SECTION 619 - PLANTING

619.01 Description. This Section describes planting and transplanting of trees, shrubs, vines, groundcovers and grass (including native groundcovers); and constructing plant barriers and rock landscaping.

619.02 Materials.

(A) Plant Material. Trees, shrubs, vines, groundcover and grass (including native groundcovers) shall be the type and size shown in the Contract or as specified by the Engineer.

(1) Certification of Plants. The Contractor's submission of a Bid shall constitute certification of availability of plants of required type, size, and quantity.

(2) Selection, Tagging, and Ordering of Plants.

(a) The Engineer will inspect plants at the nursery prior to and after delivery to the Project site. Each tree shall be tagged by the ENGINEER with consecutively numbered plastic tamper resistant self locking seal with a breaking strength of 55 lbs. Seals shall remain on trees and only be removed by the ENGINEER at the completion of the plant establishment period. Plants not conforming to the Contract requirements will be rejected.

(b) The Contractor shall request plant inspection at least one month prior to start of work. The Contractor shall obtain the Engineer's written verification that plants have been ordered.

(3) Plant Names. Trees, shrubs, vines, groundcover, and grass (including native groundcovers) shall be true to name and follow standards for nomenclature adopted by The American Joint Committee on Horticultural Nomenclature, and The Bernice P. Bishop Museum's Special Publication No. 50, "In Gardens of Hawaii."

(4) Condition of Plants. Plants shall conform to specified nomenclature, grades, and standards.

(a) General. Trees, shrubs, vines, groundcover, and grass (including native groundcovers) to be furnished by the Contractor shall have history of good growth, as determined after consultation with local landscape architects and plant nurseries. Plants furnished by the Contractor shall be

sound, healthy, vigorous, and free of disease, slugs and insects. Native plants should be locally sourced and if possible, coming from within the area to be re-vegetated.

(b) Trees. Trees shall be straight and uniformly shaped, unless unique or special characteristic is specified, and shall be undamaged.

(c) Container-grown Plants. Plants shall be grown in containers of specified size. Plant shall hold its root ball without being root bound upon removal from container.

(d) Seed.

1. Pure seed shall compose 95 percent minimum.

2. Crop seed shall compose 1 percent maximum.

3. Inert material shall compose 5 percent maximum.

4. Seed shall be tested for purity and germination by a seed laboratory certified by The Association of Official Seed Analysts. Test date shall be within 12 months of sowing. Seed shall comply with Hawaii Administrative Rules Title 4, Subtitle 6, Chapter 67 Seed Rules; shall be certified for compliance by a Hawaii-licensed seed dealer; and shall be purchased from that dealer.

5. Seed shall be delivered to the Project in unopened, sealed containers labeled with supplier's name, percent purity, percent live seed, germination rate as determined by testing, and date of testing.

(5) Native Groundcovers. Plants shall be of known local source and should possess genetic variability. As much as possible, existing native plant populations found at or near the Project site should be propagated and used for re-vegetation.

(a) **Collection/source of planting materials.** Native planting materials, as much as possible, shall be collected at or near the site (if native stands exist within the vicinity) or sourced from nurseries as long as materials were propagated from locally known populations. Collection of seeds, cuttings, clumps etc. shall commence at least 3 years prior to re-vegetation to allow large scale production of planting materials. Collection of native planting materials

shall be done with the proper permits.

(b) **Seed nursery production and establishment.** Native planting materials that were collected shall be mass propagated on a nursery setting to provide a continuous supply of planting materials for the Project. Field established nurseries shall be irrigated and kept weed-free.

1. **Pili grass.** Newly collected seeds shall be treated with 1% solution (10,000 ppm) of gibberellic acid prior to planting in order to remove seed dormancy. Otherwise, store seeds for a minimum of six months at room temperature to break seed dormancy. Plant pre-treated/stored seeds in plastic dibble tubes filled with potting mix and fertilizer. Grow plants in full sun conditions for 1-2 months before transplanting in prepared, weed-free field plots. Pili grass plugs should be planted 1 ft. apart. Row spacing shall be 2 ft apart. Apply pre-emergence herbicide (oryzalin or oxadiazon at 2 lb ai. /acre) and irrigate immediately after planting to prevent weed seed germination. Fertilize, weed and irrigate regularly to promote vigorous growth and flowering. Approximately 2 months after planting, cut pili grass plants to a height of 1.5 ft to encourage vigorous vertical growth. Mature seeds/seed heads can be harvested as early as 3-6 months after planting in the field.

2. **Mauʻu ʻakiʻaki.** Seeds from crushed seed heads can be immediately germinated on moist potting mix. One month old seedlings can be transplanted in cell trays filled with potting mix and slow release fertilizer. Plugs are allowed to grow for another 2 months before transplanting in the field. Plant plugs in plastic mulch covered ground to prevent weeds and ease seed harvesting operations. Plants shall be spaced 1 ft. within rows and 2 ft apart between rows. Fertilize, weed and irrigate regularly to promote flowering and seed production. Mature seed heads can be harvested as early as 6-9 months after transplanting.

3. **ʻAkiʻaki.** Leafy apical cuttings or three stemmed clumps of ʻakiʻaki shall be used to

produce plugs. Newly harvested cuttings shall be immediately immersed in a 5% (1:20 dilution) of rooting hormone (Dip ‘n Grow) for 24 hours prior to planting in dibble tubes filled with potting mix and slow release fertilizer. Newly planted cuttings shall be placed under continuous misting for 1 month then transferred to irrigated full sun conditions for another month prior to field planting. Rooted plugs shall be planted in rows spaced 3 ft apart with an in-row spacing of 1 ft. Pre-emergence herbicide (oxadiazon at 2 lb ai./acre or oxyfluorfen at 0.5 lb ai./acre) shall be applied immediately after planting to control germinating weeds. Fertilize, weed and irrigate the field plots regularly to ensure vigorous growth. ‘Aki‘aki cuttings can be harvested as early as 5-6 months after transplanting in the field using a sickle bar mower.

4. **Aalii.** Seeds from crushed dried seed capsules should be separated from dried plant debris and exposed to 80 grit sand paper for 30 second a Forsberg seed scarifier with a 1/3 horsepower electric motor (Forsberg, INC., Thief River Falls, MN). Scarified seeds can be immediately germinated in a common pot on moist potting mix. Two month old seedlings can be transplanted in cell trays filled with potting mix and slow release fertilizer. Plugs are allowed to grow for another 4 months before transplanting in the field. Plant plugs in plastic mulch covered ground to prevent weeds and ease seed harvesting operations. Plants shall be spaced 3 ft. within rows and 5 ft. apart between rows. Fertilize, weed and irrigate regularly to promote flowering and seed production. Mature seed heads can be harvested as early as 15-18 months after transplanting.

5. **Ahinahina.** Seeds from crushed dried seed capsules should be separated from dried plant debris. Fresh seed do not have any dormancy and can be immediately germinated in a common pot on moist potting mix. Two month old seedlings can be transplanted in cell trays filled with potting mix and slow release

fertilizer. Plugs are allowed to grow for another 4 months before transplanting in the field. Plant plugs in plastic mulch covered ground to prevent weeds and ease seed harvesting operations. Plants shall be spaced 3 ft. within rows and 5 ft. apart between rows. Fertilize, weed and irrigate regularly to promote flowering and seed production. Mature seed heads can be harvested as early as 12-14 months after transplanting.

6. **Aweoweo.** Seeds from crushed dried seed capsules should be separated from dried plant debris. Fresh seed do not have any dormancy and can be immediately germinated in a common pot on moist potting mix. Two month old seedlings can be transplanted in cell trays filled with potting mix and slow release fertilizer. Plugs are allowed to grow for another 4 months before transplanting in the field. Plant plugs in plastic mulch covered ground to prevent weeds and ease seed harvesting operations. Plants shall be spaced 3 ft. within rows and 5 ft. apart between rows. Fertilize, weed and irrigate regularly to promote flowering and seed production. Mature seed heads can be harvested as early as 11-12 months after transplanting.

7. **Ilima.** Seeds from crushed dried seed capsules should be separated from dried plant debris. Fresh seed should not be exposed to excessive drying conditions after removal from plants. The best germination is obtained by planting seed from opened seed capsules immediately after removal from plants. Excessive drying will lead to seed dormancy that may require specialized storage and or scarification for used germination to produce seedlings. Seeds with known ability to germinate should be heavily seeded to a common pot containing moist potting mix. Seedlings will emerge at different times and at two month after germination transplanted in cell trays filled with potting mix and slow release fertilizer. Plugs are allowed to grow for another 4 months before transplanting in the

field. Plant plugs in plastic mulch covered ground to prevent weeds and ease seed harvesting operations. Plants shall be spaced 3 ft. within rows and 5 ft. apart between rows. Fertilize, weed and irrigate regularly to promote flowering and seed production. Mature seed heads can be harvested as early as 13-15 months after transplanting.

8. **Uhaloa.** Seeds from crushed dried seed capsules should be separated from dried plant debris and exposed to 80 grit sand paper for 30 second a Forsberg seed scarifier with a 1/3 horsepower electric motor (Forsberg, INC., Thief River Falls, MN). Scarified seeds can be immediately germinated in a common pot on moist potting mix. Two month old seedlings can be transplanted in cell trays filled with potting mix and slow release fertilizer. Plugs are allowed to grow for another 4 months before transplanting in the field. Plant plugs in plastic mulch covered ground to prevent weeds and ease seed harvesting operations. Plants shall be spaced 3 ft. within rows and 5 ft. apart between rows. Fertilize, weed and irrigate regularly to promote flowering and seed production. Mature seed heads can be harvested as early as 10-14 months after transplanting.

(c) **Harvesting and preparation of native groundcovers prior to planting.**

1. **Pili grass.** Harvest seeds/seed heads by hand. Newly collected seeds possess dormancy (resulting in low seed germination). In order to remove dormancy, seeds shall either be stored at room temperature for at least 6 months prior to planting or treated with a 1% solution (10,000 ppm) of gibberellic acid. Plant pre-treated/stored seeds in plastic dibble tubes filled with potting mix and slow release fertilizer. Grow for 1-2 months before out planting on the roadsides.

2. **Mauʻu ʻaki ʻaki.** Harvest seed heads that can be easily crushed by hand. Seed harvesting can be facilitated by cut and vacuum operations

using an articulated hedge trimmer and a leaf/garden vacuum. Harvested seed heads are dried, lightly crushed and sieved to remove trash. Store extracted seeds in a cool, dry place away from sunlight. Prior to planting, establish a seed count for raw seed (seed + trash) and test seed viability by conducting a seed germination test of 400 seeds (100 seeds in each of the 4 petri dishes). Adjust the seeding rate accordingly based on the seed germination results.

3. **‘Aki‘aki.** Harvest leafy apical cuttings that are at least 8 inches long. Immerse newly harvested cuttings in 5% solution (1:20 dilution) of Dip ‘N Grow for 24 hours prior to planting/hydromulch capping.

4. **Aalii.** Seed are produced in a 4-winged seed capsule. The seed capsule forms in clusters that change color and texture as seed mature from fresh bright red tissue to dry and brown. The dried brown capsule is the only stage of development where round black seed, capable of germinating to produce seedlings, can be collected. The greatest dormancy relief (most germination) was achieved with the mechanical electric drum scarifier lined with 80 grit sandpaper a 30 seconds.

5. **Ahinahina.** The highest amount of seed can be collected from flowering spikes where previously open flower buds are 90% of total flower spike; florets form a 160 degree angle from main flower spike and 5-10% of loss of seed bearing capsules at the bottom of the stalk. Seed recovered from dried spikes are ready for germination and production of seedlings.

6. **Aweoweo.** The highest level of viable seed are found in seed heads that have 15-25% pale green buds, 75-85% of seed spike is brown with 5% bud drop. Seed recovered from dried spikes are ready for germination and production of seedlings.

7. **Ilima.** Mature seed are contained in seed

capsules that split open to reveal a circular set of angular dark brown seeds. Capsules that do not naturally open do not contain viable seeds. Freshly collected seed from recently opened seed capsules should not be excessively dried to avoid induction of seed dormancy. Seed recovered from freshly opened seed capsules should be used immediately for seedling production.

8. **Uhaloa.** Seeds should be collected from flower clusters that show 40-50% senesced flowers with 10% of the flower cluster showing dried tissue. The greatest dormancy relief (most germination) was achieved with the mechanical electric drum scarifier lined with 80 grit sandpaper a 30 seconds.

(d) **Planting distances and seeding rates.** Native groundcovers shall be planted either by plugs (pili grass, mauʻu ʻakiʻaki, ʻakiʻaki), seeds (pili grass, mauʻu ʻakiʻaki) or by stem cuttings (ʻakiʻaki). The recommended planting distance for plugs is 1 ft. on center. Recommended seeding rate for mau'u ʻakiʻaki is 0.4 lbs pure live seed per acre. Recommended planting density for ʻakiʻaki is 6 cuttings per square foot (cuttings laid horizontally on the ground). The following native plants should only be established through the use of 4-6 month old seedlings: Aalii, Ahinahina, Aweoweo, Ilima and Uhaloa. A seedling population of Aweoweo, Ilima and Uhaloa will show a range for growth habits from strong upright to low growing prostrate forms. Aweoweo will show rapid growth and lateral spread upon planting and should be planted at a density of 40-50 plants per 1000 ft^2 complete ground cover in 10-12 months with weed control and regular irrigation. Ilima and Uhaloa grow slower and should be planted 60-80 plants per 1000 ft^2. Aalii is a slow growing upright shrub and should be planted with 5-6 ft. between plants. Ahinahina should also be spaced with 5-6 ft. between plants.

(5) Size of Plants. Plants shall meet size indicated by minimum and maximum height, and minimum and maximum spread, as specified in the Proposal.

(a) Height.

1. Height shall be defined as vertical measurement from ground surface of plant in its natural growing position in nursery.

2. Measurement of height shall stop where main growth ends and shall not include fine or slender terminal leader, twig, or branch.

3. Range shall be specified for height of leggy plants.

(b) Spread.

1. Spread shall be defined as horizontal measurement of plant in its natural growing position in nursery.

2. Measurement of spread shall not include fine or slender terminal shoot.

3. Spread of plant shall be determined by calculating the average of the smallest and largest measurements. Smallest measurement shall not be less than 60 percent of largest.

(c) Caliper. Caliper shall be determined by measuring the trunk of the tree at a height of 4 ½ feet above ground.

(B) Hydromulch. Mulch shall be specially processed fiber conforming to Subsection 641.02(C). Seed, sprigs, or stolons shall be added to mix according to the Contract.

(C) Herbicides. Use herbicides that are approved by the State Department of Agriculture and are labeled for roadside right-of-way or non-crop use.

Manufacturer's instructions for applying herbicide shall be followed. Adjustments shall be made for field conditions. Chemical herbicide shall be applied using photosensitive dye that does not stain concrete or painted surfaces, will not injure plants and animals, and disappears within three days after spraying. Application shall be between 8:30 a.m. and 3 p.m., except on Saturdays, Sundays, and legal holidays. Spraying shall not be done when wind is brisk or when raining or expected to rain. Avoid spraying areas where herbicide can enter storm drainage systems or receiving waters. Records shall be kept by the Contractor of dates of application, type of herbicide or pesticide used quantities, and areas that

were covered and submitted to the Engineer within 24 hours of application.

(1) Pre-emergence Herbicides. Pre-emergence herbicides shall be used to control germinating weed seeds during establishment. Label of herbicide shall indicate that product has limited soil mobility and low soil persistence. The list below shows the different pre-emergent herbicides that are safe for use in select native Hawaiian groundcovers:

(a) Pili grass: oryzalin (2 lb ai./acre) or oxadiazon (2 lb ai./acre)

(b) ʻAkiaki (for transplanted plugs only): oxadiazon (2 lb ai. /acre) or oxyfluorfen (0.5 lb ai. /acre).

(c) Mauʻu ʻakiʻaki (for transplanted plugs only): oryzalin (2 lb ai./acre) or oxadiazon (2 lb ai./acre)

(d) Aalii for transplanted plugs only, 4-6 months old: 100-200 pounds per acre Ronstar G (oxadiazon – 2-4 lb ai. /acre). Remove granules from leaf surface before activation with overhead irrigation.

(e) Ahinahina for transplanted plugs only, 4-6 months old: 100-200 pounds per acre Ronstar G (oxadiazon – 2-4 lb ai. /acre). Remove granules from leaf surface before activation with overhead irrigation.

(f) Aweoweo for transplanted plugs only, 4-6 months old: 100-200 pounds per acre Ronstar G (oxadiazon – 2-4 lb ai. /acre). Remove granules from leaf surface before activation with overhead irrigation.

(g) Ilima for transplanted plugs only, 4-6 months old: 100-200 pounds per acre Ronstar G (oxadiazon – 2-4 lb ai. /acre). Remove granules from leaf surface before activation with overhead irrigation.

(h) Uhaloa for transplanted plugs only, 4-6 months old: 100-200 pounds per acre Ronstar G (oxadiazon – 2-4 lb ai. /acre). Remove granules from leaf surface before activation with overhead irrigation.

(2) Non-selective, Post-emergence Herbicides. Chemical herbicides shall contain either or both glyphosate and cacodylic acid. Non-selective, post-emergence herbicides shall be used to eradicate emerged weeds by absorption through leaves, stem and roots. Product shall have limited soil mobility and low soil

persistence.

(3) Selective, Post-emergence Herbicides. Selective, post-emergence herbicides shall be used to control emerged annual grasses and broadleaf weeds in turf (including native groundcovers) and in a wide variety of woody ornamentals, shrubs, vines, and trees. Listed below are selective post-emergence herbicides that can be applied as an over-the-top foliar spray for controlling weeds in the following native groundcover species:

(a) Pili grass (at least 21 days after planting): triclopyr (2 lb ai... /cre to control broadleaf weeds)

(b) ‘Aki‘aki: sulfosulfuron (0.9 ounces ai/acre to control sedge species) and aminopyralid (0.11 lb ai. /acre to control most broadleaf species)

(c) Mau‘u ‘aki‘aki (at least 28 days after hydro seeding): aminopyralid (0.11 lb ai. /acre to control most broadleaf weeds) and fluazifop-p-butyl (0.188 to 0.375 lb ai. /acre to control grassy weeds).

(d) Aalii for grassy weed control use spot treatment rate for Fusilade T&O (fluazifop-P-butyl, Syngenta) described as .75 oz. per gallon with the addition of .5 oz. per gallon non-ionic surfactant (foliar penetration enhancer) and spray grassy weeds to the point of complete wetting but not runoff. Reapply 2-4 months if needed to remove grassy weeds from around and within plant canopy.

(e) Ahinahina for grassy weed control use spot treatment rate for Fusilade T&O (fluazifop-P-butyl, Syngenta) described as .75 oz. per gallon with the addition of .5 oz. per gallon non-ionic surfactant (foliar penetration enhancer) and spray grassy weeds to the point of complete wetting but not runoff. Reapply 2-4 months if needed to remove grassy weeds from around and within plant canopy.

(d) Aweoweo for grassy weed control use spot treatment rate for Fusilade T&O (fluazifop-P-butyl, Syngenta) described as .75 oz. per gallon with the addition of .5 oz. per gallon non-ionic surfactant (foliar penetration enhancer) and spray grassy weeds to the point of complete wetting but not runoff. Reapply 2-4 months if needed to remove grassy weeds from around and within plant canopy.

(f) Ilima for grassy weed control use spot treatment rate for Fusilade T&O (fluazifop-P-butyl, Syngenta) described as .75

oz. per gallon with the addition of .5 oz. per gallon non-ionic surfactant (foliar penetration enhancer) and spray grassy weeds to the point of complete wetting but not runoff. Reapply 2-4 months if needed to remove grassy weeds from around and within plant canopy.

(g) Uhaloa for grassy weed control use spot treatment rate for Fusilade T&O (fluazifop-P-butyl, Syngenta) described as .75 oz. per gallon with the addition of .5 oz. per gallon non-ionic surfactant (foliar penetration enhancer) and spray grassy weeds to the point of complete wetting but not runoff. Reapply 2-4 months if needed to remove grassy weeds from around and within plant canopy.

(D) Decorative Boulders. Decorative boulders shall be fieldstone, lava rock, or moss rock that has been accepted for use as selected or imported material by the Engineer. Boulders shall be clean, hard, sound, and durable. Size of each boulder shall be 2 feet minimum and 6 feet maximum in any direction.

(1) Selected Boulder Material. Selected boulder material shall be obtained within the Right-of-Way from locations designated by the Engineer according to Section 203 – Excavation and Embankment. Boulders shall be cleaned before placement and stained if requested by the Engineer. Boulders that have paint marks or scars are not acceptable. Boulders that the Engineer considers unsuitable for use shall be disposed of according to Section 202 – Removal of Structures and Obstructions.

(2) Imported Boulder Material. Imported boulder material shall be lava rock or moss rock obtained from sources outside the Right-of-Way that has been accepted by the Engineer. Imported boulders shall be matched with on-site boulders. Boulders shall be stained if necessary to match color accepted by the Engineer. The Contractor will be responsible for arrangements and costs to import boulders.

Imported boulders shall not be removed and hauled to the Project until the Engineer accepts material and source. .

(E) Plastic Header. Plastic headers shall be bed dividers made from flexible polyethylene with 3.5 to 4 percent carbon black concentrate added for ultraviolet stabilization. Density shall be medium and melt factor under

2. Headers shall have overall height of 5 inches. Anchor stakes shall be rigid steel, 9 inches long and 1 inch wide.

(F) Tree Guard. Tree guards shall be flexible polyethylene with ultraviolet inhibitor.

(G) Root Control Barrier. Root control barriers shall be high density, high impact polypropylene with ultraviolet inhibitor. Barriers shall have minimum thickness of 0.06 inch, raised vertical ribs, and locking strips made of same material. Bio-chemical root control barriers are allowable as alternative if accepted by the Engineer.

(H) Fertilizer.

(1) Commercial Fertilizer. Fertilizer shall be in new, clean, sealed, and properly labeled bags or containers. Fertilizer shall be protected from weather after delivery to the Project. Fertilizer shall be:

(a) Nitrogen, phosphoric acid, and potash (N-P-K) in percentages recommended in the Soil Analysis Report, uniform in composition, free flowing, and suitable for application;

(b) Agriform 21-gram plant tablet; or

(c) Other fertilizer accepted by the Engineer.

(2) Manure. Manure shall be from chickens, horses, or cattle. Manure shall be aged three months to two years before use.

(3) Application Records. Records shall be kept by the Contractor of dates of application, type of fertilizer or manure used quantities, and areas that were covered and shall be submitted to the Engineer within 24 hours of application.

(I) Mulch and Soil Amendments.

(1) Wood Chips. Mulching wood chips shall be nitrogen stabilized and free of weeds, leaves, twigs, shavings, and bark. Maximum size shall be 3 inches by 1-1/2 inches by 1/2 inch thick.

(2) Aggregates. Aggregates for mulch shall be gravel, crushed stone, lava rock, or coral that passes 3-inch sieve.

(3) Burnt Bagasse. Burnt bagasse shall be product of sugar cane waste that is free of weed seed, fungus, chemicals, and materials deleterious to plant growth.

(4) Recycled Mulch Material. Recycled material, such as processed newspaper, is allowable for use as mulch if accepted by the Engineer.

(J) Stakes.

(1) Wood Stakes. Wood stakes shall be rough construction-grade redwood or eucalyptus, 2x2's, 8 feet long, unpainted and unstained.

(2) Pipe Stakes. Pipe stakes shall be galvanized iron pipe, 3/4-inch diameter and 3 feet long.

(3) Steel Bar Stakes. Steel bar stakes shall be reinforcing steel bar, 3/4-inch diameter and 3 feet long.

(K) Hose and Wire Ties. Garden hose shall be 1/2-inch diameter. Wire ties shall be No. 11 gage zinc-coated steel wire.

(L) Guy Wires. Guy wires shall be No. 12 gage zinc-coated steel wire for 15-gallon and 25-gallon trees, and No. 9 gage zinc-coated steel wire for field- grown trees. Half-inch diameter garden hose shall be provided.

(M) Turnbuckles. Turnbuckles shall be zinc-coated steel. Size of turnbuckle shall depend on size of guy wire. One turnbuckle per guy wire shall be provided.

(N) Markers. Markers shall be bright-colored plastic surveyor tape at least 18 inches long. Tape of same color shall be used throughout the Project.

(O) Weed-blocking Geotextile. Weed-blocking geotextile shall be woven or non-woven, rot-proof, mildew and chemical resisting, delustered polypropylene product that allows passage of air, water, fertilizer, and insecticide into soil but precludes growth of weeds.

619.03 Construction.

(A) Codes and Standards. Perform work according to applicable laws, codes, and regulations. Provide inspections and permits required by Federal, State, and local governmental authorities.

(B) Preparing Areas for Landscaping.

(1) Before starting soil preparation work or trenching for irrigation system, remove trash, debris, and weeds from work area. Planting areas shall be free from stones greater than a half (1/2)

inch in diameter. Dispose of material outside the Right-of-Way according to Section 201 – Clearing and Grubbing.

(2) Within limits of clearing, grub natural ground to depth necessary to remove stumps, roots, and other objectionable material.

(3) To reduce the incidence of weeds during establishment, subsequent flushing and killing of weeds is recommended at least 3 times prior to planting. To facilitate weed seed germination and growth, on-site supplemental irrigation is necessary. Weed seedlings should be killed using a post-emergence herbicide mix of triclopyr and glyphosate. Before applying herbicides, obtain the Engineer's acceptance of proposed weed control program.

(C) Verifying Subgrade Preparation. Excavate and remove material from islands and medians that will be overlaid with aggregate. Obtain the Engineer's verification and acceptance of subgrade before proceeding.

(D) Placing Boulders and Moss Rock. Place boulders and moss rock according to the Plans. For boulder groupings, use minimum of three boulders per grouping. Mix size of boulders in each grouping. Bury 1/3 of each boulder below finished grade.

(E) Installing Plastic Header. Trench ditches four inches deep. Install plastic headers according to manufacturer's instructions. Backfill and compact while maintaining proper alignment of header.

(F) Installing Weed-blocking Geotextile. Prepare subgrade, install headers, and plant trees. Install geotextile according to manufacturer's instructions.

(G) Placing Aggregates. After installing plastic header and excavating to required depth, place aggregates over weed-blocking geotextile according to the Plans. When completed, surface of aggregate bed shall be one inch below top of plastic header. Aggregate layer under curbs shall not be thicker than 1-1/2 inches.

(H) Planting Soil. Place planting soil according to Section 617.

(I) Adding Fertilizer and Amendments.

(1) Uniformly distribute fertilizer and amendments over planting areas as recommended by the Soil Analysis Report according to Section 617 – Planting Soil. Rototill top four inches of soil to evenly incorporate fertilizer and amendments. Rototill before installing drip irrigation system.

(2) Do not add soil amendment when slope is steeper than 3H:1V.

(3) Level undulations or irregularities caused by tilling or other work from surface of soil before proceeding to plant.

(J) Coordinating with Roadway Work. Adjust planting work for conformance with ground and weather conditions. Plant so that finished grades of planted areas are properly related to finished elevations of pavements and curbs.

(K) Herbicides. After establishing finish grade, commence weed control program using pre-emergence or post-emergence herbicides. Maintain control program through planting period to prevent weeds from emerging.

(L) Preparing for Planting. Do not plant until ground has been prepared, site is neat and orderly, and the Engineer accepts site for planting. Site should be cleared of weeds and debris.

(M) Planting.

(1) Locating Plants. The Engineer will direct the Contractor to site of planting or target location with stakes or other markers. Provide labor, materials, and transportation the Engineer needs to locate plants. The Engineer will determine direction trees are to face.

(2) Plant Holes. Place trees and shrubs in plant pits according to the Plans. Break up coral, rock, and hardpan to depth not less than 12 inches below normal bottom of pit.

(3) Setting Container Plants. Perform planting without delay to prevent foliage from effects of evaporation and drying. Prune bruised or broken roots with clean cut at time of planting.

(a) Set plant to keep soil surface level within pit and even with finished grade.

(b) Use plant mix consisting of one part organic soil amendment and four parts topsoil by volume to backfill plant pit. Set plant plumb, brace rigidly in position, and tamp backfill mix solidly around root ball. After pit is 3/4 full, water thoroughly to saturate root ball.

(c) Distribute plant tablets or comparable fertilizer within pit according to manufacturer's instructions. Continue filling pit to finished grade with backfill mix.

(d) Install root control barriers according to the Plans.

(e) After pit is completely filled, shape saucer berm or water basin around each plant or around perimeter of shrub beds. Provide berm or basin that is 4 inches deep for shrubs and 6 inches deep for trees.

(f) Water immediately after planting in moderate stream until soil around and below root ball is thoroughly saturated.

(4) Staking. Stake trees immediately after planting according to the Plans.

(5) Protecting Trees. Install tree guard at base of each tree.

(6) Windbreaks. Erect windbreaks immediately after planting if tree is less than 8 feet tall. Place windbreak to face prevailing wind. Remove windbreaks after conclusion of plant establishment period.

Construct windbreak that consists of two wood panels forming right angle with apex of angle facing wind, and three wood posts. Drive posts two feet into ground to secure windbreak. Cover panels with screen material such as palm leaves or burlap. Finished panels shall be 6 feet high. Each panel shall be 4 feet wide.

Locate post where two panels meet at center of windbreak, and another post at end of each panel. Post shall be 2 inches by 3 inches by 8 feet long. Nail 1-inch by 3-inch horizontal wood battens securely to posts at top of panel and bottom near ground. Lumber does not have to be new, but must be sound and free of discoloration. Staple screen material to posts and battens.

(7) Removing Surplus Excavated Material. Scatter and level surplus excavated material from tree pits and shrub holes. Break clay lumps to leave neat and smooth appearance. Dispose of material that is unsuitable for use as planting soil according to Section 203 – Excavation and Embankment.

(8) Cleanup. Remove and dispose of empty containers and accumulated debris when planting is completed.

(N) Planting Period. Ideally, planting activities should be done during the onset of the rainy season (November to March). Planting period extends 90 days from date the Engineer accepts site to start planting period. When area has mixture of grass with either or both trees and shrubs, planting period shall not start until all trees, shrubs, and grass in

area are planted. Replace plants that fail to develop healthy growth or die during planting period. Provide replacements within two weeks of receiving notification from the Engineer that plants are unacceptable. Apply fertilizer at time of planting and 40 to 50 days after planting, at following rates:

(1) Trees – 1/4 pound per inch of trunk diameter.

(2) Shrubs and Vines – 1/4 pound per plant.

(3) Ground Cover – two pounds per 1,000 square feet.

Notify the Engineer 24 hours in advance of fertilizer application. If satisfactory growth is attained before 90 days, the Contractor may submit written request for earlier end to planting period.

(O) Hydro-mulching. Perform hydro-mulch planting according to Section 641 – Hydro-mulch Seeding.

(P) Placing Mulch. Apply 2 inches of mulch to tree basins and 4 inches to shrub beds at planting. Protect and cover wood chip mulch in windy areas.

(Q) Pre-emergence Herbicides. Broadcast or spray pre-emergence herbicides over mulched areas in tree basins and shrub beds. When using granular herbicides water thoroughly to activate herbicide and wash it off plants.

(R) Pruning. Prune existing trees that will be included in landscape.

(1) Remove by accepted methods 1/3 to 1/2 of growth from shade trees with heavy tops. Prune enough to preserve natural shape and characteristics of tree. Remove broken or badly bruised branches with clean cut. Paint cut surfaces over two inches in diameter with accepted sealing compound.

(2) Use experienced tree trimmer to perform pruning. Trim according to publication ISBN 1-881956-07-5, “Tree-Pruning Guidelines,” of the International Society of Arboriculture. Dispose of cuttings outside the Right-of-Way.

(S) Watering. After initial watering, continue to water in quantity and frequency necessary to sustain plant growth.

(T) Plant Establishment Period. Plant establishment period shall extend nine months from accepted completion date of planting period.

During plant establishment period, water, fertilize, cultivate, weed,

prune, and apply pesticide when required. Replace plants that fail to develop healthy growth, become injured, or die. Provide replacements within two weeks of receiving notification from the Engineer that plants are unacceptable.

(1) Barricades. Where safety allows, set up barricades after planting to keep traffic out of newly planted areas.

(2) Watering. Water regularly to ensure vigorous plant growth. Keep planted areas moist but not over-saturated. Regulate the quantity of water to prevent erosion and formation of gullies. The following species are very sensitive to over watering and will be killed if soil is maintained in a wet condition for 2-3 weeks: Aalii, Ahinahina, Aweoweo, Ilima and Uhaloa. Uhaloa is especially sensitive to overhead irrigation and this method of water delivery is not recommended for Uhaloa. Uhaloa should water delivery should be made using drip irrigation systems or with sprinkler system that do not contact the leaves. Regular foliar contact of Uhaloa leaves will result in plant growth decline and death.

(3) Fertilizing. In addition to fertilizing during planting period, fertilize at a minimum of four times during plant establishment period, at least 2-1/2 months apart. Apply fertilizer at following rates:

(a) Trees – 1/4 pound per inch of trunk diameter.

(b) Shrubs and vines – 1/4 pound per plant.

(c) Ground cover beds – one pound per 1,000 square feet.

Exercise caution when fertilizing to avoid burning plants.

(4) Controlling Weeds. Keep planted areas at least 90 percent free of weeds and grass considered undesirable by the Engineer. Remove weeds by pulling, mowing or by spraying selective post-emergence herbicides. Do this daily if necessary. Deposit trash in appropriate containers. Reapply preemergence herbicides after every hand weeding until complete ground cover is achieved. Chemical weed control, if chosen, shall be by method accepted by the Engineer.

(5) Disease or Insect Infestation.

(a) Inspect plants, including grass, weekly for disease or insect damage. Treat infected plants immediately.

(b) Remove damaged or diseased growth from trees and shrubs.

(6) Dead or Dying Plants. Remove immediately plants that are not in vigorous thriving condition. Replace with plants of same type and size as originally planted.

(7) Guys and Stakes. Reset plants to upright or proper growing position. Re-stake, tighten, or repair guys as necessary. Contractor shall remove guys and stakes at the end of the plant establishment period

(8) Windbreaks. Adjust, repair, or replace windbreaks that have sustained damage or moved out of position.

(9) Plastic Headers. Replace or reset headers that have been damaged during maintenance.

(10) Boulders and Aggregates. Remove weeds, trash, and debris from boulder and aggregate beds at least weekly. Dispose refuse outside the Right-of-Way. Replace lost aggregate and restore bed to original finished grade. Replace boulders that have been damaged during maintenance. Restrain boulders if necessary.

The Engineer will credit the Contractor with plant establishment days when work is done according to the Contract and when the Engineer determines that no work is required, regardless of whether the Contractor actually performs plant establishment work. The Engineer will not credit the Contractor with plant establishment days when the Engineer determines that work is necessary but the Contractor fails to adequately perform plant establishment work.

(U) Acceptance. Acceptance, if granted, will be at end of plant establishment period. For hydro-mulched areas, the Engineer will base acceptance on 98 percent minimum coverage with healthy, well-established ground cover or grass. Grass shall be at least three inches tall. There shall be not more than 2 square feet of bare earth for every 100 square feet of planted area. Plants shall be in healthy growing condition.

The Engineer will schedule semi-final inspection to decide acceptability 90 days before end of the plant establishment period. At this time, the Engineer will notify the Contractor of plants that need to be replaced.

Final inspection will be scheduled 90 days after the Contractor provides plant replacements specified by the Engineer.

619.04 Measurement. The Engineer will measure:

(A) Trees, including transplanted trees, shrubs, and vines, per each according to Subsection 109.01 – Measurement of Quantities.

(B) Ground cover, including grass, per square foot according to Subsection 109.01 – Measurement of Quantities.

(C) Plastic headers and root control barriers per linear foot according to Subsection 109.01 – Measurement of Quantities.

(D) Aggregate and imported boulders per cubic yard according to Subsection 109.01 – Measurement of Quantities.

(E) Weed-blocking geotextile per square yard according to Subsection 109.01 – Measurement of Quantities.

(F) Boulders obtained as selected material from within the Right-of-Way according to Section 203 – Excavation and Embankment.

619.05 Payment. The Engineer will pay for the accepted pay items listed below at the Contract unit price per pay unit, as shown in the Proposal Schedule. Payment will be full compensation for the work prescribed in this Section and Subsection 109.02 – Scope of Payment.

The Engineer will pay for each of the following pay items when included in the Proposal Schedule:

Pay Item	**Pay Unit**
Tree (Named Type and Size)	Each
Transplanted Tree (Named Type)	Each
Shrub (Named Type and Size)	Each
Vine (Named Type and Size)	Each
Ground Cover (Named Type and Size)	Square Foot
Hydro-mulched Ground Cover	Square Foot
Plastic Header	Linear Foot
Root Control Barrier	Linear Foot
Aggregate (Named Size)	Cubic Yard

Imported Boulder (Named Size) Cubic Yard

Weed-blocking Geotextile Square Foot

The Engineer will allow partial payment of planting as follows:

(1) 30 percent of the Contract unit price upon completion of planting;

(2) 15 percent of the Contract unit price in three equal monthly payments for satisfactory performance during the planting period;

(3) 50 percent of the Contract unit price in nine equal monthly payments for satisfactory performance during the plant establishment period; and

(4) 5 percent of the Contract unit price upon final acceptance and conclusion of the plant establishment period.

The Engineer will pay for boulders obtained as selected material under Section 203 – Excavation and Embankment.

E N D OF SECTION 619