

Bluff Stabilization Techniques

Using an Integrated Planting
Approach

Traditional Approach



- Not the best approach for long term sustainability of the site.

Integrated Approach

- The integrated approach incorporates soil bioengineering techniques using a combination of woody and herbaceous plant materials in various forms

Soil Bioengineering

- **Soil Bioengineering**: The practice of utilizing plant materials alone in such a way as to perform a structural function of stabilization
- **Biotechnical Stabilization**: Utilizing a combination of plants, geotextile fabrics, and/or structural measures for stabilization.

Factors affecting bluff stabilization

- Surface Water - creates rill/gully erosion
- Ground Water - creates slumping and slope instability
- Bay Water – wave energy creates toe erosion

Surface Erosion Solutions

- Direct surface water away from the top of the bluff
- Intercept water to keep it from running over the top of the bluff
- Protect the surface to prevent erosion
 - Herbaceous vegetation
 - Bioengineering techniques (Herbaceous/Woody)
 - Hard surfacing

Vegetative Considerations

Planting Techniques

- Seeding vs vegetative material
- Plant types
 - Dormant unrooted
 - Bare root
 - Containerized

Native or naturalized materials?

- Caution with invasive plants
 - Polygonum
 - Crownvetch

Woody Plant Functions

Soil Bioengineering Systems

- Root reinforcement - root tensile strength mechanically reinforces soil.
- Soil moisture depletion - remove excess soil water through evapotranspiration.
- Buttressing and Arching - anchored & embedded stems/roots counteract downslope shear forces.
- Flexible stems deflect erosive energy

Vegetation

Herbaceous planting/seeding to protect the surface of the soil quickly

- Well adapted materials for variety of bluff conditions
 - Shaded to sunny
 - Sandy to Clayey
 - Wet to droughty

Soil Bioengineering Systems

“Keystone Species”

Species

Rooting Success

Shrub willows
(*Salix spp.*)

70%-100%

Shrub dogwoods
(*Cornus spp.*)

30%-70%

Willow Whips



- 3/8" to 5/8" in diameter
- 4-8 ft. in length
- Cut when dormant
- Nursery grown; same diameter/branching pattern



Soil Bioengineering Species

Commercially Available Willows

- ‘Streamco’ purpleosier willow (*Salix purpurea*)
- ‘Bankers’ dwarf willow (*Salix cottetii*)
- ‘Greenbank’ sandbar willow (*Salix exigua*)
- Pussy willow (*Salix discolor*)
- Silky willow (*Salix sericea*)
- Prairie willow (*Salix humilis*)
- Bebb willow (*Salix bebbiana*)
- Heart-leaved willow (*Salix eriocephala*)

- Black willow (*Salix nigra*)

Sandbar willow



Pussy Willow



Silky willow



Prairie Willow



Soil Bioengineering Species

Commercially Available Shrubs

- ‘Ruby’ redosier dogwood (*Cornus stolonifera*)
- ‘Indigo’ silky dogwood (*Cornus amomum*)
- Gray dogwood (*Cornus racemosa*) (Does not root well from dormant cuttings)



‘Ruby’ redosier dogwood
(Cornus serecia)

**Developed because of it’s
prolific layering ability.**



Soil Bioengineering Species

Limited rooting ability

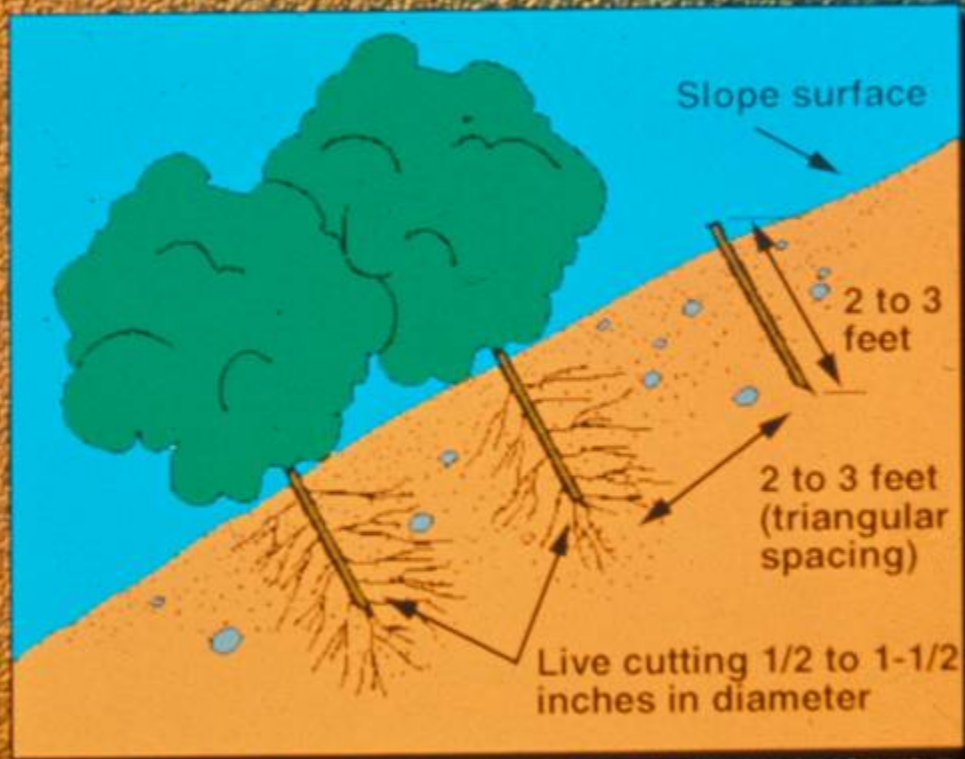
- Buttonbush (*Cephalanthus occidentalis*)
- Elderberry (*Sambucus canadensis*)*
- Ninebark (*Physocarpus opulifolia*)*
- Arrowwood, Blackhaw (*Viburnum spp.*)*
- Groundsel (*Baccharis halimifolia*)
- Indigobush (*Amorpha fruticosa*)

- * indicates shade tolerance

Soil Bioengineering

- Utilizes vegetation to provide some structural support to the slope.
- Examples
 - Fascines
 - Brushmattressing
 - Live Staking

Live Stake Installation



Live stakes

- 3/8"-1.5" diameter
- 1-3 ft. length
- Avoid “mushrooming” tops
- Approx. 75% of the length shall be inserted in the soil





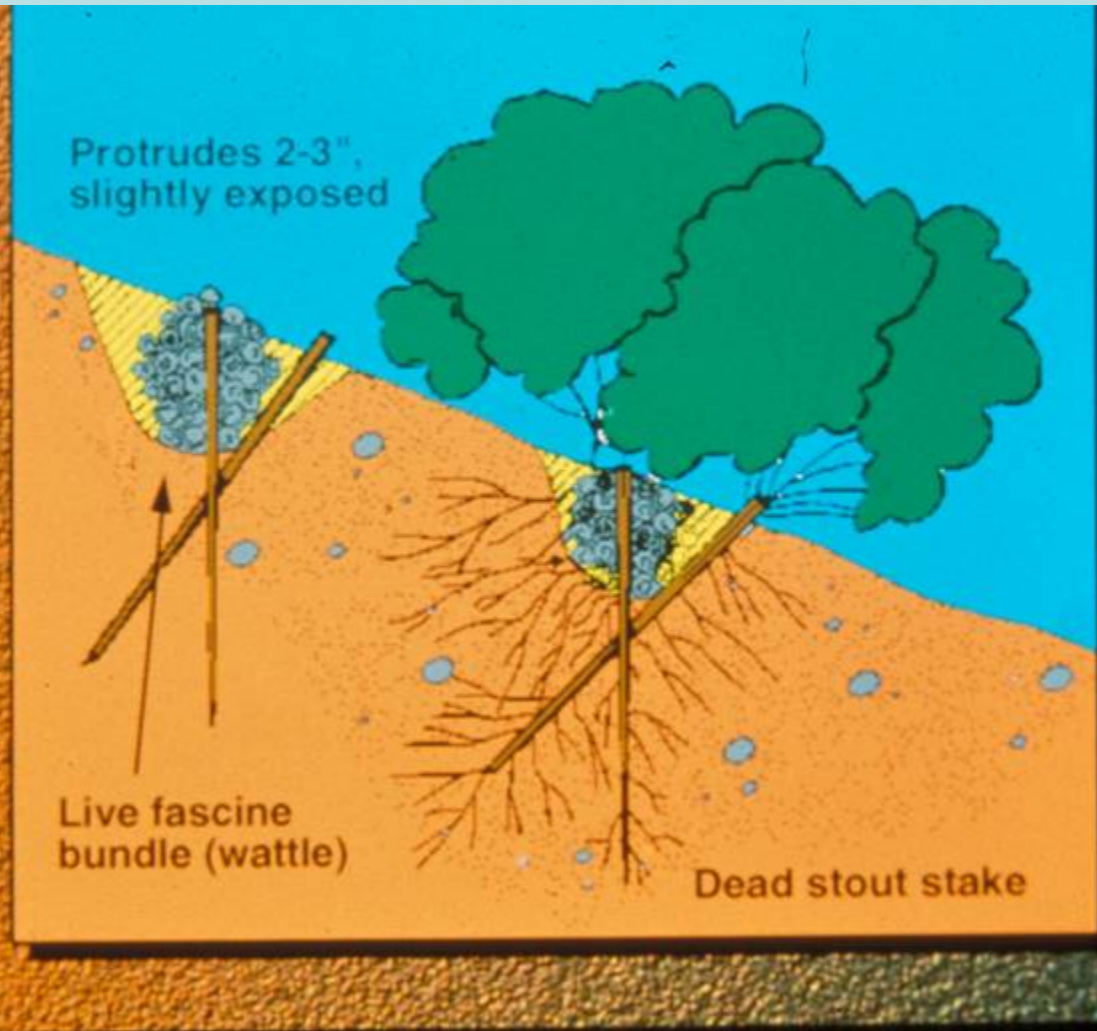
A “living” live stake

Live Fascine

Protrudes 2-3",
slightly exposed

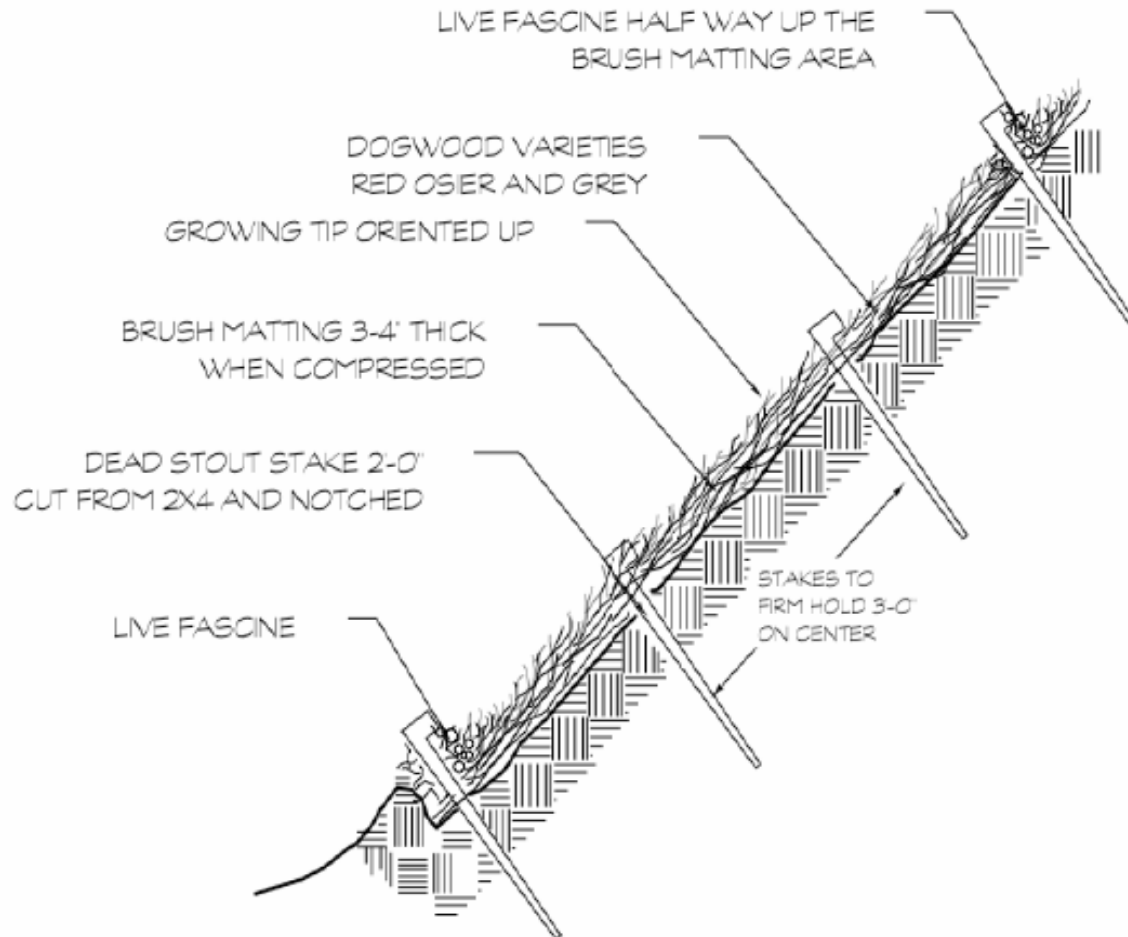
Live fascine
bundle (wattle)

Dead stout stake





Brushmattress Cross Section



5

CROSS SECTION OF BRUSH MATTING

NOT TO SCALE

Brushmattress



Brushmattress Installation



Installation of brushmattress



After one growing season

Other Plant Forms

- Unrooted cuttings
- Bare Root
- Tubelings
- Container

Unrooted Cuttings

- 1/4"-3/8" diameter
- 8"-12" length
- Perform better in moist soils
- May be planted through erosion control fabric



Rooted (bare root) plants

- field dug, bare root
- 3/8" at root collar
- Root gel (Terrasorb) increases survival in higher, drier bank zones
- May be planted through erosion control fabric



Tubelings



Containerized Plants



Container Fascine



Soil Bioengineering Species

Bare root/Containerized

- Alder species (*Alnus spp.*)*
- Red/Black chokeberry (*Aronia spp.*)*
- Gray dogwood (*Cornus racemosa*)*
- Sweet pepperbush (*Clethra alnifolia*)*
- Winterberry holly (*Ilex verticillata*)*
- Spicebush (*Lindera benzoin*)*
- Witch-hazel (*Hamamelis virginiana*)*
- Highbush blueberry (*Vaccinium corymbosum*)*

Coastal Bluff Stabilization

Full sun/Drought tolerant Species

- Bayberry (*Myrica pensylvanica*)
- Winged sumac (*Rhus copallina*)
- Sand cherry (*Prunus depressa*)
- Sweetfern (*Comptonia peregrina*)
- Indigobush (*Amorpha fruticosa*)
- Groundsel (*Baccharis halimifolia*)
- American beachgrass (*Ammophila breveligulata*)
- Coastal panicgrass (*Panicum amarulum*)
- Switchgrass (*Panicum virgatum*)
- Saltmeadow cordgrass (*Spartina patens*)
- Coastal little bluestem (*Schizachyrium scoparium var. littorale*)

Plant Materials Costs

<u>Plant Form</u>	<u>Approximate Cost</u>
Unrooted cuttings	\$0.45-\$0.75
Live stakes (1-3 ft.)	\$1.00-\$1.50
Willow whips (4'-8')	\$1.00-\$3.00
Tubelings	\$1.25-\$1.75
Bare root (1-0)	\$1.00-\$2.00
Container (1 gal)	\$ 3.00-\$12.00

Erosion Control Fabrics on Bluffs



Planting Trial Red Point-Cecil County



Red Point-Cecil County



Dormant Shrub Willow Planting



Herbaceous Plantings of beachgrass/saltmeadow cordgrass



Filling

- Filling is generally not a good idea
- Slope is typically too steep to hold materials in place
- Fill materials may cover existing vegetation
- Cutting is usually preferred as it is more stable
- Organic matter will rot down and retain water

General Bluff Planting Alternatives

- Establish good herbaceous cover then incorporate containerized, bare root, or unrooted shrubs, but no trees
- Plant a few scattered “mother” plants of well adapted shrub species and allow for natural succession due to seed dispersal
- Use the “Vegetative Barriers” approach to slope protection. Plant beachgrass, saltmeadow cordgrass, and/or coastal panicgrass on a tight (6”-8”) spacing within a row. Plant 2-3 rows one foot apart
- Soil bioengineering techniques may be used where water may be piping out of the slope.