Department of the Army
Mobile District Corps of Engineers

COMPENSATORY STREAM MITIGATION STANDARD OPERATING PROCEDURES AND GUIDELINES

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COMPENSATORY STREAM MITIGATION STANDARD OPERATING 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 is 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 (see definition) 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 and must meet the requirements of 33 CFR 332.2 (h) Compensatory Mitigation For Losses of Aquatic Resources. Stream creation is prohibited except for Priority 1 Restoration and stream relocation.** 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 neither negate nor diminish an applicant's responsibility to comply with all other laws and regulations. In accordance with 33 CFR 332.3(f), *Compensatory Mitigation For Losses of Aquatic Resources,* the district engineer reserves the right to determine appropriate compensatory mitigation required to offset unavoidable impacts to aquatic resources. 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 ephemeral, intermittent, and perennial streams within the Mobile District. Users of this guidance should refer to the requirements of 33 CFR 332, *Compensatory Mitigation*

For Losses of Aquatic Resources, for mitigation requirements not specifically addressed in this SOP. This is a living document and is expected to be reviewed and modified as needed to stay current with changing regulations and most current stream mitigation concepts.

2.0 REGULATORY AUTHORITIES AND GUIDELINES

Section 10 of the Rivers and Harbors Act of 1899: In accordance with Section 10 of the Rivers and Harbors 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 (49 CFR 230.10). 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 state 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 CFR 332 - *Compensatory Mitigation for Impacts to Aquatic Resources*. This regulation 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 an Adverse Impact 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 an In-Stream Work Worksheet in Appendix A for projects that propose in-stream work.

Section 6.0 – The "Riparian Work" section 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 Riparian Buffer 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. The following factors will determine the amount of mitigation credits required:

4.1 Stream Types: The Mobile District defines the various stream types using the following definitions and currently endorses the use of the North Carolina methodology (N.C. Division of Water Quality, 2010) for circumstances where differentiating ephemeral, intermittent, and perennial streams is difficult in the field. The North Carolina methodology recommends that streams should not be evaluated within 48 hours of a rainfall event that results in surface runoff, and the EPA guidance recommends sampling and verification of ephemeral streams during both dry and wet periods of the year (Fritz et.al 2006).

Perennial Stream - A perennial stream has bed and bank features with flowing water year-round during a typical year (Federal Register 2012). 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 bed and bank features with seasonal flowing water, when ground water provides water for stream flow. During drier periods, an intermittent stream may not have flowing water. Runoff from precipitation is a supplemental source of water for stream flow. The biological community of an intermittent stream is composed of species that are aquatic during a part of their life history or move to perennial water sources.

Ephemeral Stream – An ephemeral stream has bed and bank features with flowing stormwater only during and for a short duration after precipitation events in a typical year. The streambed of an ephemeral stream is located above the water table year-round and groundwater is not a source of water for the stream. Precipitation runoff is the primary source of water for stream flow and it typically has flowing water for a few hours to a few days after a storm event and typically has no discernable floodplain.

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. Projects that fall into more than one category must use the higher priority designation.

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 (natural undeveloped) 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 is characteristic of the system) which are:

- Designated secondary trout streams (Put and Take Fishery),
- Waters adjacent to Federal or State protected areas or Corps' approved mitigation banks,
- Within 0.5 mile upstream or downstream of 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.

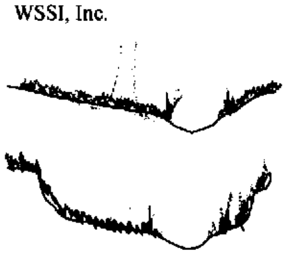
4.3 <u>Existing Condition - Channel Condition Parameter:</u> Typically, stream channels respond to disturbances or changes in flow regime and sediment loads by degrading to a lower elevation and eventually re-stabilizing at that lower elevation. This sequential readjustment of the channel to changing 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, channel substrates, 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 three 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. Geomorphologically Stable (Stable)

WSSI, Inc.



These streams exhibit reference condition pattern, profile and dimension. The channels show very little incision and little or no evidence of active erosion or unprotected banks (usually outside stream bends only), within the stream reach 80-100% of both banks are stable and contain vegetative surface protection or natural rock stability along the majority of the banks. 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 bankfull benches. Correct sediment size and type for the stream type. If sediment deposition is present, it covers less than 10% of the stream bottom and is transient. Ephemeral streams have greater than 75% canopy coverage or a high quality riparian zone habitat.

B. Partially Unstable

These channels are typically incised and may not exhibit the reference condition pattern, profile, or dimension. Vegetative surface protection is present on 40-80% of both banks however there are visible signs of bank erosion other than the outside curves of bends. 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. Additional sediment deposition affecting 30-70 % of stream bottom but impacts to stream profile features do not appear to be long-term. Depositional features (point bars and bank full benches where appropriate), that contribute to stability, are present or reforming in the appropriate stream types. Ephemeral streams have 25-75% canopy coverage or a medium quality riparian zone habitat.

C. Unstable

These channels do not exhibit reference condition pattern, profile, or dimension. These channels are typically overwidened and are incised. The channel and streambanks are vertically and/or laterally unstable and flow is usually contained within the banks during heavy rainfall events (i.e. the stream does not have access to its floodplain). They are likely to further widen and incise. The majority of both banks are near vertical with shallow to moderate root depths. Erosional scars are likely present on both banks. Vegetative surface protection is less than 40% of both banks, and is insufficient to prevent significant erosion from continuing. Stream profile and depositional features (point bars, mid-channel bars, transverse bars, and bank full benches), which contribute to stability are rare or absent. The natural stream bed substrates or profile features are absent or covered by substantial sediment deposition that is likely long-term. Ephemeral streams that have less than 25% canopy coverage or a low quality riparian zone habitat.

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 are short-term and stream will recover to pre-impact condition within 6 months of cessation of the impact.

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

Permanent means impacts are long-term and stream will not recover to pre-impact condition within 6 months of cessation of the impact or will have long-term effects such as impacts occurring during spawning or growth periods for Federal and/or State protected species.

4.5 Dominant Impact: 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 streambank, 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, 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 cumulative impact. Therefore, the scaling factor assesses the relative effects of the impacts based upon the length of a stream reach impacted by a project, as authorized under Section 404 of the Clean Water Act, and for which mitigation will be required. Each stream reach should be evaluated independently. The scaling factor score may not exceed a score of 2.0.

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 channel restoration, and stream channel enhancement. **Stream creation is prohibited except for Priority 1 Restoration and stream relocation.** Mitigation credit cannot be generated for in-stream preservation. All in-stream work 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). Similarly, credit for removal of structures described below will also be based on 3X the length of the structure. See Section 6.4 regarding the evaluation of the net benefit of mitigation projects proposed near man-made impoundments.

5.1.1 Restoration: Restoration is the process of converting an unstable, altered, or degraded stream corridor, including flood-prone areas, to a natural stable condition (neither aggrading nor degrading) while considering recent and future watershed conditions. This process is based on a reference condition/reach for the same stream valley type, use of regional curves, or other commonly accepted methods, and includes restoring the appropriate geomorphic dimension, pattern, and profile. This process supports reestablishing the streams physical, 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 will maintain 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. The following provides a summary of these management activities:

- **Priority 1 Restoration**
  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.

- **Priority 2 Restoration**
  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**
  Priority 3 Restoration is defined as stream channel restoration to a channel without an active floodplain but with a flood prone area. 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, infra-structure, 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 or riffle/run 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 streambank restoration if the mitigation segment is within 300 feet upstream of the full-pool elevation of an impoundment, or within the first 300 feet downstream of a dam structure, weir, or a channelized/piped section (see definition under dominant impacts).

Restoration Restrictions:

1. **No enhancement 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.**

5.1.2 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 six activities included in the Enhancement category: 1) In-stream 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) Streambank Planting. Removal of beaver dams for the purpose of returning hydrology to the historic stable stream channel is considered stream enhancement.

In-stream 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 **3X** the length of the structure.

Habitat Structures

This activity includes structures designed specifically for habitat creation. In-stream structures constructed for channel stability will not receive credit for habitat structures. Accepted structures can be found in Section 5.3. 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 streambanks. 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 to provide low bank erosion potential (see Section 5.2).

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; however no additional credit will be applied for that length. 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 streambank 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. Stream bank planting must create stable stream banks (see Section 4.3).

Enhancement Restrictions:

1. **Activities cannot be credited as both Restoration and Enhancement activities.**
2. **A structure cannot be credited as both an In-stream Structure and a Habitat Structure.**
3. **Mechanical bank work cannot be credited as both Bankfull Bench and Laying Back the Banks.**
4. **Bioremediation Techniques do not include Erosion Control matting.**

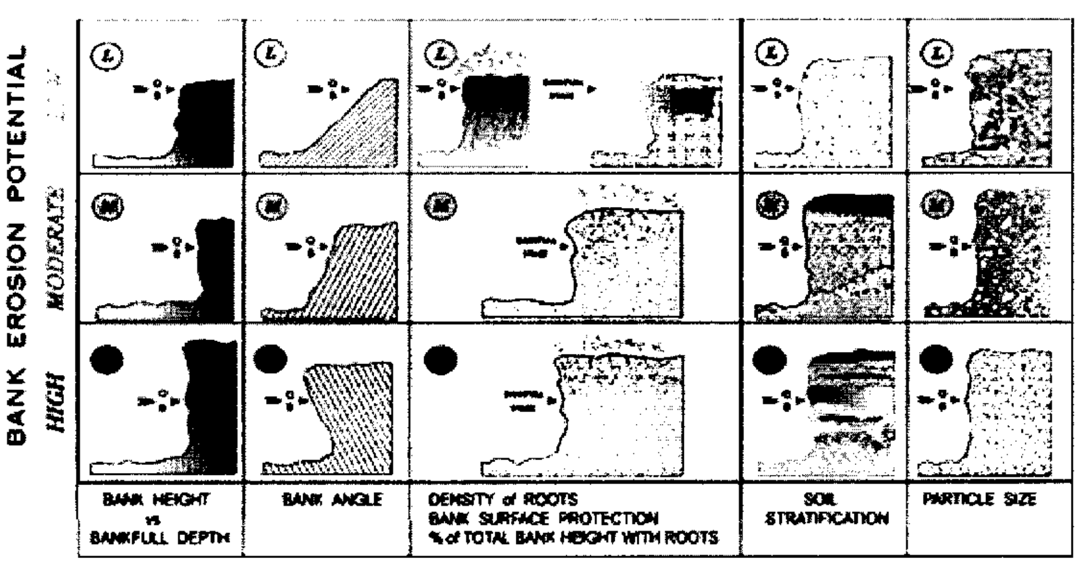
5.2 Streambank Stability: For the purposes of this stream SOP, the Bank Erosion Hazard Index is used to acknowledge the amount of work required to achieve a stable stream for stream enhancement projects only. The potential should be estimated using the figures from Table 1 and does not require the use of the formal BEHI methodology. The streambank stability/bank erosion potential addresses the existence of the potential for soil detachment from the upper and lower streambanks 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 streambanks 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, the 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) (Figure 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 (Rosgen 1996, 2001a)



5.3 In-stream Habitat: 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 diversity of organisms present, nor does it consider the water chemistry and/or quality of the stream since other factors beyond those measured (i.e. changing watershed conditions), which can affect the temporal diversity and abundance 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 in-stream habitat features provide macroinvertebrates and fish with a large number of niches. 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 typically contains riffle and run complexes with finer grain substrates. High gradient streams generally have greater than 4 percent slopes, 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 ephemeral and intermittent hydrologic regimes and may not have the diversity of habitat features or aquatic organisms 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. Typically greater than 4 percent slopes with a varied mixture of larger 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.

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 finer 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.

This assessment measures the availability of physical habitat diversity within a stream. The increased diversity and abundance of in-stream habitat features is used as an indirect measure of the potential and/or presence of a diverse and abundant epifaunal and fish communities. Each cover type must be present in appreciable amounts similar to reference sites 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 **5X** the active channel width.

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

2. 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).

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

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

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

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

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

8. 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 In-Stream Habitat: The reach is assessed for the condition of In-Stream Habitat using the following four Categories. A reference reach is needed to identify the appropriate spacing and composition of habitat types. The Evaluator selects the category most representative of the stream reach.

A. Optimal
Greater than five 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
Five 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
Four 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
Three or less 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 **Timing of Mitigation:** Mitigation must be initiated prior to or concurrent with the start of the authorized project impacts to streams. 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.

1. 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.

2. Mitigation Banks: All mitigation must be completed before the impacts occur. Release of credits will require approval by IRT using the bank's success criteria and credit release schedule.

6.0. RIPARIAN BUFFER WORK - MITIGATION CREDITS:

All stream mitigation projects require protective riparian buffers. Riparian buffer mitigation must result in high quality riparian wetland and upland habitats. **No mitigation credit will be given for riparian buffers on impacted stream channels where no corrective stream channel work is proposed.** Applicants proposing riparian wetland restoration or enhancement projects are encouraged to use the Mobile District performance criteria. Applicants may propose to amend these performance criteria, to account for regional variations, by providing field data from similar high quality wetlands within the same watershed. Performance criteria proposed for upland habitats must be based on field data collected from an in-kind high quality upland ecosystem within the same watershed. All proposed performance criteria will be evaluated for approval on a case-by-case basis.

6.1 Riparian Buffer Widths

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 streambank, 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. **Ephemeral streams may only claim credit for a maximum of a 1X the minimum buffer width. 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 feet). Buffer slope will be determined in 50-foot increments beginning at the streambank. No additional buffer width will be required for negative slopes. For the reach being buffered, degree of slope will be determined at 100-foot 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 the system. Restoration programs should strive to mimic the hydrology, and vegetation species diversity, composition, and density of an in-kind reference system within the same watershed.

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 usually entails improving the existing upland and/or wetlands habitat by improving the vegetation to mimic that of a reference system within the same watershed. For upland buffers, enhancement programs should strive to mimic the target vegetation species diversity, composition, and density of an in-kind upland 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 streambank stability and improve wildlife habitat. **Riparian buffer preservation may account for no more than 30% of credits generated by the mitigation plan. Preservation may be used when it has demonstrated that it meets all the criteria specified under 33 CFR 332.2 (h). Baseline documentation is required for demonstrating appropriate target species, diversity, and composition.**

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 streambanks. 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.
Table 1 below provides appropriate Net Benefit values for the "Riparian Restoration, Enhancement, and Preservation" mitigation worksheet. Note that on the worksheet in Appendix A, buffers on each bank generate independent mitigation credit.

Table 1. Riparian Buffer Restoration, Enhancement and Preservation Net Benefit

	% 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
	*1X 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.

* Ephemeral Streams are limited to minimum 1X (50-foot) width buffers.

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

6.3 <u>System Protection Credit;</u> Bonus mitigation credit may be generated if proposed riparian mitigation activities include atleast minimum width buffers on <u>both streambanks</u> of the reach and legal protection of a fully buffered stream channel.

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 upper end/full-pool elevation of an existing or proposed impoundment, and flows into the impoundment, then mitigation credits for this segment of stream will be reduced by 50% and you must use a mitigation factor of 0.5. Use mitigation factor of 1.0 for all other mitigation.

7.0 STREAM RELOCATION:

Stream relocation is moving a stream laterally to a new location within the same stream valley to allow a project, authorized under Section 404 of the Clean Water Act, to be constructed on the stream's former location. The relocation of a stream is considered fill when the relocation is conducted to allow development of the area where the stream was previously located (versus Priority 1 restoration). Impacts associated with stream relocation in these situations must be fully mitigated. The relocated stream can be used as compensatory mitigation if it is designed and constructed to replicate the appropriate pattern, profile, and dimension of a natural stable reference stream; restore the in-stream habitats, maintain the capacity to transport bedload sediment; and have appropriate riparian buffer on both sides of the stream. To ensure restoration of the hyporheic zone functions, streams with coarser substrates may be required to relocate the upper 12 inches of the former stream bottom substrates to the stream channel bottoms in the new constructed channel.

8.0 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 streambank 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 stream bed in thalweg divided by the maximum depth from bankfull to stream bed in 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 adverse 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.

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 to 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. 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 Stream – a stream that has bed and bank feature with flowing stormwater only during and for a short duration after precipitation events in a typical year. The streambed of an ephemeral stream is located above the water table year-round and groundwater is not a source of water for the stream. Precipitation runoff is the primary source of water for stream flow and it typically has flowing water for a few hours to a few days after a storm event and typically has no discernable floodplain.

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 depth measured at bankfull stage in the thalweg in a riffle section.

High Gradient Streams – streams with usually greater than 4 percent slopes within moderate-high gradient landscapes; substrates primarily composed of coarse sediments [gravel (2mm) or larger] or frequent coarse particulate aggregations. Riffle/run is a prevalent stream feature.

Intermittent Stream – a stream that has a bed and bank feature with seasonal flowing water, when ground water provides water for stream flow. During drier periods, an intermittent stream may not have flowing water. Runoff from precipitation is a supplemental source of water for stream flow. The biological community of an intermittent stream is composed of species that are aquatic during a part of their life history or move to perennial water sources.

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 is a prevalent.

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

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.

Perennial Stream – a stream that has bed and bank feature with 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

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 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 - are unimpaired stream reaches that are 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.

Riffle – a shallow stretch of stream where small rippled waves are formed above the stream channel substrate.

Riparian Buffer – a terrestrial area directly adjacent to the stream that is located landward from the top of bank.

Sinuosity – is the ratio of channel length to 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, steep streams have low sinuosity and flat streams have high sinuosity.

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 Channel Creation – for the purposes of this SOP, the creation of new stream channel reaches is only authorized for stream relocation and Priority 1 restoration projects. Projects must occur within regions of a natural valley where it can be demonstrated similar stream types currently of have historically occurred and any stream channel creation should be based on measurements taken in a reference reach. Braided stream channels may not be created to replace current or historic single-channel streams.

Stream Reach - stream reach is any length of a stream section with a continuous channel bed having similar channel morphology, dimension, and gradient that contains at least one complete riffle (or ripple) and pool (or run/glide) complex. Stream reach may vary depending on the stream metric being measured; however the length should be consistent for performing stream comparisons. If none noted, a suitable length is usually no less than 300 feet long. For ephemeral streams, the U.S. Army Corps of Engineers guidebook (U.S. Army Corps of Engineers 2010) utilizes 100 feet long stream assessment reaches.

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 the rebuilding of 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 – is 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 (pattern, profile, or dimension), 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. Riparian buffer enhancement is undertaken for a purpose such as water quality improvement and/or ecological functions (flood water retention or wildlife habitat). These practices are typically conducted on the streambank or in the flood prone area. Biological characteristics can be accomplished by implementing certain stream rehabilitation practices such as 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 – is 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 Relocation - stream relocation is moving a stream laterally to a new location within the same stream valley 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. To ensure restoration of the hyporheic zone functions, it is highly recommended the upper 12 inches of stream bottom substrates from the abandoned stream be used to create the stream bottoms in the constructed stream channel.

Stream Restoration – is 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.

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

Priority Area	Tertiary 0.1			Secondary 0.4			Primary 0.8		
Existing Condition	Unstable 0.1			Partially Unstable 0.8			Stable 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
Scaling 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, max score=2)				
Stream Type Impacted	Ephemeral 0.3			Intermittent 1.0			Perennial 1.15		

Factor	Stream Reach 1 Impact	Stream Reach 2 Impact	Stream Reach 3 Impact	Stream Reach 4 Impact	Stream Reach 5 Impact
Priority Area					
Existing Condition					
Duration					
Dominant Impact					
Scaling Factor					
Sum of Factors (A)	A =				
Stream Type (B)	B=				
Credits linear Foot (A x B=C)	C=				
Linear Feet of Stream Impacted in Reach	LF=				
Mitigation Credits Required (LF x C)					

Total Mitigation Credits Required = (LF X C) = ______________

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

Priority Area	Tertiary 0.05		Secondary 0.2		Primary 0.4	
*Existing Condition	Unstable 0.4			Partially Unstable 0.05		
Net Benefit	Stream Relocation 1.0		Stream Channel Restoration/Streambank Stabilization: *Enhancement 2.0		Stream Channel Restoration/Streambank Stabilization: Restoration 4.5	
*BEHI Index	Low 0.2		Medium 0.3		High 0.4	
In-stream Habitat	OPTIMAL >5 cover types 0.35		SUBOPTIMAL 5 cover types 0.25	MARGINAL 4 cover types 0.15		POOR 3 Cover types 0.1
Timing of Mitigation	Before 0.15		During 0.05		After 0	
Stream Type	Ephemeral 0.2	Intermittent 1.0	Perennial <15’ 1.15	Perennial 15’-30’ 1.20	Perennial 30’-50’ 1.25	Perennial >50’ 1.3

*Stream Enhancement Project Only

Stream Reach Benefit

Factors	Stream Reach Benefit	Stream Reach Benefit	Stream Reach Benefit	Stream Reach Benefit	Stream Reach Benefit	Stream Reach Benefit
Priority Area						
Existing Condition						
Net Benefit						
Bank Stability						
In-stream Habitat						
Timing of Mitigation						
Sum Factors (A)=	A=					
Stream Type (B)=	B=					
Credits per Linear Foot (A x B = C)	C=					
Stream Length in Reach (do not count each bank separately) (LF)=	LF=					
Total Credits per Reach (LF x C = D)	D=					
Mitigation Factor Use (MF) = 0.5 or 1.0	MF=					
Total Credits Generated (MF x D = TC)	TC=					

Total Channel Restoration/Relocation Credits Generated $\sum(TC)$ = ____________

RIPARIAN BUFFER WORKSHEET

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
Stream Type	Ephemeral 0.9	Intermittent 1.0	Perennial 1.10

Stream Reach Benefit

Factors		Stream Reach 1	Stream Reach 2	Stream Reach 3	Stream Reach 4	Stream Reach 5	Stream Reach 6
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 (A)		A =					
Stream Type (B)		B=					
Credits per Linear Foot (A x B = C)		C=					
Linear Feet of Stream Buffer (LF) (don't count each bank separately)		LF=					
Total Credits per Reach (LF x C = D)		D=					
Mitigation Factor Use (MF) = 0.5 or 1.0		MF=					
Total Credits Generated D x MF = TC		TC=					

Total Riparian Credits Generated $\sum(TC)$ = ____________

Appendix B: Guidelines for Stream Mitigation Design

Introduction

The following information is intended to give the stream designer an outline of the minimum information requirements needed by the Corps of Engineers in reviewing any proposed stream mitigation project. For instream channel restoration, there is no "one size fits all" simple approach to address achievement of a successful project. River corridors, and the channels which convey water and sediments through the corridors, are dynamic and influenced by an array of physical and ecological processes related to regional climate, geology, hydrologic regimes, hydraulics, geomorphic channel processes, connectivity to floodplain and riparian zones, and anthropogenic stressors within the upstream watershed. For each project, it will be important to take into consideration the effects of upstream land use changes on downstream delivery of water flow and sediment, particularly when developing the final instream restoration design to achieve a stable stream restoration project.

As a matter of policy, 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. Stream creation other than for stream relocation or Priority 1 restoration is not authorized. Riparian buffer preservation may account for no more than 30% of credits generated by the mitigation plan. In-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 enhancement credit.

All restoration and enhancement measures should be designed with the goal of improving the entire stream system within a target stream reach. Designs should be based upon using approved reference stream systems to properly determine stable stream pattern, profile, and dimension, stable stream bank design, and target habitats. The same reference reach strategy can be used to identify the target vegetative species composition, density, 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 it is highly recommended projects use the Mobile District's template found on the Mobile District web page at http://www.sam.usace.army.mil/RD/reg/.

Natural Stream Channel Design

Due to the variation in regional physical and ecological processes acting upon and affecting stream systems, natural stream channel design is the preferred approach endorsed by the Mobile District. This approach incorporates regional data from similar stream and valley-type, using a stable "reference reach", or reaches, near the restoration site to be used as a template for designing appropriate pattern, profile, dimension, and habitat characteristics for a stream restoration project. Reference reaches are streams of the same type (and possibly order) and position within the watershed that exhibit the least altered condition with stable stream pattern, profile, dimension, and appropriate substrate and habitat.

To provide a consistent and standardized framework for communicating stream information when presenting an instream channel restoration project, applicants should discuss the existing stream type and condition, preferably using the standardized Rosgen stream classification system and the current stage using the Lane Stream Channel Evolution Model. This discussion should center on the assessment of the upstream watershed issues that could influence stream hydrology and sediment load, verification of bankfull indicators, and a geomorphic stability assessment of the current stream dimension as well as pattern and profile. Vertical stability metrics include, but are not limited to, width depth ratio, bank height ratio, and the stream entrenchment ratio. Lateral stability metrics include, but not limited to, slope, riffle and pool bed features, sinuosity, meander width ratio, and radius of curvature (see appendix B Summary Data Worksheet). There may be instances, particularly when there is a significant level of degradation of the stream channel, where applicants may be requested to discuss a hydraulic assessment to quantify flood stage, stream velocity, sheer stress and stream power. The level of information collected will be commensurate with the level of instream features proposed for restoration. The following sections provide a helpful outline of the information needed for adequate review of stream restoration projects. Generally, all of the following information is required; however if the stream designer has cause and rationale for excluding some information they can submit a request for consideration.

1. Watershed Assessment

The watershed assessment provides information regarding how activities (i.e., development and agriculture) in the upstream watershed influence stream restoration goals and objectives. For significantly degraded streams, the watershed assessment may require hydrologic calculations to assess channel hydraulics and floodplain access. A comprehensive hydrologic evaluation may not be necessary for projects which have gage station or regional curve data, an undeveloped (i.e., forest) surrounding land-use cover, or have unaltered access to a floodplain. Information for the watershed assessment, at a minimum, is as follows:

a) Identify project watershed drainage area
b) Identify past, current and planned land use(s) and land cover(s) in the upstream watershed
c) Discuss surrounding land use and land cover trends for the project
d) Discuss soils and geology for the watershed and project site
e) Discuss the climate characteristics of the watershed
f) Discuss the topography of the watershed and project site (e.g., basin relief, basin shape, Rosgen valley type, etc.)
g) Discuss the flow regime and drainage characteristics of the watershed above the project site (e.g., drainage density, length of natural stream channel, length and relative amount of impacted reaches.)

2. Existing Stream Assessment

A baseline assessment of the stream itself should be completed prior to beginning the design of a stream restoration project. The stream assessment will evaluate the current vertical and lateral stability of the stream and identify any causes of departure from target stable stream conditions.

Stream assessment metrics must be science-based, but also practicable, repeatable and appropriate for future comparative analysis (see appendix B Summary Data Worksheet).

a) Identify Rosgen stream type and Lane's stream evolution stage.
b) Identify any impairment to stream pattern, profile, dimension, or stream characteristics (e.g., vertical instability, lateral instability, stream habitat).
c) Identify the magnitude of stream impairment (e.g., localized or widespread).
d) Identify the cause(s) of the stream impairment.
e) Discuss bankfull indicator characteristics and bankfull discharge.
f) Discuss how bankfull determination results were identified and validated (the accurate identification of bankfull is critical to assessing the appropriate stream classification, its current condition, and its departure from a potential stable state. The validation of bankfull is often a comparison to a regional bankfull and channel characteristic curve, however a more intensive validation may be required for a more complex site).
g) Discuss channel bed substrate and methods used to determine appropriate channel bed materials.
h) Provide discussion of hydrologic analysis of critical flows including frequency of bankfull events as well as extent and flows for the 2-year; 5-year; 10-year; 50-year; and 100 year flood events. This discussion should include the method used to determine this information.
i) Hydraulic analysis may be requested on significantly degraded stream channels and will be requested on a project-by-project basis.
h) Provide a detailed basemap that shows the existing stream reach, existing channel alignment, utilities, large trees, roads, wetlands, property boundaries, and any other physical elements which might affect the design of the stream restoration project. The basemap is also used to associate the documentation of the stability and geomorphic assessment results (e.g., the location of eroding banks, head cuts, and cross-section data points).

3. Stream Restoration Design Phase

a) Restoration objectives

Developers of stream restoration projects should utilize available information collected within the watershed, existing stream, and reference reach streams for assessing the cause(s) and levels of stream impairment and appropriate goals and objectives for the stream restoration project. The objectives should be both well defined and have measurable performance standards to evaluate their success. Both temporal and spatial objectives may be developed that are reflective of the goals of the overall restoration process. In addition to identifying the objectives of the project, the stream restorationist should also identify and discuss project limitations. There may be physical limitations which may affect the design, such as historical structure preservation, property access, or infrastructure conflicts. The design should address both objectives and limitations of their stream restoration project. The following provides examples of stream restoration objectives which should be identified early in the project development phase (amended from Eng et.al. 2009):

Stream Mitigation Project Objectives (select all appropriate objectives for a project)

Hydrologic Objectives

1. Restore flood flows above the bankfull stage to an abandoned floodplain. Convert a terrace into an active floodplain by raising the channel bed and associated water table.
2. Restore channel-forming flows to the appropriately sized channel.
3. Restore wetland and floodplain hydrology to meet the U.S. Army Corps of Engineers definition of a wetland.
4. Dissipate flood energy by creating a meandering channel and new floodplain at the existing bankfull elevation. Partially restore lost floodplain and wetland functions.
5. Dissipate flood energy by creating a step-pool channel and floodplain bench at the existing bankfull elevation. Restore floodprone area functions.
6. For urban channels, restore bankfull discharge to pre-development levels by providing grade control and/or recreating large floodplains.
7. Create a riparian buffer to reduce flood velocities on the floodplain and encourage infiltration and sediment deposition.

Fluvial Geomorphologic Objectives

8. Create a stable channel (pattern, profile, and dimension) that neither aggrades nor degrades over time.
9. Create streambanks that do not erode at rates above natural levels for reference reach streams of the same stream type.
10. For alluvial systems, restore a riffle-pool bedform sequence such that the pool to pool spacing and percent riffle-pool matches' reference reach streams of the same stream type.
11. For colluvial systems, restore a step-pool bedform sequence such that the pool to pool spacing matches reference reach streams of the same stream type.

Biological Objectives

12. Create instream features and structures to increase aquatic habitats within a stream reach.
16. Create a riparian buffer using native plants to improve channel shade, terrestrial habitat, and improve water quality.

b) Use of reference reaches data for design criteria

The collection of reference reach data and the subsequent development of design criteria are important to the natural channel design process because the criteria provide the template for design of the restored channel dimensions, pattern and profile, as well as appropriate aquatic habitat types.

At a minimum the discussion of the reference data should include:

a) Stream metric data presented at the same level of detail as reach data for the impaired/proposed restoration reach (Appendix B Summary Data Worksheet).
b) Discuss the suitability of the reference reach as an appropriate design template.

c) Identify any limitations to reference reach data and discuss how the restoration design addresses these limitations.

d) Develop and document proposed design criteria of pattern, profile, and dimension. Provide discussion of appropriate stream channel substrate and stream habitat.

c) Conceptual Stream Design

For a mitigation bank or in lieu fee project, the conceptual stream designs should be submitted with the Prospectus. The conceptual designs must be submitted early in the permit evaluation process for permittee responsible compensatory mitigation.

Conceptual designs should include:

a) A general location map showing the location and directions to the restoration project.

b) Detailed scale map(s) of restoration project reach showing existing conditions, utilities, delineated wetlands, existing 100-year FEMA floodplain boundary, any additional waters of the U.S., and major topographic features such as roads and buildings, etc.

c) Scale map(s) of the restoration reach showing existing and proposed stream alignment (pattern).

d) Longitudinal profile of existing and proposed conditions showing channel thalweg, and bankfull stage, proposed bankfull width and type and location of instream structures

e) Typical before and after cross sectional designs (dimension)

f) Provide a conceptual level stream flow analysis to evaluate existing and proposed stream flows at bankfull, and provide a discussion how they were incorporated into proposed stream designs.

g) Provide a conceptual analysis of sediment transport issues by identifying the status of the existing sediment supply and competency, and whether the stream is aggrading or degrading. This section should also address the ability of the stream restoration design to address any aggradation or degradation issues.

5) SIXTY PERCENT DESIGN PLAN

For a mitigation bank or in lieu fee project, the 60% stream designs should be submitted with the Mitigation Banking Instrument or Project Management Plan. The design plans must be submitted during the permit evaluation process for permittee responsible compensatory mitigation. The sixty percent design and accompanying documentation are required for all projects that propose stream channel modifications. The 60% design plans will build upon the conceptual design plans and incorporate with the reference reach information by including alignment geometry (pattern), proposed grading and sloping, revised longitudinal profiles, detailed cross sectional (cut sheets) designs (dimensions), target benthic substrate, target stream habitats, erosion and sediment control plans, and the riparian buffer management plan. If requested, the 60% design plan will include the results of the hydrologic and hydraulic analysis along with the results of the flood modeling and sediment transport analysis.

a) Sixty percent design plans include:
   - A detailed revised scale map(s) of the stream restoration reach showing existing conditions, utilities, delineated wetlands, existing 100-year FEMA floodplain boundary, any additional waters of the U.S., and major topographic features such as roads and buildings, etc.
   - A detailed revise scale map(s) of the steam restoration reach showing proposed conditions including the stream alignment, proposed bankfull width, detailed grading, type and location of instream structures and proposed FEMA 100-year floodplain boundaries
   - A revised longitudinal profile of existing and proposed conditions showing channel thalweg and bankfull stage, utilities and instream structure locations, and the alignment geometry.
   - Typical riffle and pool cross sections designs reflecting existing topography and proposed grading
   - Instream structure details and design
   - A time sequence of construction and construction specifications

b) Erosion and sediment control plans

c) Maintenance Plans

d) Hydrologic and Hydraulic Analysis Report (certain components of the analysis may be requested on a project-by-project basis depending on the condition of the stream channel). The hydrologic and hydraulic analysis will evaluate flood stages, (stream velocity, shear stress, and stream power if requested) and compare existing with reference stream and proposed flood stage conditions. The analysis will also evaluate and compare existing and proposed sediment transport, both competency (i.e., size) and capacity (i.e., load). The method used to evaluate the hydrology, hydraulics and sediment transport must be stated and explained. The hydrologic and hydraulics analysis will include (at a minimum):
   - Review existing FEMA floodplain studies and include a discussion of the existing floodplain model and discharges used to develop existing floodplain limits
   - Document the development of a revised existing floodplain model based on revised discharges, and the floodplain model used (if the existing FEMA floodplain delineation is inaccurate)
   - Prepare water surface profiles for the existing floodplain model, and the revised or new proposed floodplain model
   - Discuss any changes in floodplain limits. It must be demonstrated that proposed profiles and data are consistent with floodplain management requirements
   - Discuss any changes in stream sediments and sediment transport capacity

If requested, the following comparative hydrologic and hydraulic analysis will also be included in the 60% design plan:
   - Prepare a tractive force analysis that evaluates boundary shear stress for existing and proposed reference condition;
   - Compare existing and proposed shear stress
   - Compare existing and proposed stream power and stage or discharge

- Determine the appropriate sediment transport capacity and competence for the stream
- Document that the proposed design will provide the correct sediment transport capacity and competence.

6) Proposed 60% Design Plan Requirements (Required in approved mitigation bank MBI's and In-Lieu Fee Project Management Plans)

Cover Sheet

- Project name, owner contact, design firm contact

Table of contents

Introduction

- Project summary
- Scaled detailed vicinity map containing north arrow
- Aerial plan view of site, project boundaries, GPS coordinates

Boundary Survey Plans

- North arrow, drawing scale, graphic scale
- Boundary description
- Road names, stream names, area of tract
- Reference survey notes and dates
- Easements, utilities, restrictions, sensitive areas (cultural resources)

Topographic Survey

- Location of streams and wetlands (including reference sites)
- Detailed topographic map showing areas of in-stream restoration or enhancement
- FEMA floodplain boundaries
- Current and historic aerial or other data sources

General Description of Work

- For each stream, a description of the linear feet of in-stream restoration or enhancement and more specific priority type
- For each stream, a description of the linear feet of stream requiring structure removal
- For each stream, a description of the lengths and widths of riparian buffer restoration, enhancement, or preservation
- General sequence of construction and construction specifications

Stream Specific Restoration Detail Plans

- Scaled site plan views showing locations of stream restoration, enhancement, or preservation polygons along each stream reach
- Site plans showing locations of reference reaches
- Completed Appendix B Data Summary Worksheet for current, proposed, and reference reach streams
- Scaled site plans showing locations of existing and proposed stream alignment, bankfull widths, channel thalweg, and type and location of instream structures
- Scaled stream plans reflecting comparison of existing and proposed pattern, profile, and dimension. At minimum, typical cross sectional dimensions for riffles and pools (or ripple and pool in low gradient streams) that include bankfull dimensions
- Design plans for proposed in-stream structures and their specifications

- Bank stabilization plans
- Erosion control plans
- Maintenance Plan

Riparian Buffer Detail Plans. All streams proposed as mitigation must be protected with riparian buffers. Except for urban streams, 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.

- Scaled site plan views showing locations of riparian buffer restoration, enhancement, or preservation polygons along each stream reach
- Proposed Riparian buffer land management strategy and success criteria
- Upland riparian buffer restoration and enhancement and target ecological performance standards should be based upon target species composition, diversity, and structure metrics similar to that required for forested wetlands, gathered from high quality reference upland riparian buffers in the same watershed.

Summary Data Worksheet (next page). The following worksheet must be completed and provided for any in-stream mitigation proposal. For mitigation banks and in-lieu fee projects, the sheet must be provided for any request for a project success determination, and request for a stream credit release associated with in-stream work by a mitigation bank.
A data sheet should be completed for each established cross section along the restored reach

Parameter	Existing Stream			Design Stream			Reference Stream		
	Min	Median	Max	Min	Median	Max	Min	Median	Max
Stream name									
Stream type									
Drainage area, DA (sq mi)									
Mean riffle depth, d_{bkf} (ft)									
Riffle width, W_{bkf} (ft)									
Width-to-depth ratio, [W_{bkf}/d_{bkf}]									
Riffle cross-section area, A_{bkf} (sq ft)									
Max riffle depth, d_{mbkf} (ft)									
Max riffle depth ratio, [d_{mbkf}/d_{bkf}]									
Mean pool depth, d_{bkfp} (ft)									
Mean pool depth ratio, [d_{bkfp}/d_{bkf}]									
Pool width, W_{bkfp} (ft)									
Pool width ratio, [W_{bkfp}/W_{bkf}]									
Pool cross-section area, A_{bkfp} (sq ft)									
Pool area ratio, [A_{bkfp}/A_{bkf}]									
Max pool depth, d_{mbkfp} (ft)									
Max pool depth ratio, [d_{mbkfp}/d_{bkf}]									
Low bank height, LBH (ft)									
Low bank height ratio, [LBH/d_{mbkf}]									
Width flood-prone area, W_{fpa} (ft)									
Entrenchment ratio, ER [W_{fpa}/W_{bkf}]									
Bankfull discharge, Q_{bkf} (cfs)									
Meander length, L_m (ft)									
Meander length ratio [L_m/W_{bkf}]									
Radius of curvature, Rc (ft)									
Radius of curvature ratio [Rc/W_{bkf}]									
Belt width, W_{blt} (ft)									
Meander width ratio [W_{blt}/W_{bkf}]									
Pool length, L_p (ft)									
Pool length ratio [L_p/W_{bkf}]									
Pool-to-pool spacing, p-p (ft)									
Pool-to-pool spacing ratio, [p-p/W_{bkf}]									
Stream length, SL (ft)									
Valley length, VL (ft)									
Valley slope, VS (ft/ft)									
Average water surface slope, S (ft/ft)									
Sinuosity, k = SL/VL (ft/ft)									
Riffle slope, S_{rif} (ft/ft)									
Riffle slope ratio, [S_{rif}/S]									
Run slope, S_{run} (ft/ft)									
Run slope ratio, [S_{rif}/S]									
Pool slope, S_p (ft/ft)									
Pool slope ratio, [S_p/S]									
Glide slope, S_g (ft/ft)									
Glide slope ratio, [S_g/S]									
Riffle length, L_{rif} (ft)									
Riffle length ratio, [L_{rif}/W_{bkf}]									

Appendix C: Guidelines for the Development of Performance Standards

Performance standards are defined in the 2008 Mitigation Rule as: observable or measurable physical, chemical, and/or biological attributes that are used to determine if a compensatory mitigation project meets its objectives. The Rule goes on to say that performance standards must be tied to the objectives (see Appendix B-Restoration Objectives) of the project, and must be objective and verifiable and based on the best available science. All stream mitigation methodologies, assessments, and performance standards must be practicable, repeatable, and appropriate for implementation in the Regulatory Program and support other agency needs. Protocols and methodologies for obtaining measurable attributes must be verified and approved by the Corps.

The most notable stream system attributes associated with stream restoration projects are stream geomorphology (pattern, profile, and dimension), hydrology (magnitude, duration, and frequency), hydraulic (energy), and indirect surrogate metrics for chemistry (riparian buffer), and biology (stream habitats). While some of these parameters lend themselves to efficient measurement (e.g. geomorphology and habitat), others are more complicated. Measuring changes in chemical and biological attributes of stream ecosystems is significantly more complicated because of natural stochastic variability, regional variability, and quick responsiveness to changing development influences outside the project area. In these cases, the Mobile District supports the use of surrogate metrics within the control of the stream restoration project that are practicable, repeatable, and appropriate for implementation in the Regulatory Program. There are too many variables that must be addressed for a one-size fits all approach to stream channel restoration. The Mobile District endorses the use of natural stream channel design concepts where the development of project specific performance standards are based on clearly defined objectives and the ability to correlate the appropriate stream restoration metrics between the stream restoration project and approved reference reaches.

Reference reaches are streams of the same type (sometimes order), and position within the watershed that exhibit stable stream pattern, profile, and dimension, appropriate benthic substrates, and representative stream habitats. Reference reaches do not have to be pristine "totally undisturbed" streams, but should represent the least altered stable stream available for a watershed. While the reference reach can provide reference stream metrics for the stable stream at a single point in time, it is important to monitor these systems during the life of the project since upstream land use changes can also alter the condition of the reference system. Any changes within the upstream watershed may require adaptive management when developing the final stream restoration design.

Stream Mitigation Performance Standards

- Establishment and acceptance of Reference Stream Reach for target stream pattern, profile, and dimension using data required by Appendix B Summary Data Worksheet. The Reference Reach Stream should be evaluated for appropriate benthic substrates and aquatic habitats.

- Identification of stream attributes requiring stream restoration actions. Restore stream channel to a stable pattern, profile, and dimension (as appropriate based on impacts), appropriate benthic substrates, and appropriate aquatic habitats based upon reference stream parameters.
- Maintaining stable stream parameters, substrates, and habitats for at least two bankfull events, preferably two larger events (i.e., 2-yr, 5-yr, 10-yr, 25yr, etc. events). Exact calculation of the bankfull return and discharge will be addressed with the information required in a completed Appendix B Summary Data Worksheet. Bankfull events typically occur on a return interval of 1.5 or less. 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. One flow must inundate the floodplain.
- Riparian buffers: Except for urban streams, 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 by Mobile District. The Mobile District wetland success criteria are listed on Regional Internet Banking Information Tracking System (RIBITS) site on Mobile District Regulatory Division web site (http://www.sam.usace.army.mil/RD/reg/).
- Wetland riparian buffers: Site hydrology and vegetation mimics Corps approved wetland reference site or wetlands performance standards/success criteria (and associated credit release schedule if a mitigation bank) developed by Mobile District. Riparian enhancement projects require vegetative improvements. Riparian restoration projects require monitoring and demonstrating both vegetative and hydrologic improvements. For hydrology, monitoring wells should be placed in both the project site and the target reference site for measuring and demonstrating hydrologic improvements.
- Upland riparian buffers: An upland reference site is required that is within the same watershed. Riparian buffer restoration and enhancement ecological performance standards will be based upon the same attributes (target species composition, density, and diversity) as reflected in the Mobile District bottomland hardwood performance standards. All reference sites and proposed performance standards must be approved.

Achievement of performance standards will be determined for each stream reaches through a comparative analysis of the initial baseline data on physical parameters in the reference stream and project stream 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 (mitigation banks). Physical parameters that must be measured include and documenting stream specific stability parameters for pattern, profile, and dimension, benthic substrates, habitats, as well as deviations from stable stream conditions using, at minimum, data required by Appendix B and the monitoring data requirements identified in Appendix D. Although not required, water chemistry parameters such as water temperature, DO, turbidity, and water pH may be provided above, below, and within the restored stream reach to demonstrate no short-term adverse impacts resulting from the project. The presence of various aquatic habitats must be measured which serves as a surrogate to measuring stream biological productivity metrics such as fish and aquatic insect population metrics. While not required, aquatic species diversity and abundance may be measured above, below, and within the restored stream reach to demonstrate no short-term adverse impacts resulting from the project.

MITIGATION BANKS: Prior to requesting a credit release, mitigation banks are required to provide stream measurement data sheets (appendix B worksheet) for each stream reach to demonstrate achievement of required performance standards, including assessment of stable stream conditions, appropriate substrates, and appropriate aquatic habitats. Selected cross-sectional areas should be located at riffle and pool locations that are representative of typical pattern, profile, and dimension for the entire stream reach. The appropriate number of measurements will be determined on a project-by-project basis.

When monitoring stream restoration success criteria, information is required for evaluating hydrologic, geomorphologic, and aquatic habitat attributes of the restored stream ecosystem. Hydraulic data may be required on a case-by-case basis. The components listed in Appendices B are important to assessing the baseline condition and restored condition of a restored reach. The current performance standards for a stream restoration project are reflective of current lateral and vertical stream channel stability (pattern, profile, and dimension), hydrology and bed form diversity, channel substrate, aquatic habitat diversity, establishment of the riparian zone, and floodplain connectivity. Table 1 refers to general performance criteria categories that will be assessed:

Table 1. General performance criteria categories used to evaluate the success or failure of activities at stream mitigation project.

Mitigation Component (Item)	Success (Required on action)	Failure
1. Floodplain Connectivity	Stream has access to the floodplain or floodprone area. No signs of headcutting.	Loss of access to floodplain, stream begins to incise (bed lowering) as shown by headcuts, stream bank and stream bed erosion and scour leading to inappropriate stream profile and dimension.
2. Stream Channel Stability	Vegetated stream banks, limited erosion that does not represent a trend towards further lateral instability, stable stream channel morphology that is sustaining reference stream attributes.	Streambank erosion and avulsion is prevalent on both adjacent stream banks and has the potential to cause large (reach) scale adjustment and destabilization of stream channel pattern, profile, dimension, e.g. down-valley meander bend migration. Unnatural bank erosion is predicted to worsen over time.
3. Bed Form Diversity	Riffle/pool and depth variation meets reference conditions. Appropriate stream channel substrates.	Bed form frequency and variation does not meet reference conditions, and the loss of natural benthic substrates

4. Riparian Vegetation and Hydrology	Riparian vegetation and hydrology reflect or are trending towards achieving target success criteria (invasive species are not present, hydrology similar to reference site, tree and plant species density, diversity, and composition meet target approved by Mobile District).	Riparian vegetation and hydrology not appropriate or indicate a trend towards failure and not achieving the target success criteria.
5. Biological Indicators Aquatic Habitats *Invertebrate populations *Fish populations *Not required as a success criteria metric	Target aquatic habitat reflects appropriate composition, density, and diversity present and is demonstrating sustainability. Though not required, supporting data that reflects no short-term project related impacts to endemic aquatic species populations.	Aquatic habitat composition and diversity not present or not being sustained. If collected, data that reflects project causing negative impacts to endemic aquatic species populations.

Adaptive Management:

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 actions 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.

Appendix D: Stream Mitigation Monitoring Requirements

In general, the monitoring requirements of 33 CFR 332, *Compensatory Mitigation For Losses of Aquatic Resources*, dictate monitoring of a compensatory mitigation site as being necessary to determine if a compensatory mitigation site is meeting its performance standards and, if necessary, adaptive management is required to ensure the site is meeting its objectives. This relationship between project objectives (Appendix B), monitoring, and performance standards is also clearly stated in Regulatory Guidance Letter 08-03, Mitigation Monitoring Requirements which states, "*monitoring reports are documents intended to provide the Corps with information to determine if a compensatory mitigation project site is successfully meeting its performance standards. Remediation and/or adaptive management used to correct deficiencies in compensatory mitigation project outcomes should be based on information provided in the monitoring reports and site inspections". The objectives, performance standards, and monitoring requirements for compensatory mitigation projects required to offset unavoidable impacts to waters of the United States must be provided as special conditions of the DA permit or specified in the approved final mitigation plan (see 33CFR 332.3(k)(2)).* RGL-08-03 also outlines the <u>minimum</u> information required submitted in a monitoring report.

Consistent with information requirements in Appendix B, the following list of parameters should be considered a minimum in developing a monitoring strategy and information to be provided in monitoring reports. If any of the factors listed below are NOT used to monitor any given project, the reason for exclusion should be explained either in the mitigation banking instrument or mitigation plan. The following parameters are required not only to ascertain success of the project through the achievement of performance standards, but also to collect information to be used for adaptive management if required. Also consistent with the stream design requirements in Appendix B, reference stream(s) should also be a component of the monitoring strategy and monitored for these same parameters to provide a consistency assurance check on the progress of the project.

<u>The collection of initial baseline data on physical parameters in streams and riparian buffers is required before mitigation is implemented</u>. Monitoring and collection of the data for demonstrating progress and the achievement of interim target success criteria is required annually, for at least 5 years, or until the final success criteria have been achieved. Additional long-term monitoring may be required after mitigation is completed (mitigation banks).

Instream Monitoring

For projects proposing in-stream mitigation, the monitoring of the stream geomorphology is the primary means of determining if the restoration is "stable". Post construction monitoring serves multiple purposes in that it allows the practitioner to both evaluate the physical character of the restoration project, and also provides the opportunity to determine the degree of departure from the original design and /or reference stream over time. Generally, monitoring of this nature revolves around a suite of geomorphic parameters, and is focused on assuring that the restored resource is not in a state of disequilibria (i.e. is not experiencing elevated processes of erosion or aggradation). Relevant measurements (Appendix B Summary Data Worksheet) related to stream pattern, profile, dimension and bed material are considered key indicators of stream stability and, are most commonly evaluated by taking repeated measurements of established cross-sections and longitudinal profiles. Data from these measurements are useful in determining the lateral and vertical stability of a restored or enhanced reach, as well as a reference reach. Therefore, in cases where in-stream restoration activities are proposed, monitoring will include measurements of geomorphic parameters including channel cross-sections and longitudinal profiles within the restored stream reaches, as well as on any proposed reference channels.

To detect potential changes in stream "stability", permanent channel cross–sections will be established and located by Global Positioning System in the restored stream reaches. Channel cross sections will be erected perpendicular to the stream channel within both riffles and pools where changes in patterns of erosion and sedimentation can be indentified through corresponding changes in channel geometry (e.g., channel widening, incision, etc.). In order to help ensure reproducibility during subsequent monitoring events, cross-sections will be monumented at both ends. Cross-sections will be compared after each monitoring event to detect potential changes in channel geometry that are both consistent and directional. If Identified and outside of the designed range, these changes may serve as indicators of channel instability resulting from disequilibria between erosional and depositional processes within the stream channel.

Stream monitoring will also include surveying longitudinal profiles along restored reaches. The profiles will be located in such a manner as to provide adequate coverage along the length of the restores stream reaches. Survey points will include channel thalweg, water surface, inner berm(s), bankfull stage, and top of low bank. The profiles will be measured to monitor average water surface slope, slope, depth, and spacing of various streambed features such as riffles, runs, pools, and glides. The longitudinal profiles will extend parallel to the stream channel for a distance equal to approximately 20 bank full channel widths. Longitudinal profiles will be monumented at the upstream end to allow for reproducibility of the profiles during subsequent monitoring events.

Although not required, water chemistry parameters may be measured with long-term monitoring data of water temperature, DO, turbidity, and water pH to demonstrate no short-term adverse impacts from the project. The presence of various aquatic habitats must be measured as a surrogate to measuring stream biological productivity metrics such as fish and aquatic insect population metrics. While not required, continuous monitoring of stream aquatic species diversity and abundance may be measured for the purpose of demonstrating no short-term adverse impacts from the proposed project and adequate biological recovery of the mitigation site. Monitoring should occur above, within, and below the project stream reach.

Riparian buffer Monitoring: 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. 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 until target success criteria are achieved. Minimal information to be collected annually should include vegetation data required to demonstrate achievement of success criteria metrics reflected in the Mobile District's habitat success criteria found on the RIBITS Site on the Mobile District web page at http://www.sam.usace.army.mil/RD/reg/. Riparian restoration projects require monitoring and demonstrating vegetative and hydrologic improvements. For restoration projects, monitoring wells should be placed in both the project site and the target reference site for measuring and demonstrating hydrologic improvements. Upland riparian buffer restoration and enhancement and target ecological performance standards should be based upon target species composition, diversity, and structure metrics similar to that required for forested wetlands, gathered from high quality reference upland riparian buffers in the same watershed.

Monitoring Reports

Parameters listed underneath the functional headings below will be required to be included in monitoring reports. The following parameters are comprehensive and some may not be appropriate depending on the type of stream mitigation being proposed. Reasons for not including any of the following factors may be submit for IRT review.

A. For any in-stream restoration or enhancement project.

1) Stream pattern, profile, and dimension metrics using Appendix B Summary Data Worksheet for project site and reference sites.
2) Geomorphology
    a. Channel evolution stage
    b. Bank migration, erosional patterns, and lateral stability
    c. Bed form diversity
    d. Bed material characterization
    e. Sediment transport competency and capacity*
    f. Large woody transport and storage
3) Hydrology: stream flow measurement should be accomplished using stream gaging techniques.
    a. Bankfull discharge: baseline (pre-construction); post construction (first year); end of project.
    b. Precipitation/runoff relationship: baseline versus end of project.*
    c. Flood frequency and duration. Recommended this data be collected and calculated throughout monitoring period.
4) Hydraulic:
    a. Floodplain connectivity should be assessed using the following parameters: Bank height ratio; entrenchment ratio
    b. Flow dynamics: stream velocity*

B. For riparian zone restoration/enhancement project.

1) Current vegetative management actions
    a. Target habitat and acreages of mitigation polygon.
    b. Current land management actions achieved.

c. Data supporting progress towards achieving the interim or final Mobile District wetland habitat success criteria, or upland habitat success criteria metrics based on an approved reference site.

2) Current hydrologic management actions (if proposed).
3) Current soil management actions (if proposed).

* As needed on a case-by-case basis

Appendix E: Proposed Example of a Credit Release Schedule for Mitigation Banks and In-Lieu Fee Programs

Independent credit release schedules must be developed for each stream reach. 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.

- After initial credit release, preservation credits will be authorized in direct proportion to the percentage of funding of the long-term stewardship fund.

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

Stream A

20% Initial release (buffer and instream credits) for approved MBI, conservation easement, financial assurance and approval of final detailed stream channel restoration design plans.

- For riparian restoration work, groundwater monitoring wells installed/arrayed in project site and reference site to document the timing, duration and frequency of hydrology.

10% Upon completion of site preparation/earthwork and hydrology work related to stream buffer and channel (see explanation below). To assess in-channel hydrology, stream gages installed and correlated with bankfull indicators to show correct baseline and post project stream geomorphology.

- Upon completion of initial construction and submittal of post-construction monitoring report (see Appendix D) submitted documenting physical, hydrological, and biological improvements made pursuant to the stream channel restoration plan. Stream channel work requires submittal of Appendix B Summary Data Worksheet. Improvements include: new channel construction, grading, construction of bankfull benches, placement and construction of in-stream structures, and bank stabilization measures.
- For riparian buffer areas, groundwater monitoring well data should be provided that demonstrates the appropriate magnitude, duration, and frequency of inundation and/or saturation.
- Riparian buffer target species managed to achieve initial planting/vegetation success criteria metrics identified in the Mobile District habitat success criteria.
- If the long-term management will be coordinated by a long-term management board, 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).

20% Following first successful bankfull event.

- Success evaluated by stream stability of both in-stream pattern, profile, and dimension, streambank stability, and appropriate benthic substrates as documented by re-survey of the fixed cross-sections and monitoring points including photographic documentation, narrative descriptions (including aquatic habitat), and completed Appendix B Summary Data worksheet.

- Riparian Buffer: visual evidence of appropriate target species (and individual seedling) placement in relation to appropriate topographic/hydrologic habitat.
- Riparian Buffer: Positive trend in target species composition, diversity, and density towards achieving Mobile District success criteria.

30% Following second successful bankfull event.

- Success evaluated by stream stability of both in-stream pattern, profile, and dimension, streambank stability, and appropriate benthic substrates as documented by re-survey of the fixed cross-sections and monitoring points including photographic documentation, narrative descriptions (including aquatic habitat), and completed Appendix B Summary Data worksheet. Second bankfull event should have a return interval approximately 1.5 years from date of first bankfull event.
- Riparian Buffer: visual evidence of species (and individual seedling) placement in relation to appropriate topographic/hydrologic habitat.
- Riparian Buffer: positive trend in target species composition, diversity, and density towards achieving success criteria. Tree 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 stream stability of both in-stream pattern, profile, and dimension, streambank stability, and appropriate benthic substrates as documented by re-survey of the fixed cross-sections and monitoring points including photographic documentation, narrative descriptions (including aquatic habitat), and completed Appendix B Summary Data worksheet.
- Riparian Buffer: post-planting of shrubs and herbaceous layer.
- Riparian Buffer: a minimum of three years positive growth of planted tree species is required before shrubs and herbs are planted and/or naturally regenerate. Positive trend in target species composition, diversity, and density towards achieving success criteria. Tree plantings show positive growth of root collar, diameter, and/or height.
- Riparian Buffer: visual evidence of appropriate shrubs and herbs planted sparingly or naturally recruited, in small groupings across site.
- Full funding of Long-Term Land Stewardship Fund (non-wasting escrow account).

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

- Success evaluated by stream stability of both in-stream pattern, profile, and dimension, streambank stability, and appropriate benthic substrates as documented by re-survey of the fixed cross-sections and monitoring points including photographic documentation, narrative descriptions (including aquatic habitat), and completed Appendix B Summary Data worksheet.
- Riparian Buffer: A minimum of nine years positive growth of planted tree species.
- Riparian Buffer has achieved all the target success criteria required in the Mobile District habitat success criteria

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