

**DRAFT INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT
SALUD CREEK AT SAN GERMAN, EMERGENCY STREAMBANK PROTECTION CAP SECTION 14
MUNICIPALITY OF SAN GERMÁN, PUERTO RICO**

EXECUTIVE SUMMARY

PURPOSE AND NEED

This report is in response to a request from the Municipality of San Germán, that the U.S. Army Corps of Engineers (USACE) provide assistance in addressing streambank erosion within the Portal de San Germán community in the Municipality of San Germán, Puerto Rico. The authority for this project is Section 14 of the Flood Control Act of 1946, as amended (33 U.S.C. §701r) to prevent damage to public works and other nonprofit public services.

The purpose of this study is to determine if constructing emergency streambank protection to prevent bank erosion from damaging the housing development and the adjacent structures at Salud Creek, San Germán is feasible and economically justified. The study area, see Figure ES-1, includes Portal de San Germán, a 56-unit residential development that provides housing assistance for low income families pursuant to Section 8 of the Housing Act of 1937 (42 U.S.C. §1437f). Construction was completed in 2014 and sponsored by the Municipality of San Germán. Salud Creek runs through the middle of the subject property. The channel through the residential development in the study area has an approximate length of 1,060 feet, including approximately 940 linear feet of impacted channel embankment. Bank erosion at Salud Creek is threatening the structural integrity of the housing units and associated infrastructure, increasing the existing risk of losing the housing structure, if not human life, during a major storm event. There is an opportunity to protect the structures within Portal de San Germán. Furthermore, there is an opportunity to provide a safer living environment for residents within the development. There were over 7,000 families throughout Puerto Rico awaiting rental assistance to live in low-income housing similar to Portal de San Germán when construction was completed in 2014, and families currently residing in this development will not be able to afford rent or mortgages at the market rate. Protecting Salud Creek from further erosion will ensure the residents of Portal de San Germán are able to remain in safe, affordable housing.



Figure ES-1: Study area map of the Salud Creek at San Germán.

ALTERNATIVE PLANS AND THE RECOMMENDED PLAN

Plan Formulation

Management measures, description of the alternatives, and the results of the screening are provided in the sub-sections that follow.

Management Measures

Non-structural (NS):

NS-1) No Action

*Other measures that would typically be considered non-structural are considered under “Relocation.”

Structural (S):

S-1) Bank armoring with gabion baskets.

S-2) Bank armoring with High Performance Turf Reinforcement Mat (HPTRM).

S-3) Bank armoring with concrete.

S-4) Bank stabilization with graded stone armor (rip rap).

S-5) Channel re-alignment to original condition, prior to Portal de San German construction.

Alternative Development, and the Recommended Plan

Per ER 1105-2-100 Appendix F, Section III, F-23, alternatives are compared to determine the least cost alternative. The least cost alternative plan is considered to be justified if the total cost of the proposed alternative is less than the cost to relocate the threatened facilities. Therefore, relocation is not considered a “measure” or “alternative” but rather a basis for cost comparison.

The no-action measure (NS-1) and all the structural management measures (S-1, S-2, S-3, S-4, S-5) were carried forward to form the preliminary array of alternatives.

- Alternative 1 - No Action.
- Alternative 2 – Combination of S-1 and S-3: Bank armoring with gabion baskets and bank armoring with concrete around the rehabilitated single barrel culverts.
- Alternative 3 - Combination of S-2 and S-3: Bank armoring with High Performance Turf Reinforcement Mat (HPTRM) and bank armoring with concrete around the rehabilitated single barrel culverts.
- Alternative 4 - Bank armoring with concrete.
- Alternative 5 - Combination of S-4 and S-3: Bank stabilization with graded stone armor (riprap) and bank armoring with concrete around the rehabilitated single barrel culverts.
- Alternative 6 - Channel Re-alignment to original condition, prior to Portal de San German construction.

The preliminary alternatives were evaluated on their ability to meet the study objectives; however, due to the intent of CAP Section 14, a qualitative analysis based on construction costs, potential risk to adjacent structures and difficulty of maintenance of the alternatives was used as a screening criteria. This rationale was conducted instead of a full suite of developed hydraulic modeling, excavation calculations, and costs analysis. The Cost criteria evaluates the excavation cost based on depth of cut required, and additional costs like hauling material, real estate needed for material storage and slope preparation. The

other risk criteria evaluates the potential risk to structures based on depth of cut required and difficulty of maintenance requiring detailed inspections and repairs, as well as potential failure due to undermining or washout of the bank protection measure. One alternative was carried forward for volumes and cost estimate calculations. Table ES-1 shows the resulting alternative ranking based on the construction cost and other risk (Potential risk to structures and difficulty of maintenance).

Table ES-1: Final alternative ranking.

Alternative	Excavation Cost Rank	Additional Construction Cost Rank	Other Risk Rank	Total Ranking Points*	Overall Total Rank**
Gabions and concrete	3	3	2	8	3
HPTRM and concrete	1	1	1	3	1
Concrete	2	2	2	6	2
Stone and concrete	4	3	3	10	4
Realignment	5	3	4	12	5

 Total scored points for overall screening criteria.

 Overall Total Rank for all categories. 1 is highest performing; 5 is lowest performing.

*Individual criteria rankings were added for a final ranking.

** The lower points alternatives will perform better than the higher points alternatives.

This study shows that construction of bank armoring on approximately 840 linear feet of eroded channel embankment using anchored High Performance Turf Reinforcement Mat (HPTRM) and armoring with concrete of approximate 100 linear feet of channel embankment around two rehabilitated culverts is recommended to provide emergency streambank protection for the Portal de San Germán community. The project will use 0.81 acres of parcel number 334-021-221-05 for staging, see purple area in figure ES-2. The non-Federal sponsor will certify the availability of this parcel for staging, access, and construction via a temporary work easement. Figure ES-2 depicts the Recommended Plan in plan view.



Figure ES-2: Recommended Plan in plan view.

COST ESTIMATE AND ECONOMIC JUSTIFICATION

The cost estimate for the Recommended Plan is \$1,939,000 at FY19 price levels (including contingency, detailed design and construction management costs), see Table ES-2. Since the Project is located in Puerto Rico, the Sponsor is entitled to a \$455,000 reduction in its required share pursuant to Section 1156 of the Water Resources Development Act of 1986, Public Law 99-662 (33 USC 2310), as amended. The Federal costs of the Recommended Plan will be \$1,715,350 and the Non-Federal costs \$223,650. Table ES-3 presents the cost allocation of the recommended plan. The expected construction duration is 6 months.

Per ER 1105-2-100 Appendix F, Section III, F-23, **the least cost alternative plan is considered to be justified if the total costs of the proposed alternative are less than the costs to relocate the threatened facility.** The relocation costs are based on estimated depreciated replacement costs of selected damage elements, buildings 1 to 12, contained in the Portal de San Germán HUD Section 8 based rental project. The cost to relocate the threatened Portal de San Germán residential development, \$5,588,000, is more than the Recommended Plan to construct bank armoring with HPTRM and concrete around the rehabilitated culverts at Salud Creek, \$1,939,000 at FY19 price levels; therefore, the Project is economically justified.

Table ES-2: Total project cost of the Recommended Plan (Bank armoring with HPTRM and concrete).

Total Project First Cost (FY19) Price Levels		
WBS	Project Feature	Total Cost \$
9	Channels and canals	\$1,028,000
1	Lands and damages ¹	\$59,000
30	Planning Engineering and Design	\$554,000
31	Construction Management	\$298,000
	Total Project Cost²	\$1,939,000
1. Lands and damages include temporary easement acquisition for staging area.		
2. Including contingency, detailed design and construction management costs		

Table ES-3: Cost Allocation of the Recommended Plan.

Cost Allocation of the Recommended Plan		
Total Project Cost	Federal Maximum 65%:	Non-Federal Minimum 35%
\$ 1,939,000	\$ 1,260,350	\$ 678,650
Cost Sharing	Federal	Non-Federal
Non-Federal 5% cash		\$ 96,950
Non-Federal LERRD		\$ 59,000
Additional Non-Federal cash requirement		\$ 522,700
Non-Federal Minimum 35%		\$ 678,650
Federal cost	\$ 1,260,350	
Section 1032 of WRRDA 14 waiver ¹	\$ 455,000	\$ (455,000)
Total Cost Allocation	\$ 1,715,350	\$ 223,650
Final Cost-Sharing Percent	88.5%	11.5%
1. The WRRDA 14 Section 1032 waiver added Puerto Rico as a territory eligible for a \$455,000 waiver of non-Federal cost sharing.		

COORDINATION WITH AGENCIES AND THE PUBLIC

The USACE has prepared this environmental assessment (EA) to determine whether the proposed Federal action, the Recommended Plan, would significantly affect the human environment and require preparation of Environmental Impact Statement. This EA, integrated with the feasibility report, has been prepared pursuant to National Environmental Policy Act (NEPA) and its implementing regulations. A Notice of Availability for the draft integrated feasibility report and EA and proposed Finding of No Significant Impact will be coordinated with pertinent agencies and interested stakeholders for review and comment. The project will be in compliance with the NEPA of 1969, as amended, 42 U.S.C. §4321, et seq. Public Law 91-190.

RISK CONSEQUENCE RATING

Without action, bank erosion in Salud Creek will continue to encroach toward the buildings, threatening the structural integrity of the residential development and increasing the existing risk of losing the buildings (and possibly human life). Portal de San Germán provides housing for low income families in the Municipality of San Germán, is an essential public service, and is maintained as such. Structural failure will damage the existing buildings and associated infrastructure increasing safety concerns for residents. This will negatively impact the health and welfare of the residents of Portal de San Germán that could occur within the next two to four years. This rank is based on the following: An undesirable event is anything which causes adverse consequences. In this case, the undesirable event is structural failure, either partial or total, of the existing buildings' foundations due to streambank erosion leading to undermining the structures. "Risk Level" is an estimate of the time, starting from the present, when an undesirable event is considered most likely to occur based on best professional judgment. Buildings 8 - 12 currently are the most at risk for potential structural failure. Buildings 1 - 7 may be at risk for structural failure if the ongoing erosion continues. The remaining two structures, buildings 13 and 14, are located far enough from Salud Creek to avoid this threat. These considerations elevate the Safety Risk Ranking in the Risk Consequence Matrix to a rank of 2, signifying Risk Level B, as shown in Table ES-4.

Table ES-4: Risk Consequence Matrix

SAFETY MATRIX RANKING		Consequences Category				
		Category A	Category B	Category C	Category D	Category E
Risk Level	Level A (0 to 2 years)	1	3	5	7	12
	Level B (2 to 4 years)	2	4	6	8	12
	Level C (4 to 6 years)	3	5	7	9	12
	Level D (6 to 8 years)	4	6	8	10	12
	Level E (Over 8 years)	5	7	9	11	12

Severity of impact from the event decreases from the highest severity in Category A to the lowest severity in Category E. Projects are assigned to the highest severity category for which one or more criteria in the category apply to the project consequences. Category A means that at least one of the following is expected if the undesirable event occurs.

- Adversely impacts transportation routes with Average Daily Traffic (ADT) over 50,000.
- Adversely impacts an affected population over 50,000.
- Adversely impacts an affected disadvantaged population over 20,000.
- Losses with an estimated relocation or replacement cost over \$3,000,000.
- Adverse impacts to facilities critical to public health, safety, security, or welfare.
- Adverse impacts to facilities designated as having national cultural importance.
- Adverse impacts to facilities critical to interstate commerce.
- Loss of life is considered likely if no action is taken.

The severity of impact resulting from the structural failure of the Portal de San Germán residential buildings would meet two of the criteria under Category A:

1. Losses with an estimated relocation or replacement cost over \$3,000,000:
As will be described later in this report, the estimated relocation cost of threatened facilities is greater than \$3,000,000.
2. Adverse impacts to facilities critical to public health, safety, security, or welfare:
Portal de San Germán is a 56-unit Section 8 residential development for low income families at the Municipality of San Germán. If the existing buildings foundation fails, the structural integrity of the housing units will be impacted, increasing the existing risk of losing the housing structure and associated infrastructure, if not human life during a major storm event. Such impacts would also constitute “adverse impacts” to facilities critical to public health, safety, security, and welfare.

RESIDUAL RISK

Even with implementation of the Recommended Plan, residual risk remains. The Recommended Plan addresses current streambank erosion-causing conditions driven by heavy rain and storm events, which produce increased flows and erosion-inducing velocities. It is not designed to prevent erosion resulting from extreme high storm/Hurricane events. Residual risk remains that extreme high storm events in the future could overtop the banks of the Salud Creek and that the buildings foundations of the Portal of San German residential development could be damaged and fail, which the Recommended Plan is not designed to address.

CONCLUSION AND RECOMMENDATION

The Recommended Plan (Alternative 3: Bank armoring with HPTRM and bank armoring with concrete around the rehabilitated single barrel culverts) described in this report provides the optimum solution for emergency streambank protection within the study area that can be developed within the framework of the formulation concepts. Implementation of the Recommended Plan for the Salud Creek at San Germán, Puerto Rico, CAP Section 14 Project is recommended at this time, with such modification as the Commander, South Atlantic Division, U.S. Army Corps of Engineers (SAD), deems advisable at their discretion.