

SAN JUAN HARBOR, PUERTO RICO NAVIGATION IMPROVEMENTS STUDY

Final Integrated Feasibility Report & Environmental Assessment

APPENDIX B Dredged Material Management Plan Preliminary Assessment

June 2018



**US Army Corps
of Engineers**
Jacksonville District



**US Army Corps
of Engineers®**

**SAN JUAN HARBOR
PUERTO RICO
NAVIGATION PROJECT**

**Preliminary Assessment-
Dredged Material Management Plan**

**U.S. ARMY CORPS OF ENGINEERS
JACKSONVILLE DISTRICT
SOUTH ATLANTIC DIVISION
JACKSONVILLE, FLORIDA
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INTRODUCTION

San Juan Harbor is located on the north coast of Puerto Rico and provides access to deep-draft vessel traffic using terminal facilities located in the city of San Juan. These port facilities handle most of the cargo for Puerto Rico. It is the island's principal port, handling over 75% of the commonwealth's non-petroleum and non-coal waterborne commerce and is the only harbor on the north coast affording protection in all types of weather. Maintenance dredging within the San Juan Harbor is required to provide unrestricted navigation for ocean-going vessels calling upon the port facilities of San Juan.

The purpose of this project is to maintain navigational channels and comply with U.S. Army Corps of Engineers (USACE) regulations requiring the use of the least costly dredging and dredge material disposal alternatives consistent with sound engineering and environmental practices, including meeting all Federal environmental requirements such as those established under the Clean Water Act and the Marine Protection, Research, and Sanctuaries Act (MPRSA) (33 CFR 335.7, 53 FR 14902). Projections of future waterborne commerce, port-specific traffic, cargo volume, commodity characteristics, vessel size, and trade lane distribution drive the analysis of transportation cost savings across various alternatives. The study weighs the overall costs and benefits of each alternative against each other to identify and recommend the best solutions. Dredging and placement of dredged material constitute the major project costs. The models used to forecast the future conditions and changes for this study maintain consistency with those used on other harbor investigations and have received certification or approval for use by the U.S. Army Corps of Engineers (USACE).

This Dredged Material Management Plan (DMMP) for the San Juan Harbor Project, evaluates dredged material management alternatives to provide a cost-effective and environmentally acceptable plan for the management of all materials. This DMMP will serve as a decision document for any modifications needed of existing disposal area(s) necessary to accommodate the dredged material. Future navigation studies will contain a reevaluation of this DMMP.

AUTHORIZATION AND HISTORY

Authorization. The authority used to complete the DMMP is in accordance with the guidance in EC 1165-2-203, Technical and Policy Compliance Review, dated 15 October 1996.

History of San Juan. The city of San Juan is the capital of Puerto Rico and is the island's dominant city. Metropolitan San Juan's population in 1970 was 863,242 or nearly one-third of the island's 2,712,000 residents. More recent estimates show San Juan's population has increased to 1,114,000 while the island's total population grew to 3,522,000 residents. San Juan's percentage of the total population has remained fairly stable. Statistics show that the city generates over half of the island's net income and has over 40 percent of the factories. San Juan is also the tourist capital of the country with over half of the island's hotels located in the metropolitan area. In addition to being the governmental, commercial, industrial, and financial hub of Puerto Rico, San Juan is the transportation center. San Juan International Airport ranks in the world's top 30 in

traffic. The city is the focal point for a network of highways reaching every part of the island. Bus systems also serve the metropolitan area and link San Juan with other island cities.

AUTHORIZED PROJECT

CWIS Number: 016190

The USACE initiated a feasibility study at the request of the Puerto Rico Ports Authority (PRPA), the project's non-Federal Sponsor (NFS), under authorization provided by House Report 109-738 - 109th Congress (2005-2006), December 29, 2006, as reported by the Transportation and Infrastructure Committee which documents the resolution approving the navigation study.

A Limited Reevaluation Report, completed in August 2002, concluded that there was a potential Federal interest in pursuing navigation improvements at San Juan Harbor. A Federal interest exists when the economic benefits exceed the costs to build and maintain a potential project over the period of analysis. That conclusion led to the initiation of the feasibility study and provision of Federal funding following execution of the Feasibility Cost Sharing Agreement in September 2015. The costs for the feasibility study are shared equally by the USACE and PRPA. The study phase will end on the date the report is submitted to Congress by the Assistant Secretary of the Army for Civil Works ASA (CW) for authorization. If Congress acts to authorize and fund construction of the project, the construction costs would also be shared. The precise division of costs depends on the specific features of the recommended project.

Other Projects

San Juan Ecosystem Restoration Mitigation Project: The project work consists of dredging approximately 50,000 cubic yards of shoal material from the La Esperanza Ecosystem Restoration project located along the western shore of San Juan Bay, transporting the material approximately 2 miles across the Bay and placing the material in selected former dredge holes within the Condado Lagoon to create 1.2 acres of habitat for SAV. This compensatory mitigation is required from the impacts related to the harbor improvements that occurred in 1999.

Table 1: Federal Authorizations for Work in San Juan Harbor

ACTS	WORK AUTHORIZED	DOCUMENTS
August 8, 1917	Anchorage (inner harbor) area of 206 acres and San Antonio Channel to 30-foot.	House Document 865/63/2
September 22, 1922	Substitution of a 68-acre area 30 feet deep, along south-easterly side of anchorage area, for one 25 acres in extent and of same depth extending easterly from eastern end of the San Antonio project channel.	Specified in Act
July 3, 1930	Modified conditions of local cooperation.	House Document 45/71/2
August 30, 1935	Entrance channel across outer bar 38 feet deep and 800 feet wide, and thence across bay to Harbors anchorage area (Anegado Reach Channel) 30 feet deep and 700 feet wide and increasing anchorage area to 239 acres to a 30-foot depth.	Rivers and Harbors Comm. Doc. 38/74/1
August 26, 1937	Widening Anegado Reach Channel and increasing anchorage area to 329 acres.	Rivers and Harbors Comm. Doc. 42/75/1
October 17, 1940	Removal to 8-foot depth of Anegado, Largo, and Capitanejo Shoals, and dredging to a 30-foot depth the entrance channel and turning basin to the Graving Dock.	House Document 364/76/1
March 2, 1945	Maintenance of the 30-foot depth entrance channel and turning basin to the Army Terminal.	Specified in Act
July 3, 1958	Deepening portions of the entrance, the approach channels, and basins to Army Terminal and San Antonio Pier area to 35-45 feet; new 32-foot depth Puerto Nuevo Channel; and new 36-foot depth anchorage.	House Document 38/85/1
November 17, 1986	Centerline shifted 350 feet west and Bar Channel deepened to 48 feet over maximum width of 800 feet; deepened Anegado Channel to 46, 43, and 40 feet from the Bar Channel over a bottom width of 800 feet; deepen Army Terminal and Puerto Nuevo Channels to 40 feet and widen to 450 feet; Deepen Graving Dock Channel to 36 feet and widen to 450 feet; extend San Antonio Channel 1500 feet and deepen to 36 feet over minimum width of 500	Public Law 99-662

ACTS	WORK AUTHORIZED	DOCUMENTS
	feet; deepen Cruise Ship Basin to 36 feet; provide Sabana Approach Channel with depth of 32 feet over width of 250 feet; deepen Anchorage Area E to 38 feet and provide six mooring dolphins; provide 22 acres of shallow bay bottom for mitigation.	

SCOPE OF STUDY

The study scope encompasses the study area of San Juan Harbor. The Primary objective for the study is to maximize, to the extent practical, San Juan Harbor's contribution to national economic development by addressing inefficiencies in the existing navigation system's ability to serve the forecasted vessel fleet and process the associated cargo. The primary planning objective was used to identify the following goals:

- 1) Reduce navigation transportation costs of import and export trade through San Juan Harbor and contribute to increases in national economic development (NED) over the period of analysis;
- 2) Develop an alternative that is environmentally sustainable for the period of analysis; and
- 3) Improve navigation efficiencies by increasing Federal channel depths and turning basin widths for the existing and future fleets.

Specific study constraints associated with San Juan Harbor include:

- 1) Avoid unacceptable impacts to hard bottom communities and submerged aquatic vegetation;
- 2) Avoid unacceptable impacts to cultural resources; and
- 3) Avoid unacceptable impacts to any threatened or endangered species.

Information for the analysis came from land and hydrographic surveys, hydrodynamic surveys, available water quality information, socio-economic projections, sediment sampling, and numerous other data collection efforts. The study includes data from previous studies augmented with information from the PRPA, commercial shippers, Federal, state, and local resource agencies, as well as Geographic Information System (GIS) mapping of significant resources and features. This feasibility study forecasts waterborne cargo volumes, traffic patterns and vessel fleets, and evaluates the need for navigation system improvements over a 50-year period of analysis. It considers a wide range of structural and some non-structural measures within and near the harbor that could address inefficiencies within the system. However, it concentrates on potential changes to water-based transportation system components that are within the scope of the study authority. This includes insufficient channel depths and widths as shown, cruise ship, bulk, petroleum, and container terminals. Navigation concerns include three main types of problems: difficult wind and wave conditions, limited channel and turning basin widths, and insufficient Federal channel depths.

Throughout the study, the main factors influencing the total cargo throughput of San Juan Harbor revolve around land-based factors such as population growth, industrial and manufacturing changes, and regional maritime shipping trends limited by the capacity of the land-based infrastructure to process it.



Figure 1: Existing navigation conditions

Channel enlargements of the Recommended Plan include (Figure 2):

- Deepen Cut 6 through Anegado Channel to Army Terminal Channel (ATC) Turning Basin up to -44.0 ft.
 - Puma LR-2 can draft up to -51.7 ft.
 - Total has immediate need for -42.0 ft. draft
 - PREPA LNG vessel has -39.0 ft. design draft
- Widen Army Terminal Channel (ATC) 100.0 ft. (50.0 ft. to the east and 50 ft. to the west)
- Deepen San Antonio Approach Channel, San Antonio Channel and San Antonio Channel Extension to -36.0 ft. Expand the Federal limits of the San Antonio Channel Extension 1,050 ft to the east.

All soundings and elevations presented in this report are relative to Mean Lower Low Water (MLLW) based on the latest tidal epoch available from NOAA and the project is located geospatially in the North American Datum of 1983 (NAD83).



Figure 2: Recommended Plan

SHOALING

In order to assess changes to Operation and Maintenance resulting from proposed channel modifications, the increase in channel shoaling was predicted as a result of increasing channel dimensions of the project features, see attached Plates for details. The average annual shoaling rate for each navigation channel was calculated for the time period from 1994 to 2012 using USACE dredging records. Channel dimensions were calculated for the present-condition and were calculated for the post-project condition. Shoaling estimates for the post-project condition were calculated by prorating the historic average annual shoaling rate based upon the percent increase in channel volume.

A Sediment Trend Analysis (STA) was performed in 2002 by GeoSea Consulting (Canada) Ltd. for San Juan Harbor. The analysis delineated regions of the harbor where the sediment transport regimes were described as: Dynamic Equilibrium; Net Accretion; Net Erosion; Total Deposition. In addition, the STA analysis detailed the different regions of the harbor and the processes that lead to the particular transport regime.

Cut-6 in the San Juan Outer region is subject to the accreting trends into the harbor entrance that suggest the channel is subject to infilling.

Anegado Channel, San Antonio Approach Channel, and Anchorage Area F are in the San Juan Central region which is a transport environment that is characterized by increasing mud content as sediments are transported from the outside into the harbor. The trends extend from the northwest area of the Anegado Channel to the region where the dredged channel bifurcates forming the Graving Dock and Army Terminal Channels.

Cruise Ship Basin East, San Antonio Channel, and San Antonio Extensions are in the San Antonio Channel region. STA analysis showed that through the San Antonio channel, there is westward transport down the channel as it meets with the Anegado Channel. It appears likely that the trends are driven by flow out of the Laguna del Condado, which is also accessible to sedimentation from the Atlantic. The very eastern part of the San Antonio Channel region which includes the San Antonio Channel Extensions shows Total Deposition behavior and is filled with fine-grained sediments.

Army Terminal Channel & Army Terminal Turning Basin are in the San Juan Inner region. The sediments in the area are generally muddy (pure mud and sandy mud). The transport regime shows that infilling occurs into the channels from the shallow flats bounding the channels. All navigation channels in the San Juan Inner region are in the Total Deposition regime. It is also very likely that sediment infilling the Army Terminal Channel also come from the bay directly south of Punta Cataño.

The total additional annual shoaling that is expected due to the project is approximately 15,000 cy/yr (Table 2). A sensitivity analysis was performed to determine the effect of the highest level scenario of sea level rise 100 years from construction on channel shoaling for the project. Under that scenario, it is predicted that the shoaling rate would increase from 15,000 cy/yr to 23,000 cy/yr. However, since this increase would be applied across all depth increments being evaluated, the selection of the Recommended Plan is not affected. The absolute amount of increase does not dramatically affect the overall future project O&M as it only reflects an increase of about 5% over the existing shoaling rate of 155,000 cy/yr and for purposes of the economic analysis a conservative maintenance interval of 5 years was used while the project history shows a maintenance interval ranging from 5 to 7 years.

Table 2: Channel Dimensions and Estimated Increase in Shoaling for Deepening and Widening

Channel/Cut	Date	Depth (ft)	Area (1000's ft^2)	Volume (1000's ft^3)	Shoaling Rate cy/yr	Increased Shoaling cy/yr (based on volume %)
Army Terminal Channel & TB	1994 - 2012	40	4,656	186,229	47,000	12,000
	Post-project	45	5,156	232,029	59,000	
San Antonio Channel Extension Expansion	1994 - 2012	35*	3,173*	111,045*	6,000	1,000
	Post-project	35	509	17,816	1,000 net increase	
Cut-6	1994 - 2012	42	701	29,428	4,000	1,000
	Post-project	47	701	32,931	5,000	
Anegado Channel	1994 - 2012	40	7,239	289,550	4,000	0
	Post-project	45	7,239	325,744	4,000	
Cruise Ship Basin East	1994 - 2012	30	1,884	56,507	3,000	1,000
	Post-project	36	1,884	67,808	4,000	
TOTAL	15,000cy/yr additional					

* Estimated from the San Antonio Approach Channel shoaling rate

HISTORY OF DMMP

Recent Federal improvements began in 1917 with the authorization of inner harbor and San Antonio channel dredging. Prior to 1974, all dredged material (except for Bar Channel material) taken from San Juan Harbor and its vicinity was placed in upland disposal areas. In 1974, these areas were exhausted and no new upland site could be obtained for dredged material disposal. Since 1975, all dredged material from San Juan Harbor has been disposed offshore. The SJS was designated as an Interim Ocean Dredged Material Disposal Site in 1977 under Marine Protection, Research, & Sanctuaries Act of 1972 (MPRSA). In March 1988, the SJS was designated as a Final Ocean Dredged Material Disposal Site to receive materials from the San Juan Harbor area. Federal navigation improvements have continued into the 2000's when the last authorized modifications were constructed which included deepening the entrance channel, approach channels, and basins to Army Terminal and San Antonio Piers. The latest modifications also included dredging a new channel at Puerto Nuevo to a depth of 39 feet and a new Anchorage Area "E" to a 36 ft depth.

Table 3: San Juan Dredging History and Costs 1994-2016

DIS JobKey	Year	Gross Yardage (CY)	Costs	Placement	Type
94saj009	1994	879,566	\$1,954,423	ODMDS	O&M
98saj030	1998	3,913,663	\$8,364,044	ODMDS	Deepening
99saj060	1999	3,972,885	\$33,737,669	ODMDS	Deepening
06saj011	2006	446,565	\$4,508,105	ODMDS	O&M
11saj016	2011	378,352	\$4,711,248	ODMDS	O&M
16saj016	2016	~545,000	~\$6,012,393	ODMDS	O&M
	If we assume that 10% of the Deepening yardage is attributable to O&M, then the total for O&M are as follows:				
94saj009	1994	879,566	\$1,954,423	ODMDS	O&M
98saj030	1998	391,366	\$8,364,044	ODMDS	Deepening
99saj060	1999	397,289	\$33,737,669	ODMDS	Deepening
06saj011	2006	446,565	\$4,508,105	ODMDS	O&M
11saj016	2011	378,352	\$4,711,248	ODMDS	O&M
16saj016	2016	~545,000	~\$6,012,393	ODMDS	O&M
	Total O&M Yardage: 3,038,138 CY				
	Period under consideration is from 1994 to 2016 making a total of 22 years including O&M and new dredging events. The approximated gross annual shoaling rate is 155,400 CY per year based on EN analysis from past dredge event performance.				

Table 4: Disposal Site Data

Disposal Site(s) (Name or Identifier)	Site Type ¹ (select)	Disposal Site Capacity		Beneficial Uses (CY/Year)		Other Users ² (select)	Disposal Site Sponsor (Y/N)
		Original (000)	Percent Filled	Existing	Anti-cipated		
ODMDS	1	N/A	N/A	N	N	B	Y
Condado Lagoon	2	N/A	0%	N/A	880	B	Y
Sponsor(s) for Disposal Site(s) (List all individual sponsors)							
Name: Puerto Rico Ports Authority							
Address: P.O. Box 362829							
City: San Juan				State: Puerto Rico		ZIP: 00936-2829	
Point of Contact: Jose Suàrez Pérez-Guerra				Phone # (787) 900-5677			

NOTES:¹ Disposal Sites:

- 1 - Designated Open Water
- 2 - Open Water, unrestrained

² Non- USACE Users:

- A - None, [USACE has exclusive use]
- B - Authorized [Other parties allowed to use, with or without USACE consent]
- C - Allocated [Space available for project related non-USACE dredging at no cost]
- D - Permitted [Space available for non-USACE dredging in the area at a cost]
- E - Restricted [Non-USACE use controlled by another party, USACE has full use]
- F - Royalty [Site controlled by another party, USACE uses at a cost]

ALTERNATIVES TO THE BASE PLAN

The base plan for the recommended plan is to transport all material to the ODMDS. However, a range of beneficial use of dredged material alternatives were examined in addition to the base plan. These five alternatives, depicted in Figure 3, are discussed below.

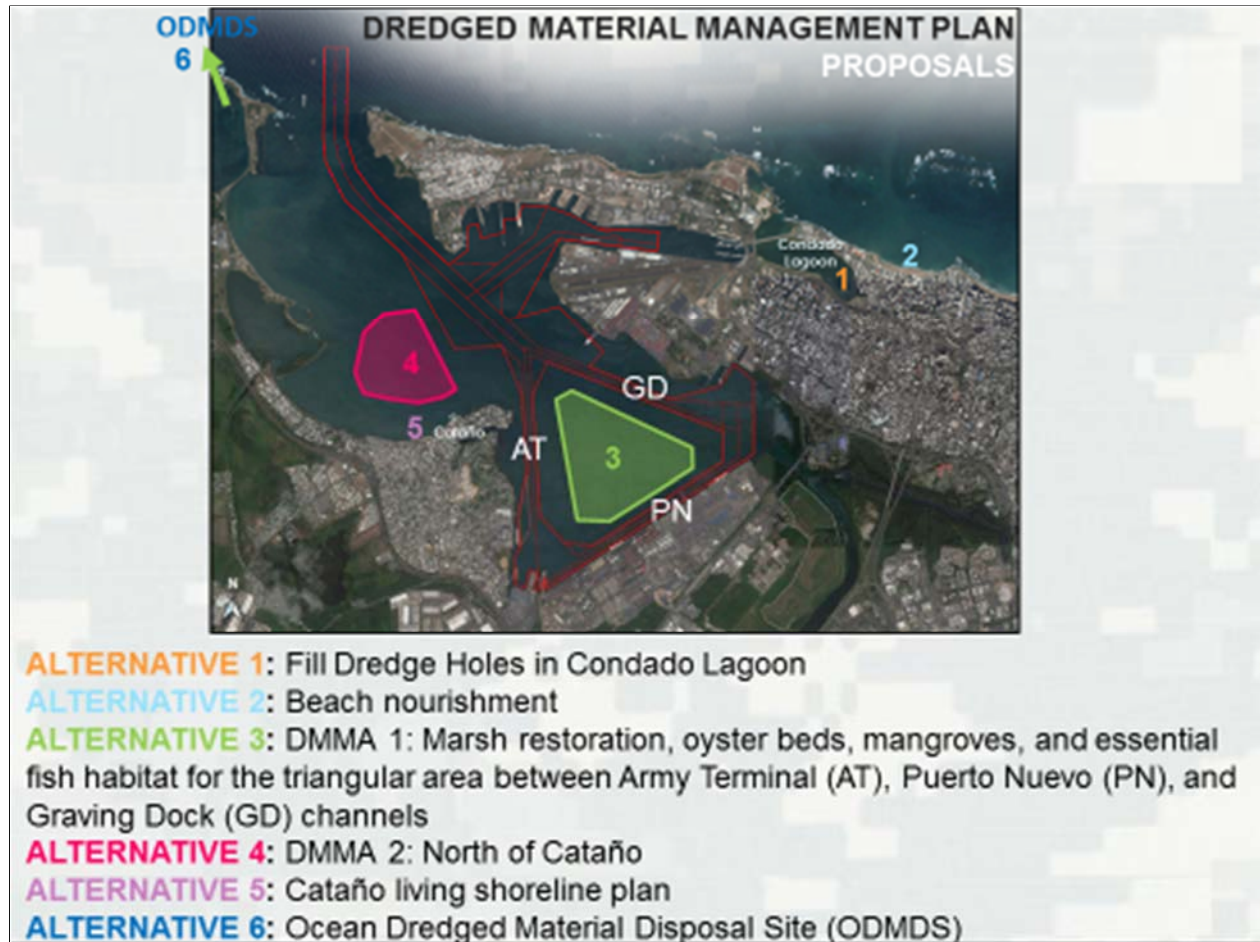


Figure 3: DMMP Alternative Plan Proposals

Alternative 1: Seagrass habitat restoration in Condado Lagoon (fill artificial depressions)

The original deepening of Condado Lagoon started in 2000. Bathymetry records of Condado Lagoon indicate the artificial depressions cover an area of about 32 acres, with a maximum depth of around 35 feet. Given this information, the USACE has estimated that approximately 230,000 cy of suitable material is needed to fill the approximate 32 acres. The holes will be filled to a total elevation of approximately 12' below sea level, this elevation would promote sea grass habitat restoration. The artificial depressions will be capped with suitable sandy material from the proposed navigation improvements. Turbidity curtains will be deployed to contain the clayey material and decrease the turbidity during construction.

The option of beneficial use in Condado Lagoon is still being pursued as an alternative pending identification of a willing cost-sharing partner for the additional costs above the base plan. For

this reason, costs were refined to identify the incremental costs above the base plan. Those are laid out below in Table 5.

Table 5: Refined Costs for Condado Lagoon Beneficial Use of Dredged Material

Type of Work	Estimated Costs above the Base Plan
Mob/Demob*	\$600,000
Transport & Placement**	\$1,100,000
Turbidity Controls***	\$600,000
Monitoring****	\$400,000
Total	\$2,700,000

NOTES:

FY18 Price Levels

*Mob/demob: mobilization/demobilization of any additional equipment required for the beneficial use above what is required for the base plan

**Transport & Placement (including sandy capping material): Additional transportation & placement costs above the base plan. Assumes hydraulic unloading from San Antonio Channels and Cut-6 to Condado Lagoon placement location. Capping material, with higher sand content, is assumed to be coming from Cut-6 for this estimate. Approximately 25% of the material transported would be used for capping. For the purposes of this estimate, all material is assumed to be coming from the federal navigation project. If additional capping material is needed, La Esperanza would be the most-likely source and would likely cost more-those costs are not incorporated into this estimate.

***Turbidity: Costs for Turbidity controls (turbidity curtains) not required for the base plan

****Monitoring: Monitoring plan, ESA observer, and turbidity monitoring that is not required for the base plan

Alternative 2: Placement of beach quality material on shores of San Juan, if available.

La Esperanza is a storm drainage area that has developed into a sediment basin. The sand is currently planned to be used in other projects such as capping of material to fill dredged holes in Condado Lagoon and is being considered to be used for beach replenishment along eroded beaches in and around San Juan. A problem with using the material for both projects is the depletion rate of the material would be greater than the time needed for sediment to accumulate. The resource agencies were also concerned with this alternative as there are significant reef formations off of the coast where the beach placement was proposed, therefore it was screened out from further consideration

Alternative 3: DMMA 1: Marsh restoration, oyster beds, mangroves, and fish habitat for the triangular area between Army Terminal, Puerto Nuevo, and Graving Dock channels.

This alternative has the triangle area either being built up with geotubes or plastics sheet piles. Using geotubes can be cost friendly since it only utilizes smaller dredging machines. To hold the material in place, geotubes could be filled with dredged soil and placed between the fill area and the vegetated shoal. This approach could also minimize movement of the material towards the shoal. A problem that appears with the containment area between the channels is that material

would have to be consistently poured because it will be constantly displaced, lost in underlying layers, and/or broken down due to factors such as ship wakes and wind. A potential problem is that the material will start to fill up the channels which would lead to more maintenance dredging projects in San Juan. Furthermore, the USCG raised concerns with this alternative as far as line of sight concerns with proposed vegetation, therefore it was screened out from further consideration

Alternative 4: DMMA 2: North of Cataño.

The municipality of Cataño submitted a letter on November 12, 2015 indicating concerns with increased wave energies as part of the harbor improvements. The letter indicated that this community is particularly vulnerable to strong winds and waves already, solely due to its positioning, therefore is concerned with making matters worse. The letter from Mayor Jose A. Rosario Melendez included some existing conditions and the impact of dredging on the municipality of Cataño. He suggested that any study should consider climate change and its effects on the coast for future projections relating to the raise in sea-level, coastal erosion, and increase of wave-action, and how these effects could be influenced by the improvements.

The study team explored the opportunity of a containment area North of Cataño which could act as breakwater as well as an area for potential fill material to elevate shoreline areas that are subject to sea level rise impacts. It can also act as a Sea Level Rise (SLR) storage area where the material can be used in future projects and maintenance.

Approximately 180,000 CY of material would be dredged from CUT-6 and the Anegado Channel and then taken a distance of approximately **2 miles** (10,300 ft.) from CUT-6 and the Anegado Channel to just North of Cataño. Turbidity curtains would have to be deployed to contain the clayey material and decrease the turbidity during construction until containment is constructed around the perimeter.

However, bathymetric surveys conducted in this area as part of the study indicated that there are seagrasses present in this proposed footprint that would be adversely impacted and therefore this alternative was removed from further consideration.



Figure 4: Locations of Proposed Dredged Material Management Areas (DMMA)

Alternative 5: Cataño living shoreline.

The proposed living shoreline has planned to use rock material and sediments generated from the navigation improvements and planted with sea-grass and mangroves and to act as a natural breakwater. The living shoreline could have contributed to storm damage reduction and prevention of future erosion along the north side of the municipality of Cataño. The erosion along Cataño is driven by wave action induced by the large fetch and northeast winds. Benefits of living shorelines include stabilization of the shoreline, protection of surrounding riparian and intertidal environment, improvement of water quality via filtration of upland run-off, and the creation of habitat for aquatic and terrestrial species.

<http://www.habitat.noaa.gov/restoration/techniques/livingshorelines.html>

Impediments for implementing this beneficial use of dredged material option include:

- 1) The use of clay within the shoreline could produce substantial amounts of turbidity and clay will not allow the mangroves to grow.
- 2) The rocks in the dredged material will not be large enough to provide substantial protection from the wave action that can occur within the area.
- 3) Waterfront property owners could oppose this idea due to change in viewshed and costs for construction are much higher than taking the material to the ODMDS.

Due to the reasons identified above, this beneficial use option was screened from further consideration.



Figure 5: Tentative Locations of Potential Living Shoreline Structures

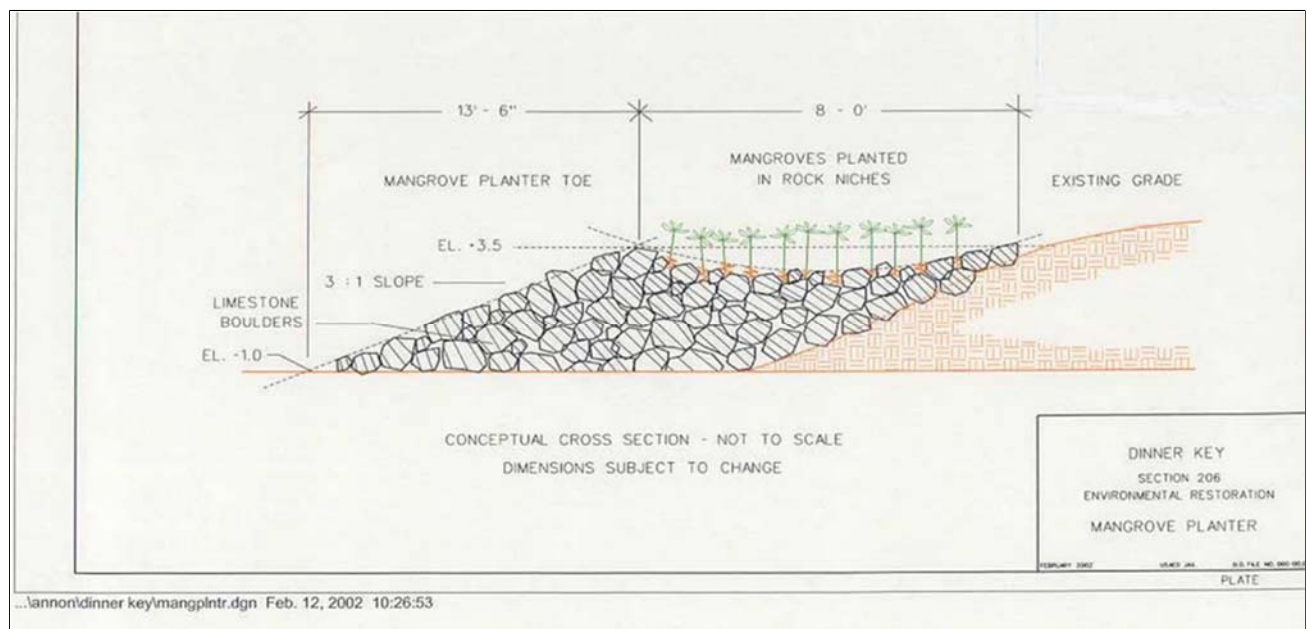


Figure 6: Living Shoreline Profile Example

These alternatives were presented to the environmental resource agencies on 5 October 2016 and a refined list was carried forward, Alternatives 1, 4, and 5, to develop rough order magnitude (ROM) costs. A comparison of the refined list of dredged material placement alternative locations is shown in Table 6. The only remaining viable option for beneficially using dredged material is the filling of holes in Condado Lagoon.

Table 6: Comparison of ROM Costs for Refined List of Beneficial Use of Dredged Material – Alternatives 1, 4, and 5.

	Beneficial Material Use	Quantities	Incremental Costs above the Base Plan
Alternative 1	Fill Dredged Holes	230,000CY	(+) ~ \$1.1M
Alternative 4	DMMA-2	2,115,653CY	(+) ~ \$9M
Alternative 5	Living Shoreline	2,115,653CY	(+) ~ \$13M

ENVIRONMENTAL CONCERNS

At a Planning Charrette on November 4, 2015 in San Juan, Puerto Rico, environmental resource representatives from NOAA Fisheries, NOAA HCD, and USFWS located protected resources on maps of San Juan Harbor. The environmental resource agencies identified the location of ESA corals, green and hawksbill sea turtles, sea grasses, and mangroves. Manatees and dolphins occasionally visit San Juan Harbor. Figure 7 shows the locations of environmental resources identified by and in coordination with the environmental resource agencies.



Figure 7: Environmental Resources Considerations

Based on database search of existing surveys and preliminary benthic surveys conducted from January through December 2016 by both NMFS HCD and USACE PD/OD, deepening and widening measures along the army terminal and graving dock channels would not result in direct impacts to SAV. Anchorage F southerly extension deepening could incur SAV impacts (survey data pending). The closest previously mapped hardbottom habitat (colonized pavement) is 1,500 feet from the closest dredge area (Cut-6) and Acroporid coral Critical Habitat is approx. 2,500' North of Cut-6. Therefore, impacts to listed corals from dredging and dredged material transport related turbidity are not anticipated.

Generally, the potential impacts of dredging and dredged material management can be summarized as follows (IADC/CEDA 1998, ICE 1995, PIANC 1996): Removal of benthic species and communities. Short-term increases in the level of suspended sediment can give rise to changes in water quality which can effect marine flora and fauna, both favorably and unfavorably, such as increased turbidity and the possible release of organic matter, nutrients and or contaminants depending upon the nature of the material in the dredging area. Settlement of these suspended sediments can result in the smothering or blanketing of benthic communities and/or adjacent intertidal communities, although this can also be used beneficially to raise the level of selected areas to offset sea level rise or erosion (short-term impact v long-term gain).

General environmental effects, associated with dredging, can be expected with any disposal methods employed. Those would involve the following impacts:

- Periodic disruption of the aquatic environment,
- Increased turbidity,
- Decrease in dissolved oxygen,
- Decline in light transmissivity,
- Disruption to and possible losses of benthic organisms, and
- Disturbance to nekton.

Sampling and Testing of Dredged Material

Sampling and testing of dredge material was conducted to determine if the sediments proposed to be dredged from the routine maintenance dredging of San Juan Harbor are acceptable for disposal in the San Juan Harbor Ocean Dredged Material Disposal Site (ODMDS). San Juan Harbors dredged material sediment report was completed in 2011 and only evaluates the ocean disposal portion under Section 103 of the MPRSA. This involved collecting and analyzing samples from two dredging units (DUs) (Reach A and Reach B) within San Juan Harbor and one offshore reference sample to determine suitability of dredge material for offshore disposal. The Reach A test sample was a composite of six subsamples. The Reach B test sample was also a composite of six subsamples. All inshore samples were taken with a vibratory coring device. The reference station was a composite of multiple grabs taken offshore of San Juan Harbor near the location designated by EPA Region 2. The results of the Short-Term Fate of Dredged Material Disposal in Open-Water Models (STFATE) module of the Automated Dredging and Disposal Alternatives Management System (ADDAMS) model indicate that all material from dredging units Reach A and Reach B may be disposed of at the center of the San Juan ODMDS using a dredge or scow with a carrying capacity of 4,800 cubic yards without violating applicable water quality criteria.

In a March 23, 2016 letter Charles LoBue, Chief of Dredging sediment and Oceans Section, EPA, Region II provided confirmation for the Planning Division about the determination of the sediments in San Juan Harbor. He concurred with the Planning Division stating that the sediments are suitable for San Juan Harbors ODMDS. He addressed that the national policy allows dredged material testing data to be used to make suitability determinations regarding ocean placement for three years. The subject Section 103 of the MPRSA three-year concurrence will expire March 23, 2019 (Table 7).

Table 7: Project Environmental Compliance Statuses

Analysis	Preparation Date	Expiration/ Revision Date
WQC	18 June 2002	
EPA Sec 103	23 March 2016	23 March 2019
NEPA	2 March 2015	2 March 2020
SMMP	6 January 2011	6 January 2021

FEDERAL AND NON-FEDERAL RESPONSIBILITIES

The USACE is responsible for budgeting for the Federal share of construction costs for all future work during the remaining economic life of the project. Federal funding is subject to budgetary constraints inherent in the formation of the national civil works budget for a given fiscal year. The USACE will perform the necessary planning, engineering and design needed for the Federal project prior to construction. The Federal and Non-Federal responsibilities are discussed in the Operations and Maintenance of the report. The cost-share breakdown is shown in Table 8.

Table 8: Federal/Non-Federal Cost Apportionment - Recommended Plan

FEDERAL/NON-FEDERAL COST APPORTIONMENT - WITH LNG CONVERSION October 01, 2017 Price Levels (FY 2018) + Deepen SAC, SAAC, SAC Extension & CSBE to 36'			
	Total Cost	Federal Share	Non-Fed Share
GENERAL NAVIGATION FEATURES (GNF)	>20' to 50'	75%	25%
Mobilization & Demobilization (Clamshell)	\$3,350,000	\$2,512,000	\$837,000
Standby Time (Mechanical Clamshell)	\$234,000	\$175,500	\$58,500
Mobilization & Demobilization (Hydraulic Hopper)	\$2,744,000	\$2,058,000	\$686,000
Standby Time (Hydraulic Hopper)	\$349,000	\$261,750	\$87,250
<i>-Economic Modeling Phase 1-</i>			
Widen ATC 100' @ Existing 40' (Cut 8)	\$7,389,000	\$5,541,750	\$1,847,250
<i>-Economic Modeling Phase 2-</i>			
Deepen Cut 6 @ 46'	\$742,000	\$556,500	\$185,500
Deepen Anegado (Cut 7) @ 44'	\$6,762,000	\$5,071,500	\$1,690,500
Deepen and Widen ATC 100' @ 44' (Costs only for deepening/widening improvements > 40')	\$8,475,000	\$6,356,250	\$2,118,750
Deepen ATTB @ 44' (Cut 8)	\$7,352,000	\$5,514,000	\$1,838,000
ATTB East & West Flares @ 44'	\$1,354,000	\$1,015,500	\$338,500
<i>-Economic Modeling Phase 5-</i>			
Deepen SAAC @ 36' (Cut 18)	\$494,000	\$370,500	\$123,500
Deepen SAC @ 36' (Cut 18)	\$2,849,000	\$2,136,750	\$712,250
Deepen SAC Extension @ 36' (Cut 20)	\$596,000	\$447,000	\$149,000
Deepen CSBE @ 36' (Cut 22)	\$2,346,000	\$1,759,500	\$586,500
Sea Turtle Non-Capture Trawl Sweeping	\$39,000	\$29,250	\$9,750
Real Estate Administrative Costs	\$66,000	\$49,500	\$16,500
Preconstruction, Engineering, & Design	\$4,619,000	\$3,464,250	\$1,154,750
Construction Management (S&A)	\$4,282,000	\$3,211,500	\$1,070,500
TOTAL GNF	\$54,041,000	\$40,530,750	\$13,510,250
SUBTOTAL PROJECT FIRST COSTS	\$54,041,000	\$40,530,750	\$13,510,250
10% OF NED GNF NON-FEDERAL**	\$0	-\$5,404,100	\$5,404,100
NON-FEDERAL CONSTRUCTION COSTS (LOCAL SERVICE FACILITIES)			
Berthing Area Dredging (COD / Total Terminals) @ 44'	\$611,000	\$0	\$611,000
Berthing Area Dredging (PUMA Terminal) @ 44'	\$446,000	\$0	\$446,000
Berthing Area Dredging (PREPA Terminal) @ 44'	\$747,000	\$0	\$747,000
PREPA LNG Facility Modifications	\$348,024,000	\$0	\$348,024,000
TOTAL NON-FEDERAL LOCAL SERVICE FACILITIES	\$349,829,000	\$0	\$349,828,000
	\$0		
USCG AIDS TO NAVIGATION (100% USCG FEDERAL COST)	\$105,000	\$105,000	\$0
	\$0		
TOTAL PROJECT COSTS	\$403,975,000	\$40,635,750	\$363,338,250
* ATC= Army Terminal Channel, ATTB=Army Terminal Turning Basin, SAC=San Antonio Channel, SAAC=San Antonio Approach Channel, CSBE=Cruise Ship Basin East			
**The Non-Federal Sponsor shall pay an additional 10% of the costs of GNF of the NED plan, pursuant to Section 101 of WRDA 1986.			

Table 9: Anticipated Dredging Quantities Programmed for the next 10 years.

Reach	Programmed Dredging (KCY) (Consistent with 5 year O&M Maintenance Plan)	Disposal Sites to be used
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Project	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Ave.	ODMDS And B/U @ Condado Lagoon
	545					777	2,110				1,144	

Note: The 545,000cy comes from the 2016 contract yardage, the volume for 2022 is an estimate from the 155,400 cy/yr updated annual shoaling rate, the 2023 event is from the feasibility study volume estimate for the expansion and deepening.

Table 10: Channel Maintenance and Improvements Cost Projections

Reach	Programmed Dredging Cost (Millions of dollars Per Year, Consistent with 5 Year Project O&M Maintenance Schedule)									
Project	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
	\$6M					\$6M	\$553M			

Note: The event in 2023 corresponds to the widening and deepening associated with the feasibility study, the base year for the study is 2026. The base year is the year in which the project is accruing benefits, therefore the improvements would be completed. The estimated time for PED and construction of the improvements in 38 months, so approximately three years before the base year in 2026.

Table 11: Economic Data

ECONOMIC STATISTICS	CURRENT CONDITIONS	FUTURE CONDITIONS ¹	FEDERAL INTEREST?
COMMODITY TYPES	GENERAL CARGO	GENERAL CARGO	YES
TONNAGE ESTIMATES	10.0 MILLION ²	9.5 MILLION ³	YES
GROWTH RATES	0% ⁴	0% ⁵	-
TRADE ROUTES	⁶	⁶	YES
VESSEL TYPES	CONTAINER CRUISE TANKER	CONTAINER CRUISE TANKER LNG	YES
VESSEL SIZES (LOA/BEAM)	965'/106' 1181'/154' 655'/106' ⁷	965'/106' 1181'/154' 800'/138' 928'/146' ⁸	YES

VESSEL OPERATIONS	CONSTRAINED	MAX LOAD, CONSTRAINED ⁹	YES
DREDGING CYCLE	5	5	
DREDGING QUANTITIES	155,400CY	230,400CY	
AVG. ANN.MAINT. COST	TBD	TBD	
PRICE LEVEL	FY17	FY17	

NOTES:

- 1- Future with-project condition
- 2- From Waterborne Commerce Statistics Center 2015 data and reported in metric tons
- 3- 2026 commodity tonnage projections based on transition of PREPA away from Fuel Oil #6 and diesel to LNG for use in power generation in the San Juan area power plants
- 4- Overall steady throughput 2010-2015.
- 5- Decline in population of Puerto Rico beginning in 2006 and expected to continue into the future. Thus, no growth is assumed.
- 6- Jacksonville (FL), Caribbean region, Europe/Baltic Sea region, Latin America, Trinidad and Tobago
- 7- Maximum vessel sizes
- 8- Ship simulation design vessel sizes for FY17 feasibility study
- 9- MR (medium range) tankers no longer constrained but some LR1 and LR2 (long range) tankers still depth constrained

CONCLUSIONS

Preliminary assessment of the deep harbor serving the port of San Juan indicates that the disposal of shoal material has no major problems for the foreseeable dredging cycle. Future dredging will utilize the designated ODMDS and/or a beneficial use site if an interested party can be found that agrees to pay the difference in costs between taking the material to the ODMDS (the current least cost disposal option) and a potential beneficial use site. The ODMDS is in deep water and has an estimated potential capacity for over 20 years of disposal for maintenance and new work dredged material.

Table 12: Maintenance Summary Status for San Juan Harbor

The ability to maintain this project for the next 20 years is limited by:	
Disposal Site Capacity	No
Economic Viability	No
Environmental Compliance	No

RECOMMENDATIONS

The selected plan is the recommended guide for future maintenance and new work dredging events associated with the San Juan Harbor project. Continued maintenance and improved management measures for this project are warranted on the basis of project usage and indicators of economic productivity, sufficient disposal capacity available, and maintenance activities in compliance with applicable environmental laws and regulations for the next 20 years. Therefore, no additional dredged material management plan (DMMP) is necessary beyond this assessment.

This assessment supports that this project's disposal requirements can be met for the next 20 years. A DMMP is not required.