COMPONENTS OF A STREAM RESTORATION PLAN – AGENCY PERSPECTIVE

Michael Moxey
Regulatory Division
Mobile District
November 2013

US Army Corps of Engineers
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§332.4 – Mitigation Plan Requirements

- Identifies 12 required components for a mitigation plan. Level of information and analysis commensurate with scope and scale of the proposed impacts.

1. **Objective(s)** of the compensatory mitigation project (332.4)
2. Site selection information (332.2)
3. Site protection instrument to be used (332.7)
4. **Baseline information** (impact and compensation site) (332.4)
5. Number of credits to be provided (332.2)
6. **Mitigation work plan** (332.4)
7. Maintenance plan (332.7)
8. **Performance standards** (332.5)
9. **Monitoring requirements** (332.6)
10. Long-term management plan (332.7)
11. Adaptive management plan (332.7)
12. Financial assurances (332.3)

Department of the Army
Mobile District Corps of Engineers

COMPENSATORY STREAM MITIGATION
STANDARD OPERATING PROCEDURES
AND GUIDELINES

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2012 Stream SOP

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2012 Stream SOP

Appendix A Stream Mitigation Worksheets:
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- 2. In-Stream Work Worksheet
- 3. Riparian Buffer Worksheet

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Appendix C Guidelines for Development of Performance Standards
Appendix D Stream Mitigation Monitoring Requirements
Appendix E Example Credit Release Schedule for Mitigation Banks

Objectives

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BIG PICTURE OBJECTIVES

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.

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

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Discuss Impacts to Streams Using Common Language

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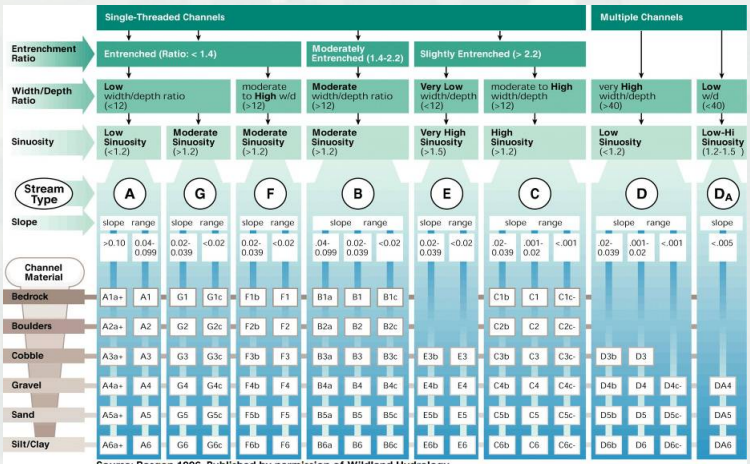
Describing Stream Channels



Source: Rosgen 1996. Published by permission of Wildland Hydrology.

Fig. 7.12 -- Rosgen's stream classification system (Level II).
In Stream Corridor Restoration: Principles, Processes, and Practices, 10/98.
Interagency Stream Restoration Working Group (FISRWG)(15 Federal agencies of the US).

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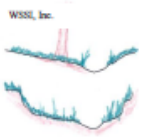
Describe Stream Channel Using SOP Existing Condition Criteria



A. Geomorphologically Stable (Stable)

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

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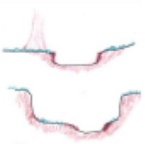

B. Partially Unstable

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.

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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.

Tell Us What You Are going to Fix Using Clear Specific Objectives

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Describe the Impacts in the Riparian Zone?

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Describe Impacts Using the Mobile District Habitat Success Criteria Metrics

Bottomland Hardwood Success Criteria – 10 year

1. Site preparation
   - Removal of exotics/invasives, and/or inappropriate or competing species
   - Elimination of impediments to desired hydrology* (removal of roads or berms, filling of ditches, ruts, etc.).
   - Establishment/acceptance of Target Forest Type (TFT) (modified from White et al. 1990)

2. Development of hydrology* (continuation of site preparation)
   - Construction of final earthworks (establishment of micro-topography)
   - Installation of monitoring wells/piezometers/flood gages

3. Tree planting
   - Should be initiated after desired hydrology has been attained*, i.e. – after annual flooding regime has been observed (species placement should be based upon micro-topographical and edaphic habitat preference) (Bledsoe & Shear 2000)
   - Tree species will be planted to achieve overall composition of 10-15 species per acre (Clewell pers. comm.) from Table 1
   - Planted to achieve a final coverage of 200-300 stems/acre, 85% canopy coverage, and a basal area of 250-325 ft^2/acre at maturity (Allen et al. 2001)

4. Introduction of shrub and herbaceous layer (if not naturally recruited)
   - Should be initiated a minimum of three years after successful establishment of target tree species (Allen et al. 2001), if natural recruitment is not sufficient
   - Shrubs must be from Table 2, a minimum of three species, with target cover 20-60%
   - Herbaceous layer: ≥ 50% of species present are from Table 3, with appropriate coverage[§] as compared to TFT. If necessary, plantings will be made if colonization has not occurred.

[§] Typical herbaceous coverage in mature BLH may range from 5% (Ezell pers. comm.) to near 100% in situations with high seasonal variability (Allen et al. 2001). Thus, target coverage of herbs needs to be determined according to TFT prior to project initiation and goals to attain this target value need to be established at the time of TFT submittal.

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Stream Mitigation Work Plan

In-stream work:

Activity	Polygon	Estimated Completion Date
Baseline Data	"	June 2011-March 2012
Reference Reach Data Collection	"	September 2012
Recordation of Conservation Easement	"	June 2013
Stream Channel Restoration Design	"	Begin April 2012 and as necessary in future
In-Stream Earthwork	"	Summer 2013
Annual Monitoring: Years 1-10	"	August 2013-August 2022
Annual Report: Years 1-10	"	September 2013-August 2023

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Riparian Buffer Work Plan

Table E: Implementation Timetable

Boundary Marking	Year 1
Fire Lane Establishment	Year 1
Initial Burn	Year 1
Initial Herbicide Application	Year 1
Thinning Of Timber	Year 2
Supplemental Herbicide Application	Year 2
Planting Of Trees	Year 2
Second Burn	Year 3
Supplemental Herbicide Application	Year 3
Supplemental Herbicide Application	Year 4
Supplemental Planting (If Needed)	Year 4
Supplemental Herbicide Application	Year 5
Third Burn	Year 6
Supplemental Herbicide Application	Year 6
Supplemental Planting (If Needed)	Year 6
Supplemental Herbicide Application/Supplemental Planting	As Needed Beyond Year 6
Fourth Burn	Year 9

GENERAL PERFORMANCE STANDARDS

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

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General Performance Standards (cont.)

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.

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Specific Stream Channel Performance Standards

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

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.

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Specific Stream Channel Design Standards

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)									

2012 SOP Appendix B Worksheet

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E- Type Stream

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C-Type Stream

SPECIFIC RIPARIAN BUFFER SUCCESS CRITERIA

Bottomland Hardwood Success Criteria – 10 year

1. Site preparation
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Use of Regional Target Forest Type (TFT)

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RIPARIAN BUFFER WIDTH LIMITATIONS

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).

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STREAM CHANNEL MONITORING

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*

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

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MONITORING REPORTS

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.

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MONITORING REPORT (cont.)

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

RIPARIAN BUFFER MONOITORING (cont.)

Monitoring:

Monitoring plots should include a specific number of set plots monitored during each period and for final credit release. There should also be an equal number of randomly placed plots to show site variation, with a minimum of 1 set and 1 random plot for each 75 acres of contiguous project area.

- Hydrology*: well/gage reports, evidence of sediment deposits, drift lines, high water marks, etc.
- Vegetation: target speciation, positive growth of root collar, height, cover, basal area, etc.
- Exotics: <1% cover at all times (no seed bearing plants at any time)

* Hydrologic manipulations and monitoring may not be applicable on all sites. The MBRT will determine the necessity and feasibility of such endeavors during the MBI review process, according to the specific site information available for individual sites.

All mitigation documents can be found on Mobile District RIBITS site at
http://geo.usace.army.mil/ribits/index.html

Mike Moxey, 251-694-3771, michael.b.moxey@usace.army.mil

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