# VERMONT CONSTRUCTION SPECIFICATION

## 56 – SOIL BIOENGINEERING PLANTINGS

### 1. Scope

The work shall consist of installing or planting live plant materials on streambanks and eroding slopes to stabilize the areas and control erosion in accordance with the drawings and these specifications.

### 2. Materials

#### A. Quality

**General** - Plant materials shall be live, viable woody vegetation. The plants shall be of the species specified on the drawings. The plant materials shall be from commercial sources, NRCS Plant Material Centers (PMC), or shall be harvested from existing local stands.

Root systems and limbs that are not required to be removed, as well as bark shall be kept intact and undamaged. Pruning cuts or cuts for live unrooted cuttings shall be smooth and shall not damage the remaining bark of the plant.

**Fascines** - Fascine bundles shall be prepared from live, shrubby material of species which will root, such as Salix species (willow), Cornus species (dogwood), Alnus species (alder), etc. Fascine bundles may vary in length, depending on materials available and size of workforce. Diameter of branches used in fabrication shall not be more than 1 1/2 inches in diameter. Stems shall be placed in the same direction and overlapped to create a shingled effect. When compressed firmly and tied, each bundle shall be approximately 8 inches in diameter. Fascines shall be tied on not more than 24-inch centers with a minimum of two wraps of natural bailing twine by a non-slipping knot.

**Live Stakes** - Live stakes shall be living, woody plant cuttings with side branches removed and the bark intact. They must be taken from a species that roots easily from cuttings such as willow. They shall be prepared from 1/2 to 2-inch diameter stock and cut into lengths of 2 to 3 feet. The basal or butt ends shall be cleanly cut at an angle to facilitate easy insertion into the soil. The top should be cut square or blunt.

**Brush** - Live brush shall consist of the whole above ground portion of willow, red osier dogwood, alder, or other hardwood species which root easily from cuttings. Plants shall be 5 to 6 feet tall. When there is a shortage of willow, up to 50 percent of the brush may be non-rooting species. When non-rooting species are used they shall be mixed randomly with the rooting species. Substitution of non-rooting species shall be approved by the technician.

**Dead Stout Stakes** - Dead stout stake material shall be a minimum of 24 inches long. They are cut to the specified length from untreated two by four (2x4) timbers. Each length shall be cut again diagonally across the four (4) inch face, to make two stakes from each length. The diagonal cut shall begin and end 1/8 to 1/4 inch from the edge of the piece so the finished stake will have a one-eighth (1/8) to one-fourth (1/4) inch tip. Only new sound, unused material shall be used.

**Wire** - Wire for securing the brushmattress shall be single strand #16 gauge wire capable of field use for at least two years.

**Geotextile Fabric** - Fabric used as wrapping for vegetated geogrid shall be natural coir #700 material or comparable jute material.

## B. Harvesting Indigenous Species

When specified on the drawings, the plant materials shall be harvested from existing stands of living woody vegetation. The harvested plant materials shall be one of the following listed species and shall be determined to be suitable by the technician:

- Cornus amomum, Silky Dogwood
- Cephalanthus occidentalis, Buttonbush
- Salix purpurea, Purpleosier Willow
- Salix cottetii, Dwarf Willow
- Salix interior, Sandbar Willow
- Salix caroliniana, Ward's Willow
- Salix rigida, Heartleaf Willow
- Salix sericea, Silky Willow
- Sambucus canadensis, American Elderberry
- Viburnum acerifolium, Mapleleaf Viburnum
- Viburnum cassinoides, Wild Raisin
- Viburnum lentago, Nannyberry
- Viburnum prunifolium, Black Haw
- Viburnum recognitum, Smooth Viburnum

Harvesting shall be done by hand or with small equipment so there will be minimal disturbance to the site. Sediment and erosion control measures shall be installed in accordance with Construction Specification 5, Pollution Control or as directed by the technician.

The materials shall be cut with chainsaws, brush axes, loppers, pruners or other devices that will provide a smooth cut without damage to the bark of the cutting or the remaining plant. Cuts made at an angle of approximately 45 degrees, 8 to 10 inches above the ground, to assure that the plants will regenerate rapidly and in a healthy manner. Live stakes shall be cut with a diagonal cut at the base of each stake and a flat cut on top.

Live cuttings shall be bundled together securely at the collection site with branches and limbs kept intact and transported to the work site in enclosed or covered trucks. Cuttings shall be sprayed with water and covered with a wet tarp during storage and transport.

Cuttings should be installed within 24 hours of harvest. Live cuttings that cannot be installed within 24 hours shall be placed in storage, at 40 to 50 degrees F. for protection. Storage will provide protection from the wind, direct sunlight and drying by covering with a wet tarp. Cuttings must be refrigerated if the air temperature is above 50 degrees F.

The harvesting site shall be left in a condition that will enhance regeneration of the plants. Remnant materials from the harvesting operation shall be chipped, or left in piles for wildlife cover.

### C. Plant Materials from Commercial Sources or PMC

Plant material from commercial sources or from NRCS Plant Material Centers (PMC) shall be harvested just before shipment to the site, or harvested no earlier than two months before planting and stored in refrigerated storage at 40 to 50 degrees Fahrenheit. When shipped, plants shall be transported in enclosed or covered trucks and scheduled to arrive on site within 24 hours. The plants shall be bundled and packed to prevent damage to the bark, limbs, or root systems. All rooted plants shall be treated with a root gel to prevent drying.

The plant materials should be planted the day they arrive on site. Plants and cuttings that cannot be planted the day they arrive shall be stored on site under a wet tarp to protect them from wind, direct sunlight, drying or other damage. Cuttings or unrooted stock that is not planted within two days after arrival on the site shall be discarded unless refrigerated at 40 to 50 degrees Fahrenheit.

Rooted stock that is not planted within five days after arrival on site shall be discarded, unless stock is refrigerated at 40 to 50 degrees Fahrenheit. Discarded materials shall be replaced from commercial sources at the contractor's expense.

## 3. Timing of Preparation, Installation and Planting

All planting of woody vegetation shall be accomplished during the dormant season, October 1 through May 7.

Installation of plant materials should begin concurrently with the earth moving operations and should be completed no later than 10 days after a cut or fill slope has been prepared. When the planting is delayed beyond 10 days, the slope shall be protected from erosion by mulching with straw mulch at a rate of 2 tons/ac. or the installation of erosion control blankets.

## 4. Installation

**Live Stakes** - Live stakes shall be installed in the configuration, spacing and areas shown on the drawings. The cuttings shall be tamped into the ground at right angles to the slope to a firm hold and a minimum depth of 18 inches. Where soils are soft and 24 inch stakes are not solid (i.e., if they can be moved by hand) 36 inch stakes shall be used. Where soils are compacted or frozen and 24-inch stakes cannot be tamped into the ground without splitting, pilot holes may be drilled using an auger or reinforcing rod. Pilot holes shall be narrower in diameter than the live stakes.

**Fascines** - Trenches shall be dug on the horizontal contour to a depth of 3/4 the diameter of the bundle. Beginning at the bottom of the slope and preceding upward, the live fascine bundle shall be placed in the prepared trench, with the ends of the bundles overlapping at least 12 inches. Dead stout stakes shall be driven directly through the fascine bundles every three feet along the length. Where bundles overlap, an additional stake shall be used at the midpoint of the overlap. The fascine bundle shall be covered immediately with soil and tamped. Workers are encouraged to walk on the fascine as work progresses to further work soil into the bundles. It is important to achieve the maximum plant material to soil contact to insure germination success. Ten to twenty percent of the bundle shall be left exposed when all construction is completed. Live stakes shall be tamped into the ground below the live fascine bundle, in between the previously placed dead stout stakes.

**Fascine Trench Spacing** - Trenches shall be spaced as shown on the drawings.

**Brushmattress** - The slope face shall be graded smooth to no steeper than 2 to 1 at the specified finished location and contours as shown on the drawings. Beginning at the base of the slope, a trench shall be dug on the horizontal contour to a depth of 3/4 the diameter of the live fascine bundle. The upslope side of the trench shall be graded to provide a smooth transition from the bottom of the trench to the upslope bank. A live fascine shall be placed in the trench in a manner as previously specified in Section 3. Place the basal ends of the brush under the live fascine. The branches should lie smoothly against the bank above, perpendicular to the live fascine. The brush shall be placed as shown on the plans or to a more or less solid layer which shall be 4 to 8 inches thick when compressed and tied down. Live stakes shall be driven to a firm hold on a grid of four foot centers each way encompassing the entire brush layer, extending beyond the sides and from just above the fascine to within 1 foot of the average top of the matting when compressed. Brushmatting shall be securely tied down between the stakes with #16 wire. Ties shall be at right angles to the brush and also diagonally between the stakes. Ties shall be placed in such a manner as to compress the brush matting. This may be accomplished by assuring the wiring is placed tightly, followed by driving the stakes nearly to ground level after tying. The brushmattress shall be partially covered with soil to encourage rooting.

**Brush Layering** - Hand trenching shall start at the bottom of the slope. Trenches shall be dug 24 to 36 inches into the slope, on contour, sloping downward into the slope from the face of the bank 10 to 20 degrees from the horizontal. Brush shall be placed with basal ends inward and in a crisscrossed manner to the thickness shown on the drawings or be 4 inches thick in cut work and 6 inches thick in fill work. Thickness shall be measured after compression by the fill or covering soil. No less than 6 inches or more than 18 inches of the tips shall extend beyond the fill face. The brush layers shall be backfilled with soil immediately following placement and the soil compacted firmly. Backfilling may be accomplished by hand or with machinery.

**Spacing of Brush Layers** - Spacing of trenches shall be as shown on the drawings.

**Vegetated Geogrid** - Vegetated geogrids incorporate brush layers with natural or synthetic geotextile materials wrapped around each soil lift. The bank shall be graded and rock riprap, if called for in the design, placed as shown on the drawings. The bank shall be excavated to a depth of 2 feet. Live brush shall be placed at right angles to the stream flow in a crisscross manner. The brush shall be 5 feet in length and placed at the rate of 5 per linear foot. The basal ends of the cuttings shall be placed against the back of the excavation. No more than 18 inches of plant material shall extend beyond the surface of the proposed finished grade. The brush will then be covered with geotextile. The geotextile will extend from the back of the excavated trench to the surface of the slope. Excavated material shall be placed on the geotextile to a depth of 2 feet and compacted. The geotextile is then wrapped around the soil layer. Live brush shall then be placed on the geotextile at right angles to the stream flow in a crisscrossed manner at the density specified in the first layer. The geotextile is wrapped over the brush. Soil is placed and compacted on the geotextile in the manner specified in the first lift. The above procedure continues until the number of lifts displayed on the plans is accomplished. The final wrap shall be secured to the bank with dead stout stakes or, if possible, live stakes.

## 5. Planting

Rooted Cuttings, Rooted Seedlings, or Trees - Plant in holes made by planting bar or shovel in the prepared cut or fill slopes. The holes shall be of sufficient size to permit placing the plant without bending the root. Place the plants in the hole to the same depth as they were originally growing before harvest.

Plant rooted cuttings or seedlings on approximately 5-foot centers in rows along the contour of the slope. Install rows of plants approximately 5 feet center to center measured parallel to the slope and stagger the plants from row to row.

All rooted plantings shall be dipped in a root gel just prior to planting.

Holes made with a shovel shall be filled with excavated soil and pressed firm around the roots up to the ground surface. Holes made with a planting bar may be closed with the planting bar firming the soil at the bottom of the hole first and then firming the soil at the top. All spaces within one foot of the planting shall be filled with soil and compacted.

All plant materials damaged during installation or determined to be unsuitable by the technician shall be removed and replaced at the contractor's expense.