

*Removal of Structures Creating Riverbank Erosion in Rio Loco in
Guanica, PR*

Project Implementation and Feasibility Report



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**Feasibility and Cost Analysis for the Removal of Structures
Creating Riverbank Erosion in Rio Loco in Guanica, PR**

The removal of in-stream structures in the Rio Loco is critical to the success of proposed river restoration efforts in the Rio Loco as every year debris flows during large storm events get entrained and caught up in the structures (that are mostly associated with the historic use of surface irrigation) causing the river channel to alter its flow around the structures creating large areas of erosion on surrounding farms. The structures are mostly associated with the past use of surface irrigation which has been replaced by drip irrigation in the Guanica Valley, as a result these structures are in a state of disrepair and inhibit natural flows in the channel and create conditions for excessive erosion.

Project Tasks as Summarized in the Contract

Table 1. Rio Loco Tasks	
Task	Lead
1. a) A technical Scoping memo/ Work plan outlining the needs for the Concrete Debris Removal process that identifies what permits are needed, equipment, personnel and what agencies (local and federal) should be part of this process Initial assessment of feasibility of structure removal and development of a scope of work and cost estimates for removal of key structures in the Rio Loco	Ridge to Reefs (RTR), Protectores de Cuencas (PC)
2. Implement Initial Phase of technical Scoping memo / Work plan: Obtain any necessary permits, remove concrete and debris from existing channel. Properly dispose of or set aside for reuse any materials that require proper disposal according to local requirements.	RTR, PC, UPR, TNC, inclusion of local stakeholders
3) Summarize work completed, remaining tasks and next steps in a Project Implementation Report.	RTR, PC



Figure 1. Shows the primary locations of severe erosion in the Rio Loco as is summarized in our field technical memo (Sites 5 and 6 are the two locations where instream structures are still contributing to river channel erosion)

Introduction

Puerto Rico and the wider Caribbean have suffered major declines in live coral reefs especially of sensitive and threatened species of *Acropora palmata* and *Acropora cervicornus*. Much of the decline has been linked to increasing land based sources of pollution. Sediment impacts to nearshore coral reefs have been documented by a number of authors including Larsen and Webb (2009) and Morelock et. al. (2001). The deposition of legacy sediments is reported from valleys across Puerto Rico during almost complete deforestation of the island during the first period of the 20th Century from 1900-1945 (Clark and Wilcock, 2001).

Restoration of the Rio Loco channel was identified as a priority of the Guanica watershed plan published in 2008, due to the amount of river erosion occurring in the Guanica Valley, particularly associated with old irrigation infrastructure left in the river channel. The Guanica Watershed Plan was selected as the 1st priority watershed for implementation by US Interagency Coral Reef Task Force (USCRTF).

Findings

Eight locations of severe erosion were originally identified in 2008 and many of these sites were associated with old irrigation infrastructure left in the channel. In our assessment, each of the 8

sites was visited and evaluated - only three of the sites still have active erosion as a result of the infrastructure. Only one of these sites is clearly, likely a historic structure (Site 8) which is also adjacent to a bridge that would need a hydrologic, hydraulic and historical assessment to determine if that structure could be removed. This site is also not contributing much erosion as the channel appears to have adjusted to the obstruction and nature is slowing taking out the middle section of this historic low head dam structure. The two remaining sites (Sites 5 and 6) are planned by the SW Soil Conservation District and National Resources Conservation Service for restoration and would need to have many of the structures removed in order to hope to have a stable restoration outcome. Those two sites are main focus of this memo: Site 5 (Santa Rita Farm) and Site 6 (Railroad bridge).

Site 5 Santa Rita Farm in Guanica

Site 5 is the largest site with the most amount of old infrastructure that is deposited in the channel. Due to the existing channel configuration and remaining structures it is where debris from upstream often gets deposited. It is located on the Santa Rita Farm and is composed of a series of three large concrete structures holding a irrigation pipeline (no longer in use) that was constructed across the channel. In addition, this area which is now a sharp curve in the river due to the major debris blockage on the pillars which are located in the middle of the channel. The channel now has a 90 degree turn and has eroded significantly into an adjacent farmers crop field over the last 10-12 years. (note pictorial sequence below)



Figure 2. Condition of the channel in 2001 (Source: Google Earth) (relatively stable configuration prior to the collapse of the pipeline/structures)



Figure 3. Between 2001 and 2004 an event must have occurred where debris accumulated and partially blocked the channel creating this new condition and resulting in tons of sediment lost to Guanica Bay (Google earth)



Figure 4. One of the key structures for removal and one that acts to impede downstream flow and create debris dams during large events (Figure 5 shows more detail)



Figure 5. Shows the patchwork of structures that makes up the key structure for removal and the structures most responsible for debris dams and erosion

Due to there being 20-30 concrete structures in the channel at this location (Figure 6) (some likely deposited here from upstream) a considerable work effort would be required to effectively remove the majority of structures from the channel. Again most of these structures would be broken up in place and the metal and steel and other trash would be removed and disposed of or recycled.



Figure 6. Photo that captures just a partial look at the many in-stream structures

Site 6 Railroad Bridge

The railroad bridge structure is composed of 3 large concrete pillars that previously carried a railroad track in the days of the sugar cane harvest. The pillars are 14 ft high by 12 ft wide - the bases of the structures over 4ft high by 12 ft wide. The structures themselves are relatively massive and require significant effort to break up. One of the pillars has fallen over into the channel (Figure 7) as it previously was part of the river bank. A second pillar the middle one is rapidly being undermined by erosion and is likely to fall during the next rainy season.



Figure 7. Railroad bridge located downstream of Rt. 116

Concrete Testing for Demolition

Concrete was tested at the sites in order to determine if traditional jack hammers could be used to break up the concrete. A generator and jackhammer equipment were rented in order to test the various concrete structures for potential demolition. This also helped us to be able to determine the amount of time, labor and machinery estimates that would be required to complete the work.

Two types of concrete were consistently identified: poured concrete where wire or rebar was used to maintain the integrity of the concrete and aggregate concrete that in some cases may have been poured in place and used local stone or aggregate as a higher percentage of the mix. This is summarized in Table 1.

Table 1. Concrete Testing in the Rio Loco Project		
Type of Concrete	Consistency	Demolition Notes
Poured Concrete	Primarily concrete and steel wire and mesh	wire should be disposed of and time consuming to de-construct
Aggregate Concrete	Concrete and stone aggregate (less wire and mesh)	-Interior of this concrete is particularly dense as it has not been exposed to much weathering increasing demolition hours -the material can be broken into small pieces and left in place



Figure 8. Testing concrete structures

Demolition and De-construction Options

Two options for demolition and deconstruction were evaluated 1) Hand labor and out of channel heavy equipment -- this would be done by demolishing the structures in place using three jackhammers, generators and a track hoe with a pneumatic demolition tool operated from the river bank; 2) Heavy equipment/Access to channel -- this would include the operation of large machinery within the channel, bulldozers, and at least one track hoe with a pneumatic hammer. Option 1 does not require permitting if done without using federal funding and could happen much quicker and at a lesser cost than Option 2. Option 2 would take longer and be more expensive if done through a separate permit process than SWSCD is doing.

Option	Permitting	Time	Equipment	Cost Estimate
1. Hand labor and out of channel heavy equipment	None if federal funds are not used	60 days -- start to finish	Generators, jackhammers, track hoe with a pneumatic demolition hammer	\$64,600
2. Heavy Equipment in-channel work	Section 404 Puerto Rico PR Environmental Policy Act (EA), NHPA, General Construction Permit (Oficina de Gerencia y Permisos) OGPe	6 -9 months minimum, design of construction access roads into the channel	Bulldozer, Track hoe with a pneumatic hammer	\$80,250

Detailed Cost Estimate Option 1 Hand Labor/Out of Channel Work

Item	Description	Rate/day	Persons	Days	Totals
General Labor	\$8/hr/10h/day	\$80.00	6	45	\$21,600.00
Coordination	\$50/hr/8/day	\$400.00	2	20	\$16,000.00
Track hoe	Track hoe with pneumatic hammer and operator	\$500.00		8	\$4,000.00
Equipment Rental	Chipping Hammers	\$50.00	3	50	\$7,500.00
	Generator	\$50.00	2	50	\$5,000.00
	4x4 Pickup Truck	\$100.00	1	50	\$5,000.00
Food	\$10/person/day	\$10.00	6	50	\$3,000.00
Fuel	For generators and transportation	\$50.00	1	50	\$2,500.00
TOTAL					\$64,600

Detailed Cost Estimate Option 2

Item	Description	Rate/day	Persons	Days	Totals
General Labor	\$8/hr/10h/day	\$80.00	3	45	\$10,800.00
Coordination	\$50/hr/8/day	\$400.00	2	20	\$16,000.00
Track hoe	Track hoe with pneumatic hammer and operator	\$500.00		20	\$10,000.00
Bulldozer	Bulldozer and operator	\$500.00		20	\$10,000.00
Equipment Rental	Chipping Hammers	\$50.00	2	45	\$4,500.00
	Generator	\$50.00	2	45	\$4,500.00
	4x4 Pickup Truck	\$100.00	1	45	\$4,500.00
Food	\$10/person/day	\$10.00	6	45	\$2,700.00
Design	Design of the access roads				\$5,000.00
Permitting	Preparation of all permitting documents*				\$10,000.00
Fuel	For generators and transportation	\$50.00	1	45	\$2,250.00
TOTAL					\$80,250.00
* See Appendix I for permitting requirements					

Stakeholder Outreach

The sites were visited with potential project partners including NRCS and Southwest Soil Conservation District (SWSCD), as well as DNER and NOAA staff to discuss the existing design plans and to discuss the needs associated with removal of the structures. The local farmers that operate the adjacent farms were also consulted to determine their opinions and concerns in regards to the in-channel structures. A summary of important information that was acquired includes:

- Mario Rodriguez, NRCS and Isella Ortiz, SWSCD joined us in the field in summer of 2013 and shared with us the design plans as well as their anticipated funding to help support the removal of the structures and to perform the river restoration itself. NRCS/SWSCD stated that they had very limited funds to remove the structures since it is not a formal NRCS Cost-share practice. They estimated they had less than \$10,000 for removal of the structures. They were also supportive of us coordinating with DNER and other partners to assist with structure removal.
- In addition, we had discussions with the two farmers that farm the adjacent land. Both farmers were supportive of the effort to remove structures from the river. Jaime felt it was important to

leave one of the structures that is still in the river bank at Site 5 (on the side of the river) -- to help protect the bank -- we concur with this observation as removing that structure may further de-stablize that bank.

- We also met with the regional staff with DNER and Guanica Dry Forest Management Official at the site to discuss their potential for assistance. DNER has bulldozers and backhoes which they use to do instream channel work they but do not have the equipment to destroy the concrete nor do they have the manual laborers to breakup the concrete in place.
- Army Corp of Engineers -- Discussion with Jose Cedeno to determine the permitting requirements or lack of requirements depending on the methods used for removal of the structures. He stated that if we not adding fill to the channel but rather breaking up existing debris and removing steel wire and other garbage from the channel and not putting large machinery in the channel or altering the channel itself that it was his professional opinion that we did not need a permit (this is consistent with Option 1). Option 2 would have significant permitting needs. More detail on permitting is found in Appendix I.

Recommended Process/ Next Steps

- 1) The SWSCD have applied for permits for their river restoration project from the Army Corp, DNER and SHPA. If those permits are received prior to finding funding to support the removal of these structures -- then an effort and some funding should be made available to assist SWSCD in removing the structures as the project is initiated. At which point either option 1 or option 2 could be utilized as large equipment will be mobilized already. Likely a combination of techniques would be most efficient.
- 2) If funding can be found prior to the permits being issued than the structures should be removed using Option 1 which does not require permits and can happen in the shortest amount of time.
- 3) In the absence of adequate funding: at a minimum before the Rio Loco river restoration project construction -- the most problematic structures should be removed / broken up in place. These include the critical structure at Site 5 Santa Rita Farm (shown in Figures 4 & 5) and at Site 6 the railroad bridge the standing structure in the middle of the channel and the one laying down in the channel should be removed, the 3rd existing structure should be removed as well if cost allows.

Completed Work

- 1) One week of fieldwork evaluating the existing erosional sites in the Rio Loco, testing concrete structures developing a detailed scope of work
- 2) Meetings/discussions with stakeholders and regulatory authorities including farmers, NRCS, SWSCS, DNER, NOAA and Army Corps of Engineers.
- 3) Scoping memo and feasibility analysis
- 4) Analysis of permit requirements and alternatives analysis
- 5) Recommended Process and Next Steps

Appendix I Summary of Permitting Requirements

Summary adapted from AG Environmental

1.1 Puerto Rico Environmental Policy Act:

The Puerto Rico Environmental Policy Act requires that all projects to be developed must evaluate the potential impact on natural resources and infrastructure of the Island. All proposed projects must comply with Article 4B (3) of this law, which requires the preparation and submittal of an environmental assessment document for its analysis and approval by all regulatory agencies.

For the purpose of this project, an Environmental Assessment (EA) may be required to evaluate potential impacts associated with the construction of the dirt road to enter the river channel and perform demolition activities within the existing river channel. The preparation and submission of this EA will include the following steps:

- _Prepare and submit to the Oficina de Gerencia de Permisos (OGPe) a Draft EA along with a Request for Environmental Recommendations (REA, by its Spanish acronym).
- _Prepare a Preliminary Final EA by incorporating responses to all comments from local agencies and the OGPe.
- _Prepare and submit a Final EA and a Request of Environmental Compliance (DCA, by its Spanish acronym).

This process would initiate once details on the project scope are finalized.

1.2 Section 404 of the Clean Water Act

Section 404 of the Clean Water Act establishes a program to regulate the discharge of dredged or fill material into waters of the United States, including wetlands. Activities in waters of the United States regulated under this program include fill for development, water resource projects (such as dams and levees), infrastructure development (such as highways and airports) and mining projects. Section 404 requires a permit before dredged or fill material may be discharged into waters of the United States, unless the activity is exempt from Section 404 regulation. In Puerto Rico, the compliance with Section 404 is through the presentation of a Joint Permit Application (JPA). This permit application include the following local and federal authorizations:

1. USACE: Section 404 of the 1972 Clean Water Act (CWA) Permit - Regulates the discharge of dredged and fill material into waters of the United States, including wetlands.
2. USACE: Section 10 of the 1899 Rivers and Harbors Act Permit - Authorizes the execution of construction works in “waters of the US”.
3. EQB: Puerto Rico Water Quality Certificate (WQC): In conformance with Section 401 of the CWA, any entity that request for a permit that could impact the quality of any US navigable waters, a WQC must be obtained from the State regulatory Agency, in this case the EQB.

4. PR Planning Board (PRPB): Certification of Compliance with the Coastal Zone Program - This certification is necessary to determine if the project is consistent with the local Coastal Zone Master Plan. It is also required by the USACE to grant its permits.
5. DNER: Soil Extraction Permit - Regulate any marine dredge activities.

The JPA application will initiate once details on the project scope are finalized.

1.3 Section 106 National Historic Preservation Act (NHPA)

Section 106 of the National Historic Preservation Act (NHPA) mandates federal agencies to undergo a review process for all federally funded and permitted projects that will impact sites listed on, or eligible for listing on, the National Register of Historic Places. Specifically it requires the federal agency to "take into account" the effect a project may have on historic properties. It allows interested parties an opportunity to comment on the potential impact projects may have on significant archaeological or historic sites. The main purpose for the establishment of the Section 106 review process is to minimize potential harm and damage to historic properties

Under Section 106 of the NHPA, all federal projects must prepare and present a historical site reconnaissance and survey for evaluation and approval of the concern agencies. According to Section 106 of the NHPA, the Puerto Rico State Historical Office (SHPO) is the responsible agency to oversee this process.

Section 106 consultation is carried out by the USACE as part of the JPA application process.

1.4 Law 112 of July 1988, Puerto Rico Terrestrial Archeology Council Law

Law 112 requires that all projects must be evaluated prior any disturbance of the site. An Archeological Site Evaluation must be prepared and submitted to the Instituto de Cultura Puertorriqueña (ICP) for its evaluation and approval if warranted by the agency.

ICP consultation is carried out by the OGPe as part of the PR Environmental Policy Act compliance process.

1.4 Compliance with the Oficina de Gerencia y Permisos (OGPe) General Permit Regulation for Construction Projects

According to the OGPe's General Permit Regulation the proposed project will need to comply with these applicable permits and endorsement:

_ Construction Recommendations (REC, by its Spanish acronym) – The proponent must submit the construction drawings along with a REC request to be approved by OGPE. A REC is required for the submittal of various construction-related permits including the Incidental Earth Movement Permit.

_ Cut, Pruning & Tree Removal Permit – Prior the commencement of the construction phase of the project, a Cut, Pruning & Tree Removal Permit must be obtained from OGPe. This permit usually entails the execution of a mitigation plan if trees are cut as result from construction activities.

_ Incidental Earth Movement Permit – Prior the commencement of the earth movement phase, an Incidental Earth Movement Permit must be obtained. This permit allows earth movement activities resulting from construction activities associated with the project.

These permits will be procured once the project is certified as compliant with the PR Environmental Policy Act.