Apalachicola River Floodplain Restoration by Breaching a Dredge Spoil Berm: Restoring Habitat and Helping a Community

Dr. Joann Mossa, PI, University of Florida and Apalachicola Riverkeeper

The following includes several figures of the site to be improved including topographic map of the site and drone photography of the eroding bluff (Figure 1), ground photography of the eroding bluff (Figure 2), and conceptual diagram of a natural floodplain and crevasses through natural levee paired with a less modified section of the Apalachicola River showing multiple crevasses (Figure 3). Figure 4 shows the hummocky ground topography of the spoil berm and Figures 5 and 6 show the elevations of the site and channel constructed by combined LiDAR and sonar data. Figure 7 shows transects where we would build breaches by removing sand in order to increase the frequency and duration of flood overtopping and by allowing lower stage flows to go through this area.

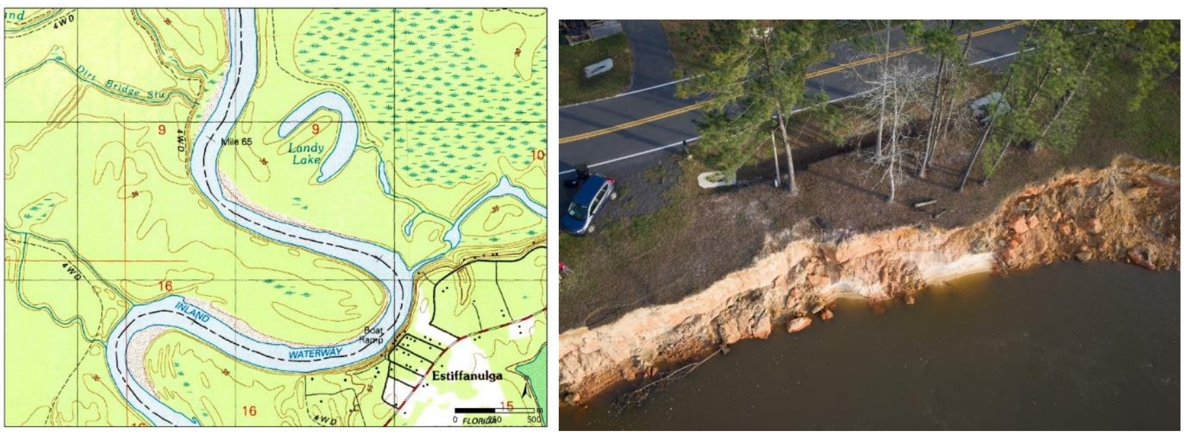

Figure 1. a) Topographic map of the Estiffanugla area in the 1980s shows several houses both west and east of the road adjacent to the river; b) Drone photograph of the eroding bluff at Estiffanugla taken March 2016 is a short distance from a road and houses. Signs of active erosion include fallen fence post and tension cracks, eroded sediment blocks, an overhanging fence line and a few eroded trees at the base (Photograph taken by Scott Walls).

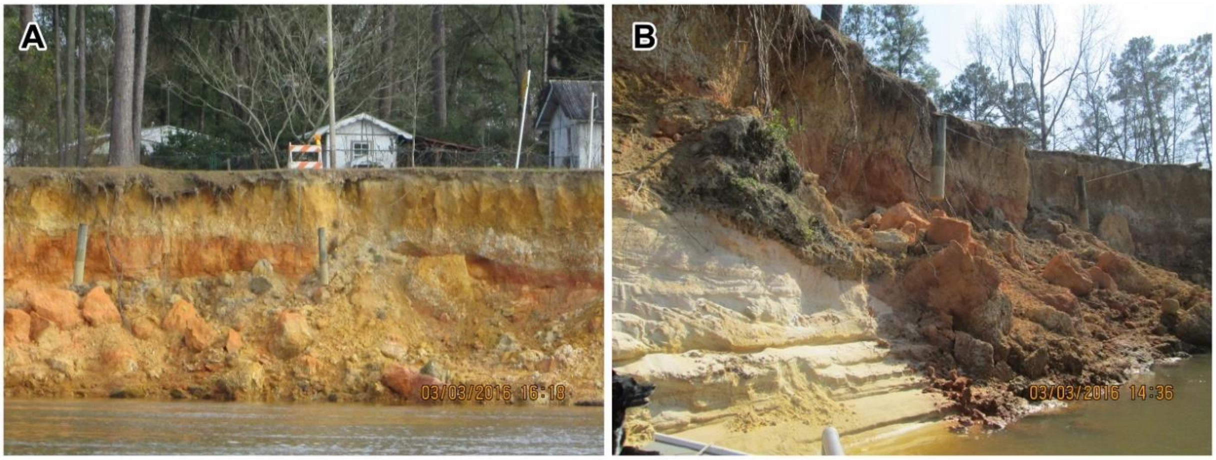

Figure 2. The eroding bluff at Estiffangula, RM 63.5, March 2016 following a high flow in earlier in the water year. (A) Frontal view of large wooden poles that used to be a fence line now hang on a steel cable in front of the bluff due to erosion; and (B) Lateral view also shows the poles, large sediment blocks near the base, fresh exposures, and overhanging roots. Active erosion site contributes sediment to this section of the profile (Photographs taken by Joann Mossa). Source: Mossa et al., 2017, *Geomorphology*.

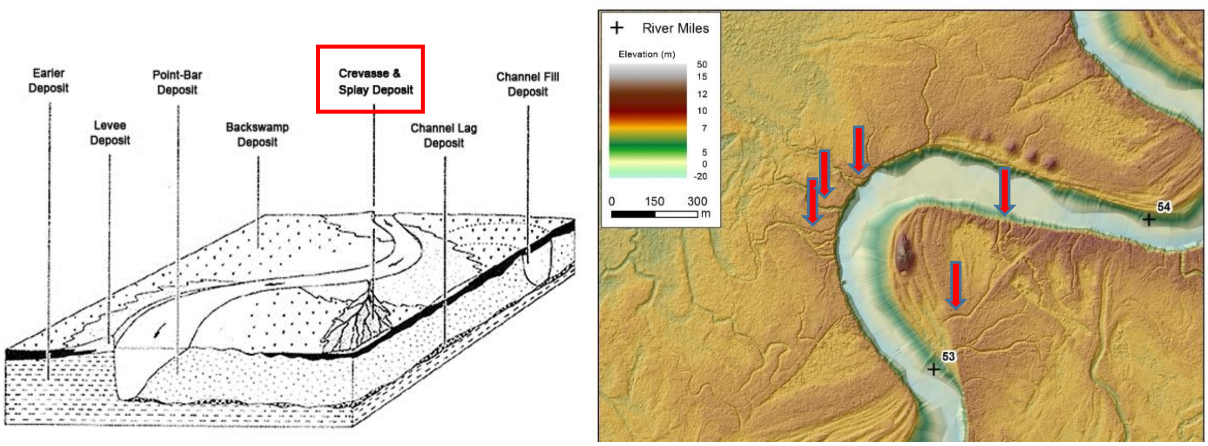

Figure 3. a) The classical meandering stream and floodplain (modified from Allen, 1965); and b) a portion of the Apalachicola River shows multiple crevasses and splays, emanating more so from the cut banks. A few are marked with red arrows. High spots are floodplain dredge spoil mounds.

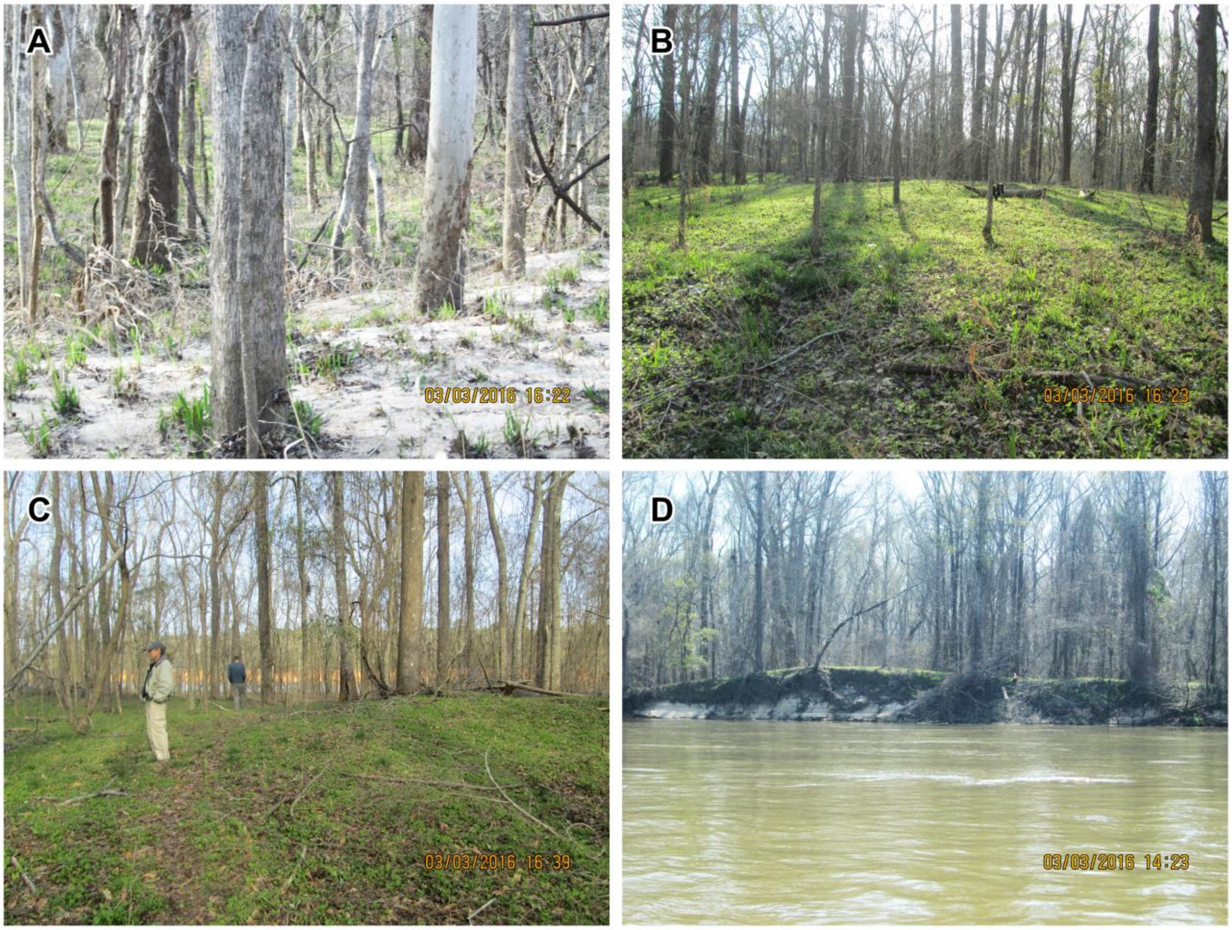

Figure 4. (A) Dredge spoil mounds.(B) Hummocky topography covered with trees and limited understory, due in part to the very sandy nature of the dredge spoil deposits not supporting as wide a variety of riparian vegetation. (C) Estiffangula Bluff in the background and people for scale. (D) Relatively high flows expose and erode some of these dredge mounds near the channel boundary (Photographs taken by Joann Mossa, March 2016 high flow). Source: Mossa et al., 2017, *Geomorphology*.

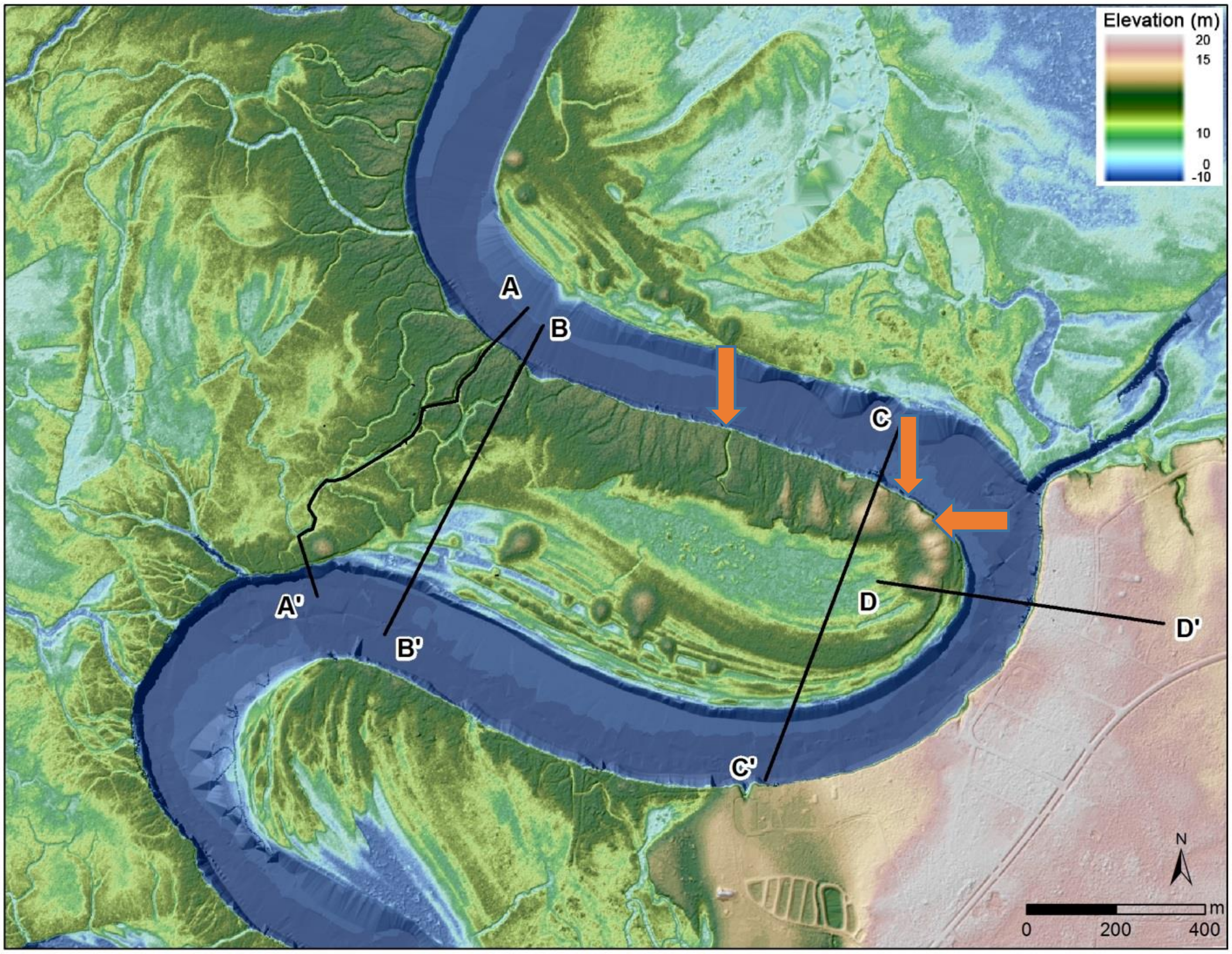

Figure 5. Floodplain and channel topography near Estiffanugla from 2007 LiDAR and 2015 and 2016 sonar data. A-A' follows the lowest floodplain elevations along a slough network and , B-B', and C-C' are topographic transects across the back floodplain without dredge spoil, and across the spoil mound berm. Profile D-D' shows how the river is confined between the high bluff at Estiffanugla and the sand dredge spoil berm on the inner bank. Upstream, however, between RM 65 and 64 nearby are several crevasses that bring flow in the floodplain. Orange arrows show proposed breaches or restorations, discussed later.

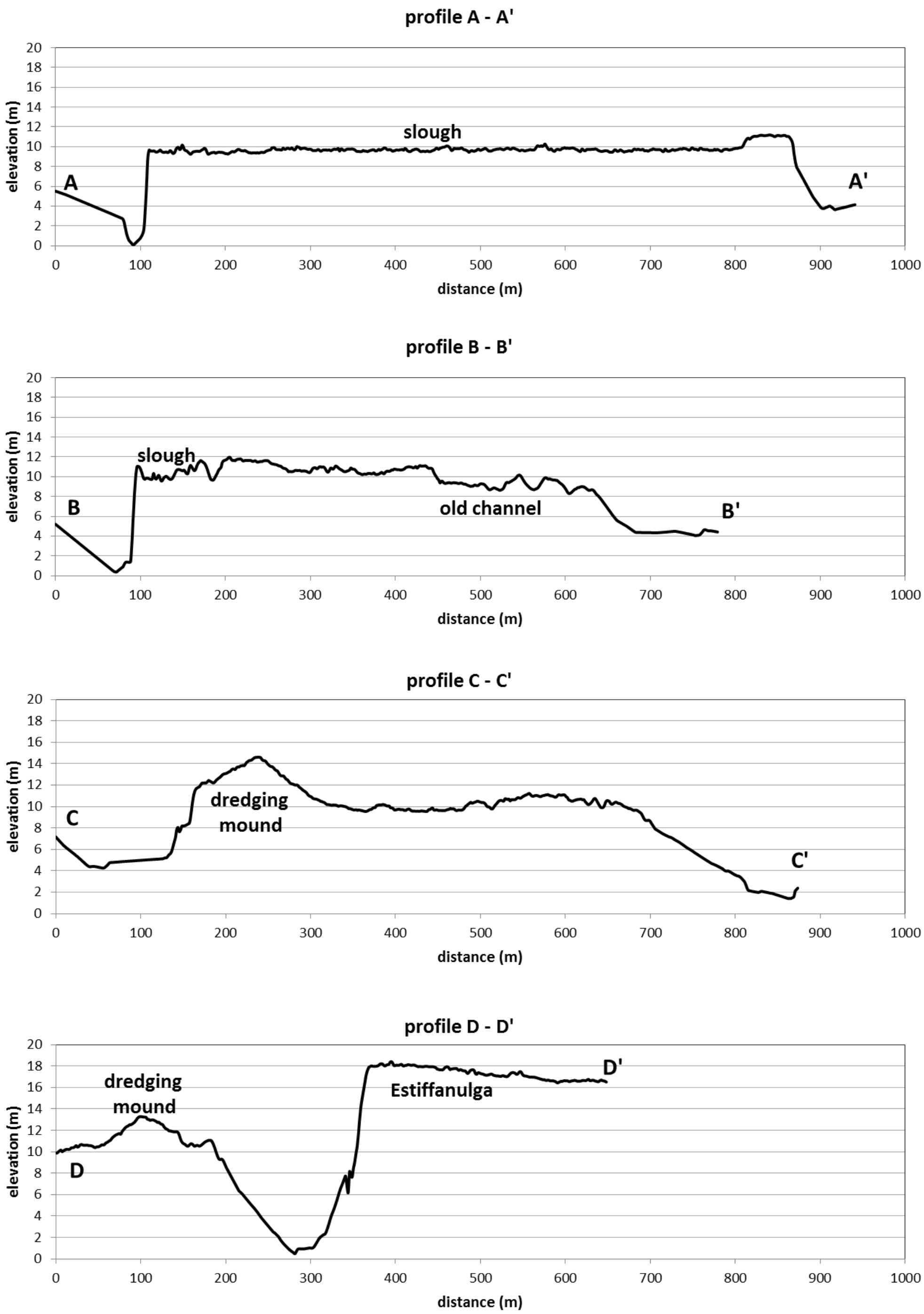

Figure 6. Transects through the meander bend across from Estiffanugla. A-A’ follows the lowest floodplain elevations along crevasses and small channels, B-B’ follows the general topography in an area without dredge spoil, C-C’ are traverses across the spoil mound berm, and D-D’ shows how the berm confines and deepens flood flows with making the floodplain 14m rather than 10 m high.

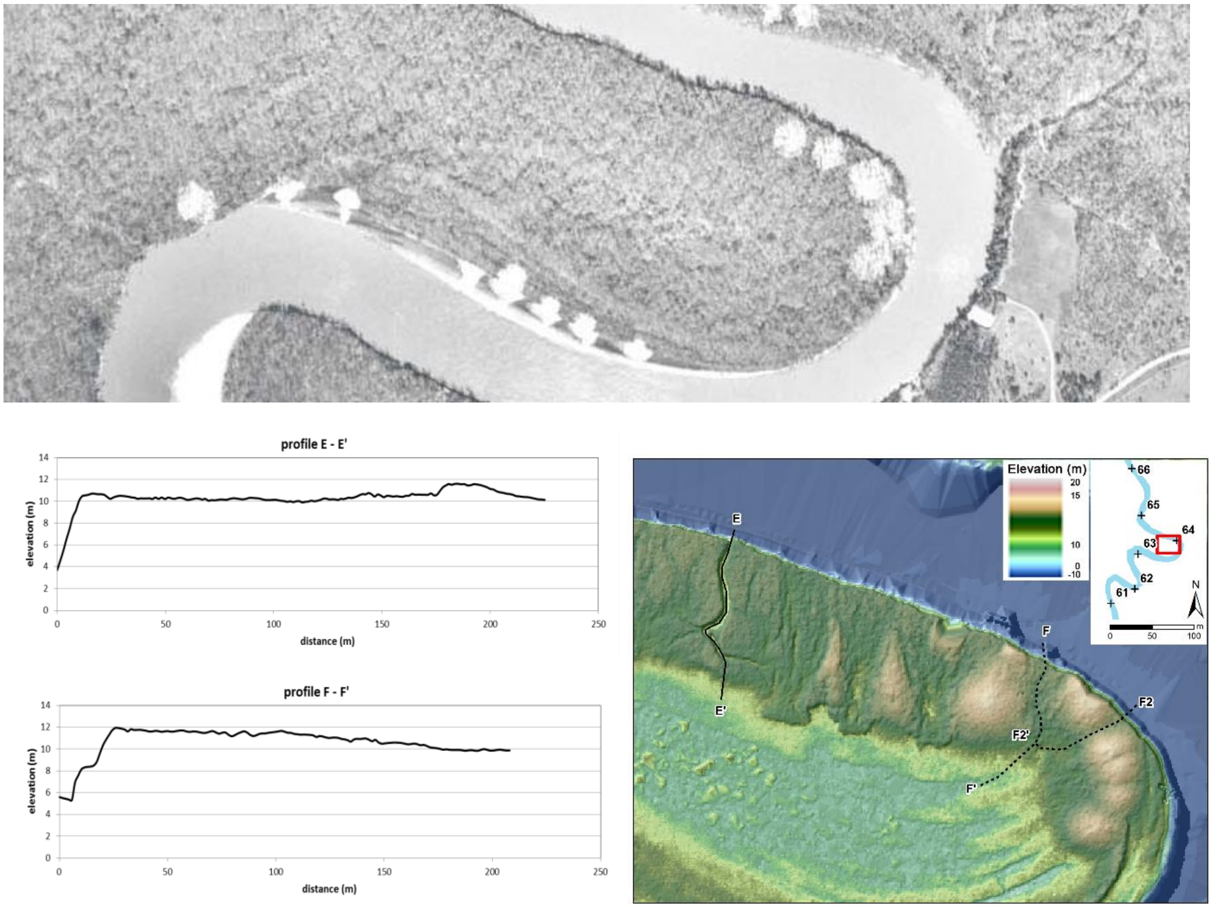

Figure 7. a) A 1957 aerial photograph of this bendway showing the early dredge spoil piles. Based on more recent LiDAR some of these mounds have eroded, some are larger and more mounds exist; b) Detailed proposed locations for crevasse enhancement (E-E’) and crevasse creation (F-F’), the latter through a low spot in the dredge spoil berm; and c) cross sections from LiDAR proposed locations for crevasse enhancement (E-E’) and crevasse creation (F-F’) with a second breach joining at F2. The proposed plan for berm breaching or crevasse enhancement and creation would be to have the maximum elevation in both features be 10 m or lower, with E-E’ likely lower.

List of Tables

The following includes a few tables pertinent to the site including success metrics for habitat and environment improvements associated with spoil berm breaching (Table 1) and project timetable with four phases that align with year and major tasks (Table 2).

Table 1. Success metrics for habitat and environment improvements associated with spoil berm breaching.

Metric of success	Expectation	Methods	Frequency of measurement
Frequency of flows reaching reach floodplain (# of times)	Increase	Total station coupled with water level recorders	Continuous, before and after construction
Duration (amount of time) flows reaches floodplain	Increase	Total station coupled with water level recorders	Continuous, before and after construction
Estimated flow reaching floodplain	Increase	Total station coupled with water level recorders and equations	Continuous, before and after construction
Groundwater levels in floodplain (wetter habitat)	Increase	Total station coupled with water level recorders	
Qualitative evidence of flow reaching floodplain such as sand splays	Increase in number and size of features	Field surveys, field photography	Annual, during or shortly following high flows
Quantitative evidence of flow reaching floodplain, e.g. enlarged breaches w/erosion	Gradual enlargement of constructed breaches	Field surveys, field photography	Annual, during or shortly following high flows
Erosion rates at Estiffanugla	Decrease	Sonar/LiDAR/Drone Aerial photographs/Total station	Once…Beginning post-construction to end of study, compared with historical
FW Mussels Abundance	Increase	Field surveys	Annual at low flow
FW Mussels Varied listed species	Increase	Field surveys	Annual at low flow
FW Mussels Diversity	Increase	Field surveys	Annual at low flow

Table 2. Project timetable for data collection, construction and monitoring-related field visits.

Year	Restoration Tasks	Site and field monitoring tasks
1	**Planning/Design/Logistics** Arrange logistics and mark sites in the field. Discuss permitting needs with various agencies and obtain relevant approvals to deepen existing crevasse. Work on boat ramp logistics. Work on sand disposal logistics.	Baseline monitoring. Install water level recorders. Investigate in better detail how nearby sloughs (A-A') and other crevasses are functioning at high flows. Establish survey and bank erosion markers on both sides of bend. Collect channel data with sonar at various flow levels. Collect mussel data at low water. Collect total station, drone, and aerial photography (as available)
2	**Construction** Breach berms and enlarge existing breaches. Remove sand and monitor site for changes during and after floods.	Post-project monitoring Continue to monitor water level recorders. Establish survey and bank erosion markers on both sides of bend and in constructed breaches. Investigate in better detail how nearby sloughs (A-A') and both constructed and prior crevasses are functioning at high flows. Collect channel data with sonar at various flow levels. Collect mussel data at low water.
3	**Intense observation and Feedback** Visit berm breaches multiple times to assess and monitor site for changes during and after floods. If construction funds are still available, consideration additions that are within the budget.	Post-project monitoring Continue to monitor water level recorders. Establish survey and bank erosion markers on both sides of bend and in constructed breaches. Investigate in better detail how nearby sloughs (A-A') and both constructed and prior crevasses are functioning at high flows. Collect channel data with sonar at various flow levels. Collect mussel data at low water.
4	**Adaptive learning.** Review planning/design, construction and monitoring phases of project. Interpret through groupthink with agency input what went right and what could be improved and how.	Post-project monitoring and synthesis Summarize water level recorder data. Synthesize survey and bank erosion markers on both sides of bend and in constructed breaches. Compile field observations, channel data and mussel data collected to date. Collect total station, drone, and aerial photography data (as available)

Table 3. Overall budget for UF and Riverkeeper Subcontractor. Includes engineering in year 1 and construction in Year 2.

Current All-Period Totals	Period 1	Period 2	Period 3	Period 4	Cumulative
Personnel:	**$79,689**	**$82,077**	**$84,541**	**$87,078**	**$333,385**
Salaries:	$71,263	$73,399	$75,602	$77,871	$298,135
Fringe:	$8,426	$8,678	$8,939	$9,207	$35,250
General:	**$70,873**	**$284,473**	**$7,273**	**$7,273**	**$369,890**
Equipment	$0	$0	$0	$0	$0
Travel - Domestic	$7,273	$7,273	$7,273	$7,273	$29,090
Travel - Foreign	$0	$0	$0	$0	$0
Participant Support	$0	$0	$0	$0	$0
Material and Supplies	$7,200	$0	$0	$0	$7,200
Publication Costs	$0	$0	$0	$0	$0
Consultant Services	$0	$0	$0	$0	$0
Computer Services	$0	$0	$0	$0	$0
Rental/User Fees - Equipment or Facility	$0	$0	$0	$0	$0
Alterations and Renovations	$0	$0	$0	$0	$0
Other					
Tuition	$0	$0	$0	$0	$0
Animal	$0	$0	$0	$0	$0
Patient Care	$0	$0	$0	$0	$0
Human Subject Payment	$0	$0	$0	$0	$0
Scholarships and Fellowships	$0	$0	$0	$0	$0
Other	$56,400	$277,200	$0	$0	$333,600
Trainee:	**$0**	**$0**	**$0**	**$0**	**$0**
Subaward:	**$44,435**	**$43,120**	**$43,200**	**$48,475**	**$179,230**
Subaward Direct:	$44,435	$43,120	$43,200	$48,475	$179,230
Subaward Indirect:	$0	$0	$0	$0	$0
Total Direct less Subaward Indirect:	**$194,997**	**$409,670**	**$135,014**	**$142,826**	**$882,507**
Total Direct:	**$194,997**	**$409,670**	**$135,014**	**$142,826**	**$882,507**
Total Indirect:	**$19,500**	**$40,967**	**$13,501**	**$14,283**	**$88,251**
Project Total:	**$214,497**	**$450,637**	**$148,515**	**$157,109**	**$970,758**