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Streambank and Shoreline Stabilization Guidance

Streambank and shoreline stabilization that remediate erosion are important tools to restore and protect water quality in Georgia. Certain methods and practices are preferred to restore or protect ecosystem function and integrity. This document will discuss the preferred, acceptable and discouraged methods of streambank and shoreline stabilization. Stabilization methods in the first and second levels, or "Preferred" and "Acceptable", do not need mitigation. Methods in the third, or "Discouraged" level will require mitigation in the form of additional nonpoint source protection and vegetative controls. Each section will list examples of methods or practices. In order to gain approval for the installation of practices from one level to the next, i.e. from "Preferred" to "Acceptable" or "Acceptable to "Discouraged"; appropriate justification must be provided that additional buffer impacts are necessary. This document is meant as a guidance document, and does not contain the technical or design information necessary to successfully implement a stabilization project. Although this guidance document is intended to clarify Georgia Environmental Protection Division (EPD)'s rules and requirements for mitigation for stabilization measures, entities or projects not subject to EPD's rules are encouraged to use this guidance. For information on design and specifications of stabilization practices, please refer to the list of additional resources at the end of this document.

Streambank and Shoreline Stabilization

Streambank and shoreline stabilization are tools to correct an existing problem with erosion. Some erosion is a natural part of a stream, shoreline, or lake system, and may not need any restoration other than minimal re-vegetation. Likewise, some streambank and shoreline restoration may occur naturally by removing a local stressor, for example by limiting livestock access to surface water. This may allow banks to naturally re - vegetate and stabilize; however, repairing sites affected by more extensive erosion is beneficial to water quality and aquatic habitat.

When addressing streambank or shoreline erosion, it is preferable to think on a watershed scale. Identifying upstream watershed activities may help to determine the underlying sources or causes of erosion downstream, such as stormwater runoff from urban or other impervious areas, wave action from boat traffic, and dam releases. If possible, these causes should be addressed to increase the likelihood of the streambank stabilization's long-term success. For example, it may be possible to implement additional measures to address runoff from impervious surfaces through a watershed planning process, or the Total Maximum Daily Load (TMDL) Implementation process. You may also consider consulting with upstream and downstream neighbors to determine if they, too, have a similar problem and if they would like to participate in a streambank or shoreline stabilization project. Although addressing the underlying causes of erosion may be beyond the scope of many streambank and shoreline stabilization projects, we encourage stabilization projects to fit within the larger context of overall watershed protection whenever possible.

Regardless of the purpose or magnitude of specific projects, funds for streambank and shoreline stabilization are limited. It is the intent of Georgia EPD to help and ensure that funds (from any source) are used as wisely as possible. Further, we want to minimize any investment in apparent solutions that will be destroyed in a short time. For more information about watershed planning and protection, contact your local government, Regional Development Center, Georgia River Network, Natural Resources Conservation Service (NRCS) or EPD.

A **stable stream** has the ability to maintain pattern and shape while transporting sediment without either aggrading or scouring the channel bed (Rosgen 1996). Eroding and failing streambanks are often the symptom of an unstable stream, and may be caused by excessive current stress on the streambanks. Frequently, the source or cause of the excessive current stress is increased volume and rate of flow due to runoff from impervious surfaces such as roads, parking lots, etc. Excessive current stress can be addressed by taking a natural channel design approach to re-stabilize the stream. The **natural channel design** approach uses stable reference streams as models to predict how to restore an unstable stream channel for a particular watershed. While extensive channel restoration may be outside the scope of many streambank and shoreline stabilization projects, using elements of natural channel design, such as rock or log current deflectors, can be an effective way to address streambank erosion. Directing excessive current stress away from streambanks also allows bioengineering approaches (i.e. stabilizing a streambank with native riparian vegetation) to be used with a higher degree of success. Streambank stabilization projects using bioengineering methods, or even hard armoring, have a high risk of failure when banks are stabilized with no regard for the natural pattern, profile and dimension of the stream channel.

Projects incorporating bioengineering practices using native riparian vegetation are preferred for stream and shoreline stabilization. However, certain structural components of stabilization are highly effective and occasionally necessary. This document lays out three levels of streambank and shoreline stabilization: non-structural (**"preferred"**), integrated (**"acceptable"**) and structural ("**discouraged**") stabilization methods. Stabilization practices will be similar for streambanks and shorelines; however, design and installation specifications will differ; for example, to address conditions associated with wave action vs. high velocity stream flow. In some cases, sites may be subject to both wave and current action at different times. Therefore, engineering, design, implementation and maintenance are all critical to successful long-term stabilization. It is important to work with local consultants, watershed groups, NRCS, or UGA Cooperative Extension to determine what practices are applicable to your site. For information on design and specifications of stabilization practices, please refer to "Additional Resources" listed at the end of this document.

Permitting Information

Activities in or near streams or lakes may require permits from local, state and/or federal agencies. A brief summary of different permit types follows; however, you should contact the appropriate agencies before beginning any stabilization activities.

Permits may be required by:
- U.S. Army Corps of Engineers (ACOE)
- U.S. Fish and Wildlife Service
- DNR – Environmental Protection Division
- DNR – Coastal Resources Division
- DNR – State Historic Preservation Division
- Local governments (Cities, Counties)
- Other entities (Utilities, Authorities)

Please contact appropriate agencies BEFORE beginning any stabilization activities.

State of Georgia: Stream Buffer Variance Permitting

Land disturbing activities that take place within 25 feet of streambanks, shorelines or marshland jurisdictional lines (or within 50 feet of trout streams) usually require a buffer variance under the Georgia Erosion and Sedimentation (E&S) Act unless otherwise exe. Some landscaping, maintenance, repair of existing structures, fences and other related activities which result in minor soil erosion may qualify as a minor land disturbing activity and thus do not require a buffer variance. Construction, maintenance, and repair of structures outside the buffer, including backfilling up to the edge of the buffer, are not subject to buffer variances but may be subject to other permits. Construction of a streambank or shoreline stabilization project within the buffer and without a buffer variance, except for minor land disturbing activities, is in violation of O.C.G.A. 12-7-6(b)(15), (16), or (17) in the E&S Act. Failure to maintain a stream buffer may require the issuance of a stop work order (O.C.G.A. 12-7-12(d)). . For additional information on the E&S Act, what constitutes a minor land disturbing activity, and the process of obtaining a buffer variance from EPD, please visit EPD's website, http://epd.georgia.gov/, or call the NonPoint Source Program of the Georgia EPD at 404-651-8554.

State of Georgia: Coastal Marshland and Shore Protection Act

Special permit requirements may apply in tidal waters and ocean shorelines of the State. The State of Georgia claims title for the public to ocean shorelines up to the ordinary high water mark and to all coastal marshlands except those that have been granted to individuals by the Crown or the State. Granted marshlands remain in the jurisdiction of the State due to the vital ecological functions performed by these wetlands. A Coastal Marshlands Protection Act permit is required for any project that involves removing, filling, dredging, draining or otherwise altering marshlands. A Shore Protection Permit is required for any shoreline engineering activity that alters the natural topography or vegetation of any area within the dynamic dune field or submerged shoreline lands of the State. Generally, projects may be permitted if they are water related or dependent on waterfront access; do not have a feasible alternative non-marshland site; do not harm or alter natural flow of navigational waters; do not increase erosion, shoaling channels or create stagnant pools; and do not interfere with public access or with the conservation of marine life, wildlife or other resources. A State revocable license may also be required for activities occurring in tidal areas. Marsh and Shore Protection Permits are coordinated with the U.S. Army Corps of Engineers (ACOE) when appropriate. For assistance in determining appropriate jurisdictional areas or for other information, please contact the Georgia Coastal Resource Division at 912-264-7218.

U.S. Army Corps of Engineers (ACOE) Nationwide Permits (NWP)

Nationwide permits are general permits that authorize specific types of activities which the ACOE has determined will have minimal impacts on the aquatic environment, individually and cumulatively, when conducted in accordance with the permit conditions (ACOE, 2007). For details on how to proceed for all NWPs, please see the ACOE website:
http://www.usace.army.mil/Missions/CivilWorks/RegulatoryProgramandPermits/NationwidePermits.aspx.

Nationwide Permit Number 13: BANK STABILIZATION

Application and/or notification to the ACOE may be required for streambank stabilization projects. Bank stabilization activities necessary for erosion prevention are covered under NWP 13 provided the activity meets **all** of the following criteria:

a. No material is placed more than the minimum needed for erosion protection;
b. The bank stabilization activity is less than 500 feet in length;
c. The activity will not exceed an average of one cubic yard of material per running foot placed along the bank below the plane of the ordinary high water mark or the high tide line;
d. No material is placed in any special aquatic site, including wetlands;
e. No material is of the type, or is placed in any location, or in any manner, to impair surface water flow into or out of any wetland area;
f. No material is placed in a manner that will be eroded by normal or expected high flows and,
g. The activity is part of a single and complete project.

Bank stabilization activities in excess of 500 feet in length or greater than an average of one cubic yard per running foot may be authorized if the permittee notifies the District Engineer in accordance with the "*Notification*" General Condition 13, and the District Engineer determines a) the activity complies with the other terms and conditions of the NWP and b) the adverse environmental effects are minimal both individually and cumulatively. This NWP may not be used for the channelization of waters of the U.S.

Nationwide Permit Number 27: STREAM AND WETLAND RESTORATION

Application and/or notification to the ACOE may be required for stream and wetland restoration projects. Installation of instream structures for the purposes of restoration are allowed under the ACOE Nationwide Permit 27, which includes "the installation of current deflectors; the enhancement, restoration, or creation of riffle and pool sequences; [or] the placement of instream habitat structures."

Protected Species Permitting

Please contact the U.S. Fish and Wildlife Service to determine if your project requires a permit related to threatened or endangered species at http://www.fws.gov/permits/ or 404-679-4176.

Native Riparian Vegetation

A buffer consisting of **native riparian vegetation** is the most effective, and frequently the least expensive, way to protect the long-term ecological function of our streams and rivers. Native riparian streambank vegetation is critical for erosion and sediment control, soil regeneration, floodplain integrity, stream shading, biological inputs, and aquatic and terrestrial habitat. To be ecologically functional and effective at addressing erosion and nonpoint source pollution, native riparian vegetation must consist of NATIVE species, and those adapted to Georgia's riparian forests and/or stream edges. Vegetation or practices such as installing lawn or non-native turf grass, invasive species or vegetation lacking multi-trophic level structure is not effective as functional native riparian vegetation. Native riparian vegetation should be "multi-trophic," i.e., many layers with a mix of low-growing grasses, forbs (non-woody flowering plants other than grass), and other plants; small trees, bushes and/or shrubs; and canopy cover from medium to larger trees. If naturally occurring vegetation at a specific site is not multi-trophic (such as marshes, savannah areas, etc.), then restored or re-established vegetation should mimic the native vegetation of surrounding areas. Contact your local extension agent at 1-800-ASK-UGA1 or http://www.caes.uga.edu/extension, NRCS at http://offices.sc.egov.usda.gov/locator/app, or consult the "Additional Resources" at the end of this document for more information about native plants of Georgia. The buffer may be trimmed to create "lines of sight" to provide views of structures and/or surface water and still remain effective; however an entire trophic layer should NOT be removed. For more information on trimming for lines of sight, see the *Riparian Buffer Modification and Mitigation Guidance Manual*, Section 3.1 at the following site: http://www.deq.virginia.gov/Portals/0/DEQ/Water/Publications/RiparianBufferManual.pdf. Certain areas such as overhead utility lines, areas subject to FAA regulations, and areas related to military training and readiness may not be required to restore trees or large shrubs.

LEVEL 1: PREFERRED

Non-Structural and/or Bio-Engineering Practices

The water-land interface and riparian ecosystem are the most important links between upland and aquatic habitats. A fully functional riparian zone includes **native riparian vegetation** consisting of canopy cover, shrub, brush and small tree structure, grasses, forbs and other vegetation and root systems. This vegetation structure plays an important role in soil stabilization and regeneration, floodplain integrity, water quality, stream inputs, and both upland and aquatic habitat. Streambank and shoreline stabilization should maintain or re-establish functional native riparian vegetation. **A Level 1 stabilization project will require shorter EPD review time for a stream buffer variance.**

Key Components:

- Very effective in areas with limited exposure to strong currents or wave action.
- Revegetation of the stabilized bank with native riparian vegetation is primary result.
- Proper design, installation and maintenance are critical.
- No additional mitigation required if installed properly**.**
- Use of current deflectors may be appropriate (see info box below).

Examples of Practices:

- Wetlands or marsh creation or restoration
- Live Posts – posts made of large cuttings installed in streambanks in square or triangular patterns.
- Live Stakes – live branch cuttings that are tamped or inserted into the earth to take root and produce vegetative growth.
- Live fascines – a long bundle of branch cuttings bound together in a cylindrical structure and placed into trenches along the streambank.
- Brush layering – live branch cuttings laid in crisscrossed fashion between successive layers of soil on horizontal benches excavated into the streambank.
- Brush mattress – a combination of live stakes, fascines, and live branch cuttings installed to cover and protect streambanks and shorelines.
- Branch packing – live woody branch cuttings and compacted soil used to repair slumped areas of streambanks.
- Toe protection (coconut fiber roll) – cylindrical structure composed of coconut husk fibers bound together with twine woven from coconut fiber.
- Toe protection (jute-mat log) - cylindrical structure composed of jute and lengths of branch cuttings.
- Vegetated geogrid – live branch cuttings placed in layers with soil lifts wrapped in erosion control fabric.

Additional Information:

- The existing erosion or other problem in need of restoration must be documented.
- No additional justification for buffer impacts of these practices is needed.

Current deflectors: Strategically placed current deflectors re-direct flow away from banks or shorelines, thus reducing erosion. Use of a current deflector will allow a more preferred means of bank stabilization when combined with bioengineering and vegetation. Shape, size, materials used, and angle of the deflection are important characteristics to consider before incorporating current deflectors into a restoration project. Rock or log vanes, J-hooks, or other instream structures are ecological and effective practices when used appropriately. Installation of instream structures for the purposes of restoration are allowed under the ACOE Nationwide Permit 27 (see *Permitting Information*, previous section). Current deflectors may not be recommended for tidal areas. Current deflectors may be advisable if your site has:

- Inadequate distance to re-slope bank to a 2:1 or 3:1 grade
- Bank failure due to excessive current stress on the outer (cut) bank of a meander bend
- Bank failure due to a migrating channel
- High undercut banks due to a channel that is deeply incised and no longer connected to the floodplain
- Channelized and straightened streams in the evolutionary process of adjusting their pattern
- Evidence of a headcut that is migrating upstream
- Increased urbanization in the watershed resulting in an increase (rate and volume) in runoff to channel
- Frequent bank-full or near bank-full flows downstream of a dam

LEVEL 2: ACCEPTABLE

Integrated Practices (Vegetative and/or bio-engineering practices with one or more structural components)
Many of the practices listed in the previous section may be adapted to areas with higher velocity flows and/or wave action by the addition of a structural component. This is most often appropriate at the "toe" of the bank or shoreline, to prevent additional bank slumping. Again, non-structural and vegetative practices should be used whenever possible; therefore, in an integrated system, the structural components should be minimal, and should only be placed where necessary to ensure the long-term success of the stabilization efforts. Level 2 stabilization should maintain or re-establish functional native riparian vegetation. **A Level 2 stabilization project may require shorter EPD review time for a stream buffer variance.**

Key Components:

- Most stabilization projects on fast-flowing streams or in areas of wave action will be Integrated Practices.
- Integrated Practices use structural components as little as possible and only where necessary and appropriate. Re-vegetation is still the main goal..
- Use of stone or riprap to stabilize the toe of a streambank may be necessary; however, use of trees, logs, and rootwads is encouraged. In most cases, structural component should extend no higher than high water mark.
- Proper design, installation and maintenance are critical, including sizing and placement of structural components.
- No additional mitigation required if installed properly.
- Use of current deflectors may allow more preferred methods of stabilization (see *current deflectors*, previous section).

Examples of Practices:

- Joint planting - the insertion of live stakes in the spaces or joints, between previously placed rock riprap.
- Live cribwalls – a rectangular framework of logs or timbers constructed with layers of live plant cuttings that are capable of rooting.
- Vegetated gabions - wire-mesh, rectangular baskets filled with small to medium size rock and soil and laced together to form a structural toe or sidewall. Live branch cuttings are placed on each consecutive layer between the rock filled baskets to take root, consolidate the structure, and bind it to the slope.
- Tree, rootwad and log revetments – an armored bank constructed from trees, root wads or logs that are cabled together and anchored to the bank.
- Breakwalls used in conjunction with other soil bioengineering practices – logs or hay bales, lined up parallel to the shore to break wave action and to promote vegetative recovery of the shoreline.
- Living Shorelines – a stabilized shoreline that is made of natural materials. Living shoreline projects utilize a variety of structural and organic materials, such as wetland plants, submerged aquatic vegetation, oyster reefs, coir fiber logs, sand fill, and stone

Additional Information:

- The existing erosion or other bank shoreline problem in need of restoration must be documented.
- Additional justification is needed as to why and which structural components are more appropriate for this specific site. This may include assessing the critical flows at the site, including magnitude and frequency of bank-full and over-bank flows.

LEVEL 3: DISCOURAGED

Structural Practices (Structural practices with limited or minimally functional vegetation, or no re-vegetation)

Structural practices such as rip rap, bulkheads and seawalls are a traditional and conventional method of hard-armoring streambanks and shorelines to address erosion. However, these practices tend to degrade the quality of aquatic habitat and contribute to downstream erosion over long periods of time. Also, such practices are frequently installed for aesthetic reasons, so it is difficult to evaluate when they are truly necessary to address erosion. Since newer technology and practices are now available, and many more contractors are familiar with new stream and shoreline stabilization practices, the use of such armoring is diminishing and should be discouraged. However, there are locations where hard armoring may be necessary.

Key Components:

- Appropriate only in cases of severe erosion or severe wave action.
- **MITIGATION:** For projects that require a buffer variance from EPD, mitigation will be required proportional to the area of the riparian buffer impacted.
- "Minimally functional" vegetation includes practices such as lawn or non-native turfgrass, invasive species (such as privet, kudzu, autumn olive, or other non-natives), or vegetation lacking multi-trophic level structure.
- Site must be evaluated for soil erosiveness, and the condition of adjacent banks and shorelines.
- Use of current deflectors may allow more preferred methods of stabilization (see *current deflectors*, previous section).
- Proper design, installation and maintenance are critical, including sizing and placement of stone.

Examples of Practices:

- Bulkheads and seawalls
- Riprap or other stone
- Non-vegetated revetments (concrete, stone, gabions)
- Other non-vegetated bank armoring

Additional Information:

- The existing erosion or other bank shoreline problem in need of restoration must be documented.
- Additional justification is needed as to why and which extreme structural components are more appropriate for this specific site and why non-structural bio-engineering or integrated practices are not being implemented. This may include assessing the critical flows at the site, including magnitude and frequency of bank-full and over-bank flows. Justification must also be provided as to why the site will not be re-vegetated.
- Examples where intense structural components MAY be justified include: potential loss of occupied dwelling, business, or school; threat to human safety; significant loss of property; threat or imminent loss of critical infrastructure such as bridges, pipelines, utility infrastructure or water intakes; threat or imminent loss of historic or cultural resources; or general public access and/or heavy recreational use.
- The applicant must indicate that transfer of streamflow or wave energy downstream or to neighboring locations will be minimized as much as is practical. This may include the use of return walls or wing deflectors.

MITIGATION FOR LEVEL 3 STABILIZATION

Mitigation required by the ACOE may be acceptable to comply with this requirement. For more information, please contact EPD's NonPoint Source Program at 404-651-8554.

If the area to be stabilized under Level 3 consists of less than 50 linear feet per single and complete project, as measured horizontally along the bank, the applicant must:

- Ensure any run-off from future impervious surface constructed **within 25 feet of the stabilization structure** does not flow untreated directly into surface water, excluding the stabilization structure itself and any boat ramps. This can be achieved through vegetative treatment or stormwater controls.
- Maintain or restore **native riparian vegetation** within the first 25 feet along 50% of the stabilization structure, with special emphasis on restoring vegetation at the high water line or the water-land interface.
- Eliminate or minimize nonpoint source impacts **within 25 feet of the stabilization structure,** including fertilizers, pesticides and pet wastes.

If area to be stabilized under Level 3 is between 50and 250 linear feet per single and complete project, as measured horizontally along the bank, the applicant must:

- Ensure any run-off from future impervious surface constructed **within 25 feet of the stabilization structure** does not flow untreated directly into surface water, excluding the stabilization structure itself and any boat ramps. This can be achieved through vegetative treatment or stormwater controls.
- Maintain or restore **native riparian vegetation** within the first 25 feet along 75% of the stabilization structure, with special emphasis on restoring vegetation at the high water line and/or the water-land interface.
- Eliminate or minimize nonpoint source impacts **within 25 feet of the stabilization structure,** including fertilizers, pesticides and pet wastes.

If the area to be stabilized under Level 3 is greater than 250 linear feet or more per single and complete project, the applicant must:

- Ensure any run-off from existing or future impervious surface constructed on **the entire site** does not flow untreated directly into surface water, excluding the stabilization structure itself and any boat ramps, and all run-off generated on-site is addressed using practices that conform to the guidance established in the *Georgia Stormwater Management Manual* (Blue Book).
- Maintain or restore **native riparian vegetation** within the first 25 feet along 75% of the stabilization structure, with special emphasis on restoring vegetation at the high water line and/or the water-land interface. If this mitigation is not feasible on-site, then buffer preservation or restoration off-site may be allowed (preferably within the same 12-digit hydrologic unit code (HUC) watershed but definitely within the same 10-digit HUC watershed).
- Eliminate or minimize nonpoint source impacts **within 25 feet of the stabilization structure,** including fertilizers, pesticides and pet wastes.

Additional Resources:

Streambank and Shoreline Restoration and Stabilization and Riparian Buffers
USDA Forest Service, *A Soil Bioengineering Guide for Streambank and Lakeshore Stabilization*, 2002.

USEPA, *National Management Measures to Control Nonpoint Source Pollution from Hydromodification*, July 2007. http://water.epa.gov/polwaste/nps/hydromod_index.cfm

GADNR-CRD, EMC Engineering, and Coastal RDC, *Georgia's Green Growth Guidelines*, Chapter 4: Streambank Stabilization, 2006.
http://www.coastalgadnr.org/cm/green/guide

North Carolina Stream Restoration Institute, *Stream Restoration: A Natural Channel Design Handbook.* *http://www.bae.ncsu.edu/programs/extension/wqg/sri/stream_rest_guidebook/guidebook.html*

GSWCC. *Guidelines for Streambank Restoration.* March, 2000.
http://gaswcc.georgia.gov/vgn/images/portal/cit_1210/60/20/31110081Guidelines_Streambank_Restoration.pdf

NRCS. Electronic Technical Guide. http://www.nrcs.usda.gov/Technical/efotg/

Palmer et al (2005) "Standards for Ecologically Sustainable River Restoration" Journal of Applied Ecology

Virginia Department of Conservation and Recreation, Riparian Buffer Modification and Mitigation Guidance Manual, 2002, http://www.cblad.virginia.gov/ripbuffstat.cfm

Watershed Planning
USEPA, *Handbook for Developing Watershed Plans to Restore and Protect our Waters*, 2005. http://www.epa.gov/nps/watershed_handbook/

TMDL Implementation Planning: EPD and Regional Development Centers

Georgia's Section 319(h) Nonpoint Source Implementation Grants

Native Vegetation
Georgia Native Plant Society – http://www.gnps.org/

Tennessee Valley Authority. *Landscaping with Native Shrubs in Utility Right-of-Ways.* 1998
http://www.tva.gov/power/projects/plantnative.pdf

Recommended Plantings for Coastal Streambanks. *Georgia's Green Growth Guidelines*, Chapter 4: Streambank Stabilization, 2006. (see above for website).