Erosion of the Ribault Bluff (Florida)

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Overview

The Ribault Monument, located in the Timucuan Ecological & History Preserve in Jacksonville, FL, has faced issues with bluff erosion and bluff destabilization. The National Park Service (NPS) wants a solution protecting against sea level rise, waves and storm tides.The project must be eco-friendly and effective for the local conditions.

Figure 1. Aerial view of the site showing the location of the existing wooden seawall and new land acquired relative to the Ribault Monument (Google Satellite Images)

Figure 2. A picture of the Ribault Monument (NPS)

Met-Ocean Data

Significant Measure Data	*Relevant Corresponding Value*
MLLW:	0 ft
Significant Wave Height :	2.034 ft
Significant Wave Period:	1.689 sec
Salinity Range:	15ppt - 35ppt
Temperature Range:	57°F to 86°F

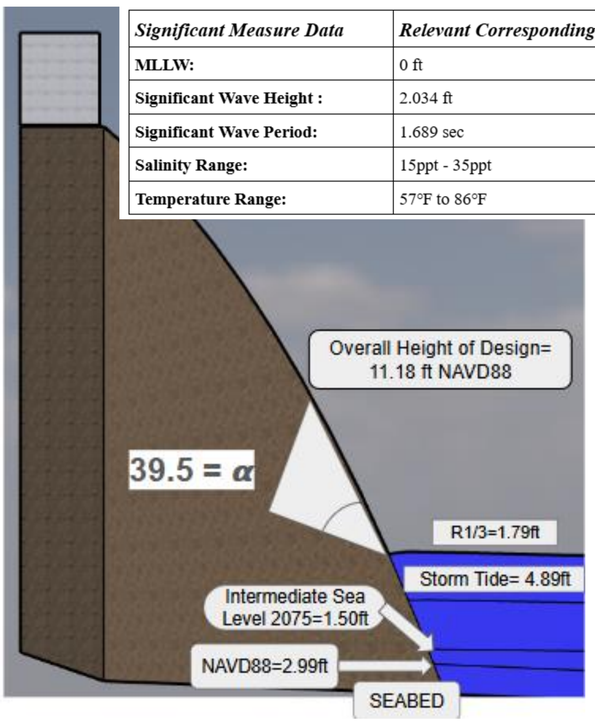

Figure 3. Ribault water level reference datum

Decision Matrix

Figure 4. A picture of the current seawall (Collins)

Table 1. The final weightings and selection for project design

		Design Alternatives					
	Weight	Do Nothing	Concrete Seawall	Increase Setback distance	Oyster Breakwater	Riprap	Living Shoreline
Effectiveness	0.35	0	4	4	3	3	1
Eco Friendly	0.25	2	3	2	2	3	1
Resilience	0.15	4	0	3	0	2	0
Maintenance	0.15	4	4	4	3	4	2
Budget	0.1	3	1	1	2	3	4
Total Score:	***1***	2.00	2.85	3.05	2.20	3.00	1.30

The decision matrix includes six alternatives considered as potential solutions to the erosion problem. The rip rap was found to be the solution that meets most design requirements with the caveat of increasing the setback distance.

Engineering Analysis

- Armor stone weight: 88lb
- Armor stone width: 0.81 ft

Surf Similarity Parameter

$$\xi_o = \frac{\tan(\alpha)}{\sqrt{H_b/L_o}}$$

Hudson Formula

$$W = \frac{w_a * H^3}{K_d * \Delta^3 * \cot(\alpha)}$$

Armor Stone Size

$$D_n = (\frac{W}{\gamma_a})^{1/3}$$

W_a=165lb/ft^3
H = 2.034 ft
K_D=2
Δ = 1.58
α = 1:2 (V:H)

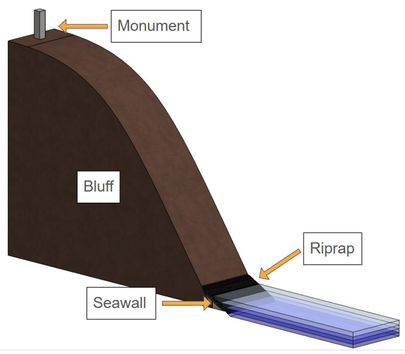

Figure 5: Full scale view of final design

Final Design

The rip rap is designed to support the existing wooden seawall and to prevent further erosion of the bluff over a 50-year design life The summation of the 2% runup height (1.79 ft) and the 50-year storm surge height (4.89 ft) a sea level rise (1.5 ft) and subtracting away the fact that the revetment sits (1.44 ft) above MLLW , resulted in a total revetment height (6.75 ft).

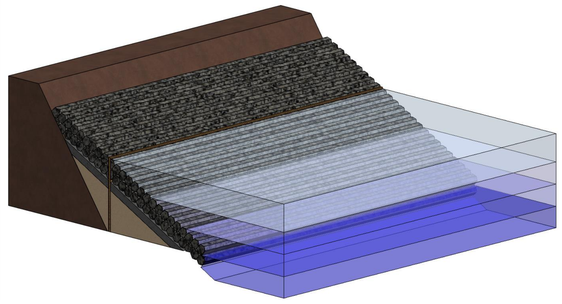

Figure 6. Magnified 3D rip rap technical drawing.

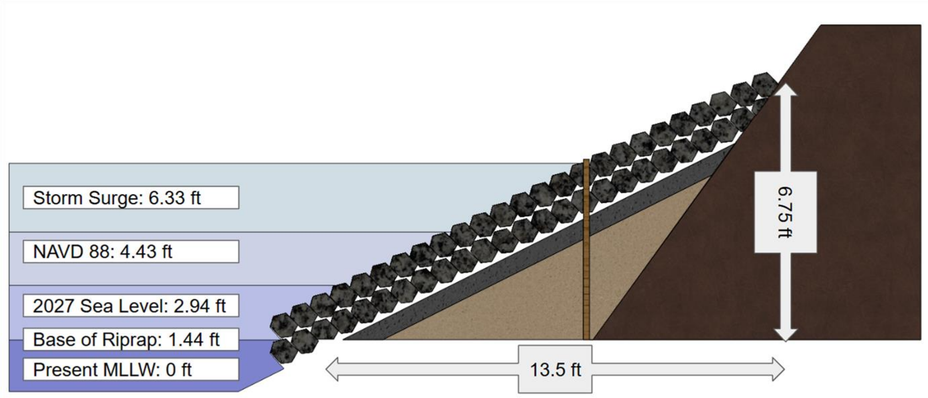

Figure 7. Tidal depths of the river compared to the final design

Economic Evaluation

Table 2. RSMeans analysis of rip rap construction costs

Resource	**Type**	**Volume (CY)**	**Costs ($)**
Stone	(50 Total Boulders)	736	$364,320
Gravel	Cobbles	9	$3,465
Fill	C-33 Concrete Sand	20	$2,640
Labor (23 Days)	N/A	N/A	TOTAL: $497,527
		Total Costs	**$867,952**

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Report