MONITORING PLAN

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For

Twelve Mile Creek Headwaters Restoration

Prepared for:

United States Army Corps of Engineers - Mobile District

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Background

The Mobile Bay National Estuary Program (MBNEP) secured funding through the Gulf Coast Ecosystem Restoration Council and the RESTORE Act to restore a portion of Twelve Mile Creek in Mobile, Alabama. Twelve Mile Creek is one of six main tributaries within the 19,000+/- acre Three Mile Creek Watershed. The selected reach for this project encompasses an 1,800+ linear foot (LF) reach of ephemeral stream located between Dickens Ferry Road and Foreman Road in the City of Mobile.

Twelve Mile Creek flows through a developed area and many reaches of the natural stream and drainages have been channelized and/or armored. The project reach was selected due to the more natural setting and absence of creek hardening. This reach is degraded and unstable in many locations. Streambank erosion between Dickens Ferry Road and Foreman Road has caused lowering of the channel bottom, bank slope failures, tree loss, and habitat impairment.

Sediment from overland sources and stream bed and bank erosion is carrying pollutants including oxygen-demanding substances and nutrients. Additionally, much of the floodplain associated with the stream has been degraded due to disconnection of the stream and has been overrun with invasive species. This degradation is linked to impaired water quality and loss of habitat for wildlife.

The goals of this project include:

- Reduce stream flow velocity and energy
- Increase stream connectivity with the floodplain
- Reduce sediment loads
- Improve water quality
- Stabilize stream banks
- Reestablish native vegetation in riparian areas
- Improve habitat

This project strives to restore a designated portion of the stream to a more natural configuration by reshaping the streambanks and the adjacent floodplain and relocating a portion of the stream within the floodplain to reduce stream energy. Additionally, the streambanks and floodplain will be replanted with native vegetation which will prevent soil erosion, improve water quality, and provide habitat for wildlife.

The purpose of the monitoring plan will be to measure the level of success in meeting described project goals and objectives, identify deficiencies, and implement corrective actions (adaptive management) that will contribute to the success of the project.

Monitoring will be conducted for a minimum of 5 years. The US Army Corps of Engineers (COE) may determine that a shorter or longer monitoring period is acceptable or required based on how the metrics perform in relation to the success criteria established in this plan. The permittee, or representative, shall closely monitor construction and conduct monthly site visits for the first year and as necessary thereafter. Monitoring reports will be submitted to the COE semi-annually for the first year and annually thereafter.

1. Monitoring Approach

Performance standards will include monitoring metrics that reflect channel stability, vegetation density, aquatic species, and water quality. Metrics will be monitored visually, utilizing survey methodology, and through sampling.   Monitoring will occur annually for a period of 5 years.   The entire project site will be walked. If sections of the restoration stream reach appear to have any problems, they will be noted. Based on our experience, the progression and re-establishment of metrics occur at different rates.   The stream monitoring schedule below presents the frequency of sampling for metrics to be monitored.

Table 1.   Stream Monitoring Schedule

Year	Photos (twice a year)	RBP	Veg Plots	BEHI	Water Quality	Longitudinal Profile	Cross-Sections	Report
As-Built	X					X	X	
Year 1	X	X			X	X	X	X
Year 2	X	X	X		X			X
Year 3	X	X	X	X	X	X	X	X
Year 4	X	X	X		X			X
Year 5	X	X	X	X	X	X	X	X

Upon completion of construction, there will be 5 years of annual monitoring which will evaluate stream stability and vegetative success over time.   Annual reports shall be submitted to the Mobile District COE. Monitoring reports will be submitted to the COE within six months from substantial completion.

2. Methods

Photographs. A total of six permanent picture stations will be established where pictures can be taken biannually (summer: full vegetation/winter: Leaf off).   Photo stations will be established with the following goals in mind.
> a. Representative stations will be established downstream of in-stream structures to provide an upstream view of the structure where possible.
> b. Representative stations will be established at bends such that a downstream view of the downstream ½ of each bend is visible.
> c. Photographs will also show riparian plantings.

Additional stations may be added to if there are areas where aggradation, degradation, erosion, and mid- channel bars have formed.   Summer pictures will focus on documenting the vegetation and bank erosion, while winter pictures will show the stream stability and geomorphology. The locations of the photograph stations will be located on the Plan View with arrows indicating the direction the picture is to be taken. Photographs will include a detailed description of the view and label any problem areas identified during the monitoring. Pictures will be color and will be included in the report appendix.

Rapid Bioassessment Protocol (RBP). The RBP, developed by the EPA, is an appropriate method to assess the overall characteristics of stream health. Other applicable methodology may be substituted based on Mobile District COE approval. The RBP form includes 10 parameters that document sedimentation, quality of in-stream habitat, flow regime, riffle/pool sequence, vegetation, and riparian corridor. Scores are added together to calculate the overall quality of stream habitat. Scores for successive years shall show an increase from the baseline.

Vegetation Plots. Permanent vegetation plots will be established and presented on the as-built drawings. Stream vegetation goals will include adequate cover to prevent erosion. Bare root seedling trees, live stakes, and shrubs will be installed and monitored for a period of five years. Credit will be given for native volunteer species to help in meeting woody stem density goals, but only as a portion of the total density requirement. This parameter will be measured in number of stems per acre. Performance standards will also include criteria for maximum percentage of invasive plant species. Success of stream vegetation, both herbaceous and woody, will be determined using the nested quadrat method. Nested sampling plots will be located at approximate one thousand-foot spacing along the restored stream corridor for a total of approximately three (3) plots. Woody stem counts and total percent cover of vegetation and bare ground (including both woody and herbaceous species) will be determined within the sampling plot. To evaluate species composition of herbaceous vegetation, a single nested meter-square quadrat will be established within a representative area of the greater sampling plot. The relative percent cover of each herbaceous species and bare ground will be determined within the meter-square quadrat.

Success measurements will be reported annually according to the success criteria found in Table 2. Invasive/exotics will be monitored, reported and managed, and native plant species will be counted towards density success criteria.

Bank Erosion Hazard Index (BEHI) Analysis. The BEHI analysis, created by Rosgen, will serve to document areas of adverse erosion in the project area. BEHI analyses will occur during monitoring Years 1 through 5. The assessment will evaluate the trends observed in for stream stability. The 'Moderate' value was selected as successful early in monitoring because the naturally steep gradient and confinement of the system may cause some erosion during the monitoring period. In addition, the establishment of large woody vegetation and root mass that would significantly lower the BEHI score takes longer than five years.

Geomorphology. Sediment gradation of streambed material will be collected and analyzed to estimate the size distribution of bed material and its stability over time. Values that do not reflect the success criteria may indicate sedimentation or degradation and be evident in the RBP scores. One representative profile will be obtained and will include a length equal to approximately 30 times the bankfull width. Pool and riffle facets, such as depth and width, will be captured in the profile. A total of 3 monumented cross sections will be established on site and will be surveyed using appropriate methods and protocols.

The proposed stream monitoring success criteria is summarized in Table 2.   Monitoring reports will detail current trends, compare previous observations and develop strategies to address deficiencies identified that are inconsistent with the project goals.

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Table 2.   Stream Monitoring Success Criteria

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Type/Category	Criteria	Pre-Construction/ Initial Design Value	Year 1	Year 2	Year 3	Year 4	Final Value (Year 5)
Geomorphological	Bank Erosion Hazard Index BEHI	Baseline Values	Observe Trends	Observe Trends	Moderate (<30)	Observe Trends	Observe Trends
	Vertical Stability – (Degrading) BHR	"As-Built" Report			1.0-1.1		1.0-1.1
	Stream Stability (bed and banks: assessed visually and documented photographically)	"As-Built" Report	No significant bank sloughing, head cuts, significant deposition	No significant bank sloughing, head cuts, significant deposition	No significant bank sloughing, head cuts, significant deposition	No significant bank sloughing, head cuts, significant deposition	No significant bank sloughing, head cuts, significant deposition
Habitat	RBP Scores	Predicted RBP score	Observe Trends	Observe Trends	Observe Trends	Observe Trends	Observe Trends
Vegetation	Trees	Max. % any one spp. Max. % Invasives**		25% 15% 80% Total	25% 15% 80% Total	25% 15% 80% Total	25% 15% 80% Total
	Shrubs	Max % any one spp. Max % Invasives**		50% 15% 80% Total	50% 15% 80% Total	50% 15% 80% Total	50% 15% 80% Total
	Herbaceous	% GC % Invasives** Species List*	≥ 80% <10% Species List	≥ 80% <10% Species List	≥ 80% <10% Species List	≥ 80% <10% Species List	≥ 80% <10% Species List

*Species list will include scientific name, common name, wetland indicator status (EMP), native vs. non-native vs. invasive status. **Invasive species are as defined in the Alabama Invasive Plant Council's Category 1 list (Severe Threat) and Category 2 list (Significant Threat) https://www.se-eppc.org/alabama/2012-updatedALIPCinvasiveplantlist.pdf