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
<table>
<thead>
<tr>
<th>Species</th>
<th>Rooting Success</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shrub willows (Salix spp.)</td>
<td>70%-100%</td>
</tr>
<tr>
<td>Shrub dogwoods (Cornus spp.)</td>
<td>30%-70%</td>
</tr>
</tbody>
</table>
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 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

- LIVE FASCINE HALF WAY UP THE BRUSH MATTING AREA
- DOGWOOD VARIETIES RED OSER AND GREY GROWING TIP ORIENTED UP
- BRUSH MATTING 3-4' THICK WHEN COMPRESSED
- DEAD STOUT STAKE 2-0' CUT FROM 2X4 AND NOTCHED
- LIVE FASCINE STAKES TO FIRM HOLD 3-0' ON CENTER

CROSS SECTION OF BRUSH MATTING

N O T TO S C A L E
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

<table>
<thead>
<tr>
<th>Plant Form</th>
<th>Approximate Cost</th>
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</thead>
<tbody>
<tr>
<td>Unrooted cuttings</td>
<td>$0.45-$0.75</td>
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<tr>
<td>Live stakes (1-3 ft.)</td>
<td>$1.00-$1.50</td>
</tr>
<tr>
<td>Willow whips (4’-8’)</td>
<td>$1.00-$3.00</td>
</tr>
<tr>
<td>Tubelings</td>
<td>$1.25-$1.75</td>
</tr>
<tr>
<td>Bare root (1-0)</td>
<td>$1.00-$2.00</td>
</tr>
<tr>
<td>Container (1 gal)</td>
<td>$3.00-$12.00</td>
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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.