

3CP 7 – SOIL BIOENGINEERING**PART 1 GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General Conditions and Special Provisions, and other Technical Specification Sections apply to this Section.

1.02 SUMMARY

- A. This Section specifies soil bioengineering, including collection and transportation of live cuttings, live cuttings preparation and installation, seeding, wattle and fabric installation.
- B. Related Sections include the following:
 - 1. Section "Planting"
 - 2. Section "Irrigation"

1.03 DEFINITIONS

- A. Owner refers to the Contra Costa County Flood Control and Water Conservation District, which is the lead agency. Owner or Owner's Representative (O.R.) for the project refers to the district engineer, associates, or agents.
- B. Soil Bioengineering: Use of native plants and organic materials to stabilize slopes and creek channel and floodplain areas. Includes the use of coir fabric, coir wattles, live cuttings, and seeding.
- C. Live Cuttings (Poles): Woody material harvested from healthy stands of local native species including but not limited to willow and cottonwood
- D. Active or Bankfull Channel: The stream channel formed by the dominant discharge, which meanders across the floodplain as it forms pools, riffles, and point bars.
- E. In-Channel: Within the Active Channel of the creek.
- F. In-Channel Work (or work in the Active Channel): Work within the channel
- G. Fabric: Coir, 100% biodegradable coconut fiber erosion control fabric devoid of any plastic mesh.
- H. Wattle (or Fabric Wattle): Erosion control "log" or "roll" made of 100% biodegradable coir fabric without plastic mesh. Wattles with plastic mesh will not be accepted.
- I. Native Soil: Existing site soil

1.04 SUBMITTALS

- A. Data and samples of Products specified in this Section.
- B. Proposed Live Collection Sites: Plan prepared by Contractor detailing the locations and species of live plant collection sites and authorizing land management agency. Contractor is responsible for securing all permits for cutting and all required cuttings.
- C. Live Cuttings Collection and Installation Schedule: Prepared by the Contractor identifying the collection dates and sequence of live cuttings installation.
- D. Live Cuttings Storage and Preparation Plan: Plan identifying locations of storage basins that provide 24-hour shade protection, and remain constantly filled with fresh water.

- E. On-site Mock-up of each soil bioengineering treatment for O.R. review and approval.
- F. Soil Bioengineering work schedule
- G. Fabric sample (Coir fabric), and fabric installation Mock-up, prior to the installation of the Riprap with Joint Planting detail. Mock-up can serve as part of the Work if accepted by O.R.
- H. Contractor Experience in Public Sector Soil Bioengineering projects.

1.05 QUALITY ASSURANCE

- A. Contractor performing soil bioengineering measures including harvesting live cuttings shall have a minimum of five years of successful experience in public sector soil bioengineering projects. Contractor shall provide references and proof of experience to O.R. for review and approval.
- B. Pre-Soil Bioengineering Meeting: Conduct meeting at Project site to comply with specified requirements.

1.06 WARRANTY

- A. Contractor shall warranty all Soil Bioengineering work and the viability of live cuttings as defined in the specifications and as modified below.
- B. Viability of live cuttings shall be reviewed both at spring leaf-out in the year of construction, and then at the end of the growing season (October 1st) in the year of construction.
- C. Warranty shall cover all live cuttings through the period noted in the specifications. Willow cuttings shall be required to meet a 90% survival rating; cottonwood cuttings shall be required to meet a 70% survival rating.

PART 2 PRODUCTS

2.01 BIOENGINEERING

- A. Fabric (if specified): North American Green, 700BN, 100% biodegradable coconut fiber erosion control blanket natural fiber netting. No plastic or metal of any kind within the Fabric shall be permitted. North American Green, 14649 Highway 41 North, Evansville, IN 47711, tel. 812.867.6632.
- B. Fabric Fastener: Specialized Fabric Fastening wood stakes by North American Green, 14649 Highway 41 North, Evansville, IN 47711, tel. 812.867.6632.
- C. Wattle: Erosion control "log" or "roll" made of 100% biodegradable coir and jute fabric without any metal or plastic mesh. 6" min diameter. Filling shall be 100% Weed free, sterile California State Rice Straw. Plastic mesh in wattles will not be acceptable.
- D. Live Cuttings: Bottom cut at 60 degree angle, top cut flat.
- E. Short Poles (Fremont Cottonwood, *Populus fremontii* and Willow spp., *Salix lasiandra* var. *lasiandra*, *Salix lasiolepis*, *Salix gooddingii*, *Salix laevigata*): Equal to or larger than 0.75" Diameter and 42" long. Willow species shall be collected in equal numbers.
- F. Long Poles (Fremont Cottonwood, *Populus fremontii*): Equal to or larger than 2" Diameter and 78" long.

2.02 NATIVE SEED MIXES

Scientific Name	Common Name	Rate (lbs pure live seed per acre)
Grasses		

Bromus carinatus	California brome	4
Elymus glaucus	blue wildrye	3
Stipa pulchra	purple needlegrass	4
Wildflowers		
Achillea millefolium	white yarrow	1
Acemispson americanus var. americanus	Spanish clover	2
Artemisia douglasiana	Douglas mugwort	1
Eschscholzia californica	California poppy	2
Lupinus nanus	sky lupine	2

- A. Seed Mixes: As provided by Hedgerow Farms, Winters, CA (530) 662-6847; or Pacific Coast Seed, Livermore, CA (925) 373-4417
- B. Furnish seed in standard containers labeled with the following information:
1. Seed Name
 2. Lot Number
 3. Net Weight
 4. Percentage of purity
 5. Percentage of germination
 6. Percentage of weed seed content and inert material clearly marked for each kind of seed in accordance with applicable state and federal laws.
- C. Furnish to the O.R. duplicate copies of a statement signed by the vendor certifying that each lot of seed has been tested by a recognized seed testing lab within six months before date of delivery on the project. Seed which has become wet, moldy or otherwise damaged in transit or storage will not be accepted.

2.03 HYDROSEEDING

- A. Fiber Mulch: Non-recycled wood fiber produced from cellulose such as wood pulp or similar organic material approved by the O.R. and shall be of such character that it will disperse into a uniform slurry when mixed with water. The fiber shall be of such character that when used in the applied mixture, an absorptive or porous mat, but not a membrane, will result on the surface of the ground. Materials which inhibit germination or growth shall not be present in the mixture. Rate: 2,000 lbs./acre. total in two applications.
- B. Water: Of such a quality that it will promote germination and growth of seeds and plants. Water shall not contain weed seeds, nor shall it be obtained from sources containing more salts than are found in irrigation water in the vicinity.
- C. Stabilizing emulsion (Tackifier): An organic binder derived from husks of plantain. Free-flowing, non-corrosive powder. Rate: 60 lbs/acre.
- D. Mycorrhizal inoculum: AM 120 mycorrhizal inoculum applied at the time of planting. Rate: 60 lbs./acre.

PART 3 EXECUTION**3.01 SOIL BIOENGINEERING SCHEDULE AND INSPECTION**

- A. Insure all work in area designated for Soil Bioengineering shall be complete prior to implementing Soil Bioengineering. Work includes but is not limited to grading, irrigation, seeding, and riprap. Provide O.R. with work schedule for review and approval prior to initiating work.
- B. Examine proposed planting areas and conditions prior to live cutting installation. Do not start live cutting installation until proper planting conditions are ensured and O.R. has approved the areas for planting.

3.02 HANDLING OF LIVE CUTTINGS

- A. Collection
 - 1. All live cuttings shall be collected within 10 miles of the Marsh Creek watershed.
 - 2. Contractor to secure appropriate location for collection of live cuttings and pay any fees that may be required for material collection on either private or public lands.
 - 3. Plant materials are to be collected by experienced restoration Contractors familiar with the various species specified and their identification. Contractor shall use sustained yield practices following standard pruning techniques for removal of live cuttings from host plant.
 - 4. Only healthy plant materials that are free of pest infestation and disease will be accepted.
- B. Transportation
 - 1. All live cuttings are to be covered and protected from damage during transport to the project site.
- C. Storage
 - 1. Live cuttings may not be stored for more than 96 hours after collection. Any plant materials not installed with the 96 hours deadline shall be discarded at Contractor's expense.
 - 2. Live cuttings shall be stored in a shaded location with root ends submerged in clean water. Live cuttings shall be kept moist during transport and anytime being staged outside of water.

3.03 SOIL BIOENGINEERING TREATMENTS: LIVE CUTTINGS, FABRIC, WATTLES

- A. General Bioengineering
 - 1. Install all areas of soil bioengineering indicated on Plans at specified spacing.
 - 2. Locate limits of soil bioengineering treatments for acceptance by the O.R. prior to installation.
 - 3. Native soil will be used for backfill unless otherwise indicated on the Plans or directed by O.R.
 - 4. Live Cuttings shall be installed after winter rains have saturated the upper-most 2-inches of the soil receiving the cuttings. Live Cuttings shall only be approved for installation in the late fall and winter season with prior O.R. approval. A typical late fall and winter season installation sequence is as follows:

- a. Day 1 – water and saturate soil to a depth of 1-inch or ensure natural conditions have attained this saturation.
 - b. Day 2 – water and saturate soil to a depth of 2-inches or ensure natural conditions have attained this saturation.
 - c. Day 3 – no work on-site (live cuttings collection day)
 - d. Day 4 – install live cuttings then after installation is complete, saturate soil to a depth of 1-inch, or ensure natural conditions have attained this saturation.
- B. Live Cuttings (Poles) Installation Method
1. Live cuttings shall be installed in areas shown on plans. As noted on Plans, Long Poles shall be installed through riprap in the (E) Riprap, and as Short Poles on the floodplain or channel bank.
 2. Live cuttings shall be installed in irregular placements within the specified area for the cutting as directed by O.R. Straight lines and even spacing will not be accepted.
 3. Each cutting shall be installed into a pre-drilled or augured hole per detail with growing end up. Contractor shall use a “stinger” backhoe attachment or similar to ensure Large Poles are installed through the existing riprap as shown on the plans.
 4. Backfill and saturate with water ensure airtight fit between soil and surface of the cutting along its entire length of embedment.
 5. Short Poles, after pre-drilling, may be tamped into place using a rubber mallet.
 6. Live Cuttings shall be trimmed to varying lengths above grade after the initial installation as directed in the field by O.R.
 7. Minor damage to the top of cutting caused by installation to be trimmed at approximately 10 degrees. Cuttings with damaged bark or that have been split during installation shall be replaced at the Contractor's expense.
- C. Fabric Staking: (Coir biodegradable erosion control fabric)
1. Fabric to be located per Plans.
 2. Fabric to be placed on earthen surfaces that are smooth, and without debris. No obstructions shall be visible on the earthen surface. Contractor shall take all fine grading and clean-up measures required to ensure fabric shall not rip or tear.
 3. Fabric shall be secured with a minimum of two (2) fabric fasteners per square yard, or per the manufacturer specifications, whichever is the tighter staking spacing.
- D. Wattles: Install on contour lines as noted on Plans. Stake with 1x2x18-inch un-treated Doug Fir stakes at 4'-0" o.c. continuously. Tie in ends of wattles to subgrade and include stake at all ends. Overlap adjoining roll ends at least 12-inches and provide (1) additional stake and adjoining roll connection points.
- 3.04 SOIL PREPARATION OF SEEDING AREA
- A. Prepare all areas to be seeded. Seeding shall occur in all areas disturbed by construction not receiving mulch and outside of the Active Channel.
 - B. If requested, seeding shall be performed under direct observation of the O.R.
 - C. Soil seed bed shall be prepared from the final, O.R. approved, graded soil condition prepared by the Contractor. No seed bed preparation shall be initiated until the final grading for the project is accepted.

- D. Seed bed preparation shall include the following where construction work has disturbed the existing finish grade. Seed bed shall be free of surface irregularities and of even compaction (80% relative compaction):
- E. Rake out all debris and litter regardless of size or type and dispose of legally. Rocks and woody material greater than 2-inches in diameter shall all be removed from the site.
- F. Where disturbed areas have become over compacted use a commercial grade rototiller and hand rake soil areas to meet conditions noted above.

3.05 HYDROSEEDING

- A. All disturbed areas, not covered with mulch, or paving, or in the Active Channel, shall be hydroseeded as noted on the Plans.
- B. Do not apply hydroseeding emulsion during rainy weather or when soil temperatures are below 40 degrees Fahrenheit.
- C. Hydroseeding shall be completed in two applications. One application will not be acceptable. Three applications can be used if approved by O.R.
- D. First application shall be a mix of the seed, mycorrhizal inoculum, fertilizer, and a thin application of mulch (1/4 inch) and tackifier at 500 pounds/acre.
- E. Second application shall be a slurry mix of as greater amount of wood fiber and organic mulch at 1,500 pounds per acre
- F. Presoak seeds for 24 hours immediately before seeding. Change water three times, at eight-hour intervals, to prevent anaerobic damage.
- G. Perform mixing in a tank with a built-in, continuous agitation and recirculation system of sufficient operation capacity to produce a homogeneous slurry and discharge system which will apply the slurry at a continuous and uniform rate. Minimum capacity of tank: 3,000 gallons. O.R. may authorize use of smaller tank if it is demonstrated that such equipment is capable of performing all operations satisfactorily.
- H. Begin slurry preparation by adding water to the tank when engine is at half-throttle. When water level has reached height of agitator shaft, add stabilizing agent. Then add seed and fertilizer, followed by fiber mulch. Add the mulch to the mixture only after the seed and only with tank half full of water. Open the engine throttle to full speed when the tank is half filled with water. All the mulch shall be added by the time the tank is two-thirds to three-fourths full. Commence spraying within two hours after the tank is full. Do not over mix, as this can break down the viability of seed.
- I. All slurry mix which has not been applied within two hours after mixing will be rejected and removed from the site at Contractor's expense.
- J. Seed and subgrade shall be kept moist until germination occurs and seasonal rains ensure steady water supply. If late fall and winter rains do not maintain moist soil and vigorous seed growth conditions Contractor is responsible for manual irrigation of the seeded area.

3.06 CLEAN-UP

- A. Keep project site free from accumulation of debris resulting from work specified in this section.
- B. Immediately remove dirt, debris, and over seeding from seeding operations from buildings and structures, walls, pavements, and curbs.

3.07 PROTECTION

- A. Provide adequate barriers marked with white flags, throughout the duration of the soil bio-engineering period to protect installations and stockpile locations.

3.08 INSPECTION

- A. A written notice or phone call requesting an inspection shall be given to the O.R. at least two days prior to any anticipated inspection date.
- B. The following progress inspections are required:
- C. Inspection and approval of all live cuttings prior to installation
- D. On-site Mock-up of each soil bioengineering treatment prior to installation
- E. Inspection of seeding processes and results

3.09 ACCEPTANCE

- A. Soil Bioengineering treatments will be accepted provided all plan and specification requirements have been complied with and live cuttings are in a healthy condition.