Streambank and Shoreline Protection (Feet) 580

DEFINITION

Treatment(s) used to stabilize and protect banks of streams or constructed channels, and shorelines of lakes, reservoirs, or estuaries.

PURPOSES

- To prevent the loss of land or damage to land uses, or facilities adjacent to the banks of streams or constructed channels, shorelines of lakes, reservoirs, or estuaries including the protection of known historical, archeological, and traditional cultural properties.
- To maintain the flow capacity of streams or channels.
- Reduce the offsite or downstream effects of sediment resulting from bank erosion.
- To improve or enhance the stream corridor for fish and wildlife habitat, aesthetics, and recreation.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to streambanks of natural or constructed channels and shorelines of lakes, reservoirs, or estuaries where they are susceptible to erosion. It applies to controlling erosion where the problem can be solved with relatively simple structural measures (such as those described in the USDA-NRCS National Engineering Handbook, Part 650, Engineering Field Handbook, Chapter 16 - Streambank and Shoreline Protection); vegetation (herbaceous or woody); or upland erosion control practices where revetments, bulkheads, or groins are no higher than 3 feet (1 m) above mean high water. It does not apply to erosion problems created by wave action on the open and unprotected shores of the Great Lakes and similar areas of complexity not normally within the scope of NRCS authority or expertise.

CRITERIA

General Criteria Applicable To All Purposes

Streambank and shoreline protection shall be planned, designed, and installed in accordance with all federal, state, local, and tribal laws and regulations.

Treatments applied shall seek to avoid adverse effects to endangered, threatened, and candidate species and their habitats, whenever possible.

An assessment of unstable streambank or shoreline sites shall be conducted in sufficient detail to identify the causes contributing to the instability (e.g., major development in contributing watershed causing more frequent occurrence of bank-full discharge and increased sediment delivery to the stream, livestock access, watershed alterations resulting in significant modifications of discharge or sediment production, in channel modifications such as gravel mining, head cutting, water level fluctuations, boat-generated waves, etc.). Due to the complexity of such an assessment, an interdisciplinary team should be utilized.

Proposed protective treatments to be applied shall be compatible with improvements being planned or installed by others.

Protective treatments shall be compatible with the bank or shoreline materials, water chemistry, channel or lake hydraulics, and slope characteristics both above and below the water line.

End sections of treatment areas shall be adequately anchored to existing treatments, terminate in stable areas, or be otherwise stabilized to prevent flanking of the treatment.

Protective treatments shall be installed that result in stable slopes. Design limitations of the bank or shoreline materials and type of measure installed shall determine steepest permissible slopes.

Designs will provide for protection of installed treatments from overbank flows resulting from upslope runoff and flood return flows.

Internal drainage for bank seepage shall be provided when needed. Geotextiles or properly designed filter bedding shall be incorporated with structural measures where there is the potential for migration of material from behind the measure.

Treatments shall be designed to account for any anticipated ice action, wave action, and fluctuating water levels.

All disturbed areas around protective treatments shall be protected from erosion. Disturbed areas that are not to be cultivated shall be protected as soon as practical after construction.

Use vegetation adapted to the site that will accomplish the desired purpose. Preference shall be given to native species in order to reduce the introduction of invasive plant species; provide management of existing invasive species; and minimize the economic, ecological, and human health impacts that invasive species may cause. If native plant materials are not adaptable or proven effective for the planned use, then non-native species may be used. Refer to the Field Office Technical Guide, Section II, Invasive Plant Species for plant materials identified as invasive species.

Livestock, wildlife, vehicle, and/or people traffic shall be excluded, as appropriate.

Side slopes shall be 2H:1V or flatter unless a slope stability analysis is conducted to support using a steeper slope.

Where possible, streambank and shoreline protection measures shall be designed such that construction activities can be performed from the bank.

Where boaters, swimmers, or other people will be using the shoreline or streambank, design measures to minimize safety hazards.

Additional Criteria For Streambanks

Stream segments to be protected shall be assessed using the Stream Classified System (Rosgen, 1996) or a Channel Evolution Model (Simon, 1989 or Schumm, et al., 1984). (See USDA-NRCS, National Engineering Handbook, Part 653, Stream Corridor Restoration: Principles, Processes, and Practices for a description of stream classification systems and channel evolution models.) Segments that are incised or contain the 5-year return period (20 percent probability) or greater flows shall be evaluated for further degradation or aggradation.

The assessment shall determine if the causes of instability are local (e.g., poor soils, high water table in banks, alignment, obstructions deflecting flows into bank, etc.) or systemic in nature (e.g., aggradation due to increased sediment from the watershed, increased runoff due to urban development in the watershed, degradation due to channel modifications, etc.). The assessment need only be of the extent and detail necessary to provide a basis for design of the bank treatments and reasonable confidence that the treatments will perform adequately for the design life of the measure.

Changes in channel alignment shall not be made without an assessment of both upstream and downstream fluvial geomorphology that evaluates the affects of the proposed alignment. The current and future discharge-sediment regime shall be based on an assessment of the watershed above the proposed channel alignment.

Bank protection treatment shall not be installed in channel systems undergoing rapid and extensive changes in bottom grade and/or alignment unless the treatments are designed to control or accommodate the changes. Bank treatment shall be constructed to a depth at or below the anticipated lowest depth of streambed scour.

If the failure mechanism is a result of the degradation or removal of riparian vegetation, stream corridor restoration shall be implemented, where feasible (see Additional Criteria for Stream Corridor Improvement), as well as treating the banks.

Toe erosion shall be stabilized by treatments that redirect the stream flow away from the toe or by structural treatments that armor the toe. Additional design guidance is found in the NRCS National Engineering Handbook, Part 650, Engineering Field Handbook, Chapter 16, Streambank and Shoreline Protection.

Where toe protection alone is inadequate to stabilize the bank, the upper bank shall be shaped to a stable slope and vegetated, or shall be stabilized with structural or soil-bioengineering treatments.

Channel clearing to remove stumps, fallen trees, debris, and sediment bars shall only be performed when they are causing or could cause unacceptable bank erosion, flow restriction, or damage to structures. Habitat forming elements that provide cover, food, pools, and water turbulence shall be retained or replaced to the extent possible.

Treatments shall be functional and stable for the design flow and sustainable for higher flow conditions.

Measures shall be functional for the design flow and sustainable for higher flow conditions based on acceptable risk.

Treatments shall not induce an increase in erosion downstream.

Treatments shall not limit stream flow access to the floodplain.

Treatments shall not create additional hazards to any upstream, downstream, or opposite bank.

Structural treatments shall be designed to extend to the elevation of the 5-year return period (20 percent probability) peak discharge, or bank-full discharge, whichever is lower in elevation. Where structural measures do not extend to the top of the bank, other measures will be implemented to ensure stability at bank-full discharge. Structural measures shall be sized based on flow depth at the top of bank as a minimum.

Where rock riprap is used for bank or toe protection, undercutting by scour shall be prevented by one of the following methods of riprap placement:

- Key riprap into the bottom of the channel to a depth equal to the design riprap thickness or 2 feet (0.6 m), whichever is greater, below the anticipated lowest scour line, or

- Place riprap as an apron with the design riprap thickness extending beyond the toe of the bank for a distance equal to at least five times the D_{50} size.

Riprap bank protection shall be keyed into the bank at both the upstream and downstream ends. The end keyway trenches shall extend from the toe keyway or end of the apron to the top of the protection. The end keyway trenches shall extend below the bottom of the riprap protection to a depth equal to the design riprap thickness or 2 feet (0.6 m), whichever is greater.

When concrete modular blocks are used for bank or toe protection, undercutting by scour shall be prevented by keying the blocks into the bottom of the channel to a depth equal to the design modular block thickness or 2 feet (0.6 m), whichever is greater, below the anticipated lowest scour line. At both upstream and downstream ends of concrete modular block bank protection, the blocks shall be keyed into the bank a depth (measured perpendicular to the bank slope) equal to at least the height of the bank protection.

Ends of revetments, bulkheads, jetties, and groins shall be keyed into the bank a depth (measured perpendicular to the bank slope) equal to at least the vertical height of the bank protection.

Where flooding is a concern, the effects of protective treatments shall not increase flow levels above those that existed prior to installation.

Additional Criteria For Shorelines

All revetments, bulkheads, or groins are to be no higher than 3 feet (1 m) above mean high water.

Structural shoreline protective treatments shall be keyed to a depth to prevent scour during low water.

For the design of structural treatments, the site characteristics below the waterline shall be evaluated for a minimum of 50 feet (15 m) horizontal distance from the shoreline measured at the design water surface.

The height of the protection shall be based on the design water surface plus the computed wave height and freeboard.

When vegetation is selected as the protective treatment, a temporary breakwater shall be used during establishment when wave run-up would damage the vegetation.

Additional Criteria For Stream Corridor Improvement

Stream corridor vegetative components shall be established as necessary for ecosystem functioning and stability. The appropriate composition of vegetative components is a key element in preventing excess long-term channel migration in re-established stream corridors.

Treatments shall be designed to achieve habitat and population objectives for fish and wildlife species or communities of concern as determined by a site-specific assessment or management plan. Objectives shall be based on the survival and reproductive needs of populations and communities, which include habitat diversity, habitat linkages, daily and seasonal habitat ranges, limiting factors, and native plant communities. The type, amount, and distribution of vegetation shall be based on the requirements of the

fish and wildlife species or communities of concern to the extent possible.

Treatments shall be designed to meet any aesthetic objectives as determined by a site-specific assessment or management plan. Aesthetic objectives shall be based on human needs, including visual quality, noise control, and microclimate control. Construction materials, grading practices, and other site development elements shall be selected and designed to be compatible with adjacent land uses.

Treatments shall be designed to achieve recreation objectives as determined by a site-specific assessment or management plan. Safety requirements shall be based on type of human use and recreation objectives.

CONSIDERATIONS

Consider the potential effects of installation and operation of streambank and shoreline protection on the cultural, archeological, historic, and economic resources.

When designing protective treatments, consider the changes that may occur in the watershed hydrology and sedimentation over the design life of the measure.

Consider utilizing debris removed from the channel or streambank into the treatment design when it is compatible with the intended purpose.

Use construction materials, grading practices, vegetation, and other site development elements that minimize visual impacts and maintain or complement existing landscape uses such as pedestrian paths, climate controls, buffers, etc. Avoid excessive disturbance and compaction of the site during installation.

Utilize vegetative species that are native and/or compatible with local ecosystems. Avoid introduced or exotic species that could become nuisances. Consider species that have multiple values such as those suited for biomass, nuts, fruit, browse, nesting, aesthetics, and tolerance to locally used herbicides. Avoid species that may be alternate hosts to disease or undesirable pests. Species diversity should be considered to avoid loss of function due to species-specific pests. Species on noxious plant lists should not be used.

Consider selecting plant materials that provide habitat requirements for desirable wildlife and pollinators. The addition of native forbs and legumes to grass mixes will increase the value of plantings for both wildlife and pollinators.

Treatments that promote beneficial sediment deposition and the filtering of sediment, sediment-attached, and dissolved substances should be considered.

Consider maintaining or improving the habitat value for fish, wildlife, *and aquatic systems* by including treatments that provide aquatic habitat in the treatment design and that may lower or moderate water temperature and improve water quality.

Consider the need to stabilize side channel inlets and outlets and outlets of tributary streams from erosion.

Consider aquatic habitat when selecting the type of toe stabilization. Toe rock should be large enough to provide a stable base and graded to provide aquatic habitat.

Consider maximizing adjacent wetland functions and values with the project design and minimize adverse effects to existing wetland functions and values.

Livestock exclusion should be considered during establishment of vegetative measures and appropriate grazing practices applied after establishment to maintain plant community integrity. Wildlife may also need to be controlled during establishment of vegetative measures. Temporary and local population control methods should be used with caution and within state and local regulations.

When appropriate, establish a buffer strip and/or diversion at the top of the bank or shoreline protection zone to help maintain and protect installed treatments, improve their function, filter out sediments, nutrients, and pollutants from runoff, and provide additional wildlife habitat.

Consider safety hazards to boaters, swimmers, or people using the shoreline or streambank when designing treatments.

Protective treatments should be self-sustaining or require minimum maintenance.

PLANS AND SPECIFICATIONS

Plans and specifications shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended use.

Support data documentation requirements are as follows:

- Inventory and evaluation records
  - Conservation Assistance notes or special report
- Survey notes, where applicable
  - Design survey
  - Construction layout survey
  - Construction check survey
- Design records
  - Physical data, functional requirements, and site constraints, where applicable
  - Soils/subsurface investigation report, where applicable
- Design and quantity calculations
- Construction drawings/specifications with:
  - Location map
  - "Designed by" and "Checked by" names or initials
  - Approval signature
  - Job class designation
  - Initials from preconstruction conference
  - As-built notes
- Construction inspection records
  - Assistance notes or separate inspection records
  - Construction approval signature
- Record of any variances approved, where applicable
- Record of approvals of in-field changes affecting function and/or job class, where applicable

OPERATION AND MAINTENANCE

An Operation and Maintenance (O&M) plan shall be developed for this practice. The O&M plan shall be consistent with the purposes of the practice, its intended life, safety requirements, and the criteria for the design.

REFERENCES

USDA-NRCS, National Engineering Handbook, Part 650, Engineering Field Handbook, Chapter 16 - Streambank and Shoreline Protection.

Rosgen, 1996. Applied River Morphology. Wildland Hydrology, Colorado.

Simon, 1989. A model of channel response in distributed alluvial channels. Earth Surface Processes and Landforms 14(1): 11-26.

Schumm, Harvey and Watson, 1984. Incised Channels: Morphology, Dynamics and Control. Water Resources Publications, Littleton, Colorado.