APPENDIX B

DRAFT COMPENSATORY STREAM MITIGATION STANDARD OPERATING PROCEDURES AND GUIDELINES

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Department of the Army
Mobile District Corps of Engineers

COMPENSATORY STREAM MITIGATION STANDARD OPERATION PROCEDURES AND GUIDELINES

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STREAM MITIGATION STANDARD OPERATION PROCEDURES AND GUIDELINES

1.0 INTRODUCTION:

The purpose of this document is to provide natural resource agencies, parties involved in stream compensatory mitigation, and the public with a set of standardized procedures and requirements for addressing stream mitigation in the Mobile District. The manual may be divided into two sections; the first section is the main body comprised of the Standard Operating Procedure (SOP) for rapidly assessing the compensatory mitigation required for permitted stream activities within the Mobile District, as well as evaluating the number of "credits" obtainable through implementation of various stream mitigation practices. The SOP describes a process to: 1) determine and assess the stream impacts; 2) determine the compensation requirement; and, 3) determine what types of and the amount of the various compensation practices that will satisfy the compensation requirement. The second section of the manual includes, in the form of supporting appendices, guidance for formulating stream mitigation plan requirements, stream mitigation monitoring requirements, and stream mitigation success criteria applicable to all forms of stream mitigation within the Mobile District, as well as a credit release schedule for stream mitigation banks. This guidance may be used for all projects required to provide stream mitigation by the Mobile District Regulatory Program.

The Mobile District encourages the use of natural stream channel design concepts for all in-stream mitigation projects. This approach incorporates the use of stable, preferably non-impacted reference quality stream reaches for designing the appropriate pattern, profile, and dimension for stream mitigation projects. The concept of using reference sites is also encouraged when designing stream riparian buffer mitigation projects. **Riparian buffer preservation may account for no more than 30% of credits generated by the mitigation plan.** Final stream restoration plans will be completed and presented to the Corps for review. The final plans will incorporate appropriate stream restoration techniques based on a reference stream and will be designed as required by the natural channel design methods.

These standard operating procedures and guidelines are not intended to take the place of project specific review and discussion between the resource agencies and the applicant, which may result in adjustments to compensation requirements or credits obtained through application of this process. These requirements do not negate nor diminish an applicant's responsibility to comply with all other laws and regulations. Applicants should defer to 33 CFR 332, Compensatory Mitigation For Losses of Aquatic Resources, for guidance on mitigation requirements not specifically addressed in this SOP. These Guidelines can be applied to stream compensation projects performed on-site, off-site, for a stream mitigation bank, or for an in-lieu fee fund project, thereby, ensuring a standard application for evaluating and crediting all stream compensation projects. These Guidelines are intended to be used on intermittent or perennial streams within the Mobile District.

2.0 REGULATORY AUTHORITIES AND GUIDELINES

Section 10 of the River and Harbor Act of 1899: In accordance with Section 10 of the River and Harbor Act, the Corps of Engineers is responsible for regulating all work in navigable waters of the United States.

Section 404 of the Clean Water Act: In accordance with Section 404 of the Clean Water Act (CWA) as amended in 1977, the Corps of Engineers is responsible for regulating the discharge of dredged or fill material in waters of the United States, including wetlands. The purpose of the CWA is to restore and maintain the physical, chemical, and biological integrity of the nation's waters. Section 404(b)(1) ("The Guidelines") of the CWA provides the substantive environmental criteria by which all proposed discharges of dredged or fill material are evaluated (49CFR230.10). The Section 404 (b)(1) Guidelines requires application of a sequence of mitigation -- avoidance, minimization and compensation. Section 230.10 (d) of the 404(b)(1) Guidelines states that "... no discharge of dredged or fill material shall be permitted unless appropriate and practicable steps have been taken which will minimize potential adverse impacts of the discharge on the aquatic ecosystem." In other words, mitigation consists of the set of modifications necessary to avoid adverse impacts altogether, minimize the adverse impacts that are unavoidable and compensate for the unavoidable adverse impacts. Compensatory mitigation is required for unavoidable adverse impacts, which remain after all appropriate and practicable avoidance and minimization has been achieved. The 404(b)(1) Guidelines identify a number of "Special Aquatic Sites," including riffle pool complexes, which require a higher level of regulatory review and protection. This stream guidance document addresses only compensatory mitigation and should only be used after adequate avoidance and minimization of impacts associated with the proposed project has occurred.

2008 Mitigation Rule, 33 C.F.R. 332 - Compensatory Mitigation for Impacts to Aquatic Resources. This guidance requires compensatory mitigation to replace aquatic resource functions unavoidably lost or adversely affected by authorized activities. The Mitigation Rule provides important guidance on compensatory mitigation including requiring increased use of functional assessment tools, improved performance standards, and a stronger emphasis on monitoring with the purpose of improving the success of compensatory mitigation projects.

Regulatory Guidance Letter (RGL) 05-05 – Ordinary High Water Mark Identification. This document provided guidance for identifying ordinary high water mark. RGL 05-05 applies to jurisdictional determinations for non-tidal waters under Section 404 of the Clean Water Act and under Sections 9 and 10 of the Rivers and Harbors Act.

Regulatory Guidance Letter (RGL) 08-03 – Minimum Monitoring Requirements for Compensatory Mitigation Projects Involving the Creation, Restoration, and/or Enhancement of Aquatic Resources. This document provides guidance on minimum monitoring requirements for compensatory mitigation projects, including the required content for monitoring reports.

3.0 ORGANIZATION OF THE STANDARD OPERATING PROCEDURE (SOP)

The Stream SOP, used to calculate credits required from an impact site and credits generated from a compensatory mitigation site, is divided into three evaluation sections, summarized below. The sections represent the basic types of stream analyses that are performed, including characterizing and assessing stream impacts, determining compensation requirements, and determining compensation credits for in-stream and riparian buffer mitigation actions. The worksheets, found in Appendix A contain the factors discussed below for Adverse Impacts, In-Stream Work, and Riparian Buffer Restoration. These SOP worksheets are to be completed when calculating the number of compensatory credits needed due to an impact and the number generated by stream mitigation and riparian buffer mitigation.

Section 4.0 - The "Adverse (Stream) Impact" section describes a method to rapidly characterize existing condition and proposed impacts to streams and calculates the compensation required. It is accompanied by a worksheet in Appendix A which is to be completed for projects that impact streams.

Sections 5.0 – The "In-stream Work" section describes a method for rapidly assessing and characterizing in-stream restoration and enhancement actions and calculates the compensation generated from these actions. It is accompanied by a worksheet in Appendix A for projects that propose in-stream work.

Section 6.0 – Riparian buffer restoration, enhancement, and preservation describes a method for rapidly assessing and characterizing riparian buffer mitigation actions and calculates the compensation generated from these actions. It is accompanied by a worksheet in Appendix A that must be completed for each stream mitigation project.

4.0 ADVERSE (STREAM) IMPACT

Streams are complex ecosystems with morphological, biological and chemical characteristics that are dependent on appropriate geomorphic dimension, pattern, and profile as well as habitat and watershed integrity. They are not simply stormwater conveyances.

The following factors will determine the amount of mitigation credits required:

4.1 Stream Types:

Perennial Stream - A perennial stream has flowing water year-round during a typical year. The water table is located above the streambed for most of the year. Groundwater is the primary source of water for stream flow. Runoff from precipitation is a supplemental source of water for stream flow. Perennial streams support a diverse aquatic community of organisms year round and are typically the streams that support major fisheries.

Intermittent Stream – An intermittent stream has flowing water during certain times of the year, when ground water provides water for stream flow. During dry periods, intermittent streams may not have flowing water. Runoff from precipitation is a supplemental source of water for stream flow. The biological community of intermittent streams is composed of species that are aquatic during a part of their life history or move to perennial water sources. For the purpose of mitigation, intermittent streams will be treated as 1st order streams.

Ephemeral Stream – An ephemeral stream has flowing water only during and for a short duration after precipitation events in a typical year. Ephemeral streambeds are located above the water table year-round. Groundwater is not a source of water for the stream. Runoff from precipitation is the primary source of water for stream flow. Ephemeral streams typically support few aquatic organisms. When aquatic organisms are found they typically have a very short aquatic life stage. Impacts to ephemeral streams will be addressed as wetland impacts.

4.2 Priority Area:

Priority area is a factor used to determine the importance of the water body proposed to be impacted or used for mitigation. Priority areas are influenced by the quality of the aquatic habitat potentially subject to be impacted or used for mitigation. The priority area factor will influence the amount of stream credits generated. The priority areas are divided into three categories:

Primary: These areas are important to the biodiversity of stream ecosystems and/or larger watersheds and provide high levels of unique stream functions. Presence and performance of these functions is typically due to the absence of widespread (i.e., cumulative) stressors in and around the stream system. Impacts to these areas should be rigorously avoided or minimized. If, after thorough agency review, impacts are deemed unavoidable, compensation for impacts in these areas should emphasize replacement in the same immediate 8-digit watershed. Designated primary priority areas include:

- Waters with Federal or State listed species,
- National Estuarine Research Reserves,
- River sections in approved greenway corridors,
- Wild and Scenic Rivers,
- Outstanding National Resource Waters,
- Outstanding State Waters,
- Essential Fish Habitat
- Anadromous fish spawning habitat
- Waters with Federal Species of Management Concern or State listed rare or uncommon species
- Designated shellfish grounds

Secondary: These areas are important to the biodiversity of stream ecosystems and/or larger watersheds and provide moderate levels of stream functions. Presence and performance of these functions has been hampered by the presence of cumulative stressors (i.e., agricultural, urban, suburban land uses) in and around the stream system. Secondary priority areas include stream reaches (i.e., a stream section containing a complete riffle and pool complex, or a suitable length of stream usually no less than 300 feet) which are:

- Designated secondary trout streams (Put and Take Fishery),
- Waters adjacent to Federal or State protected areas or Corps' approved mitigation banks,
- Waters on the 303(d) list,
- Designated State Heritage Trust Preserves,
- Within 0.5 mile upstream or downstream of primary priority reaches (as outlined above),
- Within high growth areas that aren't ranked as primary priority systems,
- Within 0.5 miles of a drinking water withdrawal site

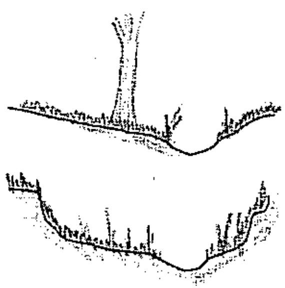
Tertiary: These areas include all other freshwater or tidally influenced lotic systems not ranked as primary or secondary priority.

4.3 Existing Condition - Channel Condition Parameter:

Typically, stream channels respond to disturbances or changes in flow regime and sediment loads by degrading to a lower elevation and eventually re-stabilizing at that lower elevation. This sequential readjustment of the channel to changing flows is the basic premise of the stream channel evolutionary process. The differing stages of this evolutionary process can be directly correlated with the current state of stream stability. The purpose of evaluating **Channel Condition** is to determine the current condition of the channel cross-section, as it relates to this geomorphologic evolutionary process, and to assess the current state of stream stability. These geomorphologic processes apply to the majority of stream systems and assessment reaches due to the constant response of streams to watershed changes in flow and sediment loads.

A channel's physical condition can be determined by visually assessing certain geomorphological indicators. These indicators include channel incision, access to original or recently created floodplains, channel widening, channel depositional features, rooting depth compared to streambed elevation, streambank vegetative protection, and streambank erosion. Each of the Channel Condition categories describes a particular combination of the state of these geomorphological indicators which generally correspond to a stream channel stability condition at some stage in the evolution process.

Existing channel condition is an assessment of the stream cross-section, along any given stream reach. The existing/current channel condition of each reach is assessed using the following five categories. However, in cases where the stream lies between category descriptions, the most characteristic condition should be selected. The Evaluator needs to identify the prevailing channel condition or problem (erosion, deposition, disconnection to the floodplain).



A. Optimal

These channels show very little incision and little or no evidence of active erosion or unprotected banks. 80-100% of both banks are stable. Vegetative surface protection may be prominent on 80-100% of the banks or natural rock stability is present along the majority of the banks.

AND/OR

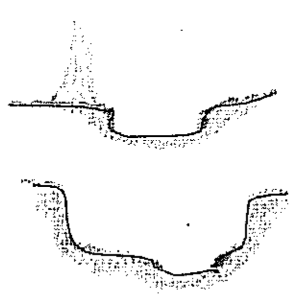
Stable point bars and bankfull benches are present (when appropriate for the stream type). These channels are stable and have access to their original floodplain or fully developed wide bankfull benches. Mid-channel bars, and transverse bars should be few. If transient sediment deposition is present, it covers less than 10% of the stream bottom.

B. Suboptimal

These channels are slightly incised and contain few areas of active erosion or unprotected banks. The majority of both banks are stable (60-80%). Vegetative surface protection may be prominent along 60-80% of the banks or natural rock stability present along the majority of both banks.

AND/OR

Depositional features (point bars, mid-channel bars, transverse bars, and bankfull benches) are likely present (when appropriate for the stream type) and most are contributing to stability. The bankfull and low flow channels (when appropriate for the stream type) are well defined. This stream likely has access to bankfull benches, or newly developed floodplains along portions of the reach. If transient sediment is present, it affects or buries 10-40% of the stream bottom.



C. Marginal

These channels are often incised, but to a lesser degree than the ***Severe*** and ***Poor*** channel conditions. The banks are more stable than the stream cross sections in the ***Severe*** or ***Poor*** condition due to lower bank slopes. Erosional scars may be present on 40-60% of both banks. Vegetative surface protection may be present on 40-60% of the banks. The streambanks may consist of some vertical or undercut banks. While portions of the bankfull channel may still widen, other portions have begun to narrow in an attempt to obtain stable dimensions.

AND/OR

Between 40-60% of the natural stream bed or bottom (pools and riffles) is covered by substantial sediment deposition. Sediment depositional features may be temporary and transient in nature, and may contribute to channel instability; however, depositional features (point bars, mid-channel bars, transverse bars, and bank full benches), that contribute to stability, may be forming or present in the appropriate stream types.

AND/OR

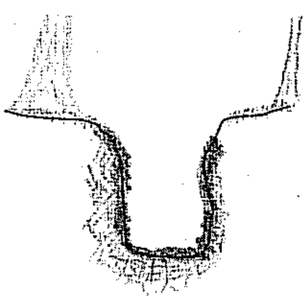
Channels that have experienced historic incision but may be relatively stable (banks and channel) at their existing elevation. These channels may have a V-shape and no connection to their floodplain. Vegetative surface protection is present on greater than 40% of the banks but evidence of instability can be observed in unvegetated areas. Marginal V-shaped channels have depositional features (point bars, mid-channel bars, transverse bars, and bank full benches), which contribute to stability.

D. Poor

These channels are overwidened and are incised. These channels are vertically and/or laterally unstable. They are more likely to widen rather than incise further. The majority of both banks are near vertical with shallow to moderate root depths. Erosional scars may be present on 60-80% of the banks. Vegetative surface protection may be present on 20-40% of both banks, and is insufficient to prevent significant erosion from continuing.

AND/OR

Between 60-80% of the natural stream bed or bottom (pools and riffles) is covered by substantial sediment deposition. Sediment depositional features are temporary and transient in nature, and are likely contributing to channel instability. Depositional features (point bars, mid-channel bars, transverse bars, and bank full benches), which contribute to stability are absent.



E. Severe

These channels are deeply incised (or excavated) with vertical and/or lateral instability and will likely continue to incise and widen. Incision is severe enough that flow is contained within the banks during heavy rainfall events (i.e. the stream does not have access to its floodplain). The streambed elevation may be below the average rooting depth within the banks and the majority of both banks may be vertical or undercut. Vegetative surface protection may be present on less than 20% of the banks and is not preventing erosion from continuing.

Obvious bank sloughing may be present. Erosional scars or raw banks may be present on 80-100% of the banks.

AND/OR

These channels are aggrading and have an excessive sediment supply that is filling the channel with alluvium, impeding its flow. Greater than 80% of the natural stream bed or bottom (pools and riffles) is covered by substantial sediment deposition that is likely contributing to channel instability. Multiple thread channels and/or subterranean flow may be present in certain aggrading channels. Note: Stable multiple thread channels naturally occur in some low-gradient streams and should not be given a *Severe* Parameter Condition.

4.4 Impact Duration: Duration is the amount of time adverse impacts are expected to persist. Impacts which do not persist are assumed to have less effect on the aquatic ecosystem than those that persist for longer time periods.

Temporary means impacts will occur within a period of less than 6 months and recovery of system integrity will follow cessation of the permitted activity.

Recurrent means repeated impacts of short duration (such as within-channel 24-hour stormwater detention).

Permanent means project impacts will be permanent or will occur during spawning or growth periods for Federal and/or State protected species.

4.5 Dominant Impact Parameter

This indicator considers direct impacts to the stream channel from anthropogenic sources for which a Corps permit is required. . The reach may or may not have been altered throughout its entire length.

Examples of channel alterations evaluated by this indicator that disrupt the natural conditions of the stream include, but are not limited to the following:

1. Straightening of channel or other channelization
2. Stream crossings (bridges and bottomless culverts)
3. Riprap along streambank or in streambed
4. Concrete, gabions, or concrete blocks along streambank
5. Manmade embankments on streambanks, including spoil piles
6. Constrictions to stream channel or immediate flood prone area
7. Livestock impacted channels (i.e., hoof tread, livestock in stream)

The presence of a structure does not necessarily result in a reduced score. For instance, a bridge that completely spans the floodplain would not be considered an alteration. Also, the Evaluator is cautioned not to make assumptions about past alterations. Incision can be mistaken for channelization.

Armor means to riprap, bulkhead, or use other rigid methods to contain stream channels.

Below Grade (embedded) Culvert means to route a stream through pipes, box culverts, or other enclosed structures (<= 100 LF of stream to be impacted per crossing). The below grade culverts should be designed to pass bankfull flow, and greater than bankfull flow to be passed through other culverts within the floodplain. The culvert bottom including head-walls and toe-walls would be designed to be embedded to a depth of no less than 12 inches below ground line. If rock runs throughout the culvert area, a bottomless culvert should be used. Improperly designed culverts will be evaluated under Dominant Impact Factor for piping. Culverts should be designed to allow fish passage and allow other natural stream processes to occur unimpeded.

Clearing means clearing of streambank vegetation or other activities that reduce or eliminate the quality and functions of vegetation within riparian habitat without disturbing the existing topography or soil. Mitigation for these impacts may be required if the impact occurs as a result of; or in association with, an activity requiring a permit, and because degradation of riparian vegetation may affect the water quality and biota of the adjacent stream.

Detention means to temporarily slow flows in a channel when bankfull is reached. Areas that are temporarily flooded due to detention structures must be designed to pass flows below bankfull stage.

Fill means permanent fill of a stream channel due to construction of dams or weirs, relocation of a stream channel (even if a new stream channel is constructed), or other fill activities.

Impound means to convert a stream to a lentic state with a dam or other detention/control structure that is not designed to pass normal flows below bankfull stage. Impacts to the stream channel where the structure is located is considered fill, as defined above.

Morphologic change means to channelize, dredge, or otherwise alter the established or natural dimensions, depths, or limits of a stream corridor.

Pipe means to route a stream for more than 100' through pipes, box culverts, or other enclosed structures.

Utility crossings mean pipeline/utility line installation methods that require disturbance of the streambed.

4.6 Scaling Factor: The Scaling factor assumes that the greater the linear distance affected by the impact the greater the impact. Therefore, the scaling factor assesses the relative effects of impacts based upon the length of stream impacted by a project, as authorized under Section 404 of the Clean Water Act, and for which mitigation will be required.

5.0 IN-STREAM WORK - MITIGATION CREDITS:

5.1. In-Stream Net Benefit: Net benefit is an evaluation of the proposed mitigation action relative to the restoration, enhancement, and maintenance of the chemical, biological, and physical integrity of the Nation's waters. Three stream mitigation categories are evaluated for Net Benefit – stream relocation, stream channel restoration, and stream channel enhancement.

All restored or enhanced channels must be protected by at least a minimum width buffer of native vegetation **on both sides** of the stream. Credit for installation of structures described below will be based on 3X the length of the appropriate size structure (e.g., 600' for a 200' tree revetment). Credit for removal of structures described below will be based on the documented length of reach that the structure impacts under current flow conditions.

5.1.1 Stream Relocation

Stream relocation is moving a stream to a new location to allow a project, authorized under Section 404 of the Clean Water Act, to be constructed on the stream's former location. (Note: relocation of a stream is considered fill under these guidelines when the relocation is conducted to allow development of the area where the stream previously was located; impacts associated with stream relocation in these situations must be fully mitigated). Relocated streams should reflect the dimension, pattern and profile of natural, referenced stable conditions; maintain the capacity to transport bedload sediment; and have at least a minimum width buffer of natural vegetation on both sides of the stream to receive mitigation credit; this buffer also will generate riparian preservation or restoration mitigation credit.

5.1.2 Restoration

Restoration is the process of converting an unstable, altered, or degraded stream corridor, including flood-prone areas, to a natural stable condition (i.e., neither aggrading nor degrading) considering recent and future watershed conditions. This process is be based on a reference condition/reach for the same stream valley type or other analog or analytical methods, and includes restoring the appropriate geomorphic dimension (cross-section), pattern (sinuosity), and profile (channel slope). This process supports reestablishing the streams biological and chemical integrity, including transport of the water and sediment produced by its watershed in order to achieve dynamic equilibrium.

An analysis of the existing geomorphological parameters of the compensation stream is compared to those in a stable reference stream. Natural stream channel design methods and calculations are then applied to develop a stable stream dimension, pattern, and profile that maintains itself within the natural variability of the design parameters. Restoration activities utilizing the natural stream channel design approach typically address the following:

1. Deficiencies in sinuosity, radius of curvature, belt width, meander length
2. Deficiencies in spacing, lengths, and depths for riffles, runs, pools, & glides
3. Restore appropriate critical shear stress
4. Deficiencies in slopes for channel, riffles, runs, pools, & glides
5. Deficiencies in width-depth ratio and cross-sectional area

Situations that readily lend themselves to inclusion in the Restoration Category include Priority 1, 2, or 3 relocations and restorations as described in *A Geomorphological Approach to Restoration of Incised Rivers*, Rosgen 1997[1]. The following provides a summary of these management activities:

- **Priority 1 Restoration[1]**
  Priority 1 Restoration is defined as stream channel restoration that involves the re-establishment of a channel on the original floodplain, using a relic channel or constructing a new channel. The new channel is designed and constructed with the proper dimension, pattern, and profile characteristics for a stable stream. The existing, incised channel is either backfilled or made into discontinuous oxbow lakes level with the new floodplain elevation. (Rosgen, 1997)

- **Priority 2 Restoration[1]**
  Priority 2 Restoration is defined as stream channel restoration that involves re-establishment of a new floodplain at the existing level or higher but not at the original level. The new channel is designed and constructed with the proper dimension, pattern, and profile characteristics for a stable stream. (Rosgen, 1997)

[1] Rosgen, David. 1997. *A Geomorphological Approach to Restoration of Incised Rivers.* Proceedings of the Conference on Management of Landscapes Disturbed by Channel Incision. 11pp.

- **Priority 3 Restoration**[1]

Priority 3 Restoration is defined as stream channel restoration to a channel without an active floodplain but with a flood prone area (Rosgen, 1997). However, the channel restoration must involve establishing proper dimension, pattern, and profile.

Some sites may present difficulties in reestablishing a sinuous pattern when they are laterally contained or have limitations in available belt width. This is often caused by utilities, infrastructure, and other floodplain encroachments. Such physical constraints often favor the creation of a step/pool bed morphology with less sinuosity (associated with Priority 3) over a riffle/pool bed morphology with greater sinuosity (associated with Priorities 1 & 2). It is necessary to consider the available belt width and the slope of the proposed stream when designing the appropriate stream type that is suitable for that situation. Information should be provided showing that the appropriate dimension, pattern, and profile are being restored for the proposed stream type in that particular situation. The compensation plan narrative needs to describe, and the plan design sheets need to clearly demarcate, the stream channel length (in linear feet) and stream reaches to be restored, as defined above.

Restoration mitigation credits cannot be generated for stream channel or stream bank restoration if the mitigation segment is within 300 feet upstream of a dam or a channelized/piped section.

Restoration Restrictions:

1. **No enhance ment activities can be coupled with restoration on the same linear foot of stream channel.**

2. **The difference between projects that are credited as Restoration and projects that are credited as Enhancement, is whether or not changes are necessary to address the current channel's dimension, pattern, and profile, as described for each of the Priorities, to produce a stable channel. All three geomorphic categories (i.e., pattern, profile, and dimension) are required to be addressed, with noted pattern limitations for Priority 3, in order to receive Restoration credit. Enhancement credit is given in all other situations when only two geomorphic variables are addressed to produce a stable channel.**

5.1.3 Enhancement

Enhancement Activities include physical alterations to the channel that do not constitute Restoration but that directly augment channel stability, enhance streambanks, streambed, and in-stream habitat, water quality, and stream ecology in accordance with a reference condition,or analytical methodology. These activities may include physical in-stream and/or streambank activities, but in total restore only one or two of the geomorphic variables: dimension, pattern and profile. There are 6 activities included in the Enhancement category: 1) Instream Structures (cross vanes, j hooks, fish passage structures etc.), 2) Habitat Structures, 3) Bankfull Bench Creation, 4) Laying Back Banks, 5) Bioremediation Techniques, and 6) Stream Bank Planting.

Instream Structures

This activity includes structures that are specifically designed and result in grade control and/or bank stabilization. Accepted structures include, but are not limited to, cross-vanes, j-hook vanes, native material revetments, rock weirs, rock vortex weirs, log-vanes, constructed riffles, and step-pools. These structures may be created out of appropriate sized rock or logs, boulders or cobbles based on the size of the stream and the flow regime. Structures not listed will be considered on case-by-case basis. Normally, a pool is constructed in combination with these structures, however, if one is not constructed this does not alter the credit provided.

The compensation plan needs to state, and clearly demarcate, the length (in linear feet) of stream channel and reaches of stream channel expected to benefit from and be influenced by the structures. An alternative strategy is that the benefit can be estimated to be 3 times the length of the structure.

Habitat Structures
This activity includes structures designed specifically for habitat creation. Although, Instream Structures typically provide habitat, they are constructed for channel stability and will not receive credit for Habitat Structures. Habitat Structures do not typically contribute to channel stability. Accepted structures include, but are not limited to, submerged shelters, fish boards or bank cover, floating log structures, root wads, and half-log cover. Riffle and pool complexes and over hanging vegetation do not qualify for credit in this activity. The compensation plan should state, and the plan sheets should clearly demarcate, the length (in linear feet) of stream channel where habitat structures are proposed.

Bankfull Bench Creation
This activity involves the creation of a bankfull bench along one or both of the stream banks. This activity may result in less than the proper entrenchment ratio but does result in a stable channel. The compensation plan should state, and the plan sheets should clearly demarcate, the length (in linear feet) of stream channel where bankfull benches are proposed.

Lay Back Bank
This activity involves the manual manipulation of the bank slope but does not create a bankfull bench or floodplain. The compensation plan should state, and the plan sheets should clearly demarcate, the length (in linear feet) of stream channel where laying back the banks is proposed.

Bioremediation Techniques
This activity primarily relates to the use of coir logs or similar materials for bank stabilization. Techniques and materials in this category include, but are not limited to, live fascines, branch packing, brush mattresses, coir logs, and natural fiber rolls. More than one of these materials or techniques may be warranted over the same stream length. In this case, no additional credit will be applied for that length. In other words, the compensation plan should include all bioremediation techniques required over a particular length. Techniques and materials other than those listed will be considered on a case-by-case basis for approval by the agencies. The compensation plan should state, and the plan sheets should clearly demarcate, the length (in linear feet) of stream channel where bioremediation techniques are proposed.

Streambank Planting
This activity includes the installation of plants other than seed along the immediate stream bank area. This is primarily done for streambank stabilization. This activity includes live stakes, dormant post/stakes, branch layering, and the installation of plants. The compensation plan should state, and the plan sheets should clearly demarcate, the length (in linear feet) of stream channel where streambank plantings are proposed.

Enhancement Restrictions:

1. **Activities cannot be credited as both Restoration and Enhancement activities.**

2. **A structure cannot be credited as both an Instream Structure and a Habitat Structure.**

3. **Mechanical bank work cannot be credited as both Bankfull Bench and Laying Back the Banks.**

4. **Biore mediation Techniques do not include Erosion Control matting.**

5.2 Streambank Stability: The streambank stability/Bank erosion potential addresses the existence of the potential for soil detachment from the upper and lower stream banks and its movement into the streams. Some bank erosion is normal in a healthy stream. Excessive bank erosion occurs where riparian zones are degraded; the stream is unstable due to changes in hydrology, sediment load, or loss of access to the floodplain, and when the stream banks are high and steep.

Low Bank Erosion Potential: where the banks are low and at the appropriate elevation to allow the stream appropriate access to the floodplain, and the banks are protected by roots and vegetation that extend to the base-flow elevation. Greater than 33 percent of the surface areas of outside stream bends are protected by roots and/or vegetation.

Moderately Bank Erosion Potential: where the banks are low and at the appropriate elevation to allow the stream appropriate access to the floodplain, and the banks are protected by roots and vegetation that extend to the base-flow elevation. Less than 33 percent of the surface areas of outside stream bends are protected by roots and/or vegetation.

High Bank Erosion Potential: where the banks are high and steep, stream no longer has access to the floodplain, and the banks are no longer protected by roots and vegetation. There is evidence of significant bank erosion with less than 5 percent of the surface areas of outside stream bends are protected by roots and/or vegetation.

Streambank stability can be assessed using the Bank Erosion Hazard Index (BEHI) (Fig. 1). Low, moderate and high bank erosion potential can be correlated with the BEHI.

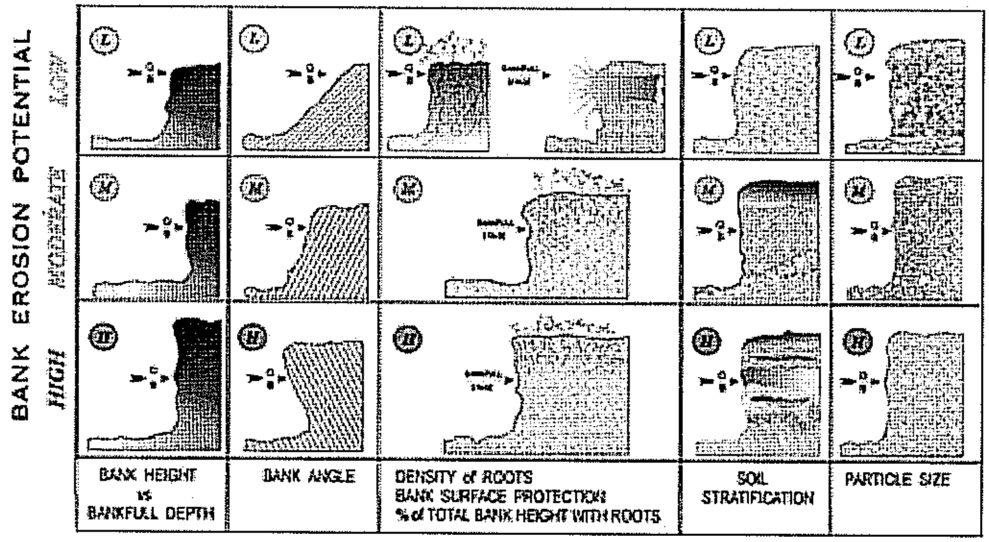


Figure 1. Illustrated examples of the five Bank Erosion Hazard Index (BEHI) criteria

5.3 <u>Instream Habitat</u>: The In-Stream Habitat assessment considers the habitat suitability for effective colonization or use by fish, amphibians, and/or macroinvertebrates. This assessment does not consider the abundance or types of organisms present, nor does it consider the water chemistry and/or quality of the stream. Other factors beyond those measured (i.e. watershed conditions), also affect the presence and diversity of aquatic organisms. Therefore, this assessment seeks to evaluate the suitability of physical elements within the stream reach which support aquatic organisms.

This habitat assessment includes the relative quantity and variety of natural structures in the stream, such as cobble (riffles), large rocks, fallen trees, logs and branches, persistent leaf packs, and undercut banks; available as refugia, feeding, or sites for spawning, and nursery functions of aquatic macrofauna. A wide variety and/or abundance of instream habitat features provide macroinvertebrates and fish with a large number of niches, thus increasing species diversity. As variety and abundance of cover decreases, habitat structure becomes monotonous, diversity decreases, and the potential for recovery following disturbance decreases. Riffles and runs are critical for maintaining a variety and abundance of benthic organisms and serve as spawning and feeding refugia for certain fish. The extent and quality of the riffle is an important factor in the support of a healthy biological condition. Riffles and runs offer habitat diversity through a variety of particle sizes. Snags and submerged logs are also productive habitat structures for macroinvertebrate colonization and fish refugia.

The assessment does not establish a percent slope for distinguishing between high and low gradient streams. Therefore, the Evaluator has to know whether a high or low gradient stream is being assessed. Generally speaking, low gradient streams occur in the Coastal Plain, wetland / marsh conditions, or wet meadows, and do not contain riffles. High gradient streams generally have alternating riffles and pools, with gravel or cobble present in the riffles. Typically, most streams north of the Fall Line are high gradient, with the exception of streams in the Coastal Plain and low gradient streams flowing through wetlands or wet meadows throughout the state. Headwater stream channels have intermittent hydrologic regimes and may not have the diversity of habitat features found in higher order stream channels. Hyporheic zone flow (subsurface region of streams where the mixture of surface water and groundwater can be found) may comprise all of the flow in intermittent streams during dry times of the year. A high gradient stream should not be scored lower because there is not submerged aquatic vegetation. Likewise, a low gradient stream should not be scored lower because it does not contain riffles.

High Gradient Streams
Physical elements of high gradient stream systems that enhance a stream's ability to support aquatic organisms and are indicative of habitat diversity include the following:

1. A varied mixture of substrate sizes (i.e., sand, gravel, cobbles, and boulders).
2. Low amount of highly mobile substrate material – While most streambed substrate mobilizes under a particular discharge, substrate that remains immobile during the more consistent and frequent discharges provides stable habitat that fish and macroinvertebrates can utilize throughout differing stages of their lifecycles.
3. Low Embeddedness of substrate material – Embeddedness is the extent to which rocks (gravel, cobble, and boulders) and snags are covered by silt, sand, or mud on the stream bottom. As rocks and snags become embedded, there is less area available for colonization for macroinvertebrates and less fish habitat. Generally, the less embedded each particle is, the more surface area available to macroinvertebrates and fish. Additionally, less embeddedness indicates less large-scale sediment movement and deposition. (Observations of embeddedness are taken in the upstream and central portions of riffles and cobble substrate areas.)
4. A varied combination of water velocities and depths (riffles and pools) - More combinations of velocity and depth patterns provide increased habitat diversity.
5. The presence of woody and leafy debris (fallen trees, logs, branches, leaf packs, etc.), root mats, large rocks, and undercut banks (below bankfull).
6. The provision of shade protection by overhanging vegetation.
7. The Hyporheic zone is wet within 12" of ground surface.

Low Gradient Streams
Physical elements of low gradient stream systems that enhance a stream's ability to support aquatic organisms and are indicative of habitat diversity include the following:

1. A varied mixture of substrate materials (i.e., sand and gravel) in pools – Varied substrate materials support a higher diversity of organisms than mud or bedrock.
2. Submerged aquatic vegetation in pools – Will also support a higher diversity of organisms.
3. The presence of woody and leafy debris (fallen trees, logs, branches, leaf packs, etc.), root mats, and undercut banks (below bankfull).
4. The provision of shade protection by overhanging vegetation.
5. The Hyporheic zone is wet within 12" of ground surface.

A diverse and abundant assemblage of these features promotes the potential for colonization by diverse and abundant epifaunal and fish communities. This assessment measures the availability of physical habitat diversity within a stream. Each cover type must be present in appreciable amounts and with high likelihood of having a long-term presence to score. This should be assessed within a representative subsection of the stream reach that is equivalent to 5 times the active channel width.

Logs/large woody debris: Fallen trees or parts of trees that provide structure and attachment for aquatic macroinvertebrates and hiding places for fish.

Deep Pools: Areas characterized by a smooth undisturbed surface, generally slow current, and deep enough to provide protective cover for fish (75-100 percent deeper than prevailing stream depth).

Overhanging vegetation: Trees, shrubs, vines, or perennial herbaceous vegetation that hang immediately over the stream surface, providing shade and cover.

Boulders: Boulders more than 10 inches in diameter or large slabs more than 10 inches in length.

Undercut banks: Eroded areas extending horizontally beneath the surface of the bank forming underwater pockets used by fish for hiding and protection.

Thick root mats: Dense mats of roots (generally from trees) at or beneath the water surface forming structure for invertebrate attachment and fish cover.

Dense macrophyte beds: Beds of emergent or submerged aquatic vegetation thick enough to provide invertebrate attachment and fish cover.

Riffles: Area characterized by broken water surface, rocky or firm substrate, moderately swift current, and relatively shallow depth (usually less than 18 inches).

5.3.1 In-Stream Habitat Categories

The reach is assessed for the condition of **In-Stream Habitat** using the following four Categories. The Evaluator selects the category most representative of the stream reach.

A. Optimal

Greater than 5 types of habitat present. Physical Elements that enhance a stream's ability to support aquatic organisms are present in greater than 50% of the reach. Substrate is favorable for colonization by a diverse and abundant epifaunal community, and there are many suitable areas for epifaunal colonization and/or fish cover.

B. Suboptimal

5 types of habitat present. Physical Elements that enhance a stream's ability to support aquatic organisms are present in 30-50% of the reach. Conditions are mostly desirable, and are generally suitable for full colonization by a moderately diverse and abundant epifaunal community.

C. Marginal

4 types of habitat present. Physical Elements that enhance a stream's ability to support aquatic organisms are present in 10-30% of the reach. Conditions are generally suitable for partial colonization by epifaunal and/or fish communities.

D. Poor

3 types of habitat present. Physical Elements that enhance a stream's ability to support aquatic organisms are present in less than 10% of the reach. Conditions are generally unsuitable for colonization by epifaunal and/or fish communities.

5.4 <u>Timing of Mitigation</u>: Mitigation must be initiated prior to or concurrent with the start of the authorized project impacts to wetlands. Any required riparian buffer tree planting must occur within the first growing season of the project. No credits are generated for this factor if the mitigation action in a reach is primarily riparian buffer preservation.

Non-Banks:

Before: All mitigation is completed before the impacts occur.
During: A majority of the mitigation is completed concurrent with the impacts
After: A majority of the mitigation will be completed after the impacts occur.

Banks: Release of credits will be determined by the MBRT on a case-by-case basis.

6.0. RIPARIAN WORK - MITIGATION CREDITS:

All stream mitigation projects require protected riparian buffers. Riparian buffer mitigation must provide high quality wetland and upland habitats based upon measurable ecological success parameters. Similar to in-stream projects, applicants are encouraged to utilize reference quality wetland and upland systems for developing their ecological success criteria. Applicants are encouraged to use the success criteria developed by the Mobile District for wetland habitats which may be adjusted for regional differences as supported by data collected from similar high quality wetland habitats in the same watershed.

Activities that constitute stream preservation, restoration and enhancement may include, but are not limited to, stream channel restoration; stream bank stabilization, and natural riparian buffer restoration, enhancement, or preservation. **Riparian buffer preservation may account for no more than 30% of credits generated by the mitigation plan and must meet the requirements contained in 33 CFR Part 332.3(h) on preservation.** Deviation from these percentages may be approved on a case-by-case basis by the Corps in consultation with other resource and regulatory agencies.

6.1 Riparian Buffer Restoration, Enhancement, and Preservation Mitigation:

The minimum buffer width (MBW) for which mitigation credit will be earned is 50 feet on one side of the stream, measured from the top of the stream bank (i.e., the bankfull stage), perpendicular to the channel. Narrower buffer widths may be allowed on a case-by-case basis for small urban streams due to physical space constraints often encountered in urban environments. Intermittent streams may only claim credit for a maximum of a 2X the minimum buffer width. If topography within a proposed stream buffer has more than a 2% slope, 2 additional feet of buffer are required for every additional percent of slope (e.g., minimum buffer width with a +10% slope is 70'). Buffer slope will be determined in 50'-increments beginning at the stream bank. No additional buffer width will be required for negative slopes. For the reach being buffered, degree of slope will be determined at 100' intervals and averaged to obtain a mean degree of slope for calculating minimum buffer width. This mean degree of slope will be used to calculate the minimum buffer width for the entire segment of stream being buffered.

6.2. Riparian Buffer Net Benefit:

Riparian Buffer Restoration means implementing rehabilitation practices within a stream riparian buffer zone to have a measurable effect on stream ecological function and water quality. Buffer restoration requires the restoration of both vegetation and hydrology to that of a reference high quality upland and/or wetlands system within the same watershed. Restoration programs should strive to mimic the hydrology, and vegetation species composition, structure, and density of an in-kind reference system.

Riparian Buffer Enhancement means implementing rehabilitation practices within a stream riparian buffer zone to have a measurable effect on stream water quality and/or ecological function. Buffer enhancement requires improving the existing upland and/or wetlands habitat either by improving the hydrology or vegetation to mimic that of a reference system within the same watershed. Enhancement programs should strive to mimic the vegetation species composition, structure, and density of an in-kind reference system.

Riparian Buffer Preservation means the conservation, in its naturally occurring or present condition, of a high quality riparian buffer to prevent its destruction, degradation, or alteration in any manner not authorized by the governing authority. For the purposes of these guidelines, an area will be considered as riparian buffer preservation if less than 10% of the area would require planting of deep-rooted vegetation to restore stream bank stability and improve wildlife habitat. **Riparian buffer preservation may account for no more than 30% of credits generated by the mitigation plan.**

Tables 1 below provide appropriate Net Benefit values for the riparian restoration, enhancement and preservation mitigation worksheet. Note that on the worksheet in Appendix A that buffers on each bank generate independent mitigation credit.

Table 1. Riparian Buffer Restoration, Enhancement and Preservation

	% Buffer that Needs Vegetation Planted	Buffer Restoration	Buffer Enhancement -		Buffer Preservation - Planting (0 – 10%)
			Planting (51 - 100%)	Planting (11% - 50%)	
Buffer Width (on one side of the stream)	4X min. width	1.6	1.2	0.8	0.4
	3X min. width	1.2	0.9	0.6	0.3
	**2X min. width	0.8	0.6	0.4	0.2
	*Minimum width (50 ft)	0.4	0.3	0.2	0.1

No mitigation credit will be given for riparian buffers on impacted streams where no in-stream work is proposed.

* Smaller buffers width may be allowed on a case-by-case basis for small urban streams.

** Intermittent streams are limited to a maximum 2X minimum buffer width (maximum 100 feet on each side).

Fencing in Actively-Grazed Riparian Buffers: Cattle are not allowed to access riparian buffers within compensatory mitigation sites. Land management actions typically include restoring vegetation and fencing livestock from pastures, where livestock grazing activities are impacting water quality and/or stream ecological function by causing streambank degradation, sedimentation, and water quality problems. Livestock exclusion is normally accomplished by fencing stream corridors and can include the construction of stream crossings with controlled access and with stable and protected stream banks. No more than one livestock crossing is allowed per 1,000 linear feet of stream mitigation. The width of the livestock crossing and any length of affected stream below will be deducted from the total length of the stream mitigation segment. After cattle have been removed, impacted riparian buffers must be restored or enhanced and may not be used for preservation purposes only.

6.2 System Protection Credit: Bonus mitigation credit may be generated if proposed riparian mitigation activities include minimum width buffers on both sides of a stream reach and legal protection of a fully buffered stream channel. (**Condition:** Mitigation plan provides for restoration or preservation of minimum width buffers, as defined in these guidelines, on both streambanks of the reach).

6.4 Mitigation Factor: It is recommended that stream mitigation be conducted on free flowing streams. However, if a proposed stream mitigation segment is located within 1 mile of the upstream end of an existing or proposed man made lake, and flows into the lake,, then mitigation credits for this segment of stream will be reduced by 50%. **Use mitigation factor of 0.5 for the above mitigation sites. Use mitigation factor of 1.0 for all other mitigation.**

7.0 DEFINITIONS:

Bankfull Discharge (effective discharge) The bankfull discharge stage is the incipient point at which water begins to overflow the bed and bank channel and onto a floodplain. Bankfull may not be at the top of the stream bank in incised or entrenched streams. On average, bankfull discharge events occur approximately once every 1.5 years. The bankfull discharge is the most important stream process in defining channel form and is the flow that is most effective at moving sediment, forming or removing bars, forming or changing bends and meanders, and doing work that results in the average morphologic characteristics of channels.

Bankfull Width- is the width of the stream channel at bankfull discharge, as measured in a riffle section.

Bank Height Ratio- is the maximum depth of the stream from top of the lowest bank to the thalweg divided by the maximum depth from bankfull to thalweg. It along with entrenchment ratio is a means to measure vertical stability of a stream.

Channel Dimension- is the stream's cross-sectional area (calculated as bankfull width multiplied by mean depth at bankfull). Changes in bankfull channel dimensions correspond to changes in the magnitude and frequency of bankfull discharge that are associated with water diversions, reservoir regulation, vegetation conversion, development, overgrazing, and other watershed changes. Stream width is a function of occurrence and magnitude of discharge, sediment transport (including sediment size and type), and the streambed and bank materials.

Channel Features- natural streams have sequences of riffles and pools or steps and pools that maintain channel slope and stability and provide diverse aquatic habitat. A riffle is a bed feature where the water depth is relatively shallow and the slope is steeper than the average slope of the channel. At low flows, water moves faster over riffles, which provides oxygen to the stream. Riffles are found entering and exiting meanders and control the streambed elevation. Pools are located on the outside bends of meanders between riffles. The pool has a flat slope and is much deeper than the average channel depth. Step/pool sequences are found in high gradient streams. Steps are vertical drops often formed by large boulders or downed trees. Deep pools are found at the bottom of each step.

Channel Pattern- refers to the plan view of the channel as seen from above. Streams are rarely straight; they tend to follow a sinuous path across a floodplain. Sinuosity of a stream is defined as the ratio of channel length/valley length. In addition to slope, the degree of sinuosity is related to channel dimensions, sediment load, stream flow, and the bed and bank materials. In general, sinuosity increases as valley gradient increases. Stream pattern is defined by measuring meander wavelength, radius of curvature, amplitude, and belt width.

Channel Profile- of a stream refers to its longitudinal slope which typically decreases downstream and is inversely related to slope. It is a reflection of irregular profile based upon bed material, riffle/pool spacing, and other variables. At the watershed scale, channel slope generally decreases in the downstream direction with commensurate increases in stream flow and decreases in sediment size. Channel slope is inversely related to sinuosity, so steep streams have low sinuosity and flat streams have high sinuosity.

Entrenchment Ratio- is an index value that describes the degree of vertical containment of a river channel. It is calculated as the width of the flood-prone area (elevation at twice bankfull max depth above thalweg) divided by width of bankfull channel.

Ephemeral Streams - streams that have flowing water only during and for a short duration after, precipitation events in a typical year. Ephemeral streambeds are located above the groundwater table year-round and typically do not have bed and bank features. Groundwater is not a source of water for the stream. Runoff from rainfall is the primary source of water for these streams which typically occur as vegetated wetland swales.

Flood-prone Area- the width of the flood prone area is measured in the field at an elevation twice-maximum depth at bankfull, measured in the thalweg. Maximum depth is the difference between the bankfull stage and thalweg elevations in a riffle section.

High Gradient Streams –streams with moderate-high gradient landscapes; substrates primarily composed of coarse sediments [gravel (2mm) or larger] or frequent coarse particulate aggregations; riffle/run prevalent.

Intermittent Streams - streams that have flowing water during certain times of the year, when groundwater provides water for stream flow. During dry periods, intermittent streams may not have flowing water. Runoff from rainfall is a supplemental source of water for stream flow.

Low Gradient Streams - streams with low-moderate gradient landscapes; substrates of fine sediment particles or infrequent aggregations of coarse sediment particles [gravel (2mm) or larger]; glide/pool prevalent.

Mean Depth at Bankfull-is the mean depth of the stream channel cross-section at bankfull stage as measured in a riffle section.

Meander Width Ratio- is defined as the meander belt width divided by bankfull width.

Natural Stream Channel Design- is the concept of determining appropriate stream channel design utilizing stable reference stream reaches that represent the best conditions attainable within a particular stream class within a watershed.

Priority 1 Restoration - is defined as stream channel restoration that involves the re-establishment of a channel on the original floodplain, using either a relic channel or construction of a new channel. The new channel is designed and constructed with the proper dimension, pattern, and profile characteristics for a stable stream. The existing, incised channel is either backfilled or made into discontinuous oxbow lakes level with the new floodplain elevation.

Priority 2 Restoration - is defined as stream channel restoration that involves re-establishment of a new floodplain at the existing level or higher but not at the original level. The new channel is designed and constructed with the proper dimension, pattern, and profile characteristics for a stable stream.

Priority 3 Restoration - is defined as stream channel restoration to a channel without an active floodplain but with a floodprone area. However, the restoration of the channel must involve establishing proper dimension, pattern, and profile. Some sites may present difficulties in reestablishing a sinuous pattern when they are laterally contained or have limitations in available belt width. This is often caused by utilities, infrastructure, and other floodplain encroachments. Such physical constraints often favor the creation of a step/pool bed morphology with less sinuosity (associated with Priority 3) over a riffle/pool bed morphology with greater sinuosity (associated with Priorities 1 & 2).

Reference Reach/Condition - Reference reaches are unimpaired stream reaches located as close as possible to the impacted reach, within the same watershed or stream whenever possible. These relatively unimpaired stream systems provide reference metrics of physical (bed features, channel forms, dimension, pattern, and profile), biological, and chemical parameters that have demonstrated to be persistent even after periodic disturbances such as flooding events.

Sinuosity: the ratio of channel length/valley length. In addition to slope, the degree of sinuosity is related to channel dimensions, sediment load, stream flow, and the bed and bank materials. In general, sinuosity increases as valley gradient increases.

Slope- slope of water surface averaged for 20-30 channel widths.

Stable Stream- a naturally stable stream channel is one that maintains its dimension, pattern, and profile over time such that the stream does not cumulatively aggrade or degrade. Naturally stable streams must be able to transport the water, organic matter, and sediment load supplied by the watershed. Stable streams are not fixed and migrate across the landscape slowly over geologic time while maintaining their form and function. In general, stream stability can be assumed if the stream maintains a stable pattern, profile, and dimension after two bankfull events which typically occur at a 1.5 year interval.

Stream Reach - stream reach is the length of a stream section containing a complete riffle and pool complex. If none noted, a suitable length is usually no less than 300 feet long

Stream Re-establishment – is the manipulation of the physical, chemical, or biological characteristics of a stream with the goal of creating natural/historic functions to former stream. Re-establishment results in rebuilding a former stream.

Stream Restoration or Rehabilitation - is the manipulation of the physical, chemical, or biological characteristics of a stream with the goal of restoring natural/historic functions of degraded streams. Rehabilitation results in a gain in stream functions. This can be accomplished by converting an unstable, altered, or degraded stream channel / stream corridor, including adjacent riparian zone and flood-prone areas to its natural or referenced, stable conditions considering recent and future watershed conditions. Stream channel restoration methods should be based on measurements taken in a reference reach and may include restoration of the stream's geomorphic dimension, pattern and profile and/or biological and chemical integrity, including transport of water and sediment produced by the streams' watershed to achieve dynamic equilibrium. (Dimension includes a stream's width, mean depth, width/depth ratio, maximum depth, flood prone area width, and entrenchment ratio. Pattern refers to a stream's sinuosity, meander wavelength, belt width, meander width ratio, and radius of curvature. Profile includes the mean water surface slope, pool/pool spacing, pool slope, & riffle slope.)

Stream Stabilization - the manipulation of the physical characteristics of stream to reduce the erosion potential of the stream. Stabilization techniques which include "soft" methods or natural materials (such as tree revetments, root wads, log crib structures, rock vanes, vegetated crib walls and sloping of streambanks) may be considered part of a restoration design. However, stream stabilization techniques that consist primarily of "hard" engineering, such as concrete lined channels, rip rap, or gabions, while providing bank stabilization, will usually not be considered restoration or enhancement in most cases.

Stream Enhancement – is the manipulation of the physical, chemical, or biological characteristics of a (undisturbed but degraded) stream or stream buffer to heighten, intensify, or improve specific function(s) or to change the growth stage or composition of the vegetation present. Enhancement is undertaken for a purpose such as water quality improvement and/or ecological functions (flood water retention or wildlife habitat). This can be accomplished by implementing certain stream rehabilitation practices. These practices are typically conducted on the stream bank or in the flood prone area but may also include the placement of in-stream habitat structures; however, they should only be attempted on a stream reach that is not experiencing severe aggradation or degradation. Care must be taken to ensure that the placement of in-stream structures will not affect the overall dimension, pattern, or profile of a stable stream.

Stream Preservation - The protection of ecologically important aquatic resources in perpetuity through the implementation of appropriate legal and physical mechanisms. Preservation will include protection of riparian areas adjacent to stream channels or other aquatic resources as necessary to ensure protection and/or enhancement of the aquatic ecosystem.

Stream Restoration - Converting an unstable, altered, or degraded stream corridor, including adjacent riparian zone (buffers) and flood-prone areas, to its natural stable condition considering recent and future watershed conditions. This process should be based on a reference condition/reach for the valley type and includes restoring the appropriate geomorphic dimension (cross-section), pattern (sinuosity), and profile (channel slopes), as well as reestablishing the biological and chemical integrity, including transport of the water and sediment produced by the **stream's watershed in order to achieve dynamic equilibrium.**

Stream Relocation- Is moving a stream to a new location to allow a project, authorized under Section 404 of the Clean Water Act, to be constructed on the stream's former location. (Note: relocation of a stream is considered fill under these guidelines when the relocation is conducted to allow development of the area where the stream previously was located; impacts associated with stream relocation in these situations must be fully mitigated). Relocated streams should reflect the dimension, pattern and profile of natural, referenced stable conditions; maintain the capacity to transport bedload sediment; and have at least a minimum width buffer of natural vegetation on both sides of the stream to receive mitigation credit; this buffer also will generate riparian preservation or restoration mitigation credit.

Width/Depth Ratio- is an index value that indicates the shape of the channel cross-section. It is the ratio of the bankfull width divided by the mean depth at bankfull.

APPENDIX A
ADVERSE IMPACT
FACTORS FOR RIVERINE SYSTEMS WORKSHEET

Stream Type Impacted	Intermittent 0.1			1st or 2nd Order Perennial Stream 0.8			>2nd Order Perennial Stream 0.4		
Priority Area	Tertiary 0.1			Secondary 0.4			Primary 0.8		
Existing Condition	Impaired 0.1			Somewhat Impaired 0.8			Fully Functional 1.6		
Duration	Temporary 0.05			Recurrent 0.1			Permanent 0.3		
Dominant Impact	Shade/ Clear 0.05	Utility Crossing 0.15	Below Grade Culvert 0.3	Armor 0.5	Detention /Weir 0.75	Morpho-logic Change 1.5	Impound-ment (dam) 2.0	Pipe >100' 2.2	Fill 2.5
Cumulative Impact Factor	<100' 0	100'-200' 0.05	201-500' 0.1	501-1000' 0.2	>1000 linear feet (LF) 0.1 for each 500 LF of impact (example: scaling factor for 5,280 LF of impacts = 1.1)				

Factor	Dominant Impact Type 1	Dominant Impact Type 2	Dominant Impact Type 3	Dominant Impact Type 4	Dominant Impact Type 5
Stream Type Impacted					
Priority Area					
Existing Condition					
Duration					
Dominant Impact					
Cumulative Impacts Factor					
Sum of Factors	M =				
Linear Feet of Stream Impacted in Reach	LF=				
M X LF					

Total Mitigation Credits Required = (M X LF) = ________________

IN-STREAM WORK
STREAM CHANNEL /STREAMBANK RESTORATION AND RELOCATION WORKSHEET

Stream Type	Intermittent	1st or 2nd Order Perennial Stream	>2nd order Perennial Stream (Bankfull width)			
			>15'	15'-30'	30'-50'	>50'
	0.05	0.4	0.4	0.6	0.8	1.0

Priority Area	Tertiary 0.05	Secondary 0.2	Primary 0.4

Existing Condition	Impaired 0.4	Somewhat Impaired 0.05

Net Benefit	Stream Relocation	Stream Channel Restoration/Stream Bank Stabilization		
		Moderate 1.0	Good 2.0	Excellent 3.5
	0.1			

Streambank Stability	Stable Banks 0.4	Moderately Stable Banks 0.2

Instream Habitat	>5 cover types 0.35	5 cover types 0.25	4 cover types 0.15	3 Cover types 0.1

Timing of Mitigation	Before 0.15	During 0.05	After 0

Factors	Net Benefit 1	Net Benefit 2	Net Benefit 3	Net Benefit 4	Net Benefit 5	Net Benefit 6
Stream Type						
Priority Area						
Existing Condition						
Net Benefit						
Bank Stability						
Instream Habitat						
Timing of Mitigation						
Sum Factors (M)=						
Stream length in Reach (do not count each bank separately) (LF)=						
Credits (C) = M X LF						
Mitigation Factor Use (MF) = 0.5 or 1.0						
Total Credits Generated C X MF =						

Total Channel Restoration/Relocation Credits Generated = ___________

RIPARIAN BUFFER RESTORATION AND PRESERVATION WORKSHEET

Stream Type	Intermittent 0.05	>2nd Order Perennial Stream 0.2	1st or 2nd Order Perennial 0.4
Priority Area	Tertiary 0.05	Secondary 0.2	Primary 0.4
Net Benefit (for each side of stream	Riparian Restoration, Enhancement, and Preservation Factors (select values from Table 1) (MBW = Minimum Buffer Width = 50' + 2' / 1% slope)		
System Protection Credit	Condition : MBW restored or protected on both streambanks To calculate:(Net Benefit Stream Side A + Net Benefit Stream Side B) / 2		
Timing of Mitigation	Before 0.15	During 0.05	After 0

Factors		Net Benefit 1	Net Benefit 2	Net Benefit 3	Net Benefit 4	Net Benefit 5	Net Benefit 6
Stream Type							
Priority Area							
Net Benefit	Stream Side A						
	Stream Side B						
System Protection Credit Condition Met (Buffer on both sides)							
Timing of Mitigation (None for primarily riparian preservation)	Stream Side A						
	Stream Side B						
Sum Factors (M)=							
Linear Feet of Stream Buffer (LF)= (don't count each bank separately)							
Credits (C) =M X LF							
Mitigation Factor Use (MF) = 0.5 or 1.0							
Total Credits Generated C X MF =							

Total Riparian Restoration Credits Generated = ________________

Appendix B: Stream Mitigation Plan Requirements

Stream Conceptual Mitigation Plan

The Mobile District encourages the use of natural stream channel design concepts for all in-stream mitigation projects. This approach incorporates the use of stable, preferably non-impacted reference quality stream reaches for designing the appropriate pattern, profile, and dimension for stream mitigation projects. The concept of using reference sites is also encouraged when designing stream riparian buffer mitigation projects. Stream mitigation projects can be very complex depending on the level of manipulation required to achieve the target stream. It requires an understanding of upstream land use changes, both at the local and watershed level, since these changes are usually the cause of the disequilibrium regarding upstream delivery of water flow and sediment that influences the final stream restoration design necessary to achieve a stable stream restoration project. The Mobile District encourages the use of the Rosgen stream classification and stream stability concepts to allow for a consistent framework for organizing information and communications. This method allows for consistent discussion regarding data requirements including the current stream stability parameters based upon stream dimension metrics such as width/depth ratio, bank height ratio, and entrenchment ratio, as well as pattern and profile metrics including slope, bed features, sinuosity, meander width ratio, and radius of curvature. ***The Corps will determine, on a case-by-case basis***, the net benefit of mitigation actions that do not involve direct manipulation of the entire length of stream. **Riparian buffer preservation may account for no more than 30% of credits generated by the mitigation plan.** Stream mitigation within 300 feet of a culvert, dam, or other man-made impact to waters of the United States generally will generate only minimal restoration or preservation credit due to impacts associated with these structures.

All of the restoration and enhancement measures should be designed with the goal of improving the entire stream system within a target reach using approved reference stream systems to properly determine appropriate stable stream pattern, profile, and dimension, stable stream bank design, and target species composition and diversity within the adjacent riparian buffer ecosystem. The level of detail required in a mitigation plan will be commensurate with the complexity of the mitigation project. All compensatory mitigation sites must be deed protected using either a conservation easement or restrictive covenant. The conservation easement or restrictive covenant must be approved by the Corps prior to being properly recorded with the appropriate local entity and be in compliance with Mobile District's requirements. They should be conforming to the most recent example edition located on the Mobile District web page at http://www.sam.usace.army.mil/RD/reg/.

In order to develop a conceptual stream mitigation plan, it is necessary to first research the stream's watershed and its history to determine the cause and extent of its deficiencies. The following questions should be answered to help identify and document the specific deficiencies to be addressed within a stream reach.

1. What is the stream name?
2. What is the reach length to be evaluated? Provide a USGS topographic map with the location of the stream reach clearly identified.
3. What is the stream order?
4. What is the approximate drainage area?

5. Describe the existing watershed and the estimated proposed land use for that watershed (i.e.: percent residential, percent forested, percent commercial, percent cleared/logged, percent industrial, percent agricultural, other).
6. Describe the existing riparian buffer (i.e.: mature forested, herbaceous and shrub layers present in understory, utility easements present, understory maintained, lawns, impervious surfaces, active row crops, etc.). Provide the estimated percentage of the total riparian area comprised of each cover type.
7. What is the estimated bankfull width?
8. What is the estimated bank height?
9. Is the channel high gradient or low gradient?
10. Does the chan nel appear to have natural sinuosity or does it appear that the channel patterns have been altered?
11. Does the chan nel appear to be aggrading, degrading, or stable?
12. Describe th e sediment supply (i.e. extreme, very high, high, etc.)
13. Are the stre ambanks eroding? Over what percentage of the reach?
14. Are he ad-cuts present within the reach?
15. Provide a general narrative overview of the existing stream pattern, profile, or dimension alterations and the proposed necessary restoration or enhancement measures to be taken to address those deficiencies.
16. What are the goals and objectives of the mitigation, and how will the mitigation plan meet those goals and objectives?
17. The Stream Impact Assessment Form can be used to further document the existing condition of the mitigation site.

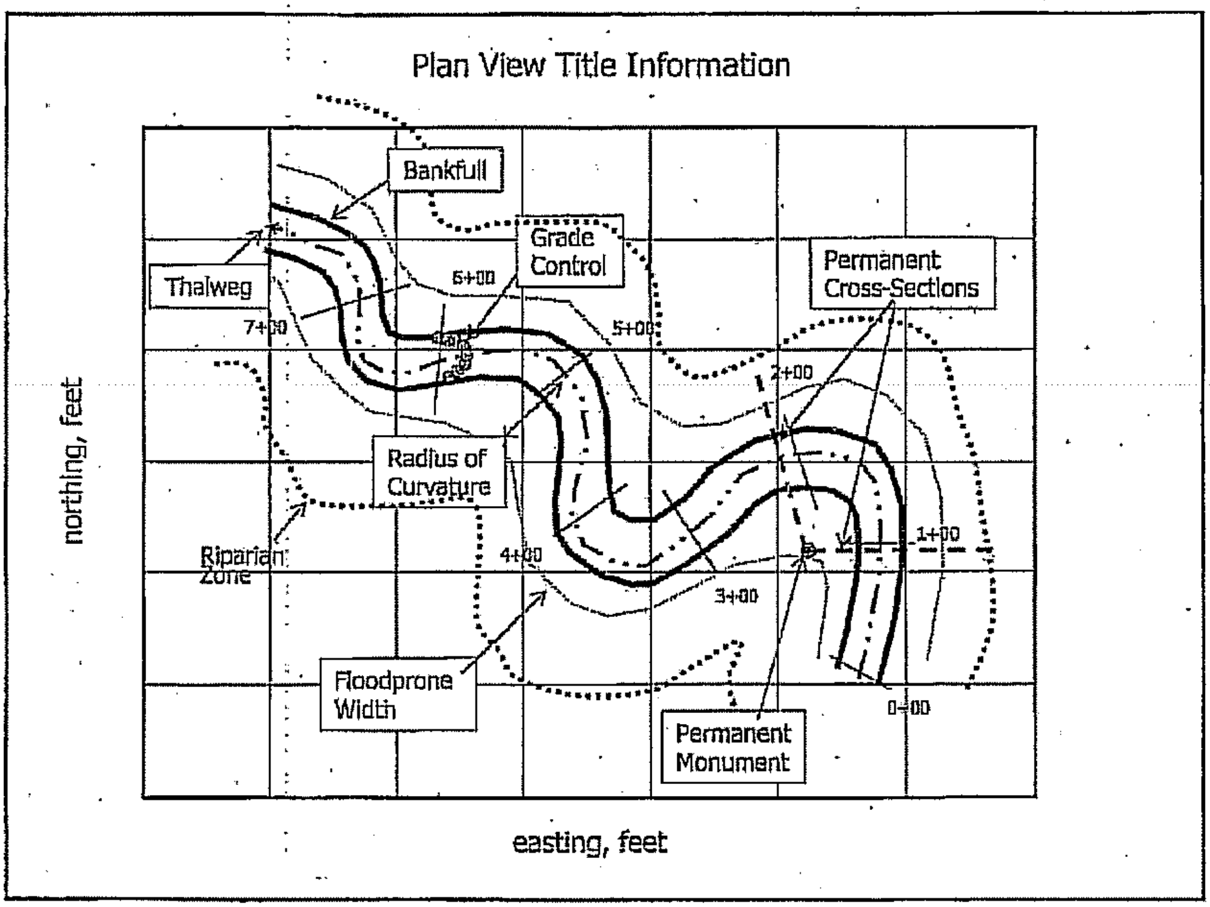
DATA SUMMARY SHEET

	EXISTING	PROPOSED	REFERENCE	AS BUILT*
Stream Name				
Stream Width				
Drainage Area				
Rosgen Stream Type				
Channel Slope				
Length of Valley				
Length of Channel Thalweg				
Sinuosity				
Meander Wavelength				
Meander Belt Width				
Radius of Curvature				
Meander Width Ratio				
Radius of Curvature Ratio				
Bankfull Width				
Bankfull Area				
Mean Depth @ BKF				
Max Depth @ BKF				
Entrenchment Ratio				
Width to Depth Ratio				
Bank Height Ratio				
Max Depth Ratio				

Sediment Type				
Flood prone width				
Flood prone area				

- *A current Summary Sheet Data worksheet must be completed and provided for each requested credit release associated with in-stream work.

Typical Plan View



Appendix C: Stream Mitigation Success Criteria

1. Introduction

There is no simple recipe approach to address how to achieve a successful stream channel restoration project. River corridors are dynamic and influenced by a diverse array of environmental processes. These physical and ecological processes are related to regional variability in hydrologic regimes, hydraulics, geology, geomorphic channel processes, connectivity to riparian zones, climates, and ever changing surrounding development influences. There are too many variables that must be addressed for a one-size fits all approach to stream channel restoration. Because of the dynamic nature in how stream systems adapt to these changing influences, the same stream restoration design plan is rarely applicable to different streams.

2. Natural Stream Channel Design

One method for addressing the wide range of variability associated with properly designing a stream channel restoration project, and the method endorsed by the Mobile District, is the concept and use of natural stream channel design for stream restoration projects. This approach incorporates the use of stable "reference reach" streams when designing appropriate pattern, profile, and dimension characteristics for a stream restoration project. Reference reaches are streams of the same order and position within the watershed that exhibit the least altered stable stream pattern, profile, and dimension. Reference reaches do not have to be perfect streams, most represent the least altered stable stream available for a watershed. While the reference reach can provide reference stream metrics for the stable stream at that one moment, it is also important to understand upstream land use changes, both at the local or watershed level, that cause disequilibrium regarding upstream delivery of water flow and sediment that influences the final stream restoration design necessary to achieve a stable stream restoration project.

3. Discussing Your Stream Channel Restoration Project

When initially presenting an instream channel restoration project, applicants should be prepared to discuss the current stream condition/type using the Rosgen stream classification system as well as the current stage in the Stream Channel Evolution Model. To provide a consistent and standardized framework for communicating stream information, this discussion should center on the current dimension (vertical stability) metrics including width depth ratio, bank height ratio, entrenchment ratio, as well as pattern and profile (lateral stability) metrics including slope, bed features, sinuosity, meander width ratio, and radius of curvature. Data sheets should be provided for all stream channel restoration projects that will require in-stream work. The level of information collected should be commensurate with the level of instream work being proposed. Final stream design data sheets should include stream measurement data for the currently impacted stream, the reference reach, and the target stream design.

4. Wetland Riparian Buffers

All streams proposed as mitigation must be protected with riparian buffers. The minimum riparian buffer that can be placed on a stream is 50 feet. Riparian buffer restoration and enhancement actions and target ecological performance standards should be based upon success criteria developed for each wetland type by the Mobile District and found on the Regional Internet Banking Information Tracking System (RIBITS) on the Mobile District Regulatory Division website.

5. Upland Riparian Buffers

For upland riparian buffers on streams, riparian buffer restoration and enhancement actions and target ecological performance standards should be based upon target species composition, diversity, and structure, gathered from high quality reference upland riparian buffers in the same watershed.

Stream Mitigation Success Criteria

1. In-stream Mitigation

- Establishment/acceptance of Reference stream reach for target stream pattern, profile, and dimension.
- Identification of stream gage station data regional curve data for region if available.

Restoration of a stream channel to a stable pattern, profile, and dimension based upon reference stream parameters.

- Maintaining stable stream parameters for two bankfull events. Bankfull events typically occur on a 1.5 year basis. The second bankfull event should be no sooner than 1.5 years after the first event to demonstrate long-term stability of the restored stream channel.

1.1 Stream Channel Monitoring

Monitoring should include annual inspections of each individual stream reach and documenting stream stability parameters for pattern, profile, and dimension as well as deviations from stable stream conditions. Prior to requesting a credit release, stream measurement data sheets should be provided for each stream reach to demonstrate stable stream conditions. Selected cross-sectional areas should be representative of typical pattern, profile, and dimension for the entire stream reach. Additional measurements may be required for individual stream reaches deviating from target stable stream conditions..

2. Riparian Buffer Mitigation

2.1 Wetlands. Restore wetlands using success criteria and credit release schedule developed by Mobile District and listed on Regional Internet Banking Information Tracking System site on Mobile District Regulatory Division web site.

2.2. Uplands. Establishment/acceptance of Reference Forest Ecosystem (RFE).

Restoration of an upland habitat to mimic species composition and diversity of RFE. Initial planting density should be approximately twice the final target density.

Appendix D: Stream Mitigation Monitoring Requirements

Monitoring should be in compliance with Regulatory Guidance Letter 08-03, Mitigation Monitoring Requirements. Monitoring and contingency plans are actions that will be undertaken during the mitigation project to measure the level of success of the mitigation work and to correct problems or failures. All projects should include contingency actions that will achieve specified success criteria if deficiencies or failures are found during the monitoring period. Monitoring is a required component of all mitigation plans and should at a minimum, address all success criteria paragraphs. The following monitoring requirements are to be applied to all stream mitigation sites as well as all reference sites.

- **Monitoring (Physical Monitoring):**
  - -- **Riparian buffer preservation:** After initial collection of baseline information on vegetation, document any changes in the preserved buffer annually for at least 5 years or the life of the mitigation project. Minimal baseline information to be collected should include vegetation present, species composition, density, and structure including average species height and average species diameter at breast height (dbh). The site should be continually monitored for the presence of exotic species and appropriate actions taken when necessary.

  - -- **Riparian buffer restoration and enhancement:** Collection of baseline information on vegetation in the buffer before mitigation is implemented and annually for atleast 5 years or the life of the mitigation project. Minimal information to be collected annually should include vegetation present, species composition, density, and structure including average species height and diameter (dbh). In addition, similar data for planted and naturally recruiting trees and vegetation should be monitored annually, at least for 5 years or the life of the mitigation project, until target success criteria are achieved.

  - -- **Stream channel restoration/stream bank stabilization and stream relocation:** Collection of initial baseline data on physical parameters in streams before mitigation is implemented and monitoring of these physical parameters annually, for at least 5 years or the life of the mitigation project, and after mitigation is completed. Physical parameters to be measured include stream pattern, profile, and dimension metrics at sites above, within, and below the restored reach, water temperature, DO, turbidity, pH, stream substrate characteristics, erosion patterns, and biological parameters that may include density and diversity of reptiles, amphibians, fish, freshwater mussels, or other macroinvertebrates and other fauna at sites within the stream.

Determinations of success will be proposed by the mitigation sponsor and confirmed by COE and review agencies. Monitoring will include items 1, 2 and 3 and may include item 4 (see Table 2) based on the project review.

Contingency Plans/Remedial Actions: In the event the mitigation fails to achieve interim or final success criteria as specified in the mitigation plan, sponsor shall develop necessary contingency plans and implement appropriate remedial actins for that phase. In the event the sponsor fails to implement necessary remedial actions or demonstrate meaningful progress towards achieving the target success criteria within an appropriate amount of time determined by the Corps, the Corps will notify sponsor and the appropriate authorizing agencies and require appropriate corrective actions that may include providing alternative compensation by purchasing mitigation credits from an approved mitigation bank.. The Corps reserves the right to take enforcement actions on all permit non-compliance issues.

Table 2. General criteria used to evaluate the success or failure of activities at mitigation sites and required remedial actions to be implemented should monitoring indicate failure of component.

Mitigation Component (Item)	**Success (Required on action)**	**Failure**	**Action**
1. Photo Reference of Sample Sites Longitudinal photos Lateral photos	No substantial instream aggradation, degradation or bank erosion.	Substantial aggradation degradation or bank erosion.	When substantial aggradation, degradation or bank erosion occurs, adaptive management actions will be planned, approved, and implemented.
2. Riparian Vegetation and Hydrology Riparian Buffer: Sample plots Tree counts Monitoring wells	Within the riparian buffer, achievement of target hydrology, tree and plant species diversity, composition, and structure as required by Mobile District wetland habitat success criteria or should mimic approved reference reach target habitats in species composition, density, and structure.	Failure to achieve target hydrology, and/or tree and plant species diversity, composition, and structure as required by Mobile District wetland habitat success criteria or approved reference site	Target species will be re-seeded and or fertilized; live stakes and bare rooted trees will be planted to achieve desired densities. Adaptive management actions will be planned, approved, and implemented.
3. Channel Stability Pattern, Profile, and Dimension, Pebble count	Stable stream with pattern, profile and dimension of similar reference reach type. No evidence of instability (down-cutting, deposition, bank erosion, increase in sands or finer substrate material).	Substantial evidence of instability, not achieving target stream design goals.	When Substantial evidence of instability occurs, remedial actions will be planned, approved, and implemented.
4. Biological Indicators Invertebrate populations Fish populations	Relative to baseline data, stream habitats and aquatic population measurements remain the same or improve, and target species composition indicates a positive trend in composition, density, and diversity.	Population measurements and target species composition indicate a negative trend.	Reasons for failure will be evaluated and remedial action plans developed, approved, and implemented.

Appendix E: Example Credit Release Schedule for Mitigation Banks

The first credit release for each habitat type, regardless of the scientific based success criteria, will include proof of subjugation of any liens or encumbrances on the property to the conservation easement. For the second credit release, if the long-term management will be coordinated by a long-term management board instead of a separate entity such as a land trust, the board members must be named by agency/profession and name. The long-term land management board must be composed of private and conservation interests and approved by the Interagency Review Team (IRT).

Stream Restoration (In-Stream and Riparian Restoration) – Credit Release Schedule (IRT standards)
Credit releases below apply to stream buffer restoration and channel restoration as noted below.

Stream A

20% Initial release (all buffer/channel stream credits) for conservation easement, financial assurance and approval of detailed stream channel restoration data collection/design plans.

10% Upon completion of site preparation and hydrology work related to stream areas (buffer and channel) (see explanation below).). To assess in-channel hydrology, stream gages should be installed and correlated with bankfull indicators to show baseline and post mitigation changes. For buffer areas, groundwater monitoring wells should be arrayed to document the timing, duration and frequency of riparian inundation and/or saturation.

- Removal of exotics (<1% and no seed producing species present), invasives, or inappropriate species.
- Upon completion of initial physical, hydrological, and biological improvements made pursuant to the stream restoration plan. Improvements include: grading, construction of bankfull benches, placement and construction of in-stream structures, riparian enhancement, and vegetative plantings as needed.
- TFT established, accepted, and documented.
- Approval of Land Trust Board and Long-term Land Management Board by MBRT

20% Following first successful bankfull event.

- Success evaluated by stability of the in-stream structures, vegetative plantings, and stream banks as documented by re-survey of the fixed cross-sections and monitoring points including photographic documentation, and narrative descriptions.
- Target species planted to achieve overall composition of 10-15 species per acre, with no greater than 25% coverage of a single species.
- Minimum of 400 trees per acre, post-planting.

30% Following second successful bankfull event.

- Success evaluated by stability of the in-stream structures, vegetative plantings, and stream banks as documented by re-survey of the fixed cross-sections and monitoring points including photographic documentation and narrative descriptions. Note: Second bankfull event should have a return interval approximately 1.5 years from date of first bankfull event.
- Visual evidence of species (and individual seedling) placement in relation to appropriate topographic/hydrologic habitat.
- Plantings show positive growth of root collar, diameter, and/or height.

10% After fifth (5th) year of successful bank stability and riparian monitoring.

- Success evaluated by stability of the in-stream structures, vegetative plantings, and stream banks as documented by re-survey of the fixed cross-sections and monitoring points including photographic documentation and narrative descriptions.
- Post-planting of shrubs and herbaceous layer and channel restoration success.
- A minimum of three years positive growth of planted tree species is required before shrubs and herbs are planted and/or naturally regenerate.
- Visual evidence of appropriate shrubs and herbs planted sparingly or naturally recruited, in small groupings across site.
- Establish non-wasting escrow account with proof of appropriate funds in place.

10% Final credit release upon completion of monitoring (approximately year 10),

- Success evaluated by stability of the in-stream structures, vegetative plantings, and stream banks as documented by re-survey of the fixed cross-sections and monitoring points including photographic documentation and narrative descriptions. Riparian area success as defined in the mitigation plan.
- A minimum of nine years positive growth of planted tree species.
- Minimum of 10 target tree species and coverage of 200-300 stems per acre, with all plantings showing positive growth of root collar, diameter, and height with a minimum of 10 trees per acre of each target species.
- Average height of planted canopy a minimum 7'-10' (excluding fast growing species such as *Platanus* and *Populus*).
- 50% of shrub species from Table 2, 20-60% cover.
- 50% of herbaceous species from Table 3, appropriate cover as related to TFT.
- <1% cover by exotics.