, or irrigation system work will be paid for as individual items as follows:

  The contract lump sum price for control and neutral conductors; the contract prices per linear foot for galvanized steel pipe and plastic pipe supply lines, and irrigation lines; the contract prices per linear foot for extend conduit, corrugated high density polyethylene pipe conduit, high density polyethylene pipe conduit, welded steel pipe conduit, corrugated steel pipe conduit, corrugated aluminum pipe conduit, acrylonitrile-butadiene-styrene (ABS) composite pipe conduit and alternative conduit; and the contract unit prices for control valves, flow sensors, gate valves, garden valves, pressure relief valves, pressure reducing valves, quick coupling valves, check valves, filter assembly units, irrigation controllers, base stations, field units, backflow preventer assemblies, sprinklers and wye strainers.

- The item or items to be paid for will be designated in the Engineer's Estimate.
- When irrigation system work is to be paid for at a contract lump sum price for irrigation system, the price shall include full compensation for furnishing all labor,

materials, tools, equipment, and incidentals, and for doing all the work involved in installing the irrigation system, complete in place, including excavation and backfill, replacing subbase, base, and pavement where pipe supply lines and conduits are installed through paved areas, testing and checking the irrigation system, maintaining existing water supply, salvaging, relocating or removing existing irrigation facilities and removing existing plants for trenching, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

- When the various components of the irrigation system work are to be paid for as individual items as described above, the following shall apply:

Remote control valves (master) will be paid for as electric remote control valves of the sizes involved.

Water line crossovers will be paid for at the contract prices per linear foot for the various sizes and types of supply line involved, which prices shall include full compensation for testing, checking, and furnishing and installing water line crossover appurtenances.

Full compensation for furnishing and installing electrical conduit for control and neutral conductors shall be considered as included in the contract lump sum price paid for control and neutral conductors and no separate payment will be made therefor.

Full compensation for sprinkler control crossovers, water line crossovers, pavement markers, pull wires, pull boxes and appurtenances, and for pressure testing the water line crossover in the conduit shall be considered as included in the contract prices paid per linear foot for the various sizes and types of conduit for irrigation crossovers in which the sprinkler control crossovers and water line crossovers are installed and no separate payment will be made therefor.

Full compensation for maintaining existing water supply shall be considered as included in the contract prices paid per linear foot for the various sizes of plastic pipe (supply line) involved and no additional compensation will be allowed therefor.

Full compensation for removing or rototilling, disposing and replacing existing ground cover to install irrigation pipes and conductors in existing ground cover shall be considered as included in the contract prices paid per linear foot for the various sizes of plastic pipe (supply line) or in the contract lump sum price paid for control and neutral conductors involved, and no additional compensation will be allowed therefor.

Full compensation for locating and marking the locations of conduits and capping the ends of conduits shall be considered as included in the contract prices paid per linear foot for the various sizes and types of conduit for water line crossovers and sprinkler control crossovers involved and no separate payment will be made therefor.

Full compensation for locating existing conduits shall be considered as included in the contract prices paid per linear foot for the various sizes of

plastic pipe (supply line) involved and no additional compensation will be allowed therefor.

Full compensation for replacing subbase, base and paving where supply lines or conduits are installed through existing paved areas shall be considered as included in the contract prices paid per linear foot for the various sizes of plastic pipe (supply line) and for the various sizes and types of conduit for water line crossovers and sprinkler control crossovers involved and no separate payment will be made therefor.

Full compensation for removing and disposing of existing pavement shown on the plans where trenches for irrigation facilities are to be excavated shall be considered as included in the contract prices paid for the items of work requiring the trenching and no separate payment will be made therefor.

Full compensation for performing the functional tests for electric automatic irrigation systems as specified herein shall be considered as included in the contract unit prices paid for the various types of irrigation controllers involved and no additional compensation will be allowed therefor.

Full compensation for furnishing and installing flexible risers, swing joints and pipe used for risers shall be considered as included in the price paid for the contract item requiring the riser or swing joint and riser and no separate payment will be made therefor.

Full compensation for furnishing and installing flow shutoff and pressure compensation devices on risers shall be considered as included in the contract unit price paid for the type of sprinkler involved and no separate payment will be made therefor.

Full compensation for checking and cleaning emitters and for checking and adjusting the various types of sprinklers for proper rate of flow and coverage, after installation, shall be considered as included in the contract unit prices paid for the various types of sprinklers involved and no separate payment will be made therefor.

Full compensation for testing new backflow preventers shall be considered as included in the contract unit price paid for the size of backflow preventer assembly involved and no separate payment will be made therefor.

Full compensation for retesting new and existing backflow preventers shall be considered as included in the contract lump sum price paid for plant establishment work and no additional compensation will be allowed therefor.

Full compensation for abandoning or removing and disposing of existing irrigation facilities shall be considered as included in the contract prices paid per linear foot for the various sizes of plastic pipe (supply line) involved and no separate payment will be made therefor.

Full compensation for relocating existing irrigation facilities shall be considered as included in the contract prices paid per linear foot for the various sizes of plastic pipe (supply line) involved and no separate payment will be made therefor.

Full compensation for salvaging existing irrigation facilities shall be considered as included in the contract prices paid per linear foot for the various

sizes of plastic pipe (supply line) involved and no additional compensation will be allowed therefor.

Full compensation for removing existing plants for trenching work shall be considered as included in the contract prices paid per linear foot for the various sizes of plastic pipe (supply line) involved and no additional compensation will be allowed therefor.

Full compensation for furnishing and installing pipe supply lines from water meters through the backflow preventers to plastic pipe supply lines shall be considered as included in the contract unit price paid for the size of the backflow preventer assembly involved and no separate payment will be made therefor.

Full compensation for furnishing flush valves and plastic pipe (locator) shall be considered as included in the contract price paid per linear foot for the size of plastic pipe (supply line) involved and no additional compensation will be allowed therefor.

When there are no separate contract items for materials necessary to complete a unit of the irrigation system, the materials shall be furnished and installed. Full compensation for furnishing and installing the materials shall be considered as included in the contract price or prices paid for the unit of the irrigation system requiring the materials and no additional compensation will be allowed therefor.

The above prices and payments shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in installing the irrigation systems, complete in place, including any structure excavation, structure backfill, concrete, and water involved, as shown on the plans, as specified in these specifications and the special provisions, and as directed by the Engineer.

SECTION 21: (BLANK)