Department of the Army
Corps of Engineers

State of Missouri
Stream Mitigation Method

Updated February 2007

COMPENSATORY STREAM MITIGATION

A. GENERAL INFORMATION:

Compensatory stream mitigation generally means the manipulation of the physical, chemical, and/or biological characteristics of a stream with the goal of repairing or replacing its natural functions. It involves the restoration, creation, enhancement or, for streams of national or state significance because of the resources they support, preservation of streams and their associated floodplains. The purpose is to compensate for unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization have been achieved. Compensatory mitigation may be required for impacts to perennial, intermittent, and ephemeral streams and should be designed to restore, enhance, and maintain stream uses that are adversely impacted by authorized activities.

Compensatory stream mitigation is determined through the implementation of current Regulatory Guidance, best professional judgment, and through the public interest review process. This assessment method has been established to supplement current guidance, and provide a consistent rationale to determine appropriate compensatory stream mitigation for stream impacts resulting from Department of the Army permit authorizations in the State of Missouri. This method will be required when assessing mitigation for impacts to streams or rivers, and in assessing credits for stream mitigation banks. Permits specific to Section 10 activities, such as associated with dredging, will generally not require the use of this assessment method. In some cases, the evaluation of the permit application may reveal that the stream compensation measures are not practicable, constructible, or ecologically desirable, such as in enforcement cases; this determination will be made at the discretion of the Regulatory Project Manager.

Activities that constitute restoration/enhancement/preservation/creation include, but are not limited to: stream channel restoration; bank stabilization; in-stream habitat enhancement; impoundment removal; livestock exclusion devices; road crossing improvements; stream relocation; and natural buffer establishment.

1. Regulatory Authorities & Guidelines

Section 10 of the Rivers and Harbors Act of 1899: In accordance with Section 10 of the Rivers and Harbors Act of 1899, 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 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 Clean Water Act is to restore and maintain the physical, chemical, and biological integrity of the nation's waters**.**

Section 230.10 (d) of the Section 404 (b)(1) Guidelines states that"... no discharge of dredged or fill material shall be permitted unless appropriate and practicable steps have been taken which will minimize potential adverse impacts of the discharge on the aquatic ecosystem." The Section 404 (b)(1) Guidelines require application of a sequence of mitigation -- avoidance, minimization and compensation. 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.

Regulatory Guidance Letter (RGL) 02-02 - Guidance on Compensatory Mitigation Projects for Aquatic Resource Impacts Under the Corps Regulatory Program Pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899. This guidance requires compensatory mitigation to replace aquatic resource functions unavoidably lost or adversely affected by authorized activities. RGL 02-02 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 provides guidance for identifying the 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 of 1899.

Regulatory Guidance Letter (RGL) 06-03 – 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.

District Mitigation and Monitoring Guidelines: These are guidelines and standard operating procedures developed by each individual District to address mitigation activities. Each Corps District has developed mitigation and monitoring procedures specific to that District. These guidelines and procedures are available on each District’s website, and are subject to review and modification as needed by each District.

B. ADVERSE IMPACT FACTORS:

Streams are complex ecosystems with morphological characteristics that are dependent on appropriate geomorphic dimension, pattern, and profile as well as biological and chemical integrity. They are not simply storm water conveyances. The following factors will determine the amount of mitigation credits required:

1. Stream Types:

Ephemeral Streams have flowing water only during and for a short duration after precipitation events in a typical year. Ephemeral streambeds are located above the water table year-round. Groundwater is not a source of water for the stream. Runoff from precipitation is the primary source of water for stream flow. Ephemeral streams typically support few aquatic organisms. When aquatic organisms are found they typically have a very short aquatic life stage.

Intermittent Streams have flowing water during certain times of the year, when ground water provides water for stream flow. During dry periods, intermittent streams may not have flowing water. Runoff from precipitation is a supplemental source of water for stream flow. The biological community of intermittent streams is composed of species that are aquatic during a part of their life history or move to perennial water sources.

Perennial Streams have 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.

2. Priority Area: Priority area is a factor used to determine the importance of the stream that would 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. As new technology is available, a stream may increase to a higher category on a case-by-case basis. The priority areas are divided into three categories:

Primary: These streams provide important contributions to biodiversity on an ecosystem scale or high levels of function contributing to landscape or human values. Impacts to these streams should be rigorously avoided or minimized. Compensation for impacts in these streams should emphasize replacement nearby and in the same immediate 8-digit hydrological unit code (HUC) watershed. Designated primary priority areas include:

National Wild and Scenic Rivers/Study Rivers
National Scenic Riverways
Outstanding National Resource Waters
Outstanding State Resource Waters
Approved greenway corridors
District Designated Waters
*Waters with listed Federal Endangered and Threatened species
*Designated Fish Spawning Habitat
*Mussel beds

* These areas are determined on a case by case basis in coordination with the USFWS and MDC

Secondary: Secondary priority areas include:

- Waters on the 303(d) list, impaired by sediment and nutrients.
- Adjacent to an approved mitigation bank or mitigation site
- Stream and river reaches within 0.5 mile upstream or downstream of primary priority reaches
- Stream or river reaches within high growth areas that are not ranked as primary priority areas. See appendix for District designations.

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

3. Existing Condition: The state of the physical, chemical, and biological health of a stream at the time of an assessment, as compared to the least disturbed condition of similar streams in the ecoregion. This is a measure of the stability and functional state of a stream and the stability of the riparian buffer before project impacts.

Fully functional stream means that the physical geomorphology of the reach is stable and is representative of an appropriate stream hydrograph for the topographical setting. The biological community of a stream that is fully functional is diverse and unimpaired by excessive anthropogenic inputs.

- The stream is one that has not been channelized.
- The stream has no more than one stream impact within 0.5 mile upstream or downstream of the proposed stream impact, including culverts, pipes, or other manmade modifications (less than 30 feet of impacted section).
- The stream does not exhibit channel incision and headcutting. If necessary, this may be quantified through the determination of an appropriate entrenchment ratio and width/depth ratio at bankfull discharge relative to the unimpaired stream condition .
- The stream has at least a minimum width riparian buffer (minimum of at least 25 feet on both sides of the stream) of deep-rooted native vegetation.

The Corps, at its discretion, may designate the largest streams within an EDU or 8-digit HUC as fully functional, regardless of whether they meet the criteria above, based on the streams recreational, commercial, or water supply values. See appendix for District designations.

Moderately Functional stream means that the stability and resilience of the stream or river reach has been compromised, to a limited degree, through partial loss of one or more of the integrity functions (chemical, physical, biological). System recovery has a moderate probability of occurring naturally.

For purposes of this methodology, a stream generally will be considered moderately functional if the stream meets one or more of the following criteria:

- The stream segment is considered moderately functional if the entrenchment ratio and width/depth ratio at bankfull discharge is inappropriate relative to the unimpaired stream conditions.
- The stream shows that human-induced sedimentation and erosion is moderate.
- The stream has a moderate riparian buffer of deep-rooted vegetation present (minimum of at least 10 feet on both sides of the stream).
- The stream has no more than three stream impacts within 0.5 miles upstream of the proposed stream impact, including culverts, pipes, or other manmade modifications (with less than 100 feet of impacted section).

Functionally Impaired stream means that there is a very high loss of system stability and resilience characterized by loss of one or more integrity functions. Recovery is unlikely to occur naturally, and further damage is likely, unless restoration is undertaken.

For purposes of this methodology, a stream generally will be considered functionally impaired if one or more of the following criteria is met.

- The stream is considered functionally impaired if the reach has been channelized.
- The entrenchment ratio and width/depth ratio at bankfull discharge is inappropriate relative to the unimpaired stream condition, and the stream has degraded to a less desirable type (e.g. Rosgen Type "G" or "E")
- The stream has extensive human-induced sedimentation.
- The stream has little or no riparian buffer of deep-rooted vegetation on one or both sides of the stream.
- The stream has banks that are extensively eroded or unstable.
- The stream has five or greater stream impacts within 0.5 miles upstream of the proposed stream impact, including culverts, pipes, or other manmade modifications.

4. Duration: Duration is the amount of time adverse impacts are expected to last.

Temporary means impacts will occur within a period of less than 6 months and recovery of system integrity will follow cessation of the permitted activity, or active restoration of the site. For example, temporary structures which will be removed and site restored to pre-project contour and conditions.

Recurrent means repeated impacts of short duration. Examples: Utility crossings, where streambed and bank is restored but considers future maintenance, Reshaping/maintaining drainage ditch in an already channelized stream segment. Also, within-channel 24-hour water detention, in which the berm/weir would be considered a permanent impact, but the stormwater backing up for short periods in an undisturbed (not physically modified) channel behind the berm/weir would be considered a recurrent impact.

Permanent means project impacts will be permanent. Examples: armoring, detention, morphological change, impoundment, piping, and channelization.

5. Activity:

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

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 linear transportation 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 and other aquatic organism passage and allow other natural stream processes to occur unimpeded.

Clearing means the clearing or removal 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. Although these impacts may not be directly regulated, mitigation for these activities may be required if the impact occurs as a result of, or in association with, an activity requiring a permit.

Detention means to temporarily slow flows in a channel. Areas that are temporarily flooded due to detention structures must be designed to pass flows below bankfull stage. Impacts to the stream channel where the structure is located are considered fill, as defined below.

Fill means the permanent fill of a stream channel including the 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 bank-full 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. This includes the creation of a concrete lined open channel, or excavation of a basin area upstream of a detention structure or dam.

Pipe means to route a stream through pipes, box culverts, or other enclosed structures.

Utility crossings mean pipeline/utility line installation methods that require temporary disturbance of the streambed. **Bridge footings** requiring fill in waters of the United States are also considered in this activity factor. This factor also includes drilled shafts, column/pier placement, cofferdams for footing/pier placement, temporary crossings and workpads.

6. Linear Impact: Linear impact means the length of stream, in feet, that will be impacted by a project, as authorized under Section 404 of the Clean Water Act, and for which mitigation will be required.

C. MITIGATION CREDITS:

Net Benefit: Net benefit is an evaluation of the proposed mitigation action relative to the restoration, enhancement, creation, and preservation of the chemical, biological, and physical integrity of the Nation's waters. Five stream mitigation methods are covered under these guidelines – 1) stream channel restoration / stream enhancement, 2) stream relocation, 3) riparian creation, 4) riparian enhancement / restoration, and 5) riparian preservation. ***The Corps will determine, on a case-by-case basis,*** the net benefit of mitigation actions.

1. In-Stream Work

- **Stream Channel Restoration / Stream Enhancement:** All restored channels will generally be protected by a buffer of native vegetation. In addition, all stabilized stream banks should be protected by a buffer. This buffer will also generate riparian preservation, enhancement, restoration, or creation mitigation credit. Credit for removal of structures described below under the **Excellent** and **Good** restoration actions will be based on the documented length of reach that the structure impacts under current flow conditions. All proposed stream channel restoration / stream enhancement actions should include design criteria and explain why/how the project will benefit water quality and/or habitat.

a. Excellent stream channel restoration actions include:

1) Creating floodplains of appropriate dimensions adjacent to streams with inappropriately low width/depth ratios at bankfull discharge.
2) Private levee removal to restore floodplain functionality.
3) Restoring appropriate bankfull discharge width, stream sinuosity, entrenchment ratio, and width/depth ratio in degraded streams to referenced morphologic patterns
4) Removing dams and large weirs, pipes, culverts and other manmade in-stream structures with >50 linear feet of direct fill/impact, then restoring the stream channel to referenced, stable morphologic patterns (i.e. Replace culverts with span bridges).

b. Good stream channel restoration / stream enhancement actions include

1) Converting stream type by shaping upper slopes and stabilizing both bed and banks.
2) Restoring streambank stability in highly eroded areas.
3) Restoring in-stream channel features (i.e., riffle/run/pool/glide habitat) using methodology appropriate to stream type
4) Culverting existing road crossings in floodplains and replacing inappropriately sized/designed culverts to allow more natural flood flows.
5) Routing a stream around an existing impoundment by creating a morphologically stable and appropriate stream channel.
6) Removing weirs, pipes, culverts and other manmade in-stream structures.

c. Moderate stream channel restoration / stream enhancement actions include:

1) Stabilize stream channel in place
2) Restoring streambank stability in moderately eroded areas
3) Replacing inappropriately sized/designed culverts
4) Constructing fish ladders or adding woody debris to create fish habitat
5) Removing check dams, weirs, and other manmade in-stream structures where these structures are contributing to bank erosion or scour or blocking stream processes and aquatic organism movements.

- **Stream Relocation:** Movement/creation of a stream at a new location to allow an authorized project to be constructed in the stream's former location. In general, relocated streams must reflect the dimension, pattern, and profile indicated by a natural reference reach/condition in order to be adequate compensation for the authorized stream impact. Relocated streams will generally require vegetative protected buffers of sufficient width. This buffer will also generate riparian preservation, enhancement, restoration, or creation mitigation credit. Relocations resulting in a reduced channel length will generally require additional mitigation to replace stream functions. Relocated mitigation activities include, but are not limited to, open channel sections and in-stream features, including restoration of stream morphology. In-stream features include items such as fish ladders, riffle/run/pool/glide habitat, cross vanes, J-hook vanes, W-weirs, root wads, step pools, rock eddies, boulder clusters, grade control structures, and other features as appropriate.

2. Riparian Buffer Creation, Enhancement, Restoration, and Preservation:

- **Riparian Buffer Creation** means the manipulation of the physical, chemical, and/or biological characteristics present to develop a buffer on an upland where a buffer did not previously exist.

- **Riparian Buffer Restoration / Enhancement** means implementing rehabilitation practices within a stream riparian buffer zone to improve water quality and/or ecological function. Buffer enhancement may include increasing or improving upland and/or wetlands habitat within or adjacent to riverine systems. Restoration programs should strive to mimic the composition, density and structure of a reference reach habitat. For the purposes of these guidelines, an area will be considered as riparian buffer restoration if 51-100% of the area would require planting of vegetation to restore streambank stability and improve wildlife habitat. For the purposes of these guidelines, an area will be considered as riparian buffer enhancement if 10-50% of the area would require planting of vegetation to restore streambank stability and improve wildlife habitat.

- **Riparian Buffer Preservation** means the conservation, in its naturally occurring or present condition, of a 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 vegetation to restore streambank stability and improve wildlife habitat.

3. Additional Riparian Improvements means restoring and/or enhancing vegetation within the riparian corridor proposed for mitigation credit as well as conducting additional improvements in the riparian corridor that have not been accounted for in this Mitigation Credit section. These additional riparian improvements may include;

- restoring or creating wetlands for purposes of improving water quality, flood storage, and increasing biodiversity in the mitigation area,
- removing substantial accumulations of trash or debris that may impair water quality in the mitigation area,
- removal of structures that disrupt the riparian community planned to be restored or enhanced in the mitigation area,
- fencing livestock from pastures, where livestock grazing activities are impacting water quality and/or stream ecological function, thereby minimizing or avoiding streambank degradation, sedimentation, and water quality problems. Livestock exclusion is normally accomplished by fencing stream corridors and can include the construction of stream crossings with controlled access and with stable and protected stream banks. No more than one livestock crossing may be planned per 1,000 linear feet of stream mitigation. The width of the livestock crossing will be deducted from the total length of the stream mitigation segment. This buffer may not be used for preservation purposes only, after cattle have been removed.

If any one of the above improvements are proposed in the mitigation area selected for restoration or enhancement, a 1.2 multiplier shall be applied to the value selected in Table 1. The use of the 1.2 multiplier will be used to calculate mitigation credits generated for additional improvements within the riparian buffer of the proposed mitigation area.

*** Requirements for Minimum Buffer Width: The minimum buffer width (MBW)** for which mitigation credit will be earned is 25 feet on one side of the stream, measured from the top of the streambank, perpendicular to the channel. Smaller buffer widths may be allowed on a case-by-case basis for small streams and consideration for a reduced buffer width will be based on issues related to construction constraints, land ownership, and land use activities (i.e. farming). 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 41 feet). Buffer slope will be determined in 50-foot increments beginning at the stream bank. 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.

Table 1 below provides appropriate Net Benefit values for the riparian creation, restoration, enhancement, and preservation mitigation worksheet. Note that on this worksheet, buffers on each bank of a given reach, generate mitigation credit separately (Stream Side A and Stream Side B).

Buffer width (on one side of the stream) Equal to or greater than	% Buffer that needs planting		
	*Buffer Creation and Restoration Exotic Removal and (51-100%)Planting	Buffer Enhancement Exotic Removal and (10-50%)Planting	Buffer Preservation (<10%)Planting
300 feet	2.8	1.4	0.7
275 feet	2.7	1.35	0.675
250 feet	2.6	1.30	0.65
225 feet	2.5	1.25	0.625
200 feet	2.4	1.2	0.60
175 feet	2.2	1.1	0.55
150 feet	2.0	1.0	0.50
125 feet	1.8	0.9	0.45
100 feet	1.6	0.8	0.4
75 feet	1.2	0.6	0.3
50 feet	0.8	0.4	0.2
25 feet (minimum width)**	0.4	0.2	0.1

Table 1. Riparian Buffer Creation, Restoration, Enhancement, and Preservation

* A minimum of Level II Monitoring is required.
** Smaller buffer widths may be allowed on a case-by-case basis for small streams and consideration for a reduced buffer width will be based on issues related to construction constraints, land ownership, and land use activities (i.e. farming).
Note: Use an additional 1.2 multiplier to calculate mitigation credits generated for buffers that will be restored or enhanced with additional improvements such as fencing livestock from the riparian buffer in actively grazed pastures, restoring or creating wetlands, removing substantial accumulations of trash, or removal of structures.

4. System Protection Credit: Additional mitigation credit may be generated if proposed riparian mitigation activities include minimum width buffers on **both** sides of a stream reach.

5. Monitoring and Adaptive Management:
Monitoring and contingency plans are actions that will be undertaken during the mitigation project to measure the level of success of the mitigation work and to correct problems or failures. All projects should include remedial actions that will achieve specified success criteria if deficiencies or failures are found during the monitoring period. Monitoring is a required component of all mitigation plans and should at a minimum, address all success criteria paragraphs.

Monitoring Level I will include only item 1 from Table 2.
Monitoring Level II will include at least two of the following items 1, 2, and 3 from Table 2 based on the project review.
Monitoring Level III will include items 1, 2 and 3 and may include item 4 from Table 2 based on the project review.

Mitigation Component (Item)	**Success (Required on action)**	**Failure**	**Action**
1. Photo Reference /Sample Site Longitudinal photos Lateral photos	No substantial aggradation, degradation or bank erosion.	Substantial aggradation degradation or bank erosion.	When substantial aggradation, degradation or bank erosion occurs, remedial actions will be planned, approved, and implemented.
2. Plant Survival Survival plots Stake counts Tree counts	$\geq$ 80% Survival within the planted plots. These plots should mimic reference reach target habitat in species composition, density and structure. *Native vegetation regeneration may be in the percentage determination.	< 80% Survival within the planted plots.	Area with less than 80% coverage of target species will be re-seeded and/or fertilized; live stakes and bare rooted trees will be planted to achieve desired densities.
3. Channel Stability Dimensions Longitudinal profiles Pebble count	Stable stream with pattern, profile and dimension of similar reference reach type. Minimal evidence of instability (down-cutting, deposition, bank erosion, increase in sands or finer substrate material).	Substantial evidence of instability.	When Substantial evidence of instability occurs, remedial actions will be planned, approved, and implemented.
4. Biological Indicators Invertebrate populations Fish populations	Population measurements remain the same or improve, and target species composition indicates a positive trend.	Population measurements and target species composition indicate a negative trend.	Reasons for failure will be evaluated and remedial action plans developed, approved, and implemented.

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

*Substantial or subjective determinations of success will be made by the mitigation sponsor and confirmed by the US Army Corps of Engineers.

6. Control/Protection: An appropriate real estate instrument, approved in advance by the Corps, will be required to protect the mitigation work in perpetuity. Which of the instruments below is appropriate for the subject property may vary depending on the situation.

Conservation easement means a legally binding recorded instrument approved by the District to protect and preserve mitigation sites by giving protection and enforcement rights by real estate interest to a third party.

Deed restriction means a provision in a deed limiting the use of the property and prohibiting certain uses. The District approves mitigation areas and requires deed restrictions to protect and preserve mitigation sites. If the applicant can demonstrate that the mitigation activity will occur within a right-of-way easement and if the easement will offer protection and preservation of the site, such as associated with highway projects, the credit will be considered the same as that for deed restriction of the mitigation site.

Restrictive covenant means a legal document whereby an owner of real property imposes perpetual limitations or affirmative obligations on the real property.

Conservancy means transferring fee title to a qualified, experienced, non-profit conservation organization or government agency. Non-profit organization means an entity recognized and operating under the rules of the Internal Revenue Services for non-profit purposes.

7. Mitigation Construction Timing: No additional credits are generated for this factor if the mitigation action in a reach is primarily riparian buffer preservation (<10% of buffer area would require planting of vegetation; see Table 1).

Non-Banks:
***Schedule 1*:** All mitigation is completed before the impacts occur.
***Schedule 2*:** A majority of the mitigation is completed concurrent with the impacts
***Schedule 3*:** A majority of the mitigation will be completed after the impacts occur.
Banks: Release of credits will be determined by the MBRT on a case-by-case basis.

8. Temporal Lag: A factor to compensate for the time required for a mitigation area to fully replace functions lost at the impact site. Different systems will require different times to reach levels of functional capacity level with the impact site. For example, a forested buffer would have a greater temporal lag than a grass covered buffer.

9. Mitigation Factor:

Use a mitigation factor of 0.5 for: 1) all out-of-kind aquatic resource or buffer replacements, 2) impacts not within a mitigation bank service area but proposing to go to a bank, or 3) permittee constructed mitigation proposed outside of 8-digit Hydrologic Unit Code (HUC) watershed in which the impacts occurred.

Use a mitigation factor of 1.0 for: 1) all in-kind aquatic resource or buffer replacements, 2) impacts within a mitigation bank service area and proposing to go to a bank, or 3) permittee constructed mitigation proposed within the 8-digit HUC watershed in which the impacts occurred.

Mitigation factors for in-lieu fee mitigation will be determined by each individual District.

Out-of-kind replacements replace aquatic resources or buffers of a different physical and functional type. This is appropriate when it provides more environmental benefit and is more practical by providing more ecological or watershed benefit than in-kind.
In-kind replacements are stream losses or buffer losses, which are replaced by a stream/buffer that is established, restored, enhanced, or protected of the same physical and functional type. This is required when the impacted resource is locally important.

D. DEFINITIONS:

Bankfull Discharge 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 (Dunne and Leopold 1978). The bankfull stage is the point at which water begins to overflow onto a floodplain. Bankfull may not be at the top of the streambank in incised or entrenched streams. On average, bankfull discharge occurs approximately every 1.5 years.

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

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

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

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 divided by bankfull width.

Flood-prone Area Width is measured in the field at an elevation twice-maximum depth at bankfull. Maximum depth is the difference between the bankfull stage and thalweg elevations in a riffle section. (Rosgen, 1994)

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

Ordinary High Water Mark (OHWM) is the line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of the soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding area.

Reference Reach/Condition: A stable stream reach generally located in the same physiographic ecoregion, climatic region, and valley type as the project that serves as the blueprint for the dimension, pattern, and profile of the channel to be restored.

Sinuosity and Stream Pattern: Stream pattern describes the view of a stream channel as seen from above. Streams are rarely straight; they tend to follow a sinuous path across a floodplain. Sinuosity of a stream is defined as the ratio of channel length/valley length. In addition to slope, the degree of sinuosity is related to channel dimensions, sediment load, stream flow, and the bed and bank materials.

Stable Stream: A naturally stable stream channel is one that maintains its dimension, pattern, and profile over time such that the stream does not degrade or aggrade. Naturally stable streams must be able to transport the sediment load supplied by the watershed. Instability occurs when scouring causes the channel to incise (degrade) or when excessive deposition causes the channel bed to rise (aggrade). (Rosgen, 1996)

Stream Enhancement – Stream rehabilitation activities undertaken to improve water quality or ecological function of a fluvial system. Enhancement activities generally will include some activities that would be required for restoration. These activities may include in-stream or streambank activities, but in total fall short of restoring one or more of the geomorphic variables: dimension, pattern and profile. Any proposed stream enhancement activity must demonstrate long-term stability.

Stream Profile: The profile of a stream refers to its longitudinal slope. 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 sinuosities and flat streams have high sinuosities.

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

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

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

Stream Riparian Zone: A riparian zone is the area of vegetated land along each side of a stream or river that includes, but is not limited to, the floodplain. The quality of this terrestrial or wetland habitat varies depending on width and vegetation growing there. As with vegetated buffer, functions of the riparian zone include reducing floodwater velocity, filtering pollutants such as sediment, providing wildlife cover and food, and shading the stream. The ability of the riparian zones to filter pollutants that move to the stream from higher elevations results in this area being referred to as the buffer zone. The riparian zone is measured landward from the bankfull elevation on each side of a stream or river.

Stream Stabilization – The in-place stabilization of an eroding streambank. Stabilization techniques, which include primarily natural materials, like root wads and log crib structures, as well as sloping stream banks and revegetating the riparian zone may be considered for mitigation. When streambank stabilization is proposed for mitigation, the completed condition should be based on a reference condition or by methods appropriate to the stream reach.

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 bank-full.

APPENDIX A

A-1: Adverse Impact Factors Worksheet
A-2: In-Stream Work Worksheet
A-3: Riparian Buffer Worksheet
A-4: Stream Mitigation Bank Credit Assessment Worksheet

ADVERSE IMPACT
FACTORS FOR RIVERINE SYSTEMS WORKSHEET

Stream Type Impacted	Ephemeral 0.1			Intermittent 0.4			Perennial 0.8		
Priority Area	Tertiary 0.1			Secondary 0.4			Primary 0.8		
Existing Condition	Functionally Impaired 0.1			Moderately Functional 0.8			Fully Functional 1.6		
Duration	Temporary 0.05			Recurrent 0.1			Permanent 0.3		
Activity	Clearing 0.05	Utility Crossing/Bridge Footing 0.15	Below Grade Culvert 0.3	Armor 0.5	Detention 0.75	Morpho -logic Change 1.5	Impound-ment (dam) 2.0	Pipe 2.2	Fill 2.5
Linear Impact	<100' 0	100'-200' 0.05	201-500' 0.1	501-1000' 0.2	>1000 linear feet (LF) 0.1 reach 500 LF of impact (example: scaling factor for 5,280 LF of impacts = 1.1)				

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

Total Mitigation Credits Required * = (M X LF) = _____

*This value may be applied to mitigation at a mitigation bank at a 1:1 ratio, when the impact area is within the service area of an approved mitigation bank. An increased multiplier will be used at the Corps discretion when an impact occurs outside of the service area of an approved mitigation bank, or when mitigation is proposed through an in-lieu fee program.

IN-STREAM WORK
STREAM CHANNEL / STREAM RESTORATION or ENHANCEMENT AND RELOCATION WORKSHEET

Stream Type	Ephemeral 0.05	Intermittent 0.4	Perennial Stream			
			<15' 0.4	15'-30' 0.6	30'-50' 0.8	>50' 1.0
Priority Area	Tertiary 0.05		Secondary 0.2		Primary 0.4	
Existing Condition	Not Applicable 0		Functionally Impaired 0.4		Moderately Functional 0.05	
Net Benefit	Stream Relocation 0.1	Stream Channel Restoration / Stream Enhancement				
		Relocated Stream with In-Stream features 0.5	Moderate 1.0		Good 2.0	Excellent 3.5
Monitoring/ Contingency	Level I 0.05			Level II 0.3	Level III 0.5	
Control / Site Protection	Corps approved site protection without third party grantee 0.1			Corps approved site protection recorded with third party grantee, or transfer of title to a conservancy 0.4		
Mitigation Construction Timing	Schedule 1 0.3			Schedule 2 0.1	Schedule 3 0	

Factors	Net Benefit 1	Net Benefit 2	Net Benefit 3	Net Benefit 4	Net Benefit 5	Net Benefit 6
Stream Type						
Priority Area						
Existing Condition						
Net Benefit						
Monitoring/Contingency						
Control/Site Protection						
Mitigation Construction Timing						
Sum Factors (M)=						
Stream length in Reach (do not count each bank separately) (LF)=						
Credits (C) = M X LF						
Total Credits Generated C X Mitigation Factor (MF) =						

Total Channel Restoration/Relocation Credits Generated = _____

RIPARIAN BUFFER CREATION, ENHANCEMENT, RESTORATION AND PRESERVATION WORKSHEET

Stream Type	Ephemeral 0.05	Intermittent 0.2	Perennial 0.4	
Priority Area	Tertiary 0.05	Secondary 0.2	Primary 0.4	
Net Benefit (for each side of stream	Additional Improvements (select values from Table 1 times 1.2 multiplier)	Riparian Creation, Enhancement, Restoration, and Preservation Factors (select values from Table 1) (MBW = Minimum Buffer Width = 25' + 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			
Monitoring/ Contingency (for each side of stream)	Level I 0.05	Level II 0.15	Level III 0.25	
Control / Site Protection	Corps approved site protection without third party grantee 0.05		Corps approved site protection recorded with third party grantee, or transfer of title to a conservancy 0.2	
Mitigation Construction Timing (for each side of stream)	Schedule 1 0.15		Schedule 2 0.05	Schedule 3 0
Temporal Lag (Years)	Over 20 -0.3	10 to 20 -0.2	5 to 10 -0.1	0 to 5 0

Factors		Net Benefit 1	Net Benefit 2	Net Benefit 3	Net Benefit 4	Net Benefit 5	Net Benefit 6
Stream Type							
Priority Area							
Net Benefit	Stream Side A						
	Stream Side B						
System Protection Credit Condition Met (Buffer on both sides)							
Monitoring/ Contingency	Stream Side A						
	Stream Side B						
Control /Site Protection							
Mitigation Construction Timing (none for primarily riparian preservation) < 10% requires planting)	Stream Side A						
	Stream Side B						
Temporal Lag							
Sum Factors (M)=							
Linear Feet of Stream Buffer (LF)= (don't count each bank separately)							
Credits (C) =M X LF							
Total Credits Generated C X Mitigation Factor (MF) =							

Total Riparian Restoration Credits Generated = _____

Data Form

STREAM MITIGATION BANK CREDIT ASSESSMENT WORKSHEET

Stream Type	Ephemeral 0.1	Intermittent 0.6	Perennial			
			<15' 0.8	15'-30' 1.0	30'-50' 1.2	>50' 1.4
Priority Area	Tertiary 0.1	Secondary 0.4	Primary 0.8			
Net Benefit [Riparian (for each side of stream)]	Additional Improvements (select values from Table 1 times 1.2 multiplier)	Riparian Creation, Enhancement, Restoration, and Preservation Factors (select values from Table 1) (MBW = Minimum Buffer Width = 25' + 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					
Net Benefit (Stream)	Moderate 1.0	Good 2.0	Excellent 3.5			
Monitoring/ Contingency (for each side of stream)	Level I 0.075	Level II 0.3	Level III 0.5			
Control /Site Protection	Corps approved site protection without third party grantee 0.075	Corps approved site protection recorded with third party grantee, or transfer of title to a conservancy 0.3				

Factors		Net Benefit 1	Net Benefit 2	Net Benefit 3	Net Benefit 4	Net Benefit 5	Net Benefit 6
Stream Type							
Priority Area							
Net Benefit (Riparian)	Stream Side A						
	Stream Side B						
System Protection Credit Condition Met (Buffer on both sides)							
Net Benefit (Stream)							
Monitoring/ Contingency	Stream Side A						
	Stream Side B						
Control /Site Protection	Stream Side A						
	Stream Side B						
Sum Factors (M)=							
Linear Feet of Stream Buffer (LF)= (don't count each bank separately)							
Total Credits (C) =M X LF							

Total Credits Generated = _____

APPENDIX B
District Designations

Priority Area

High growth areas - Stream and river reaches within these areas that are not ranked as primary priority areas, are automatically ranked as secondary priority areas.

Kansas City District Designated Areas:

Little Rock District Designated Areas:

Memphis District Designated Areas:

Rock Island District Designated Areas:

St. Louis District Designated Areas:

Existing Condition

Large streams within EDU or 8-digit HUC automatically designated as fully functional.

Kansas City District Designated Streams:

Little Rock District Designated Streams:

Memphis District Designated Streams:

Rock Island District Designated Streams:

St. Louis District Designated Streams:

APPENDIX C

C-1: References

References:

Clean Water Act, Section 404

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