Native Material Revetment

Description

A native material revetment is an interlocking matrix of woody material and stone that is anchored into the eroding bank of stream or river. It is also known as a tree revetment or root wad revetment because it uses uprooted live or dead trees and their root wads as a natural means of reducing bank erosion. It can become a *living wall* of woody vegetation over time if designed properly.

Purpose

The purpose of the native material revetment is to provide a permanent structure built with natural materials to protect eroding banks from the scour action of fast moving water. This type of structure will divert high-energy flows of bankfull stage away from the bank. This technique is a good alternative to the traditional hard approaches of gabion baskets or armour stone walls.

The combination of root wads, large logs and field stone provides good quality instream habitat along a run or outside bend of a pool. Micro-habitats for fish and other aquatic creatures are created as a result of all of the edges, gaps and voids in the root tangles.

In addition, the structure can minimize sediment loading on the stream by acting as a buffer between the erosive action of moving water and the fragile soils of the exposed bank. As the fast moving water approaches the root wad revetment, the roughness of the structure causes turbulence near the bank and this disrupts the force of the incoming flow. The velocity of the moving water is reduced and this encourages sediment deposition and plant growth behind the structure.

Application

Native material revetments are generally used in streams and rivers less than twenty metres wide and with a channel slope less than two percent. Aggravated erosion caused by unrestricted livestock access, pipeline installation or watercourse relocation is usually the justification for this bioengineering technique. Eroding bank height can range from a half to four metres. High banks are usually graded back to a stable slope following construction of the revetment. The size of the wood and rock materials are selected based on the size of the stream or river and its bankfull velocity.

A good physical understanding of the stream within the selected reach is needed for selecting this technique. You will need to know what type of watercourse you are working in, its channel characteristics and the dynamic nature of seasonal flow, ice formation, debris movement and sediment transport prior to completing the detailed designs. Sketches of the channel in plan view and cross section, indicating bankfull, low flow and thalweg will be essential for determining suitability and positioning. The outside bends of pools and eroding banks of runs are typically well-suited sites for this type of bioengineering structure. Native material revetments will work very well in a variety of channel types including A, B, C, E, F and G type channels where there is a

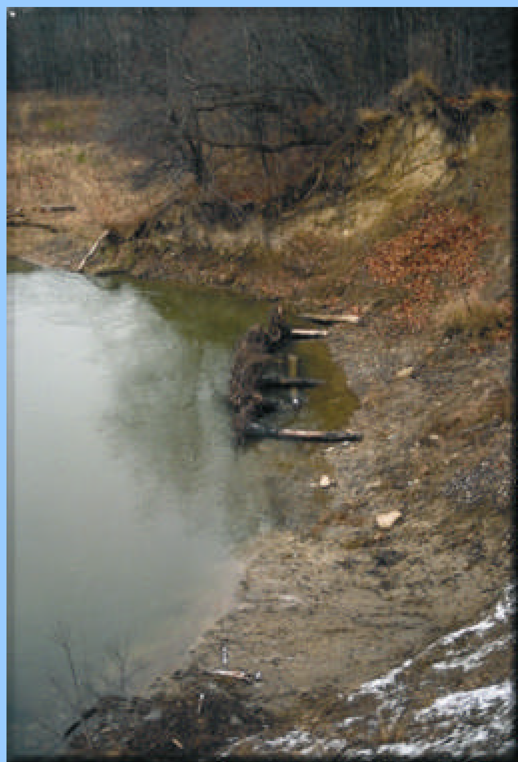

Figure 5.x: Root wads in position

Figure 5.x: Back-filling with Christmas trees and brushlayers

predominant cobble, gravel or smaller substrate. They work well in all C channels.

Native material revetments should be designed to the bankfull stage of the stream. It is highly recommended that you consult with your local MNR and/or Conservation Authority for advice on suitability. This technique is not suited for rivers where the bankfull stage is greater than thirty metres wide.

Construction Guidelines

Constructing native material revetments on small streams less than two metres wide will require only hand tools and possibly a chain saw. On larger streams and rivers, you will need heavy equipment to dig out the trenches for the footer logs, place the root wads in position and backfill with rock.

Follow these steps to construct a native material revetment:

- Remove all existing woody debris and shrubs from the bank where you will be building the revetment. The revetment will be dug into the ground to about the same elevation as the thalweg of the stream.

- Start construction at the downstream limit and work upstream. The ends of the shoreline treatment should be tied bank into the banks with large fieldstone in order to prevent erosion from occurring behind the structure.

- If the low flow water depth is one metre or less, no further toe protection is needed. If the water depth is greater than one metre, an underwater field stone revetment will be needed to reduce toe erosion.

Figure 5.x: Native material revetment eventually fills in with sediment (top photo) and rapidly stabilizes with plant growth.

- Excavate the footer log trenches parallel to the alignment of the flow of the stream to a point slightly below the streambed. Footer logs should be spaced 1.5 to 2 metres apart. The logs should also be placed such that there is a 1.5 metre overlapping of the adjacent the log at each end. Footer logs should be returned into the streambank at both the up and downstream ends to avoid future undermining.

- Excavate the root wad trunk trenches perpendicular to the alignment of the footer logs such that the root fan is perpendicular to the direction of the water current at bankfull stage (Figure 5.x). Root wads should not project into the channel any more than 10% of the length of the trunk. The centre of the root wad should be above the elevation of low flow and the root fan should extend up to the predicted bankfull stage water elevation.

- Secure the root wad trunk to the footer logs with the reinforcing steel bar in the two locations indicated in the drawing.

- Backfill the trenches with the native bank material and pack tightly.

- Fix the high stage deflector logs in tight behind the root wads in parallel with the footer logs below. Secure with the reinforcing steel bar in the locations indicated in the drawing.

- Backfill the structure with large field stones to the same elevation as the top of the high stage deflector logs.

- A combination of brushlayering and densely packed layers of Christmas trees can be used instead of rock backfill. This creates a sediment trap in behind the revetment that is eventually stabilized by vigorous plant growth (see Figures 5.x and 5.x)

- Brushlayering over the stone backfill will eventually fill in with dense roots.

- The remaining bank can then be re-graded to a stable slope and stabilized with a mulch blanket.

- Live stakes, willow posts or transplanted shrubs will rapidly grow to create a dense root zone over the native material revetment. The revetment should have live cuttings placed throughout.

Insert diagram

Materials Needed

For best results, use decay resistant species of trees for root wads and logs. Cedar, juniper, hemlock and hardwoods will work well and last a long time. If recently cut live willow or cottonwood logs are available, use them instead because they will sprout new growth in a matter of weeks and help build a living wall of roots and wood.

For small streams less than two metres wide, native material revetments are constructed with the following materials:

- 15 to 25 cm diameter cedar, hemlock or willow tree trunks with root wads, long enough to imbed 1.2 to 2.5 m in to the bank and a maximum of fifteen percent of the length into the channel
- root wad trunks are at least 1.5 metres long
- 15 to 35 cm cedar or hemlock logs about 2.5 metres long
- 0.8 m long reinforcing steel bar with a diameter of 2 cm
- 15 to 20 cm diameter field stone for backfill
- large bow saw, axe, shovels, rakes and sledge hammer

In larger streams and rivers, native material revetments should be constructed with:

- 40 to 75 cm diameter cedar, hemlock, willow or hardwood tree trunks with root wads, long enough to imbed 4 to 5 m in to the bank and a maximum of fifteen percent of the length into the channel
- root wad trunks are 6 metres long or more
- 25 to 60 cm cedar, hemlock or hardwood logs about 5 metres long
- 1.2 m long reinforcing steel bar with a diameter of 2 cm
- 40 to 60 cm diameter field stone for backfill
- back hoe or excavator, chainsaw, axe, shovels, rakes and sledge hammer

In both cases, the final grading of the bank can include brushlayering, fascines, livestakes or willow posts to encourage the growth of a dense root zone and added stability.

Cost and Maintenance Needs

Native material revetments can be a low cost technique depending on the availability of materials, site access, channel size and need for heavy equipment. Root wads with adequate length of tree trunk are typically difficult to acquire. A crew of three experienced people can construct a revetment in a small stream in two to three days. As channel size increases, so does the amount of materials and labour required to construct.

These structures typically last seven to ten years. Longevity can be extended when wood materials are constantly submerged. Life expectancy can also be extended where live willow or cottonwood trunks and logs are used since these will readily sprout growth and become part of a living wall. Frequent monitoring and maintenance is recommended during the first year to ensure proper function and correct erosion problems on re-graded slopes. Continue with annual monitoring after the first year to ensure revetments work properly.

Integration

Several bioengineering and habitat enhancement projects can be used in conjunction with native material revetments such as:

- brush layering
- willow posts
- fascines
- live staking
- sweepers
- large woody debris placement

Demonstrations

This type of habitat structure has been applied in the following demonstration projects:

- Project #66, Purpleville Creek Rehabilitation Project
- Project #67, East Humber River Rehabilitation Project
- Project #102, Petticoat Creek Rehabilitation
- Project #104, Collingwood Shipyards - CSL Property
- Project #135, Halls Creek Project

For More Information

Please refer to the following authors and their respective publications located in the bibliography:

M.T.O. 1997
Osmond, D. L. et al 1995
Rosgen, D. 1996
Slaney, P. A. and D. Zaldokas 1997