MODULE 9 – EROSION AND BANK PROTECTION APPLICABILITY SNAP-SHOT

Biotechnical/Vegetation

- If combined with rip-rap or armor stone and greater than 30 metres (100 ft) in length, the project must be designed (signed and stamped) by a professional engineer licensed to practice in the province of New Brunswick
- The bank must be uniformly graded to a slope no steeper than 2 horizontal to 1 vertical
- The height of the erosion protection material must not be any greater than the existing grade of the top of the bank
- Only non-invasive plant species native to New Brunswick are to be used for stabilization purposes

Rip-rap

- If greater than 30 metres (100 ft) in length and/or the proposed slope is steeper than 2:1, the project must be designed (signed and stamped) by a professional engineer licensed to practice in the province of New Brunswick
- The height of the rip-rap must not be any greater than the existing grade of the top of the bank as it exists immediately upstream and downstream of the project area

Timing of Project

- All erosion and bank protection projects must be carried out between June 1st and September 30th of the same year
- Works should be planned during low-flow conditions

Wetlands

- New erosion protection products may be installed within 30 metres (100 ft) of a wetland (non-provincially significant wetland only), but not within the wetland
- The maintenance/extension of existing erosion protection works may take place in or within 30 metres (100 ft) a wetland (non-provincially significant wetland only) provided the alteration results in a maximum of 100 m^2 (1076 ft^2) of permanent wetland impact

Species at Risk

- Bank protection projects where there is an aquatic species at risk under the ***Species at Risk Act*** that is subject to the DFO Critical Habitat Order require a standard WAWA permit. These areas include the habitat for the Inner Bay of Fundy Salmon and Lake Utopia Rainbow Smelt

9.0 EROSION AND BANK PROTECTION

9.1 DEFINITION

Erosion protection products (*i.e.* structures or vegetation) are used to stabilize and protect the banks of a watercourse from the scouring and erosive action of water, ice, or floating debris within the stream flow or surface runoff from the land bordering the watercourse.

9.2 OBJECTIVES

- To prevent loss of material from the banks of the watercourse and property adjacent to the banks of the watercourse
- To control channel meander and prevent the undermining of structures
- To prevent sedimentation of the watercourse

Note: The installation and placement of erosion protection products on the bank of a watercourse will only be permitted if there is erosion present on the bank that could compromise existing infrastructure or the loss of land. If there is no erosion, the application will be refused.

9.3 PLANNING CONSIDERATIONS

Natural flowing watercourses meander (*i.e.* have bends – they are not straight). The process of erosion and deposits of materials, such as gravel/sand bars and islands, is a natural process in the evolution of a watercourse. It is natural for bends, riffles, pools, and other features of a watercourse to change in size and location.

The rate and extent of erosion is influenced by the magnitude of the erosive forces from within the watercourse, soil characteristics, topography, and ground cover. The erosion protection products must be designed to modify at least one of these variables.

Taking this information into consideration, it is important to only apply erosion protection products at the appropriate location and to the appropriate degree. Otherwise, the effects can have a significant impact on the system. They may create/accelerate erosion issues to neighboring properties by distributing the energy of the water to a new location.

The inside of a bend is where the channel is shallower, and the flow is slower. This is where deposits (*i.e.* gravel/sand bars) are more likely to form. Unless the watercourse has been artificially disturbed, there is no erosion at this location. Applying erosion protection products at the inside of a bend can significantly disturb the natural flow of the watercourse and could cause additional problems downstream, creating a domino effect.

Erosion naturally occurs on the outside bend of a flowing watercourse. This is also where the flow is fastest, and the channel is deepest, creating pools for fish to rest and cool down.

Note: Bank protection projects where there is an aquatic species at risk under the ***Species at Risk Act*** that is subject to the DFO Critical Habitat Order require a standard WAWA permit. These areas include the habitat for the Inner Bay of Fundy Salmon and Lake Utopia Rainbow Smelt

9.4 COMMON PRODUCTS FOR EROSION PROTECTION

9.4.1 Vegetation

Can be in the form of grasses, shrubs, trees, vines, and live cuttings. It can also include live fascine (wattles), live stakes, and brush mattresses. A combination of a rock toe with vegetation above this layer is also an option.

9.4.2 Structural Products

Rip-rap/armor stone

The placement of a layer of boulders, cobbles, or rock fragments placed over an exposed slope.

Retaining walls

They are constructed out of wire baskets or cages filled with rock or timber crib, steel, or concrete. **Note**: Although mentioned here as a structural product, the construction of retaining walls is not permitted under the permitting system within the Watercourse Alteration Certification Program. A standard watercourse and wetland alteration permit is required for all retaining walls.

9.4.3 Choosing an Erosion Protection Product

The method used depends on the magnitude of the erosive forces and economic feasibility. Vegetation and rip-rap are the least expensive alternatives. However, they may not be applicable if the banks are excessively steep or the wave/ice action is excessive or if the soils, such as sand or heavy clay, do not allow vegetation to become established.

Other types of erosion protection products should be avoided if vegetation can be used, or they should be used in combination with vegetation wherever possible. The shade provided by the vegetation helps prevent rip-rap, and the stones used in the rock-filled wire baskets from heating up, which in turn helps reduce thermal pollution of the water.

Vegetation also provides food and cover for aquatic animals and wildlife. Mulch,

consisting of plant residue or synthetic materials, is often used to temporarily protect the work site from erosive forces of rainfall and to aid in the germination and growth of vegetation until the vegetation becomes well established or the site is permanently stabilized by another means. It can be used in combination with vegetation providing temporary protection to denuded slopes during the early phases of plant growth or can be used alone during the non-growing season where plant growth is impossible. Mulch improves water infiltration, reduces rainfall impact, and reduces surface runoff. Materials commonly used as mulch include straw, hay, corn stalks, wood or bark chips, soil binders, nets, and mats. Chemical mulches, consisting of emulsions of vinyl compounds, rubber or other substances, are mixed with water and then sprayed on the exposed soil.

All techniques require that the upstream and downstream limits of the erosion protection product be keyed unto the bank to prevent scouring around either end.

9.5 BIOTECHNICAL/VEGETATION

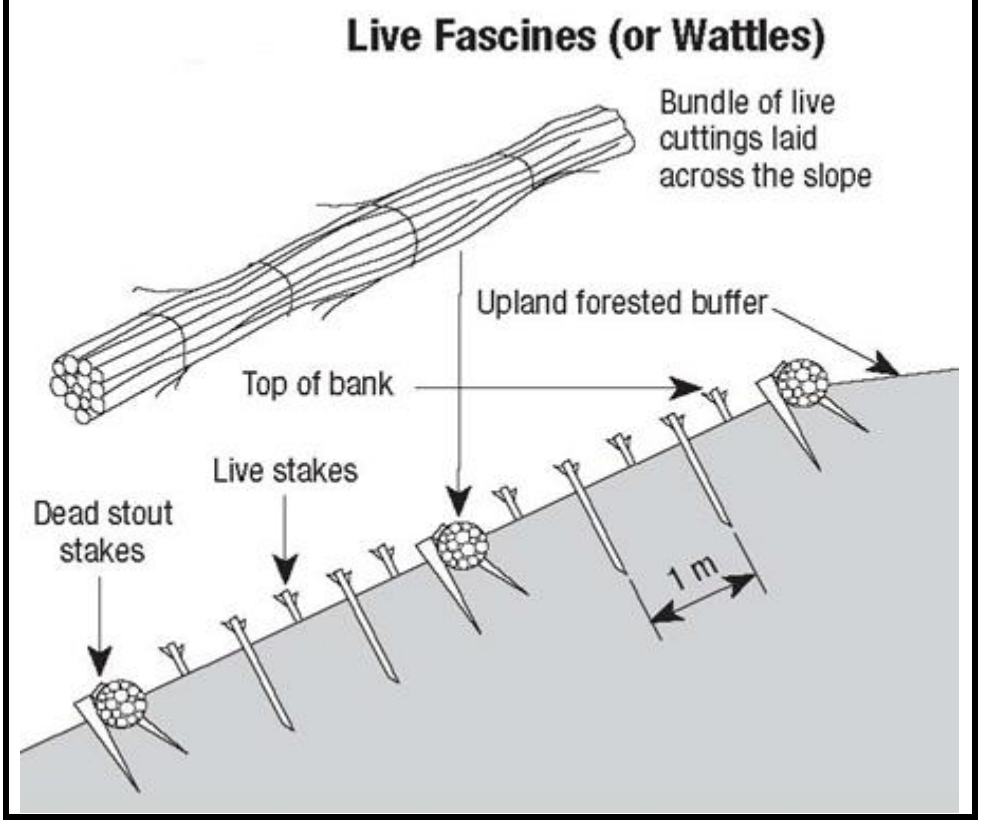
9.5.1 Definition

The placement of biotechnical products, along with trees, shrubs, vines, grasses, cuttings, or other plants used to stabilize and protect the banks of a watercourse from the erosive action of the stream flow, waves, ice, and debris within the watercourse.

It also includes live fascine (wattles), live stakes, and brush mattresses. A combination of a rock toe with vegetation above this layer is also an option. See *Figure 9.1.*

When erosion is occurring, vegetation should be the first option to consider while easing the steepness of the bank and creating a vegetated floodplain to disseminate the water flow and its energy. Instead of trying to stop the water from entering the land, the focus should be shifted to allowing the water to flow to its natural path while protecting existing infrastructure.

Figure 9-1 Live fascine (wattles), live stakes, and brush mattresses



9.5.2 Objectives

To protect the banks of a watercourse while providing and promoting habitat for fish and wildlife.

To minimize the thermal pollution of the water.

9.5.3 Planning Considerations

If the banks are made up of soil which can sustain plant growth and have slopes of 2:1 or flatter, vegetation provides excellent protection against soil erosion. It also promotes animal habitat along the banks of the watercourse and in the water by providing shade and by depositing leaf litter and insects into the water, which act as food sources for fish and aquatic insects.

If the proposed project includes rip-rap/armor stone in the design and is greater than 30 metres (100 ft) in length, the project must be designed (signed and stamped) by a professional engineer licensed to practice in the province of New Brunswick.

The degree of erosion protection offered by vegetation and vegetative products increases as the plants and root systems grow and spread. Advantages of using vegetation as an erosion protection product include the following:

- Vegetation shields the soil from raindrop impact and slows the velocity of runoff, thereby protecting the watercourse from sedimentation
- The root systems hold soil particles in place and maintain the soil's capacity to absorb water
- It is less costly than other product and requires little or no maintenance
- Vegetation is more compatible with the natural watercourse characteristics
- It helps maintain a lower water temperature and provides cover for the fish in the water and wildlife on the shoreline

9.5.4 Guidelines

Plants chosen for erosion protection should require little maintenance and be suited for the climate and soils at the site. Conditions throughout the province vary greatly and plans for vegetative stabilization must be adapted on a site-specific basis. In general, the plants should have fibrous roots and be capable of attaining dense growth, thereby providing a complete soil cover. The selected species should be easy to plant, fast-growing, requiring little or no irrigation, fertilizer, or mowing. Examples of plants used for vegetative stabilization include alders, willows, poplars, shrub willow, shrub dogwood, lupine, clover, timothy, and trefoil. A local nursery can be consulted for species of plants that are adapted to specific conditions.

Many types of plants are used for vegetative stabilization in New Brunswick. Species of grasses, legumes, vines, shrubs, or trees are used depending on slope stability, soil type, and moisture conditions. Only non-invasive plant species native to New Brunswick are to be used for stabilization purposes.

A variety of species should be planted rather than a single species of plant. The vegetation should be checked and maintained on a regular basis until growth is established. The plants may have to be watered and fertilized to promote growth initially.

The portion of the bank of the watercourse where biotechnical products are to be placed shall be uniformly graded to a slope no steeper than 2 horizontal to 1 vertical. Clean, well-graded borrow may be added if required to obtain a uniform slope. The reshaping of the eroding bank to a stable slope and any placement of material to create a uniform slope must be carried out in isolation from the remainder of the watercourse.

The height of the erosion protection material must not be any greater than the existing grade of the top of the bank as it exists immediately upstream and downstream of the project area. In other words, the grade of the property cannot be raised as a result of

the project, and the addition of the material must not create a berm.

The placement of the biotechnical products shall start at the upstream end of the eroding section of the bank and progress in the downstream direction. The upstream and downstream limits of the products shall be keyed into the bank to prevent scouring around either end.

Biotechnical products placed for the protection of agricultural land shall include establishing and maintaining a buffer of undisturbed vegetation at least five (5) metres (16.4 ft) wide along the upland edge of the stabilized bank

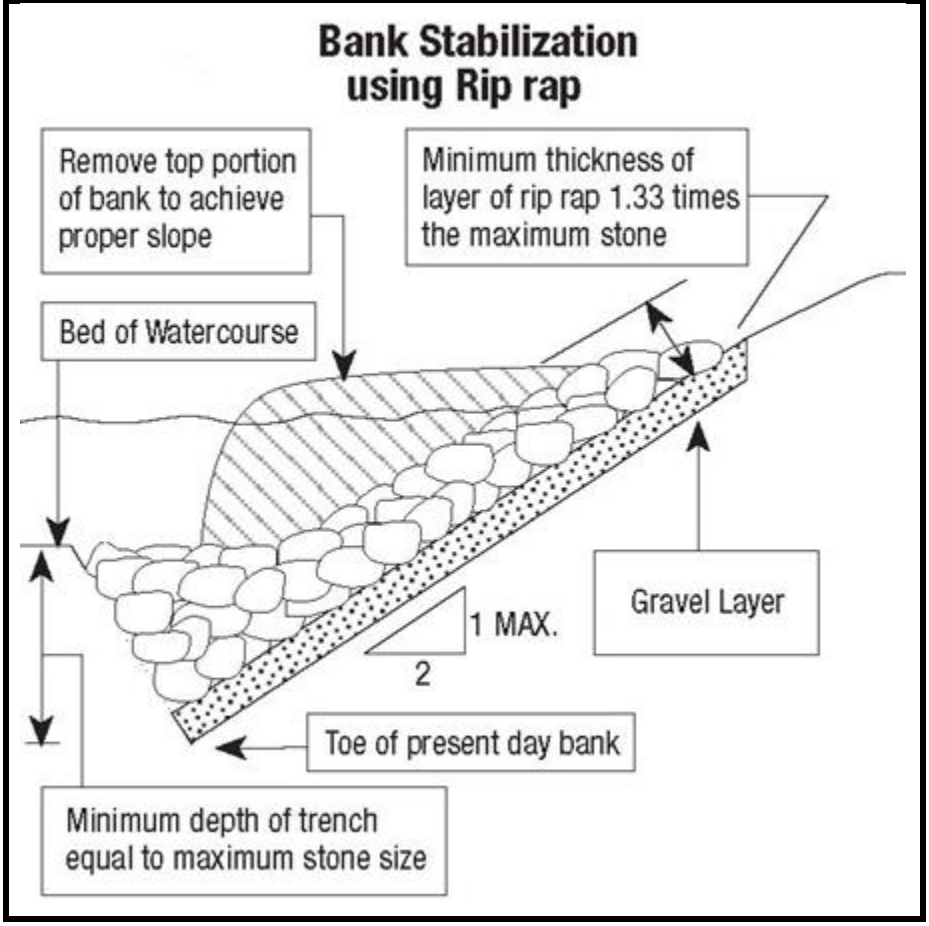
9.6 RIP-RAP

9.6.1 Definition

Rip-rap is heavy broken rock, cobbles, or boulders placed over a denuded or exposed soil, providing a permanent, erosion-resistant cover. See *Figure 9-2*. Rip-rap is used to armor the banks of watercourses for the following reasons:

- To protect the banks and adjacent upland areas from the erosive action of the stream flow, waves, ice, or floating debris
- To control channel meander thereby protecting downstream or adjacent facilities or resources
- To protect the banks near a bridge or culvert where erosion could undermine the structure
- Existing infrastructure may be too close to the bank of the watercourse, therefore creating a vegetated floodplain may not be a suitable option

Figure 9-2 Bank stabilization using rip-rap



9.6.2 Planning Considerations

Rip-rap can be used to prevent erosion on the bank of a watercourse if it is no steeper than 2:1 and if the velocity of the flowing water prevents the use of vegetation. Rip-rap depends on the soil beneath it for support; therefore, it must be founded on solid ground. If the banks are unstable, crumbling, excessively steep or vertical, rock-filled wire baskets or retaining walls may need to be used to maintain the property bordering the shoulder of the watercourse. Otherwise, the top of the bank may be cut-back/contoured to achieve the slope prescribed above.

If the proposed project is greater than 30 metres (100 ft) in length and/or the proposed slope is steeper than 2:1, the project must be designed (signed and stamped) by a professional engineer licensed to practice in the province of New Brunswick.

Rip-rap is often placed as a rock apron on the bed/bank of the watercourse at the discharge of an outfall pipe, around bridge abutments and piers to prevent scour, and around the ends of a culvert to help prevent erosion of the foreslopes.

9.6.3 Environmental Considerations

Rocks used as rip-rap can heat up from the sun, which may result in an increase in water temperature, and consequently, a decrease in dissolved oxygen required for fish.

9.6.4 Construction

The sequence for construction includes uniformly grading the surface of the banks, followed by placement of the rip-rap. In standing water environments, placement of a filter layer, such as geotechnical fabric and/or a layer of clean gravel, may be used.

9.6.5 Guidelines

Rip-rap/armor stone must be clean, durable, non-ore bearing, and non-toxic rock, and must not be obtained from a watercourse nor from within 30 metres (100 ft) of a watercourse/wetland.

Rocks used to stabilize the bank of the watercourse must be irregular in shape, with at least 70% of the material having a smallest dimension of not less than 15 centimetres (6 in).

The minimum thickness of the layer of rip-rap/armor stone must be 1.33 times the maximum rock size used.

The full thickness of the rip-rap/armor stone must be deposited as a dense mass of various sized rock with minimal voids. It shall not be placed in layers.

The rip-rap/armor stone must not be dumped or pushed over the shoulder of the bank but either lowered in place with machinery capable of controlling the dropping of the rock or placed into position using machinery stationed on a barge.

Trees and other woody vegetation removed must be limited to the minimum required to facilitate the stabilization of the bank of the watercourse. Any vegetation destroyed, including trees removed, to fulfill the project must be replaced with non-invasive perennial vegetation native to the area. The species and density of woody vegetation planted shall be similar to that which existed in the area before the project took place.

The height of the erosion protection material must not be any greater than the existing grade of the top of the bank as it exists immediately upstream and downstream of the project area. In other words, the grade of the property cannot be raised as a result of the project, and the addition of the rip-rap/armor stone must not create a berm.

The base of the rip-rap/armor stone must follow the alignment and be entrenched at the toe of the present-day bank* of the watercourse created by the effects of the erosion.

While carrying out maintenance work to the existing rip-rap/armor stone, the existing

base of the rock wall must be entrenched at the toe of the present-day bank***** of the watercourse created by the effects of the erosion if it is not currently entrenched. Furthermore, additional rip-rap/armor stone must not be placed any closer to the watercourse than the present-day bank.

***Note**: If materials are to be placed beyond toe of the present-day bank, the project does not qualify under the Watercourse Alteration Certification Program and a standard WAWA permit but be applied for using the online system.

The portion of the bank where rip-rap/armor stone is to be placed must be uniformly graded to a slope no steeper than 2 horizontal to 1 vertical. Clean, well-graded borrow may be added where needed and compacted to prepare a uniform base for the rip-rap/armor stone. The reshaping of the eroding bank to a stable slope and any placement of material to create a uniform slope must be carried out in isolation from the remainder of the watercourse.

A layer of clean, coarse gravel must be placed under the rip-rap/armor stone. If geotextile fabric is used, it must be pulled flat to eliminate wrinkles and folds which create voids.

The placement of the rip-rap/armor stone must start at the upstream end of the eroding section of the bank and progress in a downstream direction. The upstream and downstream limits of the products must be keyed into the bank to prevent scouring around either end.

Once the rip-rap/armor stone is installed, it requires minimal maintenance. Still, it should be checked periodically to ensure that any movement of the stones does not result in exposing the slope, increasing the risk of failure.

Rip-rap/armor stone placed for the protection of agricultural land must include establishing and maintaining a buffer of undisturbed vegetation at least five (5) metres (16.4 ft) wide along the upland edge of the stabilized bank.

9.7 TIMING OF PROJECT

All erosion and bank protection projects must be carried out between June 1st and September 30th of the same year, preferably during low water conditions. Construction should proceed diligently to help minimize any unnecessary environmental problems and minimize impacts to fish.

Work and project extensions outside of this window will not be approved through the Watercourse Alteration Certification Program. If there are unforeseen issues that prevent the project from being completed prior to the September 30th deadline, DELG should be contacted as soon as possible to discuss next steps.