REMR Technical Note GT-SE-1.5

BIOENGINEERING TECHNIQUE OF RESERVOIR SHORELINE EROSION CONTROL IN GERMANY

PURPOSE: To document a low-cost bioengineering technique for reservoir and lake shoreline erosion control in Germany and how to consider its applicability in the United States.

APPLICATION: The bioengineering technique includes a relatively low-cost biodegradable breakwater with wetlands shoreward of it. The technique has been applied only in areas of Germany where water levels do not fluctuate more than 1 m, but may be acceptable in situations where greater fluctuations exist. It has application for shoreline erosion control on many US reservoirs with dense thickets of young, woody trees (e.g. willow, cottonwood, and alder) near them, since these materials are used in the breakwater.

ADVANTAGES: This technique permits effective, low-cost erosion control without destroying shoreline habitat; in fact, wetlands are created that enhance the reservoir's shoreline habitat. Additionally, the wetlands also provide sediment entrapment, water quality improvement, aesthetic quality improvement, and protection of cultural and archeological resources, and other beneficial functions.

AVAILABILITY: Various modifications of the technique have been used on reservoirs and lakes near Berlin, Pritzwalk, and many other locations throughout Germany. The technique was developed, tested, and used by the following:

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Information is also available on this technique from the following:

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Note: Use of vendors' names and affiliations does not constitute an endorsement by the US Army Corps of Engineers.

BACKGROUND: The technique described in the following section was adapted from a method used to regain land lost to the North Sea throughout the North German coastline. The technique was adapted for use in a demonstration study on the Havel Lake in Berlin 8 years ago. On most of its perimeter, the lake originally had a wetland fringe that reduced wave energies and protected the shoreline from erosion. In recent times, the lake began to lose shoreline as a result of the impacts of urbanization on the wetlands. The wetlands were being gradually destroyed by a combination of one or more of the following (list is not exhaustive):

- Waves from motorboats (work and sport)
- Choking out by drifting garbage
- Trampling from people and boats, which kinks stems
- Depredation by waterfowl (overpopulated due to feeding by people)
- Discharge of toxins and contamination of water by oil, heavy metals, etc.
- Shading by woods close to the shore

Through the use of this technique or a modification of it, several kilometres of wetlands have been and continue to be restored along the shore, and the shore has been protected from further erosion.

The lake is a part of the Havel River, and its water level is controlled within 0.8 to 1.0 m in the vicinity of Berlin. The wind fetches vary from 2 to 5 km.

BIOENGINEERING TECHNIQUE USED: The technique used on the Havel Lake consists of a combination breakwater with planted wetlands shoreward of the breakwater (Figure 1). Wetland plants are often pregrown in a coconut fiber substrate in one of the following forms: fiber pallets (80 by 125 cm); coconut fiber vegetation carpets that are rolled out onsite (0.5 to 2.0 m wide by 5 m long); and 20- by 20- by 20-cm bulbs. All of these lend themselves to immediate transfer to the site and short-term shore stabilization until the vegetation becomes established. Wetlands are not usually planted until the breakwater is in place.

The breakwater has several options for its construction and can be made from various materials, i.e., stone or rocks, branches and poles, or fiberschines (large coconut fiber rolls (Figure 2)). This note focuses on one of the more commonly used breakwaters. It is called the branchbox breakwater and consists of biodegradable materials composed of long poles and faschines, which are bundles of small dead branches, such as willow and poplar, collected from woodlands (Figure 3). The breakwater is usually constructed in about 1-m-deep water in the following sequence:

- Poles that are 2- to 3-m-long are placed vertically in the lake substrate in two rows about 1 m apart. This is accomplished initially by a hydraulic jet pump; at this point, the poles are not inserted all the way into the substrate, but deep enough to be secure (Figure 4).

- A 25-cm-thick layer of dead branches is positioned perpendicular to the rows of poles. The branches should be about 1.5 m long. These branches serve **as** filter material and retard scour at the bottom of the breakwater.

Figure 1. Combination low-cost breakwater with planted wetlands for shoreline erosion control and habitat development

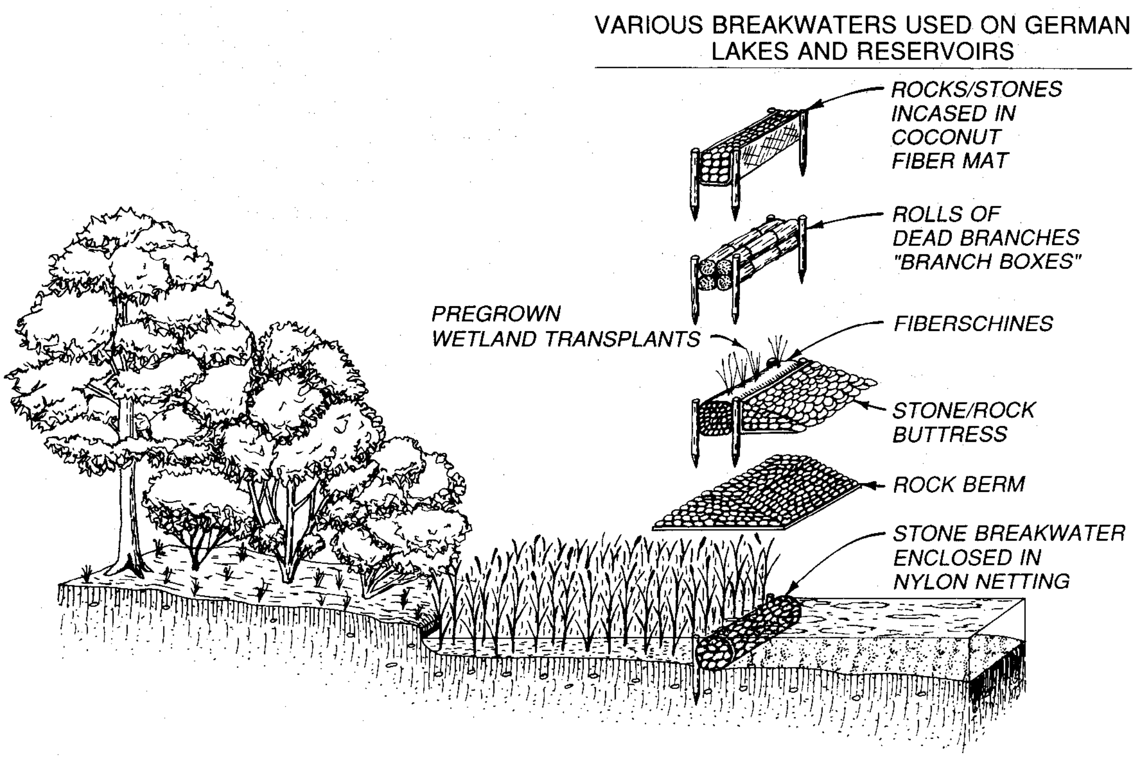

Figure 2. Various combinations of breakwaters and wetlands used on German reservoir and lake shorelines

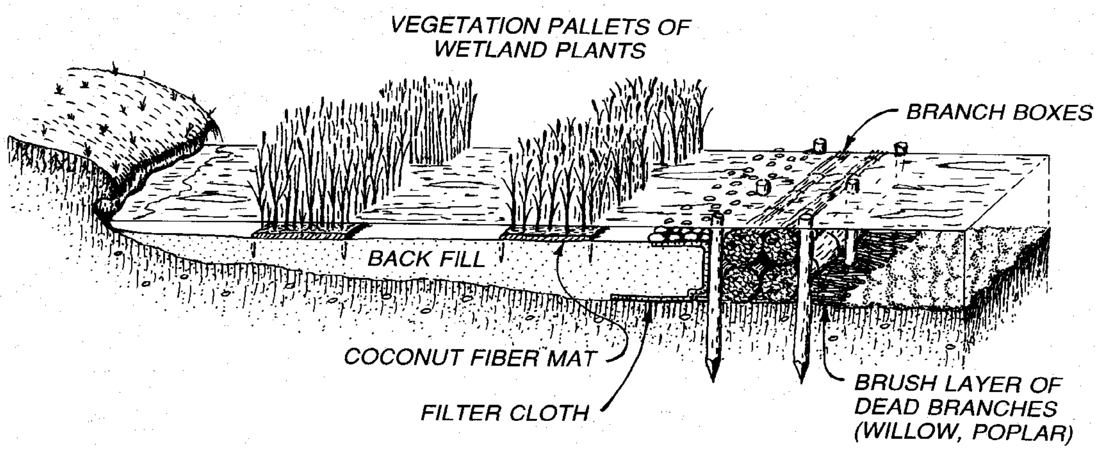

Figure 3. Branchbox breakwater with wetlands shoreward

Figure 4. Poles that are initially placed with a jetpump

- Faschines are wedged between the rows of poles, and the bundles are secured to the poles by weaving wire rope through screw eyes on each pole like a shoelace; each faschine is about 0.5 m in diameter and varies from 2 to 4 m in length; the screw eyes are placed on the poles a few centimetres above the faschines.

- Then the poles are driven down firmly with a pneumatic hammpr mounted on a barge or some other mechanical device that serves the same purpose. This process tightens the whole breakwater system.

- The tops of the poles are fastened to about 30 to 60 cm above the tops of the faschines, and the breakwater is completed (Figure 5).

Figure 5. Completed branchbox breakwater

After breakwater construction, wetland plants pregrown in fiberschines, pallets, and bulbs are transferred intact to the site and installed. The fiberschines and pallets are secured to the substrate by driving long stakes into them and tying rope between the stakes. Then everything is tightened by further driving the stakes into the substrate so that all is secure.

Wetland plants most often used in the lake around Berlin include the following:

Acorus calamus	Sweetflag
Carex gracilis	Sedge
Iris pseudacorus	Yellow flag
Phragmites australls	Common reed
Schoenoplectus lacustris	Bulrush
Typha angustifolia	Narrowleaved cattail
Typha latifolia	Broadleaved cattail

These wetland plants and others are usually placed in zones of varying water levels ranging from approximately 0.5 m below to about 0.3 m above the average water level.

COSTS: Costs for these wetland systems (1991 prices) including the branchbox breakwater,,wetland plants installed as pallets and bulbs, and coconut-fiber filter fabric are between $400 and $460 per linear metre. These costs are for about a 10- to 20-m swath from the breakwater landward. Generally, costs for bioengineering alternatives are a fraction the costs of traditional alternatives such as riprap armorment. It should be noted that construction costs could be less in Germany because of the equipment made for this purpose, such as barge-mounted pneumatic hammers and shallow-draft barges and boats. However, similar equipment could be made in the United States.

CONCLUSION: The branchbox breakwater with associated wetlands is a feasible technique for cost effectively controlling shoreline erosion in reservoirs with little water-level fluctuation. It has the added benefit of providing wetland habitat in harmony with nature. The breakwater is also biodegradable, which improves its acceptability to environmental agencies and groups. This system is plausible on reservoir shorelines receiving fluctuation more than 1 m, but caution should be exercised and a low-cost demonstration is advised before pursuing large-scale shoreline erosion control efforts on reservoirs of this type.