Structural, Non-Structural and Hybrid Options for Shoreline Protection

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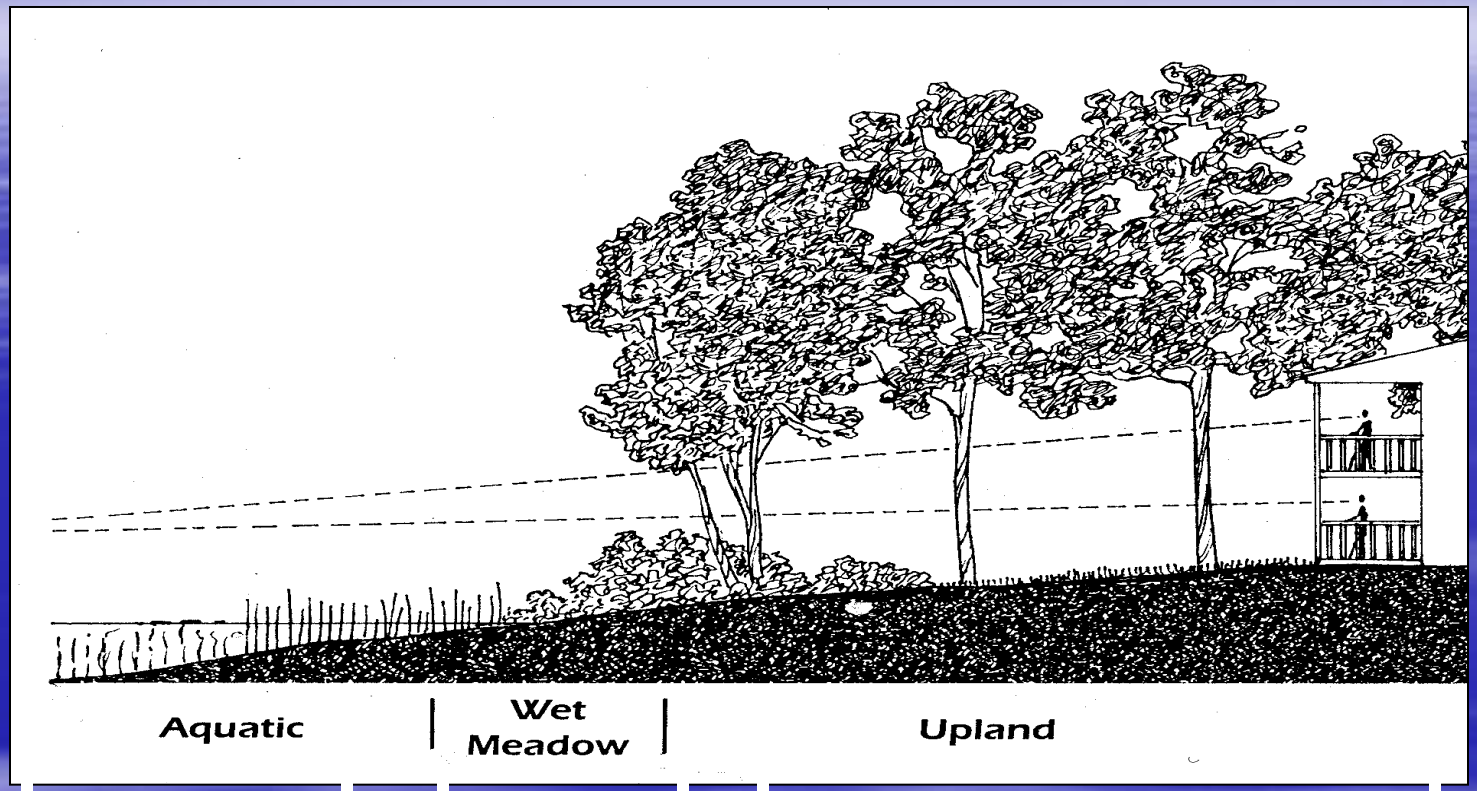
The natural shoreline “big picture”



Protect bank from wave action

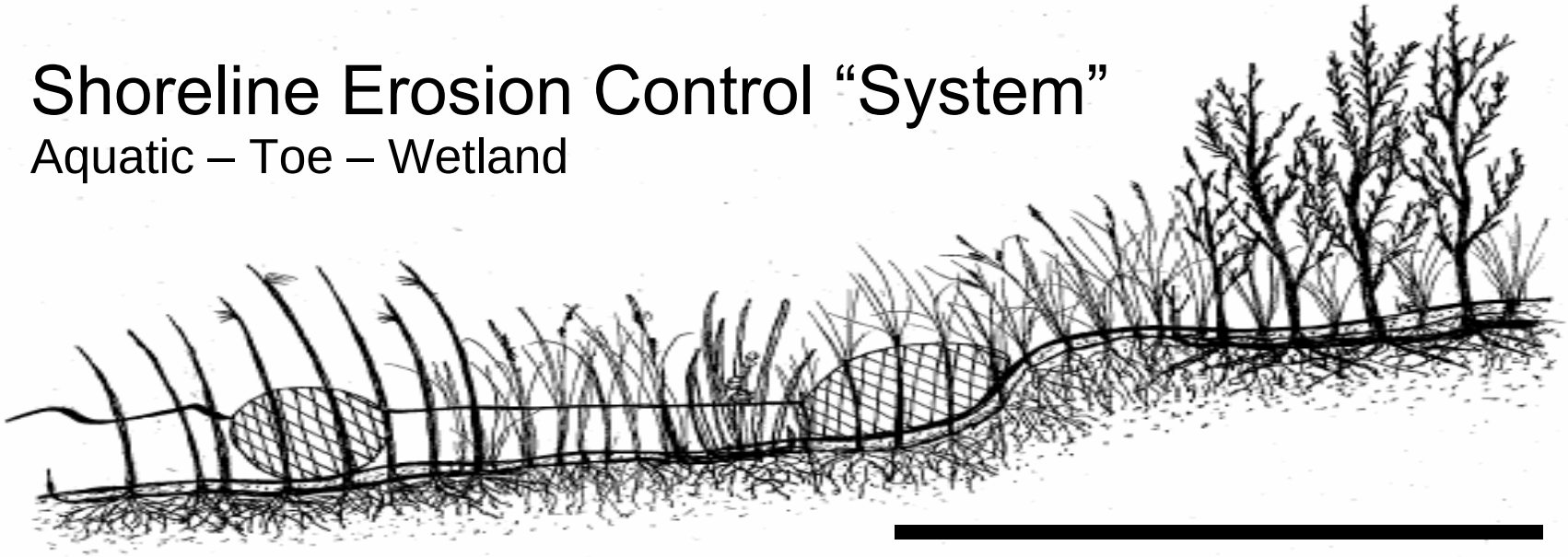
Deep roots bind the soil

Reduce run-off and pollutant inputs from the land

Plants provide critter habitat

Shoreline Erosion Control "System"

Aquatic – Toe – Wetland



Wave Break

- Brush bundle
- Wrapped bundle
- Tree revetment
- Coco log
- Rock berm

Emergent Aquatic Plants

- Containerized plants
- Prevegetated mats
- In-lake transplants

Exclosure

- Fence/posts

Toe Protection

- Brush bundle
- Wrapped bundle
- Coco log
- Flax log
- Photo-bag/corn bale
- Coco lift
- Vegetated geogrid
- Geo-bag/soil
- Stump revetment
- Tree revetment
- Log raft
- Gabion tube
- Rock riprap

Wetland Plants

- Seeded plants
- Live stakes
- Live posts
- Live fascines
- Willow wattles
- Brush mattresses
- Bare root shrubs
- Plant plugs
- Containerized plants
- (Erosion blanket)

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EXTENSION

Site evaluation

- What indicators do we use to predict soft armor/bioengineering success?

Photo: Bill Bartodziej

Photo: Greg Berg

Plant selection and sequencing

- Plant rhizomatous species first
- Add showy, clump-formers later

Rhizomatous Plants

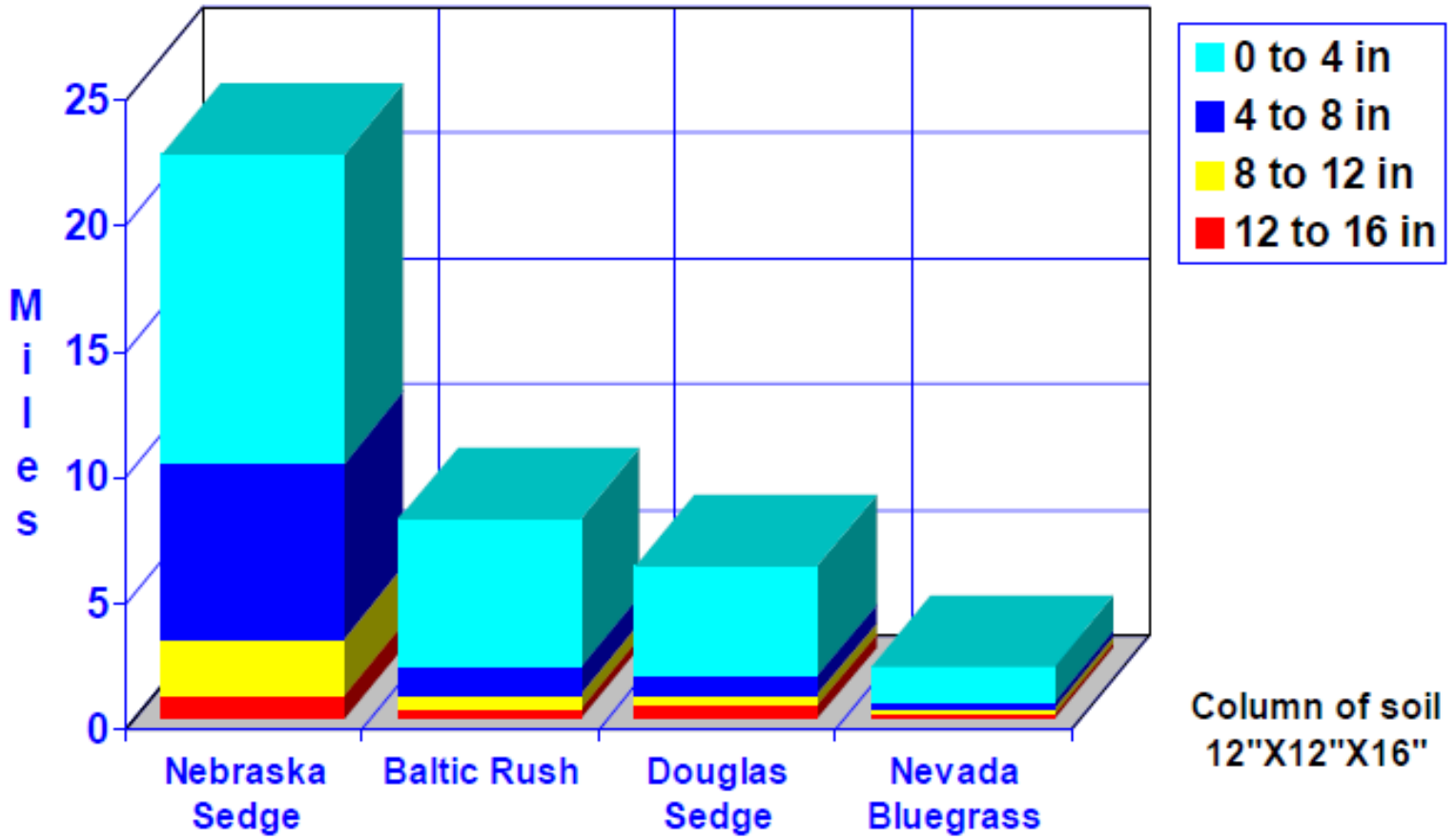
Sedges
(*Carex* spp.)

Bulrush
(*Schoenoplectus* spp.)

Bur-reed
(*Sparganium* spp.)

Bulrush
(Bolboschoenus spp.*)*

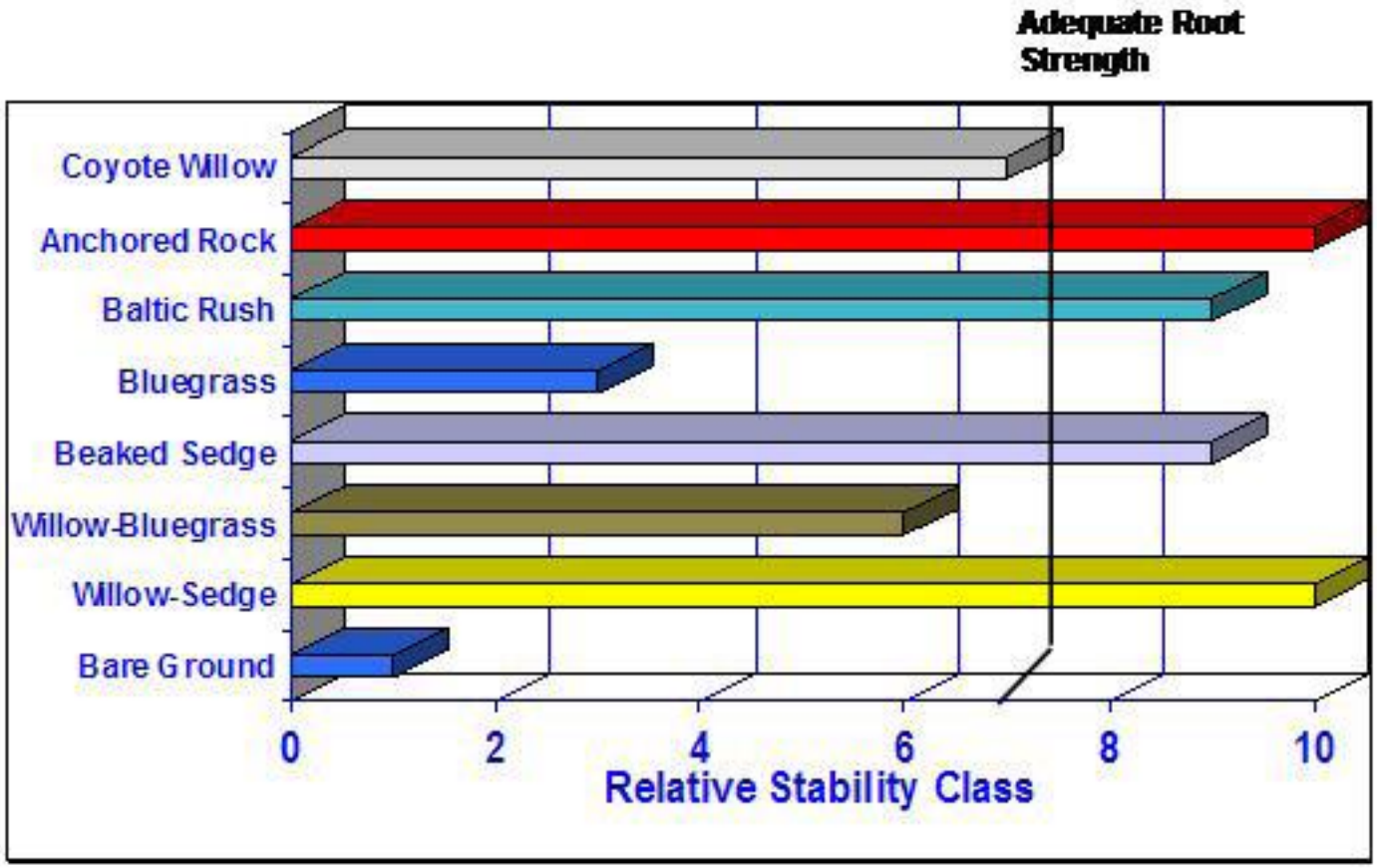
Root Length



Manning, M.E., et al, 1989

Erosion Control

Channel Stability Rating (Vegetation)



Winward 2000
Appendix B

sedge

Bioengineering Methods

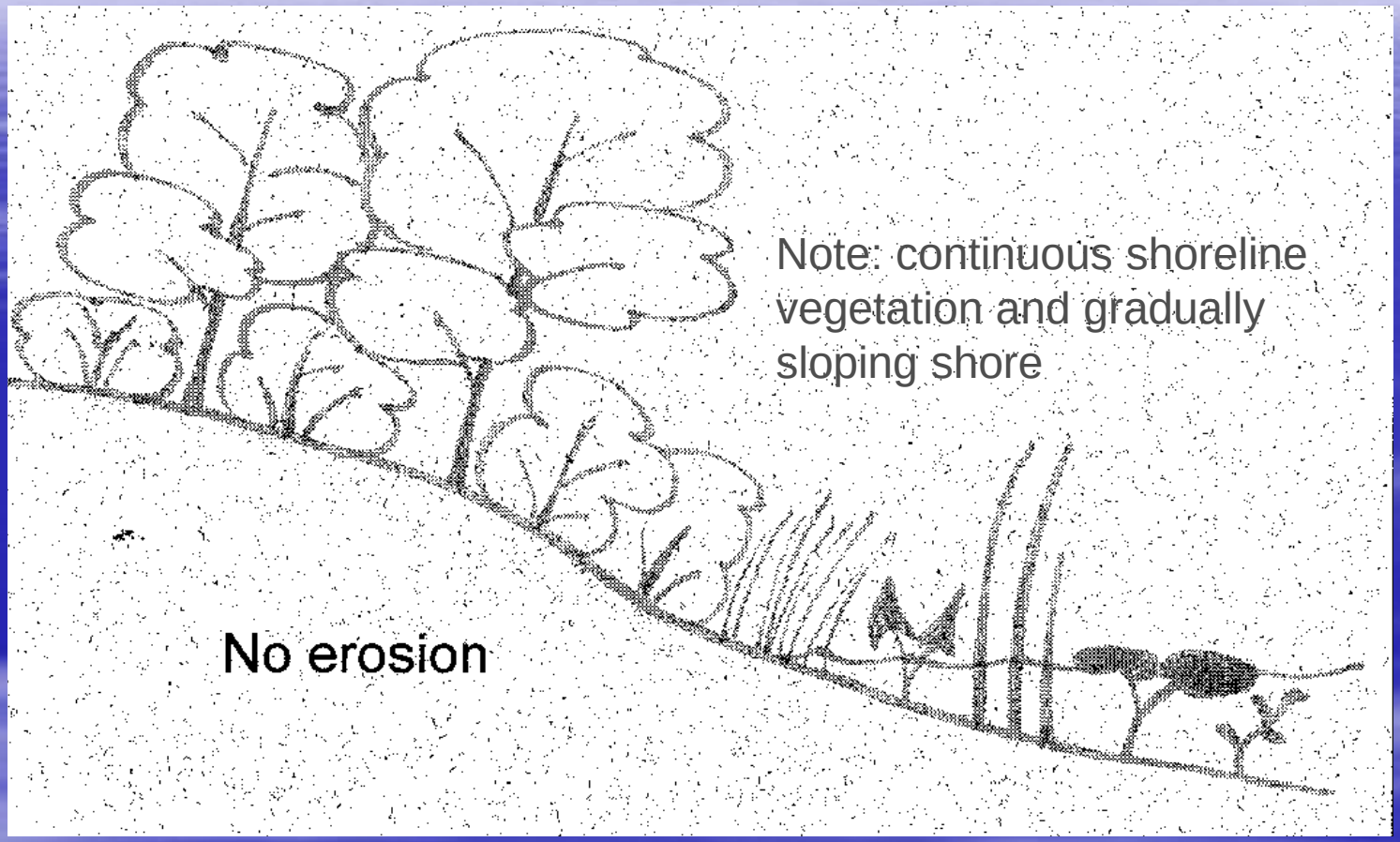
- Which bioengineering products, techniques and combinations will succeed?
- (U of MN research 2009-2012)

Bio products have a limited lifespan... plan for it!

Coco log (toe protection)

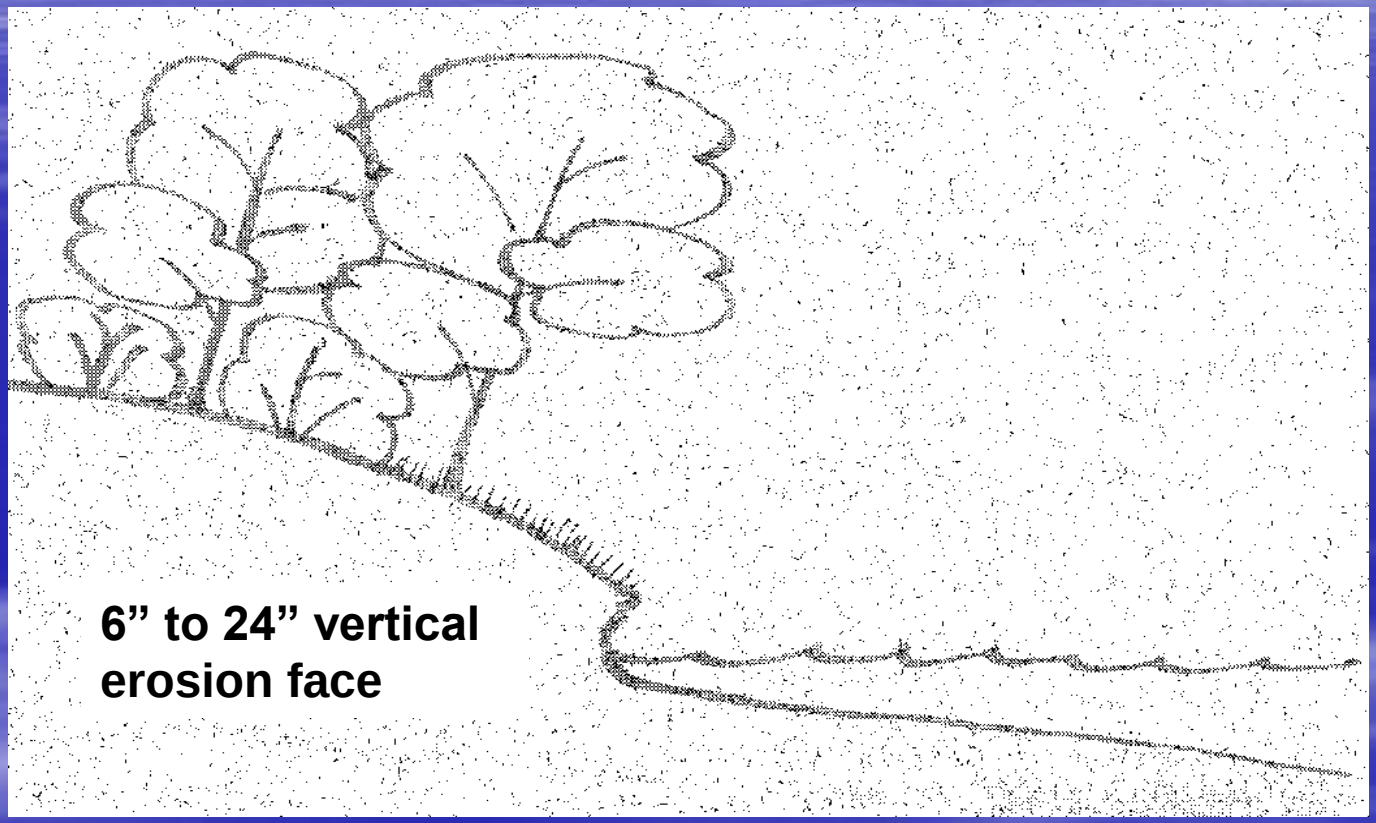
Wrapped brush bundle (wave break)

For shorelines with little/no erosion:



Maintain or enhance native vegetation

For shores undercut up to 2 ft:

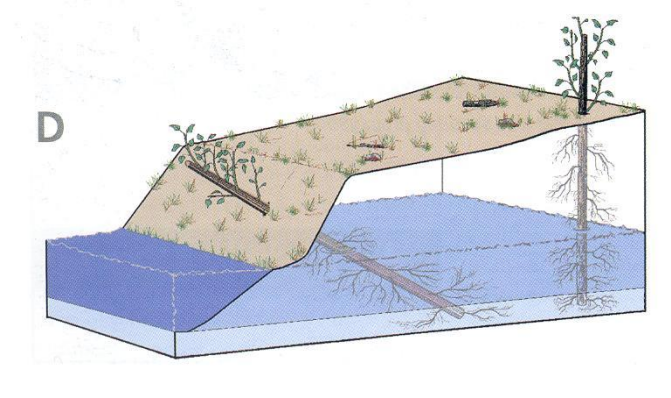


Install toe protection and native plants

Upland and wetland native plants - plugs and containerized

Cost/20 linear ft: $200 (10 ft wide)
Installation time: 0.5 hr
Maintenance time: watering yr 1
Notes:

Live stakes and posts



Cost/20 linear ft: $0
Installation time: 0.5 hr
Maintenance time: 0 hr
Notes:

For Toe Protection: bio logs

Cost/20 linear ft: $150
Installation time: 0.5 hr
Maintenance time: 0
Notes: combine with plantings

Brush bundles

Swarming Along the River Bank Like Ants, Coolies Drag Long Strands of Woven Willow Sticks to th

Others carry packs of kaoliang stalks to the water's edge. Both materials rot in the water after a few years. Then new stacks are placed
the decayed mass into the mud on the river bottom. Often the entire construction is destroyed when the current scours out the r

Wrapped bundles

Photodegradable bag/corn bale

Cost/20 linear ft: $1,160
Installation time: included
Maintenance time: 0
Notes: installed only by trained contractor; last only 1 yr in high energy site

Stump revetment

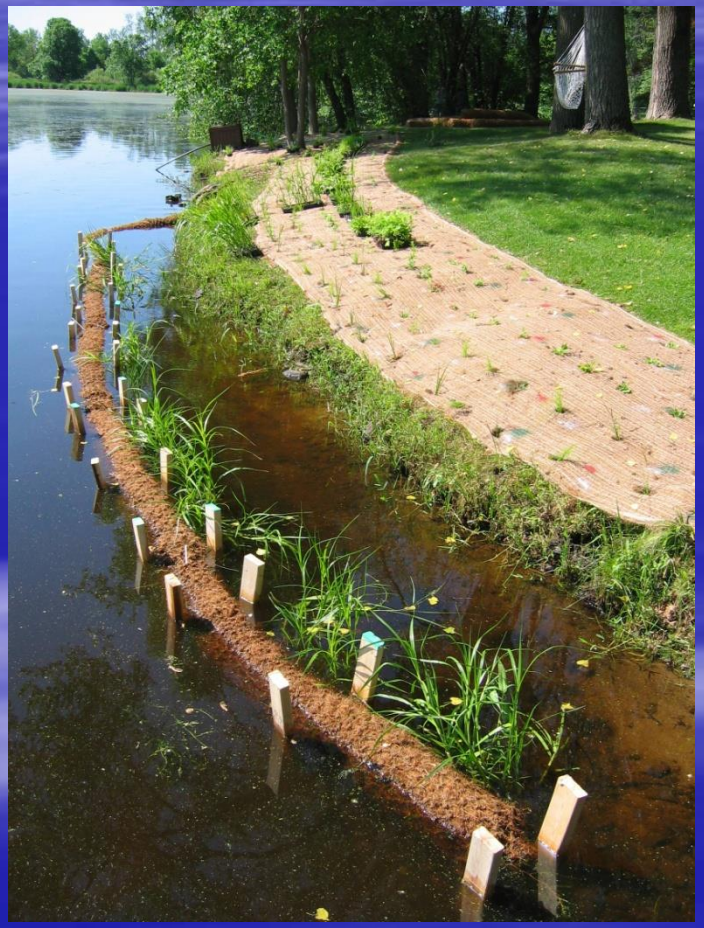
Cost/20 linear ft: $140 (hauling)
Installation time: included
Maintenance time: 0
Notes: installed by contractor; used for traffic control

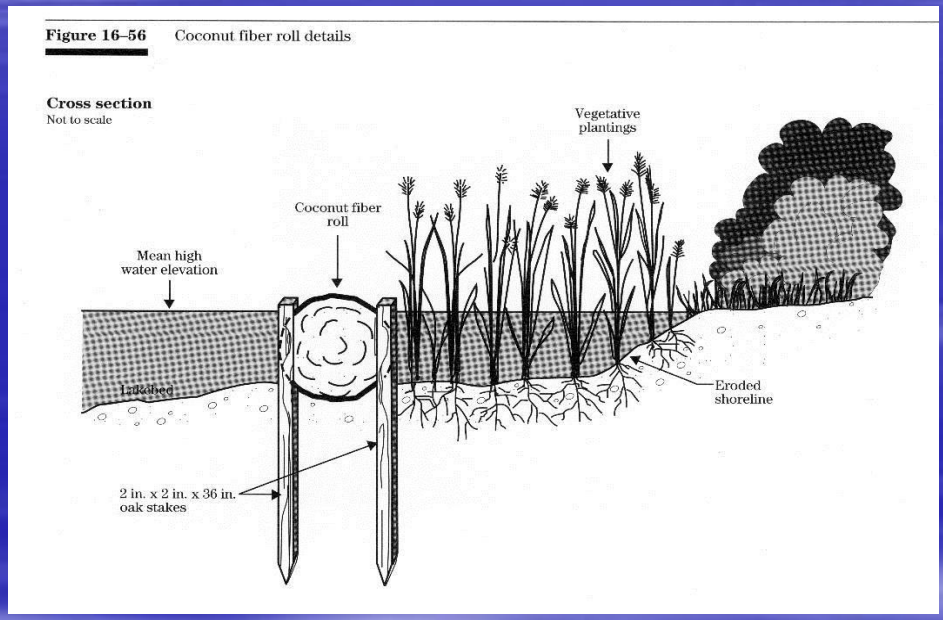
Aquatic emergent plants

Remember: Obtain a DNR permit before planting below the OHW

Cost/20 linear ft: $0-200
Installation time: 0.5 – 1 hr
Maintenance time: 0 hr
Notes: critter protection?

Planted shores may require temporary **Wave Break** using a coco log or…





Cost/20 linear ft: $150
Installation time: 0.5 hr
Maintenance time: 0 hr
Notes:

Note: *Wave breaks, aquatic and wetland plants, and toe protection can "collect" suspended sediment and help rebuild the shoreline lost to erosion, as well as protect it from future erosion.*

…cedar trees or brush bundles

Cost/20 linear ft: $20
Installation time: 0.5 hr
Maintenance time: 0.5 hr
Notes: remove prior to freeze-up?

Cost/20 linear ft: $60
Installation time: 1 hr
Maintenance time: 0
Notes: sediment collects between/behind bundles

Coco log and wrapped brush bundle


Post Planting
Gregg Thompson - AMSWCD


First spring after planting
Gregg Thompson - AMSWCD


First summer after planting
Gregg Thompson - AMSWCD


Second summer after planting
Gregg Thompson - AMSWCD

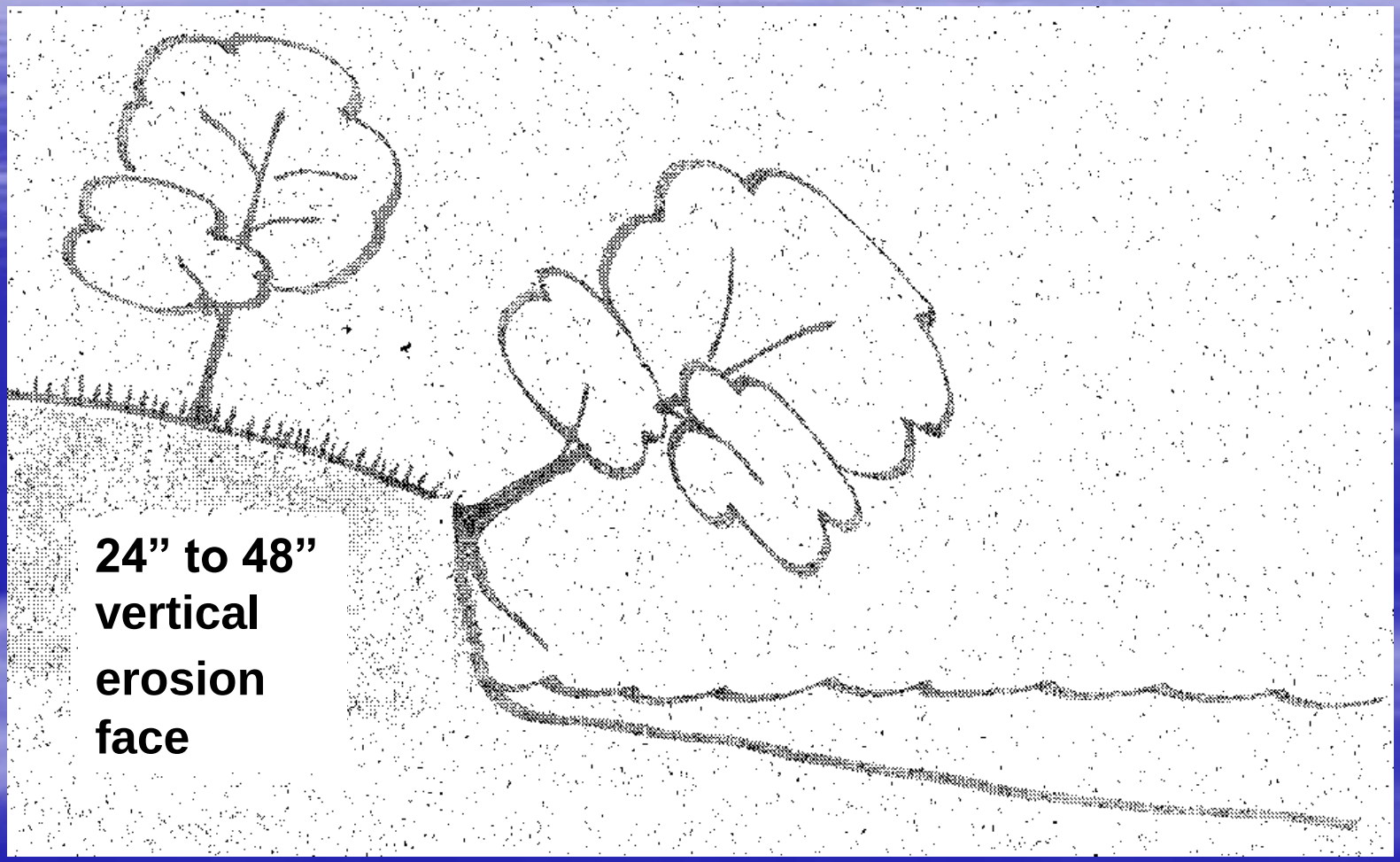
Tree revetment, bio log, live stakes – post installation

Gregg Thompson - AMSWCD

They may also need an **exclosure** (a fence to protect the plants from critters)

Cost/20 linear ft: $55
Installation time: 1 hr
Maintenance time: 0.5 hr
Notes: remove prior to freeze-up?

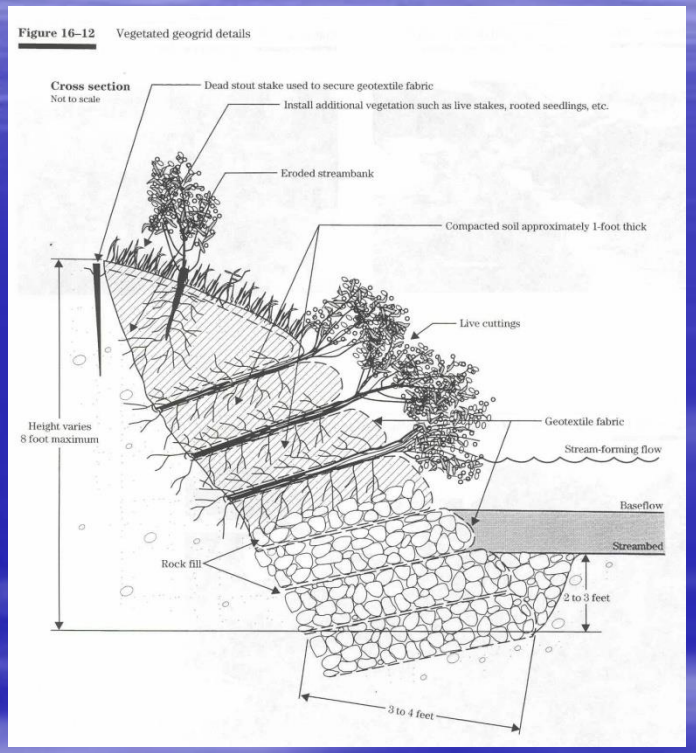
For shores undercut 2 to 4 ft



Install toe/slope protection and native plants

Vegetated geogrid

Note: Requires a shoreland alteration permit



Cost/20 linear ft: ~$400 (by hand)
Installation time: 5 hrs
Maintenance time: 0
Notes: requires dormant live stakes

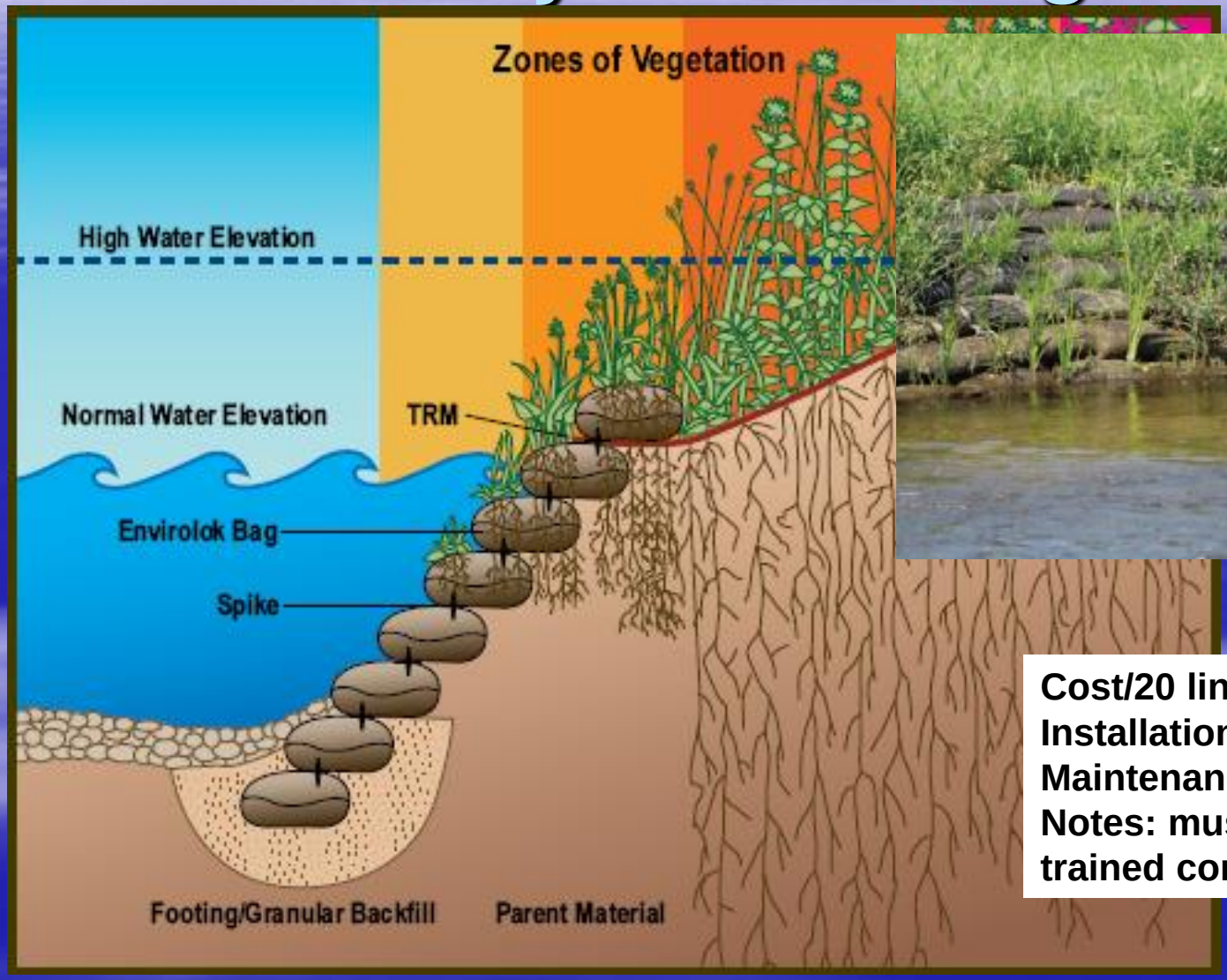
Coco lift
(with live stakes & plants)

Note: may require a shoreland alteration permit

Cost/20 linear ft: $340
Installation time: 5 hrs
Maintenance time: 0
Notes: requires plants and/or live stakes

Oops!
Retaining wall is not such a good idea

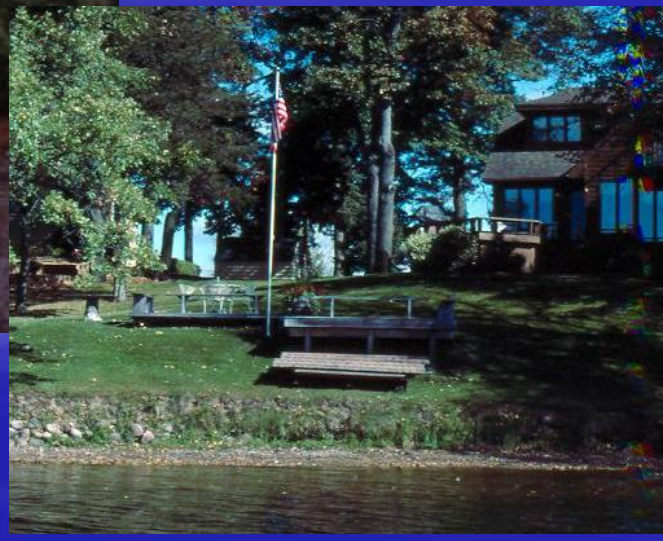
Geosynthetic bag/soil



Cost/20 linear ft: $1,500
Installation time: included
Maintenance time: 0
Notes: must be installed by trained contractor

Shape slope, blanket, plant

Note: requires a shoreland alteration permit



Cost/20 linear ft: $1,000
Installation time: 3 hrs
Maintenance time: 1 hr
Notes: requires equipment

For shores with erosion bank > 4 ft:

Shape slope, blanket, plant

Note: requires a shoreland alteration permit

Cost/20 linear ft: $1,500
Installation time: 6 hrs
Maintenance time: 1 hr
Notes: requires equipment

Tree Revetment

Greg Berg – Stearns SWCD

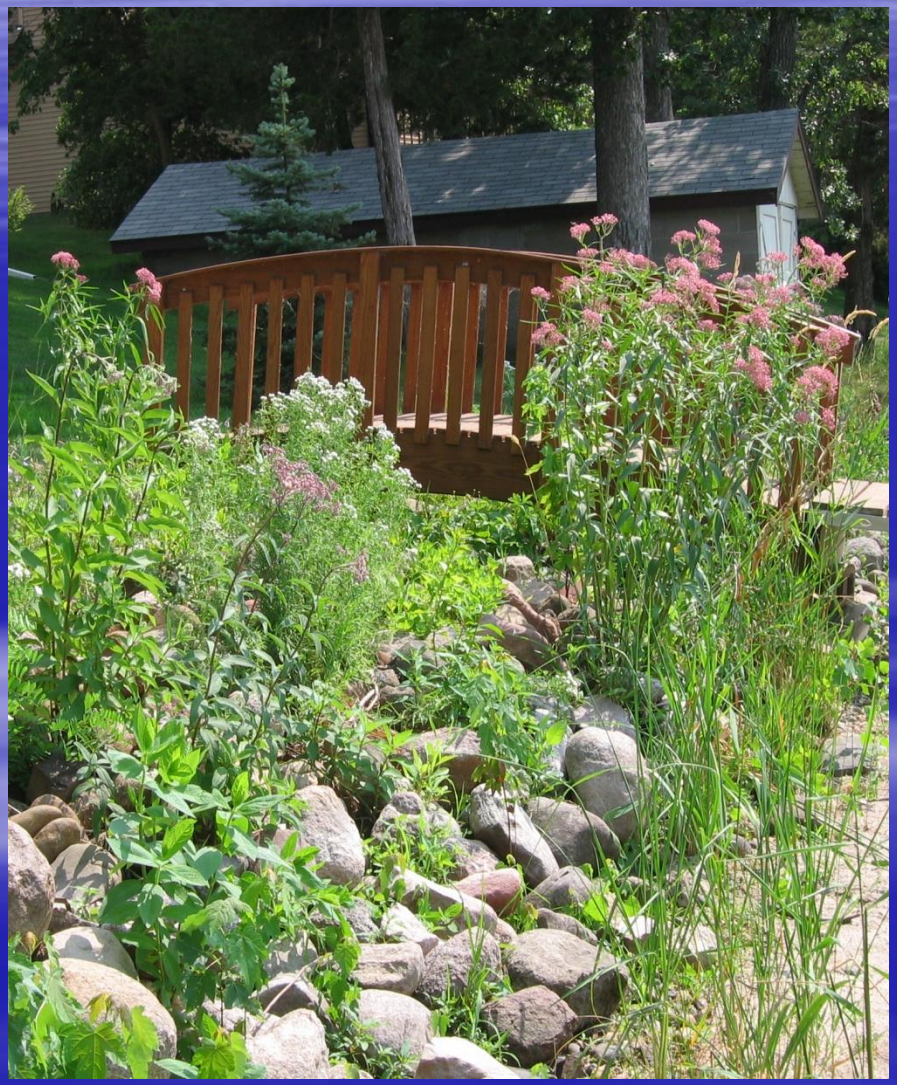
Cost/20 linear ft: $50
Installation time: 0.5 hr
Maintenance time: 0
Notes: use duck-bill anchors

Live fascines

Greg Berg – Stearns SWCD

Live fascines 5 yrs after installation

Rock rip rap & native plants



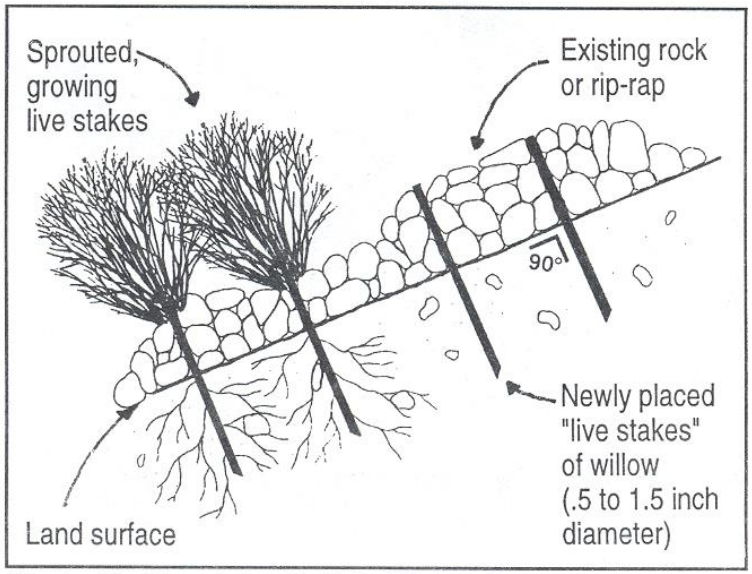


Figure 12: Live stakes installed through rip-rap.

Cost/20 linear ft rip rap: $1,200
Installation time: included
Maintenance time: varies
Notes: installed by contractor

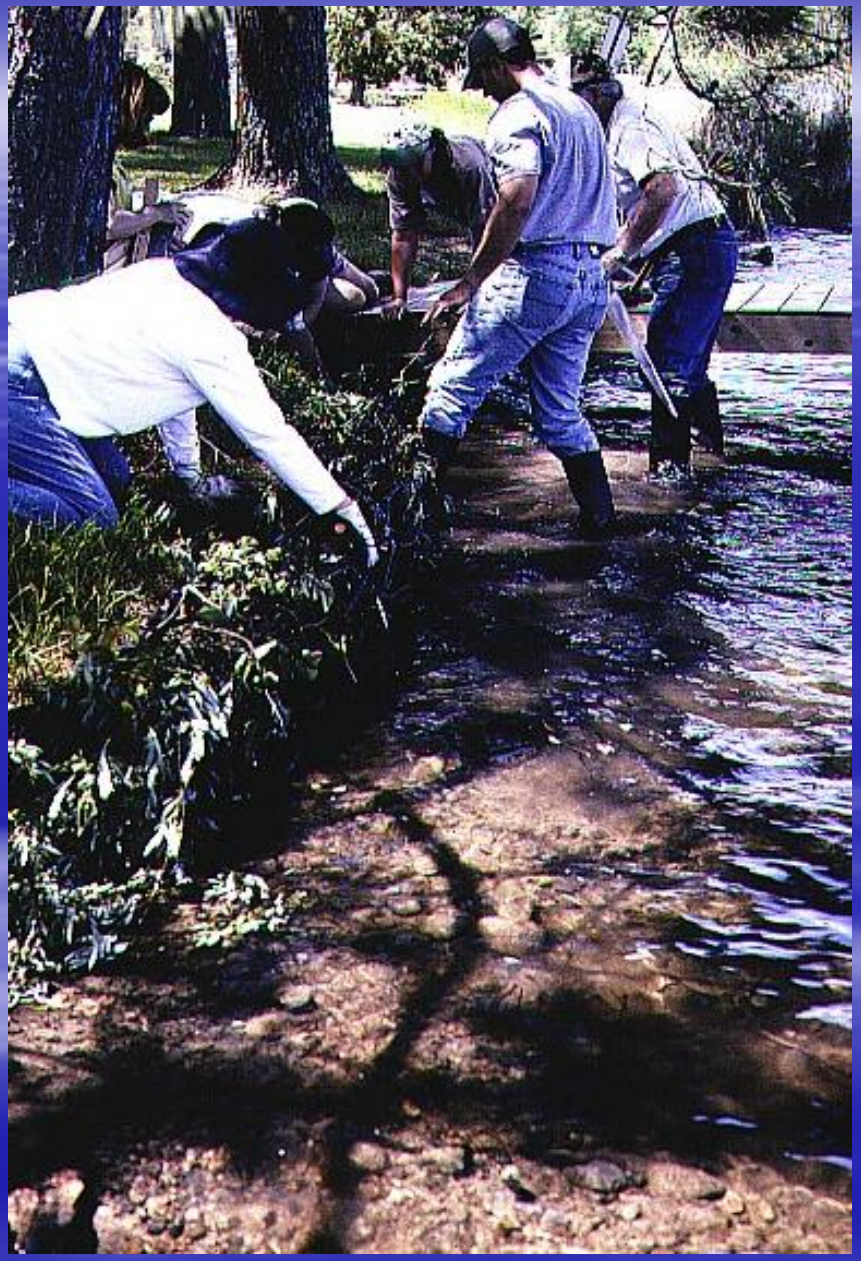
Project Examples

Little Bass Lake

- Small lake
- Small resort
- Upland and aquatic vegetation removed on 400’ of shoreline; turf seeded on upland
- Shore eroding 6”/year; 1-2’ undercut toe
- Owner preference: “My customers come to the north woods - give them the north woods”
- Total cost: $800 ($2.00/linear shoreland foot)

Aerial view

Before planting



Install willow wattle along eroding shore

Install coconut log – note sedge transplant after only one year

Install aquatic and upland plants

Shoreline after two years

Shoreline five years after planting

Snake River

- Private owner (4 years)
- 400’ shoreline on narrow channel
- Shore eroding 6”/year
- Boat traffic; seasonal flooding; muskrats
- Project cost: $5,000 ($12.50/linear shore ft.)
  - Coco logs, coco blankets, stakes, mulch
  - Plants

Lay out site

Apply mulch for weed control

- C-125 coco blanket to hold mulch in place during floods

Native plant plugs on 1.5’ centers

Coco log wave break

- Prevegetated plant mats
- Continuous row (on 2’ centers)
- 5 species

After installation

One year post-installaton

McCarrons Lake

68 acres – heavy boat traffic

Site on west side – maximum fetch = 3,000 ft

Shallow water zone – 1ft depth out 10 ft from shore

All photos in this sequence provided by Bill Bartodziej - RWMWD

Wall and turf removed

Shore regraded

Coconut logs staked on top of the NAG C-350

Soil over NAG C-350, seeded, and then covered with C-125

Plants are installed through the erosion C-125 blanket @ 1.5 ft centers

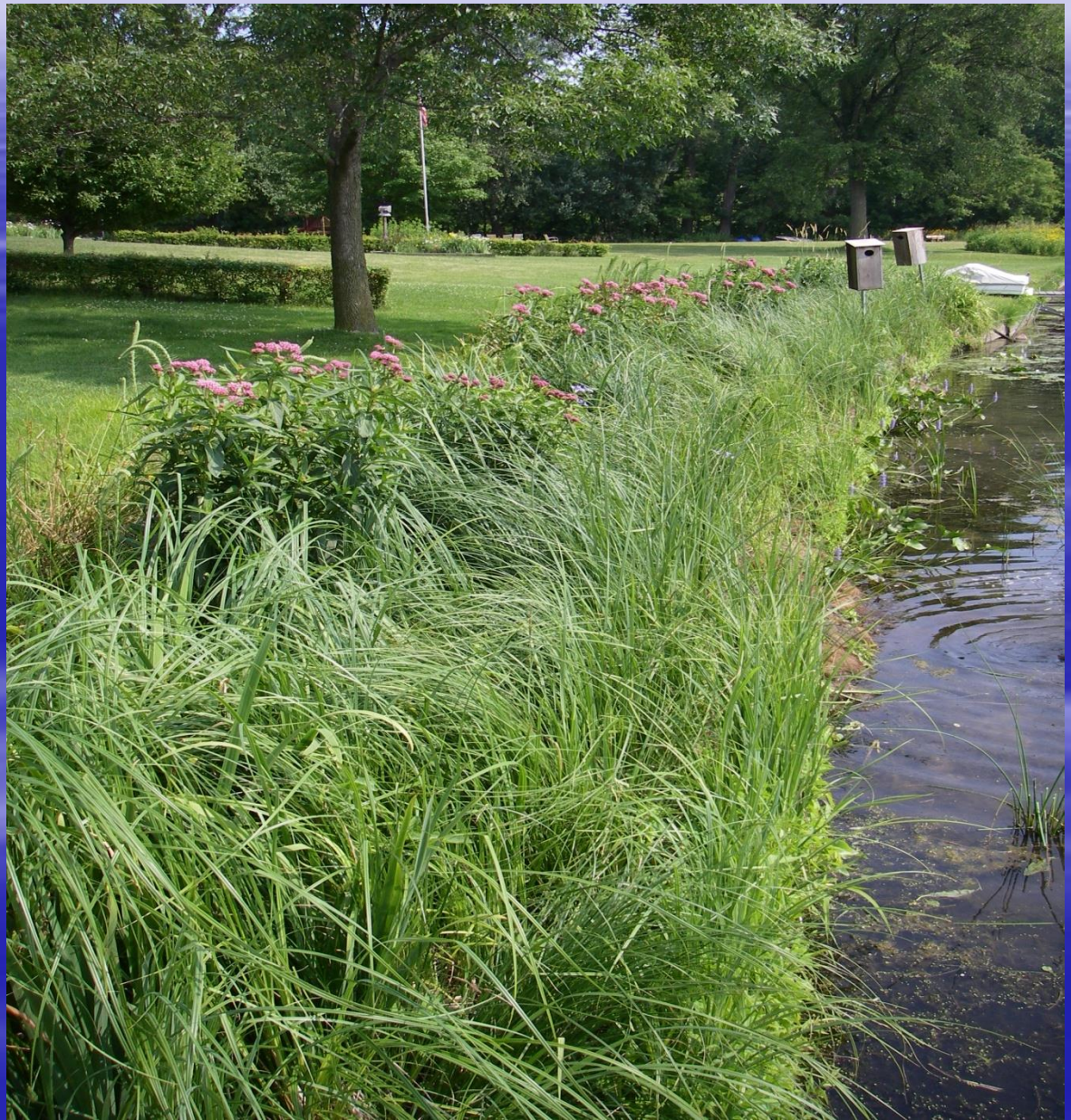
Emergents – mainly bulrush, some arrowhead and pickerel plant – 1 gallon containers @ 3-4 ft centers

September 2004

Summmer 2005

Shoreline becoming well established, emergents set back by muskrats and waves

Summer 2006 – Shore stable - Lake sedge enveloping the coconut logs



Summer 2006

What would we do differently?

- Use wave breaks in front of emergents
- Plant a higher percentange of burreed – more resistant to muskrat feeding
- Probably would not need NAG C-350 at the toe of the slope if emergents became well established

Take-home messages:

- The goal is to recreate a gradually sloping shoreline stabilized with native plants
- It is possible on some sites to “reclaim” lost shoreline
- On extreme sites bioengineering may be very costly and/or ineffective

Take-home (continued)

- Use components of the “system” that are site appropriate
- Inert bio materials have a limited lifespan – make sure you choose plants that will stabilize the site within this time
- Never underestimate the appetite of muskrats, carp, geese, beavers etc.

Resources

- The Practical Streambank Bioengineering Guide

http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17553.wba

- NRCS Engineering Field Handbook, Chapter 16: Streambank and Shoreline Bioengineering

http://plant-materials.nrcs.usda.gov/pubs/idpmcpustguid-appA.pdf

Resources (continued)

- University of MN Extension
  http://www.extension.umn.edu/shoreland/
- The Shoreland Management Resources Guide
  www.shorelandmanagement.org
- Sebastian the Goose encourages natural shorelines
  http://www.youtube.com/watch?v=ZkJF6x48fwU&feature=related